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DATA AND INITIAL MODEL SET-UP FOR THE 2022 STOCK SYNTHESIS STOCK ASSESSMENT OF THE EASTERN ATLANTIC AND MEDITERRANEAN BLUEFIN TUNA

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SUMMARY

This document describes the data used for Stock Synthesis assessment for the Eastern Atlantic and Mediterranean bluefin tuna. The initial model configuration, fleet definitions, selectivity modeling and main parameterization are also outlined. The model runs from 1950 to 2020 and is fit to length composition data and pair age-length data treated as conditional age-at-length.

RÉSUMÉ

Ce document décrit les données utilisées dans l'évaluation du thon rouge de l'Atlantique Est et de la Méditerranée au moyen de de Stock Synthesis. La configuration initiale du modèle, les définitions des flottilles, la modélisation de la sélectivité et la paramétrisation principale sont également décrites. Le modèle est exécuté de 1950 à 2020 et est ajusté aux données de composition de tailles et aux données de paires âge-taille traitées comme âge par taille conditionnel.

RESUMEN

Este documento describe los datos utilizados para la evaluación Stock Synthesis del atún rojo del Atlántico este y del Mediterráneo. También se describen la configuración inicial del modelo, las definiciones de la flota, la modelación de la selectividad y la parametrización principal. Los ensayos del modelo van de 1950 a 2020 y se ajustan a los datos de composición por tallas y a los datos de pares de edad-talla tratados como edad condicional por talla.

KEYWORDS

Atlantic bluefin tuna, stock assessment

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1. Introduction

The Standing Committee on Research and Statistics (SCRS) has been requested by the Commission to provide the stock assessment for the East Atlantic and Mediterranean bluefin tuna (E-BFT) in 2022. The Bluefin Tuna Species Group (BFTSG) plans to conduct the stock assessments by applying multiple assessment methodologies. This document provides the initial inputs of the stock assessment using Stock Synthesis.

The BFTSG had tried to apply Stock Synthesis to the E-BFT stock in 2017 (Sharma *et al.*, 2017), and the intention of this study is to update this 2017 model for the 2022 E-BFT stock assessment. Although the model input data and configuration are outlined in Sharma *et al.* 2017, they were reviewed and modified considerably during the ICCAT Bluefin stock assessment session (Anon., 2018). Furthermore, BFTSG in 2018 reviewed and revised the fleet structure for the Operating Models (OMs) in the BFT Management Strategy Evaluation (MSE) (ICCAT, 2019). This study proposed a new fleet structure for the 2022 Stock Synthesis model by harmonizing the East Atlantic components of the OM structure and the 2017 models.

This document presented the input data and initial model configuration of the base-case model embedded to the Stock Synthesis (version 3.30) (SS3) for the 2022 E-BFT stock assessment. There are two major changes from the 2017 stock assessment regarding the fleet structure and selectivity assumptions that was the proposal of the BFTSG to improve the results of diagnostics. The catch and length composition data over the historical period (1950-2020) were estimated to adapt to the new fleet structure (**Table 1**) and updated to 2020. In this document, only the updated indices used for the E-BFT VPA stock assessment in 2020 are presented. Other indices and revised age information may be taken in consideration by the BFTSG for further inclusion in the SS3 model.

The spatial structure of the SS3 model is one area, it is sex aggregated and it runs in an annual time-step. In total, the base model contains information from 16 fisheries and 10 abundance indices.

2. Material and methods

2.1 Data

Overall the E-BFT Stock Synthesis model uses catch information, size composition data, conditional age-at-length data and 10 indices (**Figure 1**).

Total catch

The time series of catch amount (t) by fleet using Task1 in the ICCAT database were updated by the Secretariat from 1950 to 2020 (**Table 2**, **Figure 2**). The catch amount (t) by F10 (PS_MED 6008Q2) was provided from the modified CATDIS (Kimoto *et al.*, 2021). An error of se=0.1 for the catch is assumed in the model, except for years 1950-1969 (initial period) and 1998-2006 (plateau catches) when se=0.15. Initial equilibrium catch was input for 3 fleets: Traps (F13_TP5011: traps by EU-Spain, EU-Portugal, and EU-Morocco in 1950-2011, and F15_TP_OTH: Traps from other countries), and Other Gears (F16_OTH) that had non-negligible catches in 1950.

Size Composition

Task 2 size data were updated in 2022 up to 2020 by using the same screening method for Stock Synthesis in 2017 (Ortiz and Palma, 2017) and for reconditioning OMs in 2021 (Kimoto *et al.*, 2021). The length composition by the new fleet structure was provided with 5 cm bin with lower limit (**Figure 3**). Length data was input in straight fork length in centimeters and modeled with 5 cm length bins between 10 and 370 cm in the model. Length composition data is modeled assuming a multinomial distribution and the sample size is set initially at a low value (n=20).

Conditional Age at length (CAA)

This input allows the integrated models to use the information from sparse age-length data without assuming that the data was representative of ages across the full range of sizes.

The CAA included in SS3 2017 assessment was not updated. The age-length pairs (9453 records in total, 934 from otoliths reading and 8519 from spine samples) are input as age frequency distributions by length bins (at 4 cm intervals) for each year and fishery from which the data were collected. Age-length data was assigned to 9 fleets: Fleet 1-3, 6, 11-14 and 16 (**Figure 4**). Age information was input with an aging error vector assuming a coefficient of variation of approximately 0.1.

There is available an updated series of pair of age-length used in 2017 SS3 model and it might be taken in consideration by the BFTSG for further inclusion in the SS3 model. All historical reads were revised to avoid the bias detected in 2017 between otoliths and spines (Anon., 2018) and new age records are included. Age observations comprised nearly 14 000 records from otoliths and first dorsal fin radius (spine) in a proportion of 37% and 63%, respectively. Age-length data were assigned to 12 fleets (**Table 3**) with a total number of age-length pairs allocated of 13 228 from years 1984-2018.

Indices

In this document, only the updated indices used for the SS3 stock assessment in 2017 (**Table 4, Figure 5**) and other indices may be taken in consideration by the Bluefin tuna Species Group for further inclusion in the SS3.

As specified in ICCAT (2019), the indices were the same as used in the 2017 and 2020 assessments. Some of them were slightly revised. Whereas the indices covering the historical period such as the Moroccan and Spanish trap index (MOR_SP_TP), the Japanese eastern Mediterranean longline index (JPN_LL_EastMed) and the Spanish Baitboat indices (SP_BB1 and SP_BB2) did not change, the other indices were updated. Some were strictly updated, no substantial change in methodology, such as the Japanese longliners indices (JPN_LL1_NEA and JPN_LL2_NEA) and the French aerial survey (FR_AER1 and FR_AER2); whereas some changes were made for the Moroccan and Portuguese trap index and the Western Mediterranean Larval index (WMED_LARV) since 2017. Details about the discussion on their selection and their construction can be found in the report of the data preparatory meetings (ICCAT, 2017, 2020). The summary of changes for the indices compared to 2020 is the following:

- Moroccan and Spanish trap index (MOR_SP_TP): 1981-2011. No change
- Moroccan and Portuguese trap index (MOR_POR_TP): 2012-2020. Accepted revision presented during the 2019 SCRS, daily catch per trap are now used as it improves how the index reflects the relative abundance of the stock. Strict update, no change in methodology
- Japanese Eastern Mediterranean longline index (JPN_LL_EastMed): 1975-2009. No change.
- Japanese longliners indices (JPN_LL1_NEA and JPN_LL2_NEA): 1990-2009 and 2010-2020. Strict update, no change in methodology, associated coefficient of variation is provided.
- Spanish baitboats in the Bay of Biscay (S6_SP_BB1) and Spanish-French baitboats in the Bay of Biscay (SP_BB2): 1968-2006 and 2007-2014.
- French aerial survey (FR_AER1 and FR_AER2): 2000-2003 and 2009-2020. Strict update, no change in methodology, some revisions documented in Rouyer et al. (2020).
- Western Mediterranean larval index (WMED_LARV): 2001-2020. Revision in the larval database length calibrations and the software used in 2017 accepted by the BFTSG for the 2020 stock assessment. Strict update based on this methodology for the purpose of continuity.

2.2 Model Specifications

The base model is implemented in Stock Synthesis 3.30.17 (Methot *et al.*, 2013). The base model has the following structure: one spatial area, sex-aggregated and an annual time-step. The model starts in 1950 and runs to 2020. The SS3 control file for base model is appended **(Annex 1**).

Changes to 2017 model:

The initial Stock Synthesis fleet structure was determined at the stock assessment session in 2017 (Anon., 2018). The fleet structure in the current OMs had been revised in 2018 (ICCAT, 2019). The East Atlantic and Mediterranean components in the OMs were harmonized with the 2017 models for the 2022 Stock Synthesis (**Table 1**).

Besides, some minor modifications were introduced in the base model related with the previous assessment:

- Increase the number of bins for length composition (360, 370).
- Change the method of recruitment deviations to adapt to the new SS3 version.
- Initial value of R0: 10.
- Increase the upper bound of Lmax.
- The standard error of landings was set at 0.1 except for :
  Fleets with initial equilibrium catch: se=0.2 and for years 1950-1969 (initial period) and 1998-2006 (plateau catches), se=0.15

Growth is modeled with a Richards curve. All growth parameters (length at age 0.5, Linf, K, Richards parameter and the CV on young and old fish) are internally estimated by the model.

The length-weight relationship used in the model: W = 1.96e-05 * L^ 3.0092.

Natural mortality is set as an age-varying rate derived from the Lorenzen's method and scaled to force M = 0.10 at ages 20+, from age 0 to 30 (Anon., 2018): 0.47, 0.37, 0.3, 0.25, 0.21, 0.18, 0.16, 0.15, 0.14, 0.13, 0.12, 0.12, 0.11 (ages 12-15), 0.1 (ages 16-30+).

The early maturity ogive is used in the assessment (Anon., 2011). The 50% maturity is assumed to be age 4 and full mature at age 5: 0 (ages 0-2), 0.25 (age 3), 0.5 (age 4), 1 (ages 5-30).

A Beverton-Holt stock-recruitment relationship (with flat top) was assumed and that spawning biomass was equal to the biomass of the mature population according to the maturity vector outlined in the biology section. Steepness and sigmaR are fixed at 0.9 and 0.6, respectively, and R0 is freely estimated by the model. Deviations from the stock-recruitment relationship were assumed to follow a log-normal distribution estimated on a log scale as N(0, sigmaR) with a min and max of -5 and 7, respectively.

Selectivity is length-based parameterized and estimated directly for each of the 16 fleets (fleet 16 is mirrored to fleet 6) (**Table 1**, **Figure 6**). Fleets 2-5 and 13-14 were modeled as double normal function which could take on either dome or asymptotic shape. To model the complex length composition observations of fleets 1, 6-12 and 15, the cubic spline function implemented in the Stock Synthesis was used. The number of nodes was selected by an iterative process that checks if an increase in the number of nodes improves the selectivity fit and the total likelihood. For nodes position the SS3 autogeneration feature was used (Methot *et al.*, 2020).

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Table 1. Definition of the fleet structure to be used in the Stock Synthesis model. Selectivy: CS: cubic spline; DN: double normal.

Fleet Number	Fleet Acronym	Description	Gear	start	end	Selectivity
1	F01_BB_5006	BaitBoat (SP, FR) for 1950 to 2006	BaitBoat	1950	2006	CS
2	F02_BB_0720	BaitBoat (SP, FR) for 2007 to 2020	BaitBoat	2007	2020	DN
3	F03_LL_JPN_E_MED	Japanese longline in the East and Mediterranean for 1957 to 20	Longline	1957	2009	DN
4	F04_LL_JPN_NE_7009	Japanese longline in the Northeast Atlantic for 1971 to 2009	Longline	1971	2009	DN
5	F05_LL_JPN_NE_1020	Japanese longline in the Northeast Atlantic for 2010 to 2020	Longline	2010	2020	DN
6	F06_LL_OTH	Other countries longliners for 1961 to 2020	Longline	1961	2020	CS
7	F07_PS_NOR	Norwegian purseiners for 1950 to 1986 (/2016-20)	Purseine	1950	2020	CS
8	F08_PS_HRV	Croatian purseiners for 1991 to 2020	Purseine	1991	2020	CS
9	F09_PS_MED_6008	Purseiners (SP, FR) for 1966 to 2008 1,3,4Q	Purseine	1966	2007	CS
10	F10_PS_MED_6008Q2	Purseiners (SP, FR) for 1966 to 2008 2Q	Purseine	1966	2008	CS
11	F11_PS_MED_0920	Purseiners (SP, FR) for 2009 to 2020	Purseine	2009	2020	CS
12	F12_PS_OTH	Purseiners other countries	Purseine	1950	2020	CS
13	F13_TP_5011	Traps (SP, PT, MA) for 1950 to 2011	Traps	1950	2011	DN
14	F14_TP_1220	Traps (SP, PT, MA) for 2012 to 2020	Traps	2012	2020	DN
15	F15_TP_OTH	Traps from other countries (DZ, LY, TN, TR, IT)	Traps	1950	2020	CS
16	F16_OTH	Other gears	Other	1950	2020	Mirror F06

Table 2. Total landings (in tonnes) and landings by fleet.

Year	Total	F01_BB_5006	F02_BB_0720	F03_LL_JPN_E_MED	F04_LL_JPN_NE_7009	F05_LL_JPN_NE_1020	F06_LL_OTH	F07_PS_NOR	F08_PS_HRV	F09_PS_MED_6008	F10_PS_MED_6008Q2	F11_PS_MED_0920	F12_PS_OTH	F13_TP_5011	F14_TP_1220	F15_TP_OTH	F16_OTH
1950	26812	2975	0	0	0	0	0	2200	0	0	0	0	1390	13596	0	4051	2601
1951	30211	3872	0	0	0	0	0	6728	0	0	0	0	1191	9362	0	4228	4830
1952	39007	4685	0	0	0	0	0	14752	0	0	0	0	1667	10185	0	2514	5204
1953	39275	4135	0	0	0	0	0	10217	0	0	0	0	1796	13631	0	4327	5169
1954	37157	5500	0	0	0	0	0	12145	0	0	0	0	2283	10368	0	3391	3470
1955	44092	6559	0	0	0	0	0	13394	0	0	0	0	1583	12661	0	3569	6327
1956	30186	3409	0	0	0	0	0	5313	0	0	0	0	1215	14957	0	2816	2476
1957	35873	4017	0	33	0	0	0	6437	0	0	0	0	1097	15376	0	4657	4255
1958	33353	4241	0	2	0	0	0	3860	0	0	0	0	3571	15509	0	4414	1756
1959	26334	3800	0	56	0	0	0	3241	0	0	0	0	4241	8407	0	3574	3015
1960	26113	1374	0	481	0	0	0	4215	0	0	0	0	2960	11686	0	3462	1936
1961	28083	1597	0	204	0	0	19	8553	0	0	0	0	3810	8502	0	3143	2253
1962	29457	1702	0	2484	0	0	0	8730	0	0	0	0	2223	9596	0	3028	1693
1963	16357	1381	0	1618	0	0	800	167	0	0	0	0	3024	5490	0	1687	2190
1964	17208	1260	0	582	0	0	363	1461	0	0	0	0	3365	6044	0	2428	1705
1965	17095	1787	0	404	0	0	434	2506	0	0	0	0	1376	6596	0	2565	1428
1966	15084	3335	0	50	0	0	541	1000	0	772	228	0	2675	3383	0	2276	824
1967	19734	1771	0	100	0	0	341	2015	0	1158	342	0	3485	4790	0	4770	962
1968	13545	1314	0	13	0	0	795	753	0	1931	569	0	1308	2088	0	3895	879
1969	15024	1760	0	2	0	0	599	842	0	1158	342	0	2816	2692	0	4016	797
1970	10808	2367	0	21	0	0	322	470	0	850	250	0	1702	2100	0	1936	789
1971	11185	2255	0	156	1	0	226	653	0	1699	501	0	1736	803	0	2147	1008
1972	10830	2102	0	344	8	0	145	430	0	850	250	0	3515	593	0	1451	1141
1973	11012	2410	0	281	9	0	321	421	0	1081	319	0	3436	653	0	1002	1078
1974	19285	1648	0	3031	1359	0	261	869	0	1390	410	0	6909	96	0	2458	855
1975	21465	1912	0	3654	506	0	163	988	0	1236	364	0	9089	451	0	1663	1438
1976	22368	1012	0	2777	164	0	350	529	0	3169	631	0	10501	493	0	1753	989
1977	18980	1791	0	2062	52	0	331	764	0	2861	321	0	7043	563	0	1371	1821
1978	15115	2522	0	566	72	0	274	221	0	1260	306	0	5769	634	0	1218	2272
1979	12435	1448	0	710	19	0	241	60	0	1379	148	0	4782	624	0	1016	2008
1980	14059	1286	0	983	16	0	256	282	0	1156	545	0	6995	817	0	1198	525
1981	14105	938	0	596	19	0	350	161	0	1410	940	0	6284	1189	0	1385	833
1982	22421	914	0	3479	55	0	768	50	0	3088	2007	0	7636	2375	0	1728	321
1983	21699	2759	0	3216	70	0	320	1	0	2146	1454	0	7146	1993	0	1513	1081
1984	24473	2931	0	2518	32	0	387	243	0	2190	1459	0	7105	2923	0	1869	2816
1985	22063	2228	0	1406	20	0	546	0	0	3254	2191	0	7101	1932	0	1018	2367
1986	19260	2147	0	1017	63	0	894	31	0	3116	454	0	7791	1263	0	947	1537
1987	18271	2046	0	1150	30	0	821	0	0	3899	571	0	5817	1412	0	1010	1515
1988	24129	2561	0	1410	17	0	1195	0	0	5097	813	0	6858	2948	0	1213	2017
1989	21161	2419	0	586	379	0	1362	0	0	3972	732	0	6326	2081	0	1124	2180
1990	23599	1860	0	1002	634	0	1052	0	0	4326	972	0	6553	4092	0	794	2313
1991	26389	1589	0	1606	1460	0	3187	0	1418	4441	936	0	7056	2458	0	775	1462
1992	31831	1389	0	1883	1590	0	3290	0	1076	7339	1373	0	9254	1582	0	935	2120
1993	34258	3704	0	2213	1064	0	1995	0	1058	6671	1725	0	10635	1710	0	670	2813
1994	46769	1360	0	1658	953	0	6693	0	1410	11148	2380	0	13223	2333	0	988	4623
1995	47303	2953	0	2482	2302	0	8207	0	1220	9302	3088	0	10647	1280	0	814	5008
1996	51497	5033	0	1558	2548	0	9962	0	1360	8241	1963	0	14780	1937	0	935	3181
1997	51211	6194	0	981	2109	0	8281	0	1088	3978	4895	0	15146	4046	0	549	3945
1998	50000	2794	0	1639	1917	0	4350	0	889	7820	10024	0	13759	3626	0	1034	2147
1999	50000	1464	0	784	2287	0	3837	5	921	9966	14338	0	9294	3991	0	821	2292
2000	50000	1310	0	1005	2026	0	4129	0	914	10101	14813	0	8070	3036	0	700	3896
2001	50000	2062	0	913	1664	0	4870	0	890	8003	14867	0	9437	3893	0	870	2532
2002	50000	2136	0	1152	1774	0	3205	0	975	11612	11763	0	10580	3236	0	515	3053
2003	50000	582	0	552	2459	0	3221	0	1137	4705	21603	0	10335	2116	0	221	3069
2004	50000	1515	0	600	2053	0	2447	0	827	7136	19580	0	11405	1979	0	153	2305
2005	50000	2148	0	807	2169	0	3151	0	1017	7027	18034	0	11758	2408	0	112	1368
2006	50000	940	0	1410	1042	0	2989	0	1022	3018	25004	0	9727	2895	0	125	1829
2007	61000	0	2104	799	1279	0	2896	0	817	11991	27436	0	8751	3788	0	93	1047
2008	24460	0	2100	155	2276	0	2437	0	821	0	4182	0	8537	3169	0	149	635
2009	19818	0	993	54	1868	0	1373	0	609	0	0	4085	6755	3164	0	144	772
2010	11338	0	613	0	0	1155	1280	0	370	0	0	2349	2267	2292	0	281	730
2011	9774	0	543	0	0	1089	998	0	366	0	0	1555	2386	2137	0	165	536
2012	10934	0	219	0	0	1093	633	0	367	0	0	1712	4105	0	2311	125	370
2013	13243	0	74	0	0	1129	643	0	380	0	0	2857	4756	0	2564	222	618
2014	13261	0	2	0	0	1134	648	0	378	0	0	3066	4751	0	2376	232	673
2015	16214	0	42	0	0	1386	865	0	438	0	0	3468	6089	0	2905	192	829
2016	19175	0	752	0	0	1578	1774	42	436	0	0	3715	7198	0	2716	0	964
2017	23665	0	867	0	0	1911	1487	47	587	0	0	4843	9075	0	3362	272	1215
2018	27782	0	211	0	0	2270	1986	11	679	0	0	6362	10094	0	4258	300	1611
2019	31134	0	219	0	0	2524	2098	48	751	0	0	6831	11945	0	4594	353	1772
2020	35032	0	135	0	0	2782	2363	189	829	0	0	7263	12785	0	5891	360	2434

Table 3. New age observations available by fleet and year (spines and otoliths together) not included in the SS3 model.

Year	F01_BB_5006	F02_BB_0720	F03_LL_JPN_E_MED	F05_LL_JPN_NE_1020	F06_LL_OTH	F08_PS_HRV	F11_PS_MED_0920	F12_PS_OTH	F13_TP_5011	F14_TP_1220	F15_TP_OTH	F16_OTH
1984	42								157			
1985	573											4
1986	541											1
1987	401											
1988	507											
1989	231											
1990	272								74			1
1991	316											
1992	245											2
1993	251											
1994	206											
1995	230											2
1996	349											
1997	377											
1998	375											
1999	162											
2000	197											
2001	133				37							
2002	140				30							
2003	74				12							68
2004	164				23							52
2005	173				145							135
2006	70											23
2007		96	32		48							3
2008		94	63						29			200
2009		122			19		8	34				20
2010		120		2	76				80			22
2011		251		2	383		17	85	218		123	46
2012		197		10	288	14		45		160	39	35
2013		192		54	72	60		9		59		12
2014		36		204	34					49		6
2015		22		248	22			56		90	43	22
2016		38		92		50	390	416		82		32
2017					107		289	447		30	24	42
2018		50			19		38	8				8
	6029	1218	95	612	1315	124	742	1100	558	470	229	736

Table 4. Abundance indices used in the E-BFT SS3 assessment.

Year	SP_BB	SP_FR_BB	MOR_SP_TRAP	MOR_POR_TRAP	JPN_LL_EastMed	JPN_LL_NEA1	*cv*	JPN_LL_NEA2	*cv*	French Aerial Survey 1	French Aerial Survey 2	WMed Larval Survey
1952	0.25											
1953	0.26											
1954	0.32											
1955	0.26											
1956	0.66											
1957	0.44											
1958	0.35											
1959	0.71											
1960	0.68											
1961	0.46											
1962	0.25											
1963	0.44											
1964	0.64											
1965	0.32											
1966	0.49											
1967	0.49											
1968	0.63											
1969	0.86											
1970	0.84											
1971	1.05											
1972	0.74											
1973	0.75											
1974	0.35											
1975	0.68				1.29							
1976	0.68				1.46							
1977	0.77				2.39							
1978	0.99				1.02							
1979	0.88				1.83							
1980	0.89				1.14							
1981	0.72		1.04		1.10							
1982	0.71		1.40		2.25							
1983	0.88		1.47		1.44							
1984	0.47		1.62		1.10							
1985	1.58		1.10		1.19							
1986	1.06		0.53		0.89							
1987	1.42		0.59		1.46							
1988	1.96		1.37		0.91							
1989	1.81		0.72		0.71							
1990	1.39		0.83		0.96	0.46	*0.32*					
1991	1.27		0.98		0.82	0.54	*0.26*					
1992	0.98		0.42		0.70	0.83	*0.17*					
1993	2.95		0.44		0.70	0.76	*0.14*					
1994	1.42		0.46		0.76	1.01	*0.15*					
1995	1.74		0.30		0.96	1.02	*0.14*					
1996	2.45		0.51		0.34	2.50	*0.12*					
1997	3.16		1.34		0.36	1.56	*0.13*					
1998	1.24		1.25		0.48	0.85	*0.15*					
1999	0.48		1.54		0.43	1.20	*0.14*					
2000	1.35		1.00		0.50	1.11	*0.12*			1.28		
2001	0.99		1.73		0.65	1.42	*0.12*			1.09		0.14
2002	0.97		1.53		1.39	0.96	*0.13*			0.93		0.35
2003	0.63		0.89		1.15	1.05	*0.15*			0.70		0.11
2004	1.70		0.45		0.56	0.93	*0.13*					0.26
2005	3.35		0.91		0.60	0.73	*0.13*					0.08
2006	1.20		0.86		1.29	0.86	*0.13*					
2007		1.18	1.35		0.64	0.92	*0.13*					
2008		1.17	0.86		0.83	1.05	*0.13*					
2009		0.52	1.18		0.70	1.61	*0.12*				0.35	
2010		1.15	1.41					2.35	*0.13*		0.27	
2011		1.51	0.91					4.01	*0.15*		0.51	
2012		1.25		0.99				8.59	*0.20*		0.35	0.97
2013		0.85		1.32				7.22	*0.16*			1.41
2014		0.37		0.66				8.06	*0.21*		1.22	0.75
2015				1.02				6.40	*0.21*		0.53	1.18
2016				0.98				5.77	*0.18*		2.06	0.87
2017				1.15				7.27	*0.21*		1.32	2.09
2018				0.75				8.70	*0.22*		0.59	
2019				1.04				8.33	*0.21*		1.20	1.68
2020				1.08				6.84	*0.19*		2.61	3.10

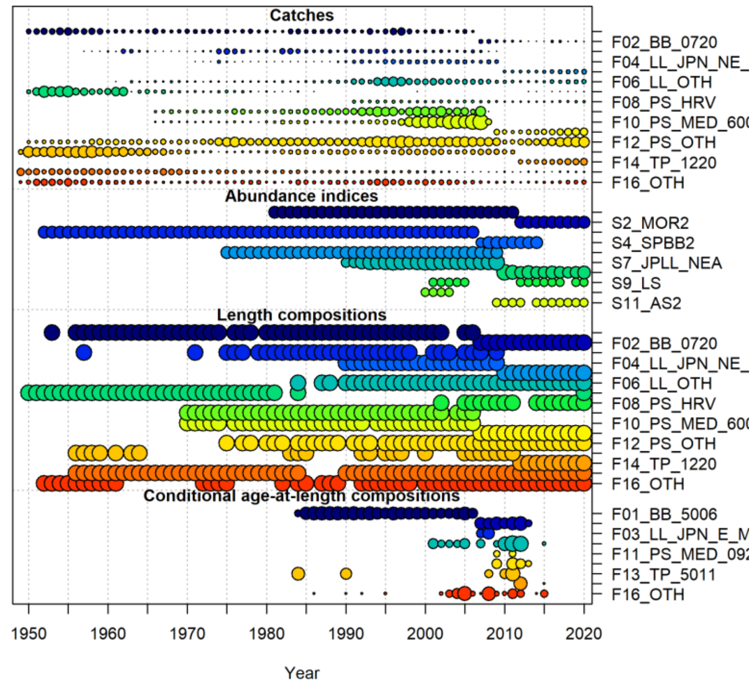

Figure 1. Time series of data inputs used in the E-BFT SS3 model.

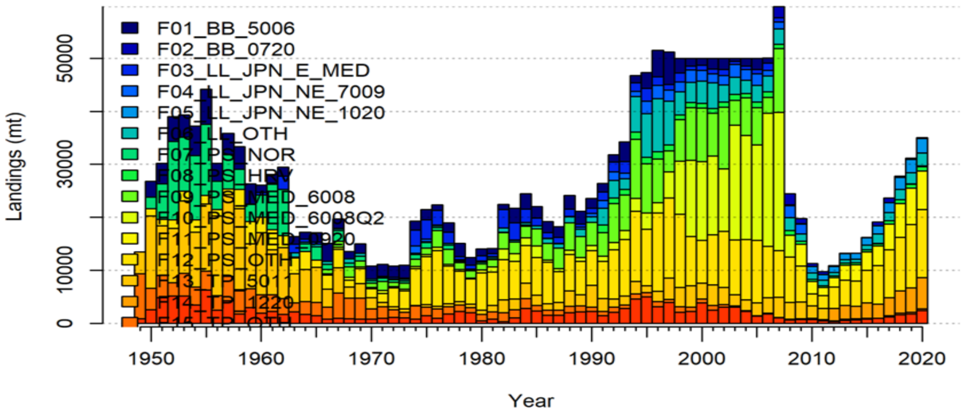

Figure 2. Landings (mt) for each of the fleets defined in the model.

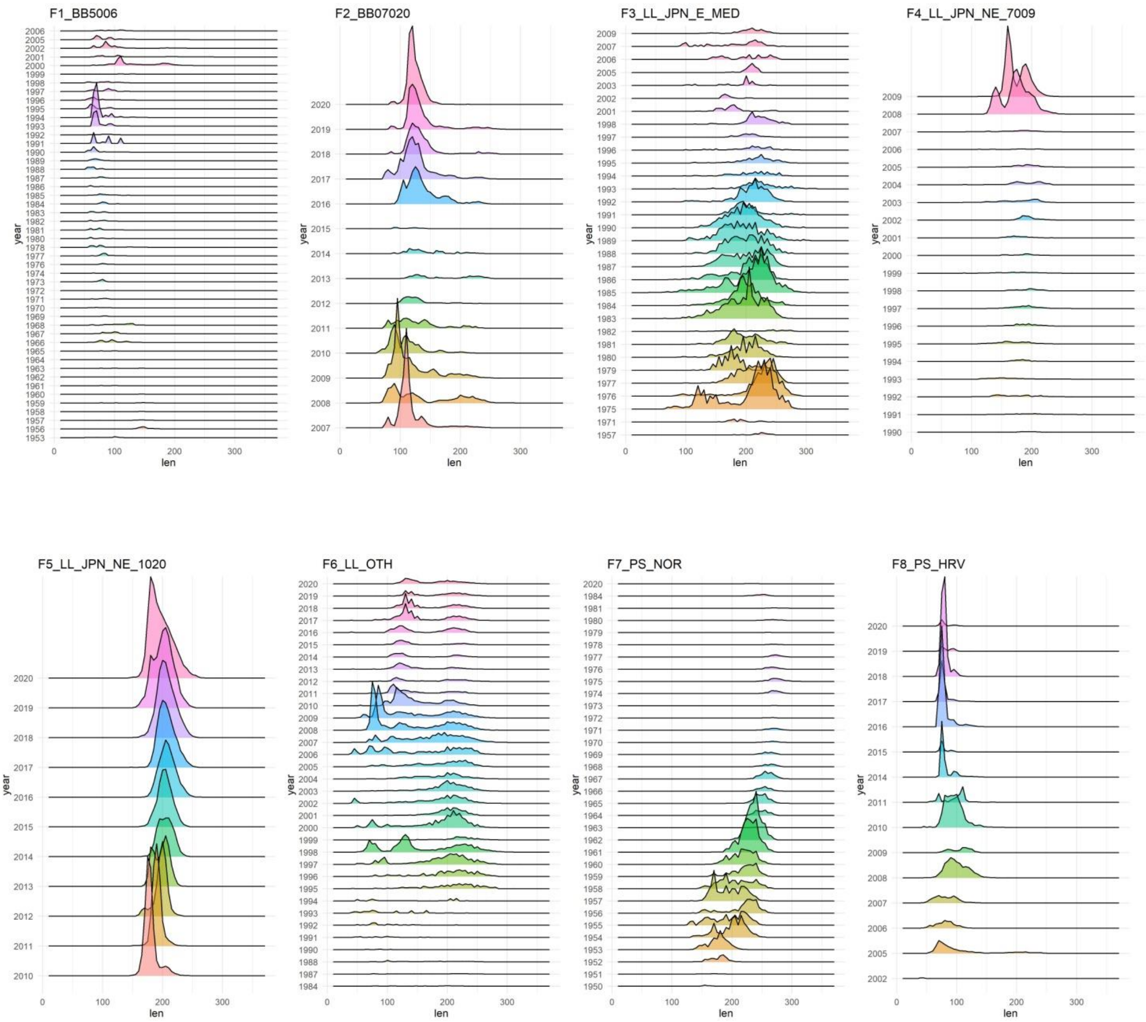

Figure 3. Time series of length composition by fleet used in the E-BFT SS3 assessment.

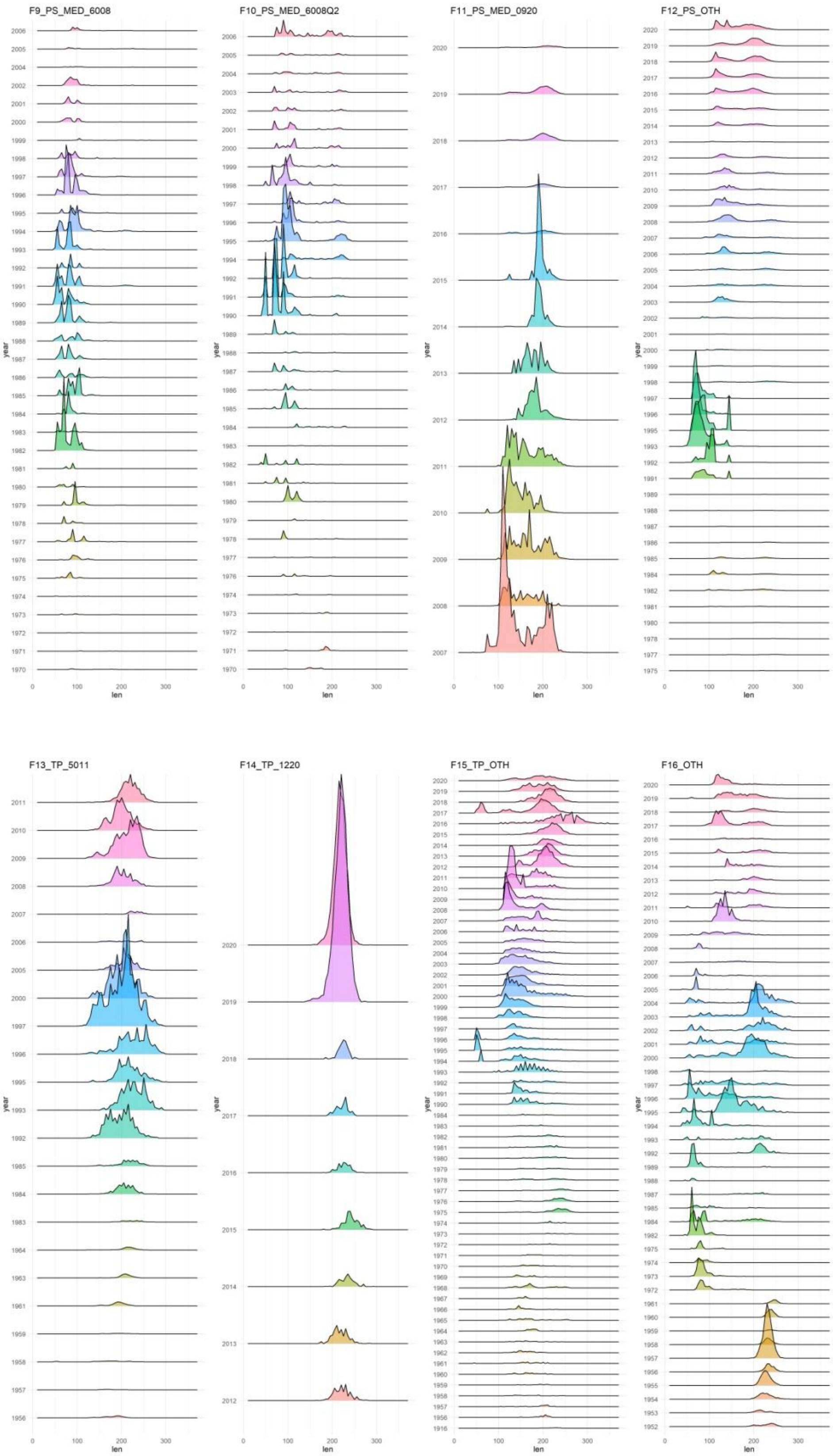

Figure 3. Cont.

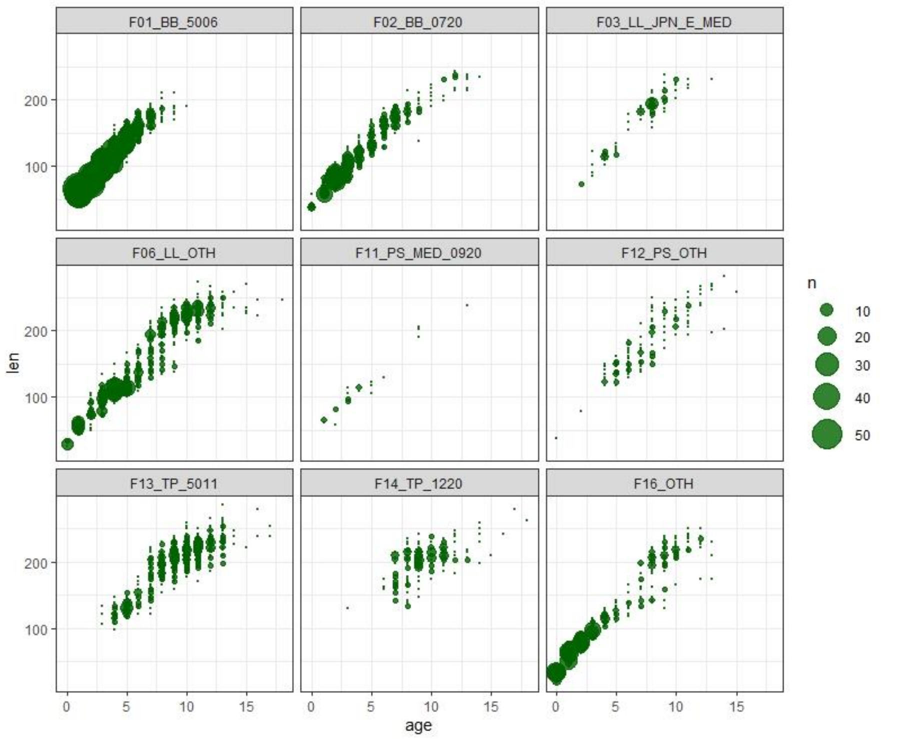

Figure 4. Age-length data used in the E-BFT SS3 assessment.

Figure 5. Time series of the indices used in the E-BFT SS3 assessment in 2017 and in 2022.

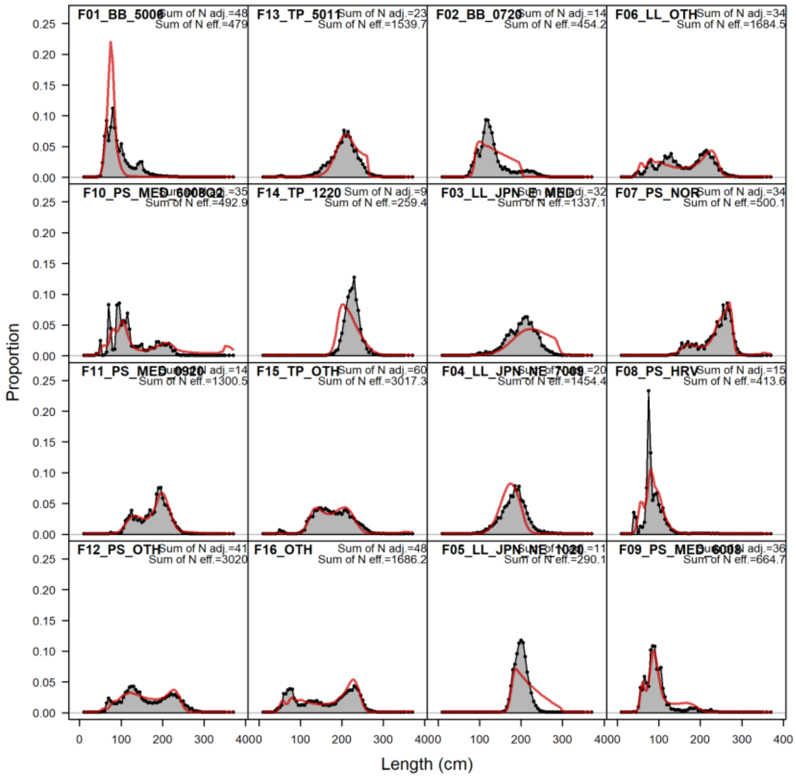

Figure 6. Annual aggregated length composition and selectivity curve fit for fleets considered in the E-BFT SS3 assessment.

Annex 1

SS3 control file

```
#V3.30.17.00;_2021_06_11;_safe;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADMB_12.3
#Stock Synthesis (SS) is a work of the U.S. Government and is not subject to copyright protection in the United States.
#Foreign copyrights may apply. See copyright.txt for more information.
#_user_support_available_at:NMFS.Stock.Synthesis@noaa.gov
#_user_info_available_at:https://vlab.noaa.gov/group/stock-synthesis
#C growth parameters are estimated
#C spawner-recruitment bias adjustment Not tuned For optimality
#_data_and_control_files: data.ss // control.ss
0 # 0 means do not read wtatage.ss; 1 means read and use wtatage.ss and also read and use growth parameters
1 #_N_Growth_Patterns (Growth Patterns, Morphs, Bio Patterns, GP are terms used interchangeably in SS)
1 #_N_platoons_Within_GrowthPattern
#_Cond 1 #_Platoon_within/between_stdev_ratio (no read if N_platoons=1)
#_Cond  1 #vector_platoon_dist_(-1_in_first_val_gives_normal_approx)
4 # recr_dist_method for parameters:  2=main effects for GP, Area, Settle timing; 3=each Settle entity; 4=none (only when N_GP*Nsettle*pop==1)
1 # not yet implemented; Future usage: Spawner-Recruitment: 1=global; 2=by area
1 #  number of recruitment settlement assignments
0 # unused option
#GPattern month  area  age (for each settlement assignment)
 1 1 1 0
#_Cond 0 # N_movement_definitions goes here if Nareas > 1
#_Cond 1.0 # first age that moves (real age at begin of season, not integer) also cond on do_migration>0
#_Cond 1 1 1 2 4 10 # example move definition for seas=1, morph=1, source=1 dest=2, age1=4, age2=10
#
1 #_Nblock_Patterns
 1 #_blocks_per_pattern
# begin and end years of blocks
 1949 1949
# controls for all timevary parameters
1 #_time-vary parm bound check (1=warn relative to base parm bounds; 3=no bound check); Also see env (3) and dev (5) options to constrain with base bounds
# AUTOGEN
 1 1 1 1 1 # autogen: 1st element for biology, 2nd for SR, 3rd for Q, 4th reserved, 5th for selex
# where: 0 = autogen time-varying parms of this category; 1 = read each time-varying parm line; 2 = read then autogen if parm min==-12345
#_Available timevary codes
#_Block types: 0: P_block=P_base*exp(TVP); 1: P_block=P_base+TVP; 2: P_block=TVP; 3: P_block=P_block(-1) + TVP
#_Block_trends: -1: trend bounded by base parm min-max and parms in transformed units (beware); -2: endtrend and infl_year direct values; -3: end and infl as fraction of base range
#_EnvLinks:  1: P(y)=P_base*exp(TVP*env(y));  2: P(y)=P_base+TVP*env(y);  3: P(y)=f(TVP,env_Zscore) w/ logit to stay in min-max;  4: P(y)=2.0/(1.0+exp(-TVP1*env(y) - TVP2))
#_DevLinks:  1: P(y)*=exp(dev(y)*dev_se;  2: P(y)+=dev(y)*dev_se;  3: random walk;  4: zero-reverting random walk with rho;  5: like 4 with logit transform to stay in base min-max
#_DevLinks(more):  21-25 keep last dev for rest of years
#
#_Prior_codes:  0=none; 6=normal; 1=symmetric beta; 2=CASAL's beta; 3=lognormal; 4=lognormal with biascorr; 5=gamma
#
# setup for M, growth, wt-len, maturity, fecundity, (hermaphro), recr_distr, cohort_grow, (movement), (age error), (catch_mult), sex ratio
#_NATMORT
3 #_natM_type:_0=1Parm; 1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate;_5=BETA:_Maunder_link_to_maturity
 #_Age_natmort_by sex x growthpattern (nest GP in sex)
 0.47 0.37 0.3 0.25 0.21 0.18 0.16 0.15 0.14 0.13 0.12 0.12 0.11 0.11 0.11 0.11 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1
#
2 # GrowthModel: 1=vonBert with L1&L2; 2=Richards with L1&L2; 3=age_specific_K_incr; 4=age_specific_K_decr; 5=age_specific_K_each; 6=NA; 7=NA; 8=growth cessation
0.5 #_Age(post-settlement)_for_L1;linear growth below this
30 #_Growth_Age_for_L2 (999 to use as Linf)
-999 #_exponential decay for growth above maxage (value should approx initial Z; -999 replicates 3.24; -998 to not allow growth above maxage)
0  #_placeholder for future growth feature
#
0 #_SD_add_to_LAA (set to 0.1 for SS2 V1.x compatibility)
0 #_CV_Growth_Pattern:  0 CV=f(LAA); 1 CV=F(A); 2 SD=F(LAA); 3 SD=F(A); 4 logSD=F(A)
#
3 #_maturity_option:  1=length logistic; 2=age logistic; 3=read age-maturity matrix by growth_pattern; 4=read age-fecundity; 5=disabled; 6=read length-maturity
#_Age_Maturity by growth pattern
 0 0 0 0.25 0.5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
3 #_First_Mature_Age
1 #_fecundity option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b; (4)eggs=a+b*L; (5)eggs=a+b*W
0 #_hermaphroditism option:  0=none; 1=female-to-male age-specific fxn; -1=male-to-female age-specific fxn
1 #_parameter_offset_approach for M, G, CV_G:  1- direct, no offset**; 2- male=fem_parm*exp(male_parm); 3: male=female*exp(parm) then old=young*exp(parm)
#_** in option 1, any male parameter with value = 0.0 and phase <0 is set equal to female parameter
#
#_growth_parms
#_ LO HI INIT PRIOR PR_SD PR_type PHASE env_var&link dev_link dev_minyr dev_maxyr dev_PH Block Block_Fxn
# Sex: 1  BioPattern: 1  NatMort
# Sex: 1  BioPattern: 1  Growth
 10 45 32.9541 36 10 0 -5 0 0 0 0 0 0 0 # L_at_Amin_Fem_GP_1
 200 360 349.67 340 5 1 4 0 0 0 0 0 0 0 # L_at_Amax_Fem_GP_1
 0.01 0.4 0.0643453 0.15 0.8 0 4 0 0 0 0 0 0 0 # VonBert_K_Fem_GP_1
 -3 3 1.04448 0.58 0.8 6 4 0 0 0 0 0 0.5 0 0 # Richards_Fem_GP_1
 0.05 0.25 0.106204 0.1 0.8 0 3 0 0 0 0 0 0 0 # CV_young_Fem_GP_1
 0.02 0.25 0.0415244 0.1 0.8 0 3 0 0 0 0 0 0 0 # CV_old_Fem_GP_1
# Sex: 1  BioPattern: 1  WtLen
 -3 3 1.96e-05 2.95e-05 0.8 0 -3 0 0 0 0 0 0 0 # Wtlen_1_Fem_GP_1
 -3 4 3.0092 3.0092 0.8 0 -3 0 0 0 0 0 0 0 # Wtlen_2_Fem_GP_1
# Sex: 1  BioPattern: 1  Maturity&Fecundity
```

3 5 4 4 0.8 0 -3 0 0 0 0 0 0 0 # Mat50%_Fem_GP_1
-7 -3 -5 -5 0.8 0 -3 0 0 0 0 0 0 0 # Mat_slope_Fem_GP_1
-3 3 1 1 0.8 0 -3 0 0 0 0 0 0 0 # Eggs/kg_inter_Fem_GP_1
-3 3 0 0 0.8 0 -3 0 0 0 0 0 0 0 # Eggs/kg_slope_wt_Fem_GP_1
Hermaphroditism
Recruitment Distribution
Cohort growth dev base
0.1 10 1 1 1 0 -1 0 0 0 0 0 0 0 # CohortGrowDev
Movement
Age Error from parameters
catch multiplier
fraction female, by GP
1e-06 0.999999 0.5 0.5 0.5 0 -99 0 0 0 0 0 0 0 # FracFemale_GP_1
#
#_no timevary MG parameters
#
#_seasonal_effects_on_biology_parms
0 0 0 0 0 0 0 0 0 0 #_femwtlen1,femwtlen2,mat1,mat2,fec1,fec2,Malewtlen1,malewtlen2,L1,K
#_ LO HI INIT PRIOR PR_SD PR_type PHASE
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no seasonal MG parameters
#
6 #_Spawner-Recruitment; Options: 1=NA; 2=Ricker; 3=std_B-H; 4=SCAA; 5=Hockey; 6=B-H_flattop; 7=survival_3Parm; 8=Shepherd_3Parm; 9=RickerPower_3parm
0 # 0/1 to use steepness in initial equ recruitment calculation
0 # future feature: 0/1 to make realized sigmaR a function of SR curvature

#_ LO	HI	INIT	PRIOR	PR_SD	PR_type	PHASE	env-var	use_dev	dev_mnyr	dev_mxyr	dev_PH	Block	Blk_Fxn # parm_name
6	15	8.06147	10.3	10	0	1	0	0	0	0	0	0	0 # SR_LN(R0)
0.2	1	0.9	0.9	0.05	0	-3	0	0	0	0	0	0	0 # SR_BH_flat_steep
0	2	0.6	0.6	0.2	0	-5	0	0	0	0	0	0	0 # SR_sigmaR
-5	5	0	0	1	0	-2	0	0	0	0	0	0	0 # SR_regime
0	0	0	0	0	0	-99	0	0	0	0	0	0	0 # SR_autocorr

#_no timevary SR parameters
1 #do_recdev: 0=none; 1=devvector (R=F(SSB)+dev); 2=deviations (R=F(SSB)+dev); 3=deviations (R=R0*dev; dev2=R-f(SSB)); 4=like 3 with sum(dev2) adding penalty
1950 # first year of main recr_devs; early devs can preceed this era
2020 # last year of main recr_devs; forecast devs start in following year
6 #_recdev phase
1 # (0/1) to read 13 advanced options
-15 #_recdev_early_start (0=none; neg value makes relative to recdev_start)
6 #_recdev_early_phase
0 #_forecast_recruitment phase (incl. late recr) (0 value resets to maxphase+1)
1 #_lambda for Fcast_recr_like occurring before endyr+1
1931 #_last_yr_nobias_adj_in_MPD; begin of ramp
1962 #_first_yr_fullbias_adj_in_MPD; begin of plateau
1998 #_last_yr_fullbias_adj_in_MPD
2083 #_end_yr_for_ramp_in_MPD (can be in forecast to shape ramp, but SS sets bias_adj to 0.0 for fcast yrs)
0.93 #_max_bias_adj_in_MPD (typical ~0.8; -3 sets all years to 0.0; -2 sets all non-forecast yrs w/ estimated recdevs to 1.0; -1 sets biasadj=1.0 for all yrs w/ recdevs)
0 #_period of cycles in recruitment (N parms read below)
-5 #min rec_dev
7 #max rec_dev
54 #_read_recdevs
#_end of advanced SR options
#
#_placeholder for full parameter lines for recruitment cycles
Specified recr devs to read
#_Yr Input_value # Final_value
1961 0.367027 # -0.385226
1962 0.0645511 # -0.119133
1963 0.48233 # -0.978755
1964 -0.438039 # -0.139683
1965 -0.784369 # -0.356251
1966 -0.744618 # -0.221928
1967 -0.687635 # 0.0133147
1968 -0.0271688 # -0.125352
1969 0.62289 # 0.117319
1970 -0.166794 # -0.209406
1971 0.00997055 # -0.164637
1972 1.11948 # -0.963679
1973 0.620815 # -0.0773809
1974 -0.400979 # -0.350818
1975 -0.435079 # -0.191194
1976 -0.905073 # -0.123584
1977 -0.920341 # -0.240536
1978 -0.602674 # -0.251143
1979 -0.268141 # -0.479225
1980 -0.919227 # -0.428253
1981 0.394313 # -0.226172
1982 0.35708 # -0.434861
1983 -0.3714 # 0.0690318
1984 0.249326 # -0.199743
1985 0.189884 # 0.172235
1986 0.113172 # 0.44323
1987 0.31583 # 0.544981
1988 -0.147574 # 0.417027
1989 1.38716 # 0.675505

```
 1990 -0.742459 # 0.519981
 1991 0.436776 # 1.19048
 1992 0.290081 # 0.646711
 1993 -0.719029 # 0.904231
 1994 1.56383 # 1.19258
 1995 -0.1184 # 1.05229
 1996 0.00826561 # 0.38307
 1997 0.26489 # 0.156676
 1998 0.504973 # 0.563028
 1999 -0.0770637 # 0.619554
 2000 1.01504 # 0.531069
 2001 0.396427 # 0.268036
 2002 1.08302 # 0.865128
 2003 1.39628 # 1.46638
 2004 0.415991 # 0.632212
 2005 0.0594356 # 0.85039
 2006 0.00417469 # 0.228435
 2007 -0.314161 # 0.114819
 2008 -0.00664716 # 0.0691553
 2009 0.070972 # 0.116097
 2010 -0.309061 # -0.629279
 2011 -0.72319 # -1.02679
 2012 -1.3122 # -0.13331
 2013 -1.11118 # 0.352475
 2014 -0.55149 # 0.0484349
#
# all recruitment deviations
#  1935E 1936E 1937E 1938E 1939E 1940E 1941E 1942E 1943E 1944E 1945E 1946E 1947E 1948E 1949E 1950R 1951R 1952R 1953R 1954R 1955R 1956R 1957R 1958R 1959R 1960R 1961R
1962R 1963R 1964R 1965R 1966R 1967R 1968R 1969R 1970R 1971R 1972R 1973R 1974R 1975R 1976R 1977R 1978R 1979R 1980R 1981R 1982R 1983R 1984R 1985R 1986R 1987R 1988R
1989R 1990R 1991R 1992R 1993R 1994R 1995R 1996R 1997R 1998R 1999R 2000R 2001R 2002R 2003R 2004R 2005R 2006R 2007R 2008R 2009R 2010R 2011R 2012R 2013R 2014R 2015R
2016R 2017R 2018R 2019R 2020F 2021F 2022F 2023F 2024F 2025F 2026F 2027F 2028F 2029F
#  -0.190679 -0.227741 -0.254602 -0.269274 -0.273966 -0.271207 -0.251749 -0.179803 -0.00118019 0.208916 0.168239 0.138941 0.277463 0.323892 -0.443172 -1.21171 -0.829051 -
0.42764 -0.602555 0.171043 -0.596969 -0.667283 0.131419 -0.222176 -0.759431 -1.19031 -0.385226 -0.119133 -0.978755 -0.139683 -0.356251 -0.221928 0.0133147 -0.125352 0.117319
-0.209406 -0.164637 -0.963679 -0.0773809 -0.350818 -0.191194 -0.123584 -0.240536 -0.251143 -0.479225 -0.428253 -0.226172 -0.434861 0.0690318 -0.199743 0.172235 0.44323
0.544981 0.417027 0.675505 0.519981 1.19048 0.646711 0.904231 1.19258 1.05229 0.38307 0.156676 0.563028 0.619554 0.531069 0.268036 0.865128 1.46638 0.632212 0.85039
0.228435 0.114819 0.0691553 0.116097 -0.629279 -1.02679 -0.13331 0.352475 0.0484349 -0.0792676 -0.0670058 -0.143648 -0.148146 -0.124807 0 0 0 0 0 0 0 0 0 0
#
#Fishing Mortality info
0.3 # F ballpark value in units of annual_F
-2001 # F ballpark year (neg value to disable)
3 # F_Method:  1=Pope; 2=instan. F; 3=hybrid (hybrid is recommended)
2.9 # max F or harvest rate, depends on F_Method
# no additional F input needed for Fmethod 1
# if Fmethod=2; read overall start F value; overall phase; N detailed inputs to read
# if Fmethod=3; read N iterations for tuning for Fmethod 3
4  # N iterations for tuning F in hybrid method (recommend 3 to 7)
#
#_initial_F_parms; for each fleet x season that has init_catch; nest season in fleet; count = 3
#_for unconstrained init_F, use an arbitrary initial catch and set lambda=0 for its logL
#_ LO HI INIT PRIOR PR_SD  PR_type  PHASE
 0 1 0.015 0.015 99 0 -1 # InitF_seas_1_flt_13F13_TP_5011
 0 1 0.03 0.01 99 0 -1 # InitF_seas_1_flt_15F15_TP_OTH
 0 1 0.005 0.005 99 0 -1 # InitF_seas_1_flt_16F16_OTH
#
#_Q_setup for fleets with cpue or survey data
#_1:  fleet number
#_2:  link type: (1=simple q, 1 parm; 2=mirror simple q, 1 mirrored parm; 3=q and power, 2 parm; 4=mirror with offset, 2 parm)
#_3:  extra input for link, i.e. mirror fleet# or dev index number
#_4:  0/1 to select extra sd parameter
#_5:  0/1 for biasadj or not
#_6:  0/1 to float
#_   fleet     link link_info  extra_se   biasadj     float  #  fleetname
      17       1        0         0         0         1  #  S1_MOR1
      18       1        0         0         0         1  #  S2_MOR2
      19       1        0         0         0         1  #  S3_SpBB1
      20       1        0         0         0         1  #  S4_SPBB2
      21       1        0         0         0         1  #  S5_JPLL_EM
      23       1        0         0         0         1  #  S7_JPLL_NEA
      24       1        0         0         0         1  #  S8_LJPLL_NEA2
      25       1        0         0         0         1  #  S9_LS
      26       1        0         0         0         1  #  S10_AS1
      27       1        0         0         0         1  #  S11_AS2
-9999 0 0 0 0 0
#
#_Q_parms(if_any);Qunits_are_ln(q)
#_        LO       HI      INIT      PRIOR      PR_SD     PR_type     PHASE    env-var    use_dev   dev_mnyr   dev_mxyr    dev_PH     Block    Blk_Fxn  #  parm_name
         -15       15    -11.0762       0          1          0      -1       0       0       0       0       0       0       0  #  LnQ_base_S1_MOR1(17)
         -15       15    -12.1176       0          1          0      -1       0       0       0       0       0       0       0  #  LnQ_base_S2_MOR2(18)
         -15       15    -8.96221       0          1          0      -1       0       0       0       0       0       0       0  #  LnQ_base_S3_SpBB1(19)
         -15       15    -8.20194       0          1          0      -1       0       0       0       0       0       0       0  #  LnQ_base_S4_SPBB2(20)
         -15       15    -10.8049       0          1          0      -1       0       0       0       0       0       0       0  #  LnQ_base_S5_JPLL_EM(21)
         -15       15    -11.3106       0          1          0      -1       0       0       0       0       0       0       0  #  LnQ_base_S7_JPLL_NEA(23)
         -15       15    -11.6488       0          1          0      -1       0       0       0       0       0       0       0  #  LnQ_base_S8_LJPLL_NEA2(24)
```

-15	15	-12.8893	0	1	0	-1	0	0	0	0	0	0	0 # LnQ_base_S9_LS(25)
-15	15	-12.3569	0	1	0	-1	0	0	0	0	0	0	0 # LnQ_base_S10_AS1(26)
-15	15	-12.9289	0	1	0	-1	0	0	0	0	0	0	0 # LnQ_base_S11_AS2(27)

```
#_no timevary Q parameters
#
#_size_selex_patterns
#Pattern:_0;  parm=0; selex=1.0 for all sizes
#Pattern:_1;  parm=2; logistic; with 95% width specification
#Pattern:_2;  parm=6; modification of pattern 24 with improved sex-specific offset
#Pattern:_5;  parm=2; mirror another size selex; PARMS pick the min-max bin to mirror
#Pattern:_11; parm=2; selex=1.0  for specified min-max population length bin range
#Pattern:_15; parm=0; mirror another age or length selex
#Pattern:_6;  parm=2+special; non-parm len selex
#Pattern:_43; parm=2+special+2;  like 6, with 2 additional param for scaling (average over bin range)
#Pattern:_8;  parm=8; double_logistic with smooth transitions and constant above Linf option
#Pattern:_9;  parm=6; simple 4-parm double logistic with starting length; parm 5 is first length; parm 6=1 does desc as offset
#Pattern:_21; parm=2+special; non-parm len selex, read as pairs of size, then selex
#Pattern:_22; parm=4; double_normal as in CASAL
#Pattern:_23; parm=6; double_normal where final value is directly equal to sp(6) so can be >1.0
#Pattern:_24; parm=6; double_normal with sel(minL) and sel(maxL), using joiners
#Pattern:_25; parm=3; exponential-logistic in length
#Pattern:_27; parm=special+3; cubic spline in length; parm1==1 resets knots; parm1==2 resets all
#Pattern:_42; parm=special+3+2; cubic spline; like 27, with 2 additional param for scaling (average over bin range)
#_discard_options:_0=none;_1=define_retention;_2=retention&mortality;_3=all_discarded_dead;_4=define_dome-shaped_retention
#_Pattern Discard Male Special
 27 0 0 5 # 1 F01_BB_5006
 24 0 0 0 # 2 F02_BB_0719
 24 0 0 0 # 3 F03_LL_JPN_E_MED
 24 0 0 0 # 4 F04_LL_JPN_NE_7009
 24 0 0 0 # 5 F05_LL_JPN_NE_1019
 27 0 0 5 # 6 F06_LL_OTH
 27 0 0 5 # 7 F07_PS_NOR
 27 0 0 3 # 8 F08_PS_HRV
 27 0 0 5 # 9 F09_PS_MED_6008
 27 0 0 7 # 10 F10_PS_MED_6008Q2
 27 0 0 4 # 11 F11_PS_MED_0919
 27 0 0 5 # 12 F12_PS_OTH
 24 0 0 0 # 13 F13_TP_5011
 24 0 0 0 # 14 F14_TP_1219
 27 0 0 3 # 15 F15_TP_OTH
 15 0 0 6 # 16 F16_OTH
 15 0 0 13 # 17 S1_MOR1
 15 0 0 14 # 18 S2_MOR2
 15 0 0 1 # 19 S3_SpBB1
 15 0 0 2 # 20 S4_SPBB2
 15 0 0 3 # 21 S5_JPLL_EM
 15 0 0 7 # 22 S6_NorPS
 15 0 0 4 # 23 S7_JPLL_NEA
 15 0 0 5 # 24 S8_LJPLL_NEA2
 0 0 0 0 # 25 S9_LS
 0 0 0 0 # 26 S10_AS1
 0 0 0 0 # 27 S11_AS2
#
#_age_selex_patterns
#Pattern:_0; parm=0; selex=1.0 for ages 0 to maxage
#Pattern:_10; parm=0; selex=1.0 for ages 1 to maxage
#Pattern:_11; parm=2; selex=1.0  for specified min-max age
#Pattern:_12; parm=2; age logistic
#Pattern:_13; parm=8; age double logistic
#Pattern:_14; parm=nages+1; age empirical
#Pattern:_15; parm=0; mirror another age or length selex
#Pattern:_16; parm=2; Coleraine - Gaussian
#Pattern:_17; parm=nages+1; empirical as random walk  N parameters to read can be overridden by setting special to non-zero
#Pattern:_41; parm=2+nages+1; // like 17, with 2 additional param for scaling (average over bin range)
#Pattern:_18; parm=8; double logistic - smooth transition
#Pattern:_19; parm=6; simple 4-parm double logistic with starting age
#Pattern:_20; parm=6; double_normal,using joiners
#Pattern:_26; parm=3; exponential-logistic in age
#Pattern:_27; parm=3+special; cubic spline in age; parm1==1 resets knots; parm1==2 resets all
#Pattern:_42; parm=2+special+3; // cubic spline; with 2 additional param for scaling (average over bin range)
#Age patterns entered with value >100 create Min_selage from first digit and pattern from remainder
#_Pattern Discard Male Special
 10 0 0 0 # 1 F01_BB_5006
 10 0 0 0 # 2 F02_BB_0719
 10 0 0 0 # 3 F03_LL_JPN_E_MED
 10 0 0 0 # 4 F04_LL_JPN_NE_7009
 10 0 0 0 # 5 F05_LL_JPN_NE_1019
 10 0 0 0 # 6 F06_LL_OTH
 10 0 0 0 # 7 F07_PS_NOR
 10 0 0 0 # 8 F08_PS_HRV
 10 0 0 0 # 9 F09_PS_MED_6008
 10 0 0 0 # 10 F10_PS_MED_6008Q2
 10 0 0 0 # 11 F11_PS_MED_0919
```

```
10 0 0 0 # 12 F12_PS_OTH
10 0 0 0 # 13 F13_TP_5011
10 0 0 0 # 14 F14_TP_1219
10 0 0 0 # 15 F15_TP_OTH
10 0 0 0 # 16 F16_OTH
10 0 0 0 # 17 S1_MOR1
10 0 0 0 # 18 S2_MOR2
10 0 0 0 # 19 S3_SpBB1
10 0 0 0 # 20 S4_SPBB2
10 0 0 0 # 21 S5_JPLL_EM
10 0 0 0 # 22 S6_NorPS
10 0 0 0 # 23 S7_JPLL_NEA
10 0 0 0 # 24 S8_LJPLL_NEA2
10 0 0 0 # 25 S9_LS
11 0 0 0 # 26 S10_AS1
11 0 0 0 # 27 S11_AS2
#
#_ LO HI INIT PRIOR PR_SD PR_type PHASE env-var use_dev dev_mnyr dev_mxyr dev_PH Block Blk_Fxn # parm_name
# 1 F01_BB_5006 LenSelex
 0 2 2 0 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Code_F01_BB_5006(1)
 -0.001 1 0.307534 0 0.001 1 3 0 0 0 0 0 0 0 # SizeSpline_GradLo_F01_BB_5006(1)
 -1 0.001 -0.00361728 0 0.001 1 3 0 0 0 0 0 0 0 # SizeSpline_GradHi_F01_BB_5006(1)
 40 200 54.0962 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_1_F01_BB_5006(1)
 40 200 72.9206 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_2_F01_BB_5006(1)
 40 200 83.7825 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_3_F01_BB_5006(1)
 40 200 105.294 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_4_F01_BB_5006(1)
 40 200 226.125 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_5_F01_BB_5006(1)
 -9 7 -5.72782 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_1_F01_BB_5006(1)
 -9 7 -1.09269 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_2_F01_BB_5006(1)
 -9 7 -1 0 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Val_3_F01_BB_5006(1)
 -9 7 -3.3724 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_4_F01_BB_5006(1)
 -9 7 -8.99894 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_5_F01_BB_5006(1)
# 2 F02_BB_0719 LenSelex
 40 250 90.3126 97 5 1 2 0 0 0 0 0 0 0 # Size_DblN_peak_F02_BB_0719(2)
 -10 3 -0.502667 -8 5 1 2 0 0 0 0 0 0 0 # Size_DblN_top_logit_F02_BB_0719(2)
 -5 9 3.54635 5 5 1 2 0 0 0 0 0 0 0 # Size_DblN_ascend_se_F02_BB_0719(2)
 -5 9 2.10037 6.2 5 1 2 0 0 0 0 0 0 0 # Size_DblN_descend_se_F02_BB_0719(2)
 -999 15 -999 -1 5 0 -3 0 0 0 0 0 0 0 # Size_DblN_start_logit_F02_BB_0719(2)
 -20 10 -999 2 100 0 -2 0 0 0 0 0 0 0 # Size_DblN_end_logit_F02_BB_0719(2)
# 3 F03_LL_JPN_E_MED LenSelex
 40 330 273.788 120 1000 0 2 0 0 0 0 0 0 0 # Size_DblN_peak_F03_LL_JPN_E_MED(3)
 -10 3 -5 -1.16787 1000 0 -2 0 0 0 0 0 0 0 # Size_DblN_top_logit_F03_LL_JPN_E_MED(3)
 -5 12 8.26663 4.81298 1000 0 3 0 0 0 0 0 0 0 # Size_DblN_ascend_se_F03_LL_JPN_E_MED(3)
 -5 9 5 6.75951 1000 0 -3 0 0 0 0 0 0 0 # Size_DblN_descend_se_F03_LL_JPN_E_MED(3)
 -999 15 -999 -1 5 0 -3 0 0 0 0 0 0 0 # Size_DblN_start_logit_F03_LL_JPN_E_MED(3)
 -999 10 -999 2 100 0 -3 0 0 0 0 0 0 0 # Size_DblN_end_logit_F03_LL_JPN_E_MED(3)
# 4 F04_LL_JPN_NE_7009 LenSelex
 40 250 199.351 120 1000 0 2 0 0 0 0 0 0 0 # Size_DblN_peak_F04_LL_JPN_NE_7009(4)
 -10 3 -7.86495 -1.16787 1000 0 2 0 0 0 0 0 0 0 # Size_DblN_top_logit_F04_LL_JPN_NE_7009(4)
 -5 9 7.61652 5 1000 0 3 0 0 0 0 0 0 0 # Size_DblN_ascend_se_F04_LL_JPN_NE_7009(4)
 -5 9 6.69224 6.75951 1000 0 3 0 0 0 0 0 0 0 # Size_DblN_descend_se_F04_LL_JPN_NE_7009(4)
 -999 15 -999 -1 5 0 -3 0 0 0 0 0 0 0 # Size_DblN_start_logit_F04_LL_JPN_NE_7009(4)
 -20 10 -7.69451 2 100 0 3 0 0 0 0 0 0 0 # Size_DblN_end_logit_F04_LL_JPN_NE_7009(4)
# 5 F05_LL_JPN_NE_1019 LenSelex
 40 250 197.703 120 1000 0 2 0 0 0 0 0 0 0 # Size_DblN_peak_F05_LL_JPN_NE_1019(5)
 -10 3 -2.69126 -1.16787 1000 0 2 0 0 0 0 0 0 0 # Size_DblN_top_logit_F05_LL_JPN_NE_1019(5)
 -5 9 5 5 1000 0 -3 0 0 0 0 0 0 0 # Size_DblN_ascend_se_F05_LL_JPN_NE_1019(5)
 -5 9 5.9369 6.75951 1000 0 3 0 0 0 0 0 0 0 # Size_DblN_descend_se_F05_LL_JPN_NE_1019(5)
 -999 15 -999 -1 5 0 -3 0 0 0 0 0 0 0 # Size_DblN_start_logit_F05_LL_JPN_NE_1019(5)
 -20 10 -10.3664 2 100 0 3 0 0 0 0 0 0 0 # Size_DblN_end_logit_F05_LL_JPN_NE_1019(5)
# 6 F06_LL_OTH LenSelex
 0 2 2 0 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Code_F06_LL_OTH(6)
 -0.001 1 0.0482188 0 0.001 1 3 0 0 0 0 0 0 0 # SizeSpline_GradLo_F06_LL_OTH(6)
 -1 0.001 -0.231883 0 0.001 1 3 0 0 0 0 0 0 0 # SizeSpline_GradHi_F06_LL_OTH(6)
 10 370 54.3851 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_1_F06_LL_OTH(6)
 10 370 113.83 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_2_F06_LL_OTH(6)
 10 370 161.53 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_3_F06_LL_OTH(6)
 10 370 210.538 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_4_F06_LL_OTH(6)
 10 370 267.092 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_5_F06_LL_OTH(6)
 -9 7 -2.96078 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_1_F06_LL_OTH(6)
 -9 7 -0.729014 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_2_F06_LL_OTH(6)
 -9 7 -1 0 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Val_3_F06_LL_OTH(6)
 -9 7 0.726971 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_4_F06_LL_OTH(6)
 -9 7 -1.59546 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_5_F06_LL_OTH(6)
# 7 F07_PS_NOR LenSelex
 0 2 0 0 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Code_F07_PS_NOR(7)
 -0.001 1 0.236421 0 0.001 1 3 0 0 0 0 0 0 0 # SizeSpline_GradLo_F07_PS_NOR(7)
 -1 0.001 -0.475462 0 0.001 1 3 0 0 0 0 0 0 0 # SizeSpline_GradHi_F07_PS_NOR(7)
 10 370 130.934 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_1_F07_PS_NOR(7)
 10 370 214.835 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_2_F07_PS_NOR(7)
 10 370 248.551 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_3_F07_PS_NOR(7)
 10 370 264.487 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_4_F07_PS_NOR(7)
 10 370 289.593 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_5_F07_PS_NOR(7)
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-9 7 -7.58596 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_1_F07_PS_NOR(7)
-9 7 -2.89497 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_2_F07_PS_NOR(7)
-9 7 -1 0 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Val_3_F07_PS_NOR(7)
-9 7 -0.463831 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_4_F07_PS_NOR(7)
-9 7 -3.36897 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_5_F07_PS_NOR(7)
# 8 F08_PS_HRV LenSelex
0 2 2 0 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Code_F08_PS_HRV(8)
-0.001 1 0.990685 0 0.001 1 3 0 0 0 0 0 0 0 # SizeSpline_GradLo_F08_PS_HRV(8)
-1 0.001 0.00080726 0 0.001 1 3 0 0 0 0 0 0 0 # SizeSpline_GradHi_F08_PS_HRV(8)
10 370 57.1865 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_1_F08_PS_HRV(8)
10 370 81.6006 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_2_F08_PS_HRV(8)
10 370 232.988 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_3_F08_PS_HRV(8)
-9 7 -8.42728 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_1_F08_PS_HRV(8)
-9 7 -1 0 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Val_2_F08_PS_HRV(8)
-9 7 -3.48928 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_3_F08_PS_HRV(8)
# 9 F09_PS_MED_6008 LenSelex
0 2 0 0 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Code_F09_PS_MED_6008(9)
-0.001 1 0.83421 0 0.001 1 3 0 0 0 0 0 0 0 # SizeSpline_GradLo_F09_PS_MED_6008(9)
-1 0.001 -0.199974 0 0.001 1 3 0 0 0 0 0 0 0 # SizeSpline_GradHi_F09_PS_MED_6008(9)
10 370 52.7621 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_1_F09_PS_MED_6008(9)
10 370 77.9775 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_2_F09_PS_MED_6008(9)
10 370 89.1766 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_3_F09_PS_MED_6008(9)
10 370 105.253 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_4_F09_PS_MED_6008(9)
10 370 238.096 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_5_F09_PS_MED_6008(9)
-9 7 -6.94673 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_1_F09_PS_MED_6008(9)
-9 7 -2.18852 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_2_F09_PS_MED_6008(9)
-9 7 -1 0 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Val_3_F09_PS_MED_6008(9)
-9 7 -1.42264 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_4_F09_PS_MED_6008(9)
-9 7 -6.41531 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_5_F09_PS_MED_6008(9)
# 10 F10_PS_MED_6008Q2 LenSelex
0 2 2 0 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Code_F10_PS_MED_6008Q2(10)
-0.001 1 0.0535416 0 0.001 1 3 0 0 0 0 0 0 0 # SizeSpline_GradLo_F10_PS_MED_6008Q2(10)
-1 0.001 -0.12291 0 0.001 1 3 0 0 0 0 0 0 0 # SizeSpline_GradHi_F10_PS_MED_6008Q2(10)
10 370 48.289 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_1_F10_PS_MED_6008Q2(10)
10 370 84.6438 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_2_F10_PS_MED_6008Q2(10)
10 370 96.2604 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_3_F10_PS_MED_6008Q2(10)
10 370 110.609 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_4_F10_PS_MED_6008Q2(10)
10 370 128.184 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_5_F10_PS_MED_6008Q2(10)
10 370 183.528 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_6_F10_PS_MED_6008Q2(10)
10 370 237.588 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_7_F10_PS_MED_6008Q2(10)
-9 7 -4.37629 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_1_F10_PS_MED_6008Q2(10)
-9 7 -1.89474 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_2_F10_PS_MED_6008Q2(10)
-9 7 -1.47961 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_3_F10_PS_MED_6008Q2(10)
-9 7 -1 0 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Val_4_F10_PS_MED_6008Q2(10)
-9 7 -1.62359 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_5_F10_PS_MED_6008Q2(10)
-9 7 -1.61801 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_6_F10_PS_MED_6008Q2(10)
-9 7 -0.927249 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_7_F10_PS_MED_6008Q2(10)
# 11 F11_PS_MED_0919 LenSelex
0 2 0 0 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Code_F11_PS_MED_0919(11)
-0.001 1 0.1551 0 0.001 1 3 0 0 0 0 0 0 0 # SizeSpline_GradLo_F11_PS_MED_0919(11)
-1 0.001 -0.104673 0 0.001 1 3 0 0 0 0 0 0 0 # SizeSpline_GradHi_F11_PS_MED_0919(11)
10 370 109.191 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_1_F11_PS_MED_0919(11)
10 370 171.805 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_2_F11_PS_MED_0919(11)
10 370 195.811 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_3_F11_PS_MED_0919(11)
10 370 246.915 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_4_F11_PS_MED_0919(11)
-9 7 -4.702 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_1_F11_PS_MED_0919(11)
-9 7 -2.23523 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_2_F11_PS_MED_0919(11)
-9 7 -1 0 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Val_3_F11_PS_MED_0919(11)
-9 7 -3.54053 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_4_F11_PS_MED_0919(11)
# 12 F12_PS_OTH LenSelex
0 2 2 0 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Code_F12_PS_OTH(12)
-0.001 1 0.0999006 0 0.001 1 3 0 0 0 0 0 0 0 # SizeSpline_GradLo_F12_PS_OTH(12)
-1 0.001 -0.300672 0 0.001 1 3 0 0 0 0 0 0 0 # SizeSpline_GradHi_F12_PS_OTH(12)
10 370 66.1992 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_1_F12_PS_OTH(12)
10 370 116.01 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_2_F12_PS_OTH(12)
10 370 148.231 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_3_F12_PS_OTH(12)
10 370 212.06 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_4_F12_PS_OTH(12)
10 370 271.086 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_5_F12_PS_OTH(12)
-9 7 -3.69984 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_1_F12_PS_OTH(12)
-9 7 -1.38722 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_2_F12_PS_OTH(12)
-9 7 -1 0 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Val_3_F12_PS_OTH(12)
-9 7 -0.147259 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_4_F12_PS_OTH(12)
-9 7 -3.68199 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_5_F12_PS_OTH(12)
# 13 F13_TP_5011 LenSelex
40 270 226.835 120 1000 0 2 0 0 0 0 0 0 0 # Size_DblN_peak_F13_TP_5011(13)
-10 3 -1 -1 1000 0 -2 0 0 0 0 0 0 0 # Size_DblN_top_logit_F13_TP_5011(13)
-5 12 7.47357 9 1000 0 2 0 0 0 0 0 0 0 # Size_DblN_ascend_se_F13_TP_5011(13)
-5 9 -4.7621 6.75 1000 0 2 0 0 0 0 0 0 0 # Size_DblN_descend_se_F13_TP_5011(13)
-999 15 -999 -1 5 0 -3 0 0 0 0 0 0 0 # Size_DblN_start_logit_F13_TP_5011(13)
-999 10 -999 2 100 0 -2 0 0 0 0 0 0 0 # Size_DblN_end_logit_F13_TP_5011(13)
# 14 F14_TP_1219 LenSelex
40 270 219.821 120 1000 0 2 0 0 0 0 0 0 0 # Size_DblN_peak_F14_TP_1219(14)
-10 3 -7.69353 -1 1000 0 2 0 0 0 0 0 0 0 # Size_DblN_top_logit_F14_TP_1219(14)
```

```
 -5 12 7.30887 9 1000 0 2 0 0 0 0 0 0 0 # Size_DblN_ascend_se_F14_TP_1219(14)
 -5 9 7.08992 6.75951 1000 0 2 0 0 0 0 0 0 0 # Size_DblN_descend_se_F14_TP_1219(14)
 -999 15 -999 -1 5 0 -3 0 0 0 0 0 0 0 # Size_DblN_start_logit_F14_TP_1219(14)
 -999 10 -999 2 100 0 -2 0 0 0 0 0 0 0 # Size_DblN_end_logit_F14_TP_1219(14)
# 15 F15_TP_OTH LenSelex
 0 2 0 0 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Code_F15_TP_OTH(15)
 -0.001 1 0.27394 0 0.001 1 3 0 0 0 0 0 0 0 # SizeSpline_GradLo_F15_TP_OTH(15)
 -1 0.001 -0.157404 0 0.001 1 3 0 0 0 0 0 0 0 # SizeSpline_GradHi_F15_TP_OTH(15)
 10 370 99.8517 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_1_F15_TP_OTH(15)
 10 370 165.575 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_2_F15_TP_OTH(15)
 10 370 262.472 190 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Knot_3_F15_TP_OTH(15)
 -9 7 -5.65268 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_1_F15_TP_OTH(15)
 -9 7 -1 0 1 0 -99 0 0 0 0 0 0 0 # SizeSpline_Val_2_F15_TP_OTH(15)
 -9 7 -3.01771 0 0.001 1 2 0 0 0 0 0 0 0 # SizeSpline_Val_3_F15_TP_OTH(15)
# 16 F16_OTH LenSelex
# 17 S1_MOR1 LenSelex
# 18 S2_MOR2 LenSelex
# 19 S3_SpBB1 LenSelex
# 20 S4_SPBB2 LenSelex
# 21 S5_JPLL_EM LenSelex
# 22 S6_NorPS LenSelex
# 23 S7_JPLL_NEA LenSelex
# 24 S8_LJPLL_NEA2 LenSelex
# 25 S9_LS LenSelex
# 26 S10_AS1 LenSelex
# 27 S11_AS2 LenSelex
# 1 F01_BB_5006 AgeSelex
# 2 F02_BB_0719 AgeSelex
# 3 F03_LL_JPN_E_MED AgeSelex
# 4 F04_LL_JPN_NE_7009 AgeSelex
# 5 F05_LL_JPN_NE_1019 AgeSelex
# 6 F06_LL_OTH AgeSelex
# 7 F07_PS_NOR AgeSelex
# 8 F08_PS_HRV AgeSelex
# 9 F09_PS_MED_6008 AgeSelex
# 10 F10_PS_MED_6008Q2 AgeSelex
# 11 F11_PS_MED_0919 AgeSelex
# 12 F12_PS_OTH AgeSelex
# 13 F13_TP_5011 AgeSelex
# 14 F14_TP_1219 AgeSelex
# 15 F15_TP_OTH AgeSelex
# 16 F16_OTH AgeSelex
# 17 S1_MOR1 AgeSelex
# 18 S2_MOR2 AgeSelex
# 19 S3_SpBB1 AgeSelex
# 20 S4_SPBB2 AgeSelex
# 21 S5_JPLL_EM AgeSelex
# 22 S6_NorPS AgeSelex
# 23 S7_JPLL_NEA AgeSelex
# 24 S8_LJPLL_NEA2 AgeSelex
# 25 S9_LS AgeSelex
# 26 S10_AS1 AgeSelex
 1 26 2 2 99 0 -99 0 0 0 0 0 0 0 # minage@sel=1_S10_AS1(26)
 1 26 4 4 99 0 -99 0 0 0 0 0 0 0 # maxage@sel=1_S10_AS1(26)
# 27 S11_AS2 AgeSelex
 1 26 2 2 99 0 -99 0 0 0 0 0 0 0 # minage@sel=1_S11_AS2(27)
 1 26 4 4 99 0 -99 0 0 0 0 0 0 0 # maxage@sel=1_S11_AS2(27)
#_No_Dirichlet parameters
#_no timevary selex parameters
#
0 # use 2D_AR1 selectivity(0/1)
#_no 2D_AR1 selex offset used
#
# Tag loss and Tag reporting parameters go next
0 # TG_custom: 0=no read and autogen if tag data exist; 1=read
#_Cond -6 6 1 1 2 0.01 -4 0 0 0 0 0 0 0 #_placeholder if no parameters
#
# no timevary parameters
#
#
# Input variance adjustments factors:
 #_1=add_to_survey_CV
 #_2=add_to_discard_stddev
 #_3=add_to_bodywt_CV
 #_4=mult_by_lencomp_N
 #_5=mult_by_agecomp_N
 #_6=mult_by_size-at-age_N
 #_7=mult_by_generalized_sizecomp
#_Factor Fleet Value
 4 1 0.0001
 5 1 0.01
 4 2 0.0001
 5 2 0.01
```

```
    4     3    0.0001
    5     3      0.01
    4     4    0.0001
    5     4      0.01
    4     5    0.0001
    5     5      0.01
    4     6    0.0001
    5     6      0.01
    4     7    0.0001
    5     7      0.01
    4     8    0.0001
    5     8      0.01
    4     9    0.0001
    5     9      0.01
    4    10    0.0001
    5    10      0.01
    4    11    0.0001
    5    11      0.01
    4    12    0.0001
    5    12      0.01
    4    13    0.0001
    5    13      0.01
    4    14    0.0001
    5    14      0.01
    4    15    0.0001
    5    15      0.01
    4    16    0.0001
    5    16      0.01
    4    17    0.0001
    5    17      0.01
    4    18    0.0001
    5    18      0.01
    4    19    0.0001
    5    19      0.01
    4    20    0.0001
    5    20      0.01
    4    21    0.0001
    5    21      0.01
    4    22    0.0001
    5    22      0.01
    4    23    0.0001
    5    23      0.01
    4    24    0.0001
    5    24      0.01
    4    25    0.0001
    5    25      0.01
    4    26    0.0001
    5    26      0.01
    4    27    0.0001
    5    27      0.01
 -9999   1    0  # terminator
#
4 #_maxlambdaphase
1 #_sd_offset; must be 1 if any growthCV, sigmaR, or survey extraSD is an estimated parameter
# read 47 changes to default Lambdas (default value is 1.0)
# Like_comp codes:  1=surv; 2=disc; 3=mnwt; 4=length; 5=age; 6=SizeFreq; 7=sizeage; 8=catch; 9=init_equ_catch;
# 10=recrdev; 11=parm_prior; 12=parm_dev; 13=CrashPen; 14=Morphcomp; 15=Tag-comp; 16=Tag-negbin; 17=F_ballpark; 18=initEQregime
#like_comp fleet  phase  value  sizefreq_method
 1 17 1 1 1
 1 18 1 1 1
 1 19 1 1 1
 1 20 1 1 1
 1 21 1 1 1
 1 22 1 0 1
 1 23 1 1 1
 1 24 1 1 1
 1 25 1 1 1
 1 26 1 1 1
 1 27 1 1 1
 4 1 1 1 1
 5 1 1 1 1
 4 2 1 1 1
 5 2 1 1 1
 4 3 1 1 1
 5 3 1 1 1
 4 4 1 1 1
 5 4 1 1 1
 4 5 1 1 1
 5 5 1 1 1
 4 6 1 1 1
 5 6 1 1 1
 4 7 1 1 1
 5 7 1 1 1
```

```
 4 8 1 1 1
 5 8 1 1 1
 4 9 1 1 1
 5 9 1 1 1
 4 10 1 1 1
 5 10 1 1 1
 4 11 1 1 1
 5 11 1 1 1
 4 12 1 1 1
 5 12 1 1 1
 4 13 1 1 1
 5 13 1 1 1
 4 14 1 1 1
 5 14 1 1 1
 4 15 1 1 1
 5 15 1 1 1
 4 15 1 1 1
 5 15 1 1 1
 4 16 1 1 1
 5 16 1 1 1
 11 1 1 1 1
 12 1 1 1 1
-9999  1  1  1  1  #  terminator
#
0 # (0/1/2) read specs for more stddev reporting: 0 = skip, 1 = read specs for reporting stdev for selectivity, size, and numbers, 2 = add options for M,Dyn. Bzero, SmryBio
 # 0 2 0 0 # Selectivity: (1) fleet, (2) 1=len/2=age/3=both, (3) year, (4) N selex bins
 # 0 0 # Growth: (1) growth pattern, (2) growth ages
 # 0 0 0 # Numbers-at-age: (1) area(-1 for all), (2) year, (3) N ages
 # -1 # list of bin #'s for selex std (-1 in first bin to self-generate)
 # -1 # list of ages for growth std (-1 in first bin to self-generate)
 # -1 # list of ages for NatAge std (-1 in first bin to self-generate)
999
```