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Different scenarios for choosing the prior over the catch in 2012 for 3M cod

by

Diana González-Troncoso
Instituto Español de Oceanografía, Vigo, Spain

Introduction

The 3M cod is assessed all years since 2008 due to the sudden recovery of the stock since 2006. An XSA Bayesian model was approved for first time in 2008 for assessing the stock and has been used since then (Fernández *et al.*, 2008). For 2011, STACFIS only had STATLANT 21A available as estimates of catches. The inconsistency between the information available to produce catch figures used in the previous year's assessments and that available for the 2011 catches has made it impossible for STACFIS to provide the best assessments for some stocks. In the case of the 3M cod stock a prior over the catch of 2011 was applied in order to be able to make an assessment.

For 2012 the same situation as 2011 is presented, that is, STACFIS only has STATLANT 21A as available estimates of the catch. So, a solution to try to solve this problem in the case of the 3M stock could be the same as last year, with a prior over the catch of 2012. The aim of this document is to try to choose the most convenient prior.

Material and Methods

The last approved assessment for 3M cod used the data from commercial vessels from 1988 to 2011 and as tuning the EU survey in Div. 3M from 1988 to 2011. This year the set of data was extended with the commercial data considered in the 2001 assessment (Vázquez and Cerviño, 2001), and the Canadian survey performed between 1978 and 1985 in Div. 3M is used as a new tuning of the assessment (data provided by Joanne Morgan). So the data to perform the preliminary assessment are the following one:

Catch data for 41 years, from 1972 to 2012

For 2011: $\text{TotalCatch}(2011) \sim \text{LogNormal}(\text{median}=9.46, \text{sd}=0.1313)$

For 2012: To be chosen

Years with catch-at-age: 1972-2001, 2006-2012

Tuning with Canadian survey for 1978 to 1985

EU survey for 1988 to 2012

More details about the data used will be provided in the SCR of the assessment during the SC of NAFO.

The median of the prior of the catch in 2011 was chosen taking into account that the effort from 2010 to 2011 was increased around a 30% and that the STACFIS estimation for the catches in 2010 was 9 281 tons.

Four different options for the prior over the total catch in 2012 were considered:

Option 1. As the TAC in 2012 (9 280 tons) is very similar to the TAC in 2011 (10 000 tons) and a preliminary exploration of some of the fleets that fish 3M cod lead in a similar effort in 2012 than in 2011, the first option is to choose a prior of the catch of 2012 equal to the prior of the catch in 2011:

$$\text{TotalCatch}(2012) \sim \text{LogNormal}(\text{median}=9.46, \text{sd}=0.1313)$$

Option 2. Taking into account that this is the second year that we have no consistent estimation of the catch, it is possible that the uncertainty on the knowledge of the actual catch could be higher than last year. For that, a prior of the catch of 2012 equal to the prior of the catch in 2011 with a shift of 20% in the SD is considered:

$$\text{TotalCatch}(2012) \sim \text{LogNormal}(\text{median}=9.46, \text{sd}=0.3136)$$

Option 3. As the TAC in 2012 is not equal to the TAC in 2011 but lower, a shift over the median of the prior of the catch in 2011 can be used as the median of the prior of the catch in 2012. This shift can be lower or higher, so a possibility can be a prior of the catch of 2012 equal to the prior of the catch in 2011 with a shift in the median via an uniform(0.9,1.1), which means a shift of 10% in the median of 2012 with regards to 2011:

$$\text{shift} \sim \text{dunif}(0.9,1.1)$$

$$\text{TotalCatch}(2012) \sim \text{LogNormal}(\text{median}=9.46+\ln(\text{shift}), \text{sd}=0.1313)$$

Option 4. In each iteration of the Bayesian assessment, a posterior median for the catch of 2011 and a catch of 2012 over the logNormal is chosen. It seems to be logical than both medians were more or less the same in the same iteration, but with the previous priors it could happen than in the same iteration the posterior median of the catch of 2011 was around 9 000 tons but near 20 000 tons for 2012. So, the two medians in the same iteration were linked via an uniform in order to avoid a difference of more than a 10% between both medians in each iteration via an uniform.

$$\text{shift} \sim \text{dunif}(0.9,1.1)$$

$$\text{TotalCatch}(2012) \sim \text{LogNormal}(\text{median}=\text{Catch}(2011)+\ln(\text{shift}), \text{sd}=0.1313)$$

To run the preassessments, 1000 iterations of the Bayesian model (instead of 5000 as it is usual in the assessment) were performed.

Results

For the four options, the prior and the posterior over the catch can be seen in Figure 1. In Table 1 the posterior median and the 5% and 95% percentiles for catch of 2011 and 2012 is presented, as far as the results of the posterior median for the 2011 catch resulting from last year assessment. The results of the preassessments with the different options could be seen for Total Biomass (Table 2, Figure 2), SSB (Table 3, Figure 3), Recruitment (Table 4, Figure 4) and F_{bar} (Table 5, Figure 5). A graph comparing Total Biomass and Total Abundance is presented in Figure 6. And the PR for 2011 and 2012 with the different options is shown in Figure 7.

As we can see, there is no an important update of the posterior median catch of 2011 this year in any option. Note that every time the assessment is run, a new posterior median will result. It is interesting to be noted that the only option for which the posterior median of the catch for 2011 is higher than the last year posterior median is the option 4, in which the catch of 2012 depends on the catch of 2011 in each iteration. The value of the posterior median is quite different in each option, being the Options 1 and 3 the ones in which the posterior median for 2012 is closer to the posterior median in 2011 (around 13 500 - 14 000 tons), and Option 2 the more different (with a posterior median of the catch of 2012 of almost 19 000 tons). The standard deviation is more or less the same for the posterior of the catch of 2011, but for the posterior of the catch of 2012 there are lot of difference for Option 2 (higher) and a bit less for Option 4. In those two options the update of the posterior median catch for 2012 with regards to the median of the prior is quite important. In all the cases, Option 2 is the one that has more differences with the rest of the options.

For the results of the assessment, Option 2 is the one that is more different to the rest of the options, particularly with regards to the F_{bar}, which is consistent with a higher catch. Besides that, in that option the biomass and the SSB is higher than in the rest of the options. Nevertheless, the results of the preassessments for the four options give us the same view of the stock.

Conclusions

As we have no actual knowledge about the catch of 2012 but the stability of the effort, it seems that the best option could be Option 1, as it is the simplest one and the assumptions about it are not too restrictive. The results of the preassessment are quite similar in all the analyzed scenarios.

References

Fernández, C., S. Cerviño and A. Vázquez, 2008. Assessment of the Cod Stock in NAFO Division 3M. NAFO SCR Doc. 08/26. Serial Number N5391

Vázquez, A. and S. Cerviño, 2001. A Review of the Status of the Cod Stock in NAFO Division 3M. NAFO SCR Doc. 01/60. Serial Number N4438

Table 1.- posterior median and the 5% and 95% percentiles for catch of 2011 and 2012

		50%	5%	95%	SD
Option 1	**2011**	13550	10989	16784	1799
	2012	13670	11089	17241	1832
Option 2	**2011**	13430	10720	16751	1873
	2012	18980	11279	31921	6454
Option 3	**2011**	13735	10900	17121	1848
	2012	13930	10889	17661	2130
Option 4	**2011**	14580	11860	18230	1951
	2012	16020	11428	21731	3095
Last year ass	**2011**	13900	11020	17321	1898

Table 2.- Posterior results: Total Biomass.

	Option 1			Option 2			Option 3			Option 4		
Year	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**
1972	82480	78329	88323	82295	78188	87441	81527	78093	86830	81857	78111	86550
1973	48785	45643	53143	48543	45495	52652	48083	45341	51887	48294	45541	51902
1974	51946	47535	59461	51626	47279	58293	51027	47092	57372	51287	47246	57155
1975	66035	59066	76517	65524	58876	75215	64218	58352	73343	64835	58782	73374
1976	107544	98118	121391	107192	97907	119721	105467	97471	116957	106149	97823	116659
1977	82490	76735	92621	82040	76260	91106	81150	75953	88799	81545	75934	89444
1978	55806	52398	60830	55515	52248	60399	55126	51901	59468	55175	52128	59470
1979	49218	45296	55507	48858	45243	55023	48390	44978	53761	48409	45114	53563
1980	30477	27642	35981	30367	27644	35384	29952	27269	34363	30104	27327	34216
1981	33516	29296	40127	33419	29154	39950	32817	28766	39073	32903	28895	39258
1982	29477	26894	33304	29374	26935	32742	28888	26673	32321	29110	26816	32301
1983	39277	35296	44873	38948	35328	44166	38444	35033	43034	38635	35038	43209
1984	45026	41059	50430	44854	41093	49481	44309	40928	48734	44366	40978	49089
1985	38038	35447	41703	37931	35430	41141	37544	35421	40550	37693	35502	40587
1986	39949	36197	45396	39740	36193	44671	39246	36045	43833	39299	36100	44039
1987	52562	47310	60296	52315	47172	58948	51657	47176	57836	51780	47408	57547
1988	64412	59496	71183	64105	59418	70235	63583	59396	68890	63654	59480	68583
1989	104367	98177	112537	104021	98058	111584	103054	97886	110154	103424	97950	109860
1990	64003	60604	68861	63852	60378	68570	63298	60227	67591	63600	60425	67324
1991	43902	40902	48272	43817	40795	48065	43281	40684	47001	43515	40676	47111
1992	57832	54800	61987	57625	54683	61524	57176	54545	60816	57308	54622	60771

Table 2 (cont.).- Posterior results: Total Biomass.

	Option 1			Option 2			Option 3			Option 4		
Year	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**
1993	45771	42845	49846	45578	42822	49365	45053	42630	48484	45384	42808	48922
1994	49444	46143	54651	49430	46157	54483	49037	46158	54309	49085	46201	53633
1995	22475	21216	24374	22473	21203	24211	22299	21194	23847	22352	21265	23977
1996	5726	5124	6706	5732	5093	6703	5669	5077	6569	5674	5090	6576
1997	4831	4157	5892	4873	4137	5954	4840	4107	5881	4778	4109	5866
1998	3487	2641	4951	3574	2604	4986	3539	2566	4892	3481	2583	4982
1999	2525	1686	3847	2563	1743	3856	2555	1703	3923	2488	1726	3855
2000	2311	1438	3890	2387	1463	3861	2374	1429	4009	2310	1438	3909
2001	1952	1472	2680	2024	1388	2818	2050	1335	2749	1928	1363	2562
2002	2273	1802	2988	2359	1731	3154	2395	1669	3105	2267	1708	2896
2003	2538	2094	3247	2632	2015	3412	2676	1954	3390	2560	2028	3153
2004	4117	3493	5001	4249	3411	5212	4258	3300	5180	4145	3410	4917
2005	4520	3823	5319	4641	3855	5502	4594	3714	5546	4507	3778	5280
2006	7019	5731	8896	7152	5837	8774	6820	5612	8583	6884	5609	8609
2007	13040	10513	16750	13347	10811	16714	12727	10342	16216	12867	10589	16150
2008	20270	16478	25976	20892	17010	26286	19744	16327	24751	20187	16485	25320
2009	30644	25166	37461	31839	26195	38741	30033	25089	36376	30615	25769	37724
2010	45377	38424	54393	46976	39798	55996	44944	38093	53090	45699	39156	54717
2011	52887	43418	67158	55829	45047	70251	53051	42556	65483	54030	44225	67752
2012	62816	46725	88630	66600	49308	91351	61483	45406	86793	62142	46688	85955

Table 3.- Posterior results: SSB.

	Option 1			Option 2			Option 3			Option 4		
Year	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**
1972	36483	33479	40217	36395	33498	40114	36200	33321	39733	36264	33500	39898
1973	20004	17030	23460	19935	17127	23470	19884	16974	23505	20026	16983	23236
1974	14956	13172	19403	14878	13133	19567	14764	13043	18907	14897	13138	19470
1975	7593	6179	11344	7561	6153	11365	7489	6110	11236	7593	6228	11364
1976	8521	6585	12592	8440	6571	12633	8285	6550	11384	8450	6485	12305
1977	20780	16922	27544	20806	16964	27105	20522	16975	26107	20611	16947	27151
1978	28237	23498	33686	28020	23346	33489	27915	23156	33428	27856	23031	33173
1979	23934	20985	28746	23870	21008	28339	23605	20955	27948	23652	21025	28218
1980	11463	9757	15710	11421	9726	15430	11205	9639	14939	11238	9633	15049
1981	13137	9271	19230	13102	9361	18872	12890	9219	18453	12834	9204	19094
1982	13063	11559	15254	13071	11593	15099	12976	11356	15389	13034	11510	15308
1983	11985	10390	14390	11904	10430	14117	11833	10232	14169	11849	10242	14118
1984	19224	16960	22204	19148	16965	21995	19008	16710	21812	19015	16790	21960
1985	20608	19051	22650	20578	19075	22455	20483	18896	22242	20556	18925	22350
1986	15384	13745	18063	15346	13834	17916	15314	13697	17994	15252	13676	18032
1987	12420	11061	15357	12371	11015	15305	12429	10964	15024	12372	11104	15115
1988	19172	15304	24036	18980	15350	23805	18966	15337	23265	18963	15392	23288
1989	33492	27330	41065	33372	27434	40520	33182	27263	40603	33361	27259	40016
1990	25261	21930	29450	25160	21926	29437	25030	21656	29117	25062	21880	28880
1991	17693	14931	21058	17709	14973	21084	17462	14795	20686	17501	14912	20969
1992	20778	18428	23889	20744	18326	23786	20702	18474	23516	20742	18384	23494

Table 3 (cont.).- Posterior results: SSB.

	Option 1			Option 2			Option 3			Option 4		
Year	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**
1993	10481	8915	13016	10456	8898	12914	10311	8851	12597	10412	8899	13169
1994	21394	18554	26123	21445	18468	26567	21278	18369	26297	21293	18485	25690
1995	19251	18021	20968	19217	18024	20807	19089	17975	20616	19164	18028	20706
1996	3468	3099	4112	3473	3080	4110	3450	3078	4063	3451	3070	4065
1997	3246	2731	4202	3285	2698	4133	3274	2691	4104	3232	2685	4167
1998	3278	2446	4719	3360	2425	4774	3322	2361	4665	3279	2384	4752
1999	2375	1552	3678	2430	1614	3716	2415	1578	3776	2348	1573	3711
2000	2153	1294	3695	2249	1316	3654	2235	1282	3860	2158	1293	3791
2001	1766	1272	2461	1835	1176	2612	1867	1169	2531	1745	1190	2347
2002	1980	1535	2687	2065	1428	2836	2106	1408	2797	1974	1426	2600
2003	2277	1836	2950	2371	1770	3123	2418	1722	3106	2281	1766	2914
2004	3376	2802	4226	3504	2737	4429	3542	2672	4481	3430	2774	4189
2005	3724	3148	4452	3822	3156	4605	3831	3062	4658	3752	3147	4408
2006	4048	3241	5029	4145	3335	5056	4005	3241	5106	4008	3238	5006
2007	5714	4390	7595	5809	4529	7594	5704	4394	7490	5639	4503	7540
2008	10117	8154	12975	10284	8234	12988	9941	8058	12689	10080	8123	12808
2009	19416	15921	24548	19906	16090	24830	19179	15736	23823	19463	16006	24143
2010	32479	27358	39810	33561	28302	40878	32484	27290	38959	32941	27808	39616
2011	33343	26198	44257	34953	27532	45536	33515	26595	43175	34094	27133	45302
2012	29065	21700	40835	32136	23119	43788	28836	21369	41331	29501	22559	41304

Table 4.- Posterior results: Recruitment.

	Option 1			Option 2			Option 3			Option 4		
Year	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**
1972	16165	13670	20152	16060	13569	19560	15550	13430	18911	15710	13568	18890
1973	56035	45797	71617	55460	45578	69550	53350	45090	66802	54030	45228	66154
1974	110750	91177	142320	110100	90468	137705	105750	89598	132605	107200	90248	132300
1975	20585	16430	27213	20405	16350	26180	19560	16060	25260	19780	16310	24942
1976	9112	7447	11700	9020	7417	11301	8703	7336	10881	8826	7370	10800
1977	2702	2104	3626	2637	2106	3551	2547	2056	3355	2596	2066	3350
1978	18245	15000	23311	18120	14970	22450	17460	14830	21670	17665	14890	21550
1979	12190	9891	15932	12100	9866	15281	11630	9769	14670	11790	9862	14561
1980	6776	5312	9188	6724	5272	8961	6442	5205	8507	6538	5245	8519
1981	18825	15260	24501	18655	15280	23654	17990	15040	22650	18205	15200	22503
1982	18585	14979	24322	18385	14858	23370	17660	14760	22410	17955	14829	22301
1983	11710	9480	15192	11605	9496	14701	11160	9367	14062	11330	9472	13931
1984	13225	10719	17310	13080	10670	16550	12600	10570	16090	12770	10580	15811
1985	52690	43308	66976	52285	43178	65250	50370	42600	62566	51120	42808	62167
1986	108750	91454	134810	108200	91310	131215	104500	90299	127200	105800	90799	126305
1987	68835	58196	85048	68360	58107	82563	66100	57490	79747	66985	57898	79470
1988	14245	11740	18031	14170	11730	17540	13610	11570	16900	13805	11640	16781
1989	19080	16190	23356	18990	16140	22722	18365	16000	22061	18600	16108	21991
1990	24125	20818	29054	24020	20748	28350	23310	20560	27572	23565	20660	27432
1991	61155	53698	72170	60915	53550	70460	59315	53120	68810	59880	53410	68427
1992	55320	48117	65796	55090	48136	64262	53635	47600	62702	54110	47889	62689

Table 4 (cont.).- Posterior results: Recruitment.

	Option 1			Option 2			Option 3			Option 4		
Year	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**
1993	2995	2617	3596	2975	2604	3479	2905	2581	3399	2932	2594	3395
1994	4111	3160	5840	4084	3179	5781	3943	3101	5530	3990	3138	5462
1995	2154	1802	2777	2150	1792	2727	2097	1784	2605	2087	1768	2559
1996	130	87	210	129	85	199	124	81	198	126	84	196
1997	126	80	199	124	80	196	121	81	192	124	77	195
1998	197	142	286	193	144	279	198	146	283	196	142	273
1999	33	23	48	32	23	47	32	23	46	33	24	45
2000	316	197	515	322	196	539	292	189	465	301	183	487
2001	548	346	911	557	355	861	523	348	818	529	336	836
2002	67	41	114	67	42	110	63	40	106	64	40	101
2003	1190	796	1821	1200	808	1788	1136	774	1745	1128	776	1781
2004	80	57	116	78	57	112	76	57	109	76	57	106
2005	3584	2396	5605	3567	2439	5573	3386	2363	5203	3460	2406	5231
2006	7505	5349	11540	7745	5508	11520	7094	5217	10540	7434	5351	10790
2007	9738	6988	14820	10220	7339	14770	9229	6894	13440	9740	7129	13780
2008	7322	5201	10860	7661	5454	11083	7083	5228	10494	7273	5237	10680
2009	13085	9050	21540	13935	9677	21814	12910	8615	20153	13380	8948	19740
2010	19630	10389	39804	19800	10250	38802	18110	10290	34175	19030	9730	35786
2011	50505	22156	105525	50830	23506	107600	47480	21838	106210	48910	20999	101300
2012	28310	9827	72286	27805	10304	74164	28255	10700	70570	27030	9685	79258

Table 5.- Posterior results: F_{bar}.

	Option 1			Option 2			Option 3			Option 4		
Year	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**
1972	0.710	0.668	0.740	0.712	0.674	0.741	0.716	0.680	0.744	0.714	0.680	0.742
1973	0.603	0.558	0.630	0.604	0.559	0.631	0.608	0.563	0.631	0.606	0.562	0.630
1974	1.404	1.228	1.513	1.410	1.237	1.518	1.419	1.257	1.525	1.416	1.242	1.521
1975	0.705	0.576	0.785	0.707	0.582	0.785	0.718	0.606	0.788	0.710	0.587	0.786
1976	0.354	0.320	0.383	0.356	0.323	0.384	0.359	0.327	0.387	0.359	0.328	0.385
1977	0.477	0.441	0.504	0.479	0.446	0.504	0.482	0.453	0.506	0.481	0.453	0.505
1978	0.485	0.441	0.513	0.486	0.448	0.514	0.491	0.453	0.515	0.489	0.456	0.515
1979	0.739	0.674	0.790	0.741	0.676	0.793	0.747	0.683	0.797	0.745	0.685	0.795
1980	0.577	0.528	0.616	0.579	0.530	0.616	0.584	0.539	0.621	0.581	0.535	0.619
1981	0.520	0.483	0.551	0.522	0.487	0.552	0.526	0.494	0.555	0.525	0.492	0.555
1982	0.624	0.572	0.666	0.626	0.579	0.667	0.632	0.588	0.668	0.631	0.582	0.666
1983	0.291	0.258	0.319	0.292	0.263	0.320	0.296	0.269	0.320	0.295	0.267	0.319
1984	0.244	0.223	0.261	0.245	0.225	0.261	0.246	0.227	0.261	0.247	0.227	0.261
1985	0.597	0.540	0.633	0.597	0.543	0.634	0.600	0.552	0.634	0.600	0.551	0.633
1986	0.771	0.703	0.825	0.775	0.714	0.826	0.779	0.724	0.825	0.778	0.723	0.825
1987	0.455	0.406	0.492	0.457	0.410	0.493	0.460	0.414	0.496	0.459	0.413	0.495
1988	0.516	0.471	0.550	0.518	0.477	0.551	0.523	0.482	0.553	0.521	0.485	0.552
1989	0.872	0.815	0.915	0.874	0.821	0.916	0.880	0.833	0.916	0.878	0.832	0.917
1990	0.908	0.853	0.953	0.910	0.858	0.955	0.918	0.867	0.957	0.915	0.869	0.956
1991	0.500	0.466	0.527	0.501	0.471	0.527	0.506	0.477	0.528	0.503	0.474	0.527
1992	1.555	1.479	1.615	1.555	1.487	1.617	1.566	1.493	1.619	1.563	1.499	1.616

Table 5 (cont.).- Posterior results: F_{bar}.

	Option 1			Option 2			Option 3			Option 4		
Year	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**	**50%**	**5%**	**95%**
1993	1.035	0.964	1.095	1.038	0.974	1.096	1.046	0.988	1.096	1.042	0.984	1.092
1994	0.957	0.910	0.993	0.959	0.917	0.996	0.965	0.920	0.997	0.963	0.922	0.997
1995	1.410	1.261	1.512	1.410	1.267	1.516	1.422	1.273	1.517	1.418	1.279	1.515
1996	0.667	0.552	0.757	0.665	0.557	0.756	0.670	0.573	0.761	0.673	0.558	0.763
1997	0.742	0.603	0.884	0.738	0.603	0.887	0.741	0.609	0.889	0.756	0.615	0.888
1998	0.306	0.225	0.418	0.301	0.226	0.411	0.303	0.226	0.416	0.310	0.232	0.418
1999	0.289	0.220	0.373	0.284	0.217	0.384	0.286	0.221	0.396	0.294	0.230	0.381
2000	0.186	0.132	0.261	0.189	0.133	0.258	0.180	0.128	0.242	0.182	0.133	0.257
2001	0.034	0.024	0.049	0.034	0.024	0.049	0.033	0.024	0.045	0.033	0.024	0.049
2002	0.015	0.008	0.029	0.016	0.007	0.032	0.013	0.007	0.035	0.013	0.007	0.027
2003	0.011	0.006	0.019	0.011	0.006	0.018	0.011	0.006	0.019	0.012	0.007	0.019
2004	0.003	0.002	0.005	0.003	0.002	0.005	0.003	0.002	0.005	0.003	0.002	0.005
2005	0.006	0.004	0.011	0.006	0.004	0.011	0.006	0.004	0.011	0.006	0.004	0.011
2006	0.213	0.164	0.270	0.212	0.167	0.270	0.216	0.166	0.276	0.218	0.166	0.279
2007	0.030	0.023	0.039	0.029	0.023	0.038	0.030	0.023	0.039	0.030	0.023	0.039
2008	0.073	0.056	0.095	0.073	0.056	0.095	0.073	0.057	0.097	0.074	0.057	0.097
2009	0.043	0.033	0.052	0.042	0.032	0.052	0.043	0.034	0.053	0.042	0.033	0.052
2010	0.283	0.229	0.344	0.267	0.217	0.328	0.287	0.232	0.345	0.276	0.220	0.335
2011	0.299	0.210	0.415	0.271	0.192	0.380	0.304	0.214	0.417	0.315	0.226	0.413
2012	0.310	0.196	0.513	0.441	0.221	0.838	0.317	0.190	0.530	0.370	0.218	0.618

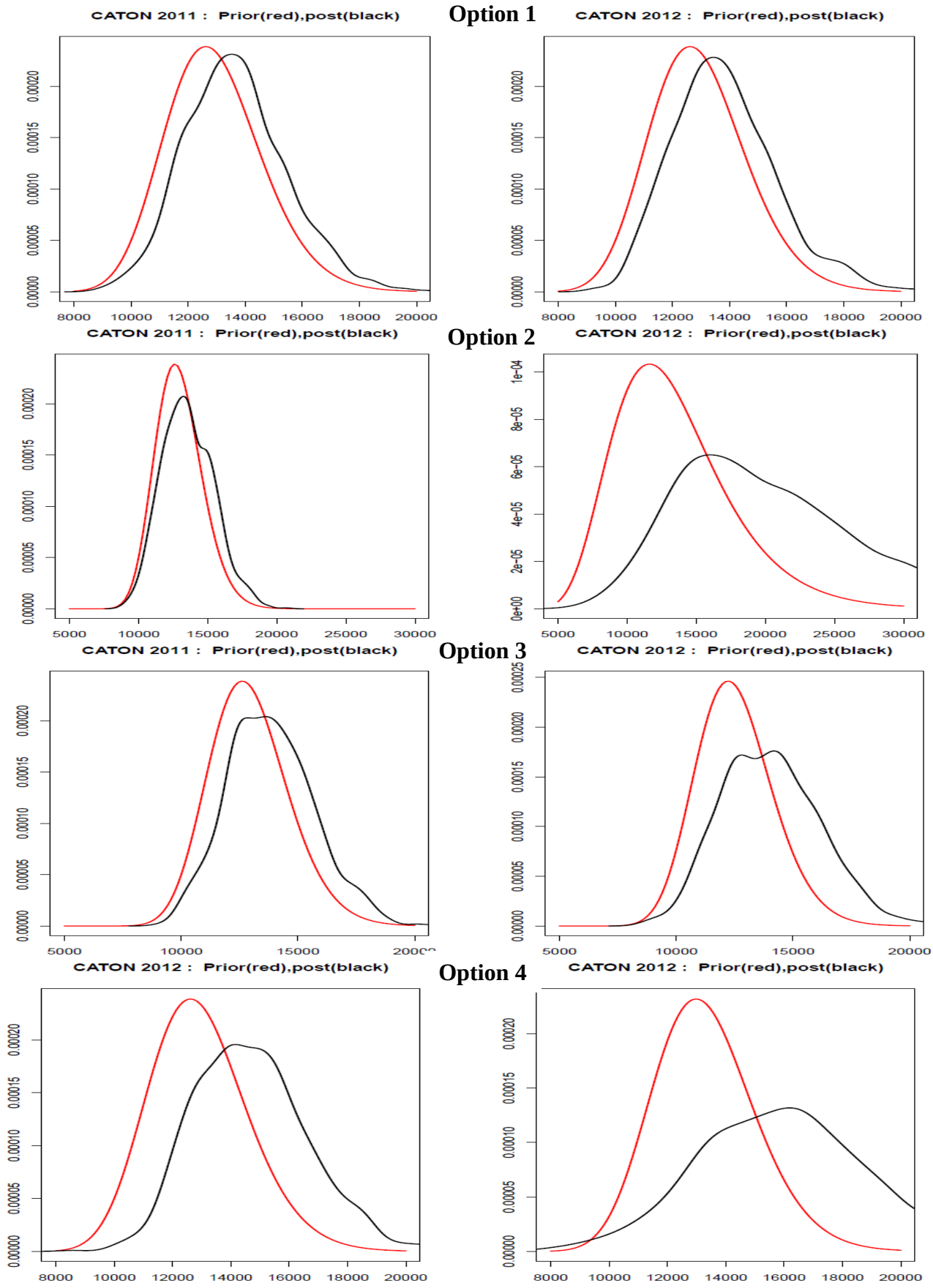


Figure 1. Prior and posterior of the catch in 2011 and 2012 for the four options. Note that in Option 3 the x-axis is up to 30 000.

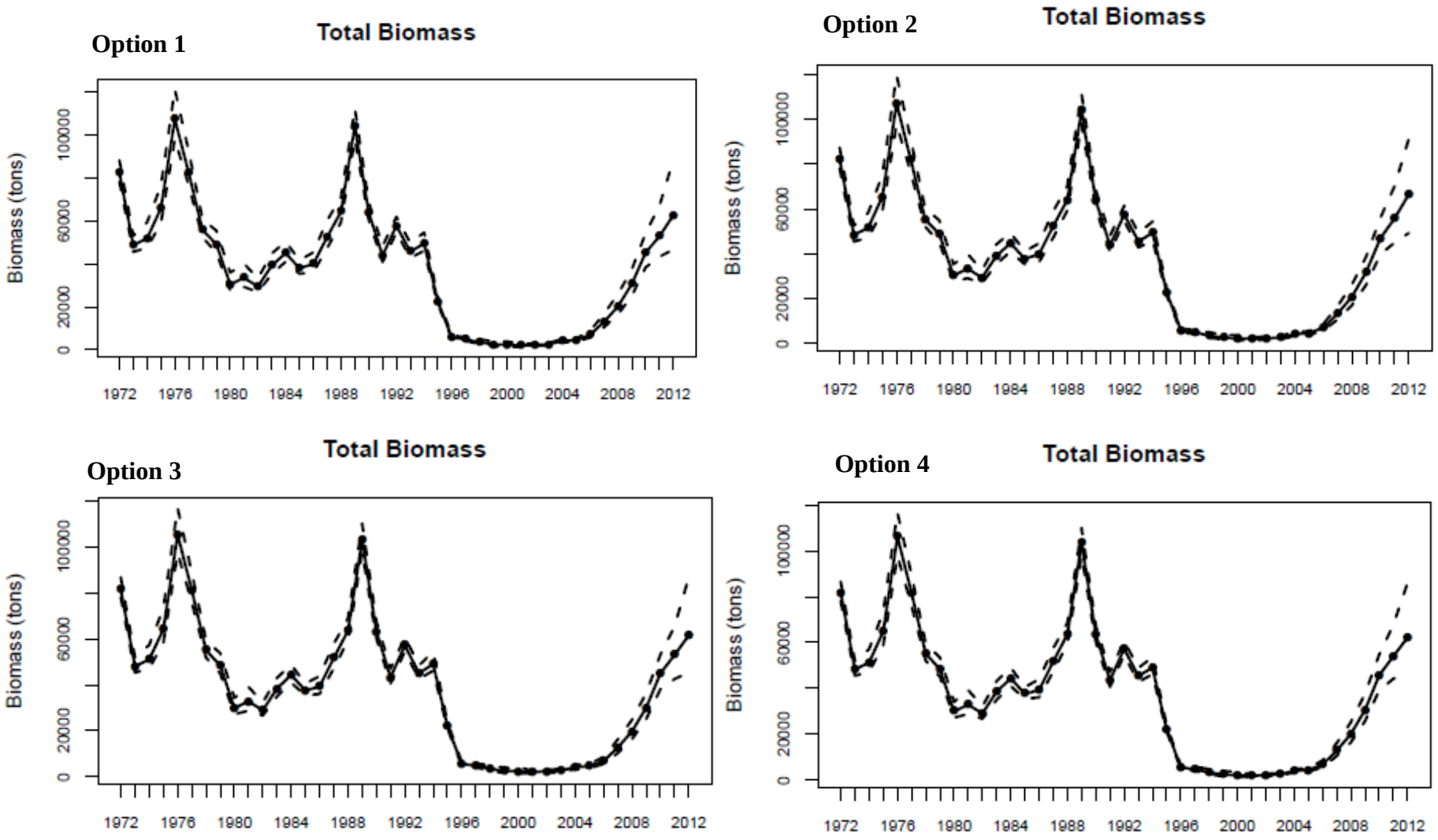


Figure 2.- Posterior results: Total Biomass

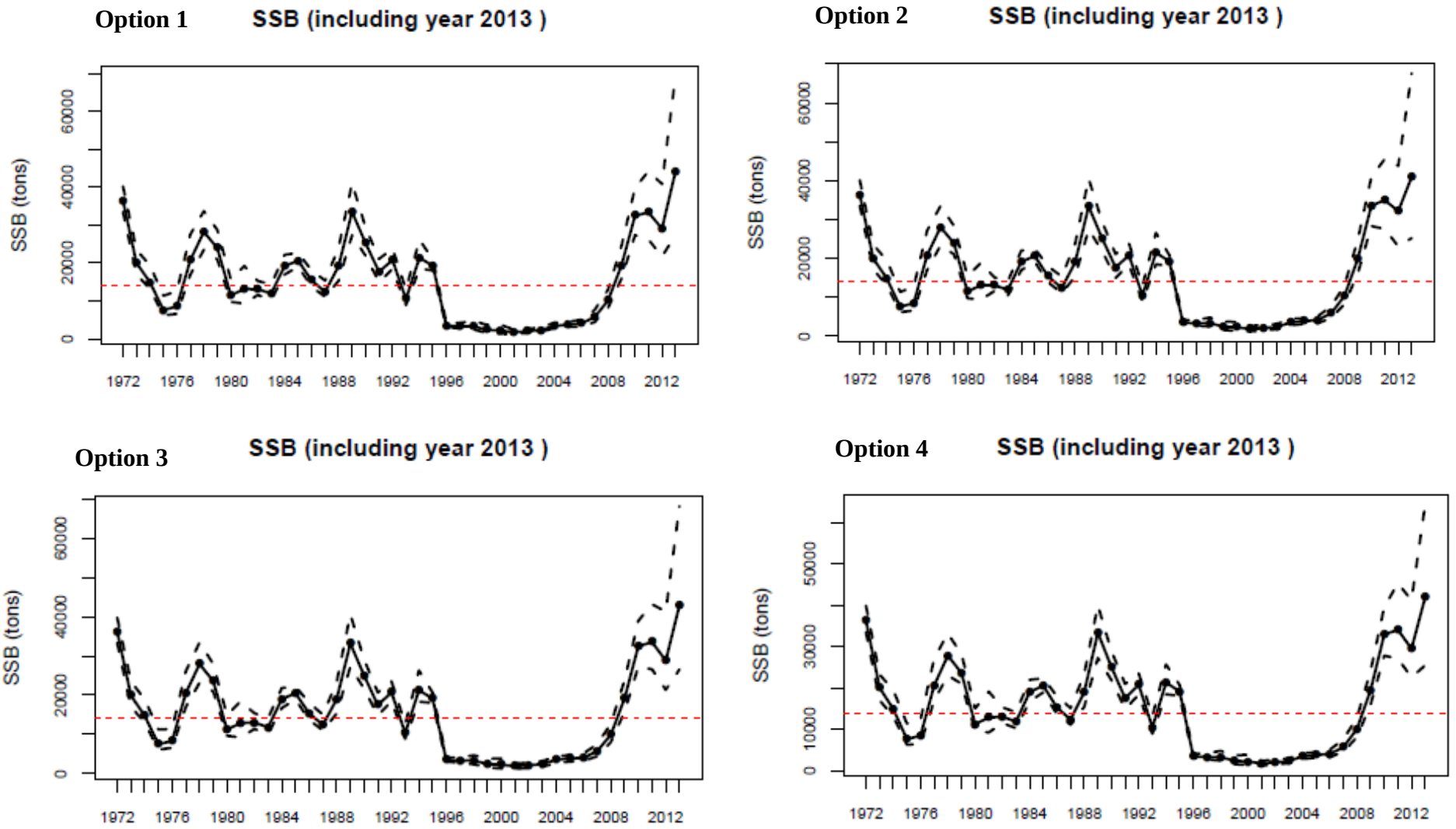


Figure 3.- Posterior results: SSB

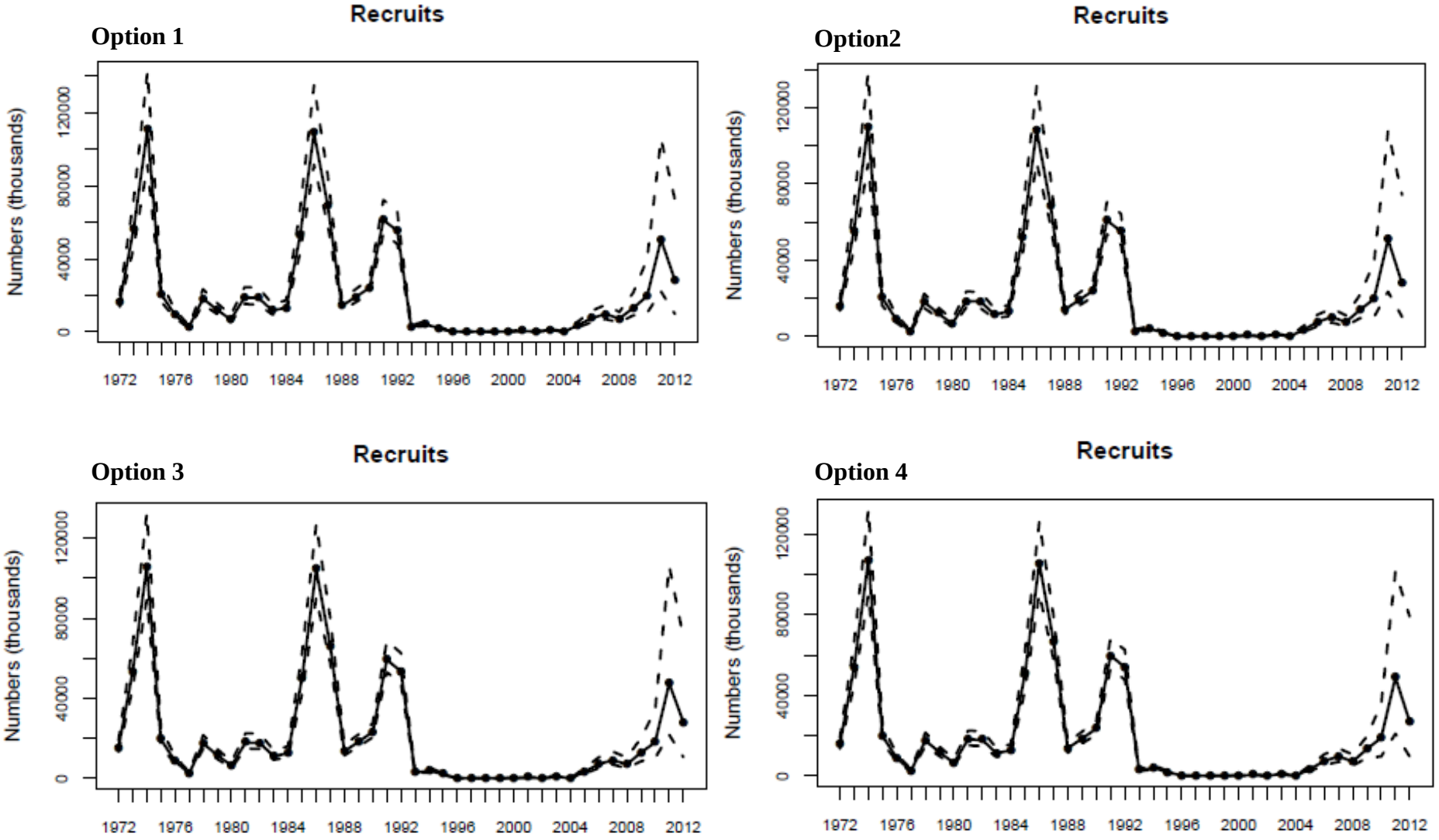


Figure 4.- Posterior results: Recruitment

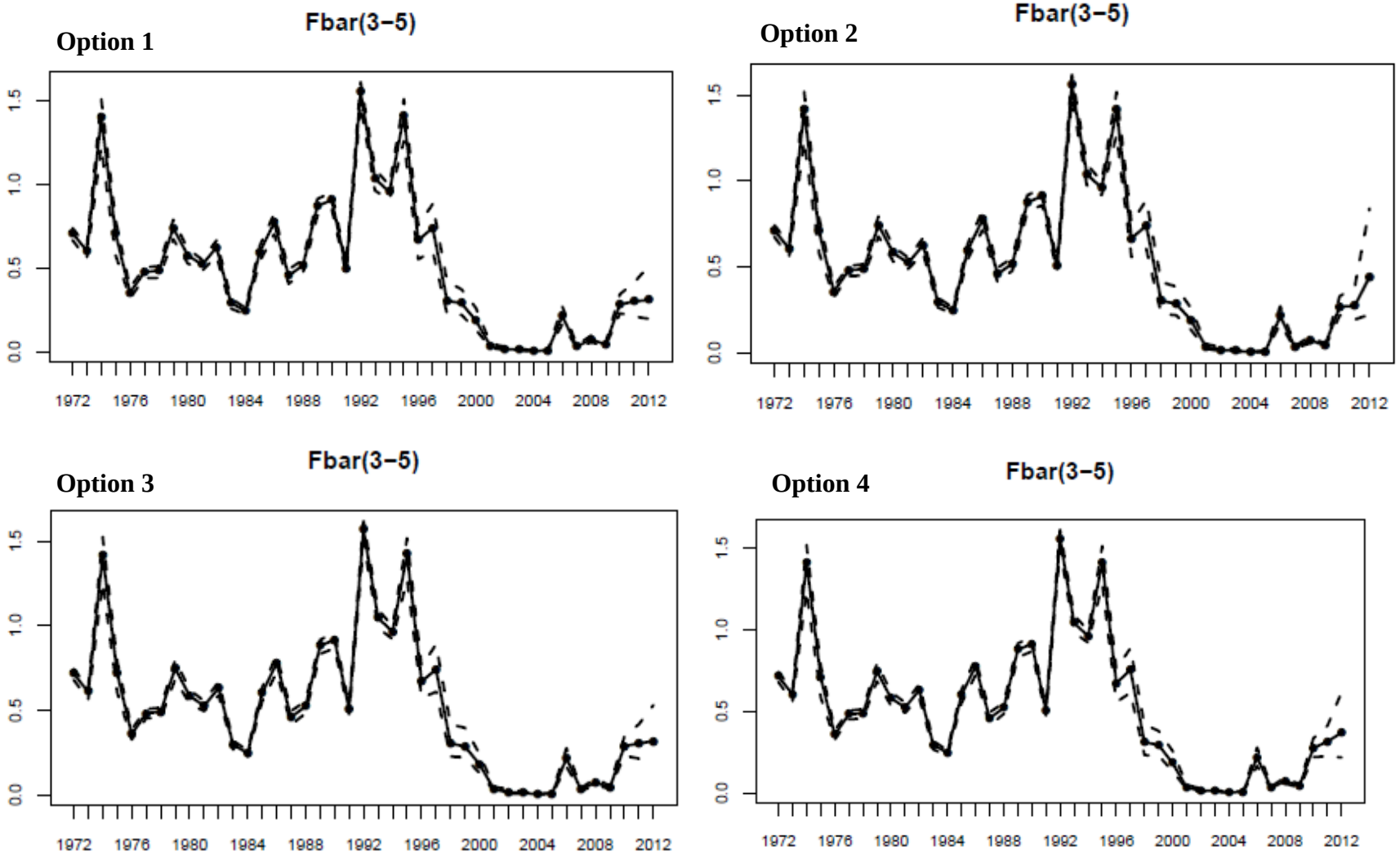
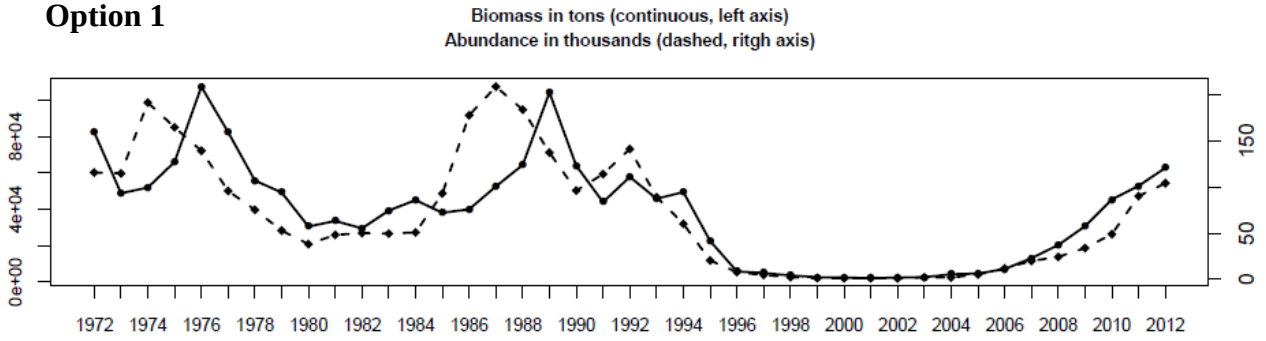
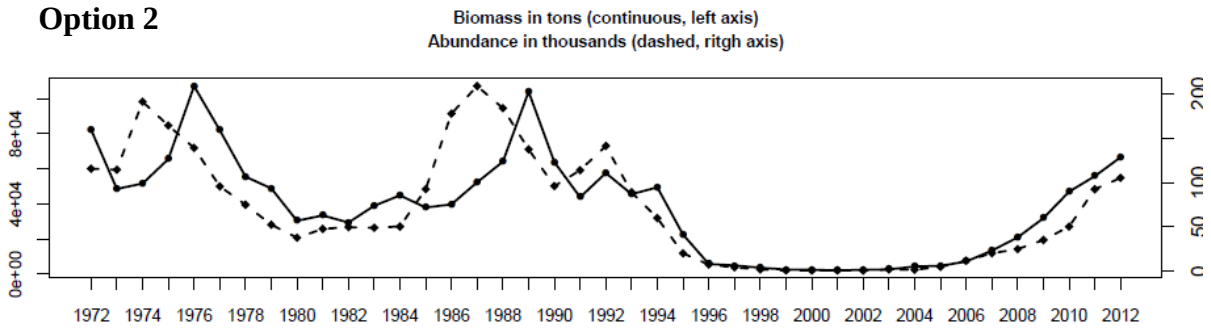


Figure 5.- Posterior results: F_{bar}

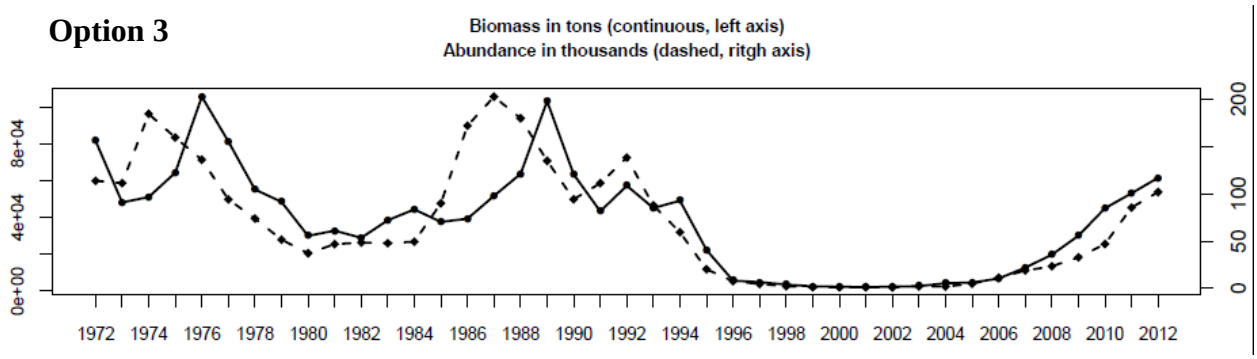
Option 1



Option 2



Option 3



Option 4

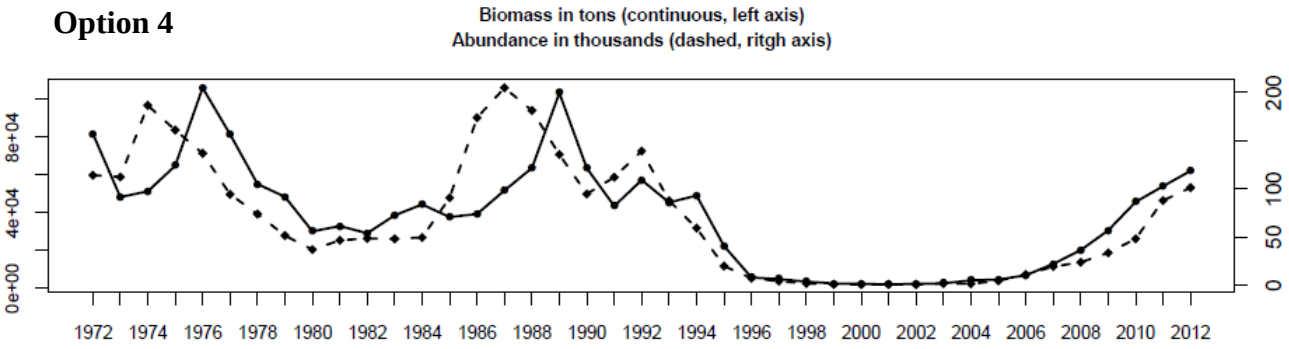
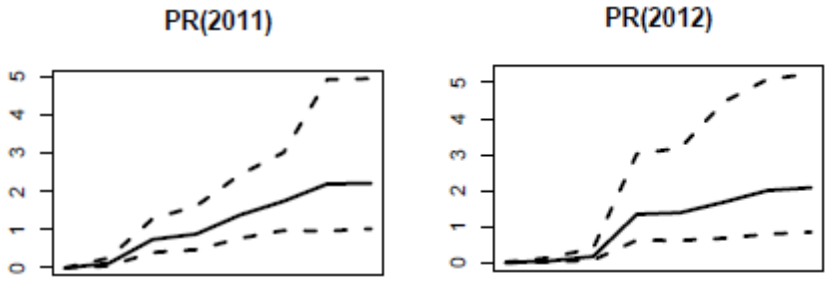
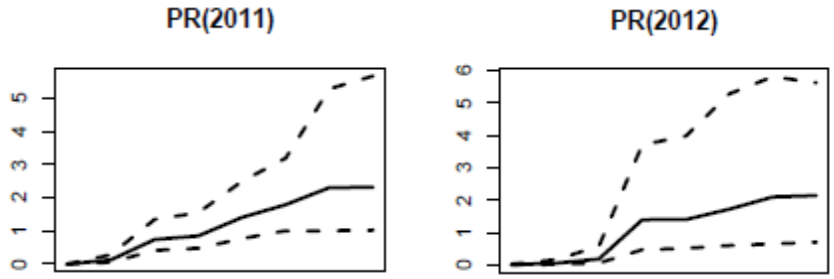


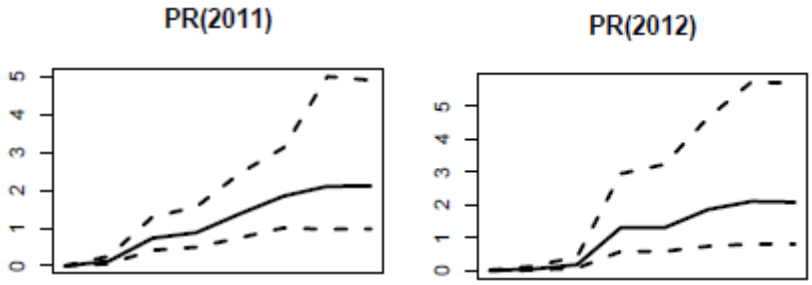
Figure 6.- Posterior results: Total Biomass and Total Abundance



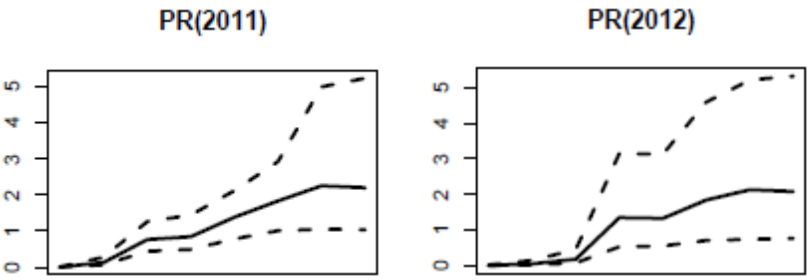
Option 1



Option 2



Option 3



Option 4

Figure 7.- Posterior results: PR for 2011 and 2012