OMP 2008 for the South Coast Rock Lobster Resource

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OMP 2008

OMP 2008 consists of an algorithm that calculates the TAC for the resource using CPUE data collected from each of three areas (New Areas 1, 2 and 3 – see Fig. 1),

Note that the TAC for season y+1 will be based upon the CPUE series that ends in season y-1, i.e. the TAC recommendation for 2008[1] would be based on a CPUE series that ended with the most recent CPUE value available at the time a recommendation was requested which would be for 2006.

1. TAC setting algorithm

The algorithm used to recommend the TAC for the South Coast Rock Lobster fishery for season y+1 is:

$$TAC_{y+1} = TAC_y[1 + \alpha(s_y - \delta)]h(r_y) \quad (1)$$

where

TAC_y is the TAC set (note NOT the catch taken) in season y ;

the value of α is set at 3.0;

s_y^A is the slope parameter from a regression of $\ln CPUE_y^A$ against y over the last five seasons' data (these will be for seasons y-5 to y-1 as data for season y will not be available at the time the recommendation is required) for each area A, and

$$s_y = \sum_{A=1}^{3} w^A s_y^A \quad (2)$$

$$\text{where } w^A = \frac{\frac{1}{\sigma_S^{A^2}}}{\sum_{A'=1}^{3}(\frac{1}{\sigma_S^{A'^2}})} \quad (3)$$

[1] The convention used here is that 2008 refers to the 2008/09 season

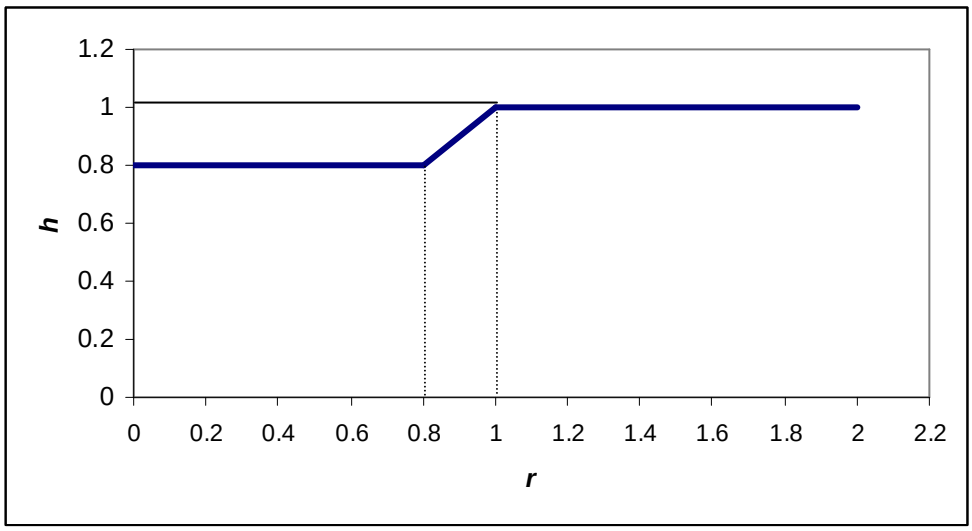
and σ_S^A is the standard error of the regression estimate of s_y^A subject to a lower bound of 0.15; and

δ is a control parameter value which has been tuned to be equal to -0.006 for the selected OMP 2008 to achieve the median recovery target specified..

Further:

$$\begin{aligned} h(r) &= 0.8 \quad \text{for} \quad r \le 0.8 \\ &= r \quad \text{for} \quad 0.8 \le r \le 1.0 \\ &= 1.0 \quad \text{for} \quad r \ge 1.0 \end{aligned} \tag{4}$$

i.e.



where *r* is the ratio of recent CPUE to that at the time the OMP commences:

$$\overline{\overline{CPUE}}_{init} = \frac{1}{3}\sum_{y'=2003}^{2005}\sum_{A=1}^{3}\lambda_A CPUE_{y'}^{A} \tag{5}$$

$$\overline{\overline{CPUE}}_{y} = \frac{1}{3}\sum_{y'=y-3}^{y-1}\sum_{A=1}^{3}\lambda_A CPUE_{y'}^{A} \tag{6}$$

$$r_y = \frac{\overline{\overline{CPUE}}_{y}}{\overline{\overline{CPUE}}_{init}} \tag{7}$$

where

$$\lambda_1 = 0.28$$
$$\lambda_2 = 0.55$$
$$\lambda_3 = 0.17$$

The CPUE weighting factors, λ_1, λ_2 and λ_3 relate to relative biomass in each area, and were calculated as follows. Using the estimated values of *q* and *B* from the operating Model 3 (Johnston and Butterworth 2008):

	Q	*B*
Area 1	0.006438	177
Area 2	0.003938	211
Area 3	0.006965	115

The relative biomass weights are: Area 1 = 177/504 = 0.35
Area 2 = 211/504 = 0.42
Area 3 = 115/504 = 0.23

In terms of CPUE what is therefore required is:

$$0.35B^1 + 0.42B^2 + 0.23B^3$$
$$= 0.35\frac{CPUE^1}{q_1} + 0.43\frac{CPUE^2}{q_2} + 0.23\frac{CPUE^3}{q_3}$$
$$= 54.5CPUE^1 + 106.8CPUE^2 + 32.8CPUE^3$$

As the CPUE weights must sum to 1, it follows that the appropriate weighted average for CPUE is given by:

$$0.28CPUE^1 + 0.55CPUE^2 + 0.17CPUE^3$$

Inter-annual TAC constraint
A rule to restrict the inter-annual TAC variation to no more than 5% up or down from season to season is applied, i.e.

$$\text{if } TAC_{y+1} > 1.05TAC_y \qquad TAC_{y+1} = 1.05TAC_y \tag{8}$$
$$\text{if } TAC_{y+1} < 0.95TAC_y \qquad TAC_{y+1} = 0.95TAC_y$$

2. The Generalized Linear Model applied to the South Cost rock lobster CPUE data to obtain area-specific indices of abundance

The nominal CPUE data for South Coast rock lobster are (re-)standardized each season by means of a Generalized Linear Model (GLM) to obtain area-specific standardized indices of abundance for input to the OMP.

Certain records are excluded from the analyses; these are as follows:

- Data from companies other than the four major companies for years prior to and including 1997.
- Data pertaining to Hout Bay Fishing vessels over the period 1997–2000, since they are considered to be unreliable.
- Sets with zero effort.
- Sets with zero catch.
- One record with a CPUE value of > 9kg/trap (this was considered an outlier).

The fishing grounds have historically been separated into four areas. However, based on recent analyses conducted by Gaylard and Bergh (2007), these four areas have been revised to three (Figure 1). It is these revised "new areas" upon which the analyses are based.

The GLM

The base case GLM applied to obtain area-specific indices of abundance is:

$$\ell n(CPUE) = I + \alpha_y + \beta_{seas} + \gamma_{depth} + \eta_{soak} + \kappa_{vess} + \lambda_{grid} + \varpi_{echo} + \theta_{gps} + \varsigma_{line} + \tau(traps) + (y \times area) + \varepsilon$$

where I is the intercept,
y is the split-year fishing season effect (1977 to season y-1),
seas is the season effect
season 1 = October – December
season 2 = January – March
season 3 = April – June
season 4 = July – September,
depth is the depth effect
d75 : depth < 100
d125 : 100 ≤ depth < 150
d175 : 150 ≤ depth < 200
d225 : 200 ≤ depth < 250
d275 : depth ≥250,
soak is the soak time effect
soak1 : soak ≤ 24 hours
soak2 : 24 < soak ≤ 48
soak3 : 48 < soak ≤ 72
soak4 : 72 < soak ≤ 96
soak5 : soak > 96 hours,
vess is the vessel effect (42 vessels to 2006),
grid is the grid effect (290 grid squares),
echo is the echo-sounder effect,
gps is the GPS effect,
video is the video plotter effect,
traps is related to effort and is treated as a continuous variable,
(y×*area*) is a fixed effect interaction term where *area* comprises each of the three areas shown in Fig. 1), and
ε is assumed to be normally distributed.

Note that both grid and area cannot be included as main effects in the model because of confounding.

The standardized CPUE indices per area are calculated by applying the equation $CPUE_{y,a} = e^{(\alpha_y + (y \times area) + median(\lambda_{grid}))}$, where $median(\lambda_{grid})$ is the median value amongst those for the grids specific to each area.

Results for data to 2006

36403 records are included in the analyses, and the amount of variation explained by the model is 26.2%. The resultant standardized indices are shown in Table 1 and Figure 2.

References

Gaylard, J.D. and M.O. Bergh. 2007. A clustering of South Coast rock lobster fishing grid blocks based on similarity of CPUE trend. 9pp. South Coast rock lobster task group document (May 2007).

Johnston, S.J. and D.S. Butterworth. 2008. Near final specifications for the sex- and area-specific Operating Models for testing OMPs for the South Coast rock lobster resource. MCM document, WG/05/08/SCRL17.

Table 1: Standardized South Coast rock lobster CPUE (kg/trap) per area as obtained from the GLM specified when applied to data to 2006.

Year	Area 1	Area 2	Area 3
1977	2.4615	2.2645	3.6316
1978	1.8415	2.1464	2.6966
1979	1.9426	2.1768	2.1659
1980	2.8797	2.4254	1.7444
1981	2.3132	2.3448	2.1453
1982	1.9996	1.9305	2.0163
1983	2.2435	2.2404	2.2997
1984	2.2055	2.1825	2.1179
1985	1.8185	2.0160	2.1966
1986	2.0742	2.1039	3.4472
1987	2.7942	2.3844	2.0852
1988	2.6311	2.5977	2.4781
1989	2.5946	2.7165	2.1620
1990	2.2683	2.0369	1.8239
1991	1.7503	1.4754	2.1795
1992	1.5275	1.6973	2.0010
1993	1.3892	1.6600	1.3822
1994	1.4372	1.3594	1.4835
1995	1.2436	1.1663	2.2318
1996	1.1240	1.0490	1.3024
1997	1.0614	0.8416	1.2010
1998	1.6427	0.7868	0.8886
1999	1.3624	0.7849	0.8614
2000	1.6451	0.7964	0.9672
2001	1.7279	1.0190	1.1259
2002	1.9223	0.9504	0.9116
2003	1.7866	1.3173	0.7173
2004	1.7346	1.6022	1.6895
2005	1.6168	1.2213	1.3688
2006	1.1821	0.9785	1.0630

Figure 1: Historic and revised (dashed lines) area definitions of the South Coast rock lobster fishing grounds.

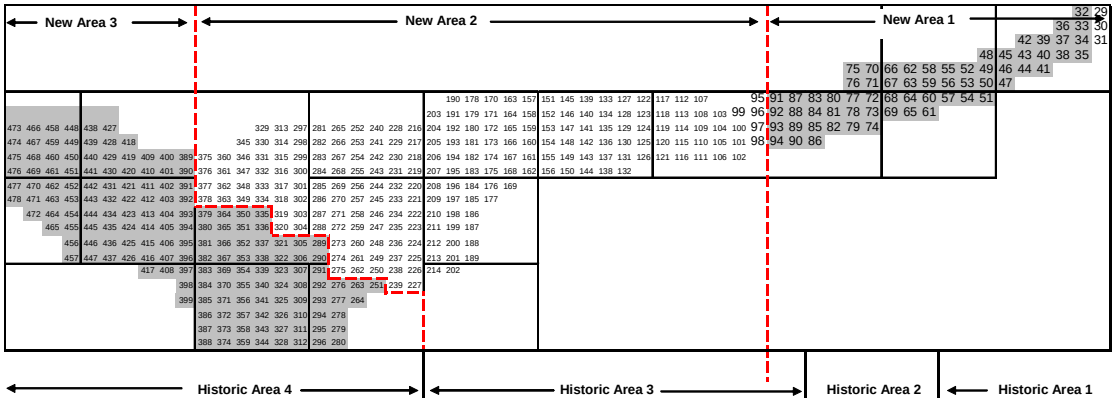


Figure 2: Standardized CPUE (kg/trap) per area for data to 2006.