Further Results Using Interim OMP-13v2

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Interim OMP-13v2 (de Moor and Butterworth 2013) was recently adopted by the Small Pelagic Scientific Working Group to finalise the anchovy TAC and small sardine TAB with anchovy for 2013. Further work on this OMP towards adopting a final OMP-13 by the end of 2013 is continuing. This document presents a number of further results using Interim OMP-13v2 to aid the understanding of some mechanisms within the OMP.

Questions of Interim OMP-13v2

The following is a list of questions posed by members of the Small Pelagic Scientific Working Group which are explored in this document.

1) The definitions of risk to the resources used to tune the OMP are defined in terms of the probability of the resource biomass falling below the risk threshold at least once during the projection period of 20 years. What does this mean in terms of the probability of biomass falling to a low level in any single year?
2) Add the performance statistic $p\left(TAC_{13-18}^{A} < c_{mntac}^{A}\right)$, the probability that Exceptional Circumstances are declared for anchovy within the next 5 years.
3) Show the distribution of anchovy TACs under OMP-08 and Interim OMP-13v2 given the past 27 years of survey observations.
4) Show the Exceptional Circumstances rule for Interim OMP-13v2 with $B_{ec}^{A} = 600$ thousand tons and $risk^{A} < 0.25$ and compare to that if $B_{ec}^{A} = 400$ or $B_{ec}^{A} = 800$ at different levels of observed or projected survey biomass.
5) Provide further results to explain why the proportion of simulated future observed November 1+ biomass below 1 million tons is greater when $B_{ec}^{A} = 600$ and $risk^{A} < 0.25$ than when $B_{ec}^{A} = 400$ and $risk^{A} < 0.25$ (Figure 3, de Moor 2013).
6) Provide some explanation as to why the average annual variation in the anchovy catch is similar (0.18 and 0.19) when $B_{ec}^{A} = 600$ or $B_{ec}^{A} = 800$ and $risk^{A} < 0.25$ (Table 1, de Moor 2013).

Results and Discussion

Each of the questions posed above are discussed in corresponding point form below.

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1) The risk to the resources, being the probability of the biomass falling below the risk threshold at least once during the projection period of 20 years, is 0.208 for sardine and 0.244 for anchovy under Interim OMP-13v2. The probability of the biomass falling below the risk threshold in any one year is 6.7% for sardine and 4.4% for anchovy.

2) The probability that Exceptional Circumstances are declared for anchovy during the projected 20 years is 0.30 under Interim OMP-13v2. This probability decreases to 0.23 between 2013-2017.

3) Table 1 shows the historical data for which anchovy TACs were calculated using both OMP-08 and Interim OMP-13v2. The data was assumed to be observed in the same order as historically occurred – this affects constraints on the maximum proportional decrease in anchovy TAC from one year to the next. There is no feedback from the TACs awarded to abundance levels of the subsequent year(s) in these calculations. However, calculating TACs under both OMPs for the same time-series of data allows for some comparisons to be drawn. Due to the higher α_{ns} control parameter for Interim OMP-13v2 compared to OMP-08, the initial anchovy TACs would have been higher under Interim OMP-13v2 compared to OMP-08 in all years except 1997 when Exceptional Circumstances are declared (Table 1, Figure 1a). Similarly, the revised normal season anchovy TACs would have been higher for Interim OMP-13v2 than OMP-08 in all years except 1997 and also 2001-2003 and 2010 (Figure 1b,c). The latter occurs when the revised normal season anchovy TAC under OMP-08 exceeded the Interim OMP-13v2 maximum TAC of 450 000t. Given the additional anchovy season under OMP-08 which could allow up to 120 000t if the observed abundance of anchovy was good, the total anchovy TAC under OMP-08 would have been higher than that under Interim OMP-13v2 in all years except 1989, 1994 and 1996 when no increase from the initial anchovy TAC was awarded during the year (Figure 1b,c).

4) Figure 2 shows the initial anchovy TAC under Interim OMP-13v2 with $B_{ec}^{A} = 600$ thousand tons compared to that if $B_{ec}^{A} = 400$ or $B_{ec}^{A} = 800$ and Table 2 gives the initial anchovy TAC for some selected survey estimates of abundance. The revised anchovy TAC is dependent on the projected biomass in the forthcoming November, taking the most recent recruitment and previous November survey estimates of abundance into account. Given a projected biomass value below an Exceptional Circumstances threshold, the revised anchovy TAC rule would be the same as for the initial anchovy TAC rule (subject to not being lower than the initial anchovy TAC). This is not, however, shown in a figure plotted against the survey estimates of November biomass or May recruitment, because a variety of combinations of survey estimates of November biomass, May recruitment, catch before and timing of the May survey can give each projected biomass value.

5) Figure 3a (reproduced from Figure 3 of de Moor 2013) shows a higher proportion of simulated future observed November 1+ biomass below 1 million tons if $B_{ec}^{A} = 600$ with $\beta = 0.090$ and $\alpha_{ns} = 0.871$ than if $B_{ec}^{A} = 400$ with $\beta = 0.094$ and $\alpha_{ns} = 0.539$. This initially

appears counter-intuitive as the control rule with $B_{ec}^{A}=600$ should be more conservative. Figure 4a shows that this conclusion is not simply due to the large bin used in the histogram of Figure 3a. Figures 3b,c and 4b,c show that for the same control parameter values, the MP with $B_{ec}^{A}=600$ is more conservative than if $B_{ec}^{A}=400$. Thus the reason for the higher proportion reaching lower biomasses if $B_{ec}^{A}=600$ compared to $B_{ec}^{A}=400$ in Figure 3a is due to the higher anchovy exploitation resulting from the control parameter choices corresponding to the corner point of the trade off curve for $B_{ec}^{A}=600$ (i.e. $\beta=0.090$, $\alpha_{ns}=0.871$) than that for $B_{ec}^{A}=400$ ($\beta=0.094$, $\alpha_{ns}=0.539$).

6) One might have *a priori* expected the average inter-annual variation in anchovy catch for $B_{ec}^{A}=800$ to be greater than that for $B_{ec}^{A}=600$ if Exceptional Circumstances are invoked more frequently. Figure 5 shows that although the probability of having a large inter-annual change[12] in anchovy catch is greater for $B_{ec}^{A}=800$ than $B_{ec}^{A}=600$, the probability of having no change[3] is also greatest for $B_{ec}^{A}=800$, thus causing the average to be similar between the two alternatives.

References

de Moor, C.L. 2013. OMP-13: Further results for alternative anchovy harvest control rules. DAFF Branch Fisheries document: FISHERIES/2013/JUN/SWG-PEL/11. 12pp.

de Moor, C.L. and D.S. Butterworth. 2013. Interim OMP-13v2. DAFF Branch Fisheries document: FISHERIES/2013/JUL/SWG-PEL/16. 18pp.

[1] Inter-annual increases in catch are not restricted.

[2] Inter-annual decreases in catch can be greater than the 25% restriction if the previous year's TAC is above the 2-tier threshold or if Exceptional Circumstances are declared.

[3] Mostly at maximum TAC

Table 1. A comparison of the anchovy TACs generated under OMP-08 compared to Interim OMP-13v2 for a given set of historic observations. The historic observations are as follows:

$B^A_{y,N}$ - November survey estimate of anchovy 1+ biomass in year y (in thousands of tons)

$N^A_{y,r}$ - May survey estimate of anchovy recruitment in year y (in billions)

t^A_y - Day of commencement of recruitment survey (time in months after 1 May)

$C^A_{y,0bs}$ - Anchovy catch at age 0 from 1 November of year $y-1$ to the day before the commencement of the recruitment survey (in billions)

$C^A_{y,1}$ - Anchovy catch at age 1 from 1 November of year $y-1$ to the day before the commencement of the recruitment survey (in billions)

$r_{y,sur}$ - Ratio of juvenile sardine to anchovy (by mass) indicated by the recruitment survey

$r_{y,com}$ - Ratio of juvenile sardine to anchovy (by mass) in the commercial catches during May

								OMP-08 TACs				Interim OMP-13v2 TACs	
	$B^A_{y,N}$	$N^A_{y,r}$	t^A_y	$C^A_{y,0bs}$	$C^A_{y,1}$	$r_{y,sur}$	$r_{y,com}$	Initial	Revised Normal Season	Addition al Season	Total	Initial	Revised and Total
1984	1553.813												
1985	1366.294	83.454	0.613	12.286	7.860	0.109		206	218	111	329	230	243
1986	2568.625	139.311	1.300	21.078	6.250	0.070		198	314	120	434	221	353
1987	2108.771	124.450	2.613	14.325	31.995	0.130	0.022	250	365	120	485	279	416
1988	1607.060	129.023	1.867	13.416	17.038	0.008	0.024	248	335	120	455	257	379
1989	751.529	33.128	1.233	12.459	14.209	0.285	0.036	248	248	0	248	248	248
1990	651.711	51.140	1.700	31.038	1.129	0.166	0.055	186	186	52	238	192	192
1991	2327.834	113.584	0.194	12.484	1.227	0.044	0.020	167	212	106	318	187	234
1992	2088.025	93.681	0.387	12.200	7.810	0.159	0.028	240	270	120	390	268	300
1993	916.359	115.058	0.645	1.471	9.064	0.246	0.088	229	280	120	400	256	309
1994	617.276	30.554	0.129	4.316	5.797	0.424	0.092	210	210	0	210	232	232
1995	601.271	110.439	1.300	12.433	1.677	0.497	0.138	166	220	110	330	185	247
1996	162.048	25.771	1.133	4.081	1.365	0.668	0.168	165	165	0	165	184	184
1997	1482.633	90.210	0.516	0.164	0.072	0.850	0.061	6	142	66	208	0	75
1998	1229.132	136.518	0.613	5.995	0.705	0.287	0.148	203	286	120	406	227	316
1999	2052.156	199.228	0.290	1.772	0.455	0.270	0.066	215	355	120	475	237	387
2000	4653.779	624.675	0.452	7.990	3.413	0.107	0.046	248	398	120	518	255	450

Table 1. (continued)

								OMP-08 TACs				Interim OMP-13v2 TACs	
	$B^A_{y,N}$	$N^A_{y,r}$	t^A_y	$C^A_{y,0bs}$	$C^A_{y,1}$	$r_{y,sur}$	$r_{y,com}$	Initial	Revised Normal Season	Additional Season	Total	Initial	Revised and Total
2001	6720.287	627.200	0.129	4.908	4.228	0.287	0.066	340	490	120	610	380	450
2002	3867.649	520.413	0.129	2.582	1.839	0.386	0.056	430	580	120	700	450	450
2003	3563.232	430.308	0.419	3.023	1.145	0.359	0.089	306	456	120	576	342	450
2004	2044.615	238.569	0.226	3.923	1.150	0.025	0.083	293	443	120	563	327	450
2005	3077.001	176.917	0.387	3.821	10.085	0.031	0.026	248	368	120	488	254	404
2006	2106.273	117.465	0.581	0.883	1.385	0.190	0.090	272	332	120	452	304	367
2007	2506.984	506.703	0.548	5.824	1.765	0.022	0.033	248	398	120	518	257	450
2008	3598.790	563.156	0.645	3.698	4.825	0.014	0.042	248	398	120	518	276	450
2009	3792.547	363.387	0.452	7.398	4.592	0.042	0.020	295	445	120	565	329	450
2010	2077.414	383.328	0.839	6.921	3.479	0.288	0.161	303	453	120	573	339	450
2011	754.124	104.166	0.839	5.781	1.666	0.191	0.123	248	271	120	391	256	301
2012	3187.964	203.160	1.500	32.050	3.413	0.093	0.046	203	353	120	473	225	450
2013		352.987	0.742	4.820	2.227	0.088	0.099	277	427	120	547	309	450

Table 2. The initial anchovy TAC for selected survey estimates of biomass under Interim OMP-13v2 with $B^A_{ec} = 600$ thousand tons compared to that if $B^A_{ec} = 400$ or $B^A_{ec} = 800$. All biomasses are given in thousands of tons. Grey shaded cells are those for which the Exceptional Circumstances rules are implemented.

	Previous year's anchovy TAC = 120 000t			Previous year's anchovy TAC = 450 000t		
$B^{obs,S}_{y-1,N}$	$B^A_{ec} = 400$	$B^A_{ec} = 600$	$B^A_{ec} = 800$	$B^A_{ec} = 400$	$B^A_{ec} = 600$	$B^A_{ec} = 800$
100	0	0	0	0	0	0
200	18	2	0	18	2	0
300	76	19	5	76	19	5
400	175	54	19	175	54	19
500	180	109	45	248	109	45
600	184	184	82	248	184	82
700	189	189	131	248	248	131

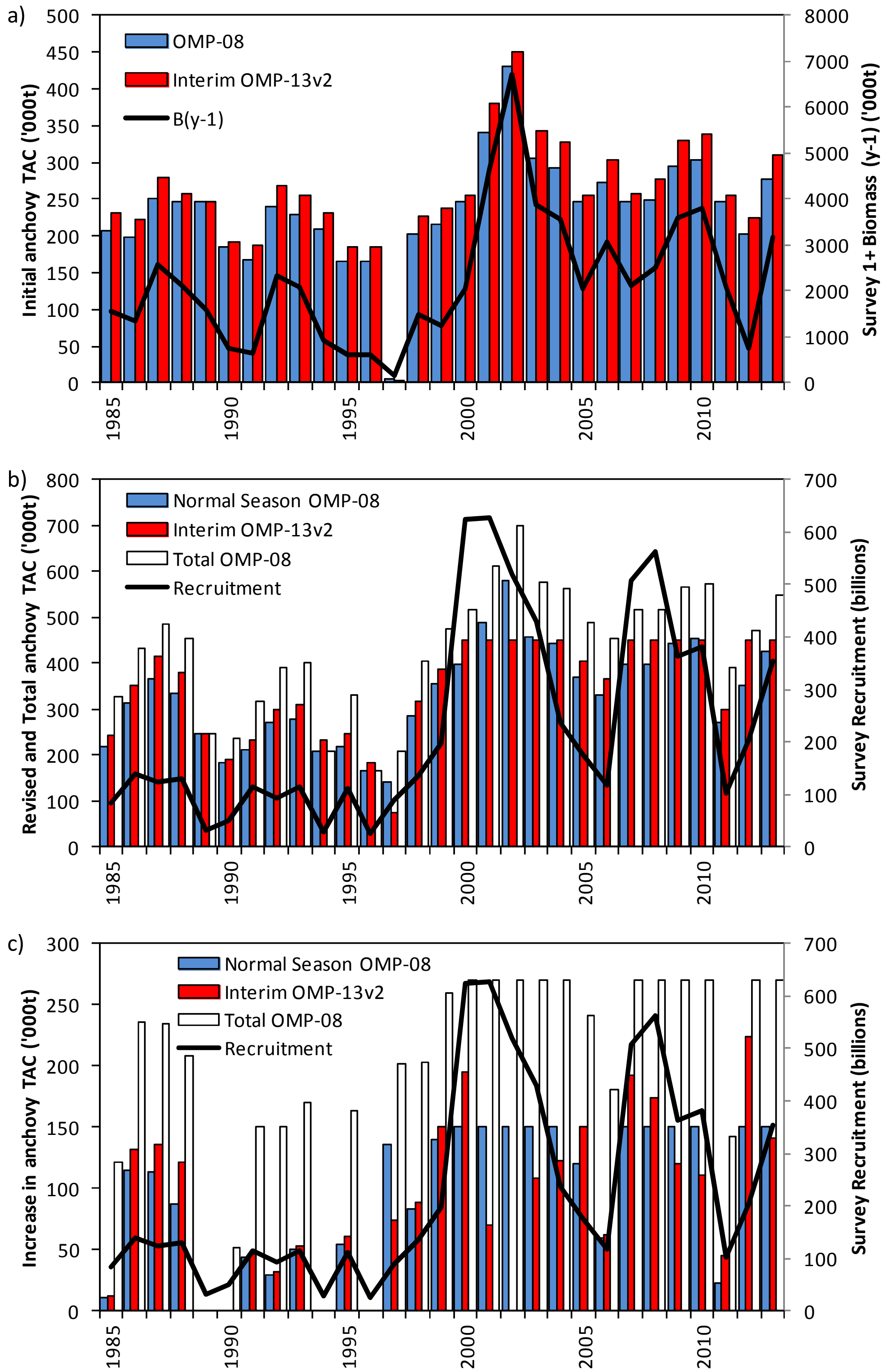

Figure 1. A comparison of the TACs generated under OMP-08 and Interim OMP-13v2 for the given set of historic observations. a) Initial anchovy TACs compared to the November survey estimate of anchovy biomass from the previous November, b) Revised normal season and total anchovy TAC compared to the May survey estimate of anchovy recruitment, and c) the mid-year increases in the anchovy TAC.

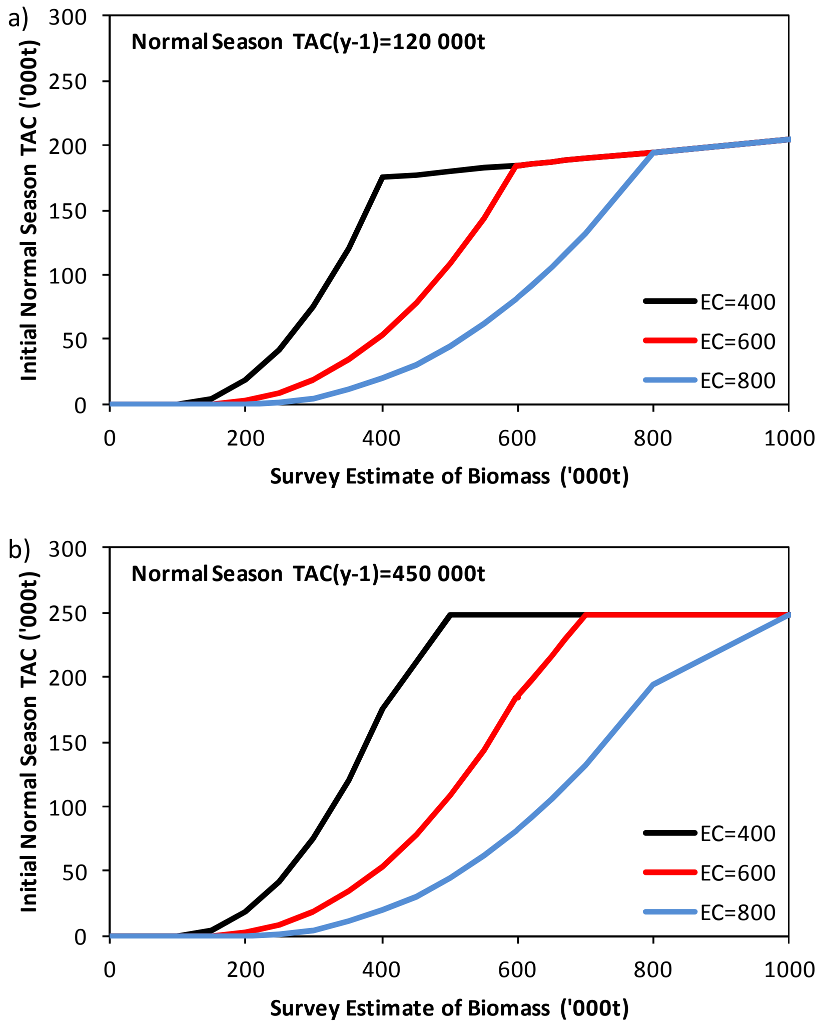

Figure 2. The initial anchovy TAC under Interim OMP-13v2 with $B_{ec}^{A} = 600$ thousand tons compared to that if $B_{ec}^{A} = 400$ or $B_{ec}^{A} = 800$, assuming the normal season anchovy TAC in the previous year is a) the minimum of 120 000t and b) the maximum of 450 000t.

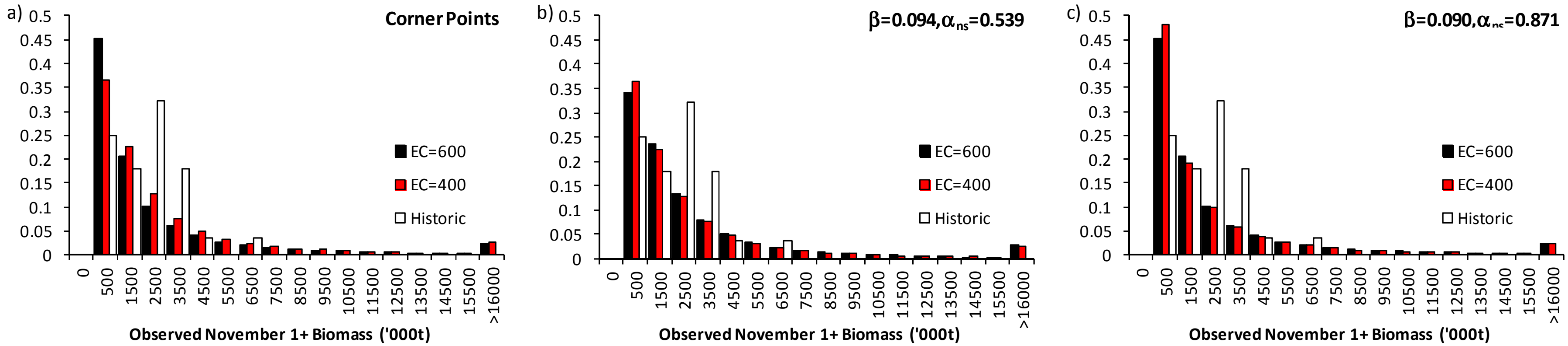

Figure 3. Histograms of the simulated future observed November 1+ biomass under Interim OMP-13v2 assuming $B_{ec}^{A}=400$ or $B_{ec}^{A}=600$ together with a histogram of the 1984-2011 observations for a) the corner points of trade-off curves ($\beta=0.094$, $\alpha_{ns}=0.539$ for $B_{ec}^{A}=400$ and $\beta=0.090$, $\alpha_{ns}=0.871$ for $B_{ec}^{A}=600$), b) $\beta=0.094$, $\alpha_{ns}=0.539$, and c) $\beta=0.090$, $\alpha_{ns}=0.871$.

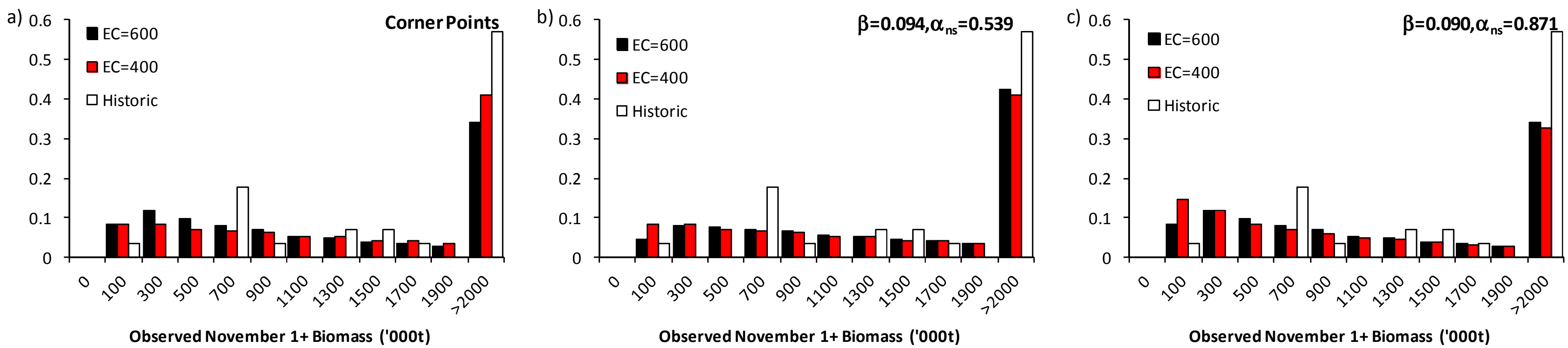

Figure 4. A repeat of Figure 1, using smaller bin sizes for the lower simulated future observed November 1+ biomass levels.

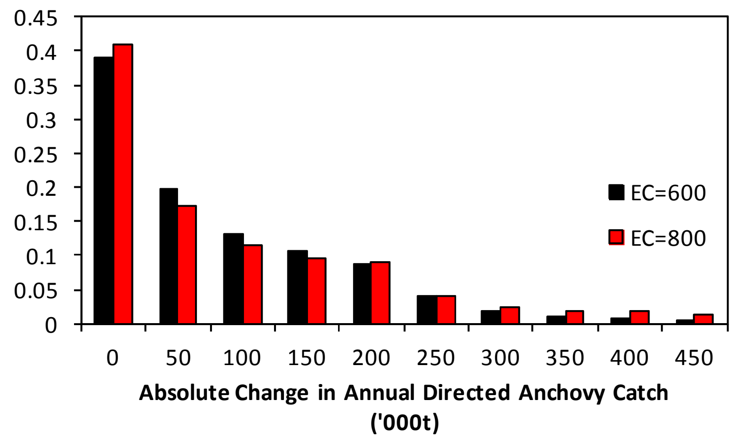

Figure 5. A histogram of the absolute inter-annual change in anchovy catch for $B_{ec}^{A} = 600$ ($\beta = 0.090$, $\alpha_{ns} = 0.871$) and $B_{ec}^{A} = 800$ ($\beta = 0.089$, $\alpha_{ns} = 1.061$).