A Note on the Sensitivity of Hake Assessments to the Choice of the Central Year for the Shift from a Primarily *M. capensis* to Primarily *M. paradoxus* Fishery

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February 2010

At the February 18 meeting of the DWG, there was a request from Industry for further assessment runs for different choices for the central year for the switch from a primarily *M. capensis* to a primarily *M. paradoxus* deep-sea trawl fishery.

This note reports the results from such assessment runs for a set of choices for this central year ranging from 1940 to 1972. Fig. 1 shows time trends of the proportion of *M. capensis* in the catch for these alternatives. These results are repeated for three different choices for the natural mortality vector assumed: both the high and low options put forward for the Reference Set (RS) in Rademeyer and Butterworth (2010), and also for the intermediate vector chosen for the Reference Case (RC = RS1). All runs show results for a modified Ricker choice for the stock-recruitment relationship, as for the RC.

Results are shown in Tables 1 and 2 which respectively list estimates and differences in – lnL from that for the best fitting of all these models. Results are shown for more choices for the central year for the intermediate natural mortality vector case than for the high and low options.

Discussion

For testing OMP-2006, the central year choices included in the RS were 1940, 1950 and 1957. There were two reasons for favouring such earlier years: the likelihoods of the model fits were better, and for later years the ratio of the current biomass of *M. capensis* to *M. paradoxus* reached larger values than were considered plausible.

It is evident from the results in Table 1 that these reasons are no longer as strong. Amongst the scenarios shown, only for the 1972 choice does the likelihood deteriorate sufficiently to argue strongly against plausibility (except for the higher natural mortality option, but for that there are other questionable features such as the very low B^{sp}_{MSY}/K^{sp} estimate and the highish current *M. capensis* to *M. paradoxus* biomass ratio). This latter concern does however now seem to come into play only for choices for the central year of 1970 and sometimes 1965.

An interesting feature of the results for *M. paradoxus* is that except at the extremes of the range for choice of the central year, the current spawning biomass B^{sp}_{2009}, expressed either in absolute terms or as a proportion of B^{sp}_{MSY}, does not change greatly as the choice for the central year is modified (though it does depend on the natural mortality vector chosen). This is an important result, as a key condition for the revised OMP, as set out in the MSC re-certification report for the hake trawl fishery (see: www.msc.org/track-a-fishery/certified/south-atlantic-indian-ocean/south-africa-hake-trawl-fishery/south-african-hake-reassessment-documents/19.02.2010-sa-hake-rep-v4.pdf - specifically pg. 148), is consideration of limit reference points, and the defaults for these are typically $0.5B^{sp}_{MSY}$. The assessments generally put *M. paradoxus* somewhat above or at least close to this default.

This in turn suggests that debate on the most appropriate choices for the central year in the RS scenarios may not be that crucial in terms of the performance which the new OMP will need to demonstrate.

In terms of likelihoods, there is little to choose amongst the various scenarios in Table 1, except that the choice of 1972 can likely be excluded. But equally this means that the data are not able to reliably distinguish choices between 1940 and 1970, so that (unless compelling new information on this issue

can be tabled) the OMP needs to demonstrate robust performance across this range as no choice within it can be unambiguously excluded on plausibility grounds.

In this context, moving the range of choices from the [1940; 1957] of the 2006 RS to the [1950 ; 1965] proposed for the 2010 RS in Rademeyer and Butterworth (2009) would seem to broadly capture this range of uncertainty in an unbiased manner.

Reference

Rademeyer RA and Butterworth DS. 2010. Proposed Reference Set for the South African hake resource to be used in OMP-2010 testing. Unpublished report, Marine and Coastal Management, South Africa. MCM/2010/FEB/SWG-DEM/05. 63pp.

Table 1: Estimates of management quantities for runs for a set of choices for the central year of the *M. capensis* to *M. paradoxus* shift and *M* values. Values in bold have been fixed. B^{sp}_{2009}/K^{sp} is 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. A * on a value for steepness (*h*) indicates a constraint boundary; the species ratio values given relate to *M. capensis* relative to *M. paradoxus*.

		M. paradoxus									*M. capensis*									
	-lnL	K^{sp}	*h*	$B^{sp}{}_{2009}$	$B^{sp}{}_{2009}/K^{sp}$	$B^{sp}{}_{MSY}/K^{sp}$	$B^{sp}{}_{2009}/B^{sp}{}_{MSY}$	*MSY*	M_{2-}	M_{5+}	K^{sp}	*h*	$B^{sp}{}_{2009}$	$B^{sp}{}_{2009}/K^{sp}$	$B^{sp}{}_{MSY}/K^{sp}$	$B^{sp}{}_{2009}/B^{sp}{}_{MSY}$	*MSY*	M_{2-}	M_{5+}	2009 species ratio B^{sp}
1940	-93.9	2148	0.93	205	0.10	0.15	0.61	110	**0.75**	**0.38**	490	0.85	271	0.55	0.54	1.00	68	**0.75**	**0.38**	1.32
1945	-93.1	1610	0.92	200	0.12	0.22	0.54	112	**0.75**	**0.38**	500	0.90	274	0.55	0.51	1.03	67	**0.75**	**0.38**	1.37
1950	-94.1	1585	0.94	201	0.13	0.22	0.55	112	**0.75**	**0.38**	442	0.92	239	0.54	0.53	0.99	64	**0.75**	**0.38**	1.19
1955	-92.1	1428	1.02	203	0.14	0.23	0.57	112	**0.75**	**0.38**	544	0.89	301	0.55	0.50	1.07	69	**0.75**	**0.38**	1.48
1958	-94.5	1363	1.08	208	0.15	0.24	0.59	113	**0.75**	**0.38**	516	1.01	279	0.54	0.47	1.12	69	**0.75**	**0.38**	1.34
1960	-94.6	1306	1.13	214	0.16	0.25	0.60	114	**0.75**	**0.38**	582	1.50*	315	0.54	0.34	1.56	83	**0.75**	**0.38**	1.47
1965	-97.7	1018	1.36	242	0.24	0.34	0.66	117	**0.75**	**0.38**	666	1.50*	408	0.61	0.43	1.39	118	**0.75**	**0.38**	1.69
1970	-94.0	644	1.38	240	0.37	0.50	0.69	120	**0.75**	**0.38**	1322	0.63	832	0.63	0.54	1.15	123	**0.75**	**0.38**	3.47
1972	-86.9	543	1.20	230	0.42	0.58	0.71	113	**0.75**	**0.38**	1318	0.79	828	0.63	0.48	1.28	135	**0.75**	**0.38**	3.60
1940	-97.3	2777	1.09	294	0.11	0.27	0.43	123	**0.60**	**0.25**	801	1.50*	400	0.50	0.37	1.34	68	**0.60**	**0.25**	1.36
1950	-99.6	2842	1.05	286	0.10	0.26	0.42	121	**0.60**	**0.25**	735	1.18	379	0.52	0.48	1.08	65	**0.60**	**0.25**	1.33
1958	-98.9	2436	1.22	288	0.12	0.27	0.47	121	**0.60**	**0.25**	792	1.50*	404	0.51	0.39	1.31	70	**0.60**	**0.25**	1.40
1965	-92.4	1683	1.50*	354	0.21	0.34	0.64	121	**0.60**	**0.25**	1793	1.50*	1156	0.65	0.42	1.52	166	**0.60**	**0.25**	3.27
1972	-30.7	1747	0.50	792	0.45	0.77	0.63	122	**0.60**	**0.25**	3113	0.45	2052	0.66	0.62	1.06	128	**0.60**	**0.25**	2.59
1940	-92.3	1435	0.87	165	0.12	0.11	0.80	110	**0.90**	**0.50**	354	0.64	206	0.58	0.60	0.91	63	**0.90**	**0.50**	1.25
1950	-92.0	967	0.86	156	0.16	0.19	0.65	110	**0.90**	**0.50**	367	0.62	214	0.58	0.61	0.91	63	**0.90**	**0.50**	1.37
1958	-89.5	869	0.97	177	0.20	0.25	0.65	111	**0.90**	**0.50**	417	0.63	247	0.59	0.59	0.96	69	**0.90**	**0.50**	1.40
1965	-92.3	662	1.14	199	0.30	0.37	0.68	111	**0.90**	**0.50**	442	1.50*	279	0.63	0.41	1.44	110	**0.90**	**0.50**	1.40
1972	-95.6	820	1.50*	219	0.27	0.06	3.83	181	**0.90**	**0.50**	998	0.66	640	0.64	0.51	1.21	135	**0.90**	**0.50**	2.92

Table 2: For each contribution to the total negative log-likelihood (-lnL), differences in –lnL compared to the case with the lowest –lnL.

		-lnL total	CPUE historic	CPUE GLM	Survey	Comm CAL	Survey CAL (sex-aggr.)	Survey CAL (sex-disaggr.)	ALK	Rec. penalty	Sel. smoothing penalty
$M2$=0.75, $M5$+=0.375	1940	5.8	0.7	3.6	1.7	-3.8	0.0	0.5	0.5	2.4	0.1
	1945	6.5	2.0	4.9	1.1	-3.3	-0.1	0.6	0.2	1.1	0.0
	1950	5.5	1.9	4.3	1.2	-3.6	-0.2	0.6	0.1	1.3	0.0
	1955	7.5	3.3	6.1	1.2	-4.2	-0.1	0.4	0.1	0.5	-0.1
	1958	5.1	1.8	5.8	1.0	-4.2	-0.2	0.5	-0.1	0.2	0.0
	1960	5.0	1.2	7.0	0.6	-4.0	-0.3	0.5	-0.1	-0.3	0.1
	1965	2.0	-0.1	6.5	1.0	-6.5	-0.2	0.1	0.3	0.6	-0.1
	1970	5.6	1.8	8.8	1.4	-6.8	0.0	0.1	0.5	-0.1	-0.1
	1972	12.8	1.9	10.9	1.9	-7.4	0.5	-0.4	2.0	3.3	0.0
M2=0.6, M5+=0.25	1940	2.3	1.0	1.0	-0.3	0.9	1.2	-0.4	-0.2	-1.0	0.0
	1950	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1958	0.8	-0.3	2.5	-0.7	-0.7	1.0	-0.2	-0.2	-1.1	0.0
	1965	7.2	-0.6	6.2	0.2	-0.9	1.2	-0.7	1.7	-0.8	0.8
	1972	68.9	19.5	14.5	3.8	13.6	6.5	5.8	2.5	1.4	0.7
M2=0.9, M5+=0.5	1940	7.3	2.6	6.7	4.6	-6.4	-0.3	0.2	-2.0	2.3	-0.3
	1950	7.6	3.1	7.5	4.0	-6.4	-0.5	0.8	-2.2	1.7	-0.4
	1958	10.1	4.2	8.3	3.4	-7.3	-0.2	2.2	-1.7	1.1	-0.3
	1965	7.3	2.2	10.3	1.8	-8.7	-0.2	2.4	-1.1	0.0	0.2
	1972	4.0	0.9	8.5	4.4	-10.9	0.0	2.5	-1.9	0.5	0.2

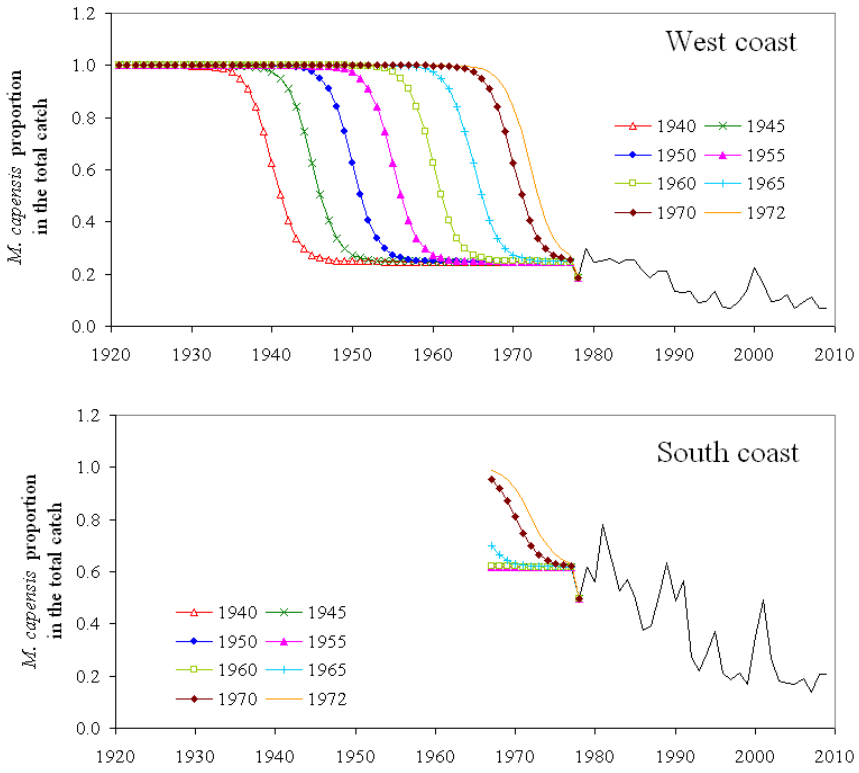

Fig.1: Assumed *M. capensis* proportion in the offshore trawl catches (West and South Coasts separately) for different choices for the central year for the switch from a primarily *M. capensis* to a primarily *M. paradoxus* deep-sea trawl fishery. From 1978 onwards, the survey species-proportion at depth relationship has been used to split the catches.