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Further developments of the Operating models for West Coast rock lobster

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Introduction

Below is a list of ideas of possible developments to consider when updating the operating models for the west coast rock lobster. These ideas come from three sources: the 2007 International workshop at UCT, MARAM and OLRAC scientists.

(1) Super-area divisions

The West Coast resource is divided into the following "super" areas:

Area 1-2: The most Northern region – only a very small tonnage is currently caught in this area.

Area 3-4 (Areas 3 and 4 only)

Area 5-6 (Areas 5 and 6 only)

Area 7 (Dassen Island), and

Area 8+ (areas to the south and east of Dassen Island, which include Area 8 (Cape Point), Area 10 (Hout Bay), Area 11 (False Bay), and Areas 12-14 (East of Hangklip).

a) What about Area 9 (Robben Island)? Should we be making some allowance for it?
b) What about an inshore/offshore split for Area 8?
c) Are we happy handling East of Hangklip as before? Is there evidence that CPUE has dropped there?

(2) The assessment should examine the sensitivity of the results to alternative assumptions regarding the magnitude and spatial split of the historical catches.

Given a spatially-structured assessment, it is necessary to disaggregate the historical (pre-1968) catches spatially. 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. See Fisheries/2010/SEP/SWG-WCRL/22 for current proportional splits used. What further proportional splits for the pre-1968 catches should perhaps be examined?

(3) Conduct a systematic evaluation of the factors which lead to reductions in estimates of recruitment prior to 1970 for reference case model.

The reference case assessment model results imply a large decline in recruitment before 1970. It is important to understand the reasons for this. The factors that should be considered in the investigation include:

a) the early length frequencies (ignore the earliest length frequencies in this sequence),

b) levels and trends in somatic growth, and

c) the survival rates for males.

(4) Somatic growth rate effects

Growth rates are estimated with error. Female growth rate estimates are particularly error prone, since they are based on few data. A suggestion is that one fits growth rate means and variances within the stock assessment model. This will slow down the implementation of the model fit since the growth transition matrix for each year becomes variable in the fitting process. There are different ways of implementing this suggestion, not specified in detail here.

(5) Recent recruitment estimates

Current Model

Recruitment is assumed to be linear between *R* (1910), *R* (1920), *R* (1950), *R* (1970), *R* (1975), *R* (1980), *R* (1985), *R* (1990), *R* (1995) and *R*(2000). *R* (2005)+ is calculated as the geometric mean of the four values *R*(1980)-*R*(1995).

Recommend adding a further estimable parameter *R*(2003). Linear interpolation will be used to calculate the annual recruitment values between 2000 and 2003, and between 2003 and 2007, where *R*(2007) (and above) is set equal to the geometric mean of the recruitment values for 1980, 1985, 1990, 1995 and 2000.

Note: In the 2009 updated assessments (see MCM/NOV/2009/SWG-WCRL/24) a sensitivity was examined where a further estimable parameter R_{2003} was added. The results w.r.t. current abundance levels were very similar to the reference case model. Implications for the future could be more substantive. If the RC operating model is updated to include R_{2003} as an estimable parameter, then updates to the highlighted sections below will be required.

(6) Reference case and alternate models

Previously it was decided that the most desirable method for producing two alternate models reflecting recent recruitment uncertainty for each super-area would be as follows:

To run the reference case model with the following penalty function added to the –*ln*L (this reflects "shrinkage to the mean". or in Bayesian terms using a prior that reflects the recent past distribution of recruitments):

$$pen = \frac{1}{2}\left(\ln R_{2000} - \ln \overline{R}\right)^2 / \sigma^2 \qquad (1)$$

where

$$\ln \overline{R} = \frac{1}{5}\sum_{y=1975}^{1995} \ln R_y \qquad (2)$$

$$\sigma^2 = \frac{1}{4}\sum_{y=1975}^{1995}\left(\ln \overline{R} - \ln R_y\right)^2 \qquad (3)$$

Suggest that the above now change to:

$$pen = \frac{1}{2}\left(\ln R_{2003} - \ln \overline{R}\right)^2 / \sigma^2 \qquad (1^*)$$

where

$$\ln \overline{R} = \frac{1}{6}\sum_{y=1975}^{2000} \ln R_y \qquad (2^*)$$

$$\sigma^2 = \frac{1}{5}\sum_{y=1975}^{2000}\left(\ln\overline{R} - \ln R_y\right)^2 \qquad (3^*)$$

The two alternate models (Alt1 and Alt2) are virtually identical to the RC model, except with regards to the R_{2003} value. For the RC model R_{2003} is an estimable parameter, (although previously it was found to be estimated with very low precision e.g. for Area 8 the 95% CI was 0.0001-1.65), and so is dominated in the estimation by the contribution from equation (1). For this reason, Alt1 and Alt2 models would correspond almost exactly to the RC best fit parameter values except for R_{2003} which would be fixed at the (approximate) upper and lower 25%iles of this distribution as follows:

$$\ln R_{2003}^{alt1} = \ln \hat{R}_{2003}^{RC} + \sigma\alpha \qquad (4)$$

and

$$\ln R_{2003}^{alt2} = \ln \hat{R}_{2003}^{RC} - \sigma\alpha \qquad (5)$$

where σ is from equation (2*) above, and the α value (0.727) corresponds to the 25%iles of a *t*-distribution with the appropriate number of degrees of freedom.

(7) Juvenile recruitment, juvenile growth rates

Currently we assume:

$R_l^m(t) = R_l^f(t) = R(t)$ for $l \le 15$ mm

$R_l^m(t) = R_l^f(t) = 0$ for $l > 15$mm

There is a suggestion that invariance of the assessment results to assumptions around juvenile recruitment and juvenile growth rate be demonstrated where these are not strongly supported by independent data. Suggested alternative assumptions?

(8) 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.

(9) Natural mortality

a) Test invariance of stock assessment to assumptions about undersize natural mortality. Further assumptions to try?

b) Attempt fit of male natural survivorship parameter (currently fixed at 0.90) or for alternate fixed values e.g. 0.87 or 0.93. What is the nature of the interaction between this estimate and the declining selectivities for larger lobsters?

(10) Plot the time-sequence of selectivity-at-length patterns

Selectivity-at-length changes over time, but the documents presented to the December 2005 Workshop did not show the annual selectivity-at-length patterns. These should be plotted and checked for realism.

(11) Recreational catch data

Estimates, based upon telephone surveys, of the percentage breakdown for the "super" areas of the total annual recreational catches are as follows:

Area 1-2: 0 %
Area 3-4: 7.5%
Area 5-6: 7.5%
Area 7: 5%
Area 8: 80%

Comment for SWG: do the more recent telephone surveys suggest any changes? Table 11 of the most recent recreational telephone survey report (MCM/2010/AUG/SWG/WCRL12) provides the following estimates for the 2009/2010 season:

Area 1-2: 1.7%

Area 3-4: 2.5%

Area 5-6: 13.1%

Area 7: 10.5%

Area 8+: 72.2%

(12) Interim Relief

The SWG had agreed to use the following GLOBAL Interim relief estimates:

2007/08: 174 MT

2008/09: 170 MT

2009/10: 278 MT.

FISHERIES/2010/SWG-WCRL/22 Table 1a reports the super-area breakdown of Interim Relief as reported in Keulder (2009). Using information in Table 1a and assuming the average % breakdown for phases II and II can be applied for phase IV, interim relief catch estimates for each of the five super-areas are provided in Table 1b.

Comment for the SWG: The SWG need to confirm the super-area breakdown of these catches. The SWG also need to agree a plausible IR tonnage for phase I (the IR taken for the initial 2006/07 season).

Note: the Interim relief catches will be added to the commercial hoopnet catches for each area for the relevant season.

(13) Poaching:

Poaching (at a non-negligible level) is assumed to start in 1951 and increase linearly to a value P_{max} in the year 1990 (these assumptions are based on anecdotal reports from the industry). Poaching is assumed to remain at the P_{max} level after 1990. The estimates of C_t^{poach} used in the model are thus:

$$C_t^{poach} = 0 \qquad \text{for } t < 1950$$

$$C_t^{poach} = P_{\max}\left(\frac{t-1950}{1990-1950}\right) \qquad \text{for } 1950 \le t \le 1990$$

$$C_t^{poach} = P\max \qquad \text{for } t > 1990$$

The reference case assessment assumes P_{max} = 500 MT based upon rough suppositions by SFRI personnel for the area-aggregated model.

Comment for SWG: Do we need to consider alternate values? What about trends in time?

(14) Model fit

Try to confirm that the minimum is global by the use of a wide variety of starting conditions for the assessment.