A species splitting mechanism for application to the commercial hake catch data 1978 to 2003.

by
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Abstract

The purpose of this document is to present working models which can be used to split commercial hake trawl catch and CPUE data into the component species *M.capensis* and *M.paradoxus*, for use in the hake resource assessment. The appropriate models are Model 5 from Gaylard & Bergh (2004) for the West Coast and Model 2.5 from Gaylard & Bergh (2003) for the South Coast. For each of these models we present 4 sets of parameter values corresponding to 4 different size classifications. These are:

(a) with size classes as defined by I&J

(b) with size classes as defined by Sea Harvest

(c) with size classes which are a median of (a) and (b)

(d) with only 1 size class containing all hake of commercially catchable size.

The size classifications are:

	(a)	**(b)**	**(c)**	**(d)**
Large:	65 cm +	52 cm +	58 cm +	
Medium:	45 cm to 64 cm	41 cm to 51 cm	43 cm to 57 cm	
Small:	21 cm to 44 cm	21 cm to 40 cm	21 cm to 42 cm	
General:				21 cm +

The model equations and sets of appropriate parameter values for each of the above classifications follow below. We have thus 4 options for implementation of the species split to the commercial data:

Option 1. If size information is available in all years and if companies may be identified we can use the parameter values for (a), (b) and (c) above.

Option 2. If size information is available in all years and if companies may not be identified we can use (c) alone.

Option 3. If size information is not available, use (d).

Option 4. If size information is available in some years and not in others, then:

(i) use Option 3 for all years

(ii) use Option 1 or 2 in the years where size is known

(iii) invoke some mechanism for calibrating the 2 sets of results and making corresponding adjustments in the years for which size is unknown. A calibration is discussed in Appendix A.

Procedure for splitting the catch for each commercial trawl.

The proportion of *M.capensis* in each trawl is calculated by:

$$\overline{p} = \frac{1}{1+e^{B}} \qquad \textbf{(1)}$$

where the formulation of B depends on coast and whether size classification is available in the data.

West Coast catches with catches sub-categorised into "large" , "medium" , "small" and "fillets".

Treat the fillets category as comprising 23% large, 62% medium and 15% small fish and adjust the large, medium and small catch totals appropriately.

Apply equation (1) to each size category for each trawl, with:

$$B = \kappa_{sc}\left[d - \left(d^{*}_{SC} + \alpha_{y} + \beta_{L} + \tfrac{1}{2}\gamma_{summer}\right)\right] \qquad \textbf{(2)}$$

where:

d	is the trawl depth in metres;
κ_{sc}	is the slope parameter for size category *SC*;
d^{*}_{SC}	is the shift parameter for size category *SC;*
α_{y}	is the year parameter for year *y;*
β_{L}	is the longshore parameter for longshore category *L;*
$\tfrac{1}{2}\gamma_{summer}$	is the average of the summer and winter season factors.

The category definitions and appropriate parameter values can be found in Table 1.

If the company is I&J use parameter set 2(a). If the company is Sea Harvest use parameter set 2(b). For other companies or if the company is unknown, use parameter set 2(c).

West Coast catches without size specification.

Apply equation (1) to each trawl, with:

$$B = \kappa\left[d - \left(d^{*} + \alpha_{y} + \beta_{L} + \tfrac{1}{2}\gamma_{summer}\right)\right] \qquad \textbf{(3)}$$

where:

d	is the trawl depth in metres;
κ	is the size-independent slope parameter ;
d^{*}	is the size-independent shift parameter;
α_{y}	is the year parameter for year *y;*
β_{L}	is the longshore parameter for longshore category *L;*
$\tfrac{1}{2}\gamma_{summer}$	is the average of the summer and winter season factors.

The category definitions and appropriate parameter values (parameter set 3) can be found in Table 1.

South Coast catches with catches sub-categorised into "large" , "medium" , "small" and "fillets".

Treat the fillets category as comprising 23% large, 62% medium and 15% small fish and adjust the large, medium and small catch totals appropriately.

Apply equation (1) to each size category for each trawl, with:

$$B = \kappa_{sc}\left[d - \left(d^{*}_{SC} + \beta_{L}\right)\right] \quad \textbf{(4)}$$

where: d is the trawl depth in metres;

κ_{sc} is the slope parameter for size category *SC*;

d^{*}_{SC} is the shift parameter for size category *SC;*

β_{L} is the longshore parameter for longshore category *L.*

The category definitions and appropriate parameter values can be found in Table 2.

If the company is I&J use parameter set 4(a). If the company is Sea Harvest use parameter set 4(b). For other companies or if the company is unknown, use parameter set 4(c).

South Coast catches without size specification.

Apply equation (1) to each trawl, with:

$$B = \kappa\left[d - \left(d^{*} + \beta_{L}\right)\right] \quad \textbf{(5)}$$

where: d is the trawl depth in metres;

κ is the size-independent slope parameter;

d^{*} is the size-independent shift parameter;

β_{L} is the longshore parameter for longshore category *L.*

The category definitions and appropriate parameter values (parameter set 5) can be found in Table 2.

References

Gaylard J.D. and M.O. Bergh 2003. An investigation into the procedure used to split commercial catches of hake on the South African South Coast into *Merluccius paradoxus* and *Merluccius capensis*. BEN/JAN04/SAH2b

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Tables

Table 1. Parameter values for substitution into equations (2) and (3). West Coast.

	Equation 2 with size classification Parameter set 2(a) Co. = I&J	Equation 2 with size classification Parameter set 2(b) Co. = Sea Harvest	Equation 2 with size classification Parameter set 2(c) Co. = other or unknown	Equation 3 without size classification Parameter set 3 All companies
κ				0.02317
κ_{small}	0.0436	0.0499	0.04722	
κ_{medium}	0.0301	0.0353	0.03325	
κ_{large}	0.0275	0.0280	0.02784	
d^*				203.57
d^*_{small}	181.13	174.34	177.46	
d^*_{medium}	297.49	265.45	282.76	
d^*_{large}	334.14	314.85	325.60	
year parameters α_y				
before 1985	**13.76**	**16.86**	**14.04**	**16.85**
1985	20.57	23.65	21.95	27.45
1986	11.45	14.84	13.52	8.89
1987	6.00	9.19	8.02	6.53
1988	-2.59	2.00	0.50	-7.52
1989	9.94	12.00	11.34	16.02
1990	31.88	34.26	32.73	38.08
1991	10.12	13.25	11.45	14.51
1992	19.35	23.41	21.14	23.46
1993	13.46	18.66	16.31	19.38
1994	4.65	7.17	4.84	5.22
1995	26.55	27.09	26.70	33.38
1996	-7.25	-5.14	-6.6	-7.08
1997	5.59	8.33	7.22	6.98
1998	**4.47**	**5.74**	**5.25**	**5.79**
1999	3.32	3.68	4.07	3.99
2000	**4.47**	**5.74**	**5.25**	**5.79**
2001	**4.47**	**5.74**	**5.25**	**5.79**
2002	20.68	21.83	21.51	25.06
2003	0.00	0.00	0.00	0.00
after 2003	**4.47**	**5.74**	**5.25**	**5.79**
longshore (latitude) factors				
North of 29°S	0.00	0.00	0.00	0.00
29°to 30°S	-4.51	-4.04	-4.02	-5.49
30°to 31°S	5.17	4.86	4.81	-2.96
31°to 32°S	1.89	2.39	1.99	-3.85
32°to 33°S	4.86	5.73	5.75	0.05
33°to 34°S	15.23	13.39	14.93	18.33
34° to 35°S	34.83	34.40	34.81	40.39
South of 35°S	37.77	34.41	36.27	45.12
γ_{summer}	-16.38	-17.02	-17.02	-11.16

Table 2. Parameter values for substitution into equations (4) and (5). South Coast.

	Equation 4 with size classification Parameter set 4(a) Co. = I&J	Equation 4 with size classification Parameter set 4(b) Co. = Sea Harvest	Equation 4 with size classification Parameter set 4(c) Co. = other or unknown	Equation 5 without size classification Parameter set 5 All companies
κ				0.03282
κ_{small}	0.08610	0.09872	0.09074	
κ_{medium}	0.02819	0.05397	0.03786	
κ_{large}	0.02133	0.02123	0.02085	
d^*				250.99
d^*_{small}	184.41	178.983	181.62	
d^*_{medium}	296.08	227.914	257.29	
d^*_{large}	403.39	369.817	386.85	
longshore (longitude) factors β_L				
West of 21°E	0.00	0.00	0.00	0.00
21°to 22°E	20.33	14.25	18.92	15.98
22°to 23°E	-19.73	-21.94	-20.74	-17.94
23°to 24°E	-30.98	-33.93	-33.63	-31.73
24°to 25°E	-32.62	-33.28	-34.00	-16.69
25°to 26°E	-12.05	-20.17	-11.64	-2.94
East of 26°E	37.97	49.71	44.51	23.68

Appendix A: Calibration of un-sized species splits

Size information is available in the commercial data for the years 1978 to 1999, allowing the use of size classification (c), referred to in the main document, to split the species. At present, size information is not available for years 2000 to 2003, thus necessitating the use of classification (d).

As a temporary measure, until size information is available for all years, the proposal is that Option 4 be adopted, i.e. that classification (c) be used up to 1999 and (d) be used from 2000 onwards, but that the (d) mechanism be calibrated to remove any relative bias between the two methods.

The bias is illustrated in Fig. A1, which shows the split in the annual catches as predicted by the two methods from 1978 to 1999.

Calibration mechanism

The mechanism adopted is to introduce an additional year-dependent calibration factor into the equations used for classification (d). These calibration factors are fitted to the commercial data 1978-1999 so that the predicted annual catch totals by species agree with those predicted by classification (c).

The un-calibrated equations for (d), as presented in the main document, are.

West Coast: $$B = \kappa \left[d - \left(d^* + \alpha_y + \beta_L + \tfrac{1}{2}\gamma_{summer} \right) \right] \quad \textbf{(3)}$$

South Coast: $$B = \kappa \left[d - \left(d^* + \beta_L \right) \right] \quad \textbf{(5)}$$

The calibrated equivalent equations are:

West Coast: $$B = \kappa \left[d - \left(d^* + \alpha_y + \beta_L + \tfrac{1}{2}\gamma_{summer} + \theta_y \right) \right] \quad \textbf{(3*)}$$

South Coast: $$B = \kappa \left[d - \left(d^* + \beta_L + \theta_y \right) \right] \quad \textbf{(5*)}$$

Where θ_y is the calibration adjustment factor for year y.

The fitted values for θ_y appear in Table A1 and are illustrated in Fig. A2. The calibration factors for years 2000 to 2003 are obtained by averaging the values for 1995 to 1999.

Figure A1: Annual catches in kilotons by coast and species as predicted using sized data (classification (c)), and un-sized data (classification (d)) before calibration.

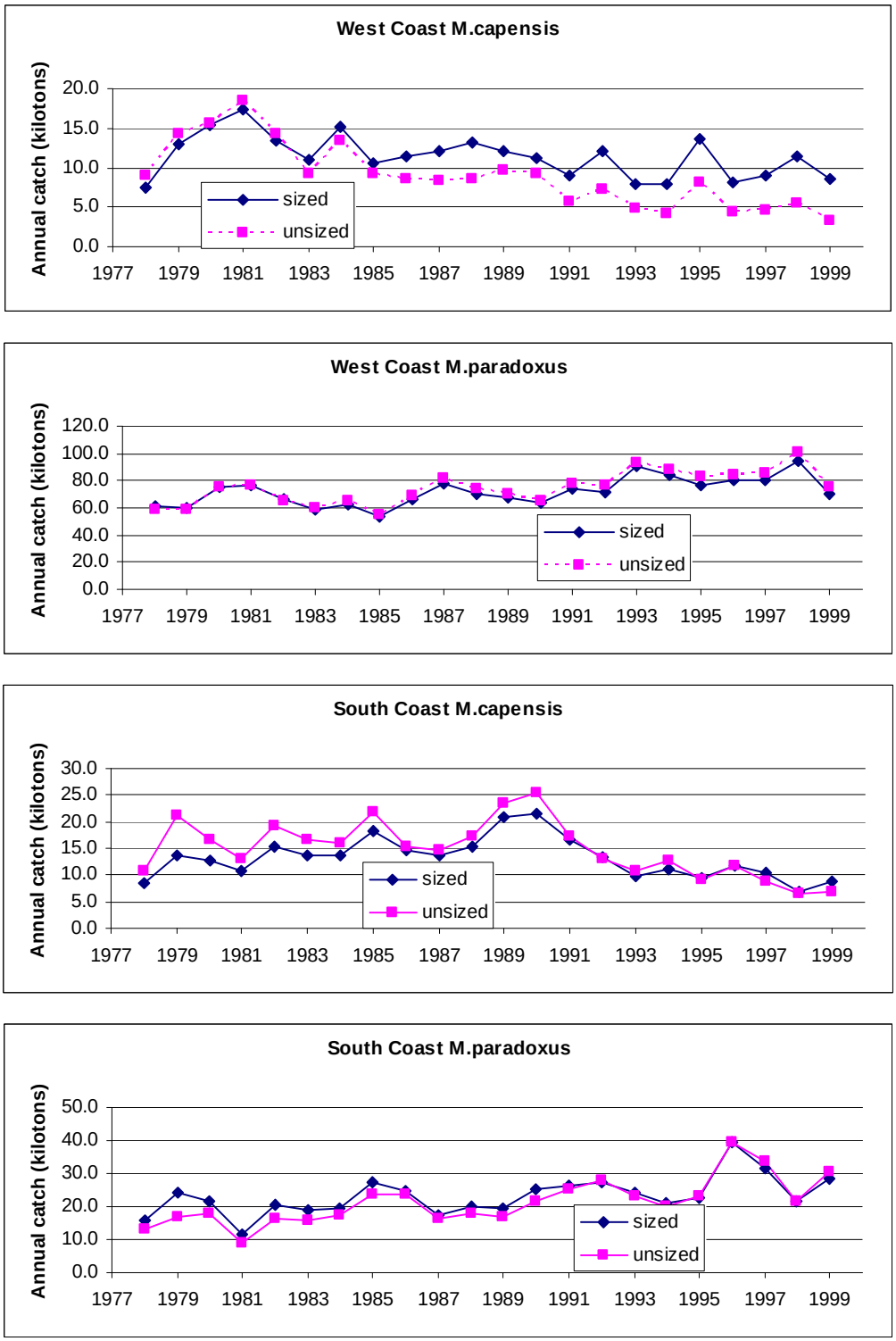

Table A1. Calibration factors θ_y for substitution into equations (3*) and (5*). The factors from 2000 to 2003 are extrapolated by averaging the factors from 1995 to 1999.

	West Coast Equation 3*	South Coast Equation 5*
1978	-8.509	-13.428
1979	2.170	-24.219
1980	8.101	-11.096
1981	3.88	-8.737
1982	3.769	-14.991
1983	22.671	-7.809
1984	19.643	-5.393
1985	16.802	-9.798
1986	27.477	6.643
1987	35.635	1.621
1988	35.368	-1.475
1989	24.901	-3.266
1990	26.825	-5.948

	West Coast Equation 3*	South Coast Equation 5*
1991	35.766	9.119
1992	43.287	12.003
1993	41.604	6.228
1994	42.546	-5.747
1995	37.586	7.066
1996	41.285	5.386
1997	43.591	16.628
1998	49.105	8.808
1999	56.377	24.908
2000	**45.589**	**12.559**
2001	**45.589**	**12.559**
2002	**45.589**	**12.559**
2003	**45.589**	**12.559**

Figure A2: Calibration factors θ_y for the West and South Coasts.