MARAM/OLRAC averaged Final area-disaggregated Assessment results for west coast rock lobster

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Female survivorship constraint

At the previous working group meeting, following the presentation of MARAM and OLRAC'S most recent area-disaggregated assessments results (see WG/06/06/WCRL25), it was decided that an upper limit of 0.89 should be imposed on the female survivorship estimable parameter for the final area-disaggregated model assessments. It was noted that for Area 5-6 and Area 7 the estimated female survivorship values (~0.94) were biologically unrealistic, also given that the male survivorship is fixed at 0.90.

MARAM/OLRAC averaged results

MARAM and OLRAC both individually fitted their models to the data to obtain best fit parameter values for each of the super-areas (and for the area-aggregated model). For the final models to be used for OMP testing purposes, the average of the MARAM and OLRAC best fit parameter values are to be used. In most cases the MARAM and OLRAC estimates were found to be very similar. Table 1 compares the $-ln$L, the B75(2005) and the replacement yields (assuming FRM and FSGL – see below) for the MARAM, OLRAC, and the "averaged" parameter models (as calculated by MARAM).

Alternate assessment models and future recruitment and somatic growth rate scenarios

OMP developers will shortly be testing a new range of OMPs for the resource, this time based on super-area models as the underlying operating models for the OMP testing procedure. A range of uncertainties (as used for the previous OMP testing procedure) has been defined (see WG/03/06/WCRL21). Following recommendations made recently by the International Rock Lobster Workshop (December 2005), it is propose that the core uncertainties listed below be considered as components of the Reference Set (RS). A weight has been set for each, following discussions in a task group meeting as well as in the Working Group.

1. Current Abundance	**WT**
• RC: Best Estimate (from RC1-like model)	0.50
• AltL: Estimated lower 25%ile for R_{2000}	0.25
• AltH: Estimated upper 25%ile for R_{2000}	0.25

The two alternate models (AltL and AltH) are virtually identical to the RC model, except with regards to the R_{2000} value. For the RC model R_{2000} is an estimable parameter, although it was found to be estimated with very low precision. For this reason, AltL and AltH models correspond almost exactly to the RC best fit parameter values except for R_{2000} which is fixed at the (approximate) upper and lower 25%iles of this distribution as described in WG/06/06/WCRL25.

2. Future Somatic growth (2005+)	**WT**
• FSGL: 1989-2004 average	0.50
• FSGM: ↑ to 1968-2004 ave over 10 yrs	0.40
• FSGH: ↑ to 1968-2004 ave over 3 yrs	0.10

The above apply to the growth rates for Areas 3-4, 5-6, 7 and 8. It is suggested that the future somatic growth rate for Area 1-2 be assumed to remain constant (at the 1989-2004 average level) in the future.

3. Median Future Recruitment	**WT**
• FRM: Median of $R_{75}, R_{80}, R_{85}, R_{90}$ and R_{95}	0.60
• FRM: 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

The combination of the above uncertainties will produce a total of 27 scenarios. Each OMP candidate will effectively be run for all 27 scenarios, with the results of each scenario being weighted by a value reflective of that scenario's total weight. Table 2 reports the total weights for each of the 27 model scenarios.

Replacement yields

For each super-area and for each of the 27 "future scenarios", a replacement yield (RY) can be calculated. This RY reflects the combined commercial and recreational TAC in MT. Tables 3a-g report the RYs for the MARAM/OLRAC averaged parameter values (as calculated by MARAM).

Table 4 reports the weighted (as per Table 2) averages of the RY estimates (in MT) for each of the Table 3 options.

Table 1: MARAM, OLRAC and the "averaged" parameter model results for the –lnL, B75(2005) and replacement yield (RY).

		MARAM	**OLRAC**	**Averaged parameters**
A1-2	-*ln*L	-20.13	-21.08	510
	*B*75(2005)	434	644	686
	RY	22	12	9
A3-4	-*ln*L	25.93	26.85	31.95
	*B*75(2005)	3161	3920	3785
	RY	220	300	229
A5-6	-*ln*L	38.53	36.39	161.27
	*B*75(2005)	566	1277	372
	RY	132	237	167
A7	-*ln*L	9.05	-2.06	21.27
	*B*75(2005)	3192	5258	4594
	RY	619	607	600
A8	-*ln*L	-55.00	-54.93	-53.60
	*B*75(2005)	9421	9190	9962
	RY	969	1057	1005
Area-aggregated	-*ln*L	-50.13	-91.96	-50.04
	*B*75(2005)	17001	18204	17783
	RY	2454	2402	2404

Table 2: Weights given to each of the 27 possible model scenarios.

	Future Recruitment for ≥ 2005	Future Somatic Growth for ≥ 2005	Recruitment for 2000		
			01 Alt L	02 RC	03 Alt H
01	**FRL**	**FSGL**	0.0125	0.0250	0.0125
02	**FRL**	**FSGM**	0.0100	0.0200	0.0100
03	**FRL**	**FSGH**	0.0025	0.0050	0.0025
04	**FRM**	**FSGL**	0.0750	0.1500	0.0750
05	**FRM**	**FSGM**	0.0600	0.1200	0.0600
06	**FRM**	**FSGH**	0.0150	0.0300	0.0150
07	**FRH**	**FSGL**	0.0375	0.0750	0.0375
08	**FRH**	**FSGM**	0.0300	0.0600	0.0300
09	**FRH**	**FSGH**	0.0075	0.0150	0.0075

Table 3a: A1-2 replacement yields calculated using the averaged MARAM and OLRAC best fit parameter values. Results are reported for 27 combinations of R_{2000}, future recruitment and future somatic growth rate. Note that the future somatic growth is assumed to remain constant at the 1989-2004 average level for all three future somatic growth options.

Area 1-2 Replacement Yields (Commercial + Recreational) / MT

	Future Recruitment for ≥ 2005	Future Somatic Growth for ≥ 2005	Recruitment for 2000		
			01 Alt L	02 RC	03 Alt H
01	**FRL**	**FSGL**	0	0	0
02	**FRL**	**FSGM**	0	0	0
03	**FRL**	**FSGH**	0	0	0
04	**FRM**	**FSGL**	4	9	17
05	**FRM**	**FSGM**	4	9	17
06	**FRM**	**FSGH**	4	9	17
07	**FRH**	**FSGL**	36	41	48
08	**FRH**	**FSGM**	36	41	48
09	**FRH**	**FSGH**	36	41	48

Table 3b: A3-4 replacement yields calculated using the averaged MARAM and OLRAC best fit parameter values. Results are reported for 27 combinations of R_{2000}, future recruitment and future somatic growth rate.

Area 3-4 Replacement Yields (Commercial + Recreational) / MT

	Future Recruitment for ≥ 2005	Future Somatic Growth for ≥ 2005	Recruitment for 2000		
			01 Alt L	02 RC	03 Alt H
01	**FRL**	**FSGL**	0	54	198
02	**FRL**	**FSGM**	106	194	346
03	**FRL**	**FSGH**	209	323	519
04	**FRM**	**FSGL**	152	229	363
05	**FRM**	**FSGM**	355	432	570
06	**FRM**	**FSGH**	548	648	826
07	**FRH**	**FSGL**	424	491	611
08	**FRH**	**FSGM**	664	737	865
09	**FRH**	**FSGH**	988	1083	1254

Table 3c: A5-6 replacement yields calculated using the averaged MARAM and OLRAC best fit parameter values. Results are reported for 27 combinations of R_{2000}, future recruitment and future somatic growth rate.

Area 5-6 Replacement Yields (Commercial + Recreational) / MT

	Future Recruitment for ≥ 2005	Future Somatic Growth for ≥ 2005	Recruitment for 2000		
			01 Alt L	02 RC	03 Alt H
01	**FRL**	**FSGL**	54	98	208
02	**FRL**	**FSGM**	75	122	238
03	**FRL**	**FSGH**	107	161	329
04	**FRM**	**FSGL**	112	167	276
05	**FRM**	**FSGM**	128	191	335
06	**FRM**	**FSGH**	226	312	475
07	**FRH**	**FSGL**	147	204	352
08	**FRH**	**FSGM**	160	242	403
09	**FRH**	**FSGH**	338	467	826

Table 3d: A7 replacement yields calculated using the averaged MARAM and OLRAC best fit parameter values. Results are reported for 27 combinations of R_{2000}, future recruitment and future somatic growth rate.

Area 7 Replacement Yields (Commercial + Recreational) / MT

	Future Recruitment for ≥ 2005	Future Somatic Growth for ≥ 2005	Recruitment for 2000		
			01 Alt L	02 RC	03 Alt H
01	**FRL**	**FSGL**	271	297	335
02	**FRL**	**FSGM**	347	385	441
03	**FRL**	**FSGH**	495	536	599
04	**FRM**	**FSGL**	575	600	639
05	**FRM**	**FSGM**	647	685	741
06	**FRM**	**FSGH**	893	936	1001
07	**FRH**	**FSGL**	1142	1175	1219
08	**FRH**	**FSGM**	1195	1227	1299
09	**FRH**	**FSGH**	1638	1690	1764

Table 3e: A8 replacement yields calculated using the averaged MARAM and OLRAC best fit parameter values. Results are reported for 27 combinations of R_{2000}, future recruitment and future somatic growth rate.

Area 8 Replacement Yields (Commercial + Recreational) / MT

	Future Recruitment for ≥ 2005	Future Somatic Growth for ≥ 2005	Recruitment for 2000		
			01 Alt L	02 RC	03 Alt H
01	**FRL**	**FSGL**	490	716	1021
02	**FRL**	**FSGM**	1161	1395	1711
03	**FRL**	**FSGH**	1953	2281	2727
04	**FRM**	**FSGL**	788	1005	1298
05	**FRM**	**FSGM**	1609	1828	2123
06	**FRM**	**FSGH**	2611	2925	3354
07	**FRH**	**FSGL**	1241	1442	1713
08	**FRH**	**FSGM**	2139	2343	2616
09	**FRH**	**FSGH**	3445	3757	4180

Table 3f: Area-aggregated replacement yields calculated using the averaged MARAM and OLRAC best fit parameter values. Results are reported for 27 combinations of R_{2000}, future recruitment and future somatic growth rate.

Area Aggregated

Replacement Yields (Commercial + Recreational) / MT

	Future Recruitment for ≥ 2005	Future Somatic Growth for ≥ 2005	Recruitment for 2000		
			01 Alt L	02 RC	03 Alt H
01	**FRL**	**FSGL**	1023	1501	2169
02	**FRL**	**FSGM**	2002	2509	3220
03	**FRL**	**FSGH**	3155	3822	4761
04	**FRM**	**FSGL**	1948	2404	3047
05	**FRM**	**FSGM**	3237	3716	4395
06	**FRM**	**FSGH**	4836	5474	6379
07	**FRH**	**FSGL**	2509	2953	3581
08	**FRH**	**FSGM**	3928	4401	5071
09	**FRH**	**FSGH**	5804	6435	7333

Table 3g: A1+2+3+4+5+6+7+8 replacement yields calculated using the averaged MARAM and OLRAC best fit parameter values. Results are reported for 27 combinations of R_{2000}, future recruitment and future somatic growth rate. The shaded blocks indicated RY which are smaller than the corresponding area-aggregated RYs.

A1+2+3+4+5+6+7+8 **Replacement Yields (Commercial + Recreational) / MT**

	Future Recruitment for ≥ 2005	Future Somatic Growth for ≥ 2005	Recruitment for 2000		
			01 Alt L	02 RC	03 Alt H
01	**FRL**	**FSGL**	815	1165	1762
02	**FRL**	**FSGM**	1689	2096	2736
03	**FRL**	**FSGH**	2764	3301	4174
04	**FRM**	**FSGL**	1631	2010	2593
05	**FRM**	**FSGM**	2743	3145	3786
06	**FRM**	**FSGH**	4282	4830	5673
07	**FRH**	**FSGL**	2990	3353	3943
08	**FRH**	**FSGM**	4194	4590	5231
09	**FRH**	**FSGH**	6445	7038	8072

Table 4: The weighted (as per Table 2) averages of the RY estimates (in MT) for each of the Table 3 options.

Area	Weighted averaged RY
A1-2	18
A3-4	435
A5-6	219
A7	815
A8	1660
Area-aggregated	3369
Sum A1-2+3-4+5-6+7+8	3147