STOCK ASSESSMENT FOR SOUTH ATLANTIC ALBACORE USING A NON-EQUILIBRIUM PRODUCTION MODEL

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SUMMARY

A Stock-Production Model Incorporating Covariates (ASPIC), a non-equilibrium surplus-production model, was attempted for the stock assessment for the southern Atlantic Ocean albacore, using the software package ASPIC ver. 5.34. Various cases exist with different index and/or period of Japanese longline CPUE. For each case, four models by different weighting and shape parameter, which were selected for final models at 2013 and 2016 assessment, were examined. Several models predicted that at some stage in the recent past, the southern Albacore stock had been overfishing and overfished. The fishing pressure appears to have eased in recent years, with a subsequent recovery in biomass. The scenarios with Japanese longline core area CPUE were more optimistic, but CPUE fit was worse. Based on the results of future projection, stock status will be in green zone with >60% probability if future catch is up to 28,000 to 30,000t (depends on the cases and scenarios).

RÉSUMÉ

Un modèle stock-production incorporant des covariances (ASPIC), un modèle de production excédentaire en conditions de non-équilibre, a été tenté pour l'évaluation du stock de germon de l'océan Atlantique Sud, en utilisant le logiciel ASPIC ver 5.34. 5.34. Il existe divers cas avec différents indices et/ou périodes de CPUE de la palangre japonaise. Pour chaque cas, on a examiné quatre modèles selon plusieurs paramètres de pondération et de forme, qui ont été retenus comme modèles définitifs lors de l'évaluation de 2013 et 2016. Plusieurs modèles ont prédit qu'à un moment donné dans le passé récent, le stock de germon du Sud avait été victime de surpêche et avait été surexploité. La pression de la pêche semble s'être atténuée au cours de ces dernières années, la biomasse s'étant rétablie par la suite. Les scénarios utilisant la CPUE de la zone centrale de la palangre japonaise étaient plus optimistes, mais l'ajustement du CPUE était pire. Selon les résultats des futures projections, l'état du stock se situera dans la zone verte avec une probabilité de >60 % si les prises futures atteignent 28.000 à 30.000 tonnes (selon les cas et les scénarios).

RESUMEN

Se probó un modelo de producción de stock que incorporaba covariables (ASPIC), un modelo de producción excedente en no equilibrio, para la evaluación de stock de atún blanco el océano Atlántico sur, utilizando un paquete ASPIC versión 5.34. Existen varios casos con diferente índice y/o período de CPUE del palangre japonés. En cada caso se examinaron cuatro modelos con diferente ponderación y parámetro de forma, que fueron seleccionados para los modelos finales en la evaluación de 2013 y 2016. Varios modelos predijeron que, en alguna fase del pasado reciente, el stock de atún blanco del sur había sido objeto de sobrepesca y había estado sobrepescado. La presión pesquera parece haberse atenuado en años recientes, con la consiguiente recuperación de la biomasa. Los escenarios con CPUE del área núcleo del palangre japonés eran más optimistas, pero el ajuste de la CPUE era peor. Sobre la base de los resultados de las proyecciones futuras, el estado del stock se situará en la zona verde con una probabilidad superior al 60 % si la captura futura es de hasta 28.000 a 30.000 toneladas (según los casos y escenarios).

KEYWORDS

Stock assessment, mathematical model, yield predictions, albacore, catch/effort

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1. Introduction

At 2013 ICCAT albacore stock assessment meeting, stock assessment of south Atlantic albacore was held based on a Stock-Production Model Incorporating Covariates (ASPIC) (Matsumoto *et al.,* 2014) and Bayesian Surplus Production (BSP) (Babcock, 2014) model because there are not enough size data for the south Atlantic and so age structured model was not used. At that time the results for both models, which were comparatively similar, were adopted for management advice. Also at the previous (2016) ICCAT albacore stock assessment meeting, the same two models, which used similar specifications as those in the 2013 stock assessment, were used and adopted for management advice. At 2019 ICCAT SCRS meeting, it was decided that stock assessment of south Atlantic albacore in 2020 will be conducted based on surplus production models (ICCAT, 2019).

This paper provides preliminary stock assessment results based on ASPIC model version 5.34 (Prager, 1992) applied to the albacore tuna stock in the southern Atlantic Ocean.

2. Model description and data input

2.1 Data

The model was fit to eight time series of catch (1956-2018) and three time series of CPUE (1968-2018 for longest series) data covering 8 distinct fishing fleets. Fleet description (**Table 1**) is similar to that used for ASPIC model at 2011 (ICCAT, 2012), 2013 (ICCAT, 2014b) or 2016 (ICCAT, 2017) assessment, and several fisheries, which were not included in the ICCAT Task I data for previous assessment, were added. In 2011, eight CPUE series were used. However, at 2013 ICCAT Atlantic albacore data preparatory meeting, the working group decided not to use indices for Japanese longline transition period (1970-1975), Brazilian longline and South African baitboat (ICCAT, 2014a). At 2016 ICCAT Atlantic albacore stock assessment meeting, the working group decided not to use indices for Japanese longline target period (1956 –1969), and recent years for Japanese longline bycatch period (2012 –2014) due to concern for target shift (ICCAT, 2017).

This year, as for CPUE by Japanese longline, in addition to that based on the same method as before (Matsumoto and Matsubara, 2020), CPUE in the south Atlantic core area is also available (Matsumoto, 2020). Therefore, in this study, CPUE for the same fleet as those in 2016 assessment (Chinese Taipei longline, Japanese longline bycatch period and Uruguay longline) were used, with some variations for Japanese longline CPUE. Some other indices were used for sensitivity analyses. **Table 2** and **Figure 1** show catch by fleet and **Table 3** and **Figure 2** show available CPUE indices including those used in the models. **Table 4** shows the list of "cases" (group of scenarios) with different CPUE series for Japanese longline.

2.2 Structural assumptions of the model

Basically, the same models as those for 2011, 2013 or 2016 assessment were examined. Both logistic (Schaefer) and FOX shape were used to fit the data. Weighting of fleet is either by equal weighting or weighting by catch amount (average catch). B_1/K was fixed to 0.9 based on decision at 2011 stock assessment meeting (ICCAT, 2012), which was also applied at 2013 and 2016 assessment. These four scenarios (**Table 5**) were applied for all the cases in **Table 4**, thus total of 20 scenarios were examined.

2.3 Future projection

Software package ASPICP ver 3.16 was used for future projections. Based on bootstrapping (500 times) of above scenarios, future projections were conducted. Projection period is 15 years (2019-2033). Constant future catch with 12,000 t to 34,000 t (at 2,000 t interval) or constant future F with $0.75*F_{2018}/F_{MSY}$ to $1.00*F_{2018}/F_{MSY}$ (at $0.05*F_{2018}/F_{MSY}$ interval) was assumed. Catch for 2019 and 2020 was assumed to be the average of 2016-2018, which was applied also for constant F scenarios.

2.4 Sensitivity analysis

Several sensitivity and retrospective analyses were conducted for one scenario (Case 2, Run08) of ASPIC model (**Table 6**). These are same as those in the previous stock assessment. Sensitivity analyses include scenarios with different B1/K, scenarios with one CPUE, and with additional CPUE. For the scenario in which start year is 1975, B1/K was set to the ratio of estimated biomass in 1975 to that in 1956 from the base model.

3. Result and discussion

Table 7 shows summary results of ASPIC runs with those for past assessment. Regarding scenarios with updated Japanese longline CPUE, estimation of MSY ranged 26.1 to 28.5 thousand tons, which was much higher than 2018 catch (17.1 thousand tons). Estimation of MSY for the scenarios with core area Japanese longline CPUE was higher (28.5 to 30.6 thousand tons). Estimation of r (intrinsic growth rate) differed depending on scenarios.

Figure 3 shows model fits to the indices of abundance for each scenario. CPUE fit was similar among scenarios in the same Case. CPUE fit was basically good, but that for Japanese longline core area index was comparatively poor. **Figure 4** shows trends of B-ratio (B/B_{MSY}) and F-ratio (F/F_{MSY}) for each scenario, and **Figure 5** shows Kobe I plot. It appears that the stock experienced overfishing and overfished around 2000 for several scenarios, but is recovering after that and the stock is currently in a green zone.

Figure 6 and **Figure 7** show the trends of F-ratio and B-ratio, respectively, for the future projection with constant catch. It was estimated that for several scenarios F exceeds and biomass drops under MSY level within 15 years if future catch is 30,000 t or hither. **Figure 8** shows the trends of B-ratio for the future projection with constant F. B-ratio approaches to MSY level with F equal to F_{MSY} level.

Table 8 shows Kobe II matrixes (risk assessment) based on future projections of each scenario, and **Table 9** shows Kobe II matrixes for the four scenarios of each case combined. To avoid to be too long, only green zone probability is shown. Seeing combined matrixes, future catch up to 28,000 to 30,000 t enables the probability of being in the green zone with >60% within 15 years.

Figure 9 shows the trends predicted yield for the future projection with constant F. Future catch sharply increases after 2019 even by $0.75*F_{MSY}$ level, and then decreases and approaches to MSY level.

It seems that, in recent years, due to lower catch level (**Figure 1**), south Atlantic albacore stock is recovering, and will continue to recover if current catch level is continued.

Figure 10 shows the results of sensitivity analysis. B-ratio of initial period changed for different B_1/K. The results were a bit more pessimistic with only Chinese Taipei longline CPUE. The model with South African baitboat CPUE did not converge. The results were very close to that in the base case as for the other scenarios. **Figure 11** shows the results of retrospective analysis. The results were close to that for the base case, but the difference was larger for the scenarios with Japanese longline core area CPUE.

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Table 1. Fleet descriptions used in the ASPIC models for south Atlantic in this study. Bold means addition from the previous stock assessment.

Fleet	Fleet 1	Fleet 2 (1956 –1969) Fleet 3 (1970 –1975) Fleet 4 (1976 –2018)	Fleet 5	Fleet 6 (1956 –1998) Fleet 7 (1999 –2018)	Fleet 8
CPUE	Chinese Taipei (LL)	Japan (LL) None (1956-1975)	None	None	Uruguay (LL)
Catch	Chinese Taipei (LL) Korea (LL)	China LL E. C. Spain (LL) E. C. Portugal (LL) Japan (LL) Philippines (LL) St Vincent and Grenadier (LL) USA (LL) Vanuatu (LL) Honduras (LL) Nei (LL) Côte D'Ivoire (LL) EU.United Kingdom (LL) Seychelles (LL) UK.Sta Helena (LL) Angola (LL) Senegal (LL) **Trinidad and Tobago (LL)**	Brazil (LL, SU) Panama (LL) South Africa (LL, UN) Argentina (LL, TW, UN) Belize (LL) Cambodia (LL) Cuba (LL, UN) Namibia (LL)	Brazil (BB, GN, HL, PS, TW, UN) E. C. Spain (PS) E. C. France (BB, PS) E. C. Portugal (BB, PS) Japan (BB, PS) Namibia (BB) Korea (BB) Maroc (PS) Panama (PS) South Africa (BB, HL, PS, RR, SP) USA (PS) USSR (SU, **UN**) UK St Helena (BB, RR) Chinese Taipei (GN) Nei (BB, PS) Argentina (PS) Belize (PS) Cape Verde (PS) Curaçao (PS) Guatemala (PS) Côte D'Ivoire (PS) Ghana (BB, PS) Guinea Ecuatorial (UN, HL) Guinée Rep. (PS) **St. Vincent and Grenadines (PS)** **Guinea Ecuatorial (HL)**	Uruguay (LL)

Table 2. Catches (t) of south Atlantic albacore for each fleet listed in **Table 1.**

Year	Fleet 1	Fleet 2	Fleet 3	Fleet 4	Fleet 5	Fleet 6	Fleet 7	Fleet 8	Total
1956		21							21
1957		725							725
1958		1,047							1,047
1959		3,015			1,700				4,715
1960		8,673			1,802				10,475
1961		8,893			1,872				10,765
1962		16,422			2,549				18,971
1963		15,104			2,281				17,385
1964	115	23,738			2,124	22			25,999
1965	346	28,309			1,190	0			29,845
1966	5,275	21,023			998	0			27,296
1967	7,412	7,719			752	0			15,883
1968	12,489	11,857			1,304	38			25,688
1969	21,732	6,331			430	0			28,493
1970	17,255		5,898		500	0			23,653
1971	21,323		3,218		344	0			24,885
1972	30,640		2,087		352	110			33,189
1973	25,888		277		1,969	100			28,234
1974	19,079		109		365	163			19,716
1975	16,614		306		536	151			17,607
1976	17,976			73	1,129	197			19,375
1977	19,858			105	1,019	473			21,455
1978	21,837			135	828	295			23,095
1979	21,218			105	532	785			22,640
1980	19,400			333	938	2,275			22,946
1981	18,869			558	976	3,614		23	24,040
1982	23,363			569	1,095	4,410		235	29,672
1983	10,101			162	1,360	2,922		373	14,918
1984	8,237			224	1,056	4,556		526	14,599
1985	20,154			623	517	8,272		1,531	31,097
1986	27,913			739	1,257	7,117		262	37,288
1987	29,173			357	1,725	9,197		178	40,630
1988	20,926			405	807	7,935		100	30,173
1989	18,440			450	788	7,450		83	27,212
1990	20,461			587	638	6,973		55	28,714
1991	19,914			804	1,333	3,930		34	26,016
1992	23,068			1,001	3,374	9,089		31	36,562
1993	19,420			748	3,753	8,863		28	32,813
1994	22,576			923	1,292	10,492		16	35,300
1995	18,354			695	941	7,513		49	27,552
1996	18,974			785	1,165	7,426		75	28,426
1997	18,169			673	769	8,354		56	28,022
1998	16,113			487	3,098	10,787		110	30,595
1999	17,391			1,560	1,651		6,965	90	27,656
2000	17,239			3,041	4,027		6,989	90	31,387
2001	15,834			5,235	6,834		10,757	135	38,796
2002	17,321			1,142	3,097		10,074	111	31,746
2003	17,356			534	2,641		7,367	108	28,005
2004	13,325			703	605		7,792	120	22,545
2005	10,772			1,446	726		5,940	32	18,916
2006	12,359			2,247	3,041		6,713	93	24,453
2007	13,202			1,313	538		5,195	34	20,283
2008	10,054			2,633	478		5,650	53	18,867
2009	9,052			2,470	493		10,152	97	22,265
2010	11,105			1,693	649		5,754	24	19,225
2011	13,103			1,888	1,417		7,684	37	24,129
2012	12,902			3,708	1,226		7,434	12	25,282
2013	8,552			4,136	991		5,569	209	19,457
2014	6,677			1,647	564		4,814		13,702
2015	7,161			2,327	617		5,095		15,199
2016	8,955			1,502	786		3,093		14,336
2017	9,176			1,743	755		2,150		13,825
2018	9,394			3,518	856		3,331		17,098

Table 3. Standardized CPUE series included in the ASPIC models for south Atlantic albacore.

Fleet	Fleet 1	Fleet 2	Fleet 3	Fleet 4	Fleet 4	Fleet 5	Fleet 6	Fleet 7	Fleet 8
CPUE series flag	Chinese Taipei LL	Japan LL1**	Japan LL2**	Japan LL3 (update)	Japan LL3 (core)	Brazil LL*	SA BB 1	SA BB 2*	Uruguay LL
1959		1.888					(NA)		
1960		1.780							
1961		1.430							
1962		1.025							
1963		0.992							
1964		0.996							
1965		0.671							
1966		0.610							
1967		0.648							
1968	1.879	0.598							
1969	1.739	0.362	2.199						
1970	1.467		1.057						
1971	1.749		1.673						
1972	1.177		0.897						
1973	0.982		0.603						
1974	0.986		0.357						
1975	1.210		0.213						
1976	1.176			1.140	1.321				
1977	1.262			0.722	0.545				
1978	1.203			1.346	0.751				
1979	1.191			0.544	1.059				
1980	1.144			0.811	0.472				
1981	1.024			1.726	1.509				
1982	1.008			1.338	1.819				
1983	1.007			1.088	0.869				1.689
1984	1.120			1.089	0.598				1.459
1985	1.088			1.892	1.834				1.526
1986	1.020			2.331	1.224				1.509
1987	0.866			0.914	0.345				1.411
1988	0.686			0.641	0.291				1.467
1989	0.632			0.800	0.467				1.754
1990	0.613			1.094	0.265				1.148
1991	0.634			1.250	0.285				1.333
1992	0.738			0.677	0.253				0.884
1993	0.792			0.578	0.361				1.546
1994	0.851			0.788	0.241				0.690
1995	1.022			0.522	0.182				1.103
1996	0.863			0.582	0.328				1.511
1997	1.156			0.737	0.409				1.110
1998	0.928			0.679	0.467	2.166			1.532
1999	0.825			0.780	0.575	1.611			1.217
2000	0.692			1.145	1.042	1.297			0.970
2001	0.823			1.276	0.976	1.547			0.564
2002	0.570			0.793	0.413	1.007			0.455
2003	0.485			0.835	0.188	0.961		1.008	0.317
2004	0.820			0.924	0.649	0.855		0.817	0.229
2005	0.804			0.677	0.817	0.890		0.942	0.145
2006	0.655			0.382	0.761	0.978		1.125	0.561
2007	0.860			0.327	1.064	0.650		1.342	0.706
2008	0.969			0.577	2.038	1.200		1.105	0.531
2009	1.018			0.760	0.735	0.973		1.463	0.671
2010	1.080			0.988	0.696	0.768		1.157	0.589
2011	0.936			0.770	1.833	0.751		0.890	0.371
2012	1.003			1.992	2.584	0.627		0.689	
2013	1.002			3.116	3.012	0.789		1.036	
2014	0.800			0.705	2.319	0.966		1.304	
2015	0.974			0.574	2.174	0.808		1.083	
2016	1.150			0.733	1.441	0.641		0.637	
2017	1.027			0.703	1.233	0.709		0.637	
2018	1.294			1.655	2.555	0.805		0.766	

* Only for sensitivity analysis, ** not used for analysis.

Table 4. List of model "cases". Each case includes four scenarios shown in **Table 5.**

Case	Name	JPN LL CPUE used	Comments
Case 1	JPLL_Update7611	Update 1976-2011	Same as 2016 assessment
Case 2	JPLL_Update7618	Update 1976-2018	
Case 3	JPLL_Update7618_no1213	Update 1976-2011, 2014-2018	
Case 4	JPLL_Core7611	Core 1976-2011	
Case 5	JPLL_Core7618	Core 1976-2018	

Table 5. List of model runs presented in this paper.

Run	Scenario name	Weight	B1/K (fixed)	Model
2	Run02_Eq_Sh	Equal for all fleets	0.9	Logistic
6	Run06_Eq_Fox	Equal for all fleets	0.9	Fox
7	Run07_CW_Sh	Weighted by catch	0.9	Logistic
8	Run08_CW_Fox	Weighted by catch	0.9	Fox

Table 6. Scenarios of sensitivity analyses for the ASPIC model runs for south Atlantic albacore.

Scenario	Abbreviation in the graph
B1/K fix at 0.8	B1/K 0.8
B1/K fix at 1.0	B1/K 1.0
Only with Chinese Taipei LL index	only TWLL
Only with index of Japan LL3 (1976-2018)	only JPLL3
Without Uruguay LL index	no URG LL
Additional South Africa BB index (late)	Add BB_L
Additional Brazil LL index	Add BZLL
Start year 1975	Start1975

Table 7. Results of the ASPIC model runs with those of 2013 and 2016 assessment.

	Model run	MSY (t)	F_{MSY}	B_{MSY} (t)	B_{2019}/B_{MSY}	F_{2018}/F_{MSY}	K(t)	r
Case 1	Run2	27,680	0.262	105,850	1.474	0.425	211,700	0.52
JPLL_Update7611	Run6	26,470	0.231	114,343	1.536	0.428	310,800	0.23
	Run7	28,500	0.177	160,800	1.563	0.386	321,600	0.35
	Run8	28,070	0.220	127,329	1.788	0.344	346,100	0.22
Case 2	Run2	27,650	0.255	108,450	1.493	0.419	216,900	0.51
JPLL_Update7618	Run6	26,670	0.237	112,466	1.591	0.410	305,700	0.24
	Run7	28,500	0.177	160,800	1.563	0.386	321,600	0.35
	Run8	28,120	0.222	126,520	1.795	0.342	343,900	0.22
Case 3	Run2	27,000	0.213	126,600	1.335	0.484	253,200	0.43
JPLL_Update7618_no1213	Run6	26,060	0.206	126,299	1.448	0.462	343,300	0.21
	Run7	28,500	0.177	160,800	1.563	0.386	321,600	0.35
	Run8	28,000	0.213	131,340	1.773	0.348	357,000	0.21
Case 4	Run2	30,320	0.723	41,950	1.686	0.331	83,900	1.45
JPLL_Core7611	Run6	28,710	0.433	66,369	2.009	0.297	180,400	0.43
	Run7	28,500	0.177	160,800	1.563	0.386	321,600	0.35
	Run8	28,560	0.256	111,694	1.870	0.323	303,600	0.26
Case 5	Run2	30,630	0.844	36,290	1.687	0.327	72,580	1.69
JPLL_Core7618	Run6	29,520	0.673	43,890	2.098	0.274	119,300	0.67
	Run7	28,650	0.186	154,300	1.577	0.380	308,600	0.37
	Run8	28,900	0.307	94,219	1.944	0.306	256,100	0.31
2016 results*	Run2	26,920	0.212	127,100	0.937	0.573	254,300	0.42
	Run6	25,200	0.172	146,200	1.001	0.564	397,300	0.17
	Run7	26,210	0.145	180,300	1.097	0.491	360,600	0.29
	Run8	25,080	0.138	182,000	1.147	0.489	494,800	0.14
2013 results*	Run2	28,060	0.301	93,330	0.813	1.076	186,700	0.60
	Run6	25,660	0.199	128,800	0.861	1.098	350,000	0.20
	Run7	22,620	0.070	323,000	0.816	1.301	646,000	0.14
	Run8	24,250	0.127	191,300	0.950	1.047	520,000	0.13

*B-ratio and F-ratio for terminal year

Table 8. Kobe II risk matrix (for the probability of being green) based on ASPIC results (each scenario) for south Atlantic albacore.

Case 1 JPLL_Update7611

Run02 Probability of being green															
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
14,000	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
16,000	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
18,000	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
20,000	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
22,000	99%	99%	99%	99%	99%	98%	97%	97%	97%	97%	97%	97%	96%	96%	96%
24,000	99%	99%	99%	99%	98%	96%	96%	95%	95%	95%	95%	95%	94%	94%	94%
26,000	99%	99%	99%	99%	96%	95%	94%	94%	93%	92%	92%	91%	91%	91%	90%
28,000	99%	99%	99%	96%	94%	93%	91%	88%	86%	84%	83%	81%	80%	79%	77%
30,000	99%	99%	95%	92%	86%	82%	77%	73%	68%	64%	59%	54%	47%	44%	38%
32,000	99%	99%	92%	83%	74%	67%	58%	47%	40%	32%	26%	20%	16%	12%	8%
34,000	99%	99%	85%	73%	60%	45%	33%	24%	18%	12%	7%	4%	2%	1%	1%
F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	99%	99%	97%	97%	95%	94%	93%	93%	92%	92%	92%	92%	92%	92%	91%
0.80*FMSY	99%	99%	92%	92%	92%	92%	91%	89%	88%	87%	87%	87%	87%	87%	87%
0.85*FMSY	99%	99%	86%	86%	86%	86%	86%	86%	84%	83%	83%	83%	82%	82%	81%
0.90*FMSY	99%	99%	74%	74%	74%	74%	74%	74%	74%	74%	74%	73%	73%	73%	73%
0.95*FMSY	99%	99%	62%	62%	62%	62%	62%	62%	62%	62%	62%	62%	62%	61%	61%
1.00*FMSY	99%	99%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	43%

Run06 Probability of being green															
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
22,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
24,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
26,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	99%	99%	98%	98%
28,000	100%	100%	100%	100%	100%	99%	98%	97%	96%	94%	92%	91%	88%	86%	84%
30,000	100%	100%	100%	100%	97%	94%	91%	86%	80%	73%	68%	60%	52%	45%	40%
32,000	100%	100%	100%	96%	89%	81%	71%	60%	48%	40%	29%	21%	16%	10%	8%
34,000	100%	100%	96%	87%	73%	58%	43%	29%	21%	14%	9%	5%	3%	2%	1%
F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	99%	99%	99%	99%
0.80*FMSY	100%	100%	98%	98%	98%	98%	98%	98%	98%	98%	98%	97%	97%	97%	96%
0.85*FMSY	100%	100%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%	92%	92%	92%
0.90*FMSY	100%	100%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
0.95*FMSY	100%	100%	62%	62%	62%	62%	62%	62%	62%	62%	62%	62%	62%	62%	61%
1.00*FMSY	100%	100%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%

Table 8. Kobe II risk matrix (for the probability of being green) based on ASPIC results (each scenario) for south Atlantic albacore (continued).

Case 1 JPLL_Update7611

Run07 Probability of being green															
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	99%	99%	99%	99%
22,000	100%	100%	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
24,000	100%	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
26,000	100%	100%	100%	100%	99%	99%	99%	99%	99%	98%	98%	98%	98%	98%	98%
28,000	100%	100%	100%	99%	99%	99%	99%	98%	98%	97%	97%	96%	95%	94%	94%
30,000	100%	100%	99%	99%	98%	97%	95%	94%	91%	88%	86%	84%	80%	77%	74%
32,000	100%	100%	99%	97%	94%	89%	85%	78%	72%	67%	63%	59%	51%	46%	40%
34,000	100%	100%	97%	92%	84%	75%	66%	59%	49%	39%	34%	26%	23%	20%	17%
F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	98%	98%	98%	98%	98%	98%	97%	96%	96%	95%	95%	95%	95%
0.80*FMSY	100%	100%	95%	95%	95%	95%	95%	95%	95%	94%	94%	94%	93%	92%	92%
0.85*FMSY	100%	100%	88%	88%	88%	88%	88%	88%	88%	88%	88%	88%	87%	87%	86%
0.90*FMSY	100%	100%	76%	76%	76%	76%	76%	76%	76%	76%	76%	76%	76%	76%	76%
0.95*FMSY	100%	100%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%
1.00*FMSY	100%	100%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%

Run08 Probability of being green															
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
22,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
24,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
26,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
28,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
30,000	100%	100%	100%	100%	100%	100%	100%	100%	99%	98%	97%	96%	94%	92%	89%
32,000	100%	100%	100%	100%	100%	99%	97%	96%	92%	88%	84%	79%	72%	65%	57%
34,000	100%	100%	100%	100%	98%	96%	89%	84%	74%	64%	54%	44%	33%	25%	20%
F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	99%	99%	99%
0.80*FMSY	100%	100%	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%
0.85*FMSY	100%	100%	91%	91%	91%	91%	91%	91%	91%	91%	91%	91%	91%	91%	91%
0.90*FMSY	100%	100%	82%	82%	82%	82%	82%	82%	82%	82%	82%	82%	82%	82%	82%
0.95*FMSY	100%	100%	67%	67%	67%	67%	67%	67%	67%	67%	67%	67%	67%	67%	67%
1.00*FMSY	100%	100%	48%	48%	48%	48%	48%	48%	48%	48%	48%	48%	48%	48%	48%

Table 8. Kobe II risk matrix (for the probability of being green) based on ASPIC results (each scenario) for south Atlantic albacore (continued).

Case 2 JPLL_Update7618

Run02 Probability of being green															
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	99%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
20,000	99%	100%	100%	99%	99%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
22,000	99%	100%	100%	99%	98%	97%	97%	97%	96%	96%	96%	96%	96%	96%	96%
24,000	99%	100%	100%	99%	97%	96%	95%	95%	95%	95%	95%	94%	94%	94%	94%
26,000	99%	100%	100%	98%	96%	95%	94%	93%	93%	92%	92%	91%	91%	91%	91%
28,000	99%	100%	98%	95%	94%	92%	91%	89%	87%	84%	82%	81%	80%	78%	77%
30,000	99%	100%	95%	92%	87%	81%	77%	73%	69%	65%	60%	57%	51%	45%	42%
32,000	99%	100%	92%	83%	74%	68%	60%	51%	44%	38%	33%	27%	20%	15%	11%
34,000	99%	100%	86%	74%	62%	48%	39%	31%	23%	15%	10%	6%	5%	3%	1%
F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	99%	100%	95%	95%	95%	94%	93%	92%	92%	91%	91%	91%	91%	91%	91%
0.80*FMSY	99%	100%	92%	92%	92%	92%	91%	90%	89%	88%	88%	88%	87%	87%	87%
0.85*FMSY	99%	100%	85%	85%	85%	85%	85%	85%	84%	82%	82%	81%	81%	81%	81%
0.90*FMSY	99%	100%	74%	74%	74%	74%	74%	74%	74%	74%	74%	74%	74%	73%	73%
0.95*FMSY	99%	100%	61%	61%	61%	61%	61%	61%	61%	61%	61%	61%	61%	61%	61%
1.00*FMSY	99%	100%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%

Run06 Probability of being green															
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
22,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
24,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
26,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%
28,000	100%	100%	100%	100%	100%	100%	100%	99%	98%	97%	97%	95%	94%	92%	90%
30,000	100%	100%	100%	100%	99%	98%	96%	91%	87%	80%	74%	67%	63%	55%	51%
32,000	100%	100%	100%	98%	96%	89%	78%	68%	59%	50%	40%	31%	23%	16%	12%
34,000	100%	100%	98%	94%	82%	67%	54%	42%	29%	20%	13%	10%	7%	6%	3%
F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	99%	99%
0.80*FMSY	100%	100%	98%	98%	98%	98%	98%	98%	98%	98%	97%	97%	97%	97%	97%
0.85*FMSY	100%	100%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%
0.90*FMSY	100%	100%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
0.95*FMSY	100%	100%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%
1.00*FMSY	100%	100%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	49%

Table 8. Kobe II risk matrix (for the probability of being green) based on ASPIC results (each scenario) for south Atlantic albacore (continued).

Case 2 JPLL_Update7618

Run07 Probability of being green															
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
22,000	100%	100%	100%	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%
24,000	100%	100%	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
26,000	100%	100%	100%	100%	99%	99%	99%	99%	98%	98%	98%	97%	97%	97%	96%
28,000	100%	100%	100%	100%	99%	99%	98%	98%	97%	96%	95%	94%	93%	93%	93%
30,000	100%	100%	99%	99%	97%	96%	93%	92%	90%	90%	88%	84%	82%	80%	78%
32,000	100%	100%	98%	96%	92%	90%	86%	81%	76%	71%	67%	61%	56%	49%	44%
34,000	100%	100%	96%	90%	85%	78%	70%	62%	54%	44%	36%	30%	25%	20%	18%

F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	98%	98%	98%	98%	97%	96%	96%	95%	94%	94%	94%	94%	93%
0.80*FMSY	100%	100%	94%	94%	94%	94%	94%	94%	94%	93%	93%	92%	91%	91%	91%
0.85*FMSY	100%	100%	89%	89%	89%	89%	89%	89%	89%	89%	89%	89%	89%	89%	89%
0.90*FMSY	100%	100%	79%	79%	79%	79%	79%	79%	79%	79%	79%	79%	79%	79%	79%
0.95*FMSY	100%	100%	66%	66%	66%	66%	66%	66%	66%	66%	66%	66%	66%	66%	66%
1.00*FMSY	100%	100%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%

Run08 Probability of being green															
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
22,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
24,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
26,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
28,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	99%	99%	99%
30,000	100%	100%	100%	100%	100%	100%	99%	99%	99%	98%	97%	95%	94%	92%	89%
32,000	100%	100%	100%	100%	99%	99%	98%	95%	92%	87%	80%	75%	69%	60%	54%
34,000	100%	100%	100%	99%	98%	95%	90%	80%	72%	59%	50%	40%	32%	25%	21%

F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	98%
0.80*FMSY	100%	100%	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%	96%	96%
0.85*FMSY	100%	100%	91%	91%	91%	91%	91%	91%	91%	91%	91%	91%	91%	91%	91%
0.90*FMSY	100%	100%	78%	78%	78%	78%	78%	78%	78%	78%	78%	78%	78%	78%	78%
0.95*FMSY	100%	100%	61%	61%	61%	61%	61%	61%	61%	61%	61%	61%	61%	61%	61%
1.00*FMSY	100%	100%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%

Table 8. Kobe II risk matrix (for the probability of being green) based on ASPIC results (each scenario) for south Atlantic albacore (continued).

Case 3 JPLL_Update7618_no1213

Run02 Probability of being green															
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	98%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
14,000	98%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
16,000	98%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
18,000	98%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
20,000	98%	99%	99%	99%	99%	99%	99%	98%	98%	98%	98%	98%	98%	98%	98%
22,000	98%	99%	99%	99%	98%	98%	98%	98%	97%	97%	97%	97%	97%	97%	97%
24,000	98%	99%	99%	99%	98%	97%	97%	97%	97%	97%	97%	97%	97%	96%	96%
26,000	98%	99%	99%	98%	97%	97%	97%	96%	96%	95%	95%	95%	94%	94%	94%
28,000	98%	99%	98%	97%	96%	95%	92%	90%	88%	85%	82%	78%	76%	72%	70%
30,000	98%	99%	96%	93%	87%	79%	71%	65%	61%	56%	50%	43%	37%	34%	29%
32,000	98%	99%	91%	79%	67%	58%	47%	38%	32%	25%	19%	12%	8%	5%	3%
34,000	98%	99%	77%	61%	45%	34%	25%	17%	9%	6%	4%	2%	1%	1%	1%
F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	98%	99%	98%	97%	97%	97%	96%	96%	96%	96%	96%	95%	95%	95%	95%
0.80*FMSY	98%	99%	96%	96%	96%	95%	95%	95%	94%	94%	94%	94%	94%	93%	93%
0.85*FMSY	98%	99%	90%	90%	90%	90%	90%	90%	90%	89%	88%	88%	88%	87%	87%
0.90*FMSY	98%	99%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	79%
0.95*FMSY	98%	99%	65%	65%	65%	65%	65%	65%	65%	65%	64%	64%	64%	64%	64%
1.00*FMSY	98%	99%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%

Run06 Probability of being green															
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
22,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
24,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
26,000	100%	100%	100%	100%	100%	100%	100%	100%	99%	99%	99%	99%	98%	98%	98%
28,000	100%	100%	100%	100%	99%	98%	97%	96%	94%	93%	92%	88%	84%	81%	76%
30,000	100%	100%	99%	97%	95%	93%	87%	79%	71%	65%	53%	43%	35%	29%	23%
32,000	100%	100%	97%	93%	83%	71%	57%	42%	32%	24%	18%	15%	9%	6%	5%
34,000	100%	100%	92%	76%	59%	38%	27%	18%	13%	8%	5%	4%	3%	3%	2%
F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	100%	100%	100%	100%	99%	99%	99%	99%	99%	99%	98%	98%	98%
0.80*FMSY	100%	100%	97%	97%	97%	97%	97%	97%	97%	96%	96%	96%	96%	96%	96%
0.85*FMSY	100%	100%	92%	92%	92%	92%	92%	92%	92%	92%	92%	92%	92%	92%	92%
0.90*FMSY	100%	100%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
0.95*FMSY	100%	100%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%
1.00*FMSY	100%	100%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%

Table 8. Kobe II risk matrix (for the probability of being green) based on ASPIC results (each scenario) for south Atlantic albacore (continued).

Case 3 JPLL_Update7618_no1213

Run07 Probability of being green															
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%
20,000	100%	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
22,000	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
24,000	100%	100%	100%	99%	99%	99%	99%	99%	99%	98%	98%	98%	98%	98%	98%
26,000	100%	100%	100%	99%	99%	99%	98%	98%	98%	98%	98%	97%	97%	97%	97%
28,000	100%	100%	100%	99%	99%	98%	98%	98%	97%	97%	95%	94%	94%	93%	93%
30,000	100%	100%	99%	98%	97%	96%	94%	92%	91%	90%	88%	85%	82%	80%	78%
32,000	100%	100%	98%	96%	93%	91%	87%	81%	76%	70%	64%	60%	55%	49%	44%
34,000	100%	100%	96%	92%	86%	78%	69%	60%	54%	43%	36%	31%	27%	22%	18%
F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	98%	98%	98%	98%	97%	97%	96%	95%	95%	94%	94%	94%	94%
0.80*FMSY	100%	100%	94%	94%	94%	94%	94%	94%	94%	93%	93%	92%	92%	92%	91%
0.85*FMSY	100%	100%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	89%	88%
0.90*FMSY	100%	100%	79%	79%	79%	79%	79%	79%	79%	79%	79%	79%	79%	79%	79%
0.95*FMSY	100%	100%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%
1.00*FMSY	100%	100%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%

Run08 Probability of being green															
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
22,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
24,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
26,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
28,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	99%
30,000	100%	100%	100%	100%	100%	100%	100%	99%	99%	98%	97%	96%	95%	93%	90%
32,000	100%	100%	100%	100%	100%	99%	97%	96%	93%	87%	81%	77%	70%	62%	55%
34,000	100%	100%	100%	100%	98%	96%	90%	80%	72%	62%	51%	42%	34%	25%	18%
F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	99%	99%	99%	99%	99%
0.80*FMSY	100%	100%	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%	96%
0.85*FMSY	100%	100%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%
0.90*FMSY	100%	100%	79%	79%	79%	79%	79%	79%	79%	79%	79%	79%	79%	79%	79%
0.95*FMSY	100%	100%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%
1.00*FMSY	100%	100%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%

Table 8. Kobe II risk matrix (for the probability of being green) based on ASPIC results (each scenario) for south Atlantic albacore (continued).

Case 4 JPLL_Core7611

Run02 Probability of being green

Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20,000	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
22,000	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
24,000	100%	100%	100%	99%	98%	98%	97%	97%	97%	97%	97%	97%	97%	97%	97%
26,000	100%	100%	100%	99%	95%	94%	93%	93%	93%	93%	93%	93%	93%	93%	93%
28,000	100%	100%	100%	97%	92%	89%	86%	85%	85%	85%	85%	84%	84%	84%	84%
30,000	100%	100%	99%	92%	85%	81%	78%	75%	74%	72%	71%	70%	69%	69%	68%
32,000	100%	100%	94%	80%	70%	60%	55%	49%	42%	36%	31%	28%	21%	17%	13%
34,000	100%	100%	86%	68%	54%	40%	31%	23%	17%	12%	8%	5%	3%	3%	2%

F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	87%	87%	84%	81%	81%	80%	80%	80%	80%	80%	80%	80%	80%
0.80*FMSY	100%	100%	80%	80%	80%	76%	75%	75%	75%	75%	75%	75%	75%	75%	75%
0.85*FMSY	100%	100%	71%	71%	71%	71%	70%	69%	69%	69%	69%	69%	69%	69%	69%
0.90*FMSY	100%	100%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
0.95*FMSY	100%	100%	54%	54%	54%	54%	54%	54%	54%	54%	54%	54%	54%	54%	54%
1.00*FMSY	100%	100%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%

Run06 Probability of being green

Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
22,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
24,000	100%	100%	100%	100%	100%	99%	99%	99%	98%	98%	98%	98%	98%	98%	98%
26,000	100%	100%	100%	100%	99%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
28,000	100%	100%	100%	100%	98%	98%	98%	98%	97%	96%	95%	95%	94%	94%	93%
30,000	100%	100%	100%	98%	98%	95%	94%	90%	87%	85%	81%	78%	75%	72%	67%
32,000	100%	100%	99%	98%	95%	88%	82%	76%	67%	61%	55%	46%	40%	35%	29%
34,000	100%	100%	98%	95%	86%	77%	64%	55%	43%	35%	28%	20%	15%	9%	6%

F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	94%	94%	94%	94%	94%	93%	91%	91%	91%	91%	91%	91%	91%
0.80*FMSY	100%	100%	87%	87%	87%	87%	87%	87%	87%	86%	86%	86%	85%	85%	85%
0.85*FMSY	100%	100%	80%	80%	80%	80%	80%	80%	80%	80%	80%	79%	79%	79%	79%
0.90*FMSY	100%	100%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	69%	69%
0.95*FMSY	100%	100%	58%	58%	58%	58%	58%	58%	58%	58%	58%	58%	58%	58%	58%
1.00*FMSY	100%	100%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%

Table 8. Kobe II risk matrix (for the probability of being green) based on ASPIC results (each scenario) for south Atlantic albacore (continued).

Case 4 JPLL_Core7611

Run07 Probability of being green															
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
14,000	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
16,000	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
18,000	99%	99%	99%	99%	99%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
20,000	99%	99%	99%	99%	98%	98%	97%	97%	97%	97%	97%	97%	97%	97%	97%
22,000	99%	99%	99%	98%	97%	97%	97%	97%	97%	96%	96%	96%	96%	96%	96%
24,000	99%	99%	99%	98%	97%	97%	96%	95%	95%	95%	95%	94%	94%	94%	94%
26,000	99%	99%	99%	97%	97%	96%	95%	94%	94%	93%	92%	92%	92%	92%	92%
28,000	99%	99%	99%	97%	96%	95%	94%	93%	92%	91%	90%	89%	88%	88%	86%
30,000	99%	99%	97%	94%	92%	90%	88%	85%	84%	81%	79%	77%	75%	73%	71%
32,000	99%	99%	94%	90%	86%	82%	78%	74%	70%	65%	60%	55%	51%	46%	43%
34,000	99%	99%	90%	84%	78%	71%	64%	55%	49%	43%	39%	32%	29%	25%	22%
F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	99%	99%	92%	92%	92%	92%	92%	92%	91%	90%	89%	88%	88%	88%	88%
0.80*FMSY	99%	99%	88%	88%	88%	88%	88%	88%	88%	87%	86%	85%	85%	84%	84%
0.85*FMSY	99%	99%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	79%
0.90*FMSY	99%	99%	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%
0.95*FMSY	99%	99%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
1.00*FMSY	99%	99%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%

Run08 Probability of being green															
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
22,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
24,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
26,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
28,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	99%	99%	98%	98%	98%
30,000	100%	100%	100%	100%	100%	100%	99%	98%	98%	98%	96%	95%	93%	92%	89%
32,000	100%	100%	100%	100%	99%	98%	97%	94%	92%	87%	82%	78%	73%	67%	61%
34,000	100%	100%	100%	99%	98%	94%	89%	82%	75%	68%	58%	47%	38%	30%	25%
F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
0.80*FMSY	100%	100%	96%	96%	96%	96%	96%	96%	96%	96%	96%	95%	95%	95%	95%
0.85*FMSY	100%	100%	89%	89%	89%	89%	89%	89%	89%	89%	89%	89%	89%	89%	88%
0.90*FMSY	100%	100%	78%	78%	78%	78%	78%	78%	78%	78%	78%	78%	78%	78%	78%
0.95*FMSY	100%	100%	65%	65%	65%	65%	65%	65%	65%	65%	65%	65%	65%	65%	65%
1.00*FMSY	100%	100%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%

Table 8. Kobe II risk matrix (for the probability of being green) based on ASPIC results (each scenario) for south Atlantic albacore (continued).

Case 5 JPLL_Core7618

Run02 Probability of being green															
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
22,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
24,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
26,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
28,000	100%	100%	100%	100%	99%	97%	96%	95%	95%	95%	95%	95%	95%	95%	95%
30,000	100%	100%	100%	99%	94%	90%	85%	81%	79%	77%	76%	75%	74%	73%	73%
32,000	100%	100%	100%	87%	70%	61%	54%	50%	44%	37%	31%	27%	23%	16%	12%
34,000	100%	100%	95%	67%	52%	40%	29%	23%	15%	10%	7%	4%	3%	2%	2%

F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	95%	95%	90%	89%	88%	88%	88%	88%	88%	88%	88%	88%	88%
0.80*FMSY	100%	100%	86%	86%	84%	80%	79%	79%	79%	79%	79%	79%	79%	79%	79%
0.85*FMSY	100%	100%	71%	71%	71%	71%	70%	69%	69%	69%	69%	69%	69%	69%	69%
0.90*FMSY	100%	100%	62%	62%	62%	62%	62%	62%	61%	61%	61%	61%	61%	61%	61%
0.95*FMSY	100%	100%	53%	53%	53%	53%	53%	53%	53%	53%	53%	53%	53%	53%	53%
1.00*FMSY	100%	100%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%

Run06 Probability of being green															
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
22,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
24,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
26,000	100%	100%	100%	100%	100%	100%	100%	99%	99%	99%	99%	99%	98%	98%	98%
28,000	100%	100%	100%	100%	100%	98%	97%	96%	96%	96%	95%	94%	94%	94%	94%
30,000	100%	100%	100%	100%	97%	94%	92%	89%	86%	83%	80%	78%	77%	74%	72%
32,000	100%	100%	100%	96%	91%	83%	76%	68%	59%	48%	41%	34%	25%	18%	14%
34,000	100%	100%	99%	92%	80%	65%	51%	38%	26%	15%	11%	7%	5%	2%	1%

F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	91%	91%	91%	91%	90%	89%	89%	88%	88%	88%	88%	88%	88%
0.80*FMSY	100%	100%	84%	84%	84%	84%	84%	83%	83%	83%	82%	82%	82%	82%	82%
0.85*FMSY	100%	100%	77%	77%	77%	77%	77%	77%	77%	77%	77%	77%	76%	76%	76%
0.90*FMSY	100%	100%	67%	67%	67%	67%	67%	67%	67%	67%	67%	67%	67%	67%	67%
0.95*FMSY	100%	100%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%	57%
1.00*FMSY	100%	100%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%

Table 8. Kobe II risk matrix (for the probability of being green) based on ASPIC results (each scenario) for south Atlantic albacore (continued).

Case 5 JPLL_Core7618

Run07 Probability of being green															
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	98%	98%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
14,000	98%	98%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
16,000	98%	98%	99%	99%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
18,000	98%	98%	99%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
20,000	98%	98%	99%	98%	98%	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%
22,000	98%	98%	99%	98%	97%	97%	97%	97%	96%	96%	96%	96%	96%	96%	96%
24,000	98%	98%	99%	97%	97%	96%	96%	96%	96%	95%	95%	95%	95%	95%	95%
26,000	98%	98%	99%	97%	97%	96%	95%	95%	94%	94%	93%	93%	93%	93%	92%
28,000	98%	98%	98%	97%	96%	95%	94%	93%	93%	92%	90%	90%	89%	87%	86%
30,000	98%	98%	97%	95%	93%	91%	89%	86%	83%	81%	80%	75%	73%	72%	69%
32,000	98%	98%	95%	92%	86%	82%	77%	73%	68%	64%	62%	57%	54%	49%	45%
34,000	98%	98%	92%	85%	76%	70%	64%	58%	52%	44%	40%	36%	31%	26%	24%
F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	98%	98%	93%	93%	93%	93%	93%	92%	91%	90%	90%	89%	89%	88%	88%
0.80*FMSY	98%	98%	88%	88%	88%	88%	88%	88%	88%	86%	85%	85%	84%	83%	83%
0.85*FMSY	98%	98%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	79%
0.90*FMSY	98%	98%	69%	69%	69%	69%	69%	69%	69%	69%	69%	69%	69%	69%	69%
0.95*FMSY	98%	98%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
1.00*FMSY	98%	98%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%

Run08 Probability of being green															
Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
22,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
24,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
26,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
28,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	99%	99%	99%
30,000	100%	100%	100%	100%	100%	100%	100%	99%	99%	97%	95%	93%	92%	90%	89%
32,000	100%	100%	100%	100%	100%	99%	96%	93%	89%	84%	79%	71%	64%	59%	52%
34,000	100%	100%	100%	100%	98%	93%	87%	79%	66%	58%	48%	37%	30%	23%	17%
F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	99%	99%	99%	99%	99%	99%	99%	98%	98%	98%	98%	97%	97%
0.80*FMSY	100%	100%	94%	94%	94%	94%	94%	94%	94%	94%	93%	93%	93%	93%	93%
0.85*FMSY	100%	100%	88%	88%	88%	88%	88%	88%	88%	88%	88%	88%	87%	86%	86%
0.90*FMSY	100%	100%	76%	76%	76%	76%	76%	76%	76%	76%	76%	76%	76%	75%	75%
0.95*FMSY	100%	100%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
1.00*FMSY	100%	100%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%	43%

Table 9. Kobe II risk matrix (for the probability of being green) based on ASPIC results (four scenarios of each case combined) for south Atlantic albacore.

Case 1 JPLL_Update7611

Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
22,000	100%	100%	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
24,000	100%	100%	100%	100%	99%	99%	99%	99%	98%	98%	98%	98%	98%	98%	98%
26,000	100%	100%	100%	100%	99%	99%	98%	98%	98%	98%	97%	97%	97%	97%	97%
28,000	100%	100%	100%	99%	98%	98%	97%	96%	95%	94%	93%	92%	91%	90%	89%
30,000	100%	100%	99%	98%	95%	93%	90%	88%	84%	81%	77%	73%	68%	64%	60%
32,000	100%	100%	98%	94%	89%	84%	78%	70%	63%	57%	50%	45%	39%	33%	28%
34,000	100%	100%	94%	88%	79%	68%	58%	49%	41%	32%	26%	20%	15%	12%	10%

F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	99%	99%	98%	98%	98%	97%	97%	97%	97%	96%	96%	96%	96%
0.80*FMSY	100%	100%	96%	96%	96%	96%	95%	95%	95%	94%	94%	94%	94%	93%	93%
0.85*FMSY	100%	100%	89%	89%	89%	89%	89%	89%	89%	89%	89%	89%	88%	88%	87%
0.90*FMSY	100%	100%	78%	78%	78%	78%	78%	78%	78%	78%	78%	78%	78%	78%	78%
0.95*FMSY	100%	100%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%
1.00*FMSY	100%	100%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%

Case 2 JPLL_Update7618

Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20,000	100%	100%	100%	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%
22,000	100%	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
24,000	100%	100%	100%	100%	99%	99%	99%	99%	98%	98%	98%	98%	98%	98%	98%
26,000	100%	100%	100%	99%	99%	99%	98%	98%	98%	97%	97%	97%	97%	97%	97%
28,000	100%	100%	99%	99%	98%	98%	97%	96%	95%	94%	93%	92%	92%	90%	90%
30,000	100%	100%	99%	98%	96%	94%	91%	89%	86%	83%	80%	76%	73%	68%	65%
32,000	100%	100%	97%	94%	90%	86%	81%	74%	68%	62%	55%	48%	42%	35%	30%
34,000	100%	100%	95%	89%	82%	72%	63%	54%	45%	35%	27%	22%	17%	14%	11%

F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	98%	98%	98%	98%	97%	97%	97%	96%	96%	96%	96%	96%	96%
0.80*FMSY	100%	100%	95%	95%	95%	95%	95%	95%	95%	94%	94%	94%	93%	93%	93%
0.85*FMSY	100%	100%	90%	90%	90%	90%	90%	90%	90%	89%	89%	89%	89%	89%	89%
0.90*FMSY	100%	100%	78%	78%	78%	78%	78%	78%	78%	78%	78%	78%	78%	78%	78%
0.95*FMSY	100%	100%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%
1.00*FMSY	100%	100%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%	47%

Case 3 JPLL_Update7618_no1213

Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20,000	99%	100%	100%	100%	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%
22,000	99%	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
24,000	99%	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
26,000	99%	100%	100%	99%	99%	99%	99%	99%	98%	98%	98%	98%	97%	97%	97%
28,000	99%	100%	99%	99%	98%	98%	97%	96%	95%	94%	92%	90%	88%	87%	85%
30,000	99%	100%	99%	97%	95%	92%	88%	84%	80%	77%	72%	67%	62%	59%	55%
32,000	99%	100%	97%	92%	86%	80%	72%	64%	58%	51%	46%	41%	35%	31%	27%
34,000	99%	100%	91%	82%	72%	61%	53%	44%	37%	30%	24%	20%	16%	13%	10%

F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	99%	100%	99%	99%	98%	98%	98%	98%	98%	97%	97%	97%	97%	97%	97%
0.80*FMSY	99%	100%	96%	96%	96%	96%	96%	96%	96%	95%	95%	95%	95%	94%	94%
0.85*FMSY	99%	100%	91%	91%	91%	91%	91%	91%	91%	91%	91%	91%	91%	90%	90%
0.90*FMSY	99%	100%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	79%	79%
0.95*FMSY	99%	100%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%	64%
1.00*FMSY	99%	100%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%

Table 9. Kobe II risk matrix (for the probability of being green) based on ASPIC results (four scenarios of each case combined) for south Atlantic albacore (continued)

Case 4 JPLL_Core7611

Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%
20,000	100%	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
22,000	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
24,000	100%	100%	100%	99%	99%	98%	98%	98%	98%	98%	98%	97%	97%	97%	97%
26,000	100%	100%	100%	99%	98%	97%	97%	96%	96%	96%	96%	96%	96%	96%	96%
28,000	100%	100%	100%	98%	97%	96%	95%	94%	93%	93%	92%	92%	91%	91%	91%
30,000	100%	100%	99%	96%	94%	92%	90%	87%	86%	84%	82%	80%	78%	76%	74%
32,000	100%	100%	97%	92%	88%	82%	78%	73%	68%	62%	57%	52%	46%	41%	37%
34,000	100%	100%	94%	86%	79%	71%	62%	54%	46%	39%	33%	26%	21%	17%	14%

F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	93%	93%	92%	92%	91%	91%	90%	90%	90%	89%	89%	89%	89%
0.80*FMSY	100%	100%	88%	88%	88%	87%	86%	86%	86%	86%	86%	85%	85%	85%	85%
0.85*FMSY	100%	100%	80%	80%	80%	80%	80%	80%	80%	80%	80%	79%	79%	79%	79%
0.90*FMSY	100%	100%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
0.95*FMSY	100%	100%	59%	59%	59%	59%	59%	59%	59%	59%	59%	59%	59%	59%	59%
1.00*FMSY	100%	100%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%

Case 5 JPLL_Core7618

Catch (t)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
12,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
14,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
16,000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
18,000	100%	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
20,000	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
22,000	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
24,000	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
26,000	100%	100%	100%	99%	99%	99%	99%	99%	98%	98%	98%	98%	98%	98%	98%
28,000	100%	100%	100%	99%	99%	98%	97%	96%	96%	96%	95%	95%	94%	94%	93%
30,000	100%	100%	99%	98%	96%	94%	91%	89%	87%	85%	83%	80%	79%	77%	76%
32,000	100%	100%	99%	94%	87%	81%	76%	71%	65%	59%	53%	47%	42%	36%	31%
34,000	100%	100%	96%	86%	76%	67%	58%	50%	40%	32%	26%	21%	17%	13%	11%

F	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0.75*FMSY	100%	100%	95%	95%	93%	93%	92%	92%	92%	91%	91%	91%	91%	91%	90%
0.80*FMSY	100%	100%	88%	88%	87%	87%	86%	86%	86%	85%	85%	85%	84%	84%	84%
0.85*FMSY	100%	100%	79%	79%	79%	79%	79%	78%	78%	78%	78%	78%	78%	78%	77%
0.90*FMSY	100%	100%	69%	69%	69%	69%	69%	69%	69%	69%	69%	69%	69%	68%	68%
0.95*FMSY	100%	100%	58%	58%	58%	58%	58%	58%	58%	58%	58%	58%	58%	58%	58%
1.00*FMSY	100%	100%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
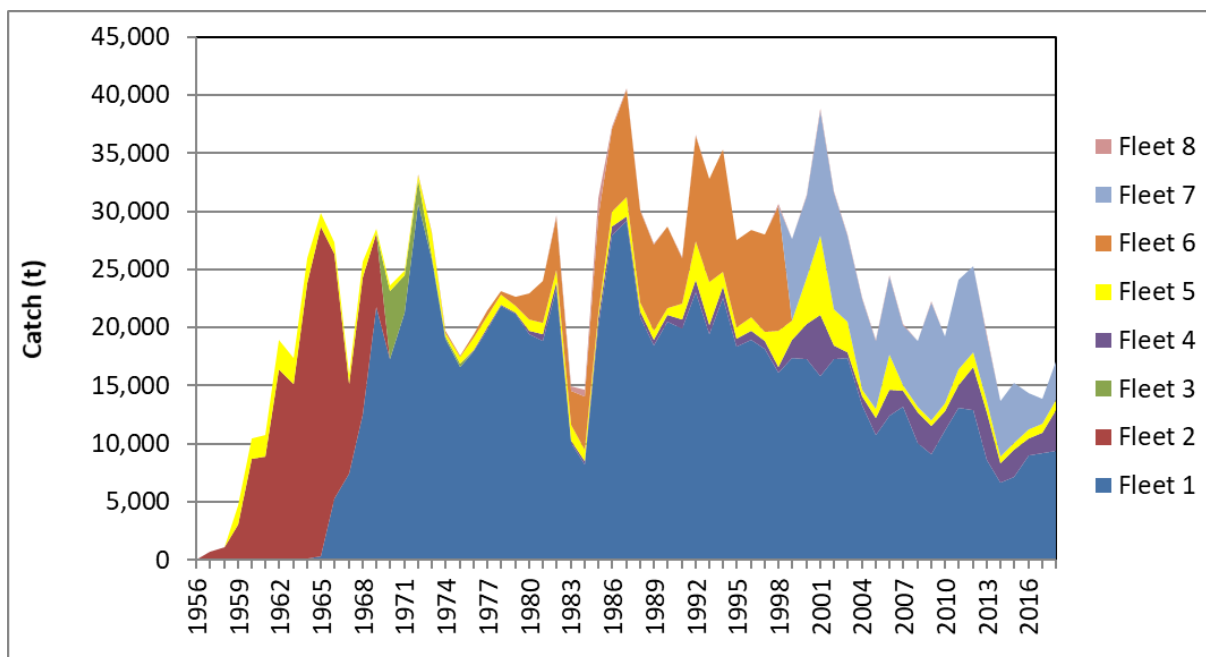
Figure 1. Annual trend of catch amount by fleet for ASPIC models for the south Atlantic.
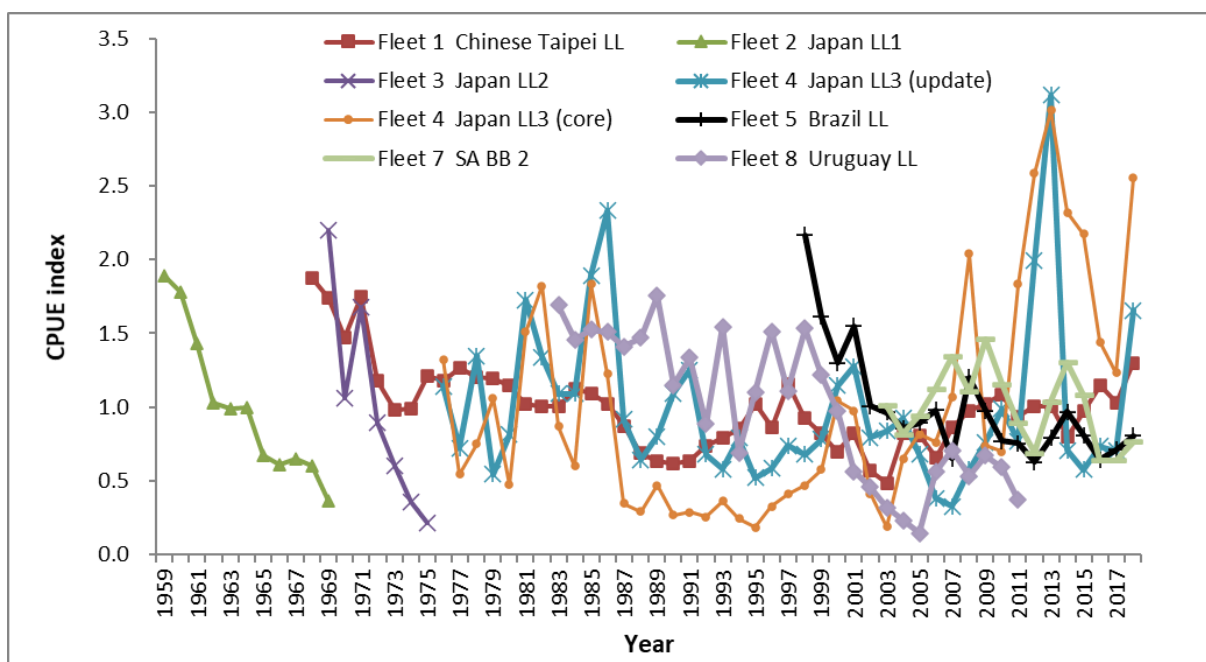
Figure 2. Annual trend of albacore standardized CPUE for the south Atlantic.
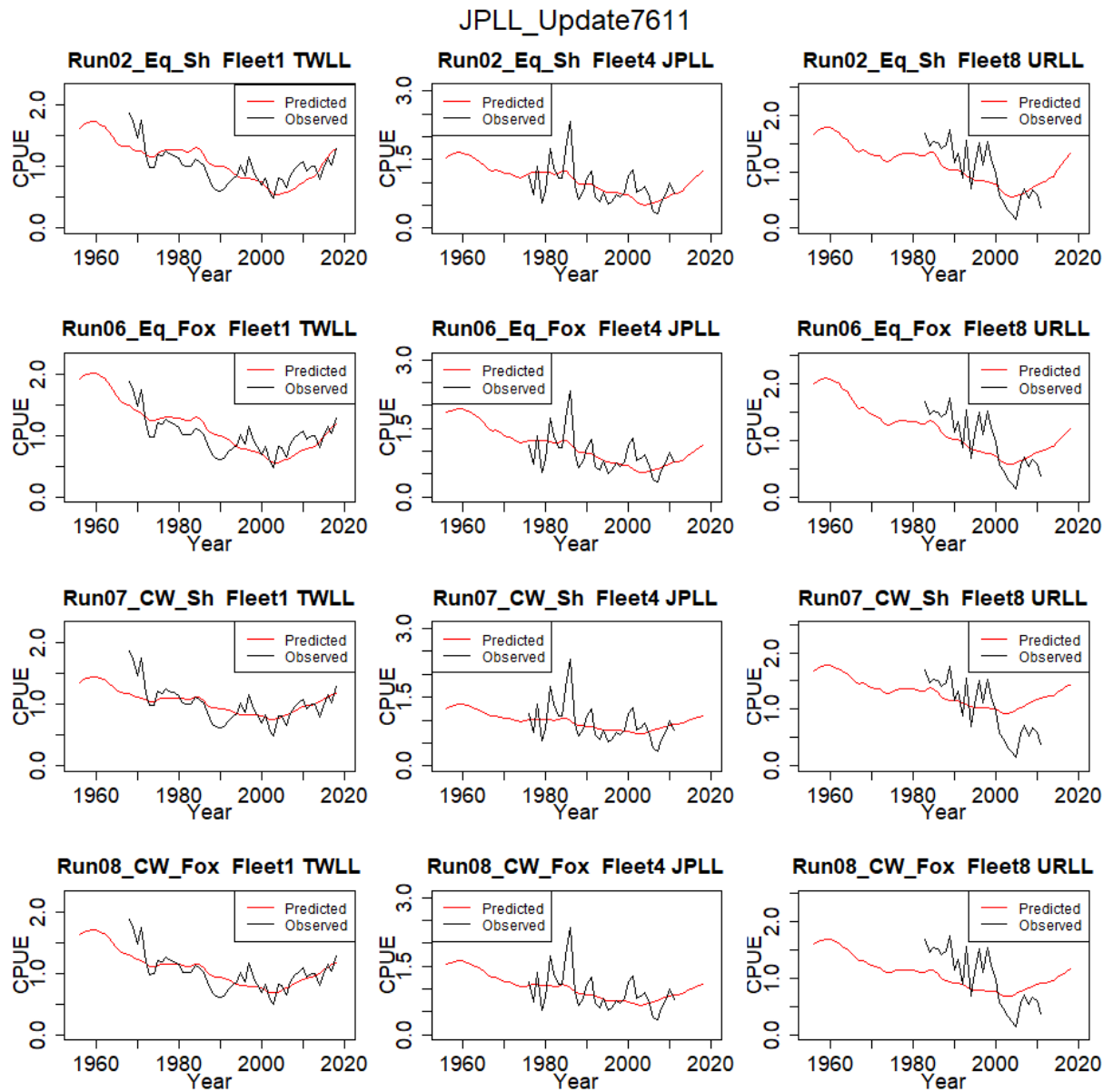
Figure 3. CPUE fit for each ASPIC runs.
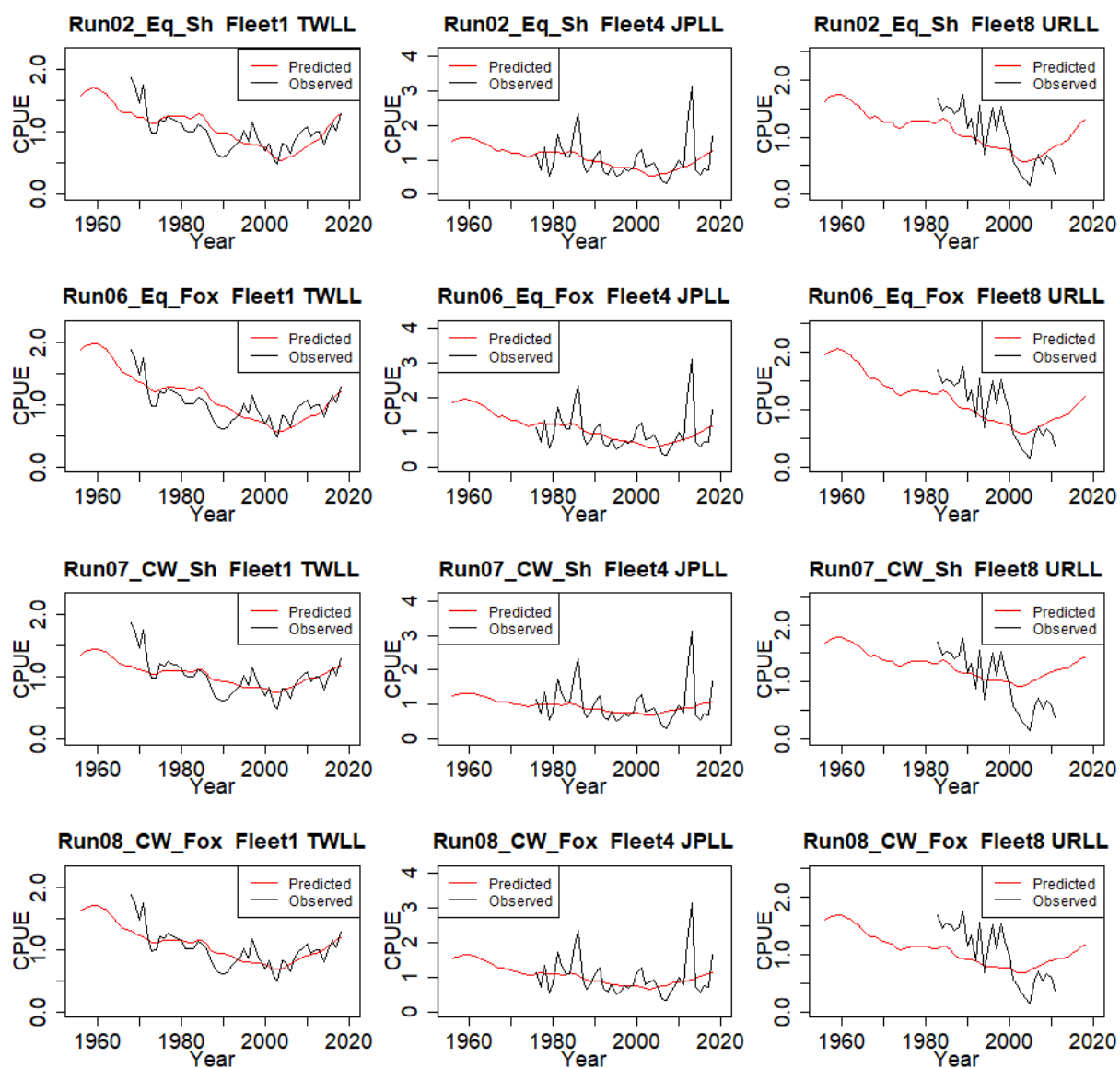
Figure 3. CPUE fit for each ASPIC runs. (continued)
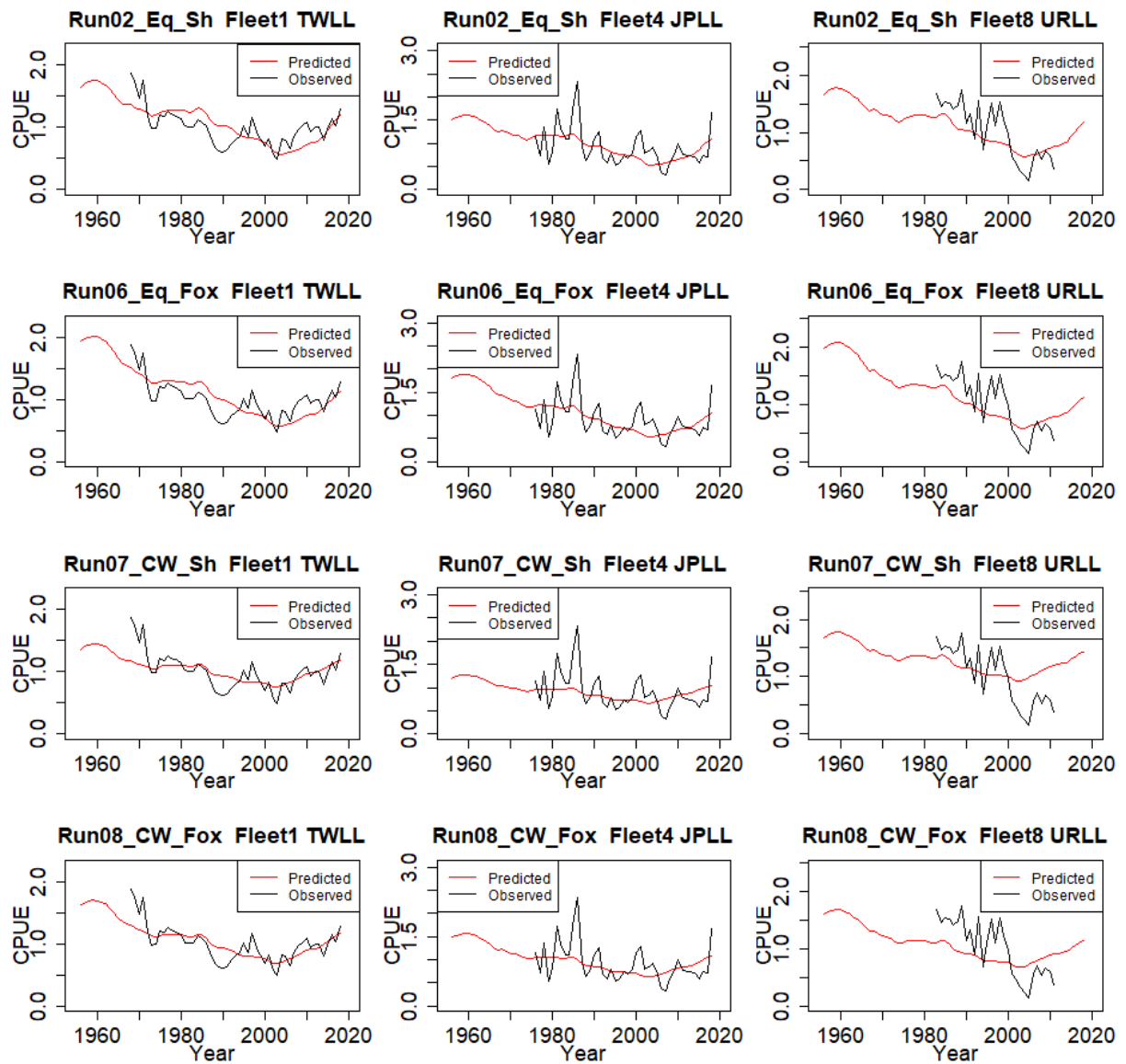
Figure 3. CPUE fit for each ASPIC runs. (continued)
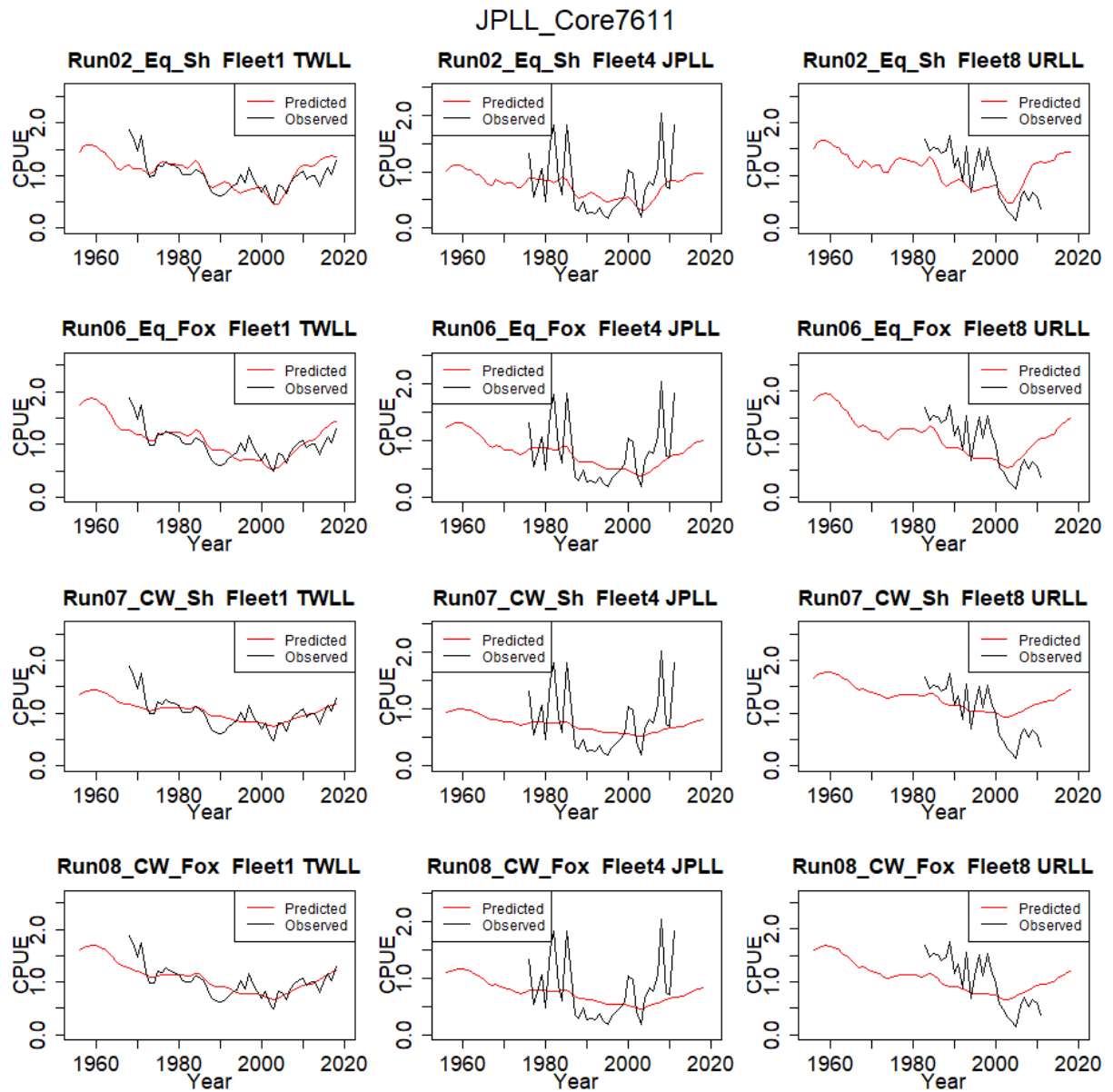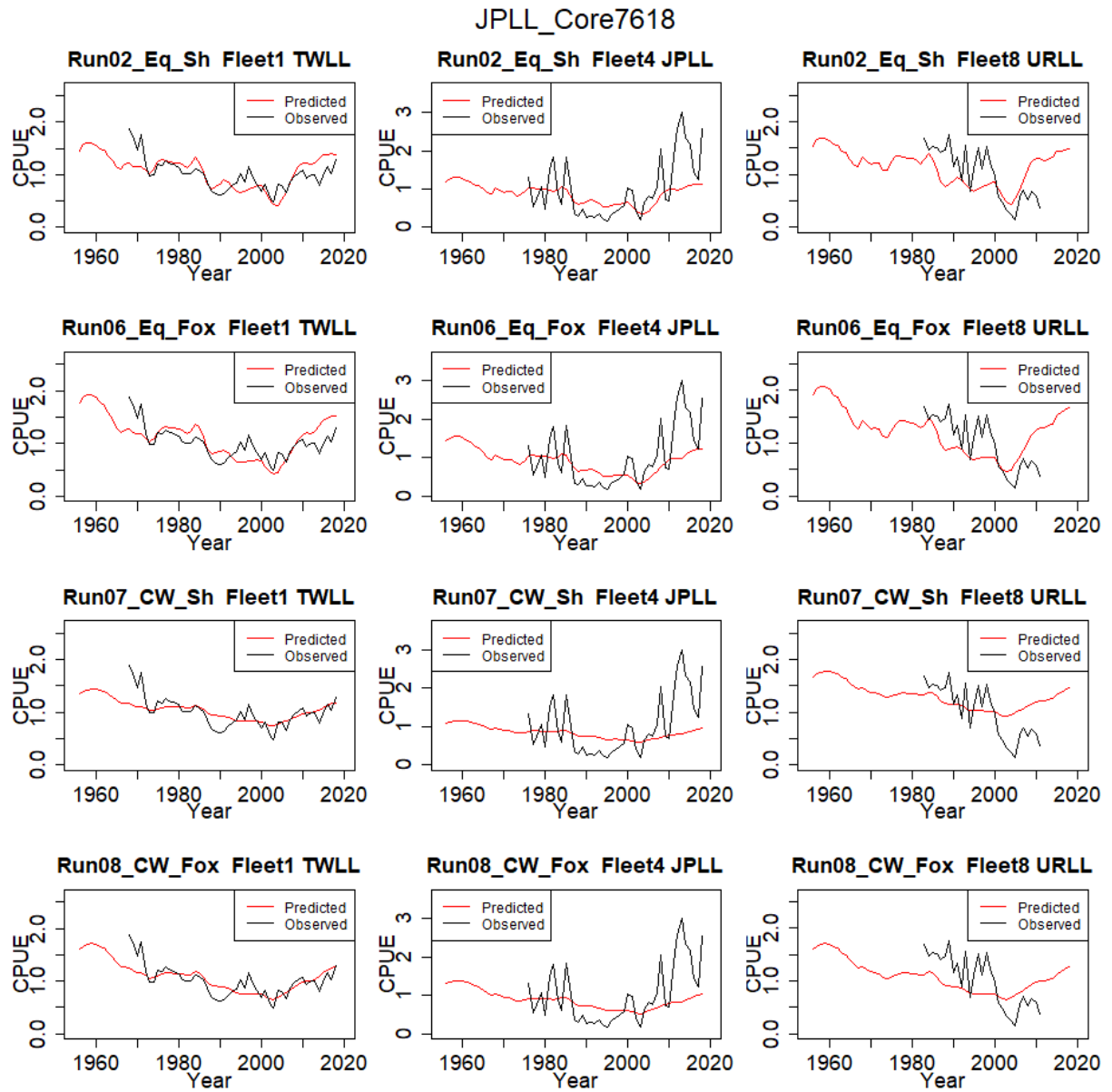
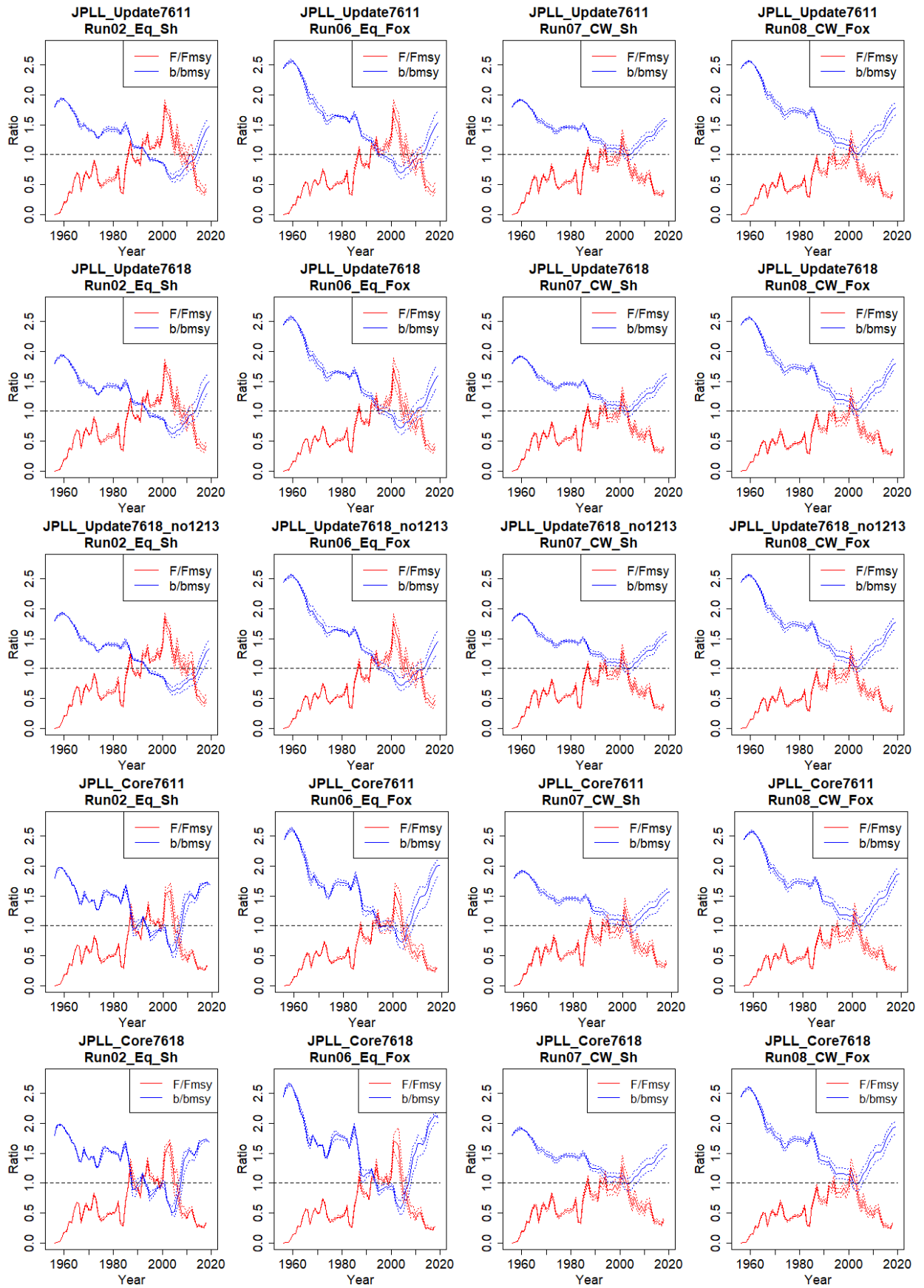**Figure 3.** CPUE fit for each ASPIC runs. (continued)

Figure 3. CPUE fit for each ASPIC runs. (continued)

Figure 4. Trajectories of B/B$_{MSY}$ and F/F$_{MSY}$ with 80% confidence limits (dashed lines) for ASPIC runs.
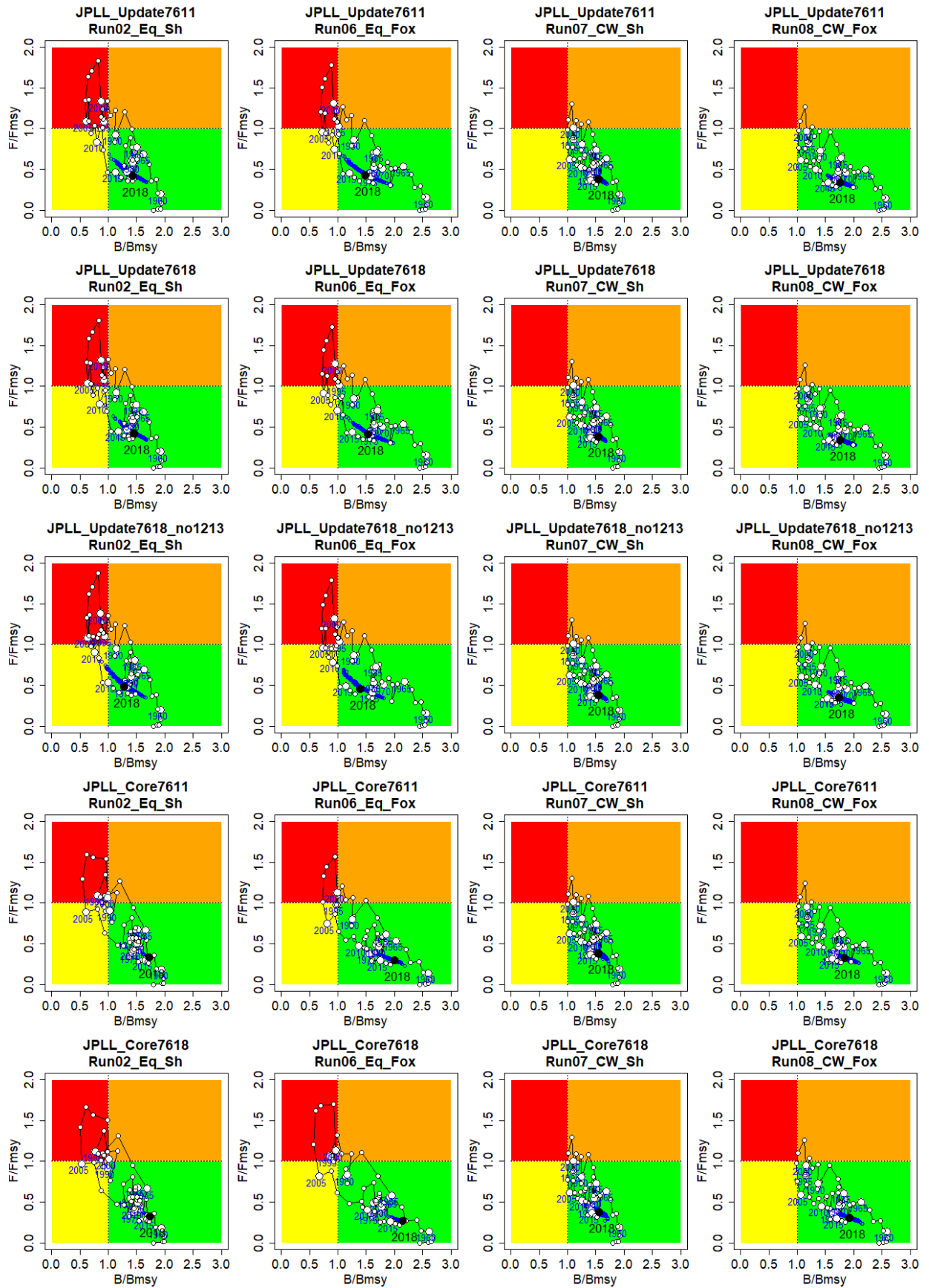
Figure 5. Kobe I plot for ASPIC runs.
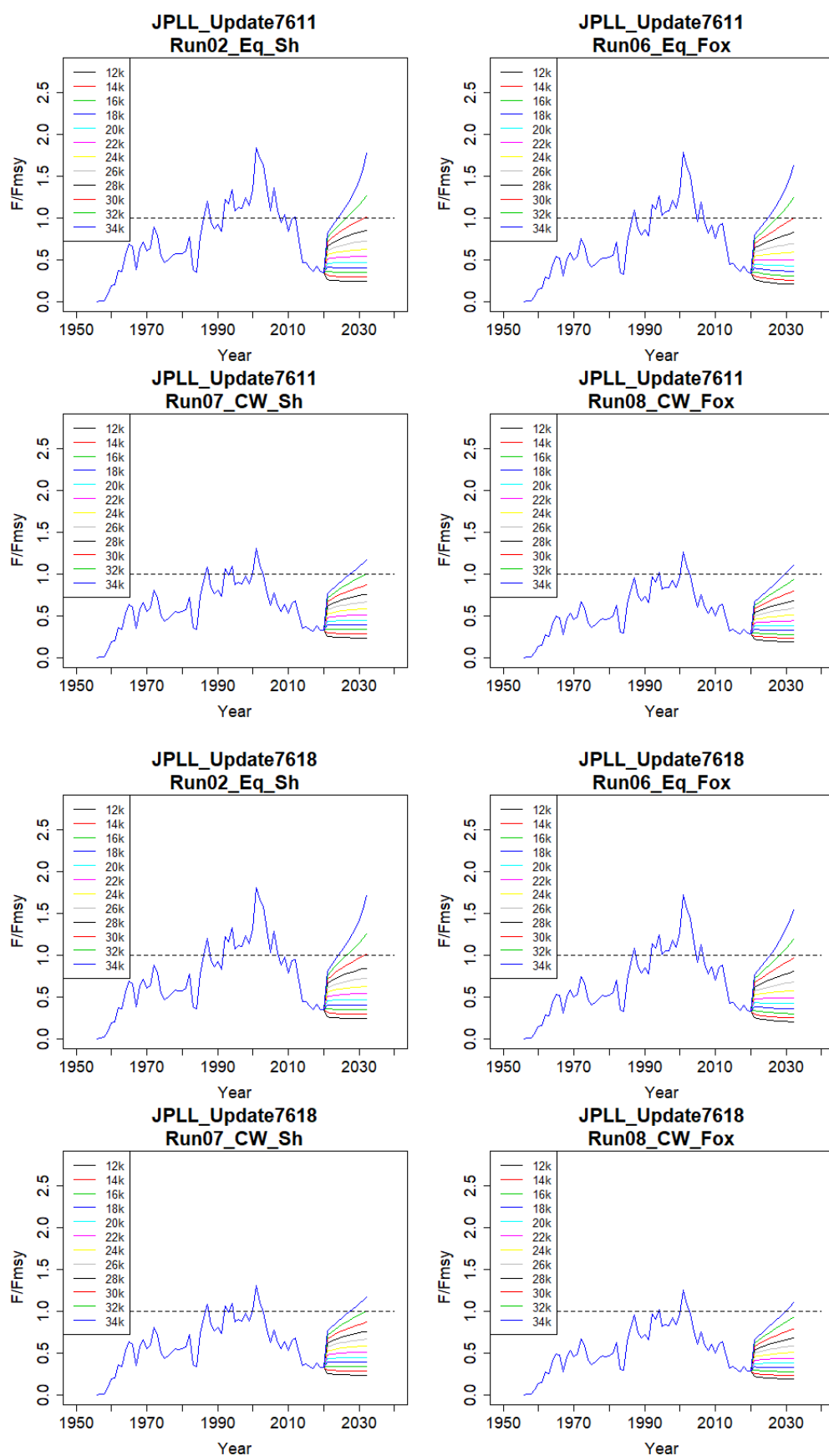
Figure 6. Future projection of F-ratio (F/F$_{MSY}$) for ASPIC runs under constant catch.
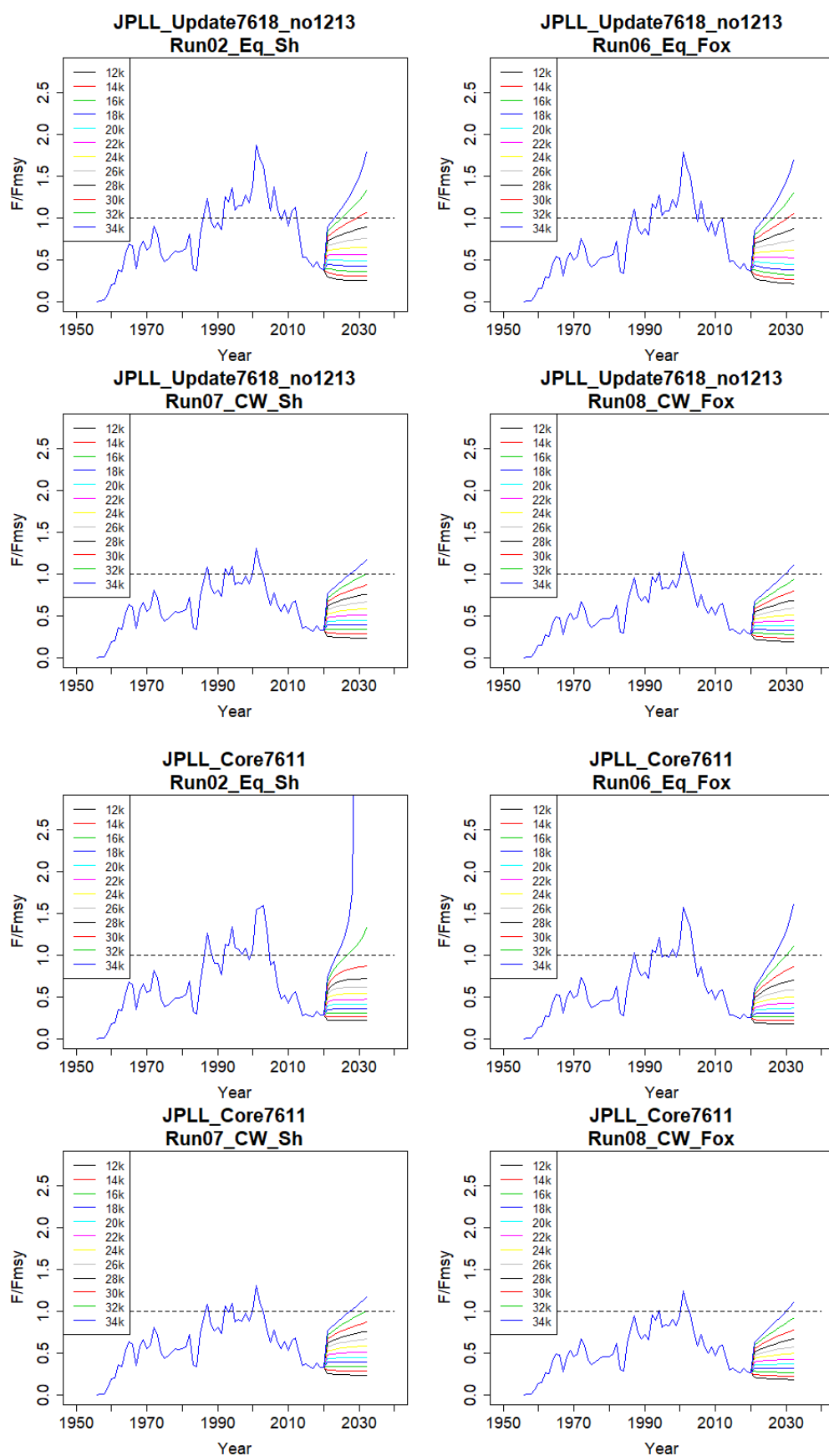
Figure 6. Future projection of F-ratio (F/FMSY) for ASPIC runs under constant catch. (continued)
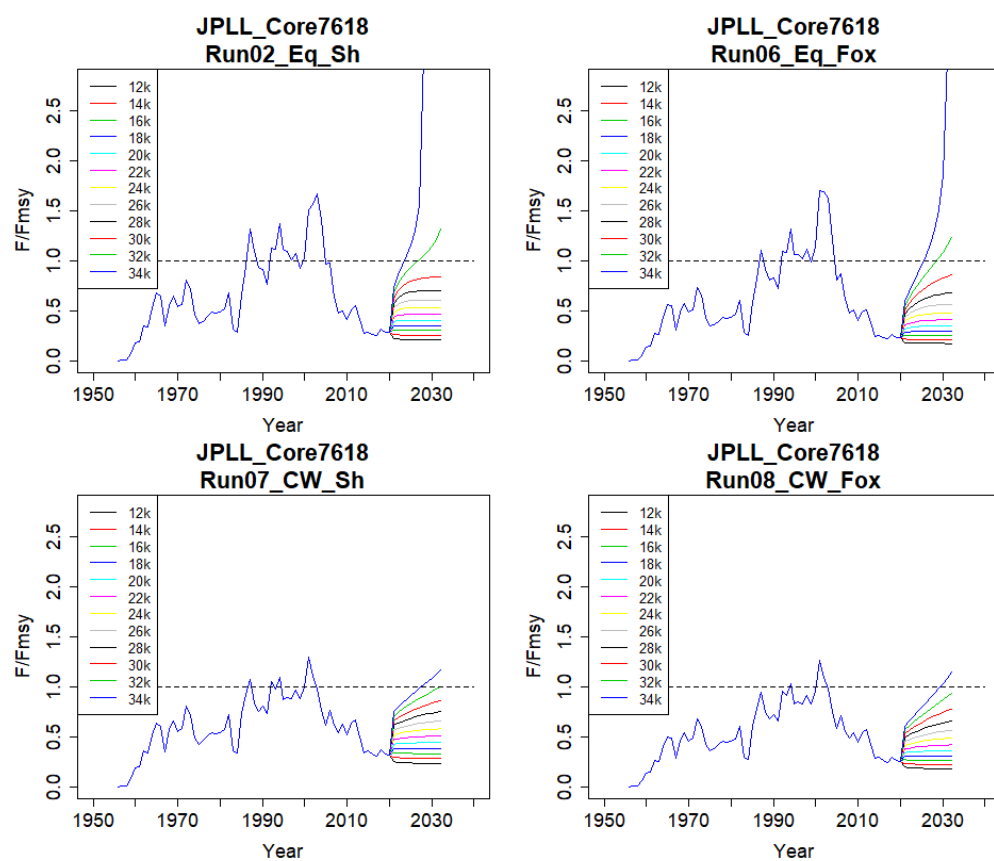
Figure 6. Future projection of F-ratio (F/FMSY) for ASPIC runs under constant catch. (continued)
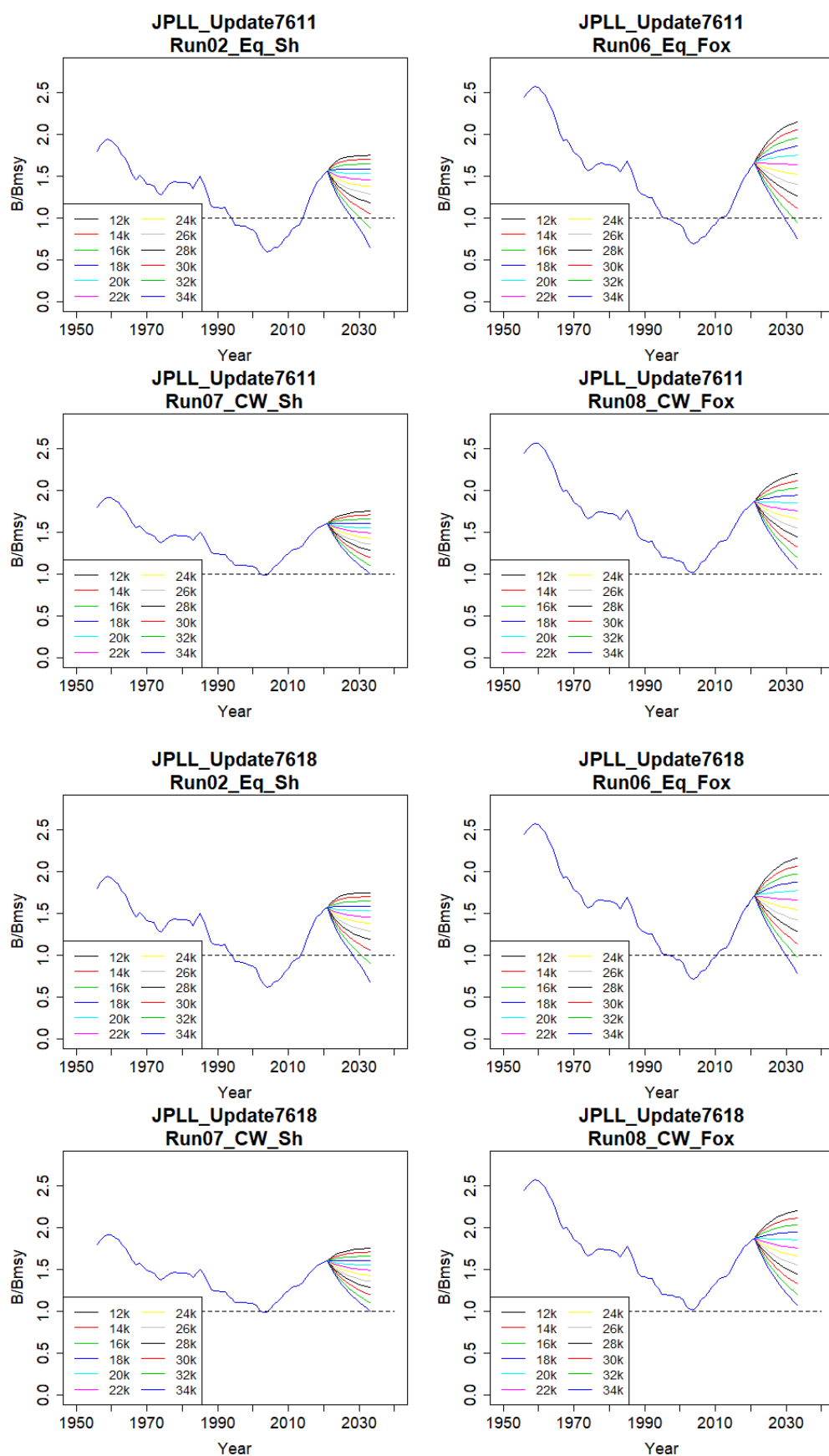
Figure 7. Future projection of B-ratio (B/B_{MSY}) for ASPIC runs under constant catch.
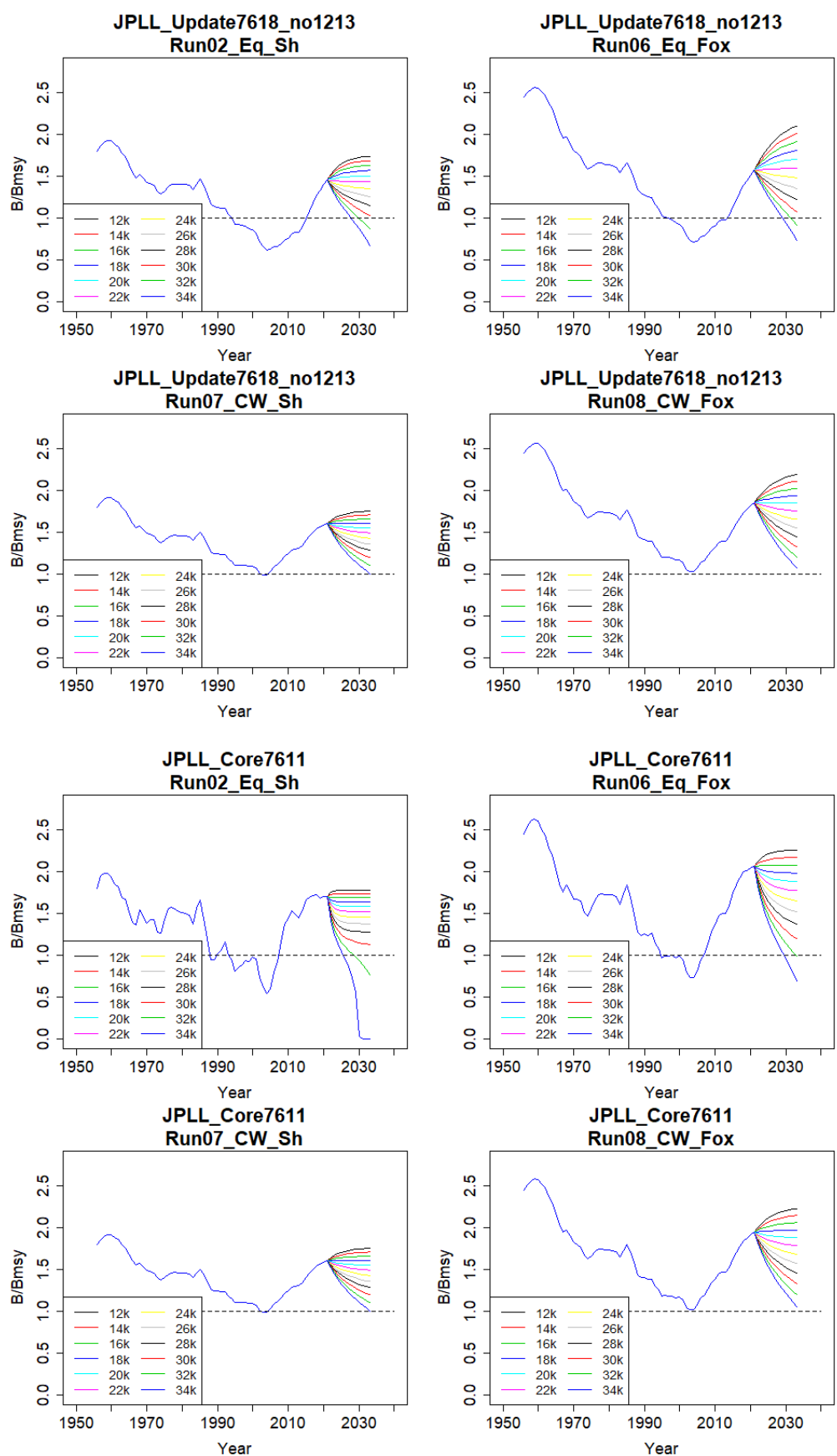
Figure 7. Future projection of B-ratio (B/BMSY) for ASPIC runs under constant catch. (continued)
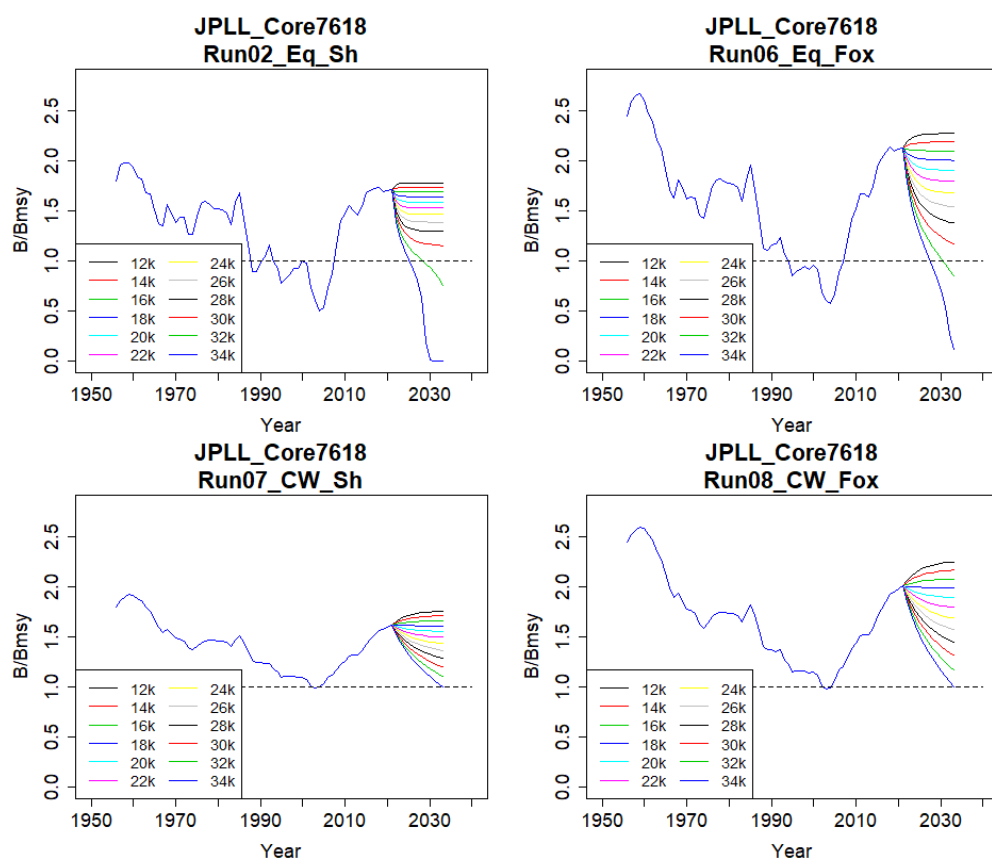
Figure 7. Future projection of B-ratio (B/BMSY) for ASPIC runs under constant catch. (continued)
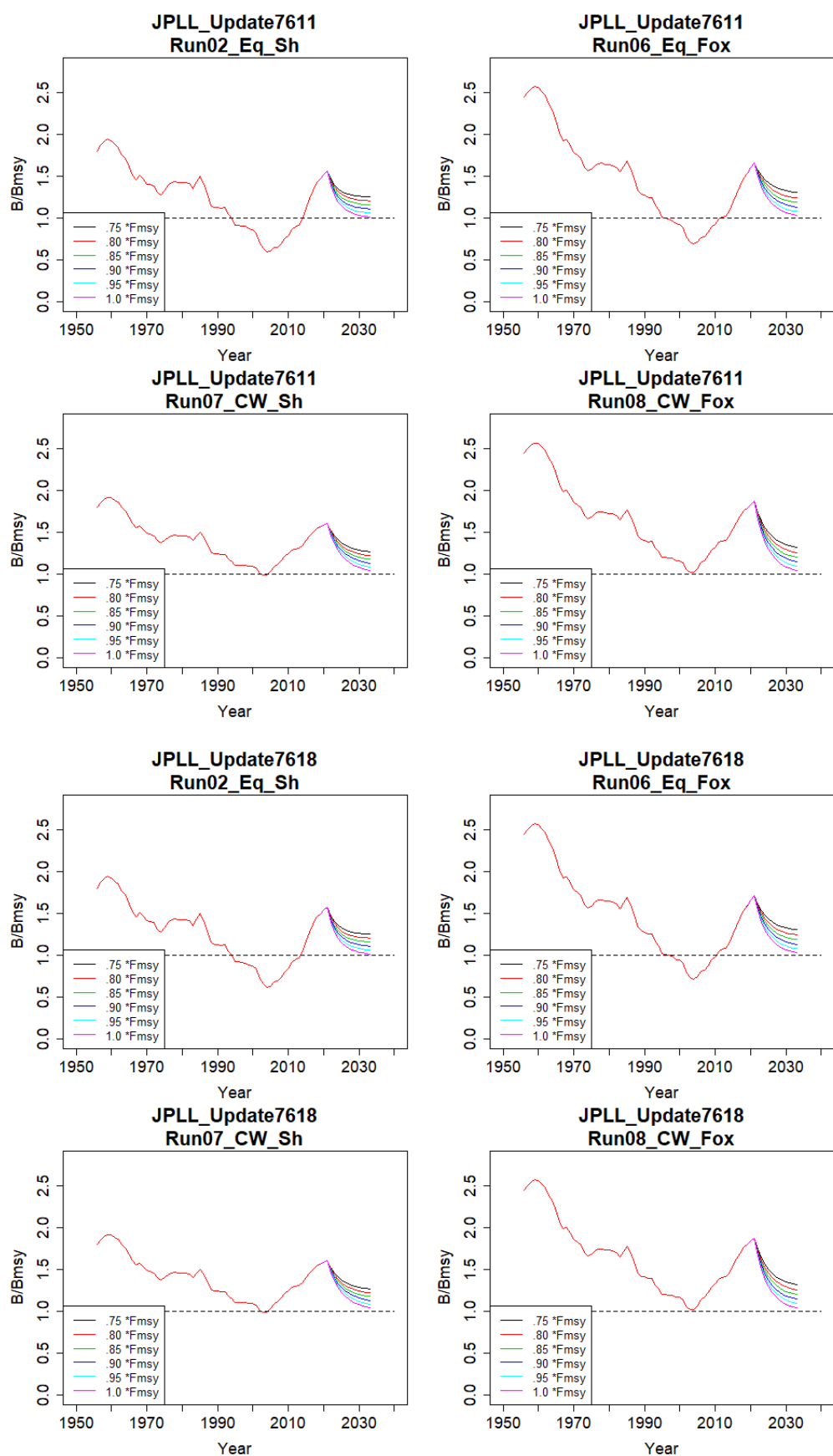
Figure 8. Future projection of B-ratio (B/B$_{MSY}$) for ASPIC runs under constant F.

Figure 8. Future projection of B-ratio (B/BMSY) for ASPIC runs under constant F. (continued)
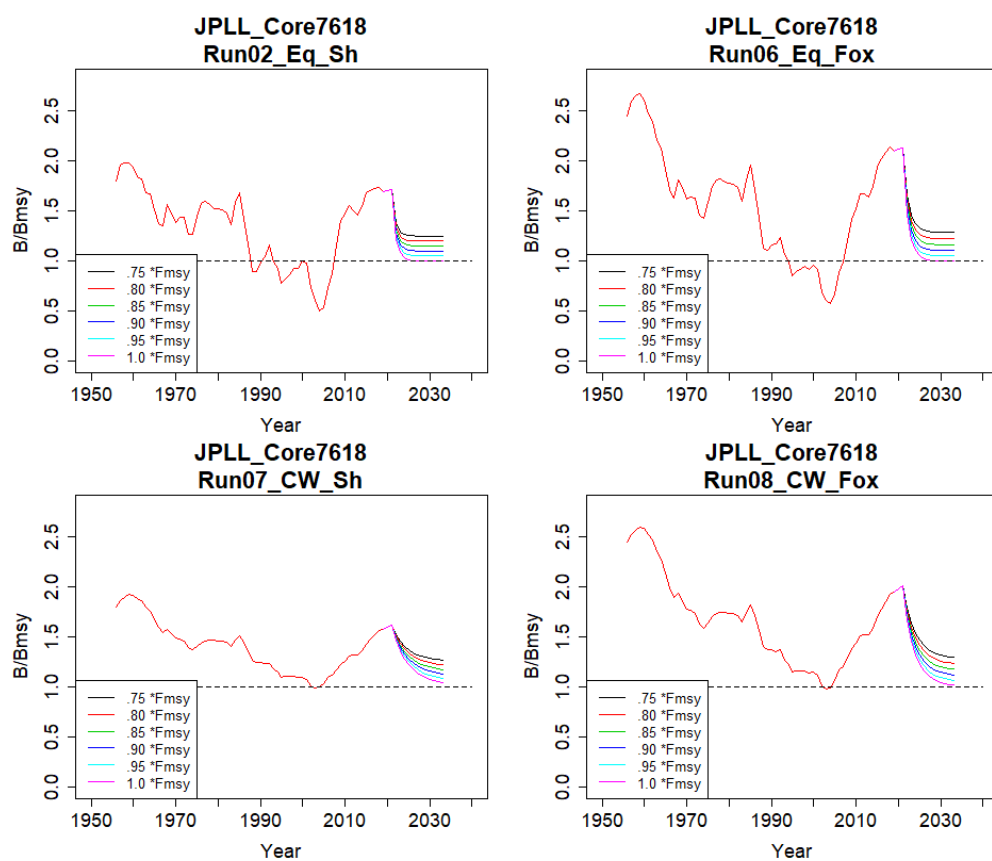
Figure 8. Future projection of B-ratio (B/BMSY) for ASPIC runs under constant F. (continued)

Figure 9. Predicted yield for future projection (15 years) for ASPIC runs for South Atlantic albacore under constant F.

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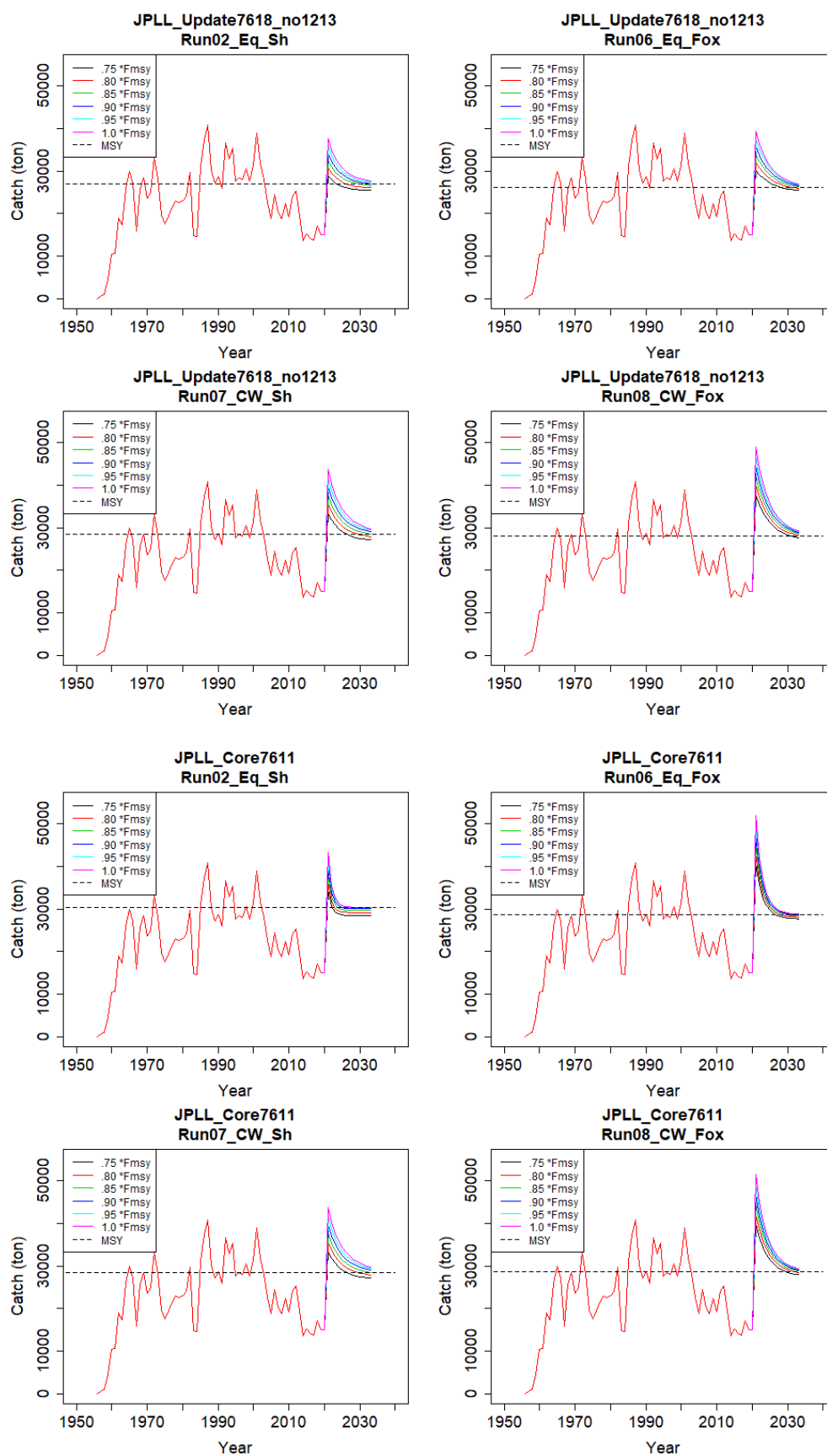
Figure 9. Predicted yield for future projection (15 years) for ASPIC runs for South Atlantic albacore under constant F. (continued)

Figure 9. Predicted yield for future projection (15 years) for ASPIC runs for South Atlantic albacore under constant F. (continued)
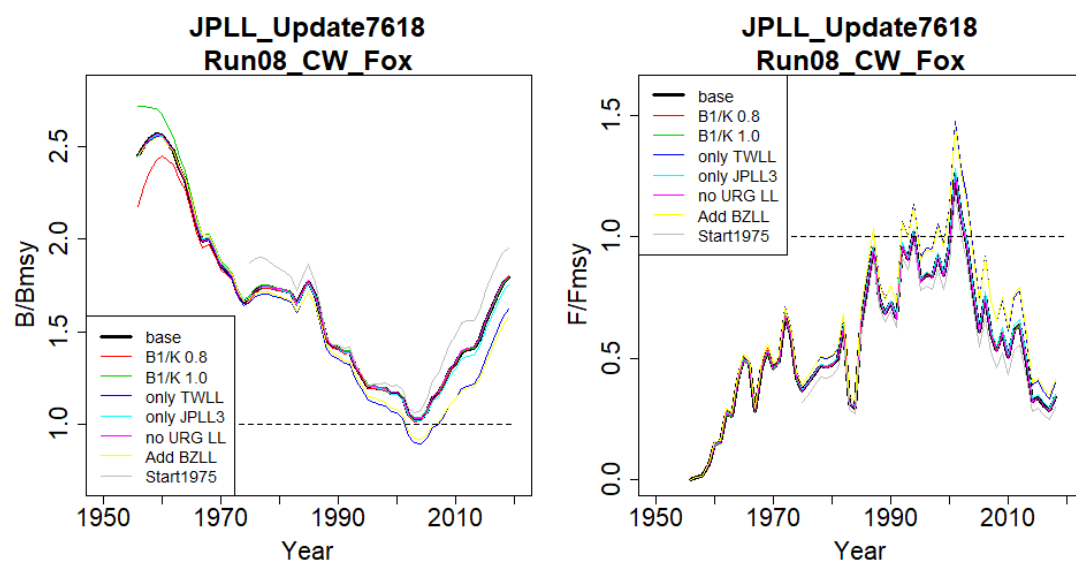
Figure 10. Results of sensitivity analyses for ASPIC Case 2 (JPLL_Update7618) Run08 for south Atlantic albacore. Note: the scenario with baitboat CPUE (ADD BB_L) didn't converge.
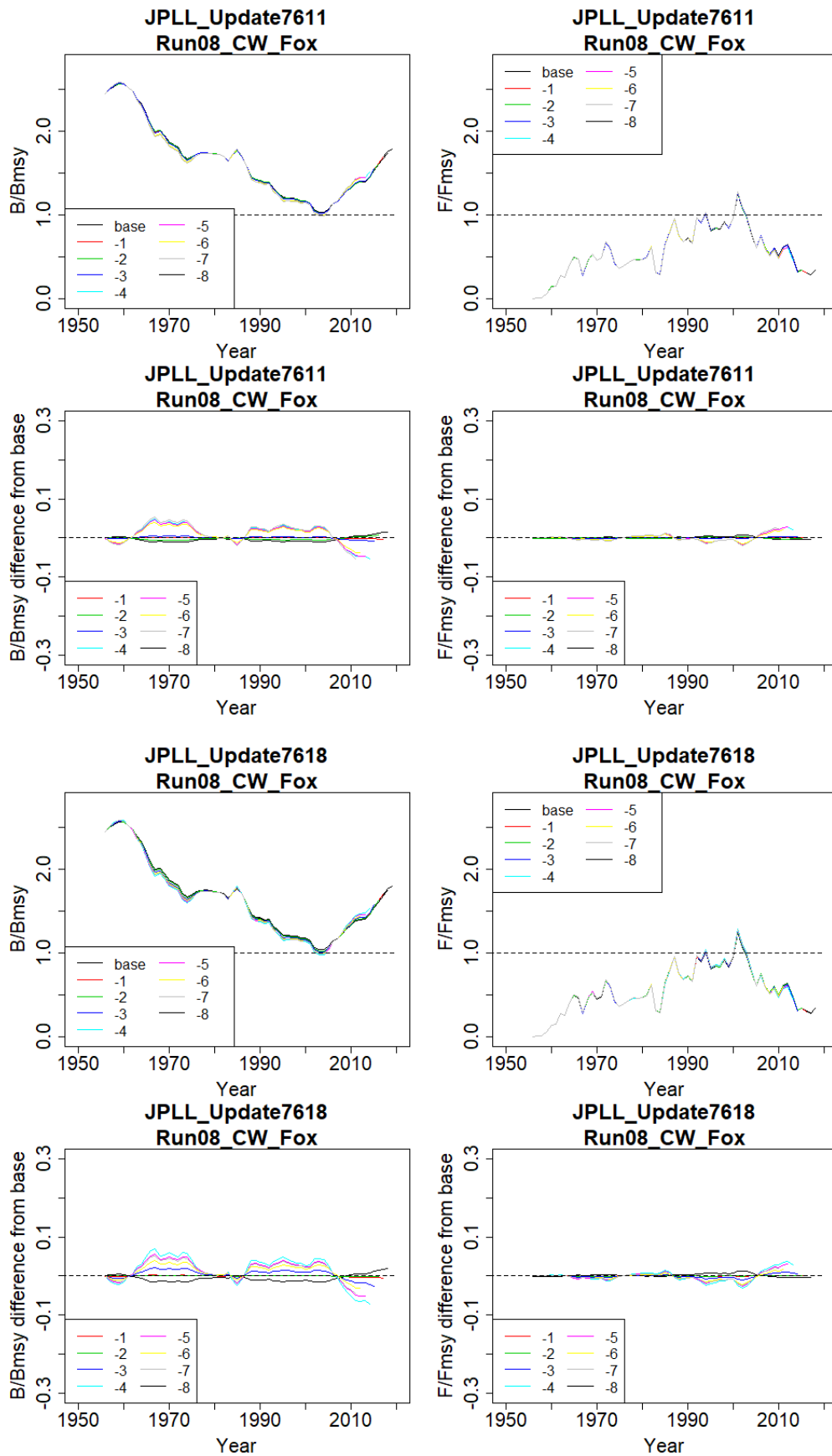
Figure 11. Results of retrospective analyses for ASPIC Run08 of each Case for south Atlantic albacore.
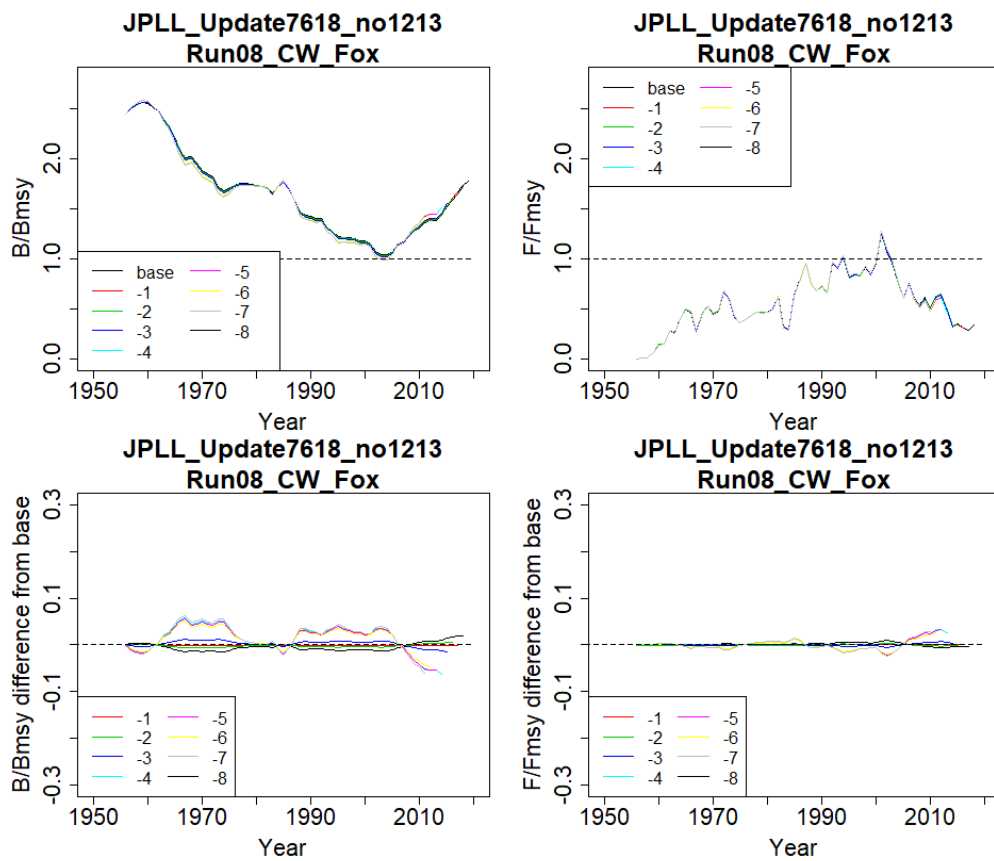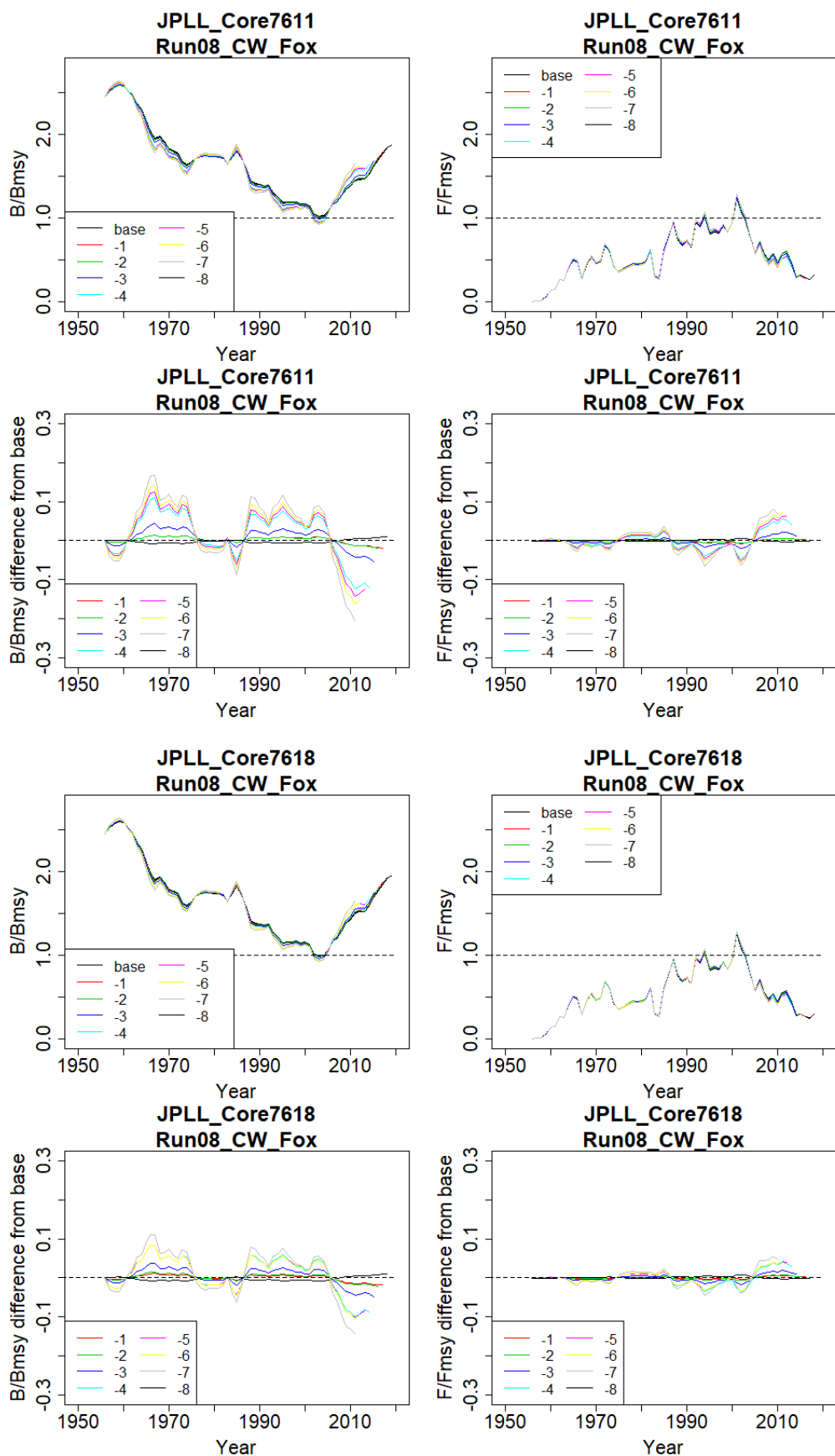
Figure 11. Results of retrospective analyses for ASPIC Run08 of each Case for south Atlantic albacore. (continued).

Figure 11. Results of retrospective analyses for ASPIC Run08 of each Case for south Atlantic albacore. (continued).

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