Appendix D: GMACS

Introduction

Implementation of Aleutian Islands golden king crab stock assessment in GMACS started in 2020 and great progress has been made since then.

Method
The model 21.1e2 (with three catchability, three additional SDs, and a knife-edge maturity size of 116 mm CL) was implemented in GMACS with the following modifications to suit GMACS estimation formulas:

1. Modified model 21.9c:
   (a) Retained and total catch size composition likelihood formulas were changed from robust normal to multinomial;
   (b) Lognormal retained catch biomass likelihood used a CV of 0.0316 for the weight 500 as in 21.1e2, and an emphasis factor 4;
   (c) Lognormal total catch biomass likelihood used a variable CV scaled by number of annual observer sampled pots with a maximum weight of 250 as in 21.1e2, and an emphasis factor 2;
   (d) Lognormal groundfish bycatch biomass likelihood used a CV of 1.3108 for the weight 0.5 as in 21.1e2, without any emphasis factor; and
   (e) Recruitment, fishing mortality and bycatch mortality deviations, and tag-release-recapture likelihood formulas were kept the same as in 21.1e2.

2. Estimated parameters from 21.9c were reparametrized to GMACS computation formula for recruitment, selectivity, growth, catchability, and fishing mortality estimation; and the reparametrized values were used as initial values in the GMACS .ctl file. Parallel .dat and .prj files were created for GMACS runs. The files were named as: GMACS9cEAG21.1e2CatchNo.ctl, GMACS9cEAG21.1e2CatchNo.dat, and GMACS9cEAG21.1e2CatchNo.prj; GMACS9cWAG21.1e2CatchNo.ctl, GMACS9cWAG21.1e2CatchNo.dat, and GMACS9cWAG21.1e2CatchNo.prj.

Implementation of the Year:Area interaction CPUE model has the same GMACS files format but 21,1e2 replaced by 21.1f with dat file selecting Year:Area interaction CPUE indices (e.g., GMACS9cEAG21.1fCatchNo.ctl).

The likelihood values, time series of abundance (i.e., N- matrix), MMB, and CPUE were compared between the status quo and GMACS estimated (GMACS_EST) models.

Management reference points for core models, 21.1e2 and 21.1f (Year:Area interaction CPUE), were also estimated by GMACS for comparing them with the status quo model results.

Results

The likelihoods (Tables D.1 and D.2) and N matrices (Tables D.4 and D.5) compared satisfactorily between the status quo and GMACS models. N matrices were restricted to 1981–2022 as the catch removal started in 1981.

The MMB (Figures D.1 and D.2) and CPUE (Figures D.3 and D.4) trends compared well among the status quo model 21.1e2, modified status quo model (21.9c), and GMACS model (GMACS_EST). The management reference points compared satisfactorily among the selected models and their GMACS counterparts for EAG, WAG, and AI (Table D.3).

Table D.1. Comparison of likelihood values among status quo (model 21.1e2 with three catchability and SDs, and knife-edge maturity size 116 mm CL), modified model 21.1e2 (i.e., model 21.9c), and GMACS model for EAG. The significant difference between the Status Quo Model and the modified 21.1e2 model is the size composition likelihood formulation: in the original model it is robust normal (it contributes a large chunk of likelihood value) whereas in the modified model, it is multinomial.

	Status Quo Model	modified 21.1e2 model	EAG21.9c Par. created input values
Likelihood Components:	EAG21.1e2	EAG21.9c	GMACS_EST
like_retlencomp	-2155.9400	278.4790	278.4738
like_totallencomp	-1387.6600	494.5800	494.6160
like_gdiscdlencomp			
like_retcpue	-30.7872	-31.1845	-31.0992
like_fishtickcpue	-15.0060	-15.7200	-15.6589
like_retdcatchB	4.3596	-411.6710	-411.6809
like_totalcatchB	15.8541	-40.1716	-40.1883
like_gdiscdcatchB	0.0003	29.4059	29.4059
like_rec_dev	22.2110	22.3041	20.3758
like_F	0.0135	0.0136	
like_gF	0.0229	0.0230	
			0.0366
like_Llyr (Tagging data likelihood)	2693.2100	2700.9600	2700.9531
like_fpen (posfunction)	0.00000002	0.00000002	
Total Likelihood	-853.7190	3027.0200	3050.9583
Reference Points:			
B_{MSY} (B_{35})	6523.9400	6665.3100	6713.2159
CurrB/B_{35}	1.1565	1.1484	1.1442
F_{35}	0.5600	0.5900	0.5815
F_{ofl} (directed fishery)	0.5600	0.5900	0.5815
F_{ofl} (groundfish byc)	0.00035	0.00035	0.00038
OFL	2898.3700	3024.7500	2989.7297
R_0 (millions)	2.3937	2.4302	2.7557

Table D.2. Comparison of likelihood values among status quo (model 21.1e2 with three catchability and SDs, and knife-edge maturity size 116 mm CL), modified model 21.1e2 (i.e., model 21.9c), and GMACS model for WAG. The significant difference between the Status Quo Model and the modified 21.1e2 model is the size composition likelihood formulation: in the original model it is robust normal (it contributes a large chunk of likelihood value) whereas in the modified model, it is multinomial.

	Status Quo Model	modified 21.1e2 model	WAG21.9c Par. created input values
Likelihood Components:	WAG21.1e2	WAG21.9c	GMACS_EST
like_retlencomp	-2109.4400	361.1050	361.2287
like_totallencomp	-1530.8700	426.6030	426.7466
like_gdiscdlencomp			
like_retcpue	-48.0187	-44.0913	-43.9358
like_fishtickcpue	-19.4746	-19.8691	-20.0301
like_retdcatchB	5.2842	-410.3630	-410.3610
like_totalcatchB	52.7969	15.7192	15.7028
like_gdiscdcatchB	0.0011	29.4073	29.4073
like_rec_dev	20.8360	20.7853	18.8745
like_F	0.0256	0.0264	
like_gF	0.0431	0.0425	
like_Llyr (Tagging data likelihood)	2694.4000	2705.0600	0.0689 2705.036
like_fpen (posfunction)	0.00000002	0.00000002	
Total Likelihood	-934.4120	3084.4300	3107.7685
Reference Points:			
B_{MSY} (B_{35})	4905.1100	4983.2000	5013.8470
CurrB/B_{35}	1.0013	1.0040	1.0060
F_{35}	0.5400	0.5500	0.5434
F_{ofl} (directed fishery)	0.5400	0.5500	0.5434
F_{ofl} (groundfish byc)	0.00056	0.00055	0.00055
OFL	1339.5400	1414.4800	1411.5386
R_0 (millions)	2.0606	2.0541	2.3271

Table D.3. Comparison of reference points among 21.1e2 and 21.1f models and their GMACS counterparts (subsequent row values) for EAG, WAG and AI (sum of EAG and WAG values).

EAG: Biomass, OFL, and ABC are in t. Current MMB = MMB in 2022.

Model	Tier	$MMB_{35\%}$	Current MMB	MMB/ $MMB_{35\%}$	F_{OFL}	$F_{35\%}$	M(yr^{-1})	OFL	ABC (0.75*OFL)
21.1e2	3a	6,524	7,545	1.16	0.56	0.56	0.22	2,898	2,174
GMACS	3a	6,713	7,681	1.14	0.58	0.58	0.22	2,990	2,242
21.1f	3a	6,523	7,591	1.16	0.56	0.56	0.22	2,918	2,188
GMACS	3a	6,739	7,836	1.16	0.57	0.57	0.22	3,045	2,284

WAG: Biomass, OFL, and ABC are in t. Current MMB = MMB in 2022.

Model	Tier	$MMB_{35\%}$	Current MMB	MMB/ $MMB_{35\%}$	F_{OFL}	$F_{35\%}$	M(yr^{-1})	OFL	ABC (0.75*OFL)
21.1e2	3a	4,905	4,911	1.00	0.54	0.54	0.22	1,340	1,005
GMACS	3a	5,014	5,044	1.01	0.54	0.54	0.22	1,412	1,059
21.1f	3a	4,911	5,175	1.05	0.54	0.54	0.22	1,452	1,089
GMACS	3a	5,052	5,412	1.07	0.53	0.53	0.22	1,550	1,163

AI: OFL and ABC are in t.

Model	OFL	ABC (0.75*OFL)
21.1e2	4,238	3,179
GMACS	4,402	3,301
21.1f	4,370	3,277
GMACS	4,595	3,447

Table D.4. N-Matrix for predicted abundance during 1981–2022 for EAG.

21.9c Nmatrix:

Mid CL/ Year	103	108	113	118	123	128	133	138	143	148	153	158	163	168	173	178	183
1981	0.4576	0.5108	0.5580	0.7036	0.7955	0.5839	0.7181	0.7792	0.7698	0.8377	0.8748	0.8502	0.7814	0.6435	0.4643	0.2894	0.2536
1982	0.4727	0.5272	0.5737	0.7167	0.8042	0.5803	0.7084	0.7599	0.7412	0.7987	0.8285	0.8032	0.7389	0.6099	0.4413	0.2757	0.2423
1983	0.4964	0.5533	0.6002	0.7441	0.8290	0.5871	0.7075	0.7424	0.7043	0.7393	0.7494	0.7157	0.6540	0.5386	0.3896	0.2435	0.2144
1984	0.5198	0.5794	0.6282	0.7779	0.8644	0.6064	0.7219	0.7411	0.6810	0.6896	0.6741	0.6252	0.5609	0.4574	0.3293	0.2055	0.1808
1985	0.4816	0.5384	0.5930	0.7595	0.8627	0.6295	0.7441	0.7509	0.6701	0.6522	0.6083	0.5398	0.4688	0.3742	0.2660	0.1649	0.1447
1986	0.3182	0.3593	0.4176	0.5953	0.7243	0.6001	0.7223	0.7277	0.6388	0.5940	0.5183	0.4303	0.3544	0.2720	0.1883	0.1148	0.0996
1987	0.4879	0.5398	0.5625	0.6379	0.6772	0.4554	0.5917	0.6254	0.5692	0.5200	0.4261	0.3277	0.2508	0.1808	0.1195	0.0707	0.0599
1988	1.3073	1.4360	1.4321	1.4256	1.3093	0.5281	0.5964	0.5750	0.4987	0.4625	0.3840	0.2887	0.2084	0.1400	0.0870	0.0492	0.0402
1989	0.3820	0.4486	0.6184	1.1104	1.4285	1.1570	1.0943	0.8341	0.5165	0.3793	0.2817	0.1971	0.1350	0.0852	0.0493	0.0262	0.0201
1990	0.7192	0.7935	0.8169	0.9074	0.9739	0.7021	0.9358	0.9156	0.6937	0.4532	0.2400	0.1191	0.0659	0.0368	0.0193	0.0094	0.0066
1991	0.7445	0.8289	0.8926	1.0831	1.1703	0.7581	0.8541	0.8003	0.6571	0.5283	0.3420	0.1814	0.0863	0.0374	0.0157	0.0066	0.0041
1992	0.6564	0.7338	0.8088	1.0358	1.1673	0.8261	0.9262	0.8397	0.6420	0.4950	0.3271	0.1859	0.0952	0.0414	0.0155	0.0054	0.0026
1993	0.5192	0.5822	0.6530	0.8696	1.0135	0.7781	0.9074	0.8452	0.6570	0.4987	0.3193	0.1774	0.0911	0.0403	0.0151	0.0049	0.0019
1994	0.5752	0.6401	0.6888	0.8416	0.9354	0.6734	0.8273	0.8232	0.6920	0.5639	0.3839	0.2222	0.1157	0.0513	0.0192	0.0062	0.0022
1995	0.6056	0.6743	0.7267	0.8872	0.9724	0.6617	0.7726	0.7418	0.6174	0.5167	0.3658	0.2213	0.1199	0.0547	0.0208	0.0067	0.0024
1996	0.4508	0.5063	0.5719	0.7705	0.8973	0.6781	0.7721	0.7118	0.5601	0.4460	0.3060	0.1842	0.1018	0.0478	0.0187	0.0062	0.0022
1997	0.7141	0.7894	0.8183	0.9128	0.9458	0.5839	0.7134	0.6993	0.5770	0.4643	0.3168	0.1888	0.1036	0.0489	0.0194	0.0065	0.0023
1998	0.7055	0.7865	0.8529	1.0509	1.1443	0.7409	0.8030	0.7233	0.5637	0.4614	0.3289	0.2018	0.1118	0.0528	0.0211	0.0072	0.0026
1999	0.6617	0.7391	0.8102	1.0268	1.1533	0.8136	0.9204	0.8471	0.6489	0.5075	0.3517	0.2146	0.1207	0.0583	0.0237	0.0081	0.0030
2000	0.7455	0.8293	0.8899	1.0774	1.1801	0.8062	0.9487	0.9150	0.7400	0.5994	0.4213	0.2562	0.1428	0.0690	0.0283	0.0099	0.0037
2001	0.4619	0.5228	0.6130	0.8849	1.0731	0.8665	0.9994	0.9621	0.7923	0.6689	0.4927	0.3111	0.1770	0.0863	0.0355	0.0124	0.0047
2002	0.5872	0.6521	0.6942	0.8308	0.9223	0.6808	0.8835	0.9355	0.8358	0.7351	0.5584	0.3658	0.2157	0.1084	0.0456	0.0162	0.0063
2003	0.4567	0.5130	0.5787	0.7772	0.9063	0.6931	0.8266	0.8511	0.7817	0.7413	0.6093	0.4263	0.2633	0.1370	0.0595	0.0217	0.0086
2004	0.3727	0.4183	0.4711	0.6349	0.7547	0.6141	0.7695	0.8127	0.7519	0.7186	0.6100	0.4505	0.2952	0.1621	0.0736	0.0278	0.0114
2005	0.7065	0.7794	0.7979	0.8610	0.8702	0.5115	0.6579	0.7188	0.6939	0.6865	0.6011	0.4600	0.3141	0.1806	0.0860	0.0340	0.0146
2006	0.5713	0.6410	0.7181	0.9453	1.0707	0.7419	0.7994	0.7513	0.6423	0.6228	0.5584	0.4399	0.3101	0.1850	0.0919	0.0379	0.0172

2007	0.4642	0.5213	0.5885	0.7958	0.9425	0.7474	0.8920	0.8803	0.7325	0.6458	0.5356	0.4077	0.2896	0.1779	0.0915	0.0391	0.0186
2008	0.6178	0.6856	0.7260	0.8547	0.9291	0.6455	0.8172	0.8629	0.7742	0.7033	0.5706	0.4146	0.2840	0.1726	0.0898	0.0394	0.0196
2009	0.5467	0.6120	0.6785	0.8786	0.9987	0.7216	0.8387	0.8406	0.7437	0.6966	0.5828	0.4269	0.2883	0.1719	0.0885	0.0390	0.0199
2010	0.4657	0.5222	0.5847	0.7768	0.9092	0.7090	0.8581	0.8727	0.7639	0.6992	0.5793	0.4256	0.2888	0.1718	0.0880	0.0387	0.0199
2011	0.4564	0.5099	0.5599	0.7157	0.8225	0.6321	0.7934	0.8382	0.7635	0.7123	0.5914	0.4329	0.2924	0.1734	0.0886	0.0389	0.0201
2012	0.4363	0.4876	0.5364	0.6867	0.7852	0.5920	0.7324	0.7743	0.7183	0.6892	0.5860	0.4358	0.2960	0.1753	0.0893	0.0391	0.0202
2013	0.4220	0.4715	0.5179	0.6608	0.7537	0.5639	0.6931	0.7264	0.6693	0.6445	0.5547	0.4196	0.2892	0.1728	0.0883	0.0387	0.0200
2014	0.5078	0.5645	0.6032	0.7236	0.7901	0.5424	0.6629	0.6885	0.6270	0.5985	0.5135	0.3900	0.2712	0.1637	0.0844	0.0371	0.0193
2015	0.6778	0.7518	0.7929	0.9191	0.9692	0.6016	0.6984	0.6908	0.5999	0.5583	0.4727	0.3563	0.2477	0.1502	0.0779	0.0345	0.0180
2016	0.6923	0.7721	0.8391	1.0403	1.1440	0.7623	0.8436	0.7835	0.6241	0.5407	0.4349	0.3155	0.2151	0.1296	0.0672	0.0299	0.0157
2017	0.7597	0.8461	0.9133	1.1192	1.2323	0.8407	0.9662	0.9134	0.7187	0.5871	0.4362	0.2926	0.1890	0.1104	0.0564	0.0249	0.0131
2018	0.9165	1.0186	1.0868	1.2960	1.3987	0.9163	1.0584	1.0119	0.8103	0.6653	0.4831	0.3075	0.1860	0.1024	0.0500	0.0216	0.0112
2019	0.6807	0.7661	0.8731	1.1951	1.4036	1.0675	1.2072	1.1326	0.8931	0.7296	0.5265	0.3286	0.1913	0.1000	0.0462	0.0190	0.0095
2020	0.5454	0.6129	0.6946	0.9489	1.1402	0.9454	1.1732	1.1821	0.9866	0.8134	0.5782	0.3541	0.2014	0.1018	0.0450	0.0176	0.0083
2021	0.4633	0.5197	0.5833	0.7820	0.9323	0.7749	1.0013	1.0729	0.9782	0.8752	0.6612	0.4214	0.2416	0.1202	0.0516	0.0194	0.0087
2022	0.5465	0.6079	0.6521	0.7917	0.8805	0.6451	0.8359	0.9160	0.8759	0.8360	0.6778	0.4635	0.2797	0.1430	0.0616	0.0229	0.0098

Ratio of 21_9c and GMACS_EST Nmatrix for EAG

1981	1.0016	1.0017	1.0017	1.0017	1.0018	1.0019	1.0020	1.0021	1.0021	1.0021	1.0021	1.0019	1.0013	0.9994	0.9957	0.9895	0.9745
1982	1.0013	1.0014	1.0014	1.0014	1.0015	1.0017	1.0018	1.0018	1.0019	1.0020	1.0020	1.0019	1.0015	1.0001	0.9971	0.9919	0.9786
1983	1.0005	1.0006	1.0006	1.0008	1.0010	1.0014	1.0015	1.0016	1.0017	1.0018	1.0019	1.0019	1.0016	1.0006	0.9982	0.9939	0.9821
1984	0.9983	0.9984	0.9986	0.9993	0.9998	1.0008	1.0010	1.0012	1.0014	1.0016	1.0017	1.0018	1.0017	1.0010	0.9991	0.9956	0.9853
1985	0.9996	0.9996	0.9994	0.9991	0.9990	0.9992	0.9997	1.0003	1.0009	1.0013	1.0015	1.0017	1.0017	1.0013	0.9999	0.9970	0.9881
1986	1.0012	1.0011	1.0008	1.0002	0.9999	0.9993	0.9993	0.9994	0.9999	1.0004	1.0010	1.0014	1.0016	1.0014	1.0004	0.9982	0.9905
1987	1.0008	1.0008	1.0008	1.0008	1.0007	1.0003	0.9999	0.9996	0.9995	0.9997	1.0002	1.0008	1.0012	1.0014	1.0008	0.9991	0.9926
1988	0.9999	0.9999	0.9999	1.0000	1.0002	1.0007	1.0005	1.0003	0.9999	0.9998	0.9999	1.0002	1.0007	1.0010	1.0009	0.9998	0.9945
1989	0.9990	0.9991	0.9993	0.9996	0.9998	1.0000	1.0001	1.0002	1.0003	1.0002	1.0000	1.0001	1.0003	1.0007	1.0008	1.0002	0.9962
1990	0.9997	0.9997	0.9997	0.9996	0.9995	0.9996	0.9998	0.9999	1.0001	1.0002	1.0003	1.0004	1.0005	1.0007	1.0010	1.0010	0.9984
1991	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997	0.9996	0.9997	0.9998	1.0000	1.0002	1.0003	1.0005	1.0007	1.0011	1.0017	1.0006
1992	0.9996	0.9997	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997	0.9998	0.9999	1.0001	1.0003	1.0005	1.0010	1.0020	1.0029
1993	1.0001	1.0001	1.0000	0.9998	0.9998	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997	0.9999	1.0002	1.0006	1.0018	1.0044

1994	1.0002	1.0002	1.0002	1.0001	1.0001	0.9999	0.9997	0.9996	0.9996	0.9995	0.9995	0.9995	0.9996	0.9998	1.0002	1.0013	1.0044
1995	0.9999	1.0000	1.0000	1.0000	1.0001	1.0001	1.0000	0.9998	0.9997	0.9995	0.9994	0.9993	0.9994	0.9995	0.9998	1.0008	1.0038
1996	0.9998	0.9998	0.9998	0.9998	0.9999	1.0000	1.0000	0.9999	0.9998	0.9996	0.9994	0.9992	0.9992	0.9992	0.9995	1.0004	1.0035
1997	0.9995	0.9995	0.9995	0.9995	0.9996	0.9998	0.9998	0.9998	0.9998	0.9997	0.9996	0.9994	0.9993	0.9992	0.9994	1.0003	1.0032
1998	0.9992	0.9992	0.9992	0.9993	0.9993	0.9995	0.9996	0.9996	0.9997	0.9997	0.9996	0.9995	0.9994	0.9994	0.9995	1.0003	1.0030
1999	0.9995	0.9995	0.9994	0.9993	0.9993	0.9993	0.9993	0.9994	0.9995	0.9995	0.9995	0.9995	0.9995	0.9995	0.9996	1.0003	1.0027
2000	0.9994	0.9994	0.9994	0.9994	0.9994	0.9994	0.9993	0.9993	0.9992	0.9993	0.9993	0.9993	0.9994	0.9994	0.9996	1.0002	1.0023
2001	0.9992	0.9992	0.9992	0.9993	0.9993	0.9994	0.9993	0.9993	0.9992	0.9991	0.9991	0.9991	0.9992	0.9992	0.9994	1.0000	1.0018
2002	0.9993	0.9993	0.9993	0.9992	0.9992	0.9992	0.9992	0.9992	0.9992	0.9991	0.9990	0.9990	0.9990	0.9991	0.9992	0.9997	1.0012
2003	0.9998	0.9998	0.9996	0.9995	0.9994	0.9993	0.9992	0.9992	0.9991	0.9990	0.9990	0.9989	0.9989	0.9990	0.9991	0.9995	1.0007
2004	0.9998	0.9998	0.9997	0.9997	0.9997	0.9995	0.9994	0.9992	0.9991	0.9990	0.9989	0.9988	0.9988	0.9989	0.9990	0.9993	1.0003
2005	0.9999	0.9999	0.9999	0.9998	0.9998	0.9997	0.9995	0.9994	0.9992	0.9990	0.9989	0.9988	0.9987	0.9988	0.9989	0.9992	0.9999
2006	0.9994	0.9995	0.9995	0.9996	0.9997	0.9999	0.9998	0.9996	0.9994	0.9991	0.9989	0.9987	0.9986	0.9986	0.9987	0.9990	0.9996
2007	0.9994	0.9994	0.9994	0.9994	0.9995	0.9996	0.9996	0.9997	0.9996	0.9993	0.9990	0.9987	0.9986	0.9985	0.9985	0.9987	0.9993
2008	1.0000	1.0000	0.9999	0.9997	0.9996	0.9994	0.9995	0.9995	0.9995	0.9994	0.9992	0.9989	0.9987	0.9985	0.9985	0.9986	0.9991
2009	1.0002	1.0003	1.0002	1.0001	1.0000	0.9998	0.9997	0.9995	0.9994	0.9993	0.9992	0.9990	0.9988	0.9986	0.9985	0.9986	0.9990
2010	0.9999	0.9999	0.9999	1.0000	1.0001	1.0001	0.9999	0.9998	0.9996	0.9994	0.9992	0.9990	0.9988	0.9986	0.9985	0.9986	0.9990
2011	0.9997	0.9998	0.9997	0.9998	0.9999	1.0000	1.0000	0.9999	0.9998	0.9996	0.9993	0.9991	0.9989	0.9987	0.9986	0.9986	0.9990
2012	0.9996	0.9997	0.9996	0.9997	0.9997	0.9998	0.9998	0.9999	0.9998	0.9997	0.9995	0.9993	0.9990	0.9988	0.9987	0.9988	0.9990
2013	0.9999	0.9999	0.9998	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9995	0.9994	0.9992	0.9990	0.9989	0.9989	0.9991
2014	1.0001	1.0001	1.0000	0.9999	0.9999	0.9998	0.9997	0.9997	0.9996	0.9996	0.9995	0.9994	0.9992	0.9991	0.9990	0.9990	0.9993
2015	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9998	0.9997	0.9996	0.9995	0.9994	0.9992	0.9991	0.9990	0.9991	0.9994
2016	0.9999	0.9999	0.9999	0.9999	0.9999	1.0000	0.9999	0.9999	0.9998	0.9996	0.9995	0.9993	0.9992	0.9991	0.9990	0.9991	0.9994
2017	1.0003	1.0003	1.0002	1.0001	1.0000	0.9999	0.9999	0.9999	0.9998	0.9997	0.9996	0.9994	0.9992	0.9990	0.9990	0.9991	0.9995
2018	1.0005	1.0005	1.0004	1.0003	1.0003	1.0001	1.0000	1.0000	0.9999	0.9998	0.9997	0.9995	0.9993	0.9991	0.9990	0.9992	0.9996
2019	1.0007	1.0007	1.0006	1.0005	1.0005	1.0004	1.0003	1.0002	1.0000	0.9999	0.9997	0.9996	0.9994	0.9992	0.9991	0.9993	0.9998
2020	1.0008	1.0009	1.0008	1.0007	1.0007	1.0006	1.0005	1.0004	1.0002	1.0001	1.0000	0.9998	0.9996	0.9995	0.9994	0.9995	1.0001
2021	1.0006	1.0006	1.0006	1.0007	1.0007	1.0007	1.0006	1.0006	1.0004	1.0003	1.0002	1.0001	0.9999	0.9998	0.9997	0.9999	1.0005
2022	1.0006	1.0006	1.0006	1.0006	1.0006	1.0007	1.0007	1.0007	1.0006	1.0005	1.0005	1.0004	1.0003	1.0002	1.0002	1.0003	1.0009

Table D.5. N-Matrix for predicted abundance during 1981–2022 for WAG.

21.9c Nmatrix:

Mid CL/ Year	103	108	113	118	123	128	133	138	143	148	153	158	163	168	173	178	183
1981	0.4986	0.6139	0.6601	0.7660	0.8202	0.6440	0.7378	0.7616	0.7321	0.7523	0.7453	0.7000	0.6314	0.5256	0.3970	0.2679	0.2918
1982	0.5294	0.6514	0.6983	0.8042	0.8549	0.6631	0.7555	0.7743	0.7388	0.7548	0.7442	0.6965	0.6268	0.5210	0.3932	0.2652	0.2888
1983	0.5835	0.7169	0.7636	0.8655	0.9059	0.6840	0.7654	0.7506	0.6817	0.6590	0.6139	0.5516	0.4839	0.3948	0.2937	0.1959	0.2112
1984	0.6970	0.8544	0.9006	0.9932	1.0127	0.7299	0.7982	0.7486	0.6429	0.5777	0.4930	0.4105	0.3402	0.2663	0.1924	0.1257	0.1330
1985	0.8065	0.9897	1.0477	1.1667	1.1956	0.8590	0.9238	0.8680	0.7416	0.6654	0.5626	0.4519	0.3565	0.2672	0.1872	0.1201	0.1250
1986	0.8745	1.0746	1.1451	1.2965	1.3468	0.9861	1.0529	0.9630	0.7914	0.6757	0.5397	0.4089	0.3046	0.2154	0.1433	0.0882	0.0885
1987	0.6674	0.8280	0.9226	1.1575	1.2958	1.0470	1.1066	0.9569	0.7330	0.5515	0.3688	0.2378	0.1563	0.0990	0.0597	0.0339	0.0315
1988	0.4576	0.5708	0.6523	0.8680	1.0289	0.9234	1.0505	0.9657	0.7746	0.5774	0.3621	0.2090	0.1189	0.0646	0.0340	0.0174	0.0144
1989	0.5356	0.6572	0.6975	0.7902	0.8454	0.6969	0.8444	0.8190	0.7042	0.5503	0.3494	0.1969	0.1036	0.0494	0.0221	0.0097	0.0067
1990	0.4212	0.5214	0.5763	0.7111	0.7885	0.6402	0.6978	0.6068	0.4901	0.3676	0.2188	0.1165	0.0582	0.0255	0.0100	0.0037	0.0019
1991	0.3123	0.3881	0.4364	0.5613	0.6483	0.5634	0.6351	0.5704	0.4577	0.3356	0.1984	0.1054	0.0518	0.0218	0.0080	0.0027	0.0011
1992	0.3571	0.4382	0.4655	0.5275	0.5605	0.4510	0.5322	0.5025	0.4236	0.3242	0.1994	0.1083	0.0531	0.0221	0.0080	0.0025	0.0009
1993	0.5273	0.6432	0.6630	0.6891	0.6666	0.4465	0.4954	0.4578	0.3883	0.3150	0.2115	0.1241	0.0642	0.0277	0.0102	0.0032	0.0011
1994	0.4409	0.5456	0.5996	0.7266	0.7861	0.5934	0.6044	0.5231	0.4136	0.3358	0.2400	0.1518	0.0848	0.0396	0.0156	0.0052	0.0019
1995	0.4532	0.5575	0.5979	0.6907	0.7350	0.5683	0.6191	0.5429	0.4133	0.2962	0.1814	0.1033	0.0564	0.0269	0.0110	0.0038	0.0014
1996	0.3849	0.4761	0.5230	0.6374	0.7030	0.5658	0.6149	0.5451	0.4276	0.3155	0.1929	0.1048	0.0531	0.0238	0.0094	0.0033	0.0013
1997	0.4371	0.5364	0.5693	0.6411	0.6711	0.5150	0.5804	0.5317	0.4302	0.3243	0.2019	0.1110	0.0558	0.0243	0.0092	0.0031	0.0012
1998	0.4417	0.5436	0.5833	0.6723	0.7095	0.5365	0.5817	0.5235	0.4245	0.3316	0.2172	0.1249	0.0644	0.0283	0.0107	0.0035	0.0013
1999	0.5303	0.6499	0.6848	0.7552	0.7708	0.5584	0.6099	0.5556	0.4510	0.3562	0.2413	0.1448	0.0781	0.0358	0.0140	0.0047	0.0017
2000	0.5737	0.7046	0.7493	0.8438	0.8703	0.6290	0.6631	0.5813	0.4556	0.3523	0.2354	0.1408	0.0770	0.0362	0.0146	0.0050	0.0019
2001	0.5510	0.6789	0.7332	0.8575	0.9129	0.6917	0.7309	0.6354	0.4867	0.3622	0.2319	0.1341	0.0722	0.0339	0.0137	0.0048	0.0019
2002	0.6138	0.7536	0.8008	0.9028	0.9399	0.7023	0.7661	0.6879	0.5414	0.4070	0.2601	0.1481	0.0780	0.0359	0.0144	0.0050	0.0020
2003	0.3370	0.4243	0.5027	0.7104	0.8576	0.7566	0.8155	0.7347	0.5881	0.4583	0.3055	0.1792	0.0952	0.0437	0.0174	0.0060	0.0024
2004	0.5041	0.6157	0.6401	0.6889	0.7113	0.5670	0.7060	0.7157	0.6273	0.5104	0.3512	0.2133	0.1171	0.0552	0.0223	0.0078	0.0030
2005	0.5470	0.6718	0.7142	0.8033	0.8292	0.6068	0.6670	0.6360	0.5653	0.4989	0.3757	0.2451	0.1410	0.0689	0.0287	0.0102	0.0041
2006	0.5332	0.6574	0.7114	0.8356	0.8950	0.6867	0.7420	0.6818	0.5664	0.4802	0.3639	0.2476	0.1519	0.0795	0.0352	0.0132	0.0055

2007	0.4991	0.6164	0.6720	0.8054	0.8824	0.7091	0.7898	0.7447	0.6220	0.5200	0.3886	0.2633	0.1647	0.0897	0.0419	0.0166	0.0074
2008	0.3501	0.4368	0.4984	0.6594	0.7762	0.6858	0.7831	0.7572	0.6491	0.5499	0.4111	0.2769	0.1730	0.0955	0.0457	0.0188	0.0089
2009	0.3921	0.4821	0.5166	0.5989	0.6544	0.5541	0.6826	0.7062	0.6438	0.5664	0.4335	0.2964	0.1867	0.1037	0.0503	0.0211	0.0104
2010	0.4129	0.5080	0.5448	0.6280	0.6694	0.5268	0.6121	0.6161	0.5695	0.5241	0.4196	0.2975	0.1918	0.1081	0.0531	0.0226	0.0114
2011	0.2952	0.3679	0.4174	0.5443	0.6308	0.5412	0.6088	0.5893	0.5228	0.4729	0.3821	0.2785	0.1855	0.1077	0.0540	0.0234	0.0121
2012	0.3855	0.4722	0.4967	0.5492	0.5744	0.4547	0.5496	0.5565	0.5005	0.4429	0.3484	0.2513	0.1689	0.1001	0.0515	0.0229	0.0122
2013	0.5017	0.6140	0.6416	0.6914	0.6905	0.4835	0.5347	0.5072	0.4432	0.3928	0.3076	0.2187	0.1453	0.0860	0.0447	0.0202	0.0111
2014	0.4610	0.5692	0.6194	0.7357	0.7891	0.5965	0.6218	0.5448	0.4304	0.3513	0.2591	0.1774	0.1157	0.0678	0.0352	0.0160	0.0089
2015	0.3979	0.4927	0.5436	0.6696	0.7482	0.6148	0.6769	0.6146	0.4850	0.3743	0.2548	0.1610	0.0992	0.0561	0.0286	0.0129	0.0073
2016	0.4031	0.4968	0.5371	0.6331	0.6910	0.5649	0.6517	0.6224	0.5193	0.4144	0.2824	0.1723	0.0998	0.0530	0.0257	0.0113	0.0063
2017	0.3350	0.4152	0.4604	0.5734	0.6475	0.5458	0.6236	0.6025	0.5202	0.4376	0.3149	0.1991	0.1153	0.0594	0.0274	0.0115	0.0061
2018	0.3835	0.4711	0.5019	0.5716	0.6088	0.4865	0.5752	0.5738	0.5100	0.4415	0.3301	0.2182	0.1310	0.0685	0.0314	0.0128	0.0065
2019	0.4228	0.5196	0.5537	0.6281	0.6576	0.4978	0.5589	0.5376	0.4716	0.4146	0.3184	0.2172	0.1346	0.0725	0.0339	0.0138	0.0068
2020	0.4373	0.5383	0.5781	0.6677	0.7073	0.5383	0.5885	0.5437	0.4528	0.3816	0.2860	0.1946	0.1227	0.0678	0.0324	0.0134	0.0067
2021	0.4896	0.6015	0.6403	0.7245	0.7566	0.5672	0.6217	0.5675	0.4592	0.3689	0.2613	0.1698	0.1048	0.0578	0.0280	0.0118	0.0060
2022	0.4685	0.5780	0.6270	0.7414	0.7994	0.6213	0.6746	0.6152	0.4974	0.3995	0.2813	0.1787	0.1070	0.0575	0.0275	0.0116	0.0059

Ratio of 21_9c and GMACS_EST Nmatrix for WAG

1981	1.0101	1.0101	1.0098	1.0091	1.0084	1.0072	1.0066	1.0058	1.0049	1.0042	1.0035	1.0027	1.0018	1.0002	0.9970	0.9916	0.9754
1982	1.0118	1.0117	1.0115	1.0109	1.0102	1.0090	1.0082	1.0073	1.0062	1.0052	1.0043	1.0034	1.0025	1.0011	0.9985	0.9939	0.9796
1983	1.0089	1.0090	1.0093	1.0101	1.0105	1.0109	1.0101	1.0093	1.0081	1.0070	1.0059	1.0048	1.0037	1.0024	1.0001	0.9963	0.9836
1984	0.9895	0.9899	0.9921	0.9976	1.0025	1.0099	1.0103	1.0106	1.0104	1.0098	1.0089	1.0078	1.0066	1.0052	1.0031	0.9998	0.9886
1985	0.9852	0.9853	0.9860	0.9880	0.9905	0.9964	1.0010	1.0054	1.0091	1.0102	1.0100	1.0093	1.0082	1.0068	1.0049	1.0020	0.9922
1986	0.9987	0.9984	0.9969	0.9932	0.9907	0.9886	0.9917	0.9958	1.0014	1.0062	1.0096	1.0113	1.0113	1.0104	1.0087	1.0062	0.9976
1987	1.0001	1.0000	0.9997	0.9987	0.9976	0.9952	0.9938	0.9936	0.9952	0.9999	1.0066	1.0129	1.0165	1.0180	1.0177	1.0160	1.0086
1988	1.0005	1.0005	1.0004	1.0001	0.9997	0.9987	0.9976	0.9970	0.9963	0.9971	1.0001	1.0050	1.0107	1.0159	1.0191	1.0197	1.0145
1989	0.9985	0.9985	0.9988	0.9993	0.9997	0.9999	0.9994	0.9990	0.9982	0.9978	0.9983	0.9998	1.0027	1.0072	1.0124	1.0165	1.0159
1990	0.9982	0.9982	0.9983	0.9985	0.9987	0.9991	0.9993	0.9994	0.9991	0.9986	0.9980	0.9976	0.9980	0.9996	1.0028	1.0076	1.0127
1991	1.0016	1.0015	1.0010	0.9998	0.9991	0.9984	0.9986	0.9987	0.9987	0.9985	0.9980	0.9972	0.9967	0.9966	0.9975	1.0007	1.0081
1992	1.0027	1.0027	1.0025	1.0019	1.0013	1.0000	0.9993	0.9986	0.9981	0.9978	0.9973	0.9966	0.9959	0.9953	0.9952	0.9970	1.0039
1993	0.9994	0.9995	0.9998	1.0005	1.0011	1.0017	1.0009	1.0000	0.9989	0.9980	0.9971	0.9962	0.9955	0.9948	0.9944	0.9953	1.0006

1994	0.9995	0.9995	0.9995	0.9996	0.9997	1.0002	1.0005	1.0006	1.0002	0.9993	0.9982	0.9971	0.9962	0.9954	0.9948	0.9952	0.9985
1995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997	0.9998	0.9999	0.9996	0.9989	0.9976	0.9964	0.9952	0.9943	0.9946	0.9976
1996	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9995	0.9995	0.9993	0.9990	0.9983	0.9974	0.9962	0.9951	0.9952	0.9983
1997	0.9998	0.9998	0.9998	0.9997	0.9996	0.9995	0.9995	0.9994	0.9993	0.9991	0.9988	0.9983	0.9977	0.9969	0.9961	0.9963	0.9997
1998	0.9997	0.9997	0.9998	0.9998	0.9997	0.9997	0.9996	0.9994	0.9992	0.9990	0.9987	0.9983	0.9978	0.9972	0.9967	0.9971	1.0004
1999	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9995	0.9994	0.9991	0.9988	0.9983	0.9979	0.9975	0.9971	0.9975	1.0003
2000	0.9998	0.9998	0.9998	0.9998	0.9997	0.9997	0.9997	0.9996	0.9994	0.9992	0.9988	0.9983	0.9978	0.9973	0.9969	0.9973	0.9998
2001	0.9999	0.9999	0.9999	0.9998	0.9998	0.9997	0.9997	0.9996	0.9994	0.9991	0.9987	0.9982	0.9976	0.9971	0.9966	0.9970	0.9995
2002	1.0001	1.0001	1.0001	1.0000	0.9999	0.9998	0.9997	0.9996	0.9994	0.9992	0.9988	0.9983	0.9978	0.9972	0.9967	0.9970	0.9992
2003	1.0002	1.0002	1.0002	1.0001	1.0001	1.0000	0.9999	0.9997	0.9995	0.9993	0.9990	0.9986	0.9981	0.9975	0.9971	0.9972	0.9992
2004	0.9999	0.9999	0.9999	1.0000	1.0001	1.0001	1.0000	0.9999	0.9997	0.9995	0.9992	0.9988	0.9984	0.9980	0.9976	0.9976	0.9991
2005	0.9985	0.9986	0.9987	0.9991	0.9995	1.0000	1.0000	1.0000	0.9998	0.9997	0.9994	0.9991	0.9988	0.9984	0.9980	0.9980	0.9991
2006	1.0010	1.0009	1.0006	0.9999	0.9995	0.9990	0.9993	0.9996	0.9997	0.9997	0.9996	0.9993	0.9991	0.9988	0.9986	0.9987	0.9996
2007	1.0000	1.0000	1.0001	1.0003	1.0003	1.0001	0.9997	0.9994	0.9993	0.9994	0.9994	0.9994	0.9993	0.9991	0.9990	0.9991	0.9999
2008	0.9996	0.9997	0.9997	0.9999	1.0000	1.0001	1.0001	0.9999	0.9997	0.9995	0.9993	0.9992	0.9991	0.9991	0.9991	0.9993	1.0000
2009	1.0000	1.0000	1.0000	0.9999	0.9998	0.9998	0.9999	0.9999	0.9998	0.9997	0.9995	0.9993	0.9992	0.9991	0.9991	0.9994	1.0001
2010	0.9994	0.9994	0.9995	0.9997	0.9998	0.9999	0.9999	0.9998	0.9998	0.9997	0.9996	0.9994	0.9993	0.9992	0.9992	0.9994	1.0001
2011	0.9984	0.9985	0.9987	0.9990	0.9993	0.9996	0.9997	0.9997	0.9997	0.9997	0.9996	0.9995	0.9994	0.9993	0.9993	0.9995	1.0002
2012	0.9982	0.9982	0.9983	0.9984	0.9986	0.9990	0.9992	0.9994	0.9995	0.9996	0.9995	0.9995	0.9994	0.9993	0.9993	0.9996	1.0002
2013	0.9989	0.9989	0.9989	0.9987	0.9985	0.9984	0.9986	0.9988	0.9990	0.9992	0.9993	0.9993	0.9992	0.9992	0.9992	0.9995	1.0002
2014	1.0006	1.0005	1.0003	0.9998	0.9993	0.9987	0.9986	0.9985	0.9985	0.9986	0.9986	0.9986	0.9987	0.9987	0.9988	0.9991	0.9999
2015	0.9997	0.9997	0.9998	1.0000	1.0000	0.9998	0.9994	0.9989	0.9985	0.9982	0.9979	0.9978	0.9978	0.9978	0.9979	0.9984	0.9993
2016	0.9981	0.9982	0.9984	0.9989	0.9993	0.9998	0.9997	0.9994	0.9990	0.9985	0.9979	0.9974	0.9971	0.9970	0.9970	0.9975	0.9986
2017	1.0000	0.9999	0.9997	0.9992	0.9989	0.9988	0.9991	0.9992	0.9992	0.9989	0.9983	0.9977	0.9972	0.9968	0.9967	0.9970	0.9982
2018	0.9960	0.9961	0.9966	0.9977	0.9984	0.9993	0.9991	0.9989	0.9988	0.9987	0.9984	0.9980	0.9975	0.9971	0.9968	0.9969	0.9979
2019	0.9904	0.9905	0.9913	0.9931	0.9947	0.9973	0.9980	0.9984	0.9987	0.9985	0.9981	0.9978	0.9974	0.9971	0.9968	0.9969	0.9976
2020	0.9941	0.9940	0.9937	0.9928	0.9924	0.9928	0.9944	0.9958	0.9971	0.9976	0.9975	0.9973	0.9969	0.9966	0.9963	0.9964	0.9971
2021	0.9961	0.9960	0.9958	0.9951	0.9944	0.9933	0.9931	0.9931	0.9937	0.9945	0.9950	0.9953	0.9952	0.9949	0.9947	0.9949	0.9956
2022	1.0000	0.9999	0.9993	0.9980	0.9968	0.9950	0.9943	0.9934	0.9927	0.9923	0.9920	0.9920	0.9922	0.9922	0.9922	0.9925	0.9933

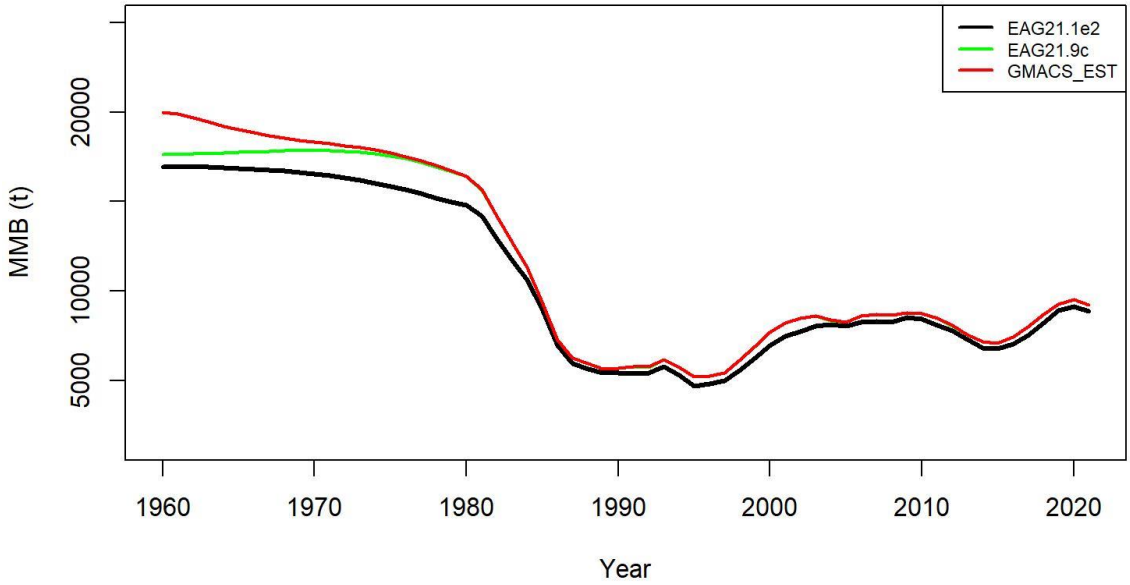

Figure D.1. Comparison of MMB trends for EAG golden king crab, 1960–2021 (black: status quo model EAG21.1e2; green: EAG21.9c (modified EAG21.1e2); and red: GMACS_EST).

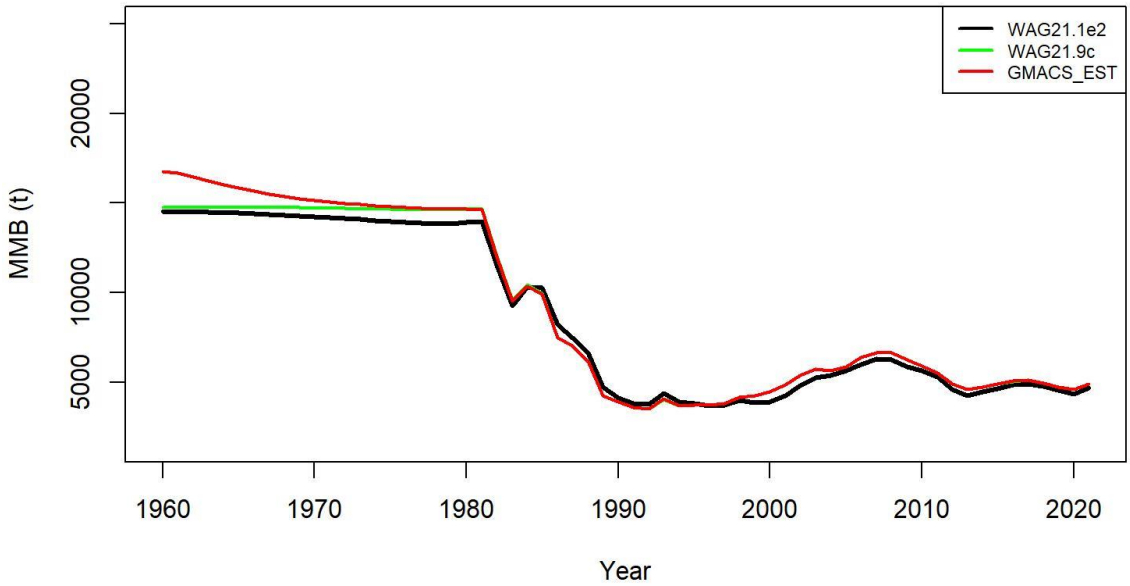

Figure D.2. Comparison of MMB trends for WAG golden king crab, 1960–2021 (black: status quo model WAG21.1e2; green: WAG21.9c (modified WAG21.1e2); and red: GMACS_EST).

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.

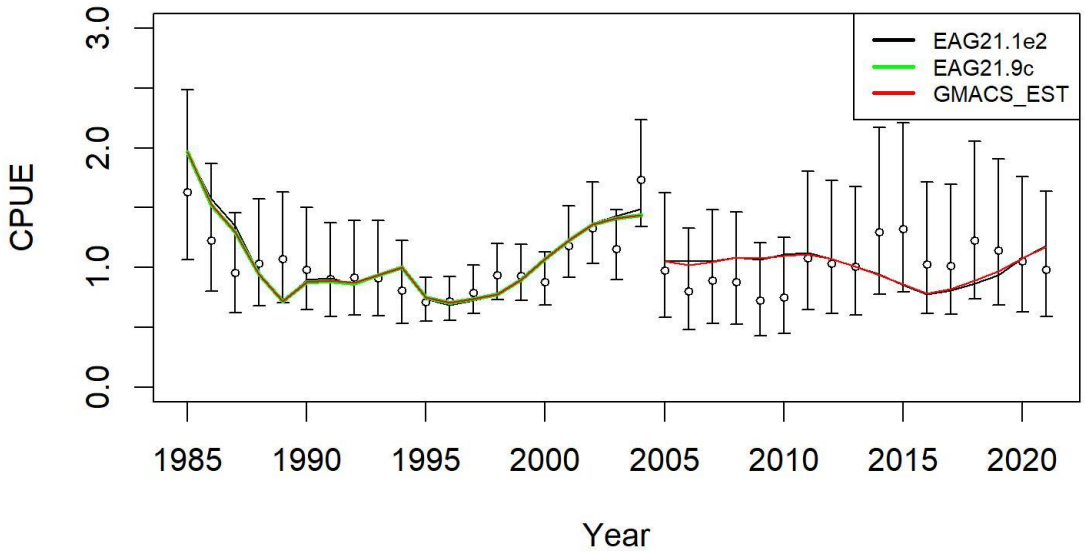

Figure D.3. Comparison of CPUE trends for EAG golden king crab, 1985–2021 (black: status quo model EAG21.1e2; green: EAG21.9c (modified EAG21.1e2); and red: GMACS_EST). Observed CPUE indices are shown in black circles with two-standard error confidence intervals. Additional model estimated constant variance is added to each observed CPUE variance.

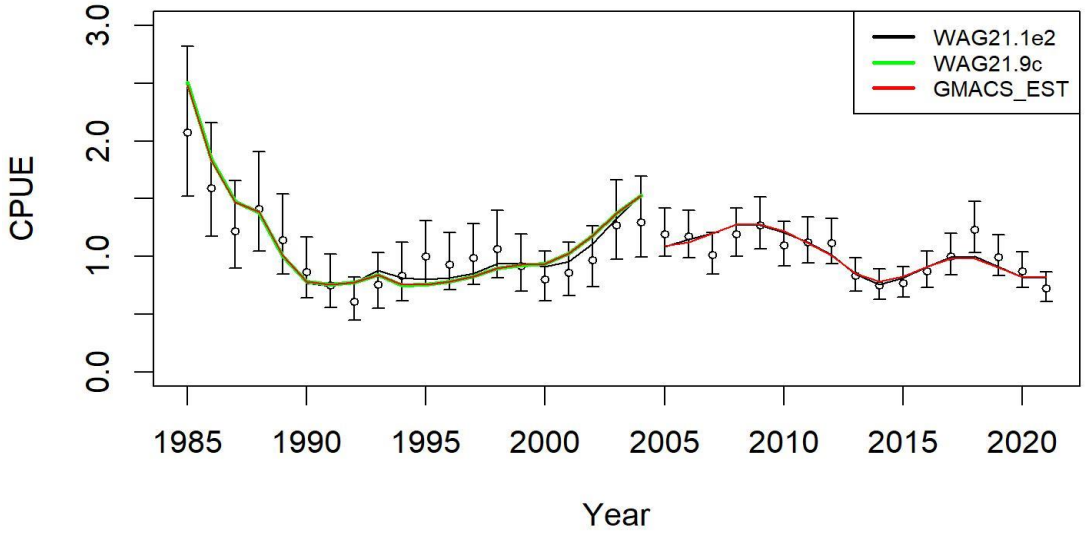

Figure D.4. Comparison of CPUE trends for WAG golden king crab, 1985–2021 (black: status quo model WAG21.1e2; green: WAG21.9c (modified WAG21.1e2); and red: GMACS_EST). Observed CPUE indices are shown in black circles with two-standard error confidence intervals. Additional model estimated constant variance is added to each observed CPUE variance.

Example EAG input files for model 21.1e2

1. *EAG21.1e2 dat file*

```
#=====================================================================
# Gmacs Main  Data  File: EAG Model 21.1e2FisheryCompleted up to 2021/22 data
# updated data from EAG  are used
# GEAR_   INDEX   DESCRIPTION
#   1       :   Pot fishery Retained catch
#   2       :   Pot fishery total catch
#   3       :   Trawl bycatch
#   4       :   Observer CPUE
#   5       :   Fishery CPUE

# Fisheries:  1 Pot Fishery, 2 Pot Total
# Cooperative Survey:
#=====================================================================

1960  # initial (start year)
2021  # terminal (end year)
#2022  # Projection year (for forecast, OFL and ABC calculation)
6     # Number of seasons: season1 for N est, season 2 for Jul 1 to MidFishing, season 3 for inst.remove C, season 4 for to spawning time,Feb15,
season 5 for inst remove byc&estimate MMB, season 6 for remaining time to June 30 and R enter
2     # Number of distinct data groups or number of fleets (pot fishing, groundfish fishing)
1     # Number of sexes (males)
1     # Number of shell condition types
1     # Number of maturity types
17     # Number of size-classes in the model
6     # Season when recruitment occurs,end of year before growth
6     # Season when molting and growth occur, end of year after recruitment
5     # Season to calculate MMB
1     # Season for  N output
# maximum size-class (males then females)
17
# size_breaks (a vector giving the break points between size intervals with dimension nclass+1, lower limits of bins)
100.5  105.5  110.5 115.5 120.5 125.5 130.5 135.5 140.5 145.5 150.5 155.5 160.5 165.5 170.5 175.5 180.5 185.5
# Natural mortality per season input type (1 = vector by season, 2 = matrix by season/year)
2
# Proportion of the total natural mortality to be applied each season (each row must add to 1)
# 1 Start biological year (Jul 1) instantaneous N estimation
# 2 to mid fishing time
# 3 instantaneous C removal
# 4 to spawning time
# 5 instantaneous byc removal and estimate MMB
# 6 Rest of the period of non-fishing from Feb 15 to June 30
#
#
#Ins N  Jul1-MidFish   Inst C     MidFish-15Feb   Ins byc    Rest up to end
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1960
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1961
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1962
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1963
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1964
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1965
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1966
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1967
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1968
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1969
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1970
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1971
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1972
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1973
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1974
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1975
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1976
```

```
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1977
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1978
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1979
 0.      0.16666667      0.      0.46073059      0.      0.37260274      #1980
 0.      0.44109589      0.      0.18630137      0.      0.37260274      #1981
 0.      0.483561644     0.      0.143835616     0.      0.37260274      #1982
 0.      0.483561644     0.      0.143835616     0.      0.37260274      #1983
 0.      0.315068493     0.      0.312328767     0.      0.37260274      #1984
 0.      0.168493151     0.      0.45890411      0.      0.37260274      #1985
 0.      0.252054795     0.      0.375342466     0.      0.37260274      #1986
 0.      0.087671233     0.      0.539726027     0.      0.37260274      #1987
 0.      0.3             0.      0.32739726      0.      0.37260274      #1988
 0.      0.4             0.      0.22739726      0.      0.37260274      #1989
 0.      0.265753425     0.      0.361643836     0.      0.37260274      #1990
 0.      0.273972603     0.      0.353424658     0.      0.37260274      #1991
 0.      0.276712329     0.      0.350684932     0.      0.37260274      #1992
 0.      0.419178082     0.      0.208219178     0.      0.37260274      #1993
 0.      0.249315068     0.      0.378082192     0.      0.37260274      #1994
 0.      0.223287671     0.      0.404109589     0.      0.37260274      #1995
 0.      0.328767123     0.      0.298630137     0.      0.37260274      #1996
 0.      0.28630137      0.      0.34109589      0.      0.37260274      #1997
 0.      0.263013699     0.      0.364383562     0.      0.37260274      #1998
 0.      0.245205479     0.      0.382191781     0.      0.37260274      #1999
 0.      0.179452055     0.      0.447945205     0.      0.37260274      #2000
 0.      0.160273973     0.      0.467123288     0.      0.37260274      #2001
 0.      0.156164384     0.      0.471232877     0.      0.37260274      #2002
 0.      0.157534247     0.      0.469863014     0.      0.37260274      #2003
 0.      0.143835616     0.      0.483561644     0.      0.37260274      #2004
 0.      0.432876712     0.      0.194520548     0.      0.37260274      #2005
 0.      0.331506849     0.      0.295890411     0.      0.37260274      #2006
 0.      0.368493151     0.      0.25890411      0.      0.37260274      #2007
 0.      0.302739726     0.      0.324657534     0.      0.37260274      #2008
 0.      0.32739726      0.      0.3             0.      0.37260274      #2009
 0.      0.293150685     0.      0.334246575     0.      0.37260274      #2010
 0.      0.263013699     0.      0.364383562     0.      0.37260274      #2011
 0.      0.275342466     0.      0.352054795     0.      0.37260274      #2012
 0.      0.27260274      0.      0.354794521     0.      0.37260274      #2013
 0.      0.247945205     0.      0.379452055     0.      0.37260274      #2014
 0.      0.228767123     0.      0.398630137     0.      0.37260274      #2015
 0.      0.420547945     0.      0.206849315     0.      0.37260274      #2016
 0.      0.409589041     0.      0.217808219     0.      0.37260274      #2017
 0.      0.349315068     0.      0.278082192     0.      0.37260274      #2018
 0.      0.32739726      0.      0.3             0.      0.37260274      #2019
 0.      0.365753425     0.      0.261643836     0.      0.37260274      #2020
 0.      0.294520548     0.      0.332876712     0.      0.37260274      #2021
#
# Fishing fleet names (delimited with : no spaces in names)
Pot_Fishery Trawl_Bycatch
# Survey names (delimited with : no spaces in names) keep empty

# Are the seasons discrete-instantaneous (0) or continuous (1)
1 1 1 1 1 1
# Number  of  catch data  frames
3
# Number  of  rows  in  each  data  frame
#       1993    total   catch   is      missing,        up      to      2021/22 data
#       1991    groundfish      bycatch is      missing,
#       retained        catch   1981/82-2021/22
      41      31      32
##  CATCH DATA in t
##  Type of catch: 1 = retained, 2 = discard, 0= total
##  Units of catch: 1 = biomass, 2 = numbers
# Mult: 1= use data as they are, 2 = multiply by this number (e.g., lbs to kg)

##  Retained Catch (numbers from 1981-1984; tonnes from 1985 onwards)
#year  seas    fleet   sex     obs     cv      type    units   mult    effort  discard_mortality
 1981    3       1       1       203.968 0.0316  1       2       1       0       0.2
 1982    3       1       1       529.787 0.0316  1       2       1       0       0.2
 1983    3       1       1       662.28  0.0316  1       2       1       0       0.2
 1984    3       1       1       801.1   0.0316  1       2       1       0       0.2
```

```
1985  3  1  1  2730.32 0.0316  1  1  1  0  0.2
1986  3  1  1  2844.91 0.0316  1  1  1  0  0.2
1987  3  1  1  1908.79 0.0316  1  1  1  0  0.2
1988  3  1  1  2423.6  0.0316  1  1  1  0  0.2
1989  3  1  1  2776.77 0.0316  1  1  1  0  0.2
1990  3  1  1  1637.48 0.0316  1  1  1  0  0.2
1991  3  1  1  2026.35 0.0316  1  1  1  0  0.2
1992  3  1  1  2125.04 0.0316  1  1  1  0  0.2
1993  3  1  1  1420.58 0.0316  1  1  1  0  0.2
1994  3  1  1  2038.35 0.0316  1  1  1  0  0.2
1995  3  1  1  2224.01 0.0316  1  1  1  0  0.2
1996  3  1  1  1624.07 0.0316  1  1  1  0  0.2
1997  3  1  1  1481.02 0.0316  1  1  1  0  0.2
1998  3  1  1  1414.76 0.0316  1  1  1  0  0.2
1999  3  1  1  1334.88 0.0316  1  1  1  0  0.2
2000  3  1  1  1359.49 0.0316  1  1  1  0  0.2
2001  3  1  1  1401.42 0.0316  1  1  1  0  0.2
2002  3  1  1  1243.19 0.0316  1  1  1  0  0.2
2003  3  1  1  1297.26 0.0316  1  1  1  0  0.2
2004  3  1  1  1269.73 0.0316  1  1  1  0  0.2
2005  3  1  1  1272.16 0.0316  1  1  1  0  0.2
2006  3  1  1  1389.5  0.0316  1  1  1  0  0.2
2007  3  1  1  1329.37 0.0316  1  1  1  0  0.2
2008  3  1  1  1421.86 0.0316  1  1  1  0  0.2
2009  3  1  1  1448.28 0.0316  1  1  1  0  0.2
2010  3  1  1  1412.73 0.0316  1  1  1  0  0.2
2011  3  1  1  1444.36 0.0316  1  1  1  0  0.2
2012  3  1  1  1499.29 0.0316  1  1  1  0  0.2
2013  3  1  1  1546.08 0.0316  1  1  1  0  0.2
2014  3  1  1  1553.36 0.0316  1  1  1  0  0.2
2015  3  1  1  1692.9  0.0316  1  1  1  0  0.2
2016  3  1  1  1658.66 0.0316  1  1  1  0  0.2
2017  3  1  1  1620.86 0.0316  1  1  1  0  0.2
2018  3  1  1  1865.11 0.0316  1  1  1  0  0.2
2019  3  1  1  2067.47 0.0316  1  1  1  0  0.2
2020  3  1  1  1735.37 0.0316  1  1  1  0  0.2
2021  3  1  1  1785.44 0.0316  1  1  1  0  0.2
#
## Total Catch (tonnes throughout)
#year  seas  fleet  sex  obs  cv  type  units  mult  effort  discard_mortality
1990  3  1  1  3980.73 0.358893929  0  1  1  0  0.2
1991  3  1  1  6596.74 0.212951406  0  1  1  0  0.2
1992  3  1  1  5435.64 0.296058703  0  1  1  0  0.2
1994  3  1  1  3444.23 0.375117372  0  1  1  0  0.2
1995  3  1  1  4640.82 0.051194102  0  1  1  0  0.2
1996  3  1  1  2563.32 0.04474373  0  1  1  0  0.2
1997  3  1  1  2976.8  0.059889204  0  1  1  0  0.2
1998  3  1  1  3140.99 0.0680779  0  1  1  0  0.2
1999  3  1  1  2605.62 0.065963387  0  1  1  0  0.2
2000  3  1  1  2759.91 0.057628024  0  1  1  0  0.2
2001  3  1  1  2237.55 0.060173859  0  1  1  0  0.2
2002  3  1  1  1915.66 0.064883292  0  1  1  0  0.2
2003  3  1  1  1901.61 0.065047278  0  1  1  0  0.2
2004  3  1  1  1694.87 0.087224566  0  1  1  0  0.2
2005  3  1  1  1742.04 0.118801346  0  1  1  0  0.2
2006  3  1  1  1646.83 0.123871783  0  1  1  0  0.2
2007  3  1  1  1819.86 0.12997936  0  1  1  0  0.2
2008  3  1  1  1823.51 0.16628614  0  1  1  0  0.2
2009  3  1  1  1770.08 0.204527938  0  1  1  0  0.2
2010  3  1  1  1756.66 0.197720567  0  1  1  0  0.2
2011  3  1  1  1780.6  0.217727165  0  1  1  0  0.2
2012  3  1  1  1946.59 0.197259943  0  1  1  0  0.2
2013  3  1  1  1851.56 0.184593328  0  1  1  0  0.2
2014  3  1  1  1967.39 0.213240733  0  1  1  0  0.2
2015  3  1  1  2135.81 0.188674437  0  1  1  0  0.2
2016  3  1  1  2234.13 0.165738888  0  1  1  0  0.2
2017  3  1  1  2339.37 0.170274949  0  1  1  0  0.2
2018  3  1  1  2734.63 0.189279828  0  1  1  0  0.2
2019  3  1  1  3032.73 0.17733387  0  1  1  0  0.2
2020  3  1  1  2608.06 0.172996036  0  1  1  0  0.2
```

```
 2021   3     1     1      2426.95 0.188674437     0      1      1      0      0.2
#
##            Trawl       fishery       discards (in tonnes)
 1989   3     2     1      0.826511       1.3108  2      1      1.538461538     0      0.65
 1990   3     2     1      2.59394        1.3108  2      1      1.538461538     0      0.65
 1992   3     2     1      1.22658        1.3108  2      1      1.538461538     0      0.65
 1993   3     2     1      1.15375        1.3108  2      1      1.538461538     0      0.65
 1994   3     2     1      0.357445       1.3108  2      1      1.538461538     0      0.65
 1995   3     2     1      1.01804        1.3108  2      1      1.538461538     0      0.65
 1996   3     2     1      0.265799       1.3108  2      1      1.538461538     0      0.65
 1997   3     2     1      0.106796       1.3108  2      1      1.538461538     0      0.65
 1998   3     2     1      1.06278        1.3108  2      1      1.538461538     0      0.65
 1999   3     2     1      0.642352       1.3108  2      1      1.538461538     0      0.65
 2000   3     2     1      1.12817        1.3108  2      1      1.538461538     0      0.65
 2001   3     2     1      1.66704        1.3108  2      1      1.538461538     0      0.65
 2002   3     2     1      2.38549        1.3108  2      1      1.538461538     0      0.65
 2003   3     2     1      1.31099        1.3108  2      1      1.538461538     0      0.65
 2004   3     2     1      0.297833       1.3108  2      1      1.538461538     0      0.65
 2005   3     2     1      1.83486        1.3108  2      1      1.538461538     0      0.65
 2006   3     2     1      3.3144         1.3108  2      1      1.538461538     0      0.65
 2007   3     2     1      1.92908        1.3108  2      1      1.538461538     0      0.65
 2008   3     2     1      4.30175        1.3108  2      1      1.538461538     0      0.65
 2009   3     2     1      2.05905        1.3108  2      1      1.538461538     0      0.65
 2010   3     2     1      6.27075        1.3108  2      1      1.538461538     0      0.65
 2011   3     2     1      5.2775         1.3108  2      1      1.538461538     0      0.65
 2012   3     2     1      6.17064        1.3108  2      1      1.538461538     0      0.65
 2013   3     2     1      3.13431        1.3108  2      1      1.538461538     0      0.65
 2014   3     2     1      2.86222        1.3108  2      1      1.538461538     0      0.65
 2015   3     2     1      1.27709        1.3108  2      1      1.538461538     0      0.65
 2016   3     2     1      0.979021       1.3108  2      1      1.538461538     0      0.65
 2017   3     2     1      1.57796        1.3108  2      1      1.538461538     0      0.65
 2018   3     2     1      1.74213        1.3108  2      1      1.538461538     0      0.65
 2019   3     2     1      3.88518        1.3108  2      1      1.538461538     0      0.65
 2020   3     2     1      0.726643       1.3108  2      1      1.538461538     0      0.65
 2021   3     2     1      1.996960       1.3108  2      1      1.538461538     0      0.65
#
##  RELATIVE  ABUNDANCE DATA
##  Units of abundance: 1 = biomass, 2 = numbers
##  Number  of  relative  abundance indices
## sex:1=male;2=female; 0=both
## maturity: 1=immature;2=mature;0 = both)

# Fishery CPUE index, Observer CPUE index2
3
# Index Type  (1=Selectivity; 2=retention)
# 2 2 2
##  Number  of  rows  in  each  index
41
# Fishery CPUE index NB error in GLM fits on Observer and Fish Tick data
# Sex: 1 = male, 2 = female, 0 = both" << endl;
#  Maturity: 1 = immature, 2 = mature, 0 = both
#  Units of survey: 1 = biomass, 2 = numbers
# Indices are in numbers
#              Observer   CPUE       index
1       1995    3       1       1       0       0.71576582      0.041540492     2       0.5
1       1996    3       1       1       0       0.722214808     0.032374582     2       0.5
1       1997    3       1       1       0       0.794809836     0.027719152     2       0.5
1       1998    3       1       1       0       0.938952781     0.020578804     2       0.5
1       1999    3       1       1       0       0.933589936     0.020756412     2       0.5
1       2000    3       1       1       0       0.880196925     0.019442281     2       0.5
1       2001    3       1       1       0       1.180906828     0.017660806     2       0.5
1       2002    3       1       1       0       1.332072936     0.018403092     2       0.5
1       2003    3       1       1       0       1.156448806     0.01957128      2       0.5
1       2004    3       1       1       0       1.734002067     0.017365612     2       0.5
2       2005    3       1       1       0       0.97748044      0.026728314     2       0.5
2       2006    3       1       1       0       0.801305427     0.029522345     2       0.5
2       2007    3       1       1       0       0.891845878     0.024688012     2       0.5
2       2008    3       1       1       0       0.880981988     0.029490401     2       0.5
2       2009    3       1       1       0       0.724519354     0.043304426     2       0.5
2       2010    3       1       1       0       0.751024699     0.041391697     2       0.5
```

```
2 2011 3 1 1 0 1.082224466 0.030007942 2 0.5
2 2012 3 1 1 0 1.035346515 0.028810673 2 0.5
2 2013 3 1 1 0 1.008106989 0.027841636 2 0.5
2 2014 3 1 1 0 1.298882115 0.027588462 2 0.5
2 2015 3 1 1 0 1.326575228 0.024716277 2 0.5
2 2016 3 1 1 0 1.029845284 0.028344527 2 0.5
2 2017 3 1 1 0 1.018072214 0.0317554 2 0.5
2 2018 3 1 1 0 1.229886224 0.028178423 2 0.5
2 2019 3 1 1 0 1.145558448 0.025989936 2 0.5
2 2020 3 1 1 0 1.055693 0.027884778 2 0.5
2 2021 3 1 1 0 0.983900252 0.034332848 2 0.5
#
# Year:Block interaction for model 21_1f
# Observer CPUE index
# 1 1995 3 1 1 0 0.791995729 0.220497934 2 0.5
# 1 1996 3 1 1 0 0.802636301 0.229653208 2 0.5
# 1 1997 3 1 1 0 0.793975194 0.204921918 2 0.5
# 1 1998 3 1 1 0 0.929278535 0.152100919 2 0.5
# 1 1999 3 1 1 0 0.921647764 0.14954673 2 0.5
# 1 2000 3 1 1 0 0.938267868 0.144902039 2 0.5
# 1 2001 3 1 1 0 1.174837375 0.094865463 2 0.5
# 1 2002 3 1 1 0 1.25765277 0.084545084 2 0.5
# 1 2003 3 1 1 0 0.991745407 0.139979038 2 0.5
# 1 2004 3 1 1 0 1.682577208 0.065900657 2 0.5
# 2 2005 3 1 1 0 0.964401086 0.036616083 2 0.5
# 2 2006 3 1 1 0 0.850079712 0.061198157 2 0.5
# 2 2007 3 1 1 0 0.894984806 0.043903214 2 0.5
# 2 2008 3 1 1 0 0.926841792 0.051357699 2 0.5
# 2 2009 3 1 1 0 0.739093154 0.092387482 2 0.5
# 2 2010 3 1 1 0 0.912234529 0.059492079 2 0.5
# 2 2011 3 1 1 0 1.006556305 0.037351535 2 0.5
# 2 2012 3 1 1 0 0.957784508 0.039865654 2 0.5
# 2 2013 3 1 1 0 0.965736789 0.038508691 2 0.5
# 2 2014 3 1 1 0 1.28444714 0.022882842 2 0.5
# 2 2015 3 1 1 0 1.232788487 0.02558437 2 0.5
# 2 2016 3 1 1 0 0.998859672 0.039479497 2 0.5
# 2 2017 3 1 1 0 1.056998156 0.033817149 2 0.5
# 2 2018 3 1 1 0 1.177000866 0.027878316 2 0.5
# 2 2019 3 1 1 0 1.108321715 0.029540799 2 0.5
# 2 2020 3 1 1 0 1.045564214 0.032676988 2 0.5
# 2 2021 3 1 1 0 1.027339988 0.035571584 2 0.5
#
#Index Year Seas fleet Sex maturity index cv abundance unit timing
3 1985 3 1 1 0 1.628685686 0.031256542 2 0.5
3 1986 3 1 1 0 1.228858309 0.03860399 2 0.5
3 1987 3 1 1 0 0.955170913 0.051223515 2 0.5
3 1988 3 1 1 0 1.035770885 0.039503475 2 0.5
3 1989 3 1 1 0 1.076478459 0.031794615 2 0.5
3 1990 3 1 1 0 0.986817549 0.045649075 2 0.5
3 1991 3 1 1 0 0.904618567 0.047224707 2 0.5
3 1992 3 1 1 0 0.917176073 0.047355471 2 0.5
3 1993 3 1 1 0 0.914494509 0.053325783 2 0.5
3 1994 3 1 1 0 0.808572288 0.051417944 2 0.5
3 1995 3 1 1 0 0.77981996 0.055409824 2 0.5
3 1996 3 1 1 0 0.779120743 0.055920143 2 0.5
3 1997 3 1 1 0 1.050514781 0.042865271 2 0.5
3 1998 3 1 1 0 1.214100014 0.042009807 2 0.5
### Number of length frequency matrices
#
2
## Number of rows in each matrix
37 31
#
## Number of bins in each matrix (columns of size data)
17 17
### SIZE COMPOSITION DATA FOR ALL FLEETS
## SIZE COMP LEGEND
## Sex: 1 = male, 2 = female, 0 = both sexes combined
## Type of composition: 1 = retained, 2 = discard, 0 = total composition
## Maturity state: 1 = immature, 2 = mature, 0 = both states combined
```

Shell condition: 1 = new shell, 2 = old shell, 0 = both shell types combined
Type 1 effective sample: Nsamp
Retain catch size comp

##Year,Seas, Fleet, Sex, Type, Shell, Maturity, Nsamp, DataVec

1985 3 1 1 1 0 0 57 0.000000 0.000000 0.000000 0.000000 0.000000 0.002122 0.034669
0.103747 0.158923 0.156292 0.157127 0.133423 0.108521 0.061545 0.038431 0.020136 0.025065
1986 3 1 1 1 0 0 11 0.000000 0.000000 0.000000 0.000000 0.000000 0.000635 0.030377
0.143149 0.183126 0.212534 0.136044 0.114523 0.075306 0.038519 0.039528 0.016971 0.009288
1987 3 1 1 1 0 0 61 0.000000 0.000000 0.003518 0.000000 0.000550 0.003212 0.070524
0.162974 0.240875 0.168335 0.132893 0.076020 0.050479 0.037065 0.026783 0.011753 0.015022
1988 3 1 1 1 0 0 352 0.000000 0.000000 0.000000 0.000000 0.000250 0.004988 0.043836
0.121611 0.173481 0.179156 0.161137 0.132840 0.073217 0.043037 0.025108 0.020902 0.020437
1989 3 1 1 1 0 0 792 0.000000 0.000000 0.000000 0.000066 0.000195 0.008435 0.108452
0.234714 0.191637 0.123151 0.094370 0.075312 0.057163 0.038218 0.026285 0.019802 0.022201
1990 3 1 1 1 0 0 163 0.000000 0.000052 0.000052 0.000000 0.000340 0.005531 0.079874
0.226018 0.260315 0.183031 0.112587 0.066439 0.038093 0.016649 0.005442 0.002781 0.002796
1991 3 1 1 1 0 0 140 0.000000 0.000000 0.000000 0.000000 0.000287 0.006172 0.074641
0.201726 0.233318 0.206834 0.127877 0.072609 0.040713 0.018307 0.009776 0.004928 0.002812
1992 3 1 1 1 0 0 49 0.000000 0.000000 0.000056 0.000120 0.000452 0.005204 0.074976
0.188394 0.240279 0.192046 0.126742 0.085203 0.048454 0.024934 0.008597 0.002697 0.001846
1993 3 1 1 1 0 0 340 0.000000 0.000000 0.000000 0.000000 0.001271 0.006339 0.057846
0.227652 0.263149 0.193126 0.115423 0.061702 0.041289 0.019439 0.008024 0.001523 0.003216
1994 3 1 1 1 0 0 319 0.000000 0.000000 0.000000 0.000000 0.000000 0.005146 0.056488
0.187163 0.253136 0.241073 0.112635 0.071796 0.038426 0.016716 0.011135 0.003629 0.002656
1995 3 1 1 1 0 0 879 0.000000 0.000000 0.000367 0.000000 0.000132 0.002554 0.053244
0.174310 0.237169 0.205691 0.131577 0.086227 0.054200 0.029541 0.014691 0.006267 0.004031
1996 3 1 1 1 0 0 547 0.000000 0.000509 0.000000 0.002673 0.004458 0.010646 0.076046
0.176767 0.219822 0.183488 0.129821 0.083593 0.049809 0.029215 0.022160 0.009716 0.001277
1997 3 1 1 1 0 0 538 0.000165 0.000000 0.000000 0.000000 0.000546 0.005501 0.067013
0.195912 0.241333 0.187580 0.126671 0.078708 0.047831 0.025562 0.014975 0.006349 0.001855
1998 3 1 1 1 0 0 541 0.000000 0.000000 0.000000 0.000000 0.000153 0.001613 0.058033
0.195363 0.237512 0.195717 0.131940 0.079974 0.046411 0.030546 0.015402 0.004854 0.002485
1999 3 1 1 1 0 0 463 0.000000 0.000000 0.000000 0.000000 0.000000 0.002647 0.056968
0.209816 0.256172 0.191463 0.123275 0.073622 0.044721 0.023946 0.011020 0.005430 0.000921
2000 3 1 1 1 0 0 436 0.000481 0.000000 0.000000 0.000000 0.000000 0.002408 0.038199
0.187100 0.243407 0.197233 0.140484 0.088336 0.054458 0.027952 0.012388 0.005379 0.002176
2001 3 1 1 1 0 0 488 0.000000 0.000040 0.000000 0.000000 0.000000 0.002185 0.043398
0.166360 0.254416 0.209148 0.150723 0.084320 0.049034 0.024928 0.010970 0.002453 0.002028
2002 3 1 1 1 0 0 406 0.000692 0.000000 0.000000 0.000000 0.000000 0.001140 0.042702
0.173724 0.231895 0.215249 0.146064 0.090496 0.052512 0.029190 0.012247 0.002809 0.001280
2003 3 1 1 1 0 0 405 0.000000 0.000000 0.000000 0.000000 0.000104 0.000939 0.025425
0.128996 0.198660 0.225076 0.168816 0.127193 0.062420 0.035472 0.017291 0.005726 0.003883
2004 3 1 1 1 0 0 280 0.000000 0.000000 0.000000 0.000000 0.000000 0.000153 0.036696
0.127904 0.215850 0.214303 0.163649 0.120783 0.069026 0.033788 0.016064 0.001630 0.000154
2005 3 1 1 1 0 0 266 0.000000 0.000000 0.000000 0.000000 0.000000 0.000885 0.018795
0.118321 0.199591 0.218250 0.176555 0.132109 0.068852 0.035158 0.023218 0.004347 0.003920
2006 3 1 1 1 0 0 234 0.000000 0.000000 0.000000 0.000000 0.000000 0.000266 0.016116
0.084749 0.179791 0.184967 0.175434 0.156561 0.101305 0.053838 0.027473 0.011261 0.008238
2007 3 1 1 1 0 0 199 0.000317 0.000000 0.000000 0.000000 0.000616 0.000000 0.023977
0.115069 0.188152 0.182646 0.168733 0.124654 0.089646 0.056234 0.027344 0.015402 0.007211
2008 3 1 1 1 0 0 197 0.000000 0.000000 0.000000 0.000000 0.000000 0.000886 0.012873
0.104580 0.201275 0.170907 0.164015 0.131524 0.089417 0.069199 0.030247 0.013294 0.011783
2009 3 1 1 1 0 0 170 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.012998
0.085646 0.178121 0.204593 0.179856 0.132916 0.096605 0.064687 0.026752 0.012521 0.005305
2010 3 1 1 1 0 0 183 0.000424 0.000000 0.000000 0.000000 0.000000 0.000497 0.019071
0.124157 0.190138 0.186530 0.154632 0.124061 0.080623 0.064508 0.031903 0.012549 0.010908
2011 3 1 1 1 0 0 160 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.006553
0.080423 0.169147 0.214179 0.181341 0.118590 0.107631 0.063368 0.033478 0.017831 0.007460
2012 3 1 1 1 0 0 187 0.000000 0.000000 0.000000 0.000000 0.000000 0.000924 0.011670
0.080888 0.167506 0.197858 0.161194 0.133335 0.105248 0.071755 0.041681 0.019324 0.008617
2013 3 1 1 1 0 0 193 0.000000 0.000000 0.000000 0.000000 0.000000 0.001621 0.015499
0.104071 0.166734 0.180076 0.184391 0.127462 0.095836 0.060360 0.035295 0.018979 0.009676
2014 3 1 1 1 0 0 168 0.000000 0.000000 0.000000 0.000000 0.000000 0.001431 0.022137
0.091465 0.171561 0.183012 0.168880 0.121834 0.102642 0.069861 0.035479 0.022149 0.009550
2015 3 1 1 1 0 0 190 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.011420
0.072221 0.169842 0.197348 0.152410 0.136227 0.095458 0.076222 0.042626 0.025670 0.020557
2016 3 1 1 1 0 0 247 0.000000 0.000000 0.000000 0.000000 0.000000 0.001569 0.023656
0.130969 0.187397 0.198963 0.152449 0.115449 0.076811 0.054592 0.029253 0.017759 0.011133

2017 3 1 1 1 0 0 224 0.000000 0.000000 0.000000 0.000000 0.000000 0.000256 0.023410
0.133188 0.218423 0.214067 0.169485 0.103612 0.069459 0.034132 0.016284 0.010683 0.007000
2018 3 1 1 1 0 0 256 0.000000 0.000000 0.000000 0.000529 0.000000 0.000135 0.027355
0.130823 0.248131 0.215962 0.158428 0.102995 0.058974 0.032543 0.013293 0.007461 0.003372
2019 3 1 1 1 0 0 242 0.000000 0.000000 0.000000 0.000000 0.000000 0.001065 0.031598
0.149950 0.250131 0.221410 0.144913 0.097167 0.052491 0.026653 0.018678 0.004507 0.001438
2020 3 1 1 1 0 0 227 0.000256 0.000000 0.000000 0.000000 0.000655 0.000431 0.044840
0.165445 0.247580 0.220790 0.148233 0.081651 0.045700 0.026418 0.007517 0.008112 0.002372
2021 3 1 1 1 0 0 271 0.000000 0.000000 0.000000 0.000000 0.000000 0.000804 0.019252
0.103990 0.217649 0.221334 0.154395 0.106584 0.074428 0.060909 0.026415 0.007645 0.006595
#

#
Total catch size comp

##Year, Seas, Fleet, Sex, Type, Shell, Maturity, Nsamp, DataVec

1990 3 1 1 0 0 0 22 0.247057 0.0713771 0.0700192 0.077615 0.101558 0.0912419
0.0849724 0.078276 0.0682135 0.0552399 0.0270515 0.0133764 0.00962329 0.0023578 0.0014792 8.22E-05
0.000459108
1991 3 1 1 0 0 0 48 0.150747 0.0569511 0.0693395 0.0749659 0.0924522 0.103903 0.109297
0.102978 0.0877103 0.0677098 0.0362255 0.0214857 0.015996 0.00453193 0.00283495 0.00109456
0.00177659
1992 3 1 1 0 0 0 41 0.218576 0.0710539 0.0702081 0.0908626 0.097516 0.0846274
0.0812049 0.0750376 0.0673011 0.058382 0.0388833 0.0238657 0.0148029 0.00460071 0.00180984
0.00105979 0.000208438
1994 3 1 1 0 0 0 34 0.390634 0.0770537 0.0638146 0.0618622 0.0740266 0.0850102
0.074093 0.0543337 0.0516942 0.0326618 0.019531 0.00986639 0.00413091 0.00128759 0 0 0
1995 3 1 1 0 0 0 1117 0.124613 0.0442733 0.0627333 0.0799967 0.0985993 0.116452
0.124387 0.107233 0.0875711 0.0651487 0.0407447 0.0231279 0.0131594 0.00656473 0.00339433
0.00116618 0.000835641
1996 3 1 1 0 0 0 509 0.103395 0.0415556 0.0569105 0.0743889 0.0931823 0.113814
0.122095 0.111671 0.0928794 0.0720616 0.0480457 0.0296772 0.0183391 0.0109164 0.00631536 0.00300188
0.00175086
1997 3 1 1 0 0 0 711 0.109124 0.0388528 0.0542848 0.0707215 0.0910392 0.11163 0.122114
0.114516 0.0975729 0.0742102 0.0466668 0.0298708 0.0187339 0.0109476 0.00603525 0.00229027
0.00139002
1998 3 1 1 0 0 0 574 0.091279 0.0396234 0.0574995 0.0785652 0.101792 0.120911 0.128335
0.117767 0.0955065 0.0692407 0.0416695 0.0271698 0.0160882 0.008442 0.00412504 0.00135657
0.000629092
1999 3 1 1 0 0 0 607 0.076032 0.0304259 0.0407786 0.060235 0.0855845 0.114671 0.136644
0.132851 0.115081 0.0863874 0.0539934 0.0306299 0.0190225 0.0102905 0.00486486 0.00188102 0.0006271
2000 3 1 1 0 0 0 495 0.0812519 0.0297586 0.0424546 0.0587412 0.0723233 0.104272
0.129143 0.140068 0.11847 0.0844907 0.0580157 0.0366426 0.0211551 0.0125915 0.00659819 0.00259604
0.00142754
2001 3 1 1 0 0 0 510 0.0560044 0.0234461 0.0328406 0.0452632 0.0604895 0.0883655
0.135255 0.152515 0.146458 0.110777 0.0675943 0.0391702 0.0223362 0.0116944 0.0045407 0.00223538
0.00101595
2002 3 1 1 0 0 0 438 0.0672552 0.0245928 0.0301661 0.0369386 0.0495942 0.0803033
0.111182 0.141262 0.143255 0.123413 0.0853576 0.050499 0.0315727 0.0143736 0.00696212 0.00228202
0.000991938
2003 3 1 1 0 0 0 416 0.043021 0.0234547 0.028494 0.0387766 0.05435 0.0870863 0.108929
0.133006 0.13769 0.129164 0.0923591 0.0576027 0.0324218 0.0176854 0.00979352 0.00396374 0.00220236
2004 3 1 1 0 0 0 299 0.0396677 0.0164496 0.0234035 0.0324723 0.0534929 0.0777852
0.103027 0.135703 0.143627 0.133979 0.0962192 0.0670814 0.0432435 0.0202071 0.00828497 0.00435757
0.000998367
2005 3 1 1 0 0 0 232 0.0253953 0.00885292 0.0100844 0.0161735 0.0288399 0.0416161
0.0787101 0.132803 0.153519 0.156458 0.131759 0.0879323 0.0660318 0.0348172 0.0167193 0.00671578
0.00357146
2006 3 1 1 0 0 0 143 0.0246625 0.00846409 0.01109 0.0137568 0.0236738 0.0371752 0.0845751
0.114118 0.155592 0.151945 0.133602 0.0970456 0.0708979 0.0405458 0.0186574 0.00897895 0.00521914
2007 3 1 1 0 0 0 134 0.00652577 0.00378906 0.0052302 0.00786267 0.018195 0.0331976
0.071528 0.124197 0.149503 0.15073 0.143045 0.100164 0.0809502 0.0507338 0.0294016 0.0159802
0.00896782
2008 3 1 1 0 0 0 113 0.00857113 0.0049083 0.00779756 0.0116225 0.0217224 0.0418616
0.0787408 0.123984 0.152078 0.153806 0.129021 0.0972501 0.0725458 0.0483485 0.0249741 0.0140889
0.00868037
2009 3 1 1 0 0 0 95 0.0113415 0.00518697 0.00881411 0.015353 0.0237856 0.0480279
0.0906078 0.13986 0.153603 0.141066 0.123676 0.0940756 0.0685207 0.0397965 0.0231241 0.00840498
0.00475553

2010 3 1 1 0 0 0 108 0.022828 0.00866797 0.013557 0.0200495 0.0368501 0.0557857
0.0905218 0.132494 0.143649 0.133755 0.108654 0.0899445 0.061541 0.0401121 0.0226787 0.0122193
0.0066932
2011 3 1 1 0 0 0 107 0.0104875 0.00697866 0.0100816 0.0137713 0.0215925 0.0390275
0.0832977 0.143807 0.155986 0.146627 0.125031 0.0913977 0.0659082 0.0435672 0.0238518 0.0119113
0.00667486
2012 3 1 1 0 0 0 99 0.00615772 0.00521303 0.00715262 0.00736057 0.0193456 0.0369768
0.0790887 0.124091 0.154593 0.149802 0.131341 0.102372 0.0726776 0.0501565 0.0303817 0.0145097
0.00878071
2013 3 1 1 0 0 0 122 0.0125185 0.00656913 0.0103487 0.015937 0.0265613 0.0505413
0.0948958 0.140513 0.154223 0.143494 0.114419 0.0849187 0.0610139 0.0423781 0.0247336 0.0108804
0.00605444
2014 3 1 1 0 0 0 99 0.0114342 0.00577775 0.0097938 0.0159057 0.0267485 0.0470268
0.0886109 0.119394 0.147714 0.137175 0.119421 0.0920404 0.0706556 0.0504406 0.0317839 0.0157829
0.0102948
2015 3 1 1 0 0 0 125 0.0126131 0.00853007 0.0139498 0.0214402 0.0325748 0.0537029
0.0885482 0.129716 0.149721 0.141136 0.108693 0.0853329 0.0588792 0.0433409 0.0264528 0.0146881
0.0106795
2016 3 1 1 0 0 0 155 0.0221805 0.0103568 0.0158631 0.0220943 0.039383 0.0683867
0.121158 0.1522 0.157448 0.132527 0.092669 0.0648578 0.0431382 0.0286815 0.0154292 0.00865352
0.00497325
2017 3 1 1 0 0 0 133 0.0286731 0.0105041 0.0158519 0.0226251 0.036473 0.0670006
0.116437 0.155027 0.162527 0.142692 0.0967285 0.0602004 0.0373219 0.0212888 0.0117646 0.0076865
0.00719791
2018 3 1 1 0 0 0 234 0.0186917 0.0113587 0.0156748 0.023319 0.045141 0.0708996
0.130263 0.150488 0.168919 0.132958 0.0982731 0.0548139 0.0348002 0.0215186 0.012037 0.00677388
0.00407118
2019 3 1 1 0 0 0 148 0.00916154 0.00612811 0.0107599 0.0187185 0.0376047 0.0765679
0.130283 0.165464 0.180549 0.14757 0.0959298 0.0578562 0.0331322 0.0176404 0.00737997 0.00375871
0.00149607
2020 3 1 1 0 0 0 155 0.0177394 0.00714948 0.0136626 0.019769 0.0440827 0.0694093
0.135446 0.170574 0.177529 0.131859 0.0973366 0.0508625 0.0332001 0.0159713 0.00856022 0.00393227
0.00291636
2021 3 1 1 0 0 0 138 0.00686642 0.0027576 0.00523951 0.00768031 0.019068 0.0523038
0.106167 0.16282 0.183086 0.159105 0.117981 0.0711493 0.049806 0.0288588 0.0151058 0.0074205
0.004585
#
Trawl byc size comp
##Year, Seas, Fleet, Sex, Type, Shell, Maturity, Nsamp, DataVec
1989 5 2 1 2 0 0 9 0.485981 0.0280374 0.0654206 0.046729 0.0373832 0.046729
0.0654206 0.0280374 0.0560748 0.0373832 0.0186916 0 0.046729 0 0 0.00934579 0.0280374
1990 5 2 1 2 0 0 13 0.50823 0.0246914 0.0205761 0.0349794 0.0411523 0.0205761
0.0534979 0.0432099 0.0329218 0.0576132 0.0411523 0.0411523 0.0288066 0.0164609 0.0246914
0.00411523 0.00617284
1992 5 2 1 2 0 0 2 0.333333 0.111111 0 0.111111 0.111111 0.111111 0 0.111111
0 0 0 0.111111 0 0 0 0 0
1993 5 2 1 2 0 0 2 0.333333 0 0.166667 0 0.166667 0 0 0.166667 0
0.166667 0 0 0 0 0 0 0
1994 5 2 1 2 0 0 4 0.415584 0.168831 0.12987 0.116883 0.0519481 0.025974 0.012987
0.038961 0.012987 0 0.012987 0.012987 0 0 0 0 0
1995 5 2 1 2 0 0 5 0.446809 0.0212766 0.0212766 0.0851064 0.0638298 0.0638298
0.106383 0.0425532 0.0212766 0.0638298 0.0212766 0.0212766 0.0212766 0 0 0 0
1996 5 2 1 2 0 0 4 0.894737 0 0.105263 0 0 0 0 0 0 0 0 0 0 0
0 0 0
1997 5 2 1 2 0 0 8 0.241935 0.0645161 0.0483871 0.112903 0.0967742 0.112903
0.0967742 0.0645161 0.016129 0.0645161 0 0.016129 0.0322581 0.016129 0 0 0.016129
1998 5 2 1 2 0 0 15 0.524715 0.0494297 0.0342205 0.0418251 0.0798479 0.0646388
0.0304183 0.0456274 0.0342205 0.0380228 0.0304183 0.0114068 0.00760456 0 0.00380228 0 0.00380228
1999 5 2 1 2 0 0 14 0.694158 0.0618557 0.0206186 0.0309278 0.0274914 0.0309278
0.0103093 0.0446735 0.00687285 0.0137457 0.0274914 0.0137457 0.00687285 0.00343643 0.00687285 0 0
2000 5 2 1 2 0 0 16 0.796076 0.0434007 0.0172414 0.0160523 0.0160523 0.0136742
0.0160523 0.020214 0.0142687 0.0118906 0.0148633 0.00832342 0.00535077 0.00178359 0.00178359
0.00178359 0.00118906
2001 5 2 1 2 0 0 13 0.316832 0.0528053 0.0792079 0.0759076 0.0610561 0.0429043
0.0445545 0.0363036 0.0379538 0.0379538 0.0363036 0.0445545 0.0330033 0.0363036 0.0264026 0.0181518
0.019802
2002 5 2 1 2 0 0 15 0.850794 0.0412698 0.0253968 0.0179894 0.0243386 0.00634921
0.010582 0.00846561 0.00740741 0.0010582 0.0010582 0.0021164 0.0021164 0.0010582 0 0 0
2003 5 2 1 2 0 0 17 0.856938 0.0286123 0.0143062 0.018598 0.0128755 0.0114449
0.0114449 0.0128755 0.00286123 0.0100143 0.00858369 0.00286123 0.00143062 0 0.00286123 0.00429185 0

2004 5 2 1 2 0 0 10 0.856061 0.00757576 0.00757576 0.00757576 0.00757576 0 0 0 0.00757576 0.0227273 0 0.0151515 0.0454545 0.00757576 0.00757576 0.00757576 0
2005 5 2 1 2 0 0 12 0.937112 0.0168291 0.00708592 0.00708592 0.0044287 0.0044287 0.00177148 0.00265722 0.0044287 0.00265722 0.0044287 0.00177148 0.00177148 0.00265722 0.00088574 0 0
2006 5 2 1 2 0 0 14 0.904403 0.0176101 0.0150943 0.0125786 0.00880503 0.00880503 0.00754717 0.0113208 0.00251572 0.00377358 0.00377358 0.00125786 0.00125786 0 0 0.00125786 0
2007 5 2 1 2 0 0 17 0.818363 0.0528942 0.0299401 0.0179641 0.0199601 0.0189621 0.00898204 0.00798403 0.00698603 0.00499002 0.00499002 0 0.00199601 0.00199601 0.000998004 0.000998004 0.00199601
2008 5 2 1 2 0 0 15 0.907824 0.0244666 0.0139403 0.00995733 0.00625889 0.00682788 0.00625889 0.00540541 0.00483642 0.00426743 0.00483642 0.00256046 0.000853485 0.000853485 0.00056899 0 0.000284495
2009 5 2 1 2 0 0 16 0.74026 0.012987 0.00779221 0.0181818 0.0337662 0.0181818 0.0181818 0.0103896 0.0207792 0.0181818 0.0233766 0.0207792 0.0207792 0.012987 0.0103896 0.00779221 0.00519481
2010 5 2 1 2 0 0 26 0.784517 0.0574621 0.0407023 0.0271349 0.0239425 0.0175579 0.0167598 0.0103751 0.00159617 0.00558659 0.00319234 0.00399042 0.00399042 0.00239425 0 0.000798085 0
2011 5 2 1 2 0 0 13 0.902135 0.0237248 0.024911 0.0154211 0.00711744 0.00771056 0.0029656 0.00237248 0.00177936 0.00237248 0.00237248 0.00177936 0.00118624 0.00059312 0.00177936 0.00177936 0
2012 5 2 1 2 0 0 18 0.697987 0.0268456 0.0268456 0.0268456 0.0134228 0.00671141 0.00671141 0.0402685 0.0201342 0.033557 0.0134228 0.00671141 0.00671141 0.033557 0.0134228 0.00671141 0.0201342
2013 5 2 1 2 0 0 17 0.673077 0 0 0 0.0192308 0 0.0192308 0.0384615 0 0.0192308 0.0384615 0.0576923 0.0384615 0.0384615 0.0576923 0 0
2014 5 2 1 2 0 0 16 0.444444 0 0.0185185 0.0740741 0.0555556 0.0555556 0.037037 0.0740741 0 0.037037 0.0555556 0.037037 0 0.037037 0 0.0555556 0.0185185
2015 5 2 1 2 0 0 10 0.859766 0.0166945 0.0183639 0.0183639 0.0217028 0.0200334 0.0166945 0.00500835 0.0116861 0.0033389 0.00166945 0.00166945 0.00166945 0.00166945 0 0.00166945 0
2016 5 2 1 2 0 0 12 0.188889 0.0666667 0.1 0.1 0.133333 0.122222 0.0555556 0.0555556 0.0666667 0.0222222 0.0222222 0.0222222 0.0222222 0.0111111 0 0.0111111 0
2017 5 2 1 2 0 0 12 0.837975 0.0455696 0.0227848 0.0126582 0.0101266 0.00759494 0.0101266 0.0151899 0.0101266 0.00759494 0.00506329 0.0101266 0.00506329 0 0 0 0
2018 5 2 1 2 0 0 9 0.863014 0.0228311 0.0228311 0.00913242 0.0136986 0.0182648 0.00913242 0.00456621 0.0182648 0.00456621 0.00456621 0 0.00456621 0 0.00456621 0 0
2019 5 2 1 2 0 0 8 0.76 0.035 0.05 0.02 0.025 0.015 0.03 0.01 0.01 0.015 0 0 0.015 0.01 0 0.005 0
2020 5 2 1 2 0 0 6 0.181818 0 0 0 0.272727 0.0909091 0 0.0909091 0.181818 0.0909091 0 0.0909091 0 0 0 0 0
2021 5 2 1 2 0 0 8 0.75 0.0887097 0.016129 0.0322581 0.00806452 0.0322581 0.00806452 0.016129 0 0.016129 0.016129 0.016129 0 0 0 0 0
#
Growth data (increment)
Type of growth increment (0=no growth data;1=size-at-release; 2= size-class-at-release)
3
nobs_growth
222
Class-at-release; Sex; Class-at-recapture; Years-at-liberty; number transition matrix; RecaptureFleet Recapture Year (if applicable) sample size

1	1	3	1	1	1	2004	2
1	1	4	1	1	1	2004	2
2	1	2	1	1	1	2004	1
2	1	4	1	1	1	2004	4
2	1	5	1	1	1	2004	10
2	1	6	1	1	1	2004	1
2	1	8	1	1	1	2004	1
3	1	5	1	1	1	2004	4
3	1	6	1	1	1	2004	6
3	1	7	1	1	1	2004	2
4	1	4	1	1	1	2004	2
4	1	6	1	1	1	2004	7
4	1	7	1	1	1	2004	29
4	1	8	1	1	1	2004	12
5	1	5	1	1	1	2004	9
5	1	6	1	1	1	2004	10
5	1	7	1	1	1	2004	25
5	1	8	1	1	1	2004	90
5	1	9	1	1	1	2004	24
5	1	10	1	1	1	2004	3

6	1	6	1	1	1	2004	18
6	1	7	1	1	1	2004	12
6	1	8	1	1	1	2004	36
6	1	9	1	1	1	2004	96
6	1	10	1	1	1	2004	21
7	1	7	1	1	1	2004	43
7	1	8	1	1	1	2004	9
7	1	9	1	1	1	2004	37
7	1	10	1	1	1	2004	64
7	1	11	1	1	1	2004	23
8	1	8	1	1	1	2004	39
8	1	9	1	1	1	2004	11
8	1	10	1	1	1	2004	28
8	1	11	1	1	1	2004	44
8	1	12	1	1	1	2004	13
8	1	13	1	1	1	2004	1
9	1	9	1	1	1	2004	48
9	1	10	1	1	1	2004	7
9	1	11	1	1	1	2004	8
9	1	12	1	1	1	2004	22
9	1	13	1	1	1	2004	3
10	1	10	1	1	1	2004	56
10	1	11	1	1	1	2004	4
10	1	12	1	1	1	2004	7
10	1	13	1	1	1	2004	12
10	1	14	1	1	1	2004	1
11	1	11	1	1	1	2004	30
11	1	12	1	1	1	2004	6
11	1	13	1	1	1	2004	1
11	1	14	1	1	1	2004	5
12	1	12	1	1	1	2004	18
12	1	13	1	1	1	2004	4
12	1	14	1	1	1	2004	2
12	1	15	1	1	1	2004	2
13	1	13	1	1	1	2004	12
13	1	14	1	1	1	2004	1
13	1	15	1	1	1	2004	1
13	1	16	1	1	1	2004	1
14	1	14	1	1	1	2004	10
14	1	15	1	1	1	2004	1
15	1	15	1	1	1	2004	3
15	1	16	1	1	1	2004	1
17	1	17	1	1	1	2004	1

#Year2

1	1	4	2	1	1	2004	1
1	1	8	2	1	1	2004	1
2	1	5	2	1	1	2004	2
2	1	7	2	1	1	2004	1
2	1	8	2	1	1	2004	4
2	1	9	2	1	1	2004	3
3	1	5	2	1	1	2004	3
3	1	6	2	1	1	2004	7
3	1	7	2	1	1	2004	1
3	1	8	2	1	1	2004	1
3	1	9	2	1	1	2004	13
3	1	10	2	1	1	2004	1
4	1	6	2	1	1	2004	1
4	1	7	2	1	1	2004	16
4	1	8	2	1	1	2004	8
4	1	9	2	1	1	2004	6
4	1	10	2	1	1	2004	10
4	1	11	2	1	1	2004	4
5	1	5	2	1	1	2004	1
5	1	6	2	1	1	2004	2
5	1	7	2	1	1	2004	15
5	1	8	2	1	1	2004	61
5	1	9	2	1	1	2004	17
5	1	10	2	1	1	2004	5
5	1	11	2	1	1	2004	10
5	1	12	2	1	1	2004	4

5	1	14	2	1	1	2004	1
6	1	6	2	1	1	2004	1
6	1	7	2	1	1	2004	2
6	1	8	2	1	1	2004	24
6	1	9	2	1	1	2004	42
6	1	10	2	1	1	2004	9
6	1	11	2	1	1	2004	3
6	1	12	2	1	1	2004	6
6	1	13	2	1	1	2004	2
7	1	7	2	1	1	2004	2
7	1	8	2	1	1	2004	5
7	1	9	2	1	1	2004	11
7	1	10	2	1	1	2004	39
7	1	11	2	1	1	2004	13
7	1	12	2	1	1	2004	1
7	1	14	2	1	1	2004	1
8	1	8	2	1	1	2004	3
8	1	9	2	1	1	2004	4
8	1	10	2	1	1	2004	10
8	1	11	2	1	1	2004	38
8	1	12	2	1	1	2004	8
8	1	13	2	1	1	2004	1
9	1	9	2	1	1	2004	5
9	1	10	2	1	1	2004	1
9	1	11	2	1	1	2004	7
9	1	12	2	1	1	2004	14
9	1	13	2	1	1	2004	5
10	1	10	2	1	1	2004	3
10	1	12	2	1	1	2004	6
10	1	13	2	1	1	2004	14
10	1	14	2	1	1	2004	2
10	1	17	2	1	1	2004	1
11	1	11	2	1	1	2004	1
11	1	13	2	1	1	2004	5
11	1	14	2	1	1	2004	4
12	1	12	2	1	1	2004	1
12	1	14	2	1	1	2004	2
12	1	15	2	1	1	2004	2

#Year3

1	1	1	3	1	1	2004	1
1	1	7	3	1	1	2004	5
1	1	9	3	1	1	2004	1
2	1	7	3	1	1	2004	3
2	1	8	3	1	1	2004	11
2	1	9	3	1	1	2004	6
2	1	10	3	1	1	2004	1
3	1	6	3	1	1	2004	1
3	1	7	3	1	1	2004	1
3	1	8	3	1	1	2004	4
3	1	9	3	1	1	2004	14
3	1	10	3	1	1	2004	5
4	1	7	3	1	1	2004	1
4	1	8	3	1	1	2004	1
4	1	9	3	1	1	2004	5
4	1	10	3	1	1	2004	14
4	1	11	3	1	1	2004	3
4	1	12	3	1	1	2004	1
5	1	7	3	1	1	2004	1
5	1	8	3	1	1	2004	4
5	1	9	3	1	1	2004	5
5	1	10	3	1	1	2004	12
5	1	11	3	1	1	2004	24
5	1	12	3	1	1	2004	12
5	1	13	3	1	1	2004	2
5	1	14	3	1	1	2004	1
6	1	6	3	1	1	2004	1
6	1	8	3	1	1	2004	2
6	1	9	3	1	1	2004	8
6	1	10	3	1	1	2004	2
6	1	11	3	1	1	2004	6

	6	1	12	3	1	1	2004	7
	6	1	13	3	1	1	2004	3
	6	1	14	3	1	1	2004	1
	7	1	8	3	1	1	2004	1
	7	1	9	3	1	1	2004	2
	7	1	10	3	1	1	2004	11
	7	1	11	3	1	1	2004	3
	7	1	13	3	1	1	2004	6
	7	1	14	3	1	1	2004	3
	8	1	10	3	1	1	2004	1
	8	1	11	3	1	1	2004	7
	8	1	12	3	1	1	2004	2
	8	1	14	3	1	1	2004	1
	9	1	11	3	1	1	2004	1
	9	1	12	3	1	1	2004	4
	9	1	13	3	1	1	2004	1
	9	1	15	3	1	1	2004	1
	9	1	16	3	1	1	2004	1
	10	1	13	3	1	1	2004	1
	13	1	15	3	1	1	2004	1
#Year4								
	1	1	10	4	1	1	2004	6
	1	1	11	4	1	1	2004	1
	2	1	8	4	1	1	2004	1
	2	1	10	4	1	1	2004	1
	2	1	11	4	1	1	2004	5
	3	1	8	4	1	1	2004	3
	3	1	9	4	1	1	2004	3
	3	1	10	4	1	1	2004	3
	3	1	11	4	1	1	2004	1
	3	1	12	4	1	1	2004	1
	3	1	14	4	1	1	2004	1
	4	1	9	4	1	1	2004	1
	4	1	10	4	1	1	2004	2
	4	1	12	4	1	1	2004	1
	4	1	14	4	1	1	2004	1
	5	1	8	4	1	1	2004	1
	5	1	10	4	1	1	2004	1
	5	1	11	4	1	1	2004	4
	5	1	12	4	1	1	2004	4
	6	1	11	4	1	1	2004	1
	6	1	12	4	1	1	2004	2
	7	1	10	4	1	1	2004	2
	7	1	12	4	1	1	2004	1
	7	1	14	4	1	1	2004	2
	8	1	14	4	1	1	2004	2
#Year5								
	1	1	10	5	1	1	2004	2
	2	1	11	5	1	1	2004	1
	2	1	12	5	1	1	2004	1
	2	1	16	5	1	1	2004	1
	3	1	11	5	1	1	2004	1
	3	1	13	5	1	1	2004	3
	3	1	14	5	1	1	2004	1
	5	1	14	5	1	1	2004	1
	7	1	13	5	1	1	2004	1
	7	1	14	5	1	1	2004	1
#Year6								
	1	1	8	6	1	1	2004	1
	1	1	9	6	1	1	2004	1
	1	1	11	6	1	1	2004	1
	1	1	12	6	1	1	2004	1
	1	1	13	6	1	1	2004	2
	2	1	11	6	1	1	2004	2
	2	1	14	6	1	1	2004	1
	3	1	9	6	1	1	2004	1
	4	1	10	6	1	1	2004	2

eof
9999

2. *EAG21.1e2 ctl file*

```
#  EAG21_1e2 Fishery Completed
# ———————— #
#  Controls  for  leading  parameter  vector  theta
#  LEGEND  FOR  PRIOR:
#  0 = uniform, 1 = normal, 2 = lognormal, 3 =  beta, 4 =  gamma
# ———————————— #
#  ntheta
 9
# ———————————— #
# ival      lb     ub       phz   prior   p1      p2      # parameter         #
# ———————————————— #
  0.22      0.01   1.0      -3     2     0.18    0.04      # M
 7.795733473  -10.0 20.0   1    0    -10.0    20.0      # ln R0,
 12.0       -10.0   20.0     -3    0    -10.0    20.0      # ln Rini, logarithm of initial recruitment(syr)

   8.0       -10.0  20.0     -1    0    -10.0    20.0       # ln Rbar,
 110.0      103.0  165.0     -2    1     72.5    7.25      #  Expected value of recruitment distribution

 1.613057863  0.001  20.0    3    0     0.1     5.0        # recruitment scale (variance component)
  -0.693147181 -10.0   0.75   -1    0   -10.0     0.75      # ln (SigmaR), 0.73       0.2    1.0       -2    3     3.0     2.0       # steepness (only used if R is
constrained by a S-R relationship)
  0.001      0.0    1.0      -3    3     1.01    1.01      # recruitment autocorrelation (only used if R is constrained by a S-R relationship)
#————————————————

# weight-at-length input  method  (1 = allometry  [w_l = a*l^b],  2 = vector by sex)
2
#a, in kg
# 1.445E-07
#b
# 3.281126995
# Male weight-at-length
 0.581515707            0.679328169            0.788032347            0.908278308            1.040724257            1.186036294
                1.344888179            1.517961114            1.705943543            1.90953096             2.129425732            2.366336933
                2.620980182            2.894077494            3.186357141            3.498553516            3.993657581
#
# Proportion mature by sex, males
  0.  0.  0.  1.  1.  1.  1.  1.  1.  1.  1.  1.  1.  1.  1.  1.
# Proportion legal by sex, males
  0.  0.  0.  0.  0.  0.  0.  1.  1.  1.  1.  1.  1.  1.  1.  1.
## ——— ##
## GROWTH PARAM CONTROLS                                                  ##
##     Two lines for each parameter if split sex, one line if not         ##
## ———————————— ##
# Use growth transition matrix option (1=read in growth-increment matrix; 2=read in size-transition; 3=gamma distribution for size-increment;
4=gamma distribution for size after increment) (1 to 8 options available)
# option 8 is normal distributed growth increment, size after increment is normal
8
# growth increment model (0=prespecified; 1=alpha/beta; 2=estimated by size-class;3=pre-specified/empirical)
1
# molt probability function (0=pre-specified; 1=flat;2=declining logistic)
2
# maximum size-class (males then females)
#17
# Maximum size-class for recruitment(males then females)
5
## number of size-increment periods
1
## Year(s) size-increment period changes (blank if no changes)

## number of molt periods
1
## Year(s) molt period changes (blank if no changes)

## Beta parameters are relative to a base level (1=Yes;0=no)
1  #
```

```
# Growth parameters
## ———————————————— ##
# ival        lb        ub      phz   prior      p1      p2         # parameter         #
# ———————————————— #
   25.301231724   10.0    50.0    7       0       0.0     20.0   # alpha,   0.090658479   -0.4    20.0     7       0       0.0     10.0   # beta,   3.679993156   0.01
5.0      7       0       0.0     3.0   # growth scale,
  141.383256037  65.0   165.0    7       0       0.0     999.0  #  moult mu,
  0.089295406  -0.1      2.0     7       0       0.0     2.0   # moult cv,
 # ———————————— ##

# The custom growth-increment matrix

# custom molt probability matrix

##  ——————————  ##
## SELECTIVITY CONTROLS                                                    ##
##     Selectivity P(capture of all sizes). Each gear must have a selectivity and a       ##
##     retention selectivity. If a uniform prior is selected for a parameter then the     ##
##     lb and ub are used (p1 and p2 are ignored)                          ##
## LEGEND                                                          ##
##     sel type: 0 = parametric (nclass), 1 = indiviudal parameter for each class(nclass),##
##              2 = logistic (2, inflection point and slope), 3 = logistic95 (2, 50% and 95% selection), 4 = double normal (3 parameters),            ##
##
##    5: Flat equal to zero (1 parameter; phase must be negative), UNIFORM1
##    6: Flat equal to one (1 parameter; phase must be negative), UNIFORM0                    ##
##    7: Flat-topped double normal selectivity (4 parameters)
##    8: Declining logistic selectivity with initial values (50% and 95% selection plus extra)
##  Extra (type 1): number of selectivity parameters to be estimated
##     gear index: use +ve for selectivity, -ve for retention                  ##
##     sex dep: 0 for sex-independent, 1 for sex-dependent                       ##
## ———————————————————————————————————————————————  ##
##  ivector  for  number  of  year  blocks  or  nodes  ##
##    Gear-1   Gear-2
## PotFishery    Trawl Byc
       2        1                # selectivity time periods
       0        0                # set 0 for male only fishery, sex specific selectivity, 0 for sex independent selectivity
       2        5                # male selectivity type model (flat equal to zero, 1 parameter) or logistic or  double normal etc.
       0        0                # within another gear insertion of fleet in another
       0        0                # extra parameters for each pattern
## Gear-1    Gear-2
      1        1                # retention time periods
      0        0                # set 0 for male only fishery, sex specific retention
      2        6                # male retention type model (flat equal to one, 1 parameter)
      1        0                # male retention flag (0 = no, 1 = yes)
      0        0                # extra
# AEPAEP
      1        1                                    # determines if maximum selectivity at size is forced to equal 1 or not
## ———————————————————##
##  Selectivity  P(capture  of  all  sizes)
## ———————————————— ##
## gear  par   sel                                    phz     start  end    ##
# index par sex  ival      lb     ub    prior     p1      p2     mirror period period  ##
## ———————————————— ##
## Gear-1
  1     1     1   0  121.527984805 105.0 180.0   0    100.0  190.0     3     1960   2004 #set sex 0 for male only fishery, from my model
  1     2     2   0  23.524122652  0.01    40.0   0     0.1    50.0     3     1960   2004 # ub increased from 20. to 40.from my model
  1     3     1   0  136.297570666 105.0 180.0   0    100.0  190.0     3     2005   2021 # from my model
  1     4     2   0   8.232679011  0.01    20.0   0     0.1    50.0     3     2005   2021 # from my model

# Gear-2
  2     5     1   0    1.00      0.99  1.02   0     10.0  200.0   -3     1960   2021
##———————————————— ##
## Retained
## gear  par   sel                                        phz     start  end
# index index par sex  ival        lb     ub      prior   p1     p2     mirror period
# Gear-1
 -1      6    1   0   136.462513750  105.0  180.0  0      100.0  190.0    3     1960   2021 #
 -1      7    2   0    2.197791627   0.0001  20.0  0      0.1    50.0     3     1960   2021 #
```

```
# Gear-2
 -2     8   1  0    1.00        0.99   1.01  0       10.0   200.0    -3     1960   2021

## ———————————— ##
# Number of asymptotic parameters
1
# Fleet   Sex     Year       ival   lb   ub    phz
      1     1     1960   0.000001   0    1     -3
## ———————————— ##
## PRIORS FOR CATCHABILITY
##     If a uniform prior is selected for a parameter then the lb and ub are used (p1   ##
##     and p2 are ignored). ival must be > 0                                          ##
## only allowed to use uniform or lognormal prior
## if analytic q estimation step is chosen, turn off estimating q by changing the estimation phase to be -ve
## LEGEND                                                                             ##
##     prior: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma              ##
## ———————————— ##
#
## SURVEYS/INDICES ONLY
## fishery and observer CPUE
## Analytic (0=not analytically solved q, use uniform or lognormal prior;
## 1= analytic),
## Lambda =multiplier for iput CV, Emphasis = multiplier for likelihood
##  ival       lb        ub    phz    prior   p1        p2     Analytic?   LAMBDA   Emphasis
 0.000624232  0.0000001   0.01   1      0      0.0     1.0      0          1       1   # observer cpue index 1995-2004
 0.000528304  0.0000001   0.01   1      0      0.0     1.0      0          1       1   # observer cpue index 2005-2021
 0.000439948  0.0000001   0.01   1      0      0.0     1.0      0          1       1   # fishery cpue index 1985-1998

## if a uniform prior is specified then use lb and ub rather than p1 and p2
## ————————————————##
## ADDITIONAL CV FOR SURVEYS/INDICES
##     If a uniform prior is selected for a parameter then the lb and ub are used (p1   ##
##     and p2 are ignored). ival must be > 0, lb should be>0                           ##
## LEGEND                                                                             ##
##     prior type: 0 = uniform, 1 = normal, 2 = lognormal, 3 = beta, 4 = gamma         ##
## ———————————— ##
##  ival        lb        ub    phz   prior   p1    p2
 0.000194204  0.0000001   0.5    6      0      0.5   100  # obs CPUE additional CV adjusted for abundance in 1000s
 0.000125488  0.0000001   0.5    6      0      0.5   100  # obs CPUE additional CV adjusted for abundance in 1000s
 0.000244461  0.0000001   0.5    6      0      0.5   100  # fishery CPUE additional CV adjusted for abundance in 1000s

### Pointers to how the additional CVs are used (0 ignore; >0 link to one of the parameters
1 2 3
####
## if a uniform prior is specified then use lb and ub rather than p1 and p2
##————————————————##
##PENALTIES  FOR  AVERAGE  FISHING  MORTALITY  RATE  FOR  EACH  GEAR
##
## ————————————————##
##  Trap  Trawl
## Male F, Female F, early_phasepenalty_sd, later_phasepenalty_sd, meanmaleF_phase, meanfemaleF_phase,
## lb meanF, ub meanF,lbannualmaleF(F_dev), ubannual maleF(F_dev),lbannualfemaleF(F_dev), ubannual femaleF(F_dev)
## BBRKC uses STD_PHZ1=0.5 STD_PHZ2=45.5
## Mean_F    Fema-Offset   STD_PHZ1 STD_PHZ2 PHZ_M PHZ_F    Lb     Ub     Lb     Ub     Lb    Ub
   0.362835284       0.0        3.0    15.0     2    -1     -12      4    -10     10     -10    10  #
   0.000220033       0.0        4.0    15.0     2    -1     -12      4    -10     10     -10    10  #
## ——————————————————————————————————————————————————————##
## OPTIONS FOR SIZE COMPOSTION DATA                                                   ##
##     One column for each data matrix                                                ##
## LEGEND                                                                             ##
##     Likelihood: 1 = Multinomial with estimated/fixed sample size                   ##
##                 2 = Robust approximation to multinomial                            ##
##                 3 = logistic normal (NIY)                                          ##
##                 4 = multivariate-t (NIY)                                           ##
##                 5 = Dirichlet                                                      ##
## AUTO TAIL COMPRESSION                                                              ##
##     pmin is the cumulative proportion used in tail compression                     ##
## ————————————————————————————————————  ##
#  ret tot
#
```

```
 1   1        # Type of likelihood
 0   0        # Auto tail compression (pmin)
 1   1        # Initial value for effective sample size multiplier
-4  -4       # Phz for estimating effective sample size (if appl.)
 1   2        # Composition aggregator if you put 1 for each it will merge, do not merge (why merge)
 # AEPAEP
 1   1        # Set to 2 for survey-like predictions; 1 for catch-like predictions
 # AEPAEP
 0.7439549140625  0.52412323046875  # Emphasis AEP for Dritchlet (Ret, Tot, multiplier of stage1 ESS)

 1   1       # LAMBDA 0 to ignore the length comp
## ———————————— ##

## TIME VARYING NATURAL MORTALIIY RATES ##
## ———————————— ##
## Type: 0 = constant natural mortality                                    ##
##       1 = Random walk (deviates constrained by variance in M)           ##
##       2 = Cubic Spline (deviates constrained by nodes & node-placement) ##
##       3 = Blocked changes (deviates constrained by variance at specific knots) ##
##       4 = Changes in pre-specified blocks                               ##
##       5 = Changes in some knots                                         ##
##       6 = Changes in Time blocks                                        ##
 0   # M type
## M is relative (YES=1; NO=0)

## Phase of estimation
3
## STDEV in m_dev for Random walk
0.25
## Number of nodes for cubic spline or number of step-changes for option 3
1
#0
## Year position of the knots (vector must be equal to the number of nodes)
1960
## number of breakpoints in M by size (keep it at 0)
0
# line groups for breakpoint
8
## Specific initial values for the natural mortality devs (0-no, 1=yes)
## 1
## ival       lb       ub       phz    extra
##    3.0       0.5      5.0      4       0

## ———————————— ##
##  TAGGING controls
## ———————————— ##
 1        # emphasis on tagging data (1 =use tag LH, 0=ignore)
## ———————————— ##
## Maturity specific natural mortality
### AEP
## ———————————— ##
# maturity specific natural mortality? (yes = 1; no = 0; only for use if nmature > 1)
 0

## ———————————————————————— ##

##            ival       lb              ub                    phz                   prior        p1                    p2        # parameter    ##


## ———————————————————————— ##

              0              -1                    1                     -1                    0            1                     1
## ———————————— ##
## ———————————— ##
##  OTHER  CONTROLS
## ———————————— ##
#
1960      # First year of recruitment estimation,rec_dev. There is a difference in timing between Gmacs and my model, EAG 21_1e2 first rec_dev is 1961 and last rec_dev 2021
2021      # last year of recruitment estimation, rec_dev
```

```
  1      # phase for recruitment estimation,earlier -1. rec_dev estimation phase, BBRKC uses 2
 -2      # phase for recruitment sex-ratio estimation
 0.5     # Initial value for Expected sex-ratio
 -3      # Phase for initial recruitment estimation, rec_ini phase
  1      # VERBOSE FLAG (0 = off, 1 = on, 2 = objective func; 3 diagnostics)
  0      # Initial conditions (0 = Unfished, 1 = Steady-state fished, 2 = Free parameters, 3 = Free parameters (revised))
  1      # Lambda (proportion of mature male biomass for SPR reference points).
  0      # Stock-Recruit-Relationship (0 = none, 1 = Beverton-Holt)
  10     # Maximum phase (stop the estimation after this phase), 10  Maximum phase. If you put 1 it  will stop after phase 1
  -1     # Maximum number of function calls, if 1, stop at fn 1 call; if -1, run as long as it takes
  1      # Calculate reference points (0=no)
  200    ### Year to compute equilibria
## EMPHASIS FACTORS (CATCH)
#ret_male  tot_male   Groundfish
       4       2          1
## EMPHASIS FACTORS (Priors) by fleet: fdev_total, Fdov_total, Fdev_year, Fdov_year
0 0 0.001 0 # Pot fishery
0 0 0.001 0 # Groundfish


## EMPHASIS FACTORS (Priors)
##
# Log_fdevs   meanF      Mdevs  Rec_devs Initial_devs Fst_dif_dev Mean_sex-Ratio  Fvecs Fdovs
#         0       0        0.0         2           0         0          0         1     0      #
# AEP
# Log_fdevs   meanF      Mdevs  Rec_devs Initial_devs Fst_dif_dev Mean_sex-Ratio  Molt_prob      Free selectivity          Init_n_at_len Fvecs
Fdovs
                0       0        0.0         2           0         0          0              0                  0                  0     1     0      #
##  EOF
9999
```

3. *EAG21.1e2 prj file*

```
# References
 0                  # 0 = Do not compute MSY (1=Yes)
 0 1                  # Set to 0 if F35% applied to this fleet; 1 if future F is to be fixed
 1986 2016              # for Rbar calc, First and last year for average recruitment,/MMB for Bspr calculation (Tier 3 or Tier 4)
 1985 2021              # First and last years for average sex ratio
 2011 2021              # First and last years for average F for discards
 2021 2021              # First and last years for M (0=last year)
 2021 2021              # First and last years for proportion of the season
 0                  # Year for specifying growth (0=last year)
 2011 0                 # First and last years for average selex and discard (0=last year)

# OFL specifications
 0.35                 # Target SPR ratio for Bmsy proxy.
 3                  # Tier
 0.10                 # Alpha (cut-off)
 0.25                 # Beta (limit)
 1.00                 # Gamma
 0.75                 # ABC-OFL buffer
 0                  # If compute MSY selection is zero, yield function compute selection should be set to zero. Produce a yield curve (1=yes;
2=no)

# Projection material
 2021                 # Last year of projection from the terminal (last year data) year
 1                  # Number of strategies (0 for no projections)
 0  1.2               #
 1                  # 0 for no mortality for non-directed fleets (see input #1 above); 1=Yes
 2                  # Mcmc replicates per draw
 -3423.8              # Fixed BMSY (negative number for replicate-specific)
 1986 2016              # for Rbar calc, First and last year for average recruitment
 1985 2021              # First and last years for average sex ratio
 2011 2021              # First and last years for average F for discards
 2021 2021              # First and last years for M (0=last year)
 2021 2021              # First and last years for proportion of the season
 0                  # Year for specifying growth for projections (0=last year)
 2011 0                 # First and last years for average selex and discard (0=last year)
```

```
 1                  # Stock-recruitment option (1=Mean Rec;2=Ricker;3=BH;4=Mean and CV)
 8                  # age-at-recruitment
#
 1960 2021              # First and last years for generating future recruitment (only used if Stock_recruitment option = 1)
 2430.211266              # Mean recruitment in 1000s for projections
 0.35                 # (only used if Stock_recruitment option = 2)
 0.2                  #
 -999                 # Initial eps (first rec_dev, set to -999 to generate it),

# State strategy
 0                  # Apply strategies [OFL, ABC] (1=yes;0=no)
 0.001474157              # Mean weight (1985-2021) to use (mature in t)
 0.001978596              # Mean weight (1985-2021) to use (legal in t)
# Stop after XX mcdraws
 10000

# Full diag
0

## eof
9999
```