Conditioning of the full set of robustness tests for the South African hake resource to be used in OMP-2010 testing and constant catch projections

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INTRODUCTION

Results for conditioning of the full set of robustness/sensitivity tests for the current hake OMP revision process are given, and projections carried out under a constant catch strategy.

Although the final one or two CMPs will be checked on the complete suite of robustness tests, only a selected subset of robustness tests will be used to test the CMPs routinely. The intention is therefore to reduce the number of robustness tests that will be run routinely on the CMPs by selecting the ones which appear under constant catch projections to present the greatest challenges from a resource conservation perspective. (Naturally constant catch projections do not provide discrimination amongst tests that involve changes to default assumptions for aspects of future data such as changes in precision, so that such tests will remain retained in this selected set.) A projected constant catch of 150 000t has been chosen as this will be more informative (in terms of the poor resource conservation performers) than a constant catch set at the current TAC.

RESULTS

Tests related to M. paradoxus

Table 1 summarises the full set of robustness/sensitivity tests considered. (Some of these tests should be considered as “sensitivities” rather than formal robustness tests to provide OMs for candidate OMP testing, because they are included more to indicate impacts of specification variation on results than as arguably alternative plausible representations of reality.) While Rob1 to Rob29 involve different assumptions about the resource dynamics or past data, it is only in the projections that Rob30 to Rob38 change from the Reference Case (RS1).

Table 2 summarises the key management quantities for Rob1 to Rob29, while Table 3 compares their different contributions to the total negative log-likelihood. Results for Rob1 to Rob16 have been presented earlier in Rademeyer and Butterworth (2010); however, an error was found in Rob10 and in some cases a better minimum was found (-lnL in bold in Table 2) so that these revised results are given here.

Fig. 1 plots the estimated spawning biomass trajectories for these tests.

Three performance statistics ($B^{sp}_{2027}/B^{sp}_{MSY}$, B^{sp}_{2030}/K^{sp} and $B^{sp}_{2030}/B^{sp}_{2010}$ for the female component of the population) are plotted in Fig. 2 for the full set of RS and robustness tests under a constant catch of 150 000t.

It is suggested that the following robustness tests related to *M. paradoxus* be retained in the selected set at this stage:

Changes in the past: robustness tests Rob5 (true Ricker), Rob13 (decrease in *K*), Rob17 (start in 1978) and Rob25 (lower steepness *h*).

Changes in the future: robustness tests 31f (case of no surveys and an undetected catchability trend for CPUE), Rob35 (undetected catchability trend for CPUE) and Rob37 (decrease in *K*).

With the exception of tests Rob31 and Rob35 for which constant catch trials do not provide a test of the issue involved, the reason for these selections is inadequate increase of spawning biomass towards its MSY level.

Tests related to M. capensis

The robustness tests described in Table 1 are mostly based on RS1, i.e. they are representative of RSa, for which *M. capensis* is currently well above MSYL. Robustness tests are also needed in the case when the extent of *M. capensis* depletion is estimated to be relatively high (RSb) and six robustness tests have been selected to be run on RS11 (one of the RSb OMs). For changes in the past, three of the four robustness tests selected for *M. paradoxus* testing above have been chosen (Rob5, Rob13 and Rob25, but not Rob17 which is of a different nature and does not show *M. capensis* to be heavily depleted) and for changes in the future, Rob37 (decrease in *K*) has been selected.

Table 4 summarises the key management quantities for the four tests based on RS11, while Table 5 compares their different contributions to the total negative log-likelihood. Fig. 3 plots the estimated spawning biomass trajectories for these tests.

Three performance statistics ($B^{sp}_{2027}/B^{sp}_{MSY}$, B^{sp}_{2030}/K^{sp} and $B^{sp}_{2030}/B^{sp}_{2010}$ for the female component of the population) are plotted in Fig. 4 for RS11 and these four robustness tests under a constant catch of 150 000t.

It is suggested that these four robustness tests related to *M. capensis* be retained in the selected set at this stage.

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Table 1: Summary of the full set of robustness/sensitivity tests.

	Shift center	SR relationship	Natural mortality *M. paradoxus*	Natural mortality *M. capensis*	Other
Changes in the past					
Rob1	1965	BH, h estimated	M_{2-}=0.6; M_{5+}=0.25	M_{2-}=0.9; M_{5+}=0.5	
Rob2	1950	BH, h estimated	M_{2-}=0.9; M_{5+}=0.5	M_{2-}=0.6; M_{5+}=0.25	
Rob3	1965	BH, h estimated	M_{2-}=0.9; M_{5+}=0.5	M_{2-}=0.6; M_{5+}=0.25	
Rob4	1950	True Ricker	M_{2-}=0.6; M_{5+}=0.25	M_{2-}=0.6; M_{5+}=0.25	
Rob5	1950	True Ricker	M_{2-}=0.9; M_{5+}=0.5	M_{2-}=0.9; M_{5+}=0.5	
Rob6			as RC		σ_R = 0.25
Rob7			as RC		W_{ALK} = 0.001
Rob8			as RC		W_{ALK} = 0.1
Rob9			as RC		W_{CAL} = 0.01
Rob10			as RC		W_{CAL} = 1.0
Rob11			as RC		M gender dependent (+0.05 for males, -0.05 for females)
Rob12			as RC		All commercial and survey selectivity slopes (in cm^{-1}): a)+0.04, b) +0.02, c) -0.04 and d) -0.02
Rob13			as RC		Decrease in K (30% linear decrease between 1980 and 2000 for both spp)
Rob14			as RC		Added weighting (5x) to last 5 year's CPUE and survey data to fit recent abundance indices more closely
Rob15			as RC		No shrinkage of recent recruitments towards the stock-recruitment relationship prediction
Rob 16			as RS2		Increasing M at large ages (linear from 0.25 at age 8 to 1 at age 15)
Rob17			as RC		Start in 1978, estimating θ and ζ
Rob 18			as RC		Change in efficiency in the offshore trawl fleet 1994/1995
Rob 19			as RC		Different CPUE series: a. all offshore vessels incl.; b. alt. depth stratifications; c. omit days with nominal CPUE=0; (d. updated after database check)
Rob 20			as RC		Survey calibration factor: a. incr. cap. factor to 0.9; b. decr. cap. factor to 0.6; c. both cap. and para. factors estimated
Rob 21			as RC		Ageing of both species out by one year
Rob 22			as RC		Ageing of both species to be halved
Rob 23			as RC		Alternative assumption for the cap. offshore selectivity
Rob 24			as RC		Alternative assumption re SC female paradoxus selectivity scaling factor: a. as lower; b. as higher
Rob 25			as RC		Alternative maturity-at-length with fixed lower h values
Rob 26			as RC		Include discards in the past
Rob 27			as RC		40/60 male/female ratio at birth instead of 50/50
Rob 28			as RC		Alternative species split algorithm (post-1978 catches and CPUE series)
Rob 29			as RC		From 1997 to 2002 q for CPUE dropped by 20% as a result of shorter tows
Changes in the future					
Rob 30			as RC		Maximum proportion of cohort catchable in one year decrease from 90% to 70%
Rob 31			as RC		Missing/reduced surveys in the future: a. no surveys; b. only WC surveys; c. only SC surveys; d. both surveys missing every 3 years; e. increase all future surveys CVs by multiplicative factor of sqrt(2); f. no surveys plus undetected increase catchability related to CPUE
Rob 32			as RC		Decrease all future survey CVs by a multiplicative factor of 1/sqrt(2)
Rob 33			as RC		MPA possible effects on future CPUE: a. no CPUE; b. new CPUE series with prior on q; c. new CPUE series with lower q; d. new CPUE series with higher q; and e. new CPUE series with no prior on q
Rob 34			as RC		Trend in F_{ratio} over time in the future: a) 2% p.a. and b) -2% p.a., for 10 years then constant
Rob 35			as RC		Undectected 2% p.a. increase in catchability related to CPUE in the future
Rob 36			as Rob26		Change in discard pattern in the future: a) past, but no future discards; b) past and future discards; c) past discards are halved in the future.
Rob 37			as RC		Decrease in K in the future (30% linear decrease between 2011 and 2016 for both spp)
Rob 38			as RC		Allow for serial correlation in recruitment residuals (estimate from RC fit)

Table 2: Estimates of management quantities for RS1 and Rob1 to Rob29. -lnL values in bold highlight cases where a better minimum was found than reported in Rademeyer and Butterworth (2010). K^{sp} and B^{sp}_{2009}/K^{sp} are for both genders combined, while B^{sp}_{MSY}/K^{sp} and $B^{sp}_{2009}/B^{sp}_{MSY}$ are in terms of the female only spawning biomass.

		M. paradoxus								*M. capensis*								2009
	-lnL total	K^{sp}	h	B^{sp}_{2009}/K^{sp}	B^{sp}_{MSY}/K^{sp}	$B^{sp}_{2009}/B^{sp}_{MSY}$	MSY	M_{2-}	M_{5+}	K^{sp}	h	B^{sp}_{2009}/K^{sp}	B^{sp}_{MSY}/K^{sp}	$B^{sp}_{2009}/B^{sp}_{MSY}$	MSY	M_{2-}	M_{5+}	spp ratio B^{sp}
RS1	-94.5	1395	1.06	0.15	0.24	0.59	113	0.75	0.38	499	1.41	0.52	0.36	1.39	70	0.75	0.38	1.21
Rob1	-81.0	3511	0.98*	0.19	0.20	1.09	119	0.60	0.25	1030	0.98*	0.60	0.16	3.59	131	0.90	0.50	0.94
Rob2	-82.0	911	0.90	0.17	0.20	0.62	109	0.90	0.50	2083	0.98*	0.58	0.20	2.95	94	0.60	0.25	7.85
Rob3	-79.8	1049	0.92	0.28	0.17	1.47	122	0.90	0.50	3002	0.98*	0.64	0.20	3.28	134	0.60	0.25	6.52
Rob4	-82.3	2210	1.21	0.18	0.42	0.49	133	0.60	0.25	774	1.50*	0.50	0.38	1.30	68	0.60	0.25	0.95
Rob5	**-81.0**	717	1.01	0.28	0.39	0.58	120	0.90	0.50	413	1.02	0.56	0.40	1.30	68	0.90	0.50	1.14
Rob6	-85.5	1522	0.95	0.15	0.21	0.65	108	0.75	0.38	486	1.45	0.59	0.36	1.57	70	0.75	0.38	1.27
Rob7	-212.2	1567	1.02	0.15	0.24	0.61	117	0.75	0.38	423	1.32	0.54	0.35	1.42	71	0.75	0.38	0.97
Rob8	958.2	1662	0.95	0.07	0.21	0.21	119	0.75	0.38	487	1.50*	0.49	0.34	1.38	69	0.75	0.38	2.09
Rob9	**-96.1**	1816	0.97	0.08	0.20	0.24	133	0.75	0.38	608	1.15	0.56	0.43	1.27	77	0.75	0.38	2.49
Rob10	-678.5	941	1.19	0.30	0.30	0.88	113	0.75	0.38	609	0.41	0.67	0.83	0.77	69	0.75	0.38	1.44
Rob11	-92.1	1528	1.09	0.14	0.23	0.55	113	0.75	0.38	531	1.50*	0.51	0.33	1.43	70	0.75	0.38	1.24
Rob12a	**-76.6**	1748	0.96	0.19	0.29	0.68	122	0.75	0.38	620	0.78	0.56	0.52	1.06	69	0.75	0.38	1.03
Rob12b	-88.2	1594	1.01	0.17	0.26	0.67	118	0.75	0.38	562	0.91	0.55	0.48	1.10	68	0.75	0.38	1.12
Rob12c	**-75.4**	952	1.15	0.22	0.27	0.66	107	0.75	0.38	416	1.50*	0.55	0.40	1.32	70	0.75	0.38	1.10
Rob12d	**-91.4**	1219	1.12	0.17	0.26	0.58	110	0.75	0.38	458	1.50*	0.52	0.36	1.38	69	0.75	0.38	1.17
Rob13	**-69.4**	876	1.31	0.21	0.34	0.63	95	0.75	0.38	639	0.95	0.34	0.26	1.24	44	0.75	0.38	1.17
Rob14	-236.4	1208	1.23	0.19	0.24	0.72	114	0.75	0.38	484	1.16	0.49	0.45	1.05	70	0.75	0.38	1.05
Rob15	-96.5	1464	0.98	0.15	0.22	0.65	110	0.75	0.38	518	1.06	0.53	0.45	1.14	68	0.75	0.38	1.25
Rob16	-85.6	2302	0.93	0.11	0.27	0.41	123	0.60	0.25	1343	0.98*	0.52	0.22	2.38	88	0.60	0.25	2.80
Rob17	-73.3	2080	0.85	0.16	0.27	0.60	124	0.75	0.38	384	1.50*	0.50	0.41	1.19	63	0.75	0.38	0.58
Rob18	-119.7	1184	1.27	0.21	0.24	0.79	115	0.75	0.38	502	1.24	0.55	0.41	1.31	70	0.75	0.38	1.14
Rob19a	-124.3	1236	1.16	0.16	0.23	0.64	111	0.75	0.38	545	1.03	0.52	0.43	1.14	67	0.75	0.38	1.38
Rob19b	-105.0	1315	1.12	0.15	0.23	0.59	112	0.75	0.38	525	0.95	0.56	0.48	1.13	68	0.75	0.38	1.53
Rob19c	-98.6	1391	1.05	0.14	0.22	0.59	111	0.75	0.38	496	1.40	0.46	0.35	1.25	69	0.75	0.38	1.16
Rob20a	-94.6	1395	1.06	0.15	0.24	0.59	113	0.75	0.38	498	1.42	0.51	0.36	1.38	70	0.75	0.38	1.20
Rob20b	-92.4	1393	1.06	0.15	0.24	0.59	113	0.75	0.38	504	1.38	0.53	0.36	1.42	70	0.75	0.38	1.26
Rob20c	-95.6	1406	1.05	0.14	0.24	0.55	112	0.75	0.38	498	1.41	0.51	0.36	1.39	70	0.75	0.38	1.28
Rob21	-72.5	1229	1.00	0.16	0.22	0.67	116	0.75	0.38	470	0.85	0.57	0.52	1.05	69	0.75	0.38	1.34
Rob22	-83.3	995	1.16	0.13	0.25	0.47	114	0.75	0.38	404	0.51	0.60	0.75	0.78	74	0.75	0.38	1.92
Rob23	-84.4	1468	1.01	0.18	0.26	0.65	114	0.75	0.38	743	0.78	0.57	0.50	1.13	74	0.75	0.38	1.62
Rob24a	-94.6	1397	1.06	0.16	0.26	0.60	113	0.75	0.38	507	1.35	0.52	0.37	1.35	70	0.75	0.38	1.20
Rob24b	-94.1	1394	1.06	0.15	0.23	0.59	113	0.75	0.38	491	1.47	0.51	0.34	1.43	70	0.75	0.38	1.20
Rob25	-43.1	1575	0.70	0.12	0.29	0.46	102	0.75	0.38	762	0.70	0.50	0.40	1.25	65	0.75	0.38	2.01
Rob26	-97.4	1510	1.06	0.15	0.23	0.61	113	0.75	0.38	492	1.50*	0.47	0.31	1.45	86	0.75	0.38	1.02
Rob27	-91.2	1300	1.02	0.15	0.25	0.62	112	0.75	0.38	499	1.22	0.51	0.37	1.44	69	0.75	0.38	1.28
Rob28	-91.0	1106	1.24	0.17	0.23	0.66	107	0.75	0.38	532	1.02	0.52	0.46	1.09	70	0.75	0.38	1.49
Rob29	-95.6	1406	1.08	0.14	0.25	0.54	114	0.75	0.38	522	1.38	0.49	0.33	1.42	69	0.75	0.38	1.27

Table 3: For each contribution to the total negative log-likelihood (-lnL), differences in -lnL compared to the Reference Case (RS1).

	-lnL total	CPUE historic	CPUE GLM	Survey	Comm. CAL	Survey CAL (sex-aggr.)	Survey CAL (sex-disaggr.)	ALK	Recruitment penalty	Selectivity smoothing penalty
RS1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rob1	13.4	-1.4	9.1	1.5	-0.3	0.2	1.4	-0.4	1.4	1.8
Rob2	12.5	1.7	14.1	3.0	-5.1	1.8	-1.9	-0.2	0.1	-0.7
Rob3	14.7	2.2	14.9	4.0	-6.4	0.7	-1.2	0.7	-0.1	0.1
Rob4	12.2	13.9	-3.5	-0.3	2.6	0.9	-1.6	0.8	-0.5	0.2
Rob5	13.4	14.1	4.1	2.0	-2.6	-0.6	-0.7	-1.8	-0.5	-0.2
Rob6	9.0	-1.8	4.0	0.2	1.1	-0.5	2.1	-1.0	5.1	-0.2
Rob7	-117.7	-1.0	-1.5	-2.7	2.8	0.2	-7.3	-107.5	0.6	-1.4
Rob8	1052.6	-2.9	7.3	11.5	13.6	6.1	14.8	1002.2	1.0	-1.0
Rob9	-1.6	-2.3	-18.2	-12.3	57.7	31.6	40.4	-5.1	-2.0	-14.1
Rob10	-584.1	3.2	20.9	3.6	-538.9	-9.8	-18.3	37.8	9.5	37.5
Rob11	2.4	-0.3	-0.7	-0.4	-0.4	-0.5	3.0	2.6	-0.1	-0.6
Rob12a	17.8	9.5	-3.5	0.5	10.6	-1.4	0.9	0.4	0.5	0.0
Rob12b	6.3	5.1	-3.4	0.4	3.7	-0.8	0.3	0.3	0.7	0.0
Rob12c	19.1	1.1	6.5	2.6	4.3	2.3	-1.1	3.2	0.2	0.0
Rob12d	3.1	0.0	3.6	0.9	-1.4	0.7	-0.6	0.0	0.0	0.0
Rob13	25.1	15.2	0.4	3.8	-2.2	0.4	-0.5	2.4	5.5	-0.1
Rob14	-142.0	-0.5	-78.1	-64.6	-1.7	0.2	0.5	0.4	1.6	0.1
Rob15	-2.0	-0.9	-0.9	0.4	-0.8	-0.3	-0.7	0.2	0.9	-0.2
Rob16	8.8	-1.6	7.4	-1.7	2.6	2.4	0.0	1.0	-1.0	0.0
Rob17	21.1	-	-4.8	-0.4	-7.4	-0.5	-1.7	0.2	-0.4	-0.7
Rob18	-25.3	-0.8	-18.3	-7.3	-1.6	-0.5	0.8	2.7	0.4	-0.8
Rob19a	-29.9	-0.9	-27.3	0.3	-1.3	-0.2	0.2	0.0	-0.4	-0.4
Rob19b	-10.6	-0.6	-10.7	1.6	-1.5	1.2	0.4	-0.4	-0.4	-0.3
Rob19c	-4.1	-0.5	-8.2	2.7	1.7	-0.3	0.0	-0.6	1.2	-0.1
Rob20a	-0.1	0.0	-0.2	0.0	0.1	0.0	0.0	0.0	0.1	-0.1
Rob20b	2.1	0.0	0.7	1.1	-0.1	0.0	0.1	0.0	-0.3	0.6
Rob20c	-1.2	-0.4	0.0	0.0	0.1	-0.2	-0.1	-0.2	0.1	-0.4
Rob21	21.9	0.2	1.2	-0.7	-4.6	-1.9	-0.1	25.3	3.3	-0.8
Rob22	11.2	-1.8	4.6	-1.8	-8.8	6.6	4.1	7.6	4.5	-4.1
Rob23	10.1	2.7	-2.1	0.3	5.4	0.1	1.0	1.0	0.6	0.9
Rob24a	-0.2	0.0	0.5	-0.1	-0.3	-0.1	-0.1	0.1	0.0	0.0
Rob24b	0.3	0.1	-0.3	0.1	0.3	0.1	0.1	0.0	0.0	0.0
Rob25	51.3	22.3	11.7	-0.2	-0.2	0.9	1.8	3.8	11.0	0.1
Rob26	-3.0	-0.4	-1.1	-0.3	0.7	-0.6	-0.6	0.2	-0.4	-0.3
Rob27	3.3	-0.6	-0.2	-0.6	-0.1	0.3	1.7	3.2	0.0	-0.4
Rob28	3.4	-0.9	9.9	-2.1	-2.9	0.0	0.6	0.7	-0.8	-1.2
Rob29	-1.2	-0.4	-1.1	-3.1	1.0	0.4	1.7	-0.2	0.4	0.1

Table 4: Estimates of management quantities for RS11 and three robustness tests based on this OM. K^{sp} and B^{sp}_{2009}/K^{sp} are for both genders combined, while B^{sp}_{MSY}/K^{sp} and $B^{sp}_{2009}/B^{sp}_{MSY}$ are in terms of the female only spawning biomass.

		M. paradoxus								*M. capensis*								2009 spp ratio B^{sp}
	-lnL total	K^{sp}	h	$\frac{B^{sp}_{2009}}{K^{sp}}$	$\frac{B^{sp}_{MSY}}{K^{sp}}$	$\frac{B^{sp}_{2009}}{B^{sp}_{MSY}}$	MSY	M_{2-}	M_{5+}	K^{sp}	h	$\frac{B^{sp}_{2009}}{K^{sp}}$	$\frac{B^{sp}_{MSY}}{K^{sp}}$	$\frac{B^{sp}_{2009}}{B^{sp}_{MSY}}$	MSY	M_{2-}	M_{5+}	
RS11	-93.4	3024	0.98*	0.10	0.24	0.44	118	0.60	0.25	788	0.39	0.18	0.41	0.42	40	0.90	0.50	0.49
Rob5(RS11)	-76.6	2041	1.32	0.17	0.41	0.45	134	0.60	0.25	717	0.39	0.20	0.47	0.41	42	0.90	0.50	0.42
Rob13(RS11)	-63.2	3328	0.97	0.09	0.17	0.65	86	0.60	0.25	524	0.88	0.31	0.17	1.74	42	0.90	0.50	0.51
Rob25(RS11)	-65.5	3233	0.70	0.15	0.33	0.57	111	0.60	0.25	627	0.39	0.15	0.40	0.36	37	0.90	0.50	0.19

Table 5: For each contribution to the total negative log-likelihood (-lnL), differences in -lnL compared to RS11.

	-lnL total	CPUE historic	CPUE GLM	Survey	Comm. CAL	Survey CAL (sex-aggr.)	Survey CAL (sex-disaggr.)	ALK	Recruitment penalty	Selectivity smoothing penalty
RS11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rob5(RS11)	16.7	16.8	4.2	-0.6	-1.9	-0.6	0.0	0.0	-0.8	-0.3
Rob13(RS11)	30.1	1.7	-11.0	2.2	5.1	3.6	2.6	4.6	19.7	1.6
Rob25(RS11)	27.9	13.4	8.7	2.4	-5.1	-0.2	1.3	2.9	2.7	1.8

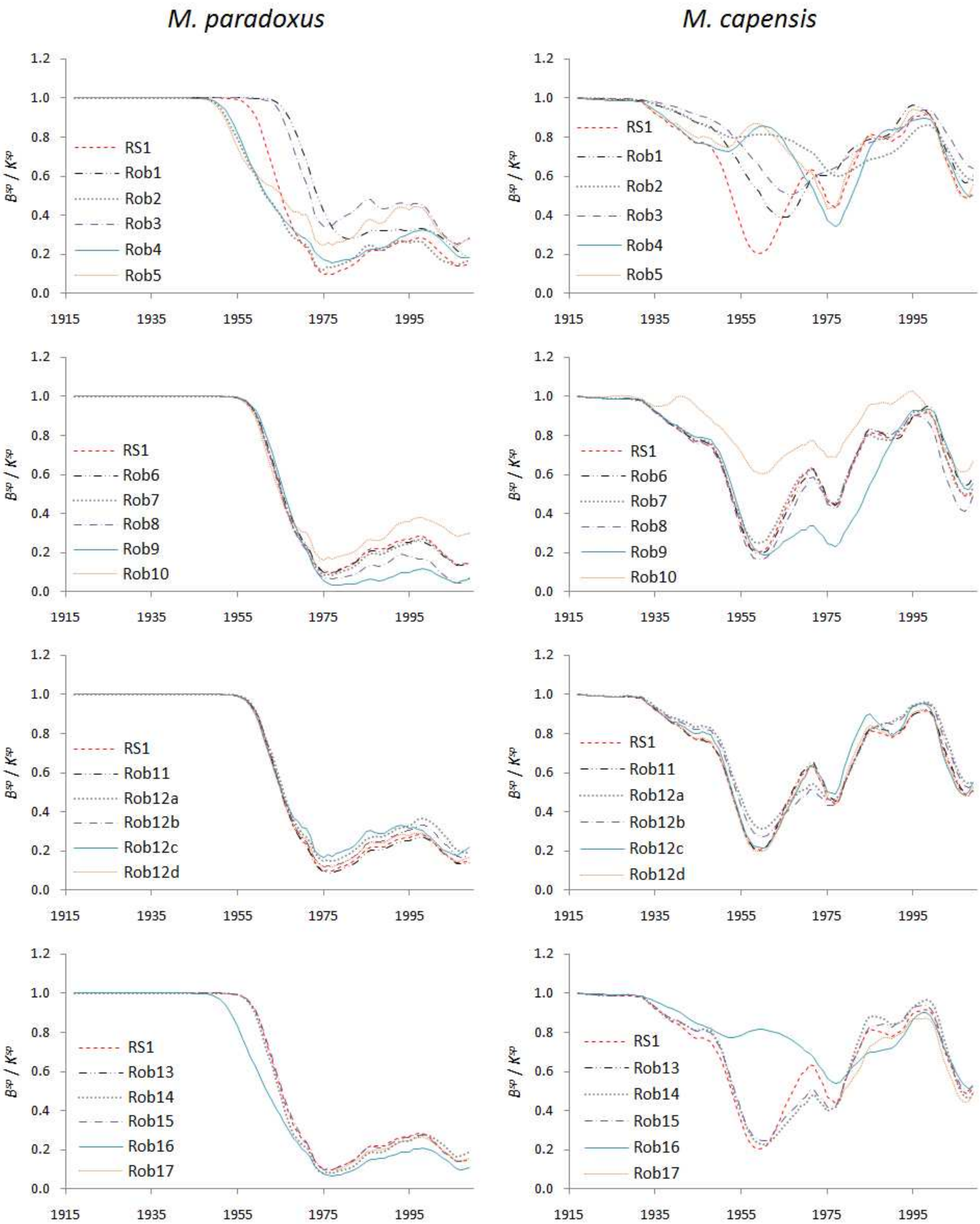

Fig. 1: Estimated gender-aggregated spawning biomass trajectories for *M. paradoxus* and *M. capensis*, relative to pre-exploitation levels, for the RC (RS1) and robustness tests Rob1-Rob29.

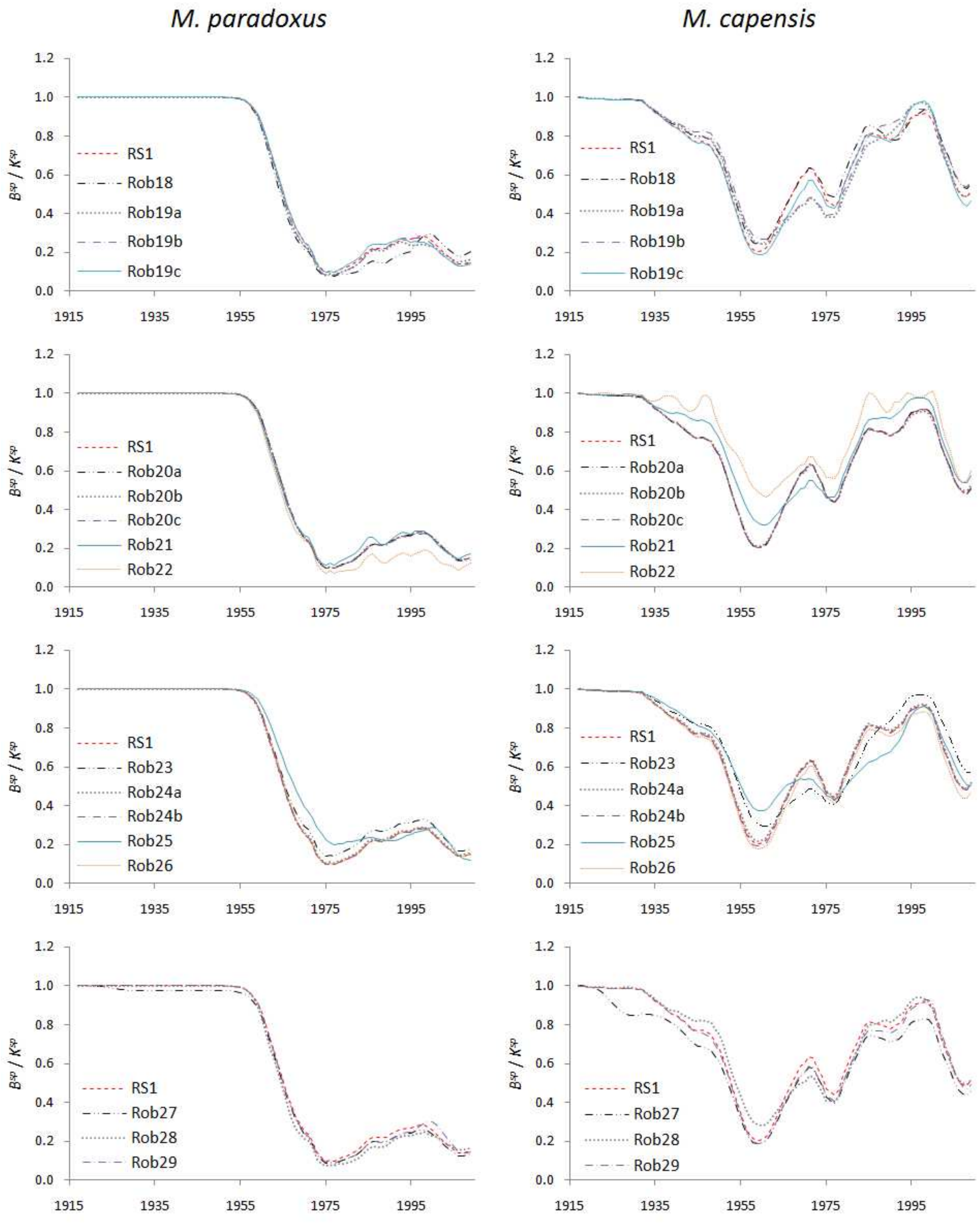

Fig. 1: continued

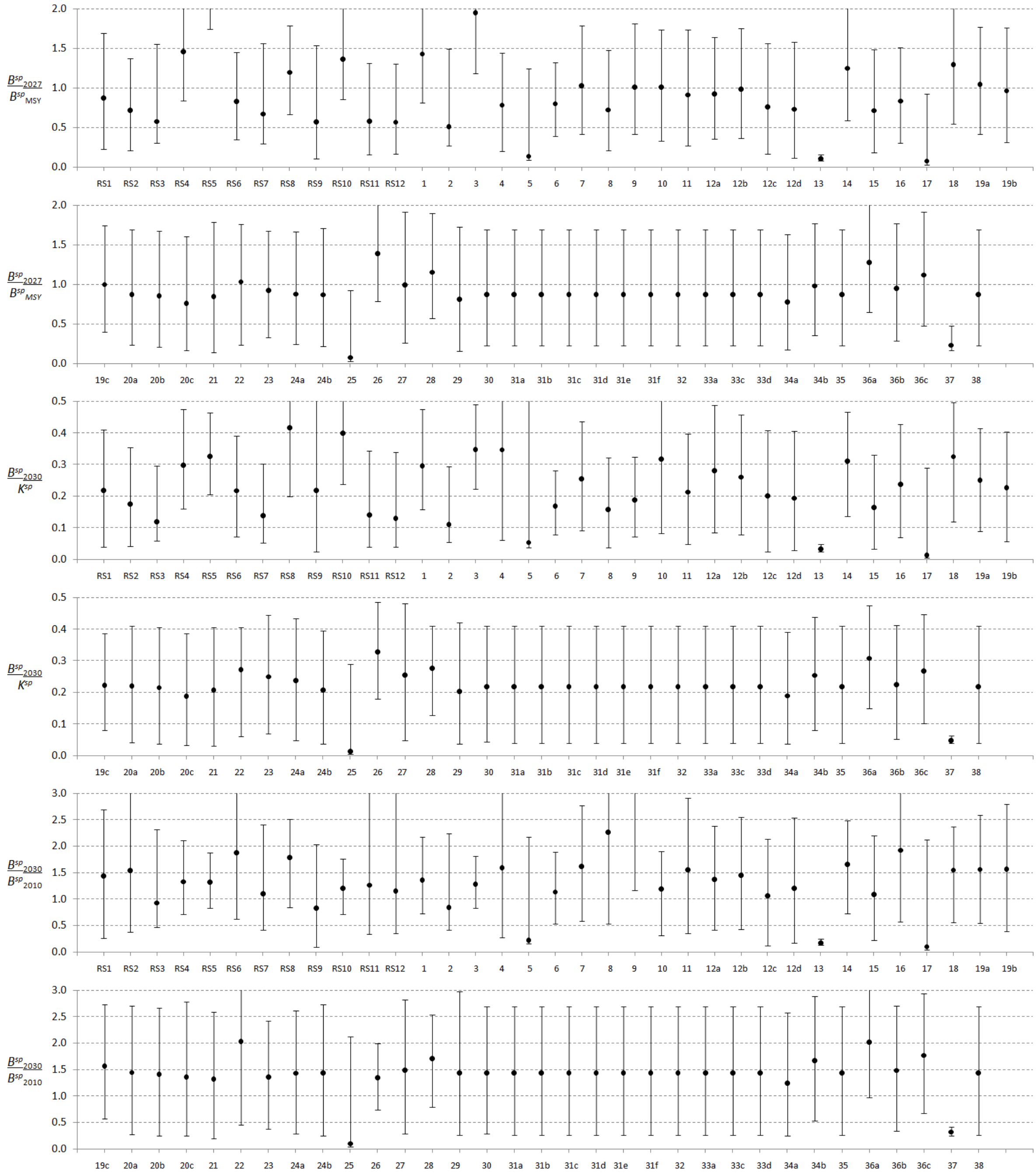

Fig. 2a: Three performance statistics ($B^{sp}_{2027}/B^{sp}_{MSY}$, B^{sp}_{2030}/K^{sp} and $B^{sp}_{2030}/B^{sp}_{2010}$, in terms of female biomass only) for ***M. paradoxus*** for the full set of RS and robustness tests under a projected constant catch of **150 000t**. In some instance, the statistics are outside the area covered by the plot.

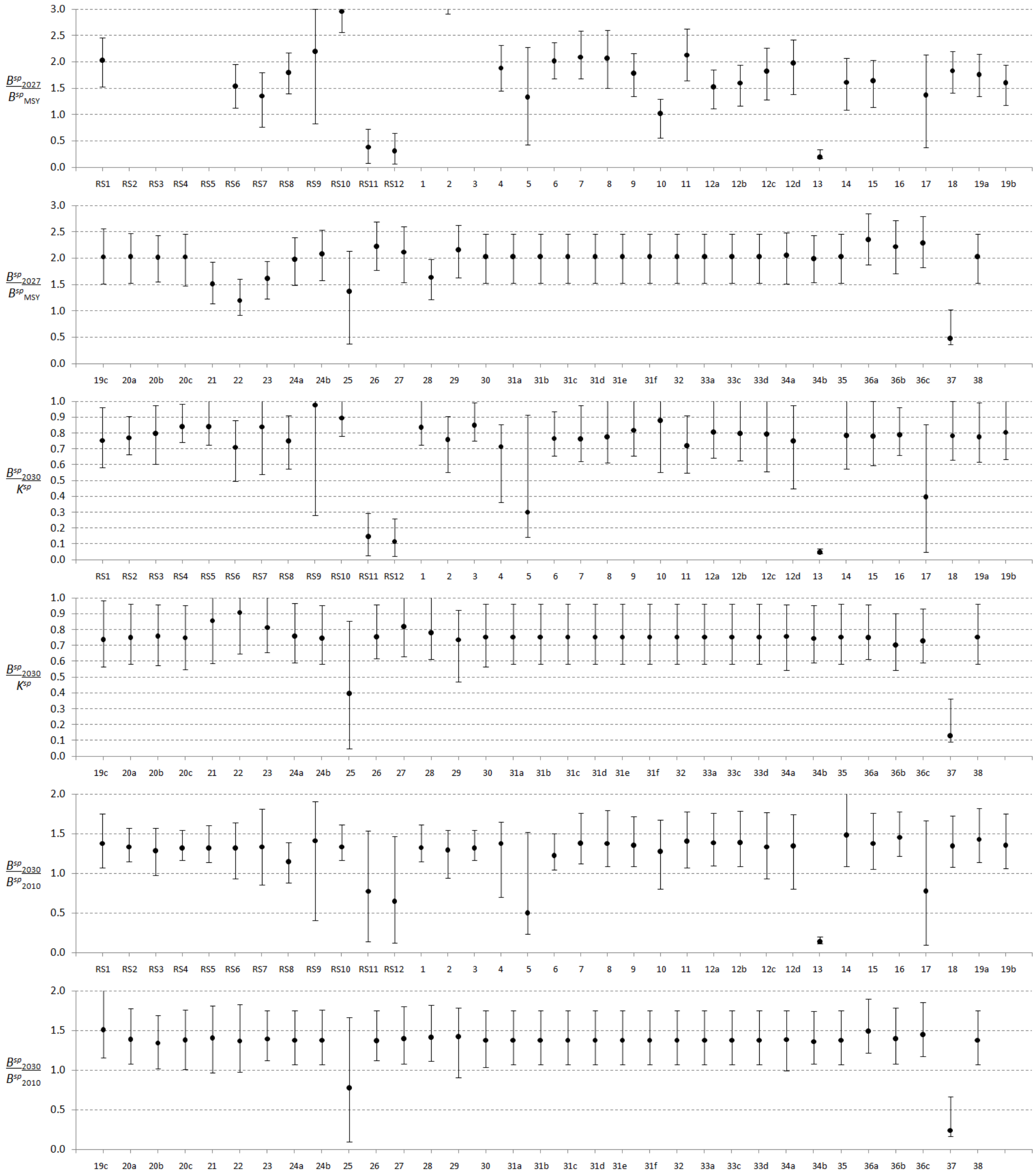

Fig. 2b: Three performance statistics ($B^{sp}_{2027}/B^{sp}_{MSY}$, B^{sp}_{2030}/K^{sp} and $B^{sp}_{2030}/B^{sp}_{2010}$, in terms of female biomass only) for ***M. capensis*** for the full set of RS and robustness tests under a projected constant catch of **150 000t**. In some instance, the statistics are outside the area covered by the plot.

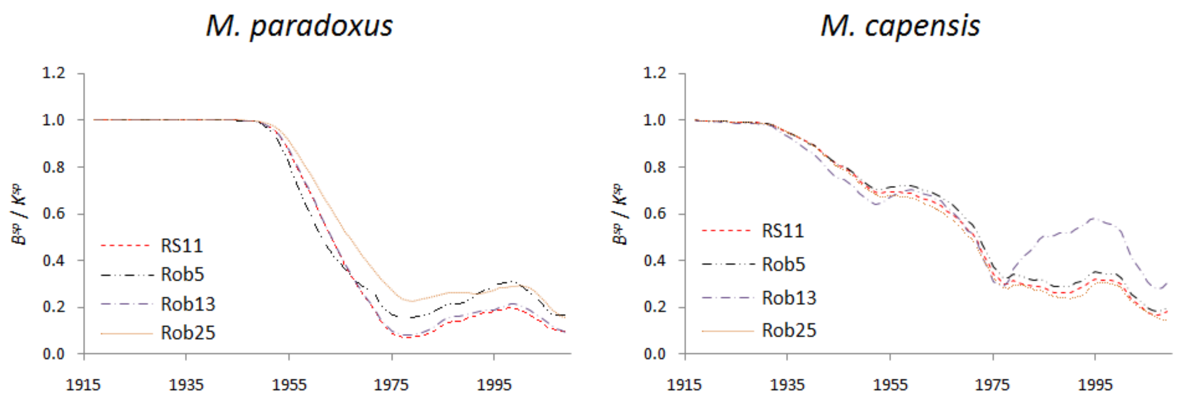

Fig. 3: Estimated gender-aggregated spawning biomass trajectories for *M. paradoxus* and *M. capensis*, relative to pre-exploitation levels, for the RS11 and three robustness tests based on this OM.

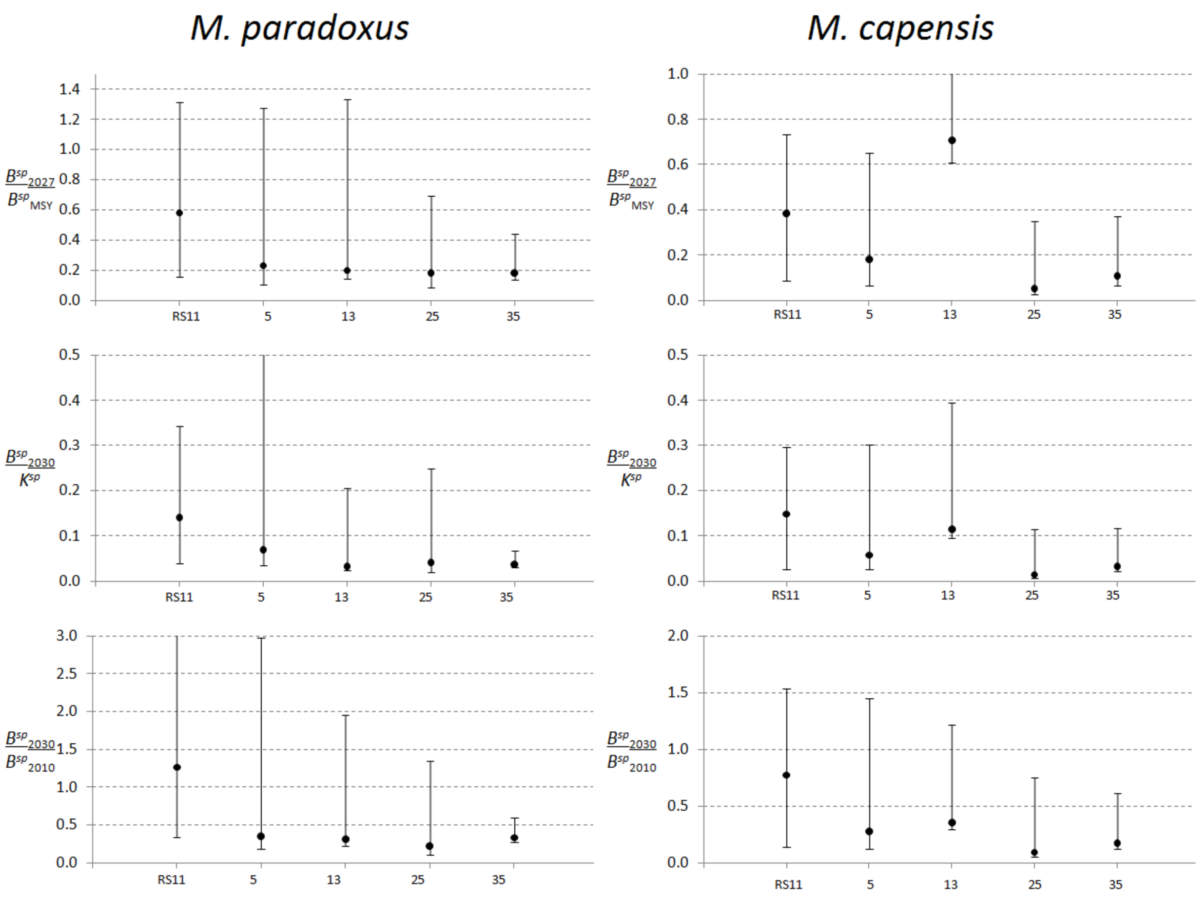

Fig. 4: Three performance statistics ($B^{sp}_{2027}/B^{sp}_{MSY}$, B^{sp}_{2030}/K^{sp} and $B^{sp}_{2030}/B^{sp}_{2010}$, in terms of female biomass only) for *M. paradoxus* and *M. capensis* for RS11 and four robustness tests based on this OM under a projected constant catch of **150 000t**.