Biological issues relating to projections of the west coast rock lobster resource into the future for OMP trials

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Note: This section in ***bold+italics*** reflect items on which decisions are required at the current meeting.

OMP 2011

The assessment models which form the "operating models" upon which alternate OMP candidates are tested are currently being updated for application in developing OMP 2011 (see Johnston and Butterworth 2011).

This document lists the various biological assumptions that need to be made by the SWG regarding future projections of the resource. These include:

- Future somatic growth rate scenarios
- Future recruitment scenarios
- Future recreational take splits by super-area
- Future poaching levels (and super-area splits)
- What levels of future implementation errors (differences between allocations and actual takes, on a sector by sector basis) should be assumed?
- Future trap:hoopnet ratios expected in each super-area

1. Future Scenarios – what was assumed for current OMP

In 2007 the reference set of operating models used for basic OMP testing comprised of 27 possible scenarios (see Table 1), which resulted as combinations of uncertainties regarding future recruitment, future somatic growth and current abundance. The various scenarios and their weights that were used in 2007 are shown below.

1.1 Median Future recruitment	**WT**
• FRM: Geometric Mean of $R_{75}, R_{80}, R_{85}, R_{90}$ and R_{95}	0.60
• FRH: Maximum of $R_{75}, R_{80}, R_{85}, R_{90}$ and R_{95}	0.30
• FRL: Minimum of $R_{75}, R_{80}, R_{85}, R_{90}$ and R_{95}	0.10

Future recruitment (for FRM)

Future R_y: where y = 2005, 2010, 2015, 2020, 2025 and 2030; linearity between each of these years (and between 2000 and 2005).

Deterministic: $R_y = \overline{\mathrm{Re}}^{\frac{1}{2}\sigma^2}$ (1)

Stochastic: R_y randomly selected from $\overline{\mathrm{Re}}^{\varepsilon_y}$, where,

$$\ln \overline{R} = \frac{1}{5}\left(\ln R_{75} \ldots \ln R_{95}\right)$$
$$\sigma = \text{SD of } \left(\ln R_{75}, \ldots \ln R_{95}\right) \quad (2)$$
$$\varepsilon_y \sim N(0, \sigma^2)$$

For FRH and FRL, the $\overline{R}$ was replaced by either the maximum or minimum R between $R_{75}, R_{80}, R_{85}, R_{90}$ and R_{95}. Note that for A1-2, the minimum R was selected from the R_{80}, R_{85}, R_{90} and R_{95} range only, as it was found in the model fitting process that the R_{75} was unrealistically small for some super-areas.

1.2 Future Somatic growth (2005+)	**WT**
• FSGL: = FSGM for 3 years (2005, 2006, 2007) then will equal the 1989-2004 average (see Figure 1)	0.50
• FSGM: ↑ linearly to 1968-2004 ave over 10 yrs	0.40
• FSGH: ↑ linearly to 1968-2004 ave over 3 yrs	0.10

[The above applied to the growth rates for Areas 3+4, 5+6, 7 and 8+. The somatic growth rate for Area 1-2 was assumed to remain constant in the future at the 1989-2004 average level for all scenarios.]

1.3 Current (2005) Abundance (B75)	**WT**
• RC: Best Estimate (from current RC1-like model)	0.50
• ALTL: Estimated lower 12.5%ile	0.25
• ALTH: Estimated upper 12.5%ile	0.25

For 2011, it is suggested that the following modifications be considered.

1. ***Future somatic growth will now apply to 2010+. There has been no indication of a return towards pre-1989 somatic growth levels for some considerable time now. It is suggested to drop the FSGH scenario, and downweight the FSGM scenario to 20%, so that FSGL would get an 80% weight.***
2. ***For future recruitment, add R_{2000} to the estimable parameters considered in each test.***
3. ***Current abundance will now refer to 2010.***

2. Other Assumptions for the Future

2.1 Future trap:hoop ratios

The previous (i.e. pre-2007) OMP testing process assumed a trap:hoop ratio of 0.70:0.30 for all years in the future. Now different ratios are assumed for each super-area (these are based on actual trap and hoopnet catches). These trap:hoop ratios are:

Area 1-2 = 0:100
Area 3-4 = 10:90
Area 5-6 = 0:100
Area 7 = 100:0
Area 8 = 78:22

We suggest it be assumed that these ratios will continue unchanged into the future.

2.2 Future Poaching level

The previous OMP testing process assumed future annual poaching levels to remain constant at 500 MT (for the entire resource). Currently the following levels of future poaching are assumed for each super-area:

Area 1-2 = 5 MT
Area 3-4 = 12.5 MT
Area 5-6 = 12.5 MT
Area 7 = 70 MT
Area 8 = 400 MT

We suggest careful re-consideration of:

- ***i) whether this level of 500 tons is appropriate:***
- ***ii) whether it has changed in the recent past;***
- ***iii) whether there is a likely trend for the medium term future; and***
- ***iv) whether the previous super-area split should be maintained?***

For 2011 we suggest consideration of the possibility of including, say, three alternate poaching scenarios in the Reference Set of operating models rather than only one as in the past. These possibilities would cover alternate possible future levels and trends, and perhaps also alternate possibilities for the past as well.

2.3 Future Recreational take

The following % breakdown of the overall recreational take (C_t^{rec}) by super-area was assumed in 2007; these %'s remain unchanged over time:

Area 1-2 = 2%
Area 3-4 = 12.5%
Area 5-6 = 12.5%
Area 7 = 4%
Area 8 = 69%

We suggest that recent telephone survey reports be checked for evidence of possible changes to these %'s.

2.4 Future Near-shore takes

In 2007, the proportional inter-super-area split of the NSQ_y was taken to be:

Area 1-2 NSQ_y^{A1-2} = 5.36% of NSQ_y
Area 3-4 NSQ_y^{A3-4} = 16.07% of NSQ_y
Area 5-6 NSQ_y^{A5-6} = 7.14% of NSQ_y
Area 7 NSQ_y^{A7} = 0% of NSQ_y
Area 8 NSQ_y^{A8} = 71.43% of NSQ_y

We assume that the above should remain unchanged. Note that the current NSQ allocation is 451 MT.

2.5 Subsistence (Interim Relief) Catches

The new OMP 2011 will need to take into account a new group of users – the subsistence (interim relief) fishers (apparently some 1500 fishers, though this needs to be confirmed).

The past levels of interim relief catches that have been assumed for the updated 2010 operating models are (in MT):

Season	**2006/2007**	**2007/2008**	**2008/2009**	**2009/2010**
Phase	**I**	**II**	**III**	**IV**
Area 1-2	2.075	4.356	7.040	9.158
Area 3-4	12.841	33.814	36.960	56.664
Area 5-6	15.285	41.272	43.010	67.447
Area 7	0	0	0	0
Area 8+	31.830	94.215	81.617	140.457
Total	**62.031**	**173.657**	**168.627**	**273.726**

Though 200 tons has been allocated for interim-relief for the 2010/2011 season, under the current season length if some 1500 fishers are permitted, the allowed take will amount to 285 tons (see Appendix). The following need to be clarified:

- ***i) the number of fishers, the effective season length, and hence the likely take for 2010/2011;***
- ***ii) whether any change to this number in the future should be considered (alternative options might be specified);***
- ***iii) whether the current allocations are such that the super-area split above has been modified.***

2.6 Implementation error for catch allocations

Distributions for likely annual differences between allocations and takes need to be agreed for each of the four sectors: offshore commercial, nearshore commercial, interim relief, and recreational. This is to be considered in conjunction with the poaching estimates.

3. Future Data

3.1 Future data available each year

This refers to data which it can reliably (i.e. almost certainly) be assumed will be available, based on recent years. The following was assumed in 2007:

Area	Trap CPUE	Hoop CPUE	FIMS	Somatic growth
1-2	No	Yes	No	Yes
3-4	No	Yes	Yes	Yes
5-6	No	Yes	Yes	Yes
7	Yes	No	Yes	Yes
8	Yes	Yes	Yes	Yes

Future data apply to seasons from 2010 onwards, and future TAC levels apply to seasons from 2011 onwards.

Data that are input to the OMP (for the super-areas for which they are available) are generated as follows:

a) Future commercial Trap CPUE estimates

Deterministic: $$\hat{CPUE}_y^{trap} = q^{trap} \sum_{l \geq l_{\min}}^{180} \left[w_l^m b_l^{m,trap}(y) N_l^m(y) + w_l^f b_l^{f,trap}(y) N_y^f(y) \right] \quad (5)$$

Stochastic: For simulation *S*, $$\hat{CPUE}_y^{trap,S} = \hat{CPUE}_y^{trap} e^{\varepsilon_y^S}, \quad (6)$$

where $\varepsilon_y^S \sim N(0, \sigma^2)$, and where σ is taken from the model fit to the trap CPUE data for that super-area and is as follows:

A1-2: N/A
A3-4: N/A
A5-6: N/A
A7: σ =0.293 (will be updated to 0.469)
A8: σ =0.150 (will be updated to 0.177)

b) Future commercial Hoop CPUE estimates

Deterministic: $$\hat{CPUE}_y^{hoop} = q^{hoop} \sum_{l \geq l_{\min}}^{180} \left[w_l^m b_l^{m,hoop}(y) N_l^m(y) + w_l^f b_l^{f,hoop}(y) N_y^f(y) \right] \quad (7)$$

Stochastic: For simulation *S*, $$\hat{CPUE}_y^{hoop,S} = \hat{CPUE}_y^{hoop} e^{\varepsilon_y^S}, \quad (8)$$

where $\varepsilon_y^S \sim N(0, \sigma^2)$, and where σ is taken from the model fit to the hoopnet CPUE for that super-area and is as follows:

A1-2: σ =0.296 (will be updated to 0.165)
A3-4: σ =0.479 (will be updated to 0.491)
A5-6: σ =0.118 (will be updated to 0.424)
A7: σ =N/A
A8: σ =0.150 (will be updated to 0.233)

c) Future FIMS estimates

Deterministic: $$\hat{FIMS}_y = q^{FIMS} \sum_{l \geq 40}^{180} \left[b_l^{m,FIMS}(y) N_l^m(y) + b_l^{f,FIMS}(y) N_y^f(y) \right] \quad (9)$$

Stochastic: For simulation *S*, $\hat{FIMS}_y^S = \hat{FIMS}_y e^{\varepsilon_y^S}$, where (10)

$\varepsilon_y^S \sim N(0, \sigma^2)$, and where σ is taken from the model fit to the FIMS CPUE data for that super-area which is as follows:

A1-2: N/A
A3-4: σ =1.594 (will be updated to 1.652)
A5-6: σ =1.072 (will be updated to 1.107)
A7: σ =0.785 (will be updated to 0.772)
A8: σ =0.150 (will be updated to 0.274)

d) Future somatic growth

The β_y^m value (being the growth of a 70mm male rock lobster) is used as the index of somatic growth rate for each super-area.

Stochastic: $\beta_y^{m,S} = \beta_y^m + \varepsilon_y^S$, where (11)

$\varepsilon_y^S \sim N(0, \sigma^2)$, and the σ values for each super-area (as calculated from the 1990-2004 observed values) are as follows:

A1-2: σ =0.79 (the 1990-2009 updated value of σ =1.09)
A3-4: σ =0.51 (the 1990-2009 updated value of σ =0.56)
A5-6: σ =0.51 (the 1990-2009 updated value of σ =0.56)
A7: σ =1.18 (the 1990-2009 updated value of σ =1.05)
A8: σ =0.51 (the 1990-2009 updated value of σ =0.56)

Note that due to the fact that future somatic growth data from A5-6 are unlikely to eventuate, and that the moult probability model treats the A3-4, A5-6 and A8 somatic growth as the same, then when generating random error (as described above) for the somatic growth rates for these three super-areas, the same error will be applied to each of these super-areas (although varying from year to year). This will ensure that somatic growth observations will either go up or down in tandem for these three super-areas.

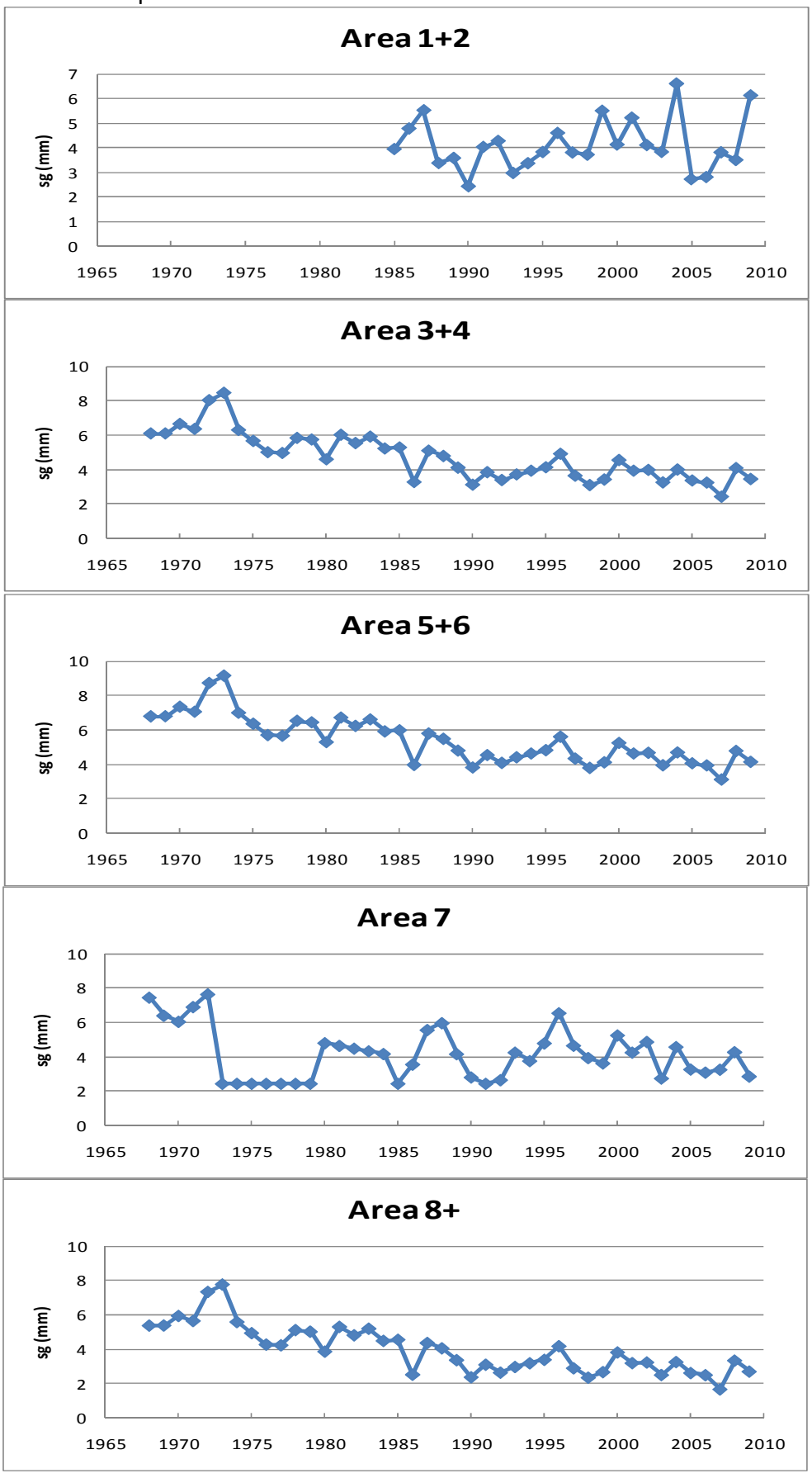
General Note: Some σ values above are rather high and will result in the generation of highly variable future data. It is proposed to consider some further limitations, such as restriction of future residuals to lie between the minimum and maximum residuals for that series evident from past analyses.

References

Johnston, S.J., Butterworth, D.S. and J.Glazer. 2010. OMP 2007 re-cast to be used for setting the TACs for the West Coast rock lobster fishery for the 2008+ season. Fisheries/2010/Aug/SWG-WCRL/13.

Johnston, S.J. and D.S. Butterworth. 2011. Updated west coast rock lobster models. FISHERIES/2011/MAR/SWG-WCRL/04.

Figure 1: Figure showing the somatic growth rate of a 70mm male lobster for each of the five super-areas.



Appendix: Estimate of Interim Relief take for the 2010/2011 season:

Assuming that the average catch rate of phases II and III (seasons 2007/08 and 2008/09) will apply to the 2010/2011 season, i.e. phase V, a total Interim Relief catch estimate of **285 MT** for the 2010/2011 season results.
i.e.:

$$C_{2010} = T_{2010} P_{2010} \bar{R}$$

where

C_{2010}	is the Interim relief catch estimate to be taken for the 2010/2011 season;
T_{2010}	is the season length in weeks for the 2010/2011 season (23 weeks);
P_{2010}	is the estimated (minimum) number of permits allocated for the 2010/2011 season (we assume 1500 here); and
$\bar{R}$	is the average catch per permit holder per week over the 2007/08 and 2008/09 seasons (i.e. average of the weekly catch rates for the 2007/08 and the 2008/09 seasons).

Thus for the 2010/2011 season:

$$C_{2010} = (823).(1500).(0.008259) = 285 \text{ MT}$$

Note: The estimate of 285 MT is 85 MT above the intended 200 MT.

Assuming the same super-areal split of the IR catch over the five super areas as for previous season, the estimated IR catches per super-area for 2010/2011 season are:

Area 1+2: 9.54 MT
Area 3+4: 59.00 MT
Area 5+6: 70.23 MT
Area 7: 0 MT
Area 8+: 146 MT
Total = 285 MT