

**INTERNATIONAL REVIEW PANEL REPORT FOR THE 2012
INTERNATIONAL FISHERIES STOCK ASSESSMENT WORKSHOP
26 - 30 November 2012, UCT
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The Panel recognised the very high quality of the research presented at the 2012 International Fisheries Stock Assessment Review Workshop. This included research on hake, sardine, anchovy, squid, linefish, and South Coast rock lobster. The work on management procedures (OMPs) continues to be world-leading. The Panel thanked the workshop participants for the hard work that went into preparing and presenting the workshop papers, and for the extra analyses undertaken during the workshop.

This report starts with observations from the Panel on some general issues for a subset of the species reviewed, and then focuses on the more detailed technical review and recommendations concerning each fishery. The Panel deliberations were guided by a set of key issues (see Appendix 1) and the text in square parentheses at the end of some of the recommendations reflects the corresponding key issue(s). The Panel did not have the time to address all of the key questions. The recommendations are annotated by their priorities (H, M, L and conclusions are indicated by asterisks). Appendix 2 contains some additional technical material.

Summary of general issues

South Coast rock lobster

The Panel agrees that the approach taken to model time-varying selectivity for South Coast rock lobster is appropriate from a technical point of view. A key consideration is, however, to continue to evaluate whether the estimated changes in selectivity are perhaps the result of sampling bias related to differences in quarterly sampling, missing quarter samples or low sample size. The Panel has several recommendations (i.e., A.1, A.2, A.6) which pertain to addressing this question.

Line fishery

The method outlined in Winker *et al.* (in press) shows considerable promise for standardizing multi-species catch per unit effort data such as for the South African line fishery. Initial simulation testing shows that the method is robust to a range of uncertainties in the way such data are generated. The Panel spent considerable time with the analysts to understand why the method performed well in the simulations, and while many analyses have been undertaken, the Panel identified desirable additional work. Results to date support the conclusion that the method is suitable for application to the South African line fishery, but until further testing is completed it should continue to be applied in conjunction with alternative methods for standardizing multi-species CPUE. In particular, the Panel **strongly supports** comparing the results from the method which treats the PC-scores as covariates with those from a method in which the records by fishing tactic (or group of fishing tactics) are analysed using a hurdle model (i.e., a model which accounts for both the probability of a zero catch and the size of the catch-rate given that the catch is non-zero).

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Hake surveys

The Panel is concerned that *Africana* may be unable to conduct a hake survey during January 2013 and perhaps beyond. Surveys provide indices of abundance that are independent of fishing operations and hence are essentially the only way to identify and correct for effects of changing fishery catchability on CPUE as an index of abundance if such a change is taking place. Moreover, surveys provide scientific data on other issues which are of assessment and management relevance (such as information on the sex ratio of hake, and trends in by-catch species). The Panel therefore **strongly supports** that a survey of some form (see below) be conducted using an industry vessel during January 2013 (even if *Africana* is available), and that plans be developed now to address the possibility that future surveys will not be conducted using *Africana*, given that the vessel is nearing the end of its working life.

If *Africana* is available in January 2013, the primary aim of including an industry vessel in the survey would be to calibrate *Africana* against that vessel, which should use the “new gear” used by *Africana* and be operated to replicate *Africana* as closely as possible. Any calibration data from the industry vessel could be used subsequently to calibrate *Africana* with a new survey vessel should one become available in the future, thus maintaining continuity in the current survey time series. The Panel recommends consulting reports on research vessel calibration exercises and develop a Calibration Workplan that can be implemented with industry and / or research vessel replacements for *Africana* (NMFS, 2010; Fowler and Showell, 2009).

If *Africana* is not available in January 2013, the survey using an industry vessel should go ahead as outlined above, but without the calibration to *Africana*. The survey on the industry vessel would then form the first point of a potential new survey time-series should *Africana* be unavailable for future surveys. However, the new data point should not be used in the OMP until a sufficient time series is built up or a calibration with *Africana* is completed. Any sex and length data collected could, however, be used in conditioning the operating model used to select a revised OMP in 2014.

Whatever surveys are conducted in January 2013, the Panel **strongly recommends** that a comprehensive plan be developed as soon as possible to ensure the ongoing provision of scientific survey data for hake (and other demersal species). Such a plan should factor in contingencies concerning the future availability of survey vessels (both industry and government vessels), and the need for calibration between vessels. Priority should be given to ensuring the continuity of comparable survey indices. If future surveys are to be conducted using industry vessels, consideration should be given to the use of multiple vessels and the estimation of between-vessel efficiency. This is particularly important if it is likely that the same industry vessel will not be used for each survey.

The Panel noted that missing surveys potentially impact an application of the current OMP. Such an application should consider the increased risk associated with the missing information, which may require a downward adjustment to the TAC. However, analyses were specified which could indicate that such an adjustment may not be necessary.

Small pelagic surveys

In regard to the use of an industry vessel (*Compass Challenger*) to conduct the remainder of the November 2012 hydro-acoustic survey for small pelagic species, the Panel identified three potential sources of bias between *Africana* and *Compass Challenger* in estimation of resource abundance: (a) the position of the transducer, (b) the difference in noise levels between the vessels, and (c) whether sardine / anchovy will avoid the two vessels differently. Based on information provided by the DAFF scientists, the Panel does not consider it likely that any such bias for *Compass Challenger* relative to *Africana* will be large. Nevertheless, it

supports the proposal to conduct a calibration exercise between *Africana* and *Compass Challenger* to confirm this.

The joint sardine-anchovy OMP relies on estimates of abundance from surveys. Rules have been agreed to handle situations in which such estimates of abundance are not available. These rules seem reasonable (although they have yet to be tested using simulations), and the Panel suggests they be applied in the event that the November 2012 survey cannot be completed sufficiently to yield acceptable estimates of sardine and anchovy abundance. A range of opinions were expressed during the workshop whether or not “Exceptional Circumstances” provisions should be implemented, and how the TAC from the OMP should be adjusted in the event a survey cannot be conducted.

A. South Coast rock lobster

A.1 (H) Review how the catch size-composition data are constructed for each area/quarter. Impose a minimum on the number of animals which are measured during each sampling event (~50) and on the number of samples which are needed for inclusion in the assessment. [*Review assessment; Is there a need for time-varying selectivity; how best is this modelled?; See A.6 below for how this information could be used to inform the design of the observer program.*]

A.2 (H) Examine whether the size-frequencies differ among quarters, for example by applying a GLM to the mean catch lengths and to their standard deviations, including quarter as a factor. If there are consistent differences among quarters, this may impact how catch length-frequencies need to be constructed. [*Review assessment; Is there a need for time-varying selectivity; how best is this modelled? See A.6 below for how this information could be used to inform the design of the observer program.*]

A.3 (H) Further investigate the way time-varying selectivity is modelled. Variant 2, developed during the workshop, which allows for time-varying selectivity only for areas 2 and 3 led to a fit to the data which was not significantly worse than a model which allows for time-varying selectivity in all areas. Models with no time-varying selectivity, and models in which the values for δ for females are constant proportions of those for males, should be explored. The selection of a base-case formulation for time-varying selectivity should be decided considering the ability to fit the data, and the sensitivity of model results to the weight assigned to the size-composition data (w_{len}). [*Review assessment; Is there a need for time-varying selectivity; how best is this modelled?*]

A.4 (H) Some analyses of the tagging data suggest that total mortality may differ between areas 2 and 3. Consequently, the sensitivity tests should include operating models that distinguish these two areas (model 2 in MARAM IWS/NOV12/SCRL/P2). [*Review assessment.*]

A.5 (H) When evaluating candidate OMPs, construct sensitivity tests based on the following specifications: (a) model the parameter δ , which determines time-varying-selectivity, as an AR-1 processes in time; (b) weight the size-frequencies for each year as a function of sample size (perhaps with the weight increasing linearly from 0 at zero sample size to 1 at some intermediate sample size); (c) examine different assumptions regarding spatial structure (models 2 and 3 of MARAM IWS/NOV12/SCRL/P2); (d) change the value of the parameter (w_{len}) which weights the length-frequency data; (e) change the value assumed for natural mortality, M (e.g. to 0.08 and 0.15yr⁻¹); (f) estimate separate residual variance parameters for the trawl CPUE series for the years before and after 1990 in area 1E (given the apparent reduction in inter-annual variation in CPUE after 1990; Figure 1a of MARAM

IWS/NOV12/SCRL/P2); (g) set steepness to 0.8; (h) consider alternative models for time-varying selectivity (e.g. no time-varying selectivity at all; no time-varying selectivity for areas 1E and 1W; perfect correlation between δ for males and females); (i) change the values for σ_λ , σ_{sel} , σ_R and ρ ; and (j) consider alternative scenarios for the historical catches. Show results for cases in which catchability for the commercial fishery is changing over time. These latter sensitivity tests would not be used to select an OMP, but would rather be used to understand the behaviour of the OMP, given a factor which should substantially impact performance. [*Provide advice on range of operating models for OMP testing.*]

A.6 (M) The outcomes of recommendations A1 and A2 should be used to refine the design of the observer program. Therefore, the results of the analyses which explore the ideal number of samples per quarter, number of animals per sample, and the distribution of samples among quarters and areas should be provided to the group considering modifications to observer program. Consider how the size of the catch (e.g., over the most-recent five years) impacts the amount of size-composition data needed.

A.7 (M) Reparameterize the way in which the year-specific recruitment proportions by areas ($\square_{A,y}$ in equation A.29 in MAMARM IWS/NOV12/SCRL/P2) are modelled, so that one of the areas acts as a reference and the estimated parameters define deviations for the other areas with respect to the reference. [*Review assessment.*]

A.8 (M) Reparameterize the way in which the average recruitment proportions to areas (λ^A , in equation A.29 in MAMARM IWS/NOV12/SCRL/P2) are modelled to avoid calculating the proportion for area 3 by subtracting those for areas 1 and 2 from unity. This can be achieved by setting λ for area 1E to 1, estimating λ for areas 1W and 2+3, and renormalizing by dividing by the sum of the 3 λ 's. [*Review assessment.*]

A.9 (M) Compare the estimates of total mortality from the assessment with the corresponding estimates based on the tagging data (MARAM IWS/NOV12/SCRL/BG5) to confirm earlier results that the tagging data and the model outputs are comparable. [*Review assessment.*]

A.10 (M) In the assessment model, specify the proportion mature in terms of length, and compute maturity-at-age taking the distribution of length-at-age into account. Similarly, formulate quantities which depend on weight in terms of weight-at-length and account for the probability distribution for length-at-age. [*Review assessment.*]

A.11 (M) Consider a model in which fishery selectivity is governed by a double logistic (or double-normal) function, and where several of the parameters of this function are time-varying. [*Review assessment; Is there a need for time-varying selectivity; how best is this modelled?*]

A.12 (L) Evaluate the implied distributions of length-at-age given the growth curves which are fitted using the tagging data (e.g. MARAM IWS/NOV17/SCRL/BG7), and compare these distributions to the distributions of length-at-age estimated in the assessment (which assume a constant CV of length-at-age). This will involve making assumptions regarding the distributions of birth dates and of the length-at-age at birth. [*Review assessment.*]

B. Linefish

B.1 (*) The approach of Winker *et al.* (in press) performs well in the simulations conducted to date. This method should be used to construct standardized CPUE indices, along with methods which involve analysing the catch rate data by fishing tactic (or a group of fishing

tactics), and the method of Stephens and MacCall (2004). Comparing the results from the method which treats the PC-scores as covariates with those from a method in which the records by fishing tactic (or group of fishing tactics) are analysed using a hurdle model (i.e. accounting for the information contained in the zero and non-zero catches) is particularly important. [*Review approach proposed for taking targeting into account in GLM standardisation of CPUE; Consideration and refinement of simulation trials to test proposed approach.*]

B.2 (H) The probability of obtaining a zero catch appears to change over time for some species. It is therefore necessary to consider models (e.g., hurdle models) which include the probability of a zero catch. If a logistic model is used to model the probability of capturing at least some of the species of interest, care needs to be taken when specifying the reference values for covariates other than the year factor because the values chosen can impact the estimates of trend in abundance. Consider setting the values for these covariates to the medians in the actual data set. [*Review approach proposed for taking targeting into account in GLM standardisation of CPUE*]

B.3 (H) Provide standard regression diagnostics (e.g. q-q plots, residuals vs covariates, etc.) for both the binomial and lognormal submodels. [*Review approach proposed for taking targeting into account in GLM standardisation of CPUE.*]

B.4 (H) Consider possible Year*FT and Year*PC interactions in the log-normal and binomial models to explore whether the estimated abundance trend differs among fishing tactics. [*Review approach proposed for taking targeting into account in GLM standardisation of CPUE.*]

B.5 (H) Rather than analysing the entire data set in one analysis, analyse the data by “Group”, where a group is a set of records which are clustered together using, say, Clara. This should provide some insight into whether the problems encountered when applying the hurdle model are due to analysing data when the probability of capturing a species of interest is virtually zero for a set of records. [*Review approach proposed for taking targeting into account in GLM standardisation of CPUE.*]

B.6 (H). The plots of histograms of PC-scores by habitat confirmed that the method was able to discriminate between habitats (where different habitats correspond to different probabilities of capture, and of catchability values given capture, for each species) in the simulation analysis conducted during the workshop. A plot should be created where the PC-scores are plotted by year and habitat to allow an exploration of whether or not trends in overall species abundance over time reduce the ability to discriminate among habitats. [*Review approach proposed for taking targeting into account in GLM standardisation of CPUE.*]

B.7. (H). Future simulation tests of the CPUE standardization method should consider (1) gear saturation; (2) fishing in multiple habitats during the same trip; and (3) a non-zero (but perhaps small) probability of capture for all species in all habitats. Data sets from the simulations should be compared with actual data sets to “condition” the specifications of the simulations as closely as possible to the actual situation. [*Consideration and refinement of simulation trials to test proposed approach.*]

B.8 (M) Explore if the CPUE standardization of Winker *et al.* (in press) can be applied in other South African fisheries. [*Review approach proposed for taking targeting into account*

in GLM standardisation of CPUE; Consideration and refinement of simulation trials to test proposed approach.]

B.9 (M) Develop heuristics to decide which transformation (root 2, root 4, no transformation...) to apply to the proportions of species in the catch, and how many PC-axes to include in the GAM. [*Review approach proposed for taking targeting into account in GLM standardisation of CPUE; Consideration and refinement of simulation trials to test proposed approach.]*

C. Squid

C.1 (H) Summarize the data used to define CPUE (catch/man-day), categorizing the chosen vessels into categories related to the number of fishers they carry (their “size”). Compute the nominal CPUE for each vessel to evaluate whether nominal CPUE differs among vessel size categories and estimate the proportion of the total effort which is represented in each size category of vessel. If the chosen vessels are not representative of the full set of vessels, and/or if CPUE differs among size categories, the approach used to compute q (and hence the target effort) will need to be re-considered. [*Consideration of alternative harvest strategies, specifically combinations of constant effort and constant catch for different sectors, and a basis to set an appropriate risk level.]*

C.2 (H) Update the CPUE standardization for the trawl CPUE index. The current index ends in 1999 and is poorly documented. Implementation of this recommendation requires that the catch and effort database is sufficiently “clean” that reliable inferences can be made. The CPUE standardization should take into account management changes that have taken place over time, and could impact squid trawl CPUE, such as changes to where trawling was prohibited. [*Review assessment.]*

C.3 (H) Standardize the jig CPUE data to take account of factors such as vessel, crew number, and month. [*Review assessment.]*

C.4 (H) Revisit the basis for setting the growth / mortality parameter g , explicitly accounting for information on longevity of chokka squid. [*Review assessment; Advice for future model refinement.]*

C.5 (H) Update the way the parameter $\hat{\sigma}$ is estimated (Equation A.16 of paper MARAM IWS/NOV12/SQ/P1) to account for the assumed value for the additional variance. Check that any resulting estimates of total variation are larger than those implied by sampling CVs for the surveys. [*Review assessment; Advice for future model refinement.]*

C.6 (H) The model is exhibiting major convergence problems. The discrete catch equation should be replaced by a continuous (e.g., Baranov) formulation, the annual fishing mortality rates by the trawl and jig fisheries should be treated as estimable parameters, and a component should be added to the objective function related to the ability of the model to fit the catch data (this component should be assigned a fairly small CV). This amounts to allowing for errors in the observed catch, instead of treating the observed catch as known without error. [*Review assessment; Advice for future model refinement.]*

C.7 (H) The priors for the assessment need to be revised.

- There is no strong basis in the data for imposing a minimum value for steepness (h) of 0.5. Consider a broader prior on h .

- The value for σ_r appears to be unrealistically low, for a species for which highly variable recruitment would normally be expected. Conduct a literature review of squid fisheries to evaluate whether there is information which could be used to set the value for this parameter.
- Conduct a literature review on longevity of squid and use this to update the prior for the growth/mortality rate parameters g .

[Review assessment; Advice for future model refinement.]

C.8 (H) Consider other data sources. In order of priority: (a) examine whether the trawl CPUE data exhibit within-year trends and use these data (within or independently of the assessment model) to estimate fishing mortality if they do exhibit such trends (this will involve changing the model time-step to month), (b) examine whether the available tagging data are adequate to estimate fishing mortality (design, timing, sample sizes), and (c) examine whether the jig CPUE data exhibit within-year trends and use these data (within or independently of the assessment model) to estimate fishing mortality if they do. [Review assessment; Advice for future model refinement.]

C.9 (M) Modify the equations which determine catch for the trawl and jig fleets as a function of effort by these fleets (Eqns A.18-A.21 of paper MARAM IWS/NOV12/SQ/P2) to account for the catch by the possible small-scale fleet. [Review assessment; Advice for future model refinement.]

C.10 (M) The sensitivity of the results to the choices for the priors should be explored. [Review assessment; Advice for future model refinement.]

C.11 (L) Explore whether the data exist to allow the new and old *Africana* gear to be calibrated for squid. [Review assessment; Advice for future model refinement.]

C.12 (L) Consider models which account for the sexually-dimorphic growth of chokka squid. [Review assessment; Advice for future model refinement.]

D. Surveys

D.1 Pelagic species

The new age-proportion data and the new and revised recruit and 1+ biomass indices for anchovy suggest that $M=0.9\text{yr}^{-1}$ is not comparable with the assumption that catchability for the recruit survey is less than for November biomass survey (k_r/k_N). In addition, the Beverton-Holt stock-recruitment relationship now provides a better fit to the data than the hockey-stick stock-recruitment relationship⁵. There is also an increasing trend in k_r/k_N over the period 2006-2011. Moving from a reference case in which $M=0.9\text{yr}^{-1}$ and the stock-recruitment relationship has the hockey-stick form to one in which $M=1.2\text{yr}^{-1}$ and the stock-recruitment relationship has the Beverton-Holt form leads to higher risk for the same OMP. [Advice on a comparable definition of risk for anchovy in finalising the small pelagics OMP in circumstances where best choices for both natural mortality and the form of the stock-recruitment curve have changed.]

DA.1 (H) For anchovy, it is desirable to make different reference case specifications more comparable in terms of risk. The Panel recommends that “comparable risk” levels be defined as the result of applying a reference OMP (e.g., OMP-08) to an operating model based on the

⁵ The form with a fixed inflection point.

2012 assessment but using data up to November 2006. It is, however, not necessary for risk for OMP-13 to be the same as for OMP-08 given that the relative probability associated with different assessment models has changed. Therefore, whether OMP-13 should be based on the same risk as OMP-08 should be evaluated taking into account the relative probability of the pertinent reference case models. [*Advice on a comparable definition of risk for anchovy in finalising the small pelagics OMP in circumstances where best choices for both natural mortality and the form of the stock-recruitment curve have changed.*]

DA.2 (H) Consider alternative (more general) stock-recruitment relationships for anchovy. [*Advice on a comparable definition of risk for anchovy in finalising the small pelagics OMP in circumstances where best choices for both natural mortality and the form of the stock-recruitment curve have changed.*]

DA.3 (H) The current rules for dealing with missing surveys are very complicated and cannot be simulation tested. As part of the process of developing OMP-13, develop simpler rules and test them using simulations in which some future surveys are missing. [*Review of current rules applied if November survey does not take place.*]

D.2 Hake

DB.1 (H) The approach in MARAM IWS/NOV12/SURV/HK/P2add is appropriate for evaluating the implications of the impact of survey estimates on the performance of the OMP for the Cape hakes. The current set of results suggests that having surveys in only two out of every three years will not increase risk much, but additional analyses along the following lines are necessary for further understanding of the impact on risk of missing surveys:

- Consider a scenario in which there is no survey for an additional number of years before surveys are conducted again by *Africana*.
- Assume that the most recent commercial trawl CPUE series are governed by the equation $CPUE_y = q e^{\beta \cdot y} B_y$, starting from 1992 (when net lining is assumed to have ceased), and estimate the rate of increase in catchability (there are closed form maximum likelihood estimates for both q and β). Use the estimates of β (and their uncertainty) to select scenarios regarding the possible rate of increase in catchability in the future.
- Consider a scenario in which new West and south Coast surveys commence in January 2013 and in which the results from these surveys are treated as new indices. This would entail modifying the OMP to specify how the results from a new survey would be used, which may mean that this suggestion cannot be implemented until a full review of the hake OMP is undertaken.
- Consider a scenario in which new West and South Coast surveys commence in January 2013 and the results from these surveys are treated as continuations of the existing West and South coast series. Assume that catchabilities for the new surveys are 20% larger and 20% smaller than the estimates of survey catchability currently used for forecasting.
- Consider a sensitivity test in which there is a “recruitment failure” (implemented as recruitment deviation of ~ -3) in some future year.

[*Review role of survey inputs to current OMP.*]

DB.2 (H) In addition to showing the results of forecasts for the different scenarios regarding the future availability of survey estimates as differences (e.g., in risk) from the reference case, consider re-tuning the current OMP so that the lower 2.5%iles of the depletion distributions

for *M. paradoxus* for all years until 2020 are at least as large as under the present tuning for the current reference case. The results from this analysis should be expressed as reductions in catch to achieve the same level of risk. Analyses should be conducted to determine the cost of (a) starting a new survey time-series where the new survey vessel and *Africana* cannot be calibrated, and (b) continuing the current survey series using an industry vessel.
[Review role of survey inputs to current OMP.]

References

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Appendix 1

KEY ISSUES FOR EACH MAJOR AGENDA TOPIC

South Coast Rock Lobster

- Review assessment
- Aim is to provide advice on range of operating models for OMP testing
- Is there a need for time-varying selectivity; how best is this modelled?

Squid

- Review assessment
- Consideration of alternative harvest strategies, specifically combinations of constant effort and constant catch for different sectors, and a basis to set an appropriate risk level
- Advice for future model refinement

Linefish

- Review approach proposed for taking targeting into account in GLM standardisation of CPUE
- Consideration and refinement of simulation trials to test proposed approach
- (Time permitting) review assessment of carpenter and silver kob

Survey-TAC Small Pelagics

News as of 23 November is that the *Africana* cannot complete the hydroacoustic survey, but that substitution of an industry vessel, the *Compass Challenger*, has just been approved

- Review of current rules applied if November survey does not take place
- What constitutes adequacy of the survey; to what extent is extrapolation admissible?
- Possible improvement of current rules for both November and May surveys
- Implications for 2013 mid-year TAC revisions if either or both of the current November and the May 2013 survey do not provide satisfactory estimates of abundance
- (Time permitting) advice on a comparable definition of risk for anchovy in finalising the small pelagics OMP in circumstances where best choices for both natural mortality and the form of the stock-recruitment curve have changed

Survey-TAC hake

News as of 23 November provides no clarity as to whether the *Africana* will be able to carry out the January hake trawl survey, or whether if not, substitution of an industry vessel might be approved.

- Review role of survey inputs to current OMP
- How best to calibrate the catchability for an industry vessel against the *Africana*'s, including whether commercial nets should be used, or the *Africana*'s nets substituted in that industry vessel.
- Does the OMP need adjustment, and if so how?

Appendix 2

