2013 Update of the Reference Set of Operating Models used in testing Candidate OMPs for the South African hake resource

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November 2013

Introduction

A Reference Set (RS) of 12 scenarios was selected as the primary basis to be used to simulation test candidates for OMP-2011 (Rademeyer and Butterworth, 2010). This paper presents an update of this RS, based on updated commercial data (catches, trawl and longline length distribution and trawl CPUE), some revisions of biological parameter values, and new survey data (biomass estimates and length distributions) until January 2012.

The three factors that were found to contribute to most of the variability in the previous (2009) assessment results were:

i) pre-1978 species split of the offshore trawl catches;

ii) natural mortality-at-age specifications; and

iii) the stock-recruitment relationship.

The RS consists of 12 cases, detailed in Table 1. These 12 cases vary in their choices of factors along these three axes, which seem to contribute most variability to the assessment results.

Results and Discussion

The Hessian CVs reported in Table 1 for RS1 were obtained by fixing all the somatic growth and all the selectivity parameters at their estimated values (otherwise positive-definite Hessian was not obtained).

For OMP-2011, RS11 and RS12 formed part of "RSb", for which the extent of *M. capensis* depletion was high for the 2009 assessments, rather than relatively low for the other RS scenarios. However the 2013 equivalent runs for RS11 and RS12 do not give similar results (see Table 3 and Fig. 2). This outcome (a high current extent of *M. capensis* depletion) had also been obtained when a negative trend in bias in the GLM CPUE for both species was introduced (see Chapter 7, Rademeyer 2012). This was also tried but the current *M. capensis* biomass is still estimated to be well above MSY level.

Commercial selectivities-at-length are compared for RS2 (lower natural mortalities: M_{2-}=0.6; M_{5+}=0.25) and RS3 (higher natural mortalities: M_{2-}=0.9; M_{5+}=0.5) in Fig. 2

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REFERENCES

Rademeyer RA. 2012. The Evolution of Management Procedures for the South African Hake Resource in the 2000s. PhD thesis. University of Cape Town.

Rademeyer RA and Butterworth DS. 2010. Proposed Reference Set for the South African hake resource to be used in OMP-2010 testing. Unpublished report. MCM/2010/FEB/SWG-DEM/05.

Table 1: Description of the 12 scenarios forming the RS.

	Shif center	SR relationship	Natural mortality	
			M. paradoxus	*M. capensis*
RS1 (RC)	1958	Modified Ricker	M_{2-}=0.75; M_{5+}=0.375	M_{2-}=0.75; M_{5+}=0.375
RS2	1950	BH, h estimated	M_{2-}=0.6; M_{5+}=0.25	M_{2-}=0.6; M_{5+}=0.25
RS3	1950	BH, h estimated	M_{2-}=0.9; M_{5+}=0.5	M_{2-}=0.9; M_{5+}=0.5
RS4	1965	BH, h estimated	M_{2-}=0.6; M_{5+}=0.25	M_{2-}=0.6; M_{5+}=0.25
RS5	1965	BH, h estimated	M_{2-}=0.9; M_{5+}=0.5	M_{2-}=0.9; M_{5+}=0.5
RS6	1950	Modified Ricker	M_{2-}=0.6; M_{5+}=0.25	M_{2-}=0.6; M_{5+}=0.25
RS7	1950	Modified Ricker	M_{2-}=0.9; M_{5+}=0.5	M_{2-}=0.9; M_{5+}=0.5
RS8	1965	Modified Ricker	M_{2-}=0.6; M_{5+}=0.25	M_{2-}=0.6; M_{5+}=0.25
RS9	1965	Modified Ricker	M_{2-}=0.9; M_{5+}=0.5	M_{2-}=0.9; M_{5+}=0.5
RS10	1965	BH, h = 0.7	M_{2-}=0.9; M_{5+}=0.5	M_{2-}=0.9; M_{5+}=0.5
RS11	1950	BH, h estimated	M_{2-}=0.6; M_{5+}=0.25	M_{2-}=0.9; M_{5+}=0.5
RS12	1950	BH, h estimated	M_{2-}=0.6; M_{5+}=0.25	M_{2-}=0.5; M_{5+}=0.5

Note that for the Modified Ricker SR relationship, the parameter γ is estimated – the resultant SR parameter values will yield an equivalent value for steepness *h.*

Table 2: Comparison of estimates of management quantities of the *M. paradoxus* and *M. capensis* coast-combined resources for the 12 scenarios included in the RS. Biomass units are thousand tons. Note that the –lnL values are not comparable given that different data are used. K^{sp}, B_y^{sp}/K^{sp}, B_{MSY}^{sp}/K^{sp} and B_y^{sp}/B_{MSY}^{sp} are all in terms of the female component of the spawning biomass only. Hessian CVs for RS1 are given in parenthesis (see main text for details).

		RS1		RS2	RS3	RS4	RS5	RS6	RS7	RS8	RS9	RS10	RS11	RS12
	-lnL total	-172.3		-160.0	-170.1	-155.6	-170.7	-166.1	-157.4	-154.0	-162.9	-160.5	-164.7	-143.4
	CPUE historic	-39.9		-40.3	-36.0	-40.4	-37.8	-40.3	-35.8	-40.8	-37.1	-34.2	-40.6	-40.1
	CPUE GLM	-168.6		-166.9	-169.9	-168.5	-168.7	-166.8	-163.4	-166.9	-162.8	-166.0	-171.6	-166.6
	Survey	-32.1		-33.1	-33.2	-34.2	-33.0	-33.0	-32.9	-34.1	-32.5	-31.7	-35.3	-34.1
	Commercial CAL - trawl	-45.1		-45.0	-42.4	-44.0	-43.2	-45.8	-40.9	-43.9	-44.3	-48.5	-41.6	-44.6
	Commercial CAL - longline	-68.4		-61.1	-70.2	-54.4	-69.7	-64.8	-65.9	-54.0	-67.5	-68.5	-60.3	-50.1
	Survey CAL (sex-aggr.)	-3.0		-1.2	-4.8	-2.0	-4.5	-0.5	-4.8	-2.5	-4.7	-5.1	-4.5	-0.2
	Survey CAL (sex-disaggr.)	42.9		40.6	47.1	43.1	45.5	43.2	44.6	43.7	43.8	45.5	48.0	49.0
	ALK	117.4		121.2	114.7	117.4	115.9	119.6	117.8	118.8	117.5	118.0	117.1	117.1
	Recruitment penalty	8.6		10.9	9.2	10.8	9.2	7.7	8.1	8.0	8.5	13.5	9.2	13.2
	Selectivity smoothing penalty	15.5		14.9	15.4	16.2	15.4	14.5	15.8	17.4	16.1	16.2	14.9	13.0
M. paradoxus	K^{sp}	754	(0.05)	1521	527	1645	507	1313	711	1716	547	596	1655	1494
	h	0.96	(0.08)	0.98	0.85	0.98	0.88	1.07	0.77	1.00	0.85	0.70	0.98	0.98
	B^{sp}_{2012}	114	(0.10)	182	103	282	106	143	141	317	129	148	220	145
	B^{sp}_{2012}/K^{sp}	0.15	(0.12)	0.12	0.20	0.17	0.21	0.11	0.20	0.19	0.24	0.25	0.13	0.10
	B^{sp}_{2013}	108	(0.13)	182	96	290	98	144	134	330	122	132	227	138
	B^{sp}_{2013}/K^{sp}	0.14	(0.14)	0.12	0.18	0.18	0.19	0.11	0.19	0.19	0.22	0.22	0.14	0.09
	B^{sp}_{MSY}	158	(0.05)	347	125	385	113	296	150	392	95	172	399	371
	B^{sp}_{MSY}/K^{sp}	0.21	(0.09)	0.23	0.24	0.23	0.22	0.23	0.21	0.23	0.17	0.29	0.24	0.25
	$B^{sp}_{2012}/B^{sp}_{MSY}$	0.72	(0.13)	0.52	0.83	0.73	0.94	0.48	0.94	0.81	1.35	0.86	0.55	0.39
	$B^{sp}_{2013}/B^{sp}_{MSY}$	0.68	(0.14)	0.52	0.77	0.75	0.87	0.49	0.90	0.84	1.28	0.77	0.57	0.37
	MSY	113	(0.04)	120	115	115	113	118	124	119	117	111	126	121
M. capensis	K^{sp}	239	(0.08)	451	173	523	195	273	281	456	295	257	167	200
	h	1.03	(0.12)	0.98	0.95	0.98	0.93	1.12	0.87	1.16	0.90	0.70	0.97	0.93
	B^{sp}_{2012}	152	(0.08)	164	86	221	104	162	210	286	217	140	81	102
	B^{sp}_{2012}/K^{sp}	0.64	(0.08)	0.36	0.49	0.42	0.54	0.59	0.75	0.63	0.73	0.54	0.49	0.51
	B^{sp}_{2013}	170	(0.08)	185	97	245	116	182	229	312	236	156	92	115
	B^{sp}_{2013}/K^{sp}	0.71	(0.08)	0.41	0.56	0.47	0.60	0.67	0.81	0.68	0.80	0.61	0.55	0.57
	B^{sp}_{MSY}	96	(0.04)	85	29	98	34	134	112	190	108	74	26	37
	B^{sp}_{MSY}/K^{sp}	0.40	(0.12)	0.19	0.17	0.19	0.17	0.49	0.40	0.42	0.37	0.29	0.15	0.19
	$B^{sp}_{2012}/B^{sp}_{MSY}$	1.58	(0.10)	1.93	2.97	2.26	3.09	1.21	1.88	1.50	2.01	1.89	3.14	2.75
	$B^{sp}_{2013}/B^{sp}_{MSY}$	1.76	(0.10)	2.17	3.35	2.51	3.45	1.36	2.05	1.64	2.19	2.11	3.57	3.10
	MSY	63	(0.04)	48	53	54	60	55	96	73	99	57	53	57

Table 3: Comparison of estimates of B^{sp}_{MSY}/K^{sp} and B^{sp}_{y}/B^{sp}_{MSY} for *M. paradoxus* and *M. capensis* for the 2009 RS and the current (2013) RS.

	M. paradoxus					*M. capensis*				
	2009		*2013*			*2009*		*2013*		
	B^{sp}_{MSY}/K^{sp}	$B^{sp}_{2009}/B^{sp}_{MSY}$	B^{sp}_{MSY}/K^{sp}	$B^{sp}_{2009}/B^{sp}_{MSY}$	$B^{sp}_{2013}/B^{sp}_{MSY}$	B^{sp}_{MSY}/K^{sp}	$B^{sp}_{2009}/B^{sp}_{MSY}$	B^{sp}_{MSY}/K^{sp}	$B^{sp}_{2009}/B^{sp}_{MSY}$	$B^{sp}_{2013}/B^{sp}_{MSY}$
RS1	0.24	0.59	0.21	0.47	0.68	0.47	1.12	0.40	1.21	1.76
RS2	0.24	0.45	0.23	0.35	0.52	0.20	2.88	0.19	1.56	2.17
RS3	0.20	0.63	0.24	0.58	0.77	0.17	3.41	0.17	2.07	3.35
RS4	0.20	1.09	0.23	0.53	0.75	0.20	3.24	0.19	1.89	2.51
RS5	0.11	2.19	0.22	0.65	0.87	0.17	3.54	0.17	2.26	3.45
RS6	0.26	0.42	0.23	0.30	0.49	0.48	1.08	0.49	0.98	1.36
RS7	0.19	0.65	0.21	0.66	0.90	0.61	0.91	0.40	1.46	2.05
RS8	0.34	0.64	0.23	0.58	0.84	0.42	1.52	0.42	1.30	1.64
RS9	0.37	0.68	0.17	0.96	1.28	0.41	1.44	0.37	1.58	2.19
RS10	0.28	1.12	0.29	0.71	0.77	0.30	2.10	0.29	1.39	2.11
RS11	0.24	0.44	0.24	0.37	0.57	0.41	0.42	0.15	2.17	3.57
RS12	0.24	0.45	0.25	0.26	0.37	0.41	0.39	0.19	1.99	3.10

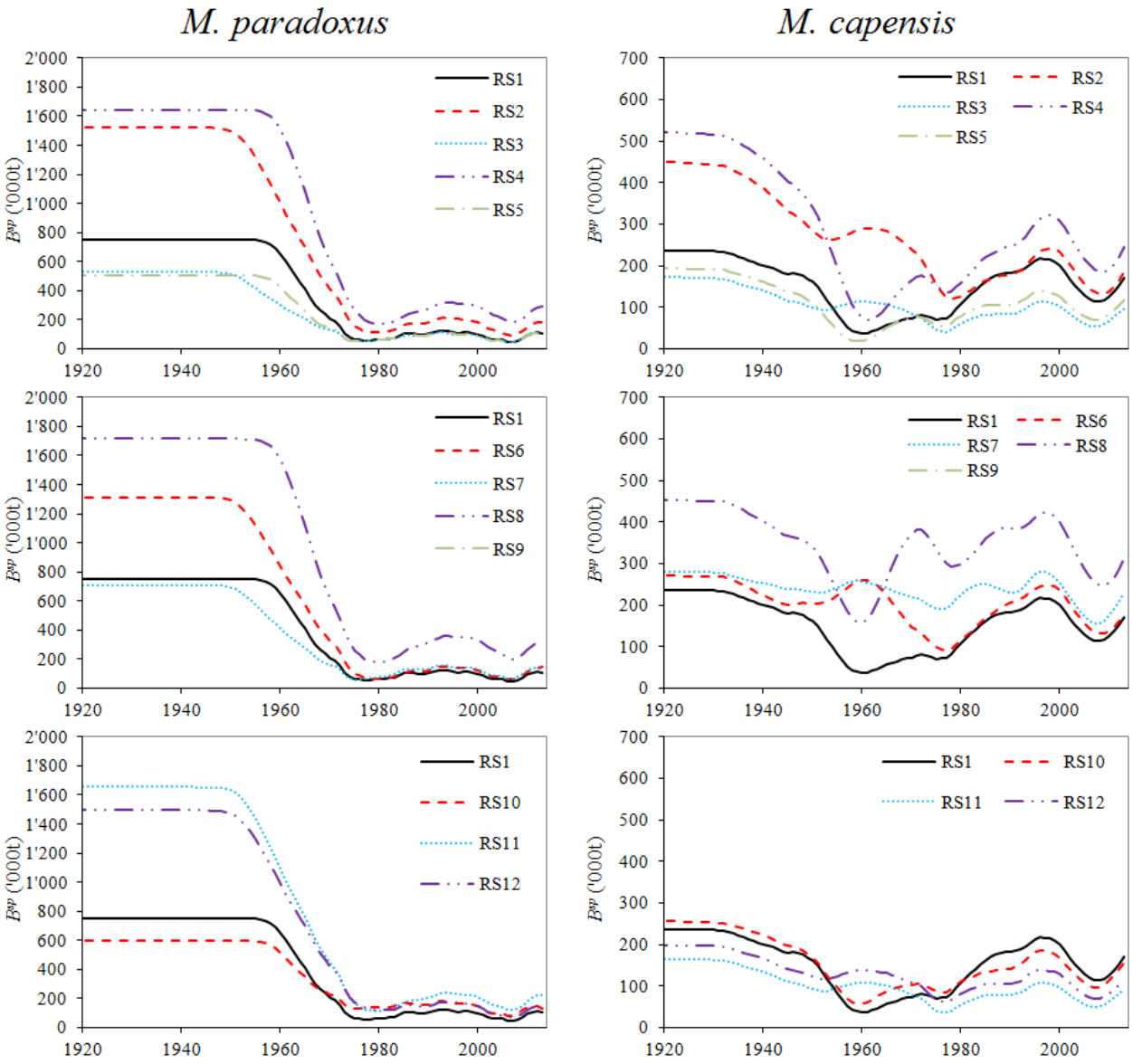

Fig. 1: Trajectories of female spawning biomass for the 12 assessment scenarios.

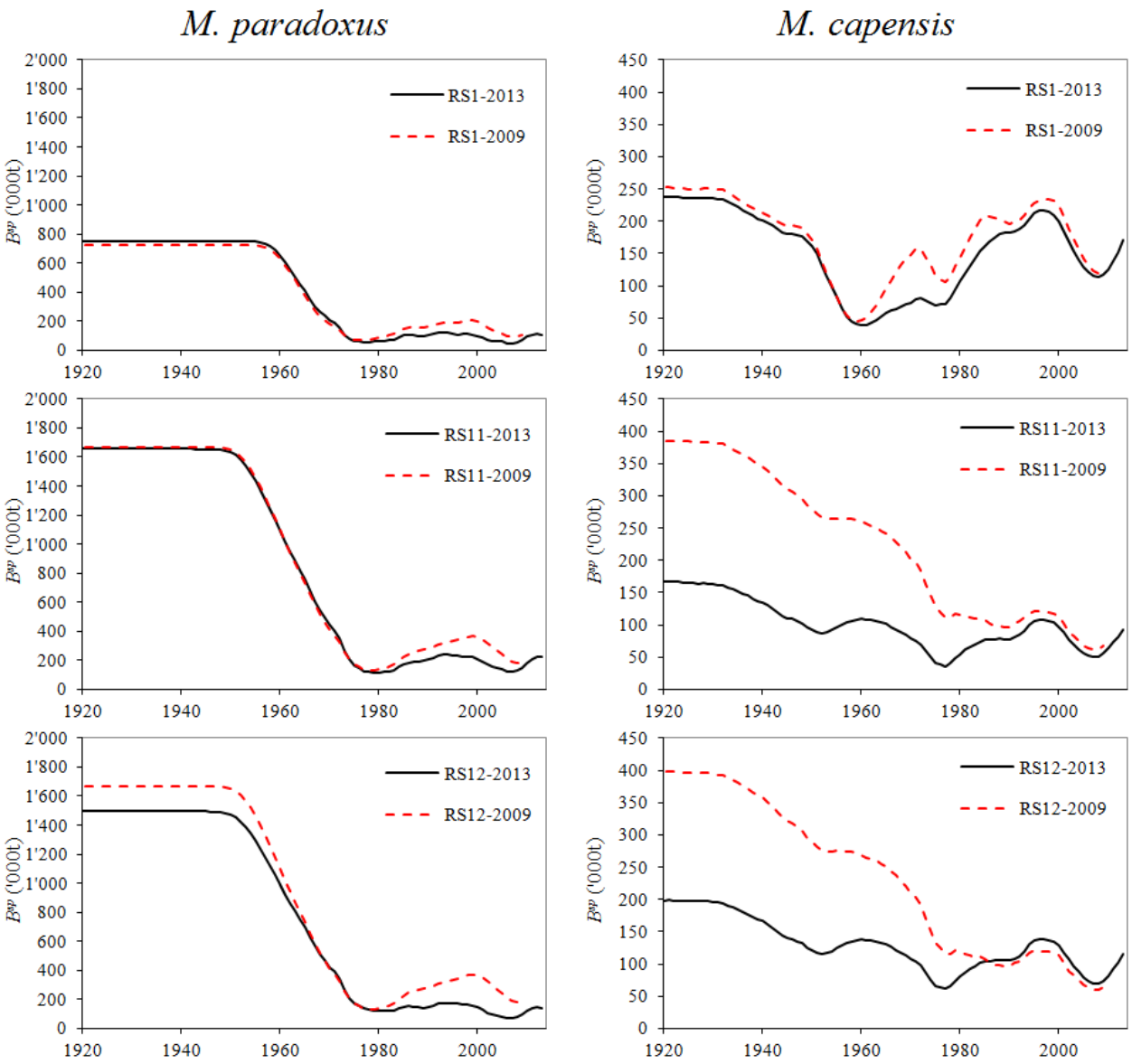

Fig. 2: Comparison of female spawning biomass for the 2009 and 2013 assessment for three of the OMs in the RS.

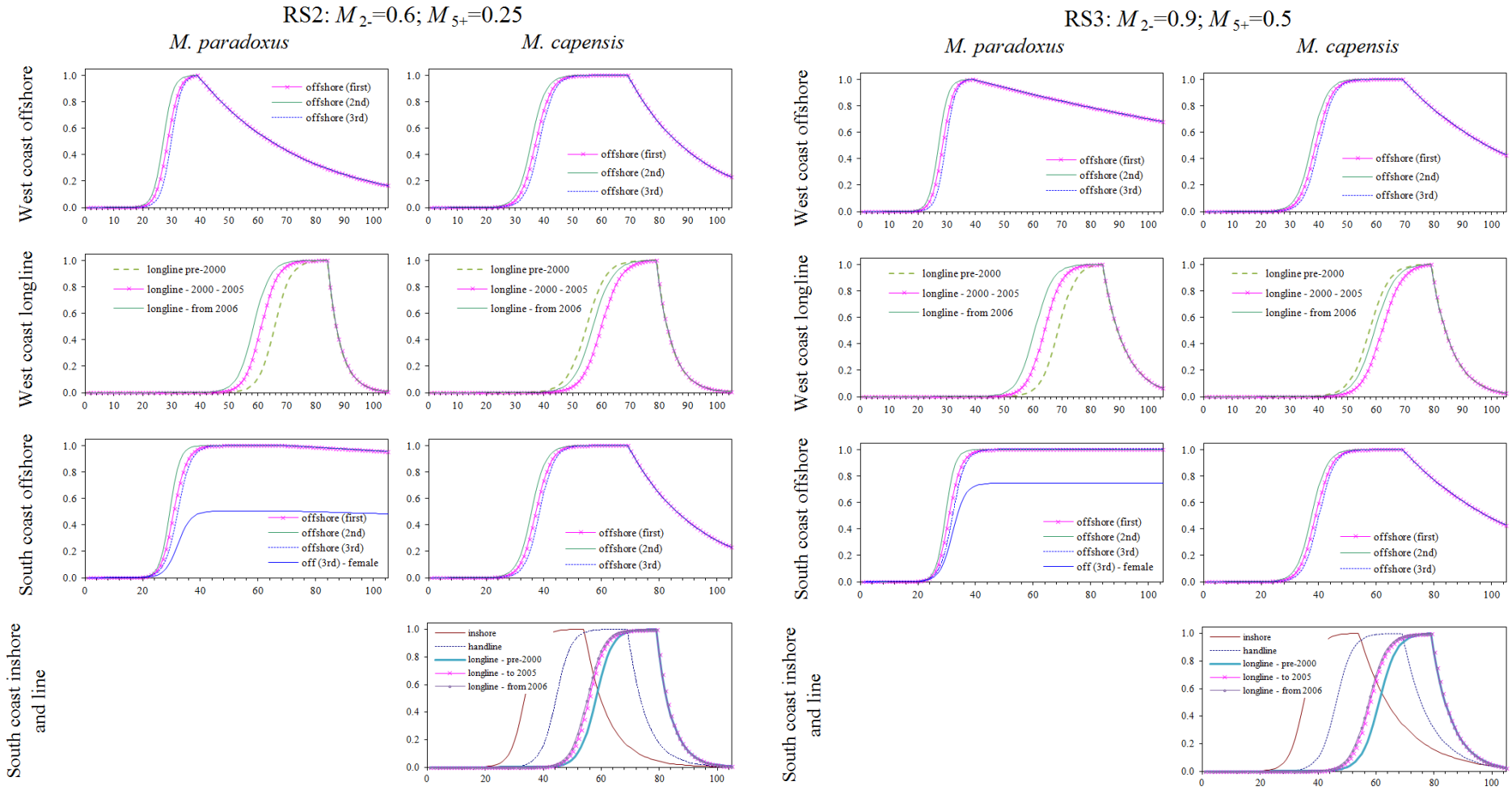

Fig. 3: Commercial selectivities-at-length for RS2 (lower natural mortalties: M_{2-}=0.6; M_{5+}=0.25) and RS3 (higher natural mortalities: M_{2-}=0.9; M_{5+}=0.5).