

List of possible robustness tests for the 2018 OMP review

A. Ross-Gillespie and D.S. Butterworth¹

Email: mlland028@myuct.ac.za

This document provides an overview of past hake OMP robustness tests suggestions from various sources, and goes on to propose an order of priority for addressing them. The order is suggested more as a basis to initiate discussions than one with firm preferences.

Table 1: Robustness tests from IWS 2017 and those flagged as most important in the OMP2010 review

Table 2: Sensitivity tests arising from DWG discussions

Table 3: Summary and attempt at prioritisation of the OMP2010 robustness tests

Proposed workplan:

1. High and High-Medium priority items from Table 1
 - a. Model starting in 1978
 - b. Restrict $q < 1$ to see what in the negative log-likelihood is driving the $q > 1$ estimates
 - c. Rob31: C.future.1: Missing/reduced surveys and surveys on another only partially calibrated vessel.
 - d. Survey q 's for industry vessels
 - i. Data for industry vessels should be down-weighted.
 - ii. OM projections should take uncertainty regarding possible q 's for industry vessels into account
 - iii. Try estimating one q for all the industry vessels.
 - e. Rob35: C.future.3: Undetected increase in catchability related to CPUE, with and without future surveys
 - f. Rob13: B.others.2: Changes in past K values over time (30% linear decrease over 1980 to 2000 for both species).
 - g. Rob37: C.future.5: Decrease in K .
2. From Table3 – priority 1 or 2
3. From Table 2 – medium priority
4. Not sure we'll be able to do much more than this?
5. Any priority allocations in Table 2 that should change?

¹ Marine Resource Assessment and Management Group, Department of Mathematics and Applied Mathematics, University of Cape Town, Rondebosch.

Table 1: List of robustness tests from three sources: Recommended by the panel for the 2017 International Stock Assessment Workshop (IWS2017), recommended by the DAFF Demersal Working group (DWG) and those found to present the greatest challenges from a resource conservation perspective during the development of OMP-2011 and consequently used as robustness tests for OMP-2014 (MARAM IWS/DEC13/Hake/P6). The priorities indicated are a “first-cut” by D Butterworth to provide a baseline for discussion.

Robustness test	Reference	Priority
Model starting in 1978.	IWS2017	H
Restrict $q < 1$ to see what in the negative log-likelihood is driving the $q > 1$ estimates.	IWS2017 and DWG	H
Rob31: C.future.1: Missing/reduced surveys and surveys on another only partially calibrated vessel.	MARAM IWS/DEC13/Hake/P6	H
Survey q 's for industry vessels.	Data for industry vessels should be down-weighted. OM projections should take uncertainty regarding possible q 's for industry vessels into account. Try estimating one q for all the industry vessels. Do a sensitivity run adjusting survey estimates for month effect as surveys using industry vessels occur later.	H H H H
Rob35: C.future.3: Undetected increase in catchability related to CPUE, with and without future surveys.	MARAM IWS/DEC13/Hake/P6	H
Rob13: B.others.2: Changes in past K values over time (30% linear decrease over 1980 to 2000 for both species).	MARAM IWS/DEC13/Hake/P6	H/M
Rob37: C.future.5: Decrease in K .	MARAM IWS/DEC13/Hake/P6	H/M
Examine the consequences of fishery selectivity changing in the future.	IWS2017	M
Examine an OM where at least one fleet/survey has near asymptotic selectivity for <i>M. capensis</i> .	IWS2017	M
Alternative CPUE and catch data to the Model A6b data (see FISHERIES/2018/JULY/SWG-DEM/27 for alternatives).	DWG	M
von Bertalanffy parameterisation.	Estimate L_1 , L_5 and $\ln K$ instead of L_5 , $\ln K$ and t_0 .	M

M. paradoxus/ M. capensis biomass ratios	Some recommendations were made by the panel, and a suggestion was made at the DWG to form a working group to look into this.	M
Weighting of RS OMs	Selection of OMP18 should be based on equal weighting, with sensitivity explored to different weightings - see panel recommendations.	M
Slope-based HCR	Trade-offs between implications of slope-based vs target-based approaches should be explored.	M
Shrinkage for recent recruitment	Procedure could be improved, but this is not high priority.	M
Convergence	Implement hybrid method. Impose soft bounds on parameters. Set values of parameters sitting on their bounds equal to that bound. Try to isolate problem parameters by fixing most and free-ing step-by-step.	M/L M/L M/L M/L
Fit OM to geostatistical estimates of biomass (to 500m)	IWS2017	L
Include data (index and size-composition) from 500-750m as a separate time-series	IWS2017	L
Rob25: B.others.6: Alternative maturity-at-length with fixed lower h values (The maturity-at-length ogive is shifted to the right by 20 cm so that the age at 50% maturity corresponds to approximately 6 rather than about 4 in the RC. Together with this alternative maturity-at-length, the steepness parameters for both species are fixed to 0.7 (MCM/2009/NOVEMBER/SWG-DEM/93))	MARAM IWS/DEC13/Hake/P6	L
Large changes in RS results since 2013 - Figure 1a of MARAM/IWS/2017/Hake/P4	Check for convergence problems	L
Methot and Taylor (2011) method for year-specific bias-correction factors for stock-recruitment residuals	Can only be applied when a positive definite Hessian matrix has been obtained.	L

Rob5: B.SR.3: Other combinations of BH/Ricker and level of natural mortality (Rob5 based on RS1 and RS11 of OMP-2011: True Ricker, trawl catches shift centre in 1950 and M2=-0.9 and M5+=0.5 for both species).	MARAM IWS/DEC13/Hake/P6	NA
Estimation uncertainty	Model uncertainty is likely to out-weigh parameter uncertainty	NA

Table 2: Sensitivity tests arising from DWG discussions

1	Constant catch projections with Rebecca's old F ratio method
2	Constant catch projections with the fleet ratios averaged over the last five years rather than the legal allocations
3.	Sensitivity to mortality-at-age vectors – or is should this be a robustness test? OLRAC mortality vector, original mortality vectors used in the past (Low, Medium, High)

Table 3: Summary of the robustness tests from MCM/2010/JUNE/SWG-DEM/31 and an attempt at prioritising the tests based on the performance statistics of DEM/31. These performance statistics were B_{2027}^{sp}/B_{MSY} , B_{2030}^{sp}/K^{sp} and $B_{2030}^{sp}/B_{2010}^{sp}$, and the priority allocation was done by a rough qualitative classification of the robustness tests, with those scoring the lowest in these performance statistics receiving the highest priority. Rows with grey text indicate that the robustness test is no longer relevant given changes in the model since 2010.

No.	Priority		Keyword1	Keyword 2	Description	Variant	Comment
1	4	past	SR	mortality	B-H + mortality		Replace with other mortality vectors? E.g. OLRAC vector, mortality vectors previously used in the RS (low, med, high mortality)
2	2	past	SR	mortality	B-H + mortality		
3	4	past	SR	mortality	B-H + mortality		
4	3	past	SR	mortality	Ricker + mortality		
5	1	past	SR	mortality	Ricker + mortality		
6	3	past	SR		Sigma_R=0.25		
7	3	past	Likelihood weighting	ALK	W_ALK=0.001		
8	2	past	Likelihood weighting	ALK	W_ALK=0.1		
9	3	past	Likelihood weighting	CAL	W_CAL=0.01		
10	2	past	Likelihood weighting	CAL	W_CAL=1.0		
11	2	past	Mortality	Gender	Gender-dependent mortality (increase males +0.05, decrease females -0.05)		
12a	3	past	Selectivity & survey	Commercial & survey	All commercial & survey selectivity slopes	0.04	Selectivity was modelled with a logistic curve, and selectivity slopes were defined as rate of decrease in selectivity with length for fish longer than some length l_{slope} . No longer relevant as selectivity is now defined as a double normal.
12b	3	past	Selectivity & survey	Commercial & survey	All commercial & survey selectivity slopes	0.02	
12c	2	past	Selectivity & survey	Commercial & survey	All commercial & survey selectivity slopes	-0.04	
12d	2	past	Selectivity & survey	Commercial & survey	All commercial & survey selectivity slopes	-0.02	

13	1	past	Carrying capacity		Decrease in K (30% linear between 1980 and 2000)		Already in Table 1
14	4	past	Likelihood weighting	CPUE & survey	Increase weighting of recent CPUE and survey data		
15	2	past	SR		No shrinkage of recent recruitment		
16	3	past	Mortality	Larger ages	Increase M at larger ages		
17	1	past	Model structure		Start in 1978		Already in Table 1
18	4	past	Fishing	offshore efficiency	Change in efficiency in offshore trawl fleet in 1994/1995		
19a	3	past	CPUE		Different CPUE series	all offshore vessels alternative depth stratifications omit days with nominal CPUE=0	Still relevant? Replace with one of the series resulting from other species splitting algorithm (already in Table 1 with medium priority)?
19b	2	past	CPUE		Different CPUE series		
19c	3	past	CPUE		Different CPUE series		
20a	2	past	Survey	Calibration	Survey calibration factor	incr. cap factor to 0.9 decr. cap factor to 0.6 both cap and par factors estimated	
20b	2	past	Survey	Calibration	Survey calibration factor		
20c	2	past	Survey	Calibration	Survey calibration factor		
21	2	past	Biological	Ageing	Ageing of both species out by one year		
22	2	past	Biological	Ageing	Ageing of both species to be halved		
23	2	past	Selectivity	Commercial	Alternative assumption for the cap offshore selectivity		Offshore trawl fleet is assumed to be equal to the inshore trawl fleet (MCM/2009/NOVEMBER/SWG-DEM/93)
24a	2	past	Selectivity	Commercial	Alternative assumption re SC female paradoxus selectivity scaling factor	as lower	
24b	2	past	Selectivity	Commercial	Alternative assumption re SC female paradoxus selectivity scaling factor	as higher	

25	1	past	Biological	Maturity-at-length	Alternative maturity-at-length with fixed lower h values		The maturity-at-length ogive is shifted to the right by 20 cm so that the age at 50% maturity corresponds to approximately 6 rather than about 4 in the RC. Together with this alternative maturity-at-length, the steepness parameters for both species are fixed to 0.7 (MCM/2009/NOVEMBER/SWG-DEM/93)
26	4	past	Fishing	Discards	Include discards in the past		
27	2	past	Biological	male:female ratio	40/60 male/female ratio at birth instead of 50/50		
28	4	past	CPUE	Species splitting algorithm	Alternative species splitting algorithm		
29	2	past	CPUE		CPUE drops by 20% from 1997 to 2002 as a result of shorter tows		
30	2	future	CPUE & survey	catchability	Max proportion of cohort catchable in one year decrease from 90% to 70%		
31a	2	future	Survey	missing	Missing/reduced surveys in the future	no surveys	Already in Table 1
31b	2	future	Survey	missing	Missing/reduced surveys in the future	only WC surveys	
31c	2	future	Survey	missing	Missing/reduced surveys in the future	only SC surveys	
31d	2	future	Survey	missing	Missing/reduced surveys in the future	both surveys missing every three years	
31e	2	future	Survey	missing	Missing/reduced surveys in the future	increase all future survey CVs by factor of sqrt(2)	

31f	2	future	Survey	missing	Missing/reduced surveys in the future	no surveys plus undetected increase catchability related to CPUE	
32	2	future	Survey		Decrease all future survey CVs by a factor of $1/\sqrt{2}$		
33a	2	future	MPA	CPUE	MPA possible effects on future CPUE	no CPUE	
33c	2	future	MPA	CPUE	MPA possible effects on future CPUE	new CPUE series with lower q	
33d	2	future	MPA	CPUE	MPA possible effects on future CPUE	new CPUE series with higher q	
34a	2	future	Fishing	Fratio trend	Trend in Fratio over time in the future	2% p.a. for 10 years then constant	
34b	2	future	Fishing	Fratio trend	Trend in Fratio over time in the future	-2% p.a. for 10 years then constant	
35	2	future	CPUE	catchability	Undetected 2% p.a. increase in catchability related to CPUE in the future		Already in Table 1
36a	4	future	Fishing	Discards	Change in discard pattern in the future	past, but no future discards	
36b	2	future	Fishing	Discards	Change in discard pattern in the future	past and future discards	
36c	4	future	Fishing	Discards	Change in discard pattern in the future	past discards are halved in the future	
37	1	future	Carrying capacity		Decrease K in the future (30% linear decrease in first five years of projection)		Already in Table 1
38	2	future	SR		Allow for serial correlation in recruitment residuals (estimate from RC fit)		Included in the model now