Results for final set of candidate OMPs for the new OMP 2011 for West Coast Rock Lobster

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Results of the final set of alternate candidate OMPs are presented here. All results are presented for the full 1000 simulations. The OMP candidates reported here have three main new features compared with the current OMP 2007 re-cast:

1) Allowance of the inter-annual TAC downward constraint to be changed from the baseline 10% to as much as 30% if circumstances require (RULE 1)
2) Allowance for exceptional circumstances to be invoked in a super-area which results in all fishing in that super-area being suspended (EC rule).
3) After the initial total offshore TACs area calculated, a further adjustment is made, where 20% of the offshore A8+ TAC is transferred to A3+4, A5+6, and A7. This 20% removal from A8+ is phased in over four years (i.e. will only be 5% in first season 2011). Each year a fixed 20 MT is given to A5+6, and the remainder of the transferred tonnage from A8+ is split between A3+4 and A7 in a ratio 30:70.

The idea underlying the "EC rule" is not to suggest that this complete closure would occur in practice. Rather, what would need happen is an early OMP review with shifting of effort by nearshore, commercial and interim relief/subsistence to other super-areas. The reason underlying presenting calculation results in this extreme form is to demonstrate that if the situation became "so bad" in a super-area, it remains possible to achieve some reasonable extent of recovery by appreciable reductions in future catches from that super-area.

Results all assume the "alternative" sector split method proposed, except for one model which shows results for the "current" sector split.

OMP 2011

Method for calculating the Global TAC

$$TAC_y^G = \alpha\left(\bar{J}_y - J_{min}\right) \qquad (1)$$

where

α and J_{min} are two tuning parameters, and

$\bar{J}_y$ is the combined abundance index – combined over both super-areas and gear-type:

$$\bar{J}_y = \sum_{gear=1}^{3} W^{gear} J_y^{gear} \qquad (2)$$

where

J_y^{gear} is a relative measure of the immediate past level in the abundance index "gear" (I_y^{gear})(for gear type trap, hoop or FIMS) as available for use in calculation of the global TAC for year *y:*

$$J_y^{gear} = \frac{e^{\left[\sum_{y'=y-3}^{y'=y-1} \ln\left(I_{y'}^{gear}\right)\right]/3}}{e^{\left[\sum_{y'=2005}^{y'=2009} \ln\left(I_{y'}^{gear}\right)\right]/5}}$$

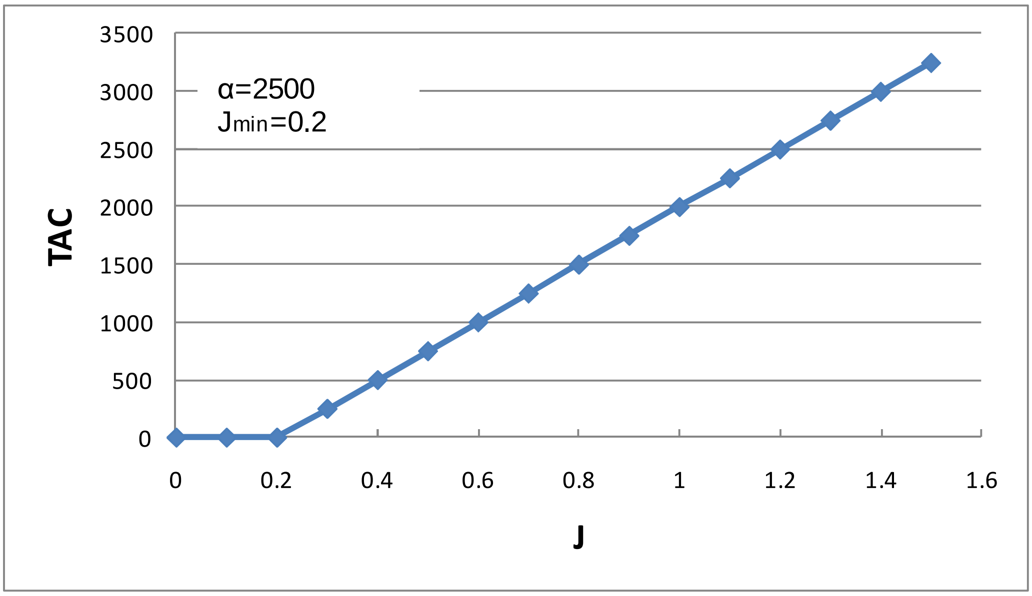
and

W^{gear} is the relative weight given to that gear type.

The W^{gear} values selected by the SWG are:

$W^{trap} = 0.45$; $W^{hoop} = 0.35$; and $W^{FIMS} = 0.20$.

Figure 1: The illustrative figure below shows the TAC as a function of "J", where the value of α is 2500 and J_{min} is 0.2.



Adjusting TAC for recent somatic growth

The global TAC value is then adjusted up or down by the addition or subtraction of an amount "Z" such that:

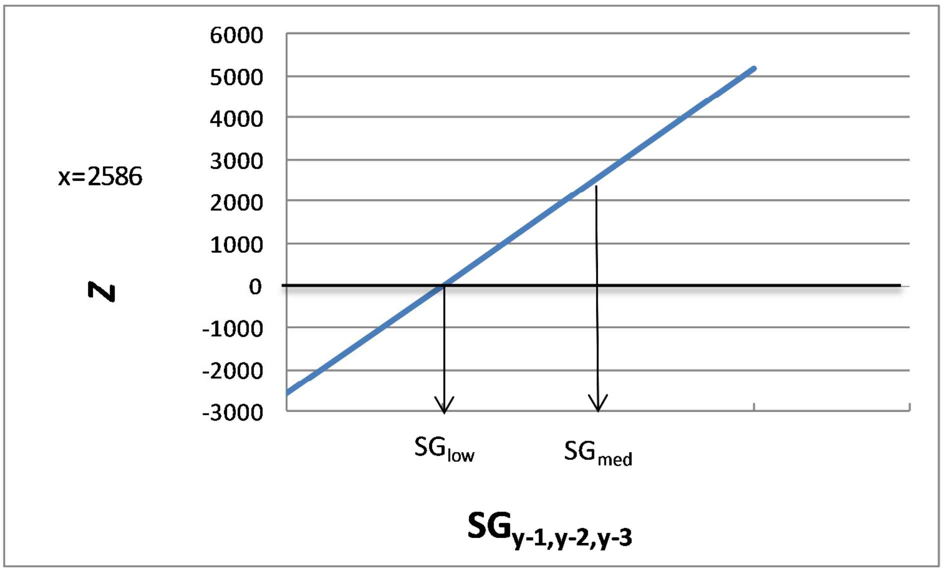
$$TAC_y^G = TAC_y^G + Z \qquad (4)$$

and where

$$Z = \bar{x}\frac{\overline{SG}_{y-1,y-2,y-3} - SG_{low}}{SG_{med} - SG_{low}} \qquad (5)$$

where $\overline{SG}_{y-1,y-2,y-3}$ is the geometric mean of the combined somatic growth index for the three most recent seasons. The value of $\bar{x}$, which is 2586 MT, was calculated by comparing the tonnage differentials between the low and medium somatic growth rates that would result in the same biomass level after 10 years. Figure 2 below illustrates the dependence of Z on $\overline{SG}_{y-1,y-2,y-3}$.

Figure 2: The relationship between *Z* and (see Equation 5).

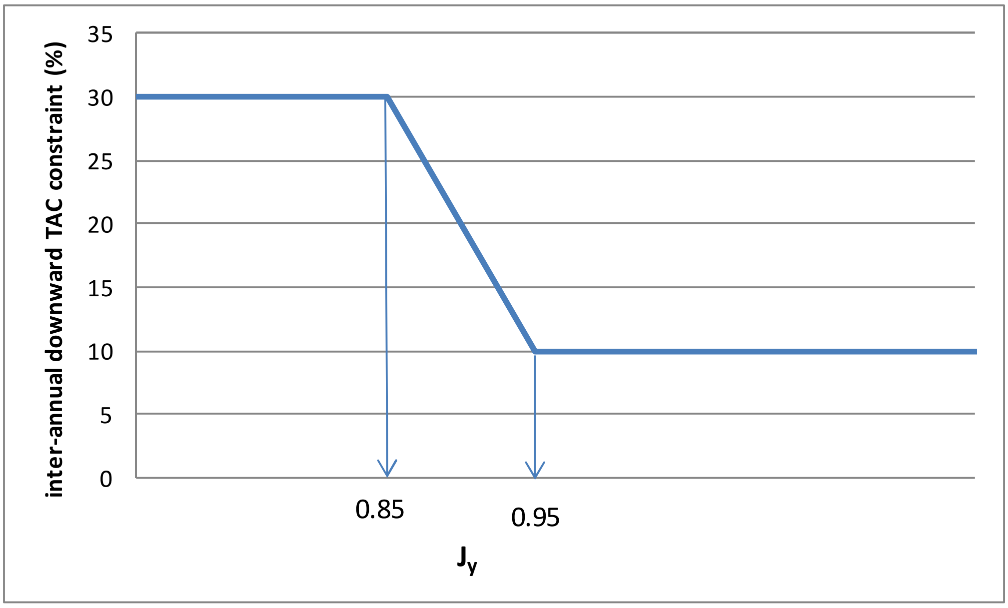


If is equal to SG_{low}, then the value of *Z* will be zero. If the value of is equal to SG_{med}, then the value of *Z* will be 2586 MT. If drops to below SG_{low}, then the value of *Z* will be negative, and the TAC will be adjusted downwards.

Inter-annual TAC constraints

Both the total Global TAC and total Offshore TAC values are constrained by the amount they can vary from the previous year's value. This amount has been set at 10%. However, a further rule, "RULE 1", allows for the TAC values to decrease by as much as 30% under certain conditions of poor resource performances, as indexed by . Figure 3 below shows how this TAC decrease constraint would be set. The amount of TAC decrease permitted is dependent of the value and is set equal to 10% for values of and set equal to 30% for values of , with linear interpolation between values between 0.85 and 0.95.

Figure 3: RULE 1 - inter-annual downward TAC constraint calculation based on value of $\bar{J}_y$.



Method for calculating the sector splits: two alternate approaches

Table 1a: Sector splits of global TAC ("Current")

Sector	Baseline % of Global TAC	Range of global TAC allowed before revert to baseline	Maximum allowed
Recreational	5%	3% - 6%	250 MT
Subsistence/IR	8.8%	7% - 11%	500 MT
Nearshore commercial	19.7%	16% - 24%	800 MT
Offshore commercial	66.5%	Currently max 10% pa	-

Table 1b: Sector splits of global TAC ("Alternative")

Sector	Baseline % of Global TAC	Range of global TAC allowed before revert to baseline	Maximum allowed	2011 starting value
Recreational	8%	6% - 10%	400 MT	182.9 MT
Subsistence/IR	11%	8% - 14%	600 MT	251.48 MT
Nearshore commercial	19.7%	16% - 24%	800 MT	451 MT
Offshore commercial	61.3%	Currently max 10% pa	-	No less than 90% of 2010 value

Method for splitting the sector TACs amongst super-areas

Table 1c: Super-area splits of the Nearshore, Subsistence and Recreational TACs/allocations

	Nearshore	Subsistence	Recreational
A1+2	0.0536	0.033	0.02
A3+4	0.1607	0.207	0.125
A5+6	0.0714	0.246	0.125
A7	0.000	0.000	0.04
A8+	0.7143	0.513	0.69

Splitting of offshore TAC

The total Offshore TAC is split between the super-areas based on a method (the same for OMP 2007) that uses the slopes of the recent resource indices where available, e.g. trap and hoop CPUE and FIMS. The Offshore TAC is split between A3+4, 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:

$$slope^A = \frac{\left(\frac{slope^A_{trap}}{\sigma^2_{slope^A_{trap}}} + \frac{slope^A_{hoop}}{\sigma^2_{slope^A_{hoop}}} + \frac{slope^A_{FIMS}}{\sigma^2_{slope^A_{FIMS}}}\right)}{\frac{1}{\sigma^2_{slope^A_{trap}}} + \frac{1}{\sigma^2_{slope^A_{hoop}}} + \frac{1}{\sigma^2_{slope^A_{FIMS}}}}$$ (assuming three series), (6)

where:

$\sigma^2_{slope^A} = \frac{1}{n-2}(slope^A)^2 \frac{1-r^2}{r^2}$ 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+$slope^A$) for that super-area, giving a new set of commercial allocations by super-area, which will not necessarily total to the new overall offshore commercial TAC (TAC_y^{off}). If the allocations do not total to the total offshore commercial TAC, simply scale them all by the same proportion so that they do total to match the required offshore commercial TAC.

STEP 5: Transfer of 20*Y% of the offshore commercial TAC (TAC_y^{off}) from A8+ to A3+4, A5+6 and A7. This transfer is phased in over four seasons thus Y=0.25 for 2011, Y=0.5 for 2012, Y=0.75 for 2013, and Y=1 for 2014 and thereafter. A 20 MT is apportioned to A5+6 each year, and the remainder of the transferred TAC from A8+ is split between A3+4 and A7 in the ration 30:70.

The intent of this approach is first to adjust the split to take account of possible different trends in abundance in the three super-areas, and also to effect a movement of commercial catch from A8+ to A3+4, A5+6 and A7 because the current take in A8+ is too high. This last change is phased in over four years to cause less disruption to the offshore commercial industry operations.

Exception Circumstances (EC) rule:

$J_{\text{area,y}}$ is an index of recent resource performance for that super-area, relative to recent (2005-2009) levels, which is calculated for each area using the resource indices available for that super-area e.g. hoop and trap CPUE and FIMS. The appendix gives the equations used for calculating $J_{\text{area,y}}$.

If $J_{area,y} < X_{crit}^{area}$ then EC invoked for that area and year (*y*) then all catches set to zero in that area for that year and the remaining years to 2020.

The values of X_{crit}^{area} used here are:

X_{crit}^{A1+2} =0.7

X_{crit}^{A3+4} =0.85

X_{crit}^{A5+6} =0.7

X_{crit}^{A7} =0.8

X_{crit}^{A8+} =0.7

Simulation Method

For each simulation a set of random numbers is generated which are used to select between the various choices that are required for future somatic growth (2 options), future recruitment (3 options), current abundance levels (3 options), historic poaching level (2 options) and future poaching levels (6 options). The weights that each of these options receive remain the same as agreed previously by the WCRL SWG.

Results reported here are for 1000 simulations. The medians and 5th , 25th and 95th percentiles are determined from these 1000 simulations.

Results

Table 2 reports the median, 5th and 25th percentile values of B75m(2021/2006) values and the Global TAC for three different CMPs which are identical except for the resultant median recovery targets(1.21%, 1.30% and 1.40%). CMP1, CMP2 and CMP3 all assume the “alternative” sector split.

Results using the tuning parameter for the 1.30% median recovery is used to produce results for both the “current” sector split, and for the “alternative poaching scenario”. The alternative poaching scenario assumes a 35:65 split of poaching between A8:A1-7 both historically and idn the future.

Table 3a reports the number of time (expressed also as percentages) one can expect the EC rule to be invoked for the four CMPs reported in Table 2. Table 4b reports the number of times (and percentages) that one can expect the same rule to be invoked in the first four years (i.e. period 2011-2014).

Table 4 reports detailed output statistics for the various sector catches/takes per area as well as biomass recovery values. Medians, 5th, 25th and 95th percentiles are reported. These results are shown for the CMP 2 (α=3000) and CMP 2(α=3000) but for “current” sector split.

Figure 1a and 2a show the Total Global TAC and B75m(y/2006) trajectories for CMP 2 α=3000 (“alternative” sector split), and CMP 5 α=3000 (“current” sector split). Median, 5th, 25th and 95th percentiles are shown. Global recreational allocations are also reported. Figures 1b and 2b show the offshore, nearshore and subsistence allocations for each for the two models respectively.

Discussion

There is very little difference in terms of resource performance for the current and alternative sector splits (see Tables 2 and 4, Figures 1 and 2). Hence the choice by decision makers of either or something intermediate would be biologically acceptable.

Though median resource recovery is better under CMP 2 (1.30 tuning) for the alternative poaching scenario, risk levels deteriorate – note lower percentiles for B75m for A8+ and especially A7 and A3+4 (see Table 2).

As expected, higher tuning levels result in less catch, but more recovery in median terms and importantly also in the lower percentile for B75m for the various super-areas.

Table 2: B75m(2021/2006) median values (with 5th and 25th percentiles in parentheses). The final row shows the global TAC (in MT).

	CMP 1	CMP 2	CMP 3	CMP 2 “current” sector split method	CMP 2 but “alternate poaching scenario”
# simulations	1000	1000	1000	1000	1000
α	2400 “1.40 tuning”	3000 “1.30 tuning”	3500 “1.21 tuning”	3000 “1.30 tuning”	3000 “1.30 tuning”
A1+2	1.36 (0.68; 0.98)	1.31 (0.65; 0.95)	1.26 (0.62; 0.90)	1.36 (0.67; 0.99)	1.46 (0.37; 1.04)
A3+4	1.30 (0.48; 0.85)	1.18 (0.34; 0.75)	1.06 (0.25; 0.66)	1.15 (0.33; 0.73)	1.01 (0.003; 0.50)
A5+6	1.74 (1.24; 1.46)	1.71 (1.22; 1.45)	1.69 (1.20; 1.43)	1.77 (1.27; 1.50)	1.89 (1.15; 1.55)
A7	2.00 (0.37; 1.00)	1.81 (0.32; 0.89)	1.66 (0.23; 0.75)	1.71 (0.26; 0.81)	1.79 (0.06; 0.67)
A8+	1.04 (0.41; 0.75)	0.95 (0.38; 0.67)	0.88 (0.35; 0.61)	0.99 (0.41; 0.70)	0.95 (0.22; 0.64)
T	1.40 (0.76; 1.08)	1.30 (0.71; 1.00)	1.21 (0.65; 0.93)	1.31 (0.72; 1.00)	1.43 (0.57; 1.05)
Global TAC	2005 (1346; 1701)	2237 (1466; 1979)	2430 (1542; 2028)	2218 (1422; 1833)	2347 (1365; 1832)

Table 3a: # times out of 10000 (1000 simulations and 10 years) that the EC rule is invoked in any one super-area for the different CMP 3 tunings. The % chance of the EC occurring is given in parentheses.

	CMP 1	CMP 2	CMP 3	CMP 2 "current" sector split method
α	**2400**	**3000**	**3500**	**3000**
A1+2	108 (1.08%)	129 (1.29%)	154 (1.54%)	95 (0.95%)
A3+4	135 (1.35%)	149 (1.49 %)	170 (1.70%)	149 (1.49%)
A5+6	38 (0.38%)	40 (0.4%)	41 (0.41%)	35 (0.35%)
A7	379 (3.79%)	419 (4.19%)	453 (4.53%)	439 (4.39%)
A8+	333 (3.33%)	417 (4.17%)	474 (4.74%)	381 (3.81%)
T	933 (9.33%)	1154 (11.54%)	1292 (12.92%)	1099 (10.99%)

Table 3b: # times out of 4000 (1000 simulations and 4 years) that the EC rule is invoked in any one super-area **during the first four years** for the different CMP 3 tunings.

	CMP 1	CMP 2	CMP 3	CMP 2 "current" sector split method
α	**2400**	**3000**	**3500**	**3000**
A1+2	0 (0%)	0 (0%)	0 (0%)	0 (0%)
A3+4	10 (0.25%)	10 (0.25%)	10 (0.25%)	10 (0.25%)
A5+6	7 (0.175%)	7 (0.18%)	7 (0.175%)	6 (0.15%)
A7	209 (5.23%)	211 (5.28%)	212 (5.3%)	211 (5.28%)
A8+	1 (0.03%)	1 (0.03%)	1 (0.03%)	1 (0.03%)
T	227 (5.68%)	229 (5.73%)	230 (5.75%)	228 (5.7%)

Table 4: Comparison between CMP 2 for the "alternative" and "current" sector splits. Medians with 5th, 25th and 95th percentile values shown in parentheses. [Results for 1000 simulations.]

Sector split method		**Alternative sector split**	**Current sector split**
		CMP 2	**CMP 2**
	α	**3000**	**3000**
	J_{min}	**0.2**	**0.2**
10-yr (2011-2020) Ave Global TAC	A1-2	35 [21; 29; 45]	32 [19; 27; 41]
	A3-4	420 [225; 352; 630]	423 [226; 351; 638]
	A5-6	135 [96; 119; 167]	112 [82; 99; 139]
	A7	446 [0; 218; 1013]	577 [0; 207; 1065]
	A8	1150 [885; 1033; 1478]	1104 [842; 898; 1434]
	T	2236 [1466; 1880; 3142]	2218 [1422; 1833; 3094]
10-yr (2011-2020) Ave offshore TAC	A1-2	0 [0; 0; 0; 0]	0 [0; 0; 0]
	A3-4	277 [132; 217; 471]	299 [146; 236; 504]
	A5-6	20 [20; 20; 20]	20 [20; 20; 20]
	A7	539 [0; 215; 1004]	573 [0; 205; 1060]
	A8	582 [441; 513; 800]	622 [470; 548; 854]
	T	1382 [865; 1128; 2018]	1497 [914; 1213; 2144]
10-yr (2011-2020) Ave near shore TAC	A1-2	24 [15; 20; 31]	24 [15; 20; 31]
	A3-4	72 [42; 60; 92]	71 [42; 59; 92]
	A5-6	32 [21; 27; 41]	32 [21; 27; 41]
	A7	0 [0; 0; 0]	0 [0; 0; 0]
	A8	322 [215; 274; 411]	317 [213; 268; 410]
	T	451 [300; 379; 575]	442 [296; 374; 574]
10-yr (2011-2020) Ave subsistence TAC	A1-2	8 [5; 7; 10]	7 [4; 5; 8]
	A3-4	52 [31; 43; 66]	41 [24; 34; 52]
	A5-6	62 [40; 53; 79]	49 [32; 41; 62]
	A7	0 [0; 0; 0]	0 [0; 0; 0]
	A8	128 [87; 110; 164]	102 [68; 86; 130]
	T	250 [164; 211; 320]	199 [131; 166; 253]
10 yr (2011-2020) Ave Total Recreational Take	T	175 [107; 150; 235]	102 [63; 86; 123]
***B75*$_m$(21/06)**	A1-2	1.31 (0.65; 0.95; 3.29)	1.36 (0.67; 0.99; 3.32)
	A3-4	1.18 (0.34; 0.75; 3.42)	1.15 (0.33; 0.73; 3.42)
	A5-6	1.71 (1.22; 1.45; 3.44)	1.77 (1.27; 1.50; 3.51)
	A7	1.81 (0.32; 0.89; 8.38)	1.71 (0.26; 0.81; 8.22)
	A8	0.95 (0.38; 0.67; 2.24)	0.99 (0.41; 0.70; 2.31)
	T	1.30 (0.71; 1.00; 3.03)	1.31 (0.72; 1.00; 3.04)

Figure 1a: Total Global TAC and B75m(y/2006) trajectories for CMP 2 α=3000 (“alternative” sector split). Median, 5th, 25th and 95th percentiles shown. Global recreational allocations are also reported.

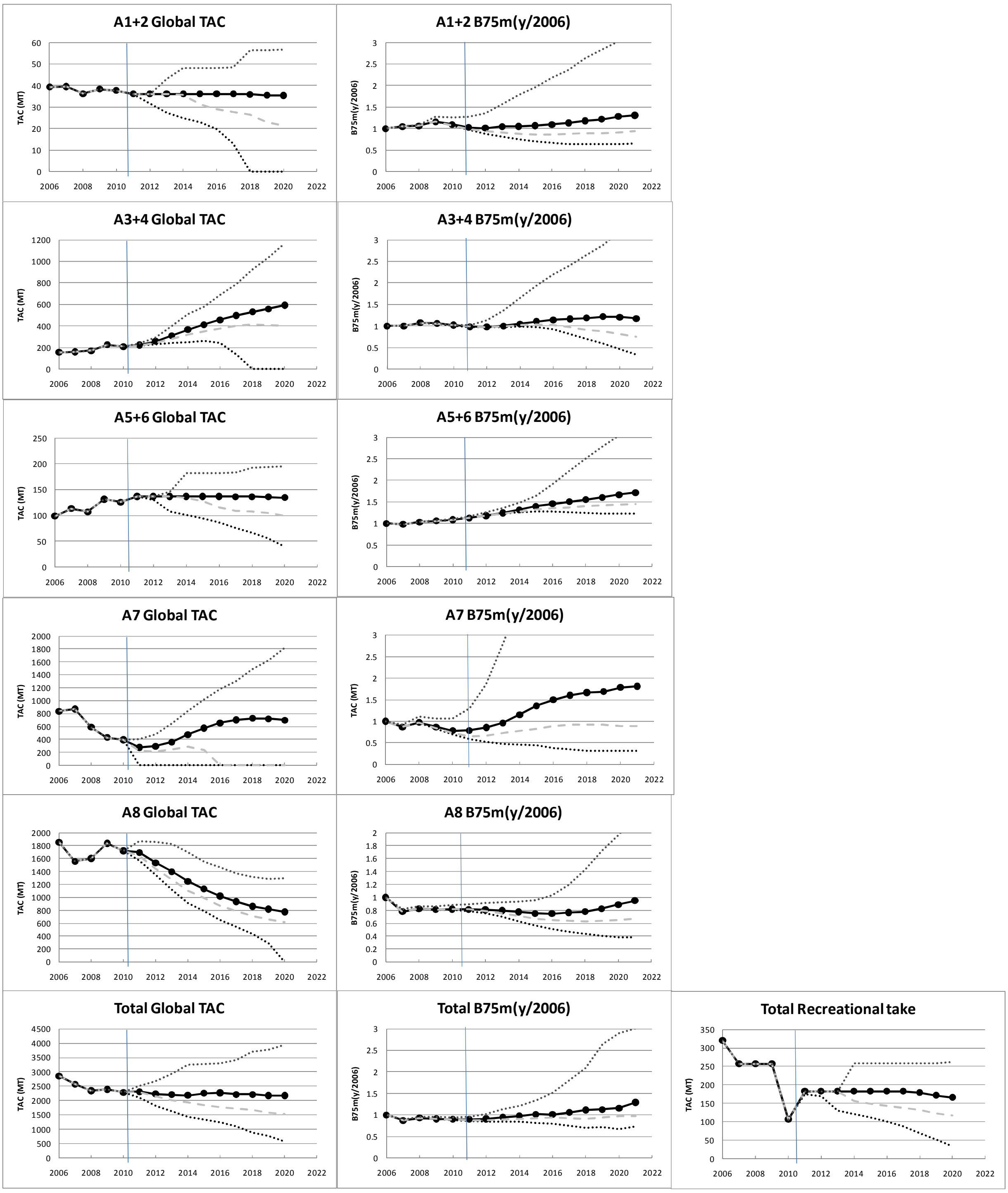


Figure 1b: Offshore, nearshore and subsistence allocation trajectories for CMP 2 α=3000 (“alternative” sector split). Median, 5th, 25th and 95th percentiles shown.

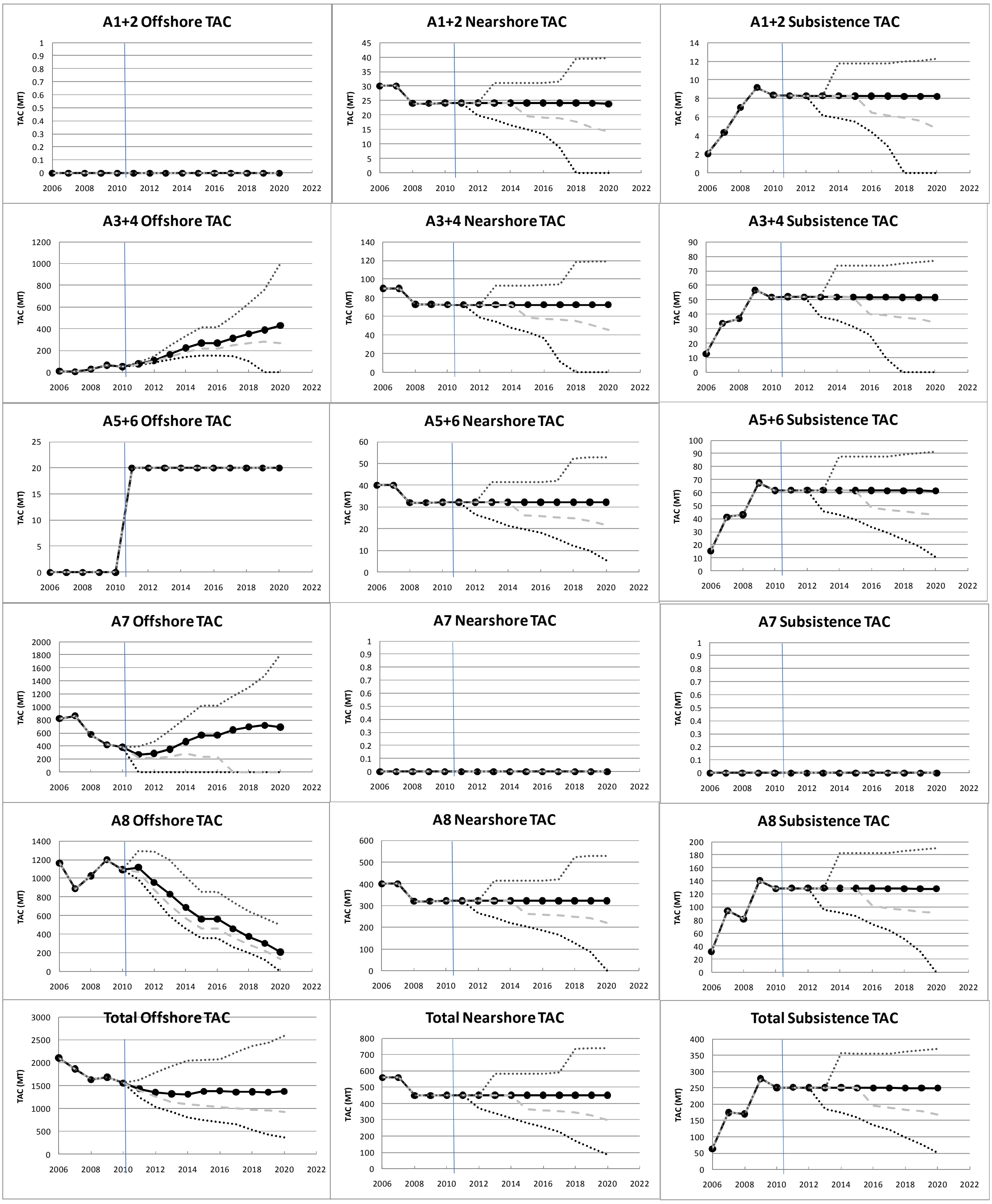


Figure 2a: Total Global TAC and B75m(y/2006) trajectories for CMP 2 α=3000 ("current" sector split). Median, 5th, 25th and 95th percentiles shown. Global recreational allocations are also reported.

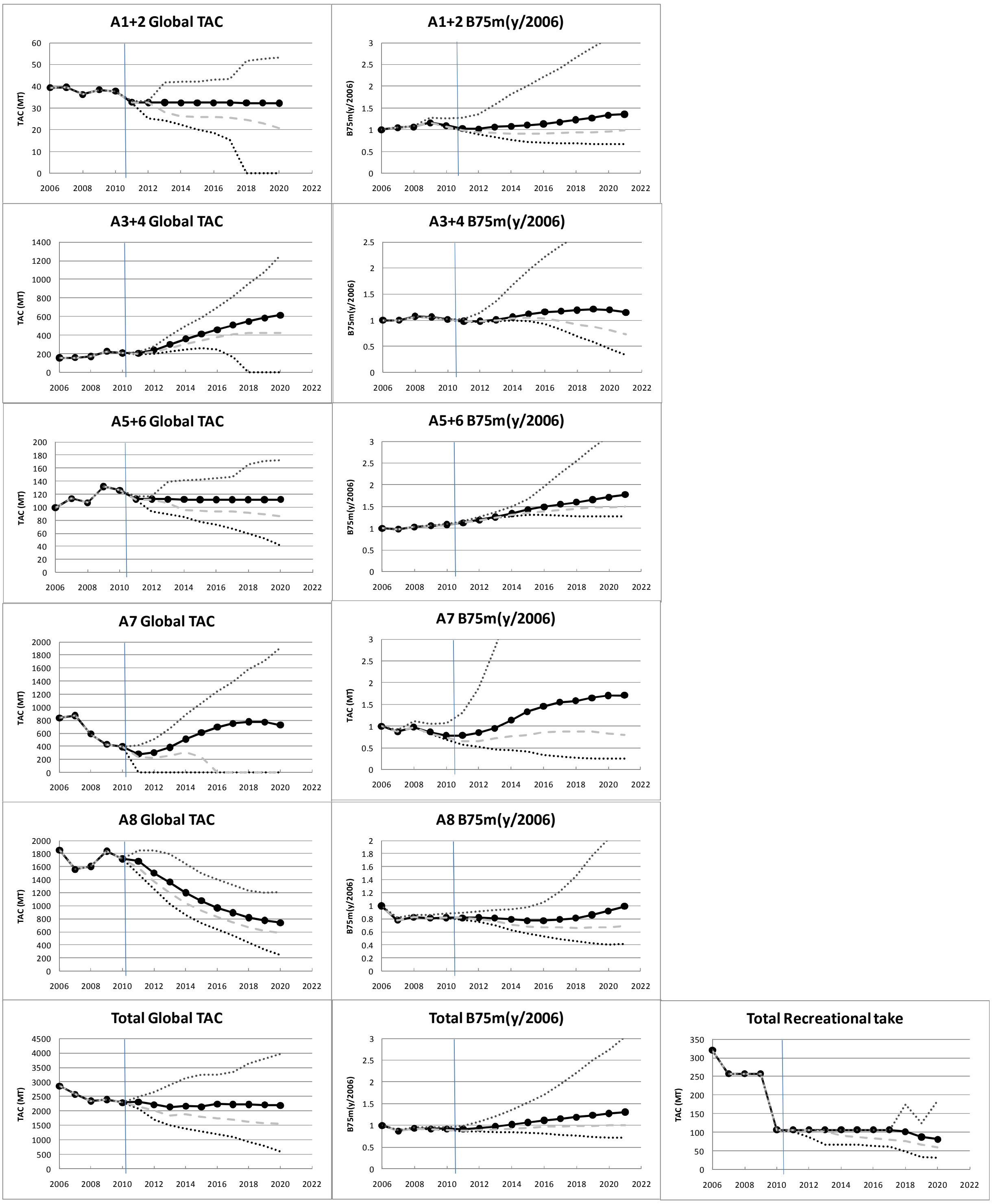
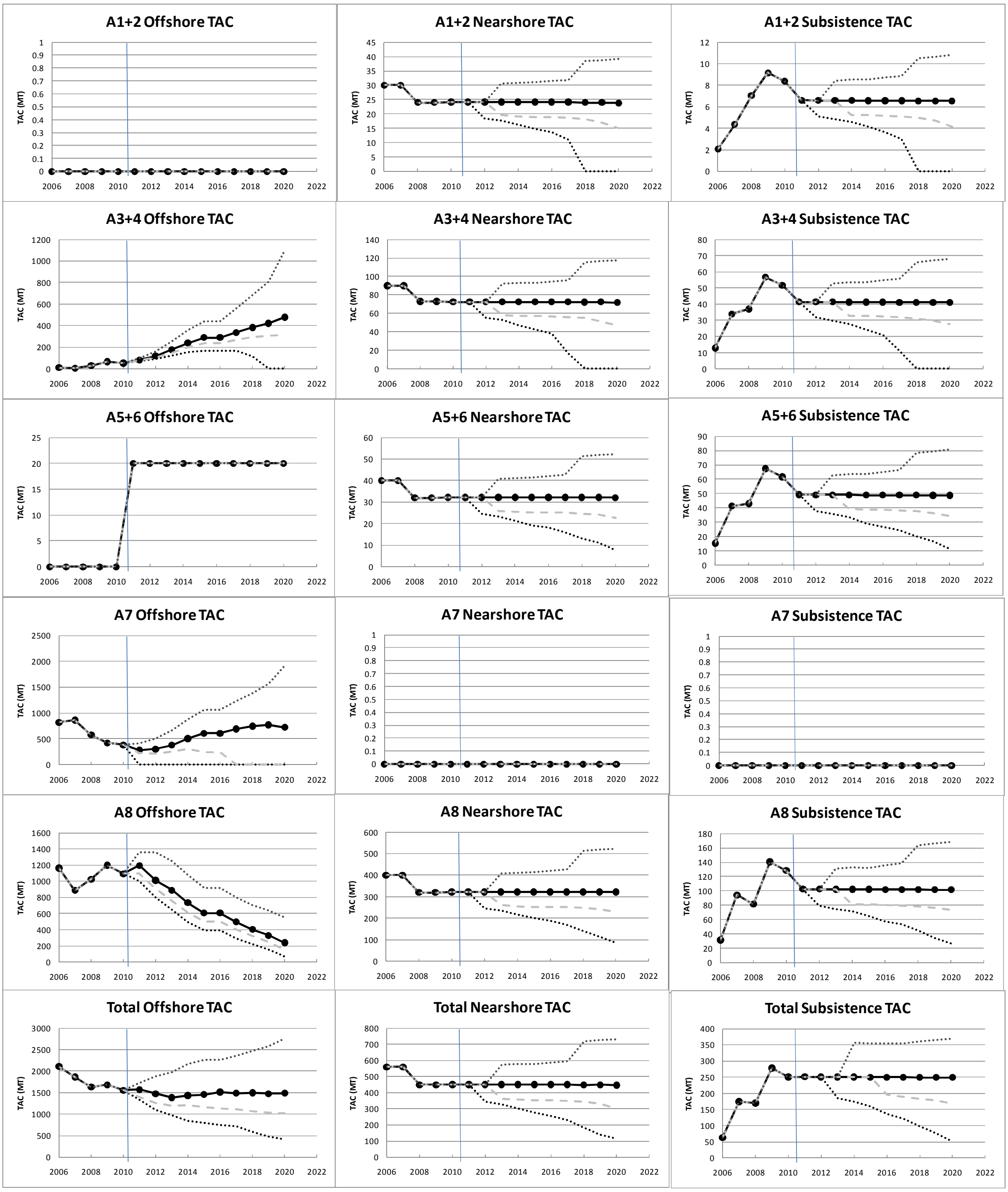


Figure 2b: Offshore, nearshore and subsistence allocation trajectories for CMP 2 α=3000 ("current" sector split). Median, 5th, 25th and 95th percentiles shown.



Appendix: Method used for calculating $J_{area,y}$ values for use in the EC rule.

The EC rule requires a single index for each area using the available trap CPUE, hoop CPUE and FIMS for each season in the future.

STEP 1: For each super-area for which data are assumed to be available in the future, there will be for each season *Y* (here trap CPUE is used as an example):

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

STEP 2: Evaluate the geometric means of the CPUEs (and FIMS) for the super-area concerned (here we use A1-2 as an example) over the year period 2005…2009.

STEP 3: Re-normalise the CPUEs series as follows (e.g. for traps in Area A1-2):

$$CPUE_Y^{trap,A1-2} \Rightarrow X_Y^{trap,A1-2} = \frac{CPUE_Y^{trap,A1-2}}{Geometric\,mean\,(CPUE_y^{trap,A1-2}: y = 2005...2009)} \qquad (A.1)$$

STEP 5: Calculate a combined index for each area as follows:

$$J^*_{area,Y} = (w_{area}^{trap} X_Y^{trap,area} + w_{area}^{hoop} X_Y^{hoop,area} + w_{area}^{FIMS} X_Y^{FIMS,area}) / (w_{area}^{trap} + w_{area}^{hoop} + w_{area}^{FIMS}) \qquad (A.3)$$

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

The weights have been calculated in the following manner. For example, for trap and hoop CPUE, obtain $\overline{B}^{75}$, the average (male plus female) selectivity-weighted biomass above 75mm carapace length over the 2000-2009 period for each super-area:

$$\overline{B}_{A1-2}^{75}, \overline{B}_{A3-4}^{75}, \overline{B}_{A5-6}^{75}, \overline{B}_{A7}^{75}, \overline{B}_{A8}^{75};$$

then:

$$\overline{B}_{TOTAL}^{75} = \sum_{A=1..8} \overline{B}_A^{75} \text{ and} \qquad (A.4)$$

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

For FIMS, as above, but $\overline{B}^{60}$ is used instead of $\overline{B}^{75}$.

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.

The table below lists the weighting *w* values. [Note that '-' 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.]

	w_A^{trap}	w_A^{hoop}	w_A^{FIMS}
A1-2	-	0.034	-
A3-4	-	0.231	0.214
A5-6	-	0.187	0.173
A7	0.174	-	0.107
A8	0.826	0.548	0.507

Finally, $J_{area,Y}$ is calculated as the geometric mean of the three most recent years,

$$J_{area,Y} = e^{[\sum_{T=Y-1}^{T=Y-3} \ln(J^*_{area,T})]/3}$$