

ECOREGION Bay of Biscay and Atlantic Iberian waters
SUBJECT EU request for clarification on the request for the evaluation of the harvest control rule for sole in the Bay of Biscay, October 2013

Advice summary

Table 7.2.3.1.2 presents the requested probabilities of the realised fishing mortality F being equal to or less than the F_{MSY} rate in each of the requested years. Table 7.2.3.1.3 presents the requested probabilities that paragraphs 2, 3, 4, 5, or 6 of the harvest control rule (HCR) will be applied for each year of the simulations. Table 7.2.3.1.4 presents the forecasted catch corresponding to the application of the harvest control rule in each year of the simulations.

This advice is a clarification of the original advice that was released in October 2013. This clarifying advice is therefore based on the same simulations as the 2013 advice and no additional biological assumptions have been investigated.

Request (letter from the European Commission dated 10 February 2014)

In in the course of several discussions concerning this advice, it has become apparent that certain different interpretations of ICES advice have arisen. Certainly some readers, including myself, found the advice confusing and open to misinterpretation as to the nature of the probabilities that are tabulated. As you know because of budgetary reasons, we are not currently in a position to request further advice concerning this stock, but if ICES were able to make some clarification of its existing advice, within the same financial allocation as has already been agreed, this would be extremely helpful to the advice recipients and stakeholders. Specifically, could ICES present:

1. *a table of probabilities similar to Table 7.3.5.2.1, but this time setting out the estimated probabilities that the realised fishing mortality F is less than or equal to the F_{msy} rate in each year?*
2. *table(s) of probabilities that, in each year of the simulations, paragraphs 2, 3, 4, 5 or 6 of the harvest rule will apply ?*
3. *a table of expected forecast catch corresponding to the application of the harvest rule in each year of the simulations ?*

Some advice recipients have also expressed surprise that ICES advice seems to indicate that exploiting the stock at a fixed TAC close to catch levels seen over the previous decade will lead, with high probability, to substantial reduction in fishing mortality. If ICES could provide an explanation, this would be extremely helpful.

Elaboration on ICES advice

Point 1 in the 2013 request from the Commission detailed six clauses¹ for the fixed-TAC scenario. These clauses are referred to throughout this advice by number.

1. *Rules for setting the TAC for the stock of sole in the Bay of Biscay are defined with the objective to reach F_{MSY} (i.e., $F = 0.26$) by 2020;*
2. *The TAC is set at a constant value until the fishing mortality is equal to F_{MSY} . TAC levels in a range of 3500 to 4500 tonnes (by 100 tonne steps) are tested;*
3. *When fishing mortality is equal to F_{MSY} , the TAC is set to give a forecast fishing mortality at F_{MSY} (0.26);*
4. *When the rule of paragraph 3 applies, the TAC set for a given year shall not correspond to a variation of less than or more than 10% compared to the TAC of the preceding year;*
5. *Notwithstanding paragraph 2, if fishing mortality increases during the two years preceding the advice on the status of the stock, the TAC is reduced by 10% compared to the previous year. The TAC level set in this way becomes the reference TAC fixed for the application of the rule in paragraph 2;*
6. *If the spawning stock biomass is estimated to be less than the biomass limit ($B_{lim} = 13,000$ tons), the TAC is set at a level corresponding to F_{MSY} .*

¹ For clarity, ICES refers to “clauses” throughout this advice; however, in the Commission’s request to ICES they are referred to as “paragraphs” and in Merzèreaud *et al.* (2013) as “rules”.

The information provided here is a clarification of the original advice that was released in October 2013. This clarifying advice is therefore based on the same simulations as the 2013 advice and no additional biological assumptions have been investigated. That said, further model checks were conducted to explore the effect(s) of the different clauses in the HCR.

Each of the questions posed by the European Commission in this request is answered below.

1) Probability of $F \leq F_{MSY}$

Table 7.2.3.1.1 (extracted from Table 7.2.3.2.1 in ICES, 2013) shows the probability (in per cent, for initial fixed-TAC values between 3500 and 4500 tonnes) of experiencing a change from the fixed-TAC regime (Clauses 2 and 5) to the F_{MSY} -target regime (Clauses 3 and 4). Table 7.2.3.1.1 does not give the probability of being above or below F_{MSY} . Rather, Table 7.2.3.1.1 shows the probability that, by following the HCR, F_{MSY} will have been reached during the preceding year and that management has shifted, for the given year, from a fixed-TAC regime to a F_{MSY} -target regime.

Table 7.2.3.1.2 gives the probability (in per cent) of the realised F being $\leq F_{MSY}$ when following the HCR, for initial fixed-TAC values between 3500 and 4500 tonnes. Figure 7.2.3.1.1 and Table 7.2.3.1.3 show how the probability of $F \leq F_{MSY}$ is derived and how the different clauses in the HCR contribute to this total probability. Three options (3500, 4000, and 4500 tonnes) were selected from Table 7.2.3.1.2 to illustrate the range of options and are shown in Figure 7.2.3.1.1. The centre panels of Figure 7.2.3.1.1 show the probability (in per cent) of F being less than or equal to F_{MSY} under the different HCR clauses and also when all clauses are applied in the HCR.

For all fixed-TAC options shown in Figure 7.2.3.1.1, the probability of F being less than F_{MSY} ($F < F_{MSY}$) increases over time under Clause 2. At an initial TAC of 4500 tonnes the probability under Clause 2 is initially quite low, rising to around 50% only by 2030. In contrast, at an initial TAC of 4000 tonnes the probability that $F \leq F_{MSY}$ under Clause 2 rises to 50% by 2020. An initial TAC of 3500 tonnes produces a more rapid response, with the probability that $F \leq F_{MSY}$ under Clause 2 rising to 50% by 2016. It should be noted that once Clause 3 is invoked, Clause 2 will never be invoked again even if the estimated F resulting from the other clauses should become higher than F_{MSY} .

The right-hand panels of Figure 7.2.3.1.1 show the overall probability of F being less than F_{MSY} under the HCR. The contributions of each part of the HCR are shown in different colours. An important contribution under Clause 2 (blue bars) to the total probability from exploitation in the beginning of the simulated period stems from uncertainty in the observations. The true magnitude of this contribution will depend on the actual magnitude and characteristics of the error in the assessment and advice. The present simulations were carried out with a simple error applied to F which may not mimic the true error in a real assessment. Nevertheless, it is undoubtedly true that in some cases the fixed TAC is maintained though the true F has reduced; conversely, the transition to the F_{MSY} -target regime will occur even though F is still higher than F_{MSY} , so the blue bars in the right panel of Figure 7.2.3.1.1 represent a real contribution to the probability of $F \leq F_{MSY}$. The overall effect of the HCR is, in the medium term, to give higher than 50% probabilities of F being at or below F_{MSY} . Two mechanisms are behind this: (1) error in observations coupled with a one-way transition from the fixed-TAC to the F_{MSY} -target regime; and (2) the 10% constraint, which is expected to initially limit TAC increases more than TAC decreases.

2) Probabilities in each year of the simulations, that paragraphs 2, 3, 4, 5, or 6 of the harvest rule will apply

Table 7.2.3.1.3 shows the probability by year of applying each clause when following the HCR with fixed-TAC options from 3500 to 4500 tonnes. Three of the initial fixed-TAC options (3500, 4000, and 4500 tonnes) have been selected from the table and are shown in Figure 7.2.3.1.1. The left-hand panels of Figure 7.2.3.1.1 show the percentage probability of following Clauses 2, 3, 4, and 5 as the HCR progressively switches from Clause 2 to Clauses 3 and 4. The blue bars (Clause 2) show how the transition from the 100% probability of a fixed TAC drops to around 5% by 2018, 2021, and 2026 for the initial fixed-TAC values of 3500, 4000, and 4500 tonnes, respectively. This transition table was provided in Table 7.2.3.2.1 of the original advice (ICES, 2013). In addition to the transition from Clause 2 to Clause 3, Figure 7.2.3.1.1 also shows that Clause 5 (10% reduction in the fixed target TAC) is rarely implemented when the starting TAC is 3500 tonnes. With a starting TAC of 4500 tonnes, the probability of Clause 5 being applied is estimated to be 13% in 2016 (the first year it can be applied, i.e. year 3 of the plan), with the probability increasing by more than 3% per year over the next five years (see the last row but one in Table 7.2.3.1.3 and the purple bars in the lower left panel of Figure 7.2.3.1.1). Overall this implies a 28% probability of a 10% reduction in the fixed TAC over these six years, with a small possibility of this including two 10% reductions in two of the years. The 28% probability drops to 9% with a starting TAC of 4000 tonnes, and 0.6% with a starting TAC of 3500 tonnes. Clause 5 is only implemented before the HCR transits to the F_{MSY} -target regime (Clauses 3 and 4).

When the HCR transits from Clause 2 to Clause 3 the probability that $F < F_{MSY}$ increases with time; this probability rises to over 50% and then settles (slowly) at 50% as long as Clause 4 is included in the HCR. This overshoot effect is

substantial for an initial TAC of 3500 tonnes, though it is less for greater initial TACs. Tests of the HCR with Clause 4 omitted do not show this overshoot but give a 50% probability of $F < F_{MSY}$ under Clause 3.

3) Expected forecast catch corresponding to the application of the harvest rule in each year of the simulations

Table 4 shows the mean (expected) catch forecast when applying the HCR with initial fixed TACs from 3500 to 4500 tonnes. At a low initial TAC, the transit to Clauses 3 and 4 is rapid, and on average catches are expected to rise slowly. Conversely, at a high initial TAC, the higher catch is maintained for two or three years, but the higher fixed TAC shows a non-trivial probability of Clause 5 being applied (10% reduction in the fixed-TAC value). On average, if the initial TAC is set to 4500 tonnes, the mean TAC is expected to decline to 4319 tonnes over the next six years; most of the decline in TAC is due to the mechanism of Clause 5.

It is important to remember that Table 4 illustrates only the mean values over 1000 realisations. The TACs that will be experienced will depend both on the recruitment and errors in estimating F in the assessment.

4) Reductions in F (modelling assumptions)

There are a number of reasons why the high fixed TACs result in achieving lower F s.

- a) Although the HCR is nominally a fixed-TAC HCR, Clause 5 of the HCR is implemented if recruitment is low and F rises. Therefore, if the chosen fixed TAC is too high for realised recruitment, the original fixed TAC is reduced and F reduces accordingly. Thus, the HCR adapts to the actual situation at hand; a key property of the HCR.
- b) The HCR contains a number of mechanisms that reduce F , but there is no major mechanism for increasing F . Random errors appear to assist the reduction of F due to (1) the potential for a premature irreversible transition to the F_{MSY} -target stage by mistake, and (2) two consecutive increases in F will result in an irreversible 10% reduction in the original fixed TAC.
- c) As indicated, aforementioned simulations were based on the full range in observed recruitment. This was done because recent recruitment (i.e. in 2009) was similar to the larger recruitment values observed more than twenty years ago; it was therefore considered to be inappropriate to use only the recent low values. This choice results in potentially higher mean catches than those observed in the last decade. The specific yields given in the simulations are derived directly from these assumptions. ICES reiterates what was stated in the original advice (ICES, 2013):

It should be kept in mind that from 2004 to 2008 as well as in 2010 and in 2011, the recruitments are estimated by the last WGHMM to be below the mean values which are used in the simulations. The analysis carried out here is conditional on the assumption on the stock-recruitment relationship. If the recruitments estimated in future assessments continue to be lower than GM, this may impact the stock-recruitment relationship and the evaluation of the HCR will need to be updated. If a management plan is to be developed based on this HCR, some provision should be incorporated in the plan to allow for such a revision.

Basis of advice

The document by Merzèreaud *et al.* (2013) contains a description of the simulations and the overall results which form the basis of the advice given above.

Sources

ICES. 2013. EU request for the evaluation of the harvest control rule for sole in the Bay of Biscay. In Report of the ICES Advisory Committee, 2013. ICES Advice 2013, Section 7.3.5.2.

Merzèreaud, M., Biais, G., Lisardy, M., Bertignac, M., and Biseau, A. 2013. Evaluation of proposed harvest control rules for Bay of Biscay sole. ICES CM 2013/ACOM:75. 16 pp.

Table 7.2.3.1.1

The probability (in per cent) of having changed from the initial fixed-TAC (Clauses 2 and 5) to the F_{MSY} -target regime (Clauses 3 and 4), for initial fixed-TAC values between 3500 and 4500 tonnes. The simulations include the implementation of all clauses of the HCR.

Fixed TAC	Year									
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
3500	0	0	24	54	81	93	98	100	100	100
3600	0	0	20	49	75	89	96	99	100	100
3700	0	0	16	42	67	84	93	98	99	99
3800	0	0	13	36	60	79	90	96	99	99
3900	0	0	11	31	53	72	86	93	97	99
4000	0	0	9	26	46	64	80	90	95	98
4100	0	0	7	20	38	56	73	84	91	94
4200	0	0	6	16	33	49	66	78	86	92
4300	0	0	5	12	27	42	58	72	81	88
4400	0	0	3	9	22	33	49	62	72	81
4500	0	0	2	8	18	29	41	53	64	74

Table 7.2.3.1.2

The probability (in per cent) of the true $F \leq F_{MSY}$, for initial fixed-TAC values between 3500 and 4500 tonnes. The simulations include the implementation of all clauses (1–6) of the HCR.

Fixed TAC	Year									
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
3500	0	14	47	72	84	87	86	85	79	77
3600	0	9	37	63	78	83	84	81	78	78
3700	0	6	29	55	71	77	81	80	78	78
3800	0	4	22	46	61	71	77	78	77	77
3900	0	3	16	38	54	66	72	76	75	76
4000	0	2	12	31	46	60	67	72	73	74
4100	0	2	8	23	38	52	61	66	68	72
4200	0	1	6	17	31	44	54	61	64	69
4300	0	1	3	14	25	38	45	55	59	67
4400	0	1	2	9	18	30	39	48	53	61
4500	0	0	2	6	13	25	32	42	46	55

Table 7.2.3.1.3

Probability by year of a given clause of the proposed HCR being applied for fixed-TAC values from 3500 to 4500 tonnes.

Fixed TAC	HCR clause	Year									
		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
3500	2	100.00	99.80	75.86	45.74	18.97	6.90	2.33	0.30	0.00	0.00
3500	3	0.00	0.00	8.32	15.52	17.34	22.62	21.60	23.73	25.15	26.67
3500	4	0.00	0.00	15.82	38.64	63.29	70.39	76.06	75.96	74.85	73.33
3500	5	0.00	0.00	0.00	0.10	0.41	0.10	0.00	0.00	0.00	0.00
3500	6	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3600	2	100.00	99.80	79.67	50.61	24.19	10.37	3.66	0.61	0.20	0.10
3600	3	0.00	0.00	6.30	14.84	19.72	22.97	22.87	24.19	25.10	26.42
3600	4	0.00	0.00	14.02	34.35	55.49	66.36	73.37	75.20	74.59	73.48
3600	5	0.00	0.00	0.00	0.20	0.61	0.30	0.10	0.00	0.10	0.00
3600	6	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3700	2	100.00	99.80	83.94	57.72	31.81	14.84	6.20	1.93	0.81	0.51
3700	3	0.00	0.00	6.30	13.31	17.89	24.49	23.98	25.00	26.42	25.51
3700	4	0.00	0.00	9.76	28.25	49.39	59.96	69.51	72.76	72.66	73.98
3700	5	0.00	0.00	0.00	0.71	0.91	0.71	0.30	0.30	0.10	0.00
3700	6	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3800	2	100.00	99.80	87.14	63.27	38.27	19.90	8.98	3.47	1.02	0.51
3800	3	0.00	0.00	5.00	12.04	18.67	25.00	24.90	24.80	26.63	26.43
3800	4	0.00	0.00	7.86	23.57	41.73	53.98	65.51	71.43	72.14	73.06
3800	5	0.00	0.00	0.00	1.12	1.33	1.12	0.61	0.31	0.20	0.00
3800	6	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3900	2	100.00	99.80	89.19	67.38	44.95	26.81	13.25	6.22	2.34	1.12
3900	3	0.00	0.00	4.79	10.09	17.84	24.87	23.65	24.16	27.22	25.59
3900	4	0.00	0.00	6.01	20.90	35.47	46.99	62.08	69.01	70.13	73.19
3900	5	0.00	0.00	0.00	1.63	1.73	1.33	1.02	0.61	0.31	0.10
3900	6	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4000	2	100.00	99.80	90.78	72.23	51.95	34.02	18.95	9.53	4.30	2.15
4000	3	0.00	0.00	3.59	8.40	16.19	22.54	21.21	24.59	27.87	26.84
4000	4	0.00	0.00	5.53	17.21	29.41	41.50	58.30	65.06	67.42	70.80
4000	5	0.00	0.00	0.00	2.15	2.46	1.95	1.54	0.82	0.41	0.20
4000	6	0.00	0.20	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4100	2	100.00	99.80	92.85	76.61	58.43	41.47	25.13	15.42	8.58	5.31
4100	3	0.00	0.00	2.45	7.76	14.30	20.84	21.45	24.51	27.07	25.54
4100	4	0.00	0.00	4.60	11.85	24.11	35.04	51.28	59.14	63.64	68.95
4100	5	0.00	0.00	0.00	3.78	3.17	2.66	2.15	0.92	0.72	0.20
4100	6	0.00	0.20	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4200	2	100.00	99.79	94.03	78.68	63.44	47.27	30.90	20.49	12.46	8.24
4200	3	0.00	0.00	1.96	5.87	12.15	18.74	20.49	23.69	24.82	27.60
4200	4	0.00	0.00	3.91	10.09	21.01	30.69	45.93	54.38	61.59	63.95
4200	5	0.00	0.00	0.00	5.36	3.40	3.30	2.68	1.44	1.13	0.21
4200	6	0.00	0.21	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4300	2	100.00	99.79	95.18	80.62	69.33	54.56	38.05	26.56	17.44	11.49
4300	3	0.00	0.00	1.33	3.79	10.15	16.31	19.69	22.46	25.44	26.56
4300	4	0.00	0.00	3.28	8.21	17.13	25.33	38.67	49.13	55.28	61.23
4300	5	0.00	0.00	0.00	7.28	3.38	3.79	3.59	1.74	1.85	0.72
4300	6	0.00	0.21	0.21	0.10	0.00	0.00	0.00	0.10	0.00	0.00
4400	2	100.00	99.79	96.48	80.83	74.09	61.87	47.25	35.23	25.60	17.41
4400	3	0.00	0.00	1.04	2.59	7.67	12.64	16.48	20.83	22.59	24.46
4400	4	0.00	0.00	2.28	6.63	14.20	20.31	32.64	41.24	49.02	56.89
4400	5	0.00	0.00	0.00	9.84	4.04	5.08	3.63	2.69	2.80	1.24
4400	6	0.00	0.21	0.21	0.10	0.00	0.10	0.00	0.00	0.00	0.00
4500	2	100.00	99.79	97.33	78.87	77.13	65.95	53.95	43.69	33.03	24.51
4500	3	0.00	0.00	0.31	2.26	6.67	10.97	13.33	17.85	21.03	22.97
4500	4	0.00	0.00	2.15	5.33	11.79	17.54	27.90	35.38	42.87	50.56
4500	5	0.00	0.00	0.00	13.44	4.31	5.33	4.72	3.08	3.08	1.85
4500	6	0.00	0.21	0.21	0.10	0.10	0.21	0.10	0.00	0.00	0.10

Table 7.2.3.1.4 Mean predicted catch by year for each of the fixed-TAC values from 3500 to 4500 tonnes. This table illustrates only the mean values over 1000 realisations. The TACs that will be experienced will depend primarily on the realised recruitment (described in Section 4, point c).

TAC	Year									
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
3500	4365	3503	3512	3580	3718	3890	4086	4295	4484	4648
3600	4364	3603	3604	3652	3766	3914	4088	4281	4456	4616
3700	4363	3703	3697	3723	3807	3932	4092	4268	4427	4582
3800	4363	3802	3790	3800	3858	3956	4095	4255	4398	4549
3900	4364	3903	3888	3880	3910	3980	4101	4250	4381	4529
4000	4363	4002	3981	3963	3977	4021	4117	4245	4365	4501
4100	4361	4103	4081	4052	4052	4067	4144	4254	4347	4469
4200	4365	4204	4181	4142	4128	4124	4185	4263	4339	4449
4300	4365	4303	4282	4231	4209	4186	4221	4284	4345	4430
4400	4365	4403	4386	4328	4296	4255	4269	4315	4358	4422
4500	4365	4503	4487	4413	4372	4324	4319	4348	4371	4415

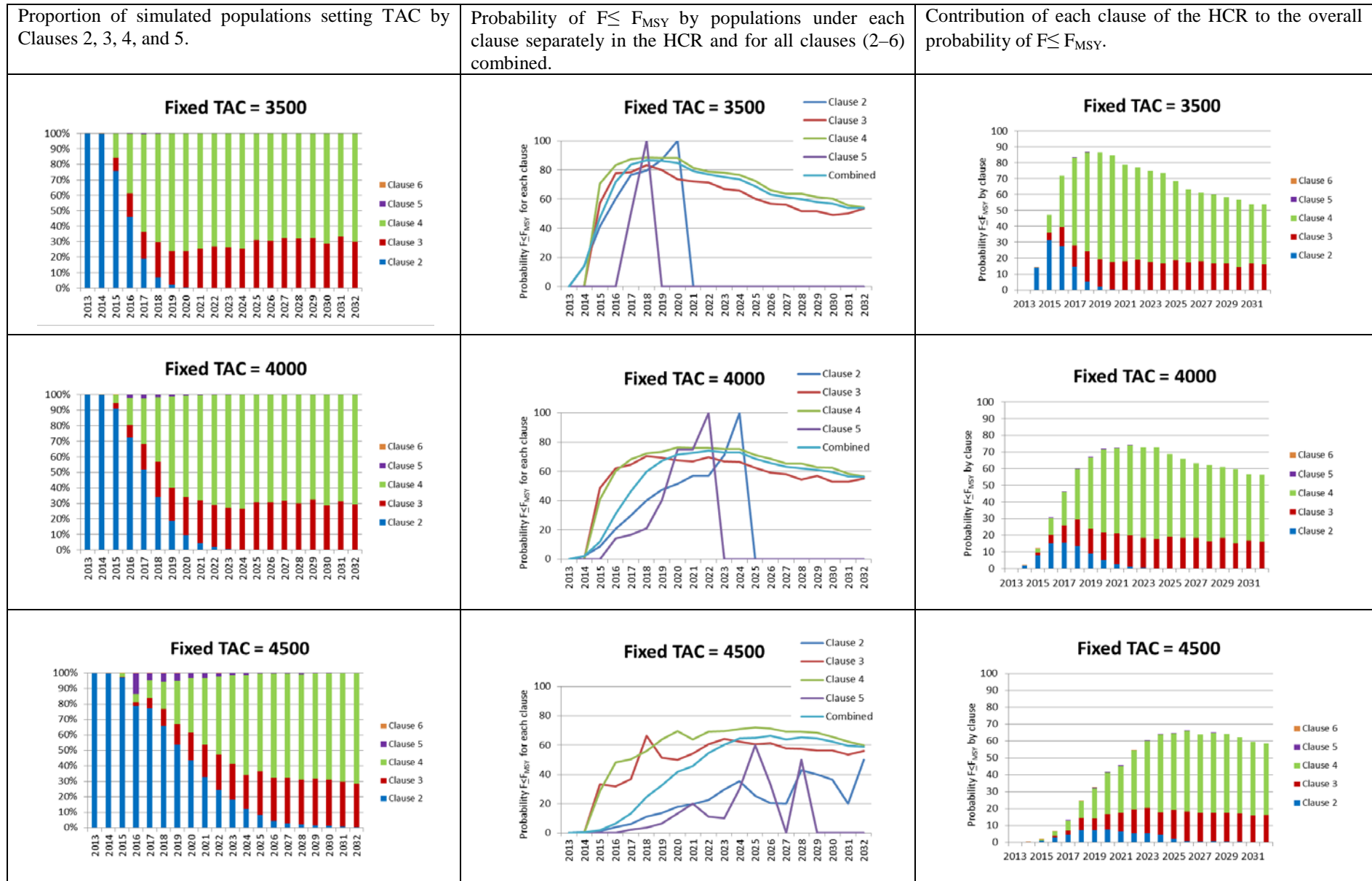


Figure 7.2.3.1.1

Comparison of the performance of the HCR with all five clauses (2–6) implemented in the simulations for three different initial fixed TACs (3500, 4000, and 4500 tonnes), one in each row of the table. The left panels show the proportion of simulated populations which are managed under each clause in each year, the middle panels show the probability of $F \leq F_{MSY}$ for simulated populations under each clause in the HCR and for all clauses (2–6) combined, and the right panels show the contribution of the populations by clause to the overall probability of $F \leq F_{MSY}$.