OMP 2007 re-cast to be used for setting TACs for the West Coast rock lobster fishery for the 2008+ seasons

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Introduction

OMP-2007 was the OMP variant selected for setting TACs for the 2007+ seasons. OMP-2007 is estimated to lead to a median average commercial TAC over the 10-year period (2006-2015) of 2336 MT and a biomass (above 75mm carapace length) recovery of male lobsters 20.6% by 2016, i.e. B^m_{2016} / B^m_{2006} =1.206.

OMP-2007 was used in conjunction with updated input data from the various super-areas of the fishery to provide super-area TACs for the 2007 season[1]. Table 1 summarises these TACs.

Table 1: Final 2007 TAC recommendations (in MT), as followed from OMP-2007.

	Global TAC (Commercial + recreational)	**Commercial only**	**Offshore commercial**	**Near-shore commercial**	**Recreational**
Total	**2571**	**2314**	**1754**	**560**	**257**
A1-2	35	30	0	30	
A3-4	127	95	5	90	
A5-6	72	40	0	40	
A7	874	863	863	0	
A8+	1463	1286	886	400	

<u>"OMP-2007 re-cast"</u>

In early 2008 it was decided by the Rock Lobster Scientific Working Group to re-cast OMP-2007 before applying it to produce the next set of TACs for the 2008 season. This re-casting was required to accommodate their recommendation that nearshore rights holder allocations vary in similar fashion to recreational allocations. For the reason that this also required OMP re-tuning, the opportunity was taken to update two other aspects, i.e. three adjustments have been made in all to OMP-2007:

[1] In this document, 2007, for example, refers to the 2007/08 season.

i) During the 2006 season the full commercial TAC was not caught – "OMP-2007 re-cast" takes this into account by updating the operating models of the resource (used for testing the OMP) with the actual catches made, and not the TACs. The catch values for each super-area used are as follows (the TAC value is in brackets):

Area 1-2: 8.4 MT (30 MT)
Area 3-4: 1.3 MT (100 MT)
Area 5-6: 0 MT (40.25 MT)
Area 7: 526.8 MT (821.75 MT)
Area 8: 1670.6 MT (1565 MT)
Total: 2207.1 MT (2557 MT)

The effective under-catch from the 2006 season was thus 2557 - 2207 = 350 MT.

These 2006 catches also take into account the amount that was caught in 2006 which was actually part of the "over-catch" allowed from 2005. Appendix 1 provides details of these calculations.

ii) During the 2007 season an additional catch in the form of an interim relief quota was set by the Minister. Assuming:

- the interim relief fishers had 103 allowable fishing days (excluding 5 public holidays)
- each caught their allowed 4 lobsters per day
- there are 858 such recognised fishers
- an average weight of 0.0003 ton/lobster, then

the estimated additional amount to be attributed to this interim relief is **106 MT** (Keulder, MCM, pers. commn). This amount (106 MT) is now taken into account in the re-cast OMP – in updating both the historic catches considered in operating models as well as the historic catches used in the OMP population model. The breakdown of the interim relief tonnage is as follows:

Area 1-2: 9.1 MT
Area 3-4: 27.3 MT
Area 5-6:25.3 MT
Area 7: 0 MT
Area 8: 44.5 MT

iii) "OMP-2007 re-cast" also makes a change to the way Nearshore Rights Holders (NRH) TACs are calculated. OMP-2007 fixed these at the following values:

Super-Area	Nearshore rights holders TAC
Area 1-2	30 MT
Area 3-4	90 MT
Area 5-6	40 MT
Area 7	0 MT
Area 8	400 MT

"OMP-re-cast" now calculates the NRH TACs in a manner similar to that for recreational takes – see below (pg 11) for further details. The reason, as stated in previous recommendations made by the Working Group, is that it is not scientifically defensible to maintain constant catch allocations in circumstances where resource abundance can drop as a result of recruitment fluctuations, and responsible management must allow for catch reductions in such circumstances (note also that for two of the five super-areas, to complete allocation is to NRH's only).

Note also that "OMP-2007 re-cast" also makes a slight modification with respect to somatic growth rate inputs into the OMP – see Appendix 2 for details.

"OMP-2007 re-cast" (as did OMP-2007) involves three main components:

1. How the data are combined across super-areas for input into the OMP
2. The OMP formulae to provide a global TAC
3. How the global TAC is split between super-areas and resource user groups.

The details described below apply to "OMP-2007 re-cast".

1. How to combine super-area data into single indices for input to the OMP

The OMP uses input data from all five super-areas where available.

Combined CPUE and FIMS indices:

The "global" OMP requires a single index for each data source (somatic growth, trap CPUE, hoop CPUE and FIMS) for each year in the future. The last three of these are combined across super-areas as follows:

STEP 1: For each super-area for which data are assumed available, there will be for any year (for trap CPUE and 2006 as an example):

$$CPUE_{2006}^{trap,A1-2}, CPUE_{2006}^{trap,A3-4}, CPUE_{2006}^{trap,A5-6}, CPUE_{2006}^{trap,A7}, CPUE_{2006}^{trap,A8}$$

STEP 2: Evaluate the geometric means of the CPUEs (and FIMS) for the super-area concerned over the five year period 2000…2004.

STEP 3: Express the values for CPUE (and FIMS) generated in STEP 1 as fractions of these means, e.g:

$$CPUE_{2006}^{trap,A1-2} \Rightarrow X_{2006}^{trap,A1-2} = \frac{CPUE_{2006}^{trap,A1-2}}{geomtric\ mean\ 2000...2004\ values}$$

STEP 4: Calculate a combined CPUE (and FIMS) index as follows:

$$X_{2006}^{trap,TOTAL} = w_{A1-2}^{trap} X_{2006}^{trap,A1-2} + w_{A3-4}^{trap} X_{2006}^{trap,A3-4} + ...w_{A8}^{trap} X_{2006}^{trap,A8}$$

where $w_{A1-2}^{trap} + w_{A3-4}^{trap} + ...w_{A8}^{trap} = 1$

The weights are calculated in the following manner. For example, for trap and hoop CPUE, get $\overline{B}^{75}$ for 2001-2005 for each super-area: $\overline{B}_{A1-2}^{75}, \overline{B}_{A3-4}^{75}, \overline{B}_{A5-6}^{75}, \overline{B}_{A7}^{75}, \overline{B}_{A8}^{75}$. Note that these are selectivity-weighted biomasses; then:

$$\overline{B}^{75}_{TOTAL} = \sum_{A=1..8} \overline{B}^{75}_{A} \text{ and}$$

$$w^{trap}_{A1-2} = w^{hoop}_{A1-2} = \frac{\overline{B}^{75}_{A1-2}}{\overline{B}^{75}_{TOTAL}} \text{ etc.}$$

For FIMS, as above, but use B^{60} instead of B^{75} (again, use the biomass weighted by the appropriate selectivity).

Since there will be a lack of certain data types for some super-areas, summations above are adjusted accordingly:
Traps: A7 and A8 only
Hoops: A1-2, A3-4, A5-6 and A8 only
FIMS: A3-4, A5-6, A7 and A8 only.

Combined somatic growth index:

What is needed is an index, e.g. 70mm male annual somatic growth, as used in each separate assessment.

The procedure is to use similar weighting factors e.g. $w^{SG}_{A1-2} = \frac{\overline{B}^{male,70}_{A1-2}}{\overline{B}^{male,70}_{TOTAL}}$ as for trap and hoop CPUE (except that now weighting factors for all five super-areas are used). Note also the biomass relates to total male biomass above 70mm only.

Thus $\beta_t = w^{SG}_{A1-2}\beta^{A1-2}_t + w^{SG}_{A3-4}\beta^{A3-4}_t + w^{SG}_{A5-6}\beta^{A5-6}_t + w^{SG}_{A7}\beta^{A7}_t + w^{SG}_{A8}\beta^{A8}_t$
where:
β_t is the combined annual somatic growth of a 70mm male lobster in year *t*.

Since the assessments are now finalised, the biomasses above are all available and hence also the weighting factors which are now fixed. Table 2 below lists these *w* values. [Note that the blanks indicate that data are not expected from that super-area for that gear type in the future, and hence such data are omitted from the OMP.]

NB: the w_A calculation is based on the best (RC1-like) assessment, and yields the following:

Table 2: A: Assuming use of data from all five super-areas as input into OMP.

	w^{trap}_A	w^{hoop}_A	w^{FIMS}_A	w^{SG}_A
A1-2	-	0.025	-	0.018
A3-4	-	0.234	0.157	0.176
A5-6	-	0.152	0.075	0.082
A7	0.400	-	0.188	0.229
A8	0.600	0.588	0.580	0.495

Appendix 2 reports the super-area somatic growth input data for each super-area and provides the details of the associated data analyses.

The somatic growth data provided in Appendix 2 led to the single index series reported as “new series” in Table 3. In Table 3 the single index series used in the OMP simulations for the period 1992-2005 is also provided (old series). In order to retain the same average somatic growth rate over the 1992-2005 period under simulated conditions and using the new data series, the “new series” is renormalized so that its 1992-2005 average is identical to the “old series” average. Thus the “renormalized new series” is the final single index somatic growth rate series used as input into “OMP-2007 re-cast”. Future somatic growth rate indices provided by the OLRAC (2005) moult probability model (see Appendix 2) will be renormalised by this same factor.

Table 4 reports the resultant single-index input data series for all four data series for the calculation of the 2007 TAC which were used in conjunction with OMP-2007.

Appendix 3 reports the super-area trap CPUE input data for each super area and provides the details of the associated data analyses.

Appendix 4 reports the super-area hoop CPUE input data for each super area and provides the details of the associated data analyses.

Appendix 5 reports the super-area FIMS input data for each super area and provides the details of the associated data analyses.

2. OMP TAC setting rule

The following basic TAC algorithm is used to calculate the global (commercial + recreational all super-areas) TAC (TAC_y^G) for season *y*, but subject to modifications i) – iii) detailed at the end of this section:

$$TAC_y^G = w_y TAC_{y-1}^G + (1-w_y)\alpha\left(\frac{\beta_{y-3,y-2,y-1}}{\overline{\beta}_{89-04}}\right)^{\lambda}\left(\frac{\hat{B}_y}{\hat{B}_{1992}}\right) \quad x$$

$$\left[f_1\left(\frac{CPUE^{trap}_{y-1,y-2,y-3}}{CPUE^{trap}_{93,94,95}}\right) + f_2\left(\frac{CPUE^{hoop}_{y-1,y-2,y-3}}{CPUE^{hoop}_{93,94,95}}\right) + (1-f_1-f_2)\left(\frac{FIMS_{y-3,y-2,y-1}}{FIMS_{92,93,94,95}}\right)\right]^p$$

where (1)

w_y = 0.50 for all years,

p = 0.5,

f_1 = 0.40;

f_2 = 0.20; and

α is the primary tuning parameter, which for OMP-2007 was 4250, and for “OMP-2007 re-cast” is XXXX. [Note that these tuning parameter values for the two

OMPs ensure that both OMP versions produce the same anticipated median biomass recovery over the 10-year period, ie. that B^m_{2016}/B^m_{2006} =1.206 for both.]

Note that β refers to the somatic growth rate of a 70mm male lobster, and that $\overline{\beta}_{89-04}$ refers to the geometric mean β over the 1989-2004 period. Note also that it is the multiplicative factor in equation (1) related to the β parameters that is changed under modification ii) below.

The choice of parameter values f_1 and f_2 for the final term means a TRAP:HOOP:FIMS weighting of 0.4:0.4:0.2.

Estimation of $\hat{B}_t$ ***and*** $\hat{B}_{1992}$

The underlying approach is to fit a simple population model to available *CPUE*^{trap}, *CPUE*^{hoop}, *FIMS* and somatic growth data to model the dynamics from 1992 to season *t*-1, the most recent season for which data are available, i.e.:

$$B^p_{T+1} = B^p_T + G_T - (C_T + P_T) \tag{2}$$

where

B^p_T = population model biomass in season *T*,

G_T = annual "growth" of resource in season *T*,

C_T = annual commercial + recreational catch in season *T*, and

P_T = annual estimate of poaching for season *T*.

B^p_{1992} is a parameter estimated in fitting this model to the data.

The annual somatic growth parameter β_T is the moult-probability model (OLRAC 2005) estimated somatic growth of a male rock lobster of 70mm carapace length (renormalized as detailed in the preceding text). For any season *t* for which a TAC is required, β_T is known for all preceding seasons.

In the population model, the annual "growth" of the resource, G_T, is set to be:

$$G_T = a(\beta_T + b) \tag{3}$$

The value of b is set externally by regressing against β the equilibrium sustainable yield for the RC1, ALTL and ALTH assessment models' estimates of the biomass in 2005 (for the case where all the super-areas are considered together) for different values of β (this relationship is near linear). The intercept of this regression with the horizontal axis (β), averaged over these three area-aggregated assessments, yields a value of b = -2.5636 for use in equation (3).

Each season (from t = 2007), as new data become available, the population model (see equation 1) is fitted by minimising the following negative log-likelihood:

$$\begin{aligned} -\ln L = & \sum_{T=1993}^{t-1} \left\{ \ln\sigma_{CPUE^{trap}} + \frac{1}{2\sigma^2_{CPUE^{trap}}} \left(\ln CPUE_T^{trap} - \ln q_{CPUE^{trap}} - \ln B_T^P \right)^2 \right\} \\ & + \sum_{T=1993}^{t-1} \left\{ \ln\sigma_{CPUE^{hoop}} + \frac{1}{2\sigma^2_{CPUE^{hoop}}} \left(\ln CPUE_T^{hoop} - \ln q_{CPUE^{hoop}} - \ln B_T^P \right)^2 \right\} \\ & + \sum_{T=1992}^{t-1} \left\{ \ln\sigma_{FIMS} + \frac{1}{2\sigma^2_{FIMS}} \left(\ln FIMS_T - \ln q_{FIMS} - \ln B_T^P \right)^2 \right\} \end{aligned} \tag{4}$$

where

$CPUE_T^{trap}$	is the trap CPUE for year T
$CPUE_T^{hoop}$	is the hoop CPUE for year T
$FIMS_T$	is the FIMS CPUE for year T
$q_{CPUE^{trap}}$	is the trap catchability coefficient
$q_{CPUE^{hoop}}$	is the hoop catchability coefficient
q_{FIMS}	is the FIMS catchability coefficient

$$\ln q_{CPUE^{trap}} = \frac{\sum_{T=1993}^{t-1} \left(\ln CPUE_T^{trap} - \ln B_T^P \right)}{n_{CPUE^{trap}}} \tag{5}$$

$$\ln q_{CPUE^{thoop}} = \frac{\sum_{T=1993}^{t-1} \left(\ln CPUE_T^{hoop} - \ln B_T^P \right)}{n_{CPUE^{hoop}}} \tag{6}$$

$$\ln q_{FIMS} = \frac{\sum_{T=1992}^{t-1} \left(\ln FIMS_T - \ln B_T^P \right)}{n_{FIMS}} \tag{7}$$

$$\sigma_{CPUE^{trap}} = \sqrt{\frac{\sum_{T=1993}^{t-1}\left(\ln CPUE_T^{trap} - \ln q_{CPUE^{trap}} - \ln B_T^P\right)^2}{n_{CPUE^{trap}}}}, \quad (8)$$

$$\sigma_{CPUE^{hoop}} = \sqrt{\frac{\sum_{T=1993}^{t-1}\left(\ln CPUE_T^{hoop} - \ln q_{CPUE^{hoop}} - \ln B_T^P\right)^2}{n_{CPUE^{hoop}}}}, \quad (9)$$

$$\sigma_{FIMS} = \sqrt{\frac{\sum_{T=1992}^{t-1}\left(\ln FIMS_T - \ln q_{FIMS} - \ln B_T^P\right)^2}{n_{FIMS}}} \quad (10)$$

The parameters of the likelihood L estimated in the fitting process are B_{1992}^P and a.

A penalty function is added to the negative log-likelihood function for the "*a*" parameter of the G_T relationship (equation 3) used. The penalty function is as follows:

$$P = \frac{(a-3000)^2}{2\sigma_a^2}$$

where $\sigma_a = 1000$.

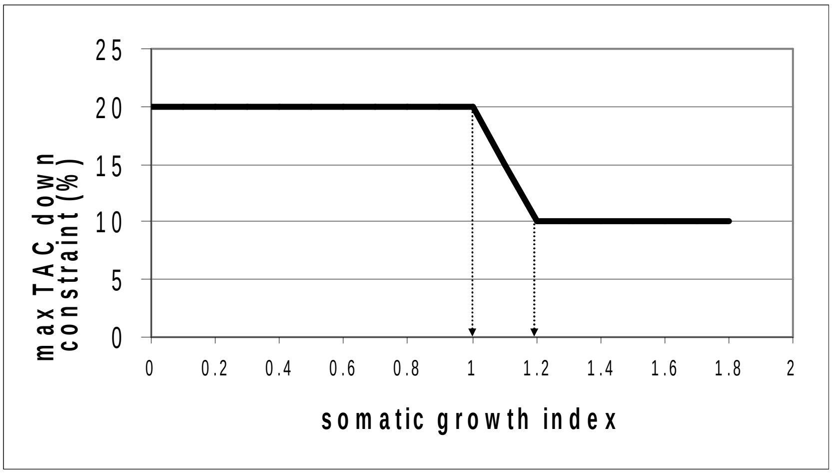
Thus, equation (4) becomes:

$$-\ln L = \sum_{T=1993}^{t-1}\left\{\ln\sigma_{CPUE^{trap}} + \frac{1}{2\sigma_{CPUE^{trap}}^2}\left(\ln CPUE_T^{trap} - \ln q_{CPUE^{trap}} - \ln B_T^P\right)^2\right\}$$
$$+ \sum_{T=1993}^{t-1}\left\{\ln\sigma_{CPUE^{hoop}} + \frac{1}{2\sigma_{CPUE^{hoop}}^2}\left(\ln CPUE_T^{hoop} - \ln q_{CPUE^{hoop}} - \ln B_T^P\right)^2\right\}$$
$$+ \sum_{T=1992}^{t-1}\left\{\ln\sigma_{FIMS} + \frac{1}{2\sigma_{FIMS}^2}\left(\ln FIMS_T - \ln q_{FIMS} - \ln B_T^P\right)^2\right\} + P$$

A number of further modifications are made to the basic TAC algorithm of equation (1). Their aim is particularly to react to reduce catches sufficiently if especially poor resource signals are forthcoming. These are as follows.

i) Maximum (global) TAC inter-annual downward constraint

A maximum TAC downward inter-annual constraint of 10% is assumed for the first two seasons (2007 and 2008). From 2009 onwards, this constraint is modified according to the value of the somatic growth rate index ($\frac{\overline{\beta}_{y-3,y-2,y-1}}{\overline{\beta}_{89-04}}$), where $\overline{\beta}_{\{y\}}$ indicates the average value of β over the seasons in $\{y\}$ as follows:



Thus for seasons 2009+ the maximum TAC downward change constraint is allowed to range from 10%-20%.

Note: A maximum global TAC upward change constraint of 10% is imposed for all seasons.

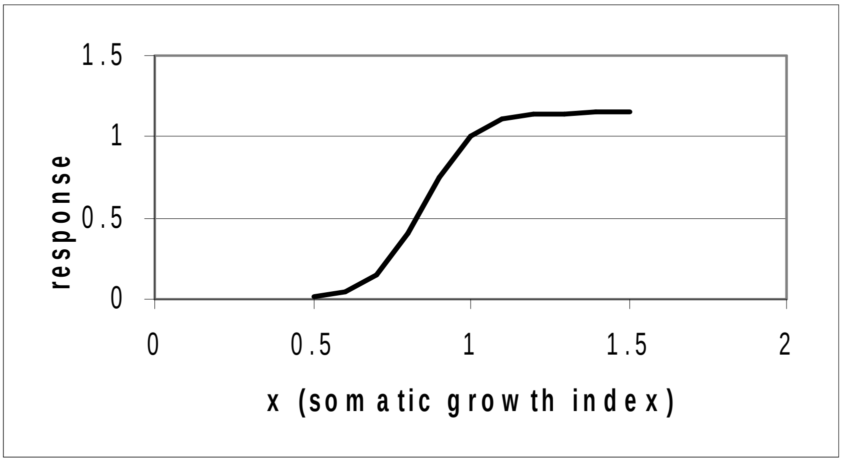
ii) Response to somatic growth changes

If $x = \dfrac{\bar{\beta}_{y-3,y-2,y-1}}{\bar{\beta}_{89-04}}$, then the response to the annual somatic growth rate index in the basic TAC algorithm (equation (1)) is given by x^{λ}, with λ set at 1 so that this term varies linearly with recent somatic growth rate.

The final OMP incorporates a more sharply changing response for *x* (in the sense that the TAC drops more sharply for values of $x < 1$), which is as follows:

$$x^{\lambda} \text{ changed to } \frac{1+P_1}{1+P_1 e^{-(x-P_2)/P_3}}$$

For values $P_1 = 0.15$, $P_2 = 1.0$ and $P_3 = 0.08$ (which were selected for optimal OMP performance), the following somatic growth rate response function then applies:



iii) **Capping of input data**
A maximum inter-annual increase in any one of the input indices from each super-area (prior to the combining over all five areas into a single index for input into the OMP) is imposed. The reason relates to the fact that for some simulations used in this testing process, due to very large variances (σ values) being used to generate the "real" data for use in the OMP, some VERY large CPUE or FIMS values occurred. To avoid the associated high output variance which could result, a cap is imposed on any input index value (from any of the 5 super-areas) which is greater then 2.5 times the **average** of the previous 5 years' values.

3 How the global (combined) TAC generated from the OMP is split amongst the super-areas

The final OMP TAC setting rule will produce a global TAC each year - TAC_t^G.

For the recreational take, the following algorithm is applied:

$C_t^{rec} = 320$ MT initially

If $C_t^{rec} / TAC_t^G > 0.12 TAC_t^G$ then $C_t^{rec} = 0.10 TAC_t^G$
If $C_t^{rec} / TAC_t^G < 0.08 TAC_t^G$ then $C_t^{rec} = 0.10 TAC_t^G$

If $C_t^{rec} > 450$ MT then $C_t^{rec} = 450$ MT

where C_t^{rec} is the overall recreational take for year *t*, and TAC_t^G is the "global" (commercial plus recreational) TAC for year *t* as output by the OMP.

The following proportional breakdown of the overall recreational take (C_t^{rec}) by super-area is assumed (for the purposes of OMP trials); these proportions remain unchanged over time:
Area 1-2 = 2%
Area 3-4 = 12.5%
Area 5-6 = 12.5%
Area 7 = 4%
Area 8 = 69%

The remaining (commercial) TAC ($TAC_t^{comm} = TAC_t^G - C_t^{rec}$) (adjusted if necessary at this stage to conform to inter-annual TAC change constraints) must then be split into super-area TACs. First the nearshore allocations are calculated, and then subtracted as indicated below.

The total nearshore allocation varies up and down over time in a similar manner to the recreational take. Thus, first the total nearshore TAC each year, NSQ^T, is calculated as follows:

$NSQ_t^T = 560$ MT initially

If $NSQ_t^T / TAC_t^G > 0.16\, TAC_t^G$ then $NSQ_t^T = 0.195\, TAC_t^G$
If $NSQ_t^T / TAC_t^G < 0.24\, TAC_t^G$ then $NSQ_t^T = 0.195\, TAC_t^G$

If $NSQ_t^T > 800$ MT then $NSQ_t^T = 800$ MT

The proportional inter-area split of the NSQ_t^T remains the same as for 2006, i.e.

Area 1-2 NSQ_t^{1-2} = 5.36% of NSQ_t^T
Area 3-4 NSQ_t^{3-4} = 16.07% of NSQ_t^T
Area 5-6 NSQ_t^{5-6} = 7.14% of NSQ_t^T
Area 7 NSQ_t^7 = 0% of NSQ_t^T
Area 8 NSQ_t^8 = 71.43% of NSQ_t^T

Finally the TAC for offshore rights holders $TAC_t^{off,A} = TAC_t^{comm,A} - NSQ_t^A$, is divided between super-areas A34, A7 and A8 as follows:

STEP 1: For each of these super-areas there are 1-3 abundance index time series. For each index, linearly regress *ln*(index) *vs* season for the last seven seasons of data, and calculate the slope.

STEP 2: If there is more than one series for a super-area, take the average of the slopes for each series, using inverse variance weighting as follows:

$$slope = \frac{\left(\frac{slope_{trap}}{\sigma^2_{slope_{trap}}} + \frac{slope_{hoop}}{\sigma^2_{slope_{hoop}}} + \frac{slope_{FIMS}}{\sigma^2_{slope_{FIMS}}}\right)/3}{\frac{1}{\sigma^2_{slope_{trap}}} + \frac{1}{\sigma^2_{slope_{hoop}}} + \frac{1}{\sigma^2_{slope_{FIMS}}}}$$ (assuming three series), where

$$\sigma^2 = \frac{1}{n-2} slope^2 \frac{1-r^2}{r^2}$$ from each regression, where *r* is the correlation coefficient and *n* = 7 given that seven seasons of data are used.

STEP 3: If these resultant slopes are above 0.15 or below -0.15, replace them with the corresponding bound.

STEP 4: Take the previous season's offshore commercial allocation for the super-area and multiply it by (1+*slope*), giving a new set of commercial allocations by super-area, which will not necessarily total to the new overall offshore commercial TAC for the super-areas concerned. If the allocations do not total to that, simply scale them all by the same proportion so that they do total to match that.

STEP 5: Transfer of 5% of the offshore commercial TAC from A8 to A34 and A7 in the ratio 1:4.

The offshore rights holders TACs are then simply calculated as:
$TAC_t^{off,A} = TAC_t^{comm,A} - NSQ_t^A$.

Summary of order of TAC calculations

1. OMP generates the global (all super-areas combined) commercial (offshore+nearshore rights holders)+recreational TAC = TAC_t^G.
2. Check for inter-annual TAC constraint violations (at global level) and adjust TAC_t^G if necessary.
3. Remove the total recreational TAC (which would then be split into super-areas as per the specified proportions for subsequent computations in any simulation testing):
   $TAC_t^{comm} = TAC_t^G - C_t^{rec}$.
4. Re-check that the remaining commercial (offshore+nearshore rights holders) TAC_t^{comm} does not violate inter-annual TAC constraints; if it does adjust it to the bound concerned.
5. Calculate the total nearshore TAC NSQ_t^T .
6. Split the total nearshore TAC into super-areas according to fixed proportions – note no nearshore TACs for super-area 7. This gives
   $NSQ_t^{12}, NSQ_t^{34}, NSQ_t^{56}, NSQ_t^8$.
7. Remove the total nearshore TAC from the total commercial TAC to give the amount to be split into offshore TACs for super-areas A34, A7 and A8 (note no offshore TACs for A12 and A56), i.e. $TAC_t^{off} = TAC_t^{comm} - NSQ_t^T$.
8. Split the offshore TAC into A34, A7 and A8 (using the slopes method above– this gives initial $TAC_t^{off,34}, TAC_t^{off,7}, TAC_t^{off,8}$).
9. Calculate the initial total commercial TAC for each super-area, i.e.:
   $TAC_t^{comm,12} = NSQ_t^{12}$
   $TAC_t^{comm,34} = NSQ_t^{34} + TAC_t^{off,34}$
   $TAC_t^{comm,56} = NSQ_t^{56}$
   $TAC_t^{comm,7} = TAC_t^{off,7}$
   $TAC_t^{comm,8} = NSQ_t^8 + TAC_t^{off,8}$.
10. Transfer 5% of commercial TAC from A8 into A34 (20%) and A7 (80%):
    $TAC_t^{comm,34} = TAC_t^{comm,34} + (0.2)(0.05)TAC_t^{comm,8}$
    $TAC_t^{comm,7} = TAC_t^{comm,7} + (0.8)(0.05)TAC_t^{comm,8}$
    $TAC_t^{comm,8} = 0.95TAC_t^{comm,8}$.
11. The final offshore rights holders' TACs are then:
    $TAC_t^{off,12} = TAC_t^{comm,12} - NSQ_t^{12} = 0$
    $TAC_t^{off,34} = TAC_t^{comm,34} - NSQ_t^{34}$
    $TAC_t^{off,56} = TAC_t^{comm,56} - NSQ_t^{56} = 0$
    $TAC_t^{off,7} = TAC_t^{comm,7} - NSQ_t^7$
    $TAC_t^{off,8} = TAC_t^{comm,8} - NSQ_t^8$

Remember too that the operating models don't distinguish between offshore and nearshore TACs (i.e. one ton caught by either group of rights holders is taken to have the same impact on the resource in the super-area concerned), and that the division of the commercial TAC into these two sectors is only for management purposes.

Notes: It is hypothetically possible (but very unlikely) that steps 3, 7 or 11 above could result in negative allocations. Should such extreme circumstances arise, they would be grounds for and dealt with under the Exceptional Circumstances provisions specified in the overall protocol for OMPs.

Further the OMP relies on the overall mechanism for adjusting nearshore allocations as being sufficient to counter negative resource trends in super-areas 1-2 and 5-6, for which only nearshore allocations are made, rather than to react directly to abundance index trends for these super-areas only. This is to avoid a situation where quotas for individual nearshore rights holders would differ between super-areas. However, this situation will be kept under review in terms of the routine assessments conducted under the agreed overall protocol for OMPs, and dealt with under Exceptional Circumstances provisions should sufficiently adverse resource trends in either of these two super-areas become evident.

References

OLRAC. 2005. Updated male somatic growth rate estimates for input into the spatially disaggregated assessment for West Cost rock lobsters. MCM document, WG/09/05/WCRL17.

Johnston, S.J. and D.S. Butterworth. 2005. Evolution of operational management procedures for the South African West Coast rock lobster (*Jasus lalandii*) fishery. New Zealand J mar and Freshwater Res 39: 687-702.

Table 3: The annual somatic growth data used (in mm for a 70m carapace length male lobster) in simulations (old series), the "new series" somatic growth and the final "renormalized new series" data.

	old series	**new series**	**renormalised new series**
1992	2.849	2.783	2.711
1993	3.461	3.421	3.333
1994	3.566	3.498	3.408
1995	3.937	3.836	3.737
1996	4.893	4.981	4.852
1997	3.565	3.511	3.420
1998	3.052	3.127	3.046
1999	3.102	3.140	3.059
2000	4.417	4.321	4.209
2001	3.631	3.615	3.521
2002	3.777	3.839	3.740
2003	2.580	2.795	2.723
2004	2.962	3.879	3.779
2005	2.686	3.020	2.942
2006		2.983	2.905
ave 1992-2005	3.463	3.555	3.463

Table 4: The final single-index input data into OMP-2007 to provide the 2007 TAC recommendations.

	Trap CPUE	Hoop CPUE	FIMS	Somatic growth
1992	-	-	2.270	2.711
1993	0.701	0.988	1.640	3.333
1994	0.566	0.901	1.023	3.408
1995	0.775	1.190	2.935	3.737
1996	0.943	1.180	5.419	4.852
1997	1.034	1.154	1.156	3.420
1998	1.163	1.350	2.811	3.046
1999	1.090	1.202	0.552	3.059
2000	1.209	1.076	0.719	4.209
2001	1.662	1.668	1.856	3.521
2002	1.579	0.885	2.341	3.740
2003	1.239	1.014	2.050	2.723
2004	1.080	0.833	1.961	3.779
2005	0.908	0.693	2.210	2.942
2006	0.960	0.693	1.150	2.905

Appendix 1: Details of TACs and Catches made in the 2005/06 and 2006/07 seasons.

Table A1.1: TAC and actual catches (in MT) for 2005/06 season.

2005/06 Season	A	B	A-B
	05/06 TAC	**Actual Catch**	**Under-catch 05/06**
Area1-2	30	16	14
Area 3-4	108	89	19
Area 5-6	40.5	11	29.5
Area 7	969.3	558	411.3
Area 8+	1727.5	1323	404.5
Total	**2875.3**	**1997**	**878.3**

Table A1.2: Details of the 2006/07 TACs and catch allocations (in MT).

2006/07 Season	A	B	A+B	C	C-B	(A+B)-C
	06/07 TAC from OMP	**05/06 roll-over**	**total 06/07 "TAC"**	**Actual 06/07 Catch taken**	**Catch attributed to 06/07**	**Under-catch 06/07**
Area1-2	30	14	44	22.4	8.4	21.6
Area 3-4	100	19	119	20.3	1.3	98.7
Area 5-6	40.25	29.5	69.75	16.3	0	53.45
Area 7	821.75	411.3	1233.05	938.1	526.8	294.95
Area 8+	1565	404.5	1969.5	2075.1	1670.6	-105.6
Total	**2557**	**878.3**	**3435.3**	**3072.2**	**2207.1**	**363.1**

Appendix 2: Male somatic growth rate analyses to provide inputs into the OMP.

[Calculation specification to come from OLRAC]

Appendix 3 – Trap CPUE analyses to provide inputs to the OMP.

[Calculation specifications to be provided by Jean Glazer]

Appendix 4 – Hoopnet CPUE analyses to provide inputs to the OMP

[Calculation specifications to be provided by Jean Glazer]

Appendix 5 – FIMS analyses to provide inputs to the OMP.

[Calculation specifications to be provided by Jean Glazer]