December 2005 Rock Lobster International Workshop recommendations pertaining to West Coast rock lobster – progress made

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This document divides the recommendations made at the December 2005 international workshop into the following four sections:
(1) Data
(2) Assessments
(3) OMP
(4) Other

The first three sections list only the items required for the OMP development process (as agreed by the December workshop), together with some possible additions. The "other" section lists all other recommendations. Below each recommendation is a summary of the progress that has been made. The original recommendation numbering from the workshop report has been retained here.

(1) Data

a) Catch – no recommendations (i.e. no changes to existing series of total annual catches, but see B.14 in section (2) following re their spatial split).

b) CPUE and FIMS

A.2 (H*). **The basis for developing standardized catch-rate indices should be revisited starting with model selection. During this exercise, it is necessary to: a) compare the standardized and nominal catch-rate series and determine which factors cause the standardized catch-rate indices to differ from the nominal catch-rate series, and b) examine all of the standard regression diagnostics (e.g. standardized residuals versus predicted values; q-q plots; residual trends with time).**
The models and methods used for catch-rate standardization were selected by the MCM Rock Lobster Working Group several years ago and it is now appropriate to revisit these given new information and techniques. Consideration should be given to treating the logarithm of catch as the dependent variable if measures of effort are to be included in the catch-effort standardization. In addition, the number of years that each vessel has used GPS and plotter should be considered as a factor if the relevant data are available.

PROGRESS*: Stepwise regressions were applied to obtain area- and method- (traps or hoopnets) specific models for CPUE standardization and standard regression diagnostics were examined. The logarithm of catch has not yet been considered as a dependent variable because of time constraints, and no information has yet become available regarding GPS and plotter introduction.*

B.2 (H*). **It is necessary to check whether the results of a GLM that analyses the catch and effort data for all methods and areas simultaneously differ from those in which each method by area data set is analyzed separately.**
The standardized catch-rate series (by area) all have a peak in 2001/02, but this peak is not evident in all the nominal catch-rates. This may be due to the use of a GLM model that has factors that are common across areas and methods.

PROGRESS*: The CPUE data for each area have been analysed separately. The analyses have further been separated by the fishing method employed (trapboats or hoopnets).*

B.3 (H*). **Modify the areas used when calculating standardized catch-rate indices and the FIMS indices of abundance so that these include all of the area within the relevant strata.**
The areas currently used when calculating area-aggregated catch-rate series, and the FIMS index of abundance, exclude areas in MPAs and that north of the Olifants River. However, the biomass in the assessment pertains to entire resource so that these areas need to be taken into account. The Workshop noted that this implies the assumption that the average density in unsampled areas equals that in sampled areas.

PROGRESS: *The area sizes have been modified in the case of the commercial CPUE data, but not as yet for FIMS.*

B.6 (H*). **The decision whether to split super-area A3-6 into two areas should be based on an examination of trends in catch-rates, and an investigation into whether there are differences in catch size-composition, growth and biological parameters.**
The papers presented to the Workshop indicate that it is possible to conduct separate stock assessments for areas A3-4 and A5-6. However, there needs to be an objective basis to decide whether or not to split super-area A3-6 because doing so is likely to lead to greater imprecision.

PROGRESS: *A task group met on 13 Feb 2006 (Bergh, Butterworth, Glazer, Jacobs, and Johnston). The task group reviewed information relating to the CPUE, catch-at-size (and F% - the % females in the catch) and somatic growth data for both Areas A3-4 and A5-6. The Rock Lobster Working Group needed to make a final recommendation whether these two areas should be assessed separately or lumped together to form an Area A3-6.*

The task group examined the following A3-4 and A5-6 data in detail:

1. *CPUE data (WG/02/06/WCRL6 and 7)*
2. *Catch-at-size (and F%) data (WG/02/06/WCRL9)*
3. *Somatic growth data (WG/02/06/WCRL9)*

The task group found that there are clearly different trends occurring in areas A3-4 and A5-6 for all these data sources. For example, see Figures 15a-b of WG/02/06/WCRL6 for trap CPUE comparisons – note the different trends.

For this reason the task group recommended that the two areas be assessed separately, and the Working Group agreed that this was the most appropriate decision.

(2) Assessments

B.8 (H*). **Attempt to simplify the population dynamics model.**
The assessment model fits currently take a long time to converge, which makes it difficult to conduct many analyses quickly. While in the longer term the ideal is to improve the coding of the model in ADMB, substantial reductions in run times can be achieved by: a) increasing the length-class width from 1mm to 2mm, b) increasing the lowest and decreasing the highest lengths included in the model, c) increasing the first year in the model from 1870 to 1910, and d) increasing programming efficiency for multiplying of sparse matrices. It is necessary to specify how the catches between 1870 and 1910 are to be treated (e.g. all allocated to 1910) if the first year in the model is increased to 1910.

Note: B.8 essentially subsumes recommendation A.4 which states:
A.4 (H). **Examine the sensitivity of the results of the assessment to choice of width of each length-class.**
The speed with which calculations can be conducted, and hence the number of scenarios that can be examined, depends in part on the width of each length-class. The sensitivity of the results to these widths should be examined to determine whether it is possible to assume wider length-classes than is currently the case.

PROGRESS: *b), c) and d) have been implemented in the current size-structured software, which consequently runs in less than half the time taken previously. a) proved problematic because that size data to which the models are fitted are in 5mm size classes. OLRAC found that the improvement in run time in ADMB when moving from 1mm to 2mm is about an order of magnitude (Albie Jacobs, pers. commn).*

B.22 (L*). **Place lower bounds on the residual variances.**
The residual standard deviations for several of the data sources for some of the areas in the spatially-disaggregated assessment are unrealistically low, indicating the possibility of over-fitting.

PROGRESS: *A lower bound of 0.15 (related to logs of indices) is now in place in the assessment model.*

B.9 (H*). **RC2 should become one of the sensitivity tests and two scenarios based on RC1 in which the current spawning biomass should be constrained to be higher and lower than the best estimate should be examined**.
RC2 leads to selectivity patterns that appear unrealistic (sharply declining selectivity with increasing length). Implementing a model that is spatially-disaggregated and

forces a global stock-recruitment relationship will, in any case, be computationally infeasible. Examining scenarios in which current spawning biomass is larger and smaller than the best estimate captures a key source of uncertainty, namely that associated with current (absolute) population size. If a likelihood profile for current spawning biomass can be constructed, the lower and upper 12.5%iles can be selected for the larger and smaller current spawning biomasses. The weight given to these scenarios would be 0.25 while the weight assigned to the best estimate would be 0.5. The Workshop noted that there is no evidence for an increase in somatic growth in recent years. The weight assigned to the hypothesis that somatic growth will increase to average levels over the next 3 years should lower than 0.15.

PROGRESS: *This approach has been followed (see ASWS/JUL07/WCRL/MP/1).*

B.14 (M*). **The assessment should examine the sensitivity of the results to alternative assumptions regarding the magnitude and spatial split of the historical catches.**
If the assessment is to be spatially-structured, it is necessary to disaggregate the historical catches spatially. The analyses presented to the Workshop were based on the assumption that the historical catches in each area are a constant (over time) proportion of the total catch. However, there is considerable uncertainty regarding both the magnitude and spatial distribution of the historical catches, and it is clear that the pattern of catches today is very different from that in the past.

PROGRESS: *Much time was spent in the Working group debating the best method for splitting the catch, although due to time-constraints, sensitivity to alternate assumptions have not yet been undertaken.*

B.7 (H*). **The operating model to be used when evaluating OMPs should be based on spatially-disaggregated assessments rather than a spatially-aggregated assessment.**
A spatially-disaggregated operating model is preferred as the basis for evaluating candidate OMPs primarily because in cases for which there are biological differences (growth, size-at-maturity, trends in catches and catch-rates, etc.) spatially, as appears to be the case for West Coast rock lobster, the default approach to assessment should always be to try to capture this. Furthermore, the only way to determine the implications of using spatially-aggregated OMPs when there are spatial differences in, for example, biological parameters is to have a spatially-disaggregated operating model. The Workshop noted that the OMPs for West Coast rock lobster may not necessarily involve conducting assessments at fine spatial scales, but rather involve using a spatially-aggregated assessment to determine overall resource status and some other approach (such as dividing this TAC in proportion to the estimated abundance by area) to assign catch limits spatially.

PROGRESS: *This approach has been followed – see ASWS/JUL07/WCRL/ASS/2.*

B.10 (H). **The scenarios on which OMPs for West Coast rock lobster are based should include some in which the model is configured to mimic the recent downward trend (last four years) in catch rate.**

The area-aggregated assessment model does not mimic the recent downward trend in catch rates very well. While this recent trend may simply reflect the effects of correlated environmental factors, it is nevertheless important to confirm that any OMP is robust to this trend reflecting an actual downward change in abundance. One possible way to mimic the trend in catch-rates is to estimate additional recruitment parameters. The Workshop noted that the poor fits to the recent catch-rate data may be the result of spatial aggregation of data (the fits to recent catch-rates are better when the data are disaggregated spatially) and the declining trends in catch-rate for some of the areas may be a reflection of problems with the GLM-based catch-rate series and not a real effect (see also recommendation B.2).

PROGRESS: *Not directly considered. However, updated area-disaggregated models do fit this decline somewhat better – see Figures a and b.*

B.15 (M). **The sensitivity of the results of assessments to ignoring the data on somatic growth for the years for which the data set is small should be examined.**
The tag-recapture sample sizes for some years are small (particularly when the data set is pruned to capture a 'moult window'), which results in estimates of somatic growth for those years that are very imprecise. However, the assessment model currently ignores the precision of the estimates of somatic growth. In the longer term, consideration should be given to integrating the analysis of the growth data within the assessment model, as is suggested for South Coast rock lobster (see Annex D).

PROGRESS*: Not yet considered because of time constraints.*

B.18 (M). **Conduct sensitivity tests in which the data for females are ignored or down-weighted**.
The selectivity patterns for females appear fairly unrealistic, particularly because of the marked changes in selectivity over small length ranges. However, it is not clear that these data have a marked impact on the final results of the assessment and hence whether it is important to resolve the issue of the plausibility of the selectivity patterns that are estimated for females.

PROGRESS: *Not yet considered. However, because of these uncertainties concerning results for females, the decision has been made to base OMP selection on projections for the male component of the resource only.*

B.19 (M). **Estimate additional recruitment deviations.**
The number of recent recruitment deviations that are treated as estimable parameters is small compared to the case for most other rock lobster assessments worldwide. The number of such recent recruitments should be increased, and an analysis conducted to determine whether this leads to appreciable improvements in fit.

PROGRESS*: This was attempted, but the data were found to be unable to support parameterization at a finer scale than the current 5-yearly interval.*

(3) OMP

B.11 (H*). **Target abundance levels used for candidate OMPs should not be based on reference points linked directly to the population size in 1870.**
There is considerable uncertainty regarding the recruitments prior to the 1970s. As a result, the 1870 population size is not estimated with sufficient reliability to the form the basis for choice of a target abundance level.

***PROGRESS**: The Working group has yet to discuss target reference points in detail, although current OMP output includes recovery levels of 2016/2006, 2016/1980 and 2016/1910, so that short, medium and longer terms can be taken into account. Note that when the first OMP was put in place in 1997, the chosen target recovery for B_{75} was for $B_{75}(2006/1996) = 1.20$.*

B.12 (H*). **Take the nature of the spatial distribution of the rights holders into account.**
The OMP needs to be allocate catch limits spatially and the operating model needs to divide catch limits by area into catch limits by area and gear type.

***PROGRESS**: The spatial distribution of the limited rights holders is taken into account in the new OMP.*

(4) Other

B.1 (H). **Convene a meeting to review the FIMS programme and provide recommendations for how it could be refined**.
The Workshop agreed that there is value in having a reliable cost-effective fishery-independent index of abundance, particularly when the nature of the fishery is changing due to changes in the make-up and fishing practices of the industry. There is, however, a need to review and refine the FIMS programme at regular intervals, and a workshop consisting of local scientists is the most appropriate way to achieve this. Such a workshop should consider the benefits of spreading the sampling temporally and moving the sampling to months during which catch-rates vary the least, in terms of the implications of this for the precision of the index of abundance and other quantities provided by FIMS (e.g. the size-composition information). Care should be taken to capture the impact (if any) of between-month correlations in catch-rates. That workshop should also consider how the results for the inshore FIMS could be used quantitatively rather than only qualitatively, and whether the ability to calibrate the inshore to the offshore FIMS would be enhanced by changing how the inshore FIMS is conducted (e.g. by using some traps). The Workshop endorsed the practice of not visiting stations that consistently have zero catches as long as the area of the stratum in which the station is found is reduced appropriately.

***PROGRESS**: A paper summarizing the results from FIMS which would provide background information for such a meeting is nearing completion.*

B.4 (H). **Convene a meeting of local experts to discuss the logistical considerations (including issues related to education, type of traps, etc.) related to implementing an at-sea programme to collect length-frequency information.**
This is an additional data source that would enhance the assessment of West Coast rock lobster. It is possible that an at-sea sampling programme could replace the currently shored-based sampling programme.

***PROGRESS**: The issue is on hold until the whole observer scheme issue at MCM is resolved. At-sea sampling for size composition would be one of the primary responsibilities of any observer on rock lobster vessels.*

A.3 (H). **Convene a meeting to discuss the best way to expand the data recorded in logbooks.**
It is possible, in principle at least, to explore the relative probabilities of alternative explanations for changes in standardized catch-rate over time by analyzing data reported at a fine spatial scale. In addition, collection of further data, e.g. on fishing location, could be used to refine the indices of relative abundance. Possible additions to the existing information in logbooks that merit incorporation include: location (at a level sufficient to determine depth), soak time, and the catch in numbers (in addition to that in mass).

***PROGRESS**: A new daily landing form (recording catch and effort data at greater spatial resolution, together with more details on aspects such as double pulls) was developed after consultation between MCM and Industry. These forms are currently being used by ten selected skippers as a trial run before general implementation.*

B.13 (M). **Factors based on the impact of week (or month) of tagging should be added to existing models of somatic growth to determine the impact of this factor based on *in situ* information.**
Analyses were presented to the Workshop related to the possible impact of tagging on moult increment, but they were insufficient to enable final conclusions to be drawn regarding the impact *in situ* of tagging on growth rates.

***PROGRESS**: OLRAC are currently working on this.*

B.16 (M). **Consider the use of an Empirical Bayes approach to estimating the values for the hyper-parameters when analyzing changes over time in somatic growth. Alternatively, examine whether the random effects variant of ADMB (e.g. Trenkel and Skaug, 2005: ICES J. Mar. Sci. 62:1543-1555) which is based on the Laplace approximation can be used to estimate the variance of the random effects.**
The moult probability model used to analyse the tag-recapture data includes random effects. However, estimating the variance of the random effects can be difficult, especially when a Bayesian estimation approach is used.

***PROGRESS**: The random effects model does incorporate an Empirical Bayes approach. OLRAC are currently attempting to get the Laplace approximation working on the west coast rock lobster tagging data (Bergh pers. commn).*

B.17 (M). **Conduct a systematic evaluation of the factors which lead to reductions in estimates of recruitment prior to 1970 for the RC1 model.**
The RC1 model implies a large decline in recruitment before 1970. It is important to understand the reasons for this. The factors that should be considered in this investigation include: a) the early length-frequencies (ignore the earliest length-frequencies in sequence), b) levels and trends in somatic growth, and c) the survival rate for males.

PROGRESS*: No progress made due to time constraints.*

B.20 (L). **Hypotheses related to shifts in rock lobster population distribution should be developed and tested to the extent that this is possible. Environmental factors should be considered during this exercise.**
Several shifts in distributions (inferred in part from catch patterns) have occurred over the history of the fishery (e.g. a historical southward shift, and most recently in the East of Hangklip area). There are various hypotheses related to why these shifts have occurred, but no quantitative analyses were presented to the Workshop.

PROGRESS*: No progress made.*

B.21 (L)**. Plot the time-sequence of selectivity-at-length patterns.**
Selectivity-at-length changes over time, but the documents presented to the Workshop did not show the annual selectivity-at-length patterns. These should be plotted and checked for realism.

PROGRESS*: Yet to be extracted.*

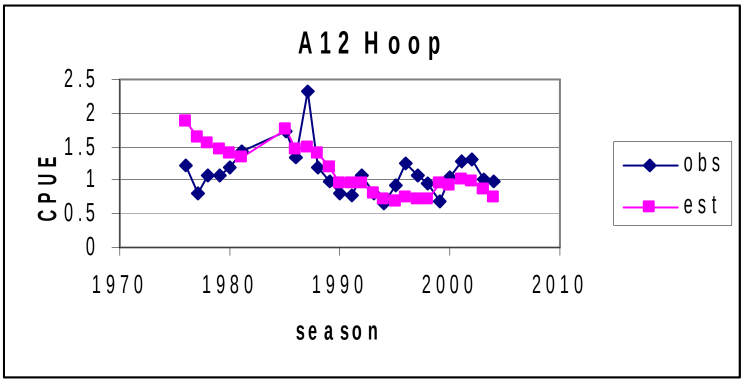
B.23 (L). **Examine the sensitivity of the results to starting the model in recent years**
There is uncertainty about the dynamics of the population in the years prior to the first year for which length-frequency data are available. The robustness of the performance of the OMP to starting the operating model in a recent year (e.g. 1975) should be evaluated. It is necessary to specify a method to determine the initial abundance and length-structure of the population in the first year considered in the model for a complete specification.

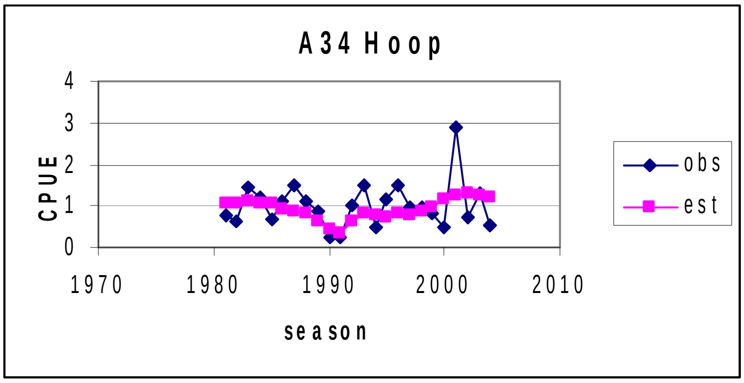
PROGRESS*: The only change to the starting year explored, due to time constraints, was moving from 1870 to 1910.*

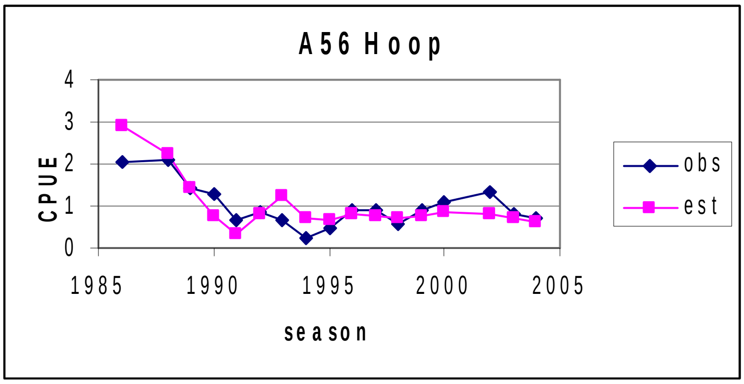
A.1 (H). **Add an ecosystem section to the annual report to MCM management giving scientific advice of measures such as TACs.**
Although information on ecosystem impacts is not currently used directly in OMPs in South Africa, such information is increasingly becoming a focus for fisheries management and should be included in the document on management advice.

PROGRESS*: This will be developed further when the MCM rock lobster Working Group picks up on a Risk Analysis evaluation of the fishery calculated by the MCM EAF Working Group.*

Figure 1a: Area-disaggregated fits to hoop CPUE data.







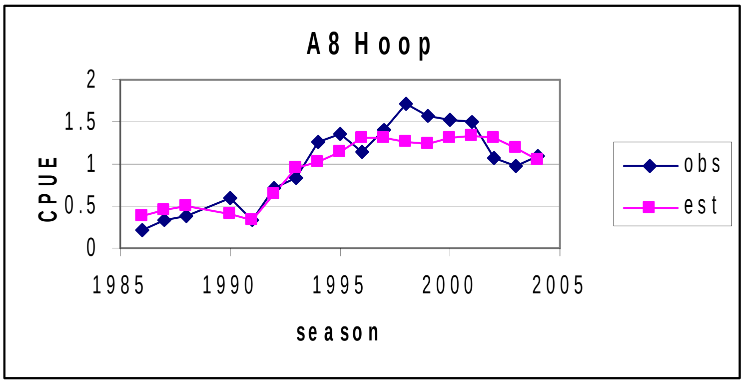


Figure 1b: Area-disaggregated fits to trap CPUE data.