



2008 Routine Update of the South African Hake Baseline Assessment

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This paper presents a routine update of the South African hake assessment, including new commercial (catches and CPUE) and survey (abundance estimates) data. This update is for a “baseline” assessment, chosen to correspond to the scenario amongst the 2006 Reference Set which had the highest likelihood (M1-H1-C1-SR2).

METHODOLOGY and DATA

The methodology is as detailed in Rademeyer and Butterworth (2006). The data used are listed in Appendix A. Note that no further catch-at-age data have been used.

Two changes to the biological information have been recommended by the Demersal WG:

- 1) Changing the maturity-at-age has from being knife-edge at age 4 to knife-edge at age 3 (for both species),
- 2) Changes in the weight-at-length relationship (see Table App.A.13 and Fig. App.A.1).

These have been implemented here for the final 2008 baseline assessment.

RESULTS AND DISCUSSION

Four assessments are compared:

- (A) the 2006 baseline assessment;
- (B) the comparable 2007 assessment with the data updated;
- (C) the comparable 2008 assessment with the data updated;
- (D) the 2008 baseline assessment, with the data updated as in (C) and the two updates to biological parameters.

Table 1 compares estimates of management quantities for these four assessments, while Fig. 1 plots the spawning biomass trajectories. Care must be taken in comparing results for assessment D with those for other assessments, particular given the change made to the age-at-maturity.

Figs 2 and 3 show the fit of the 2008 baseline assessment to the CPUE and survey abundance indices, while ‘bubble’ plots of the survey and commercial catch-at-age residuals are given in Fig. 4 and 5. Fig. 6 compares the standardised stock-recruitment residuals for the 2007 and 2008 baseline assessment and plots the estimated stock-recruitment relationship.

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Table 1: Comparison of estimates of management quantities of the *M. paradoxus* and *M. capensis* coast-combined resources for the 2006, 2007 and 2008 assessments (with and without updated biological information). *MSY* and associated quantities are given for the offshore fleet. Biomass units are thousand tons. Where a biomass *B* for year *y* is indicated, this refers to the same year as the assessment, i.e. either 2006, 2007 or 2008. Note that the $-\ln L$ values are not comparable given that different data are used.

		A	B	C	D
		2006 baseline assessment	2007 baseline assessment	2008 assessment with new data only	2008 assessment with new data and updated biological information
-lnL total		-196.9	-193.6	-190.7	-192.1
<i>M. paradoxus</i>	K^{sp}	1271	1230	1241	1407
	<i>h</i>	0.95	0.95	0.95	0.95
	<i>MSY</i>	117	119	117	116
	B_y^{sp}	88	96	122	216
	B_y^{sp}/K^{sp}	0.07	0.08	0.10	0.15
	B_y^{sp}/MSY^{sp}	0.35	0.40	0.50	0.64
	MSY^{sp}	0.20	0.20	0.20	0.24
	<i>M</i>				
	0	0.53	0.47	0.52	0.52
	1	0.53	0.47	0.52	0.52
	2	0.53	0.47	0.52	0.52
3	0.45	0.43	0.44	0.44	
4	0.40	0.40	0.40	0.38	
5+	0.36	0.38	0.37	0.35	
<i>M. capensis</i>	K^{sp}	620	613	604	692
	<i>h</i>	0.95	0.95	0.95	0.95
	<i>MSY</i>	65	68	79	81
	B_y^{sp}	317	314	342	434
	B_y^{sp}/K^{sp}	0.51	0.51	0.57	0.63
	B_y^{sp}/MSY^{sp}	2.33	2.39	2.77	2.01
	MSY^{sp}	0.22	0.21	0.20	0.31
	<i>M</i>				
	0	1.00	1.00	1.00	1.00
	1	1.00	1.00	1.00	1.00
	2	1.00	1.00	1.00	1.00
	3	0.70	0.71	0.73	0.73
	4	0.52	0.53	0.57	0.57
5	0.40	0.41	0.46	0.46	
6	0.40	0.41	0.46	0.46	
7+	0.40	0.41	0.46	0.46	
SC survey <i>q</i>		0.78	0.72	0.60	0.59
species ratio	B_y^{sp}	3.60	3.27	2.80	2.00
(<i>capensis/paradoxus</i>)	B_y^{2+}	1.97	1.68	1.81	1.86

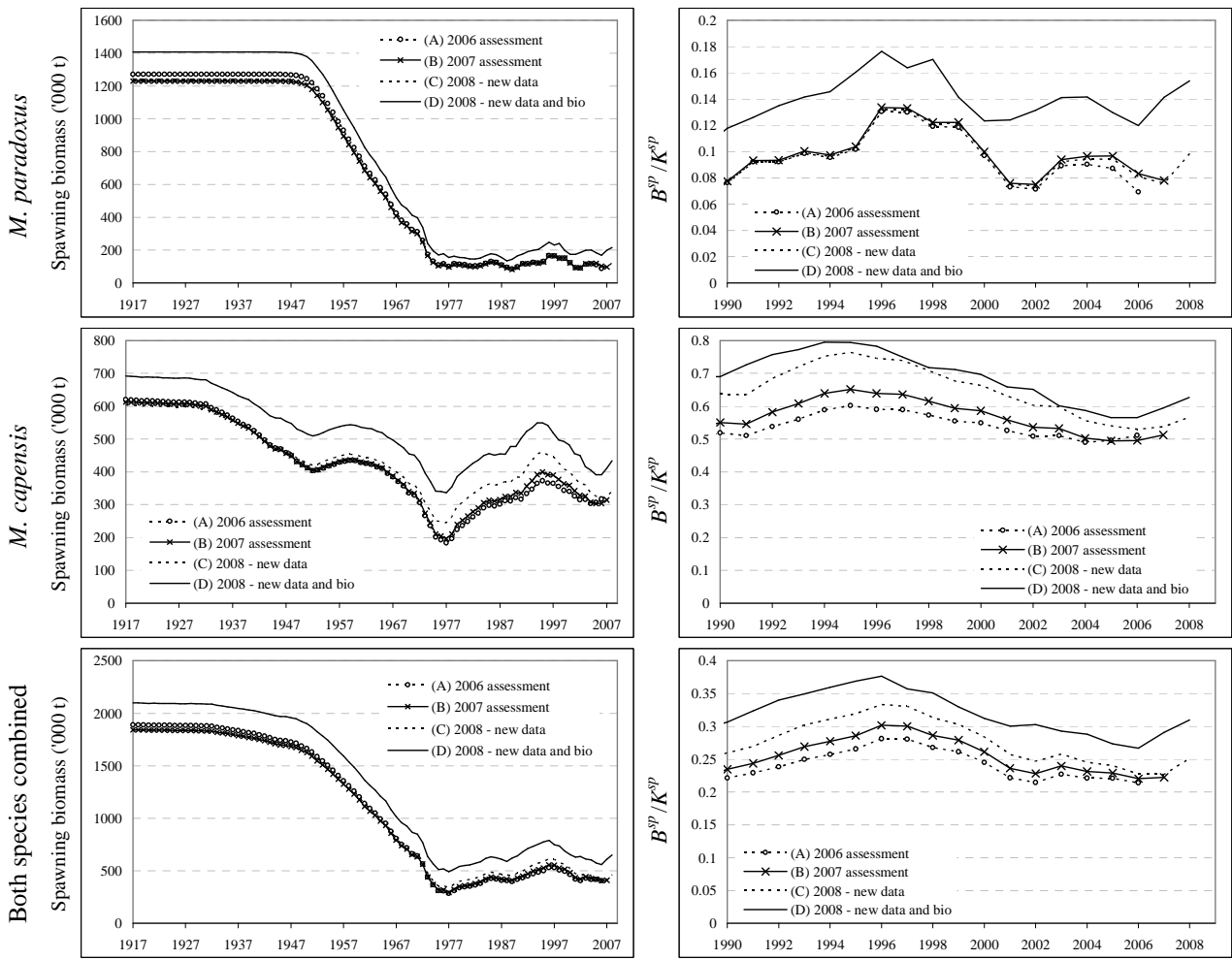


Fig. 1: Trajectories of spawning biomass (in absolute terms and as a proportion of the pre-exploitation level) for the 2006 (A), 2007 (B) and 2008 (C, with updated data only; D, with updated data and biological information) assessments. Note the different vertical scales.

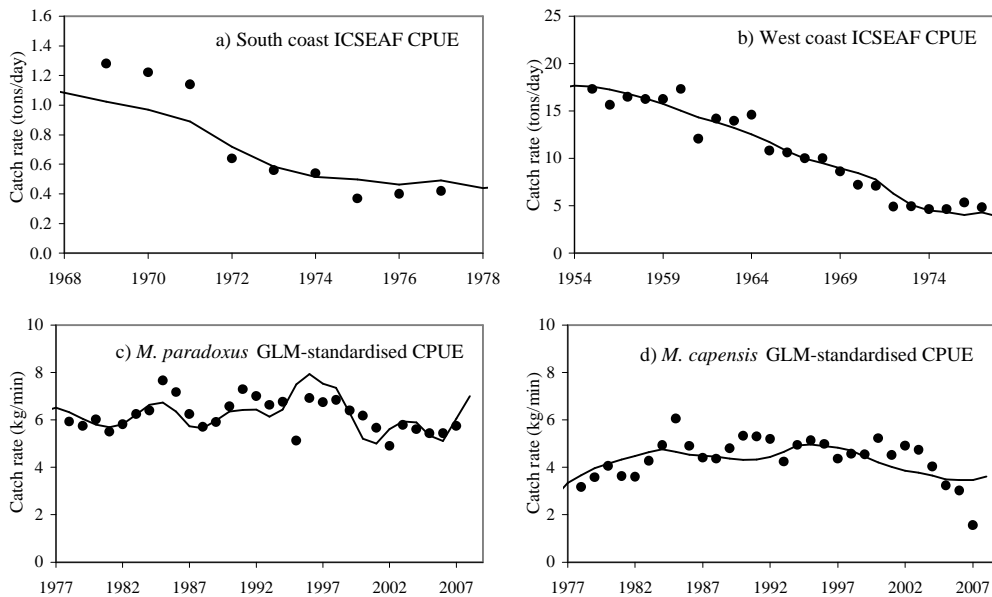


Fig. 2: Fits to the CPUE abundance indices for the 2008 baseline assessment (D). The historic (pre-1978) CPUE data are for both *M. capensis* and *M. paradoxus* combined.

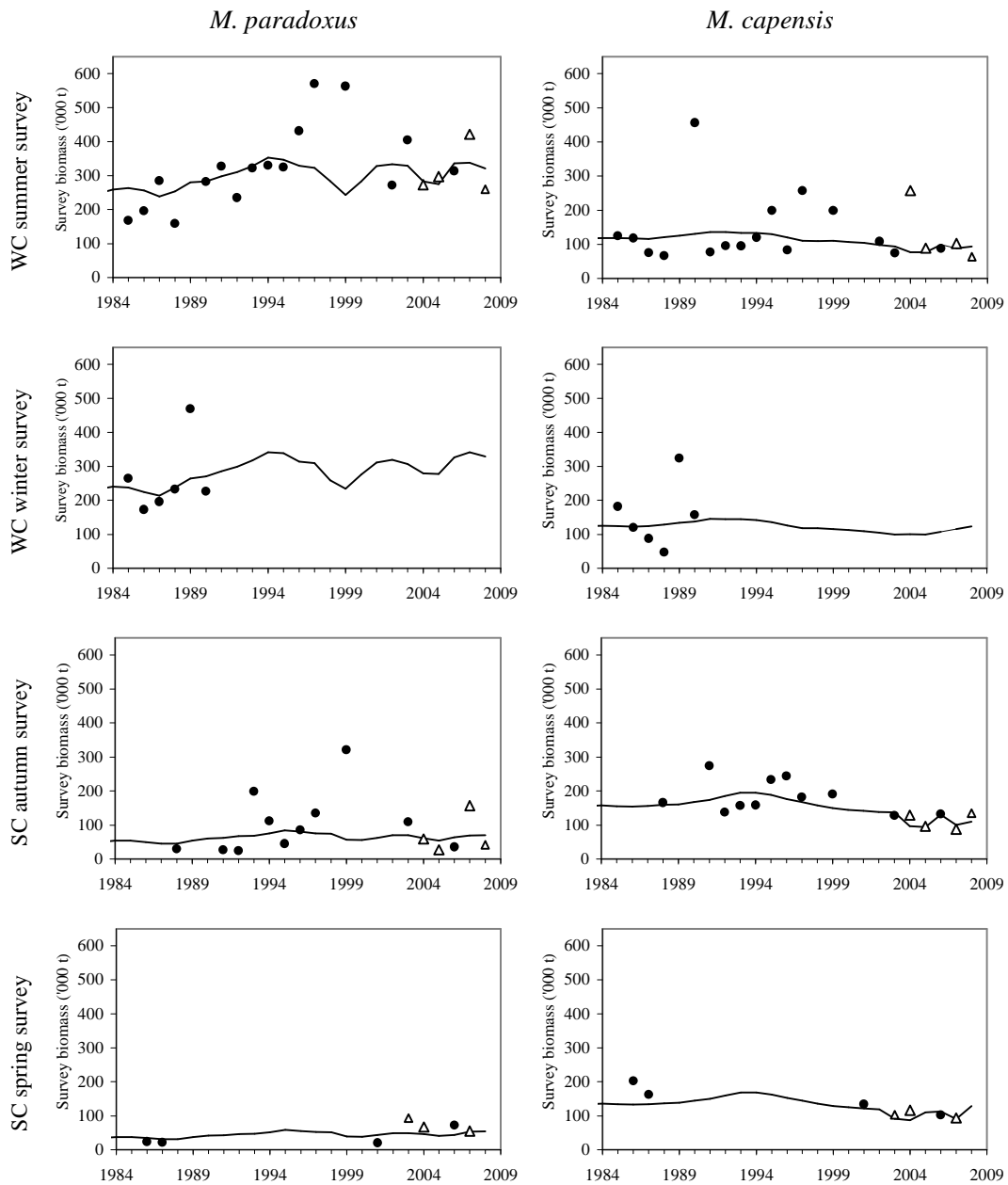


Fig. 3: Fits to the west coast summer and south coast autumn abundance series from surveys by *Africana* (the two longest series) for the 2008 baseline assessment (D). The observed values shown as Δ were conducted by the *Africana* with the new gear and have been rescaled by the agreed calibration factor for the species concerned.

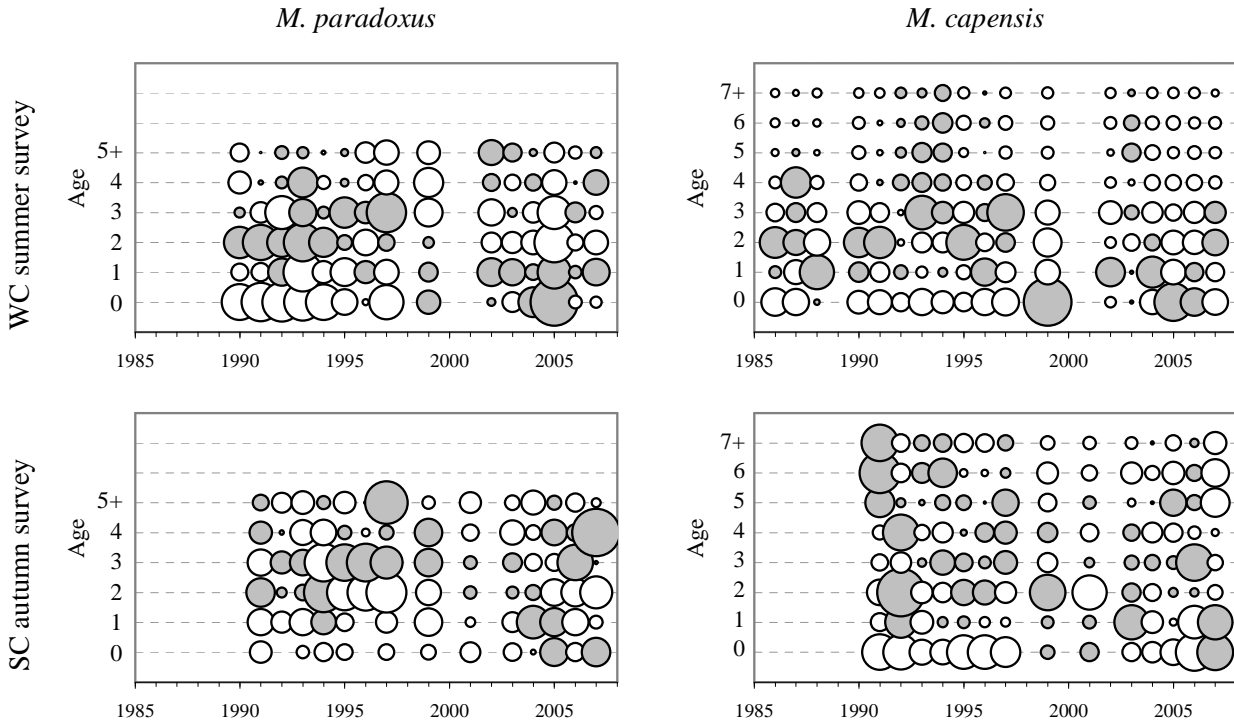


Fig. 4: ‘Bubble plots’ of the survey catches-at-age standardised residuals for the 2008 baseline assessment (D). The size (area) of the bubble is proportional to the magnitude of the corresponding standardised residuals. For positive residuals the bubbles are grey, whereas for negative residuals they are white.

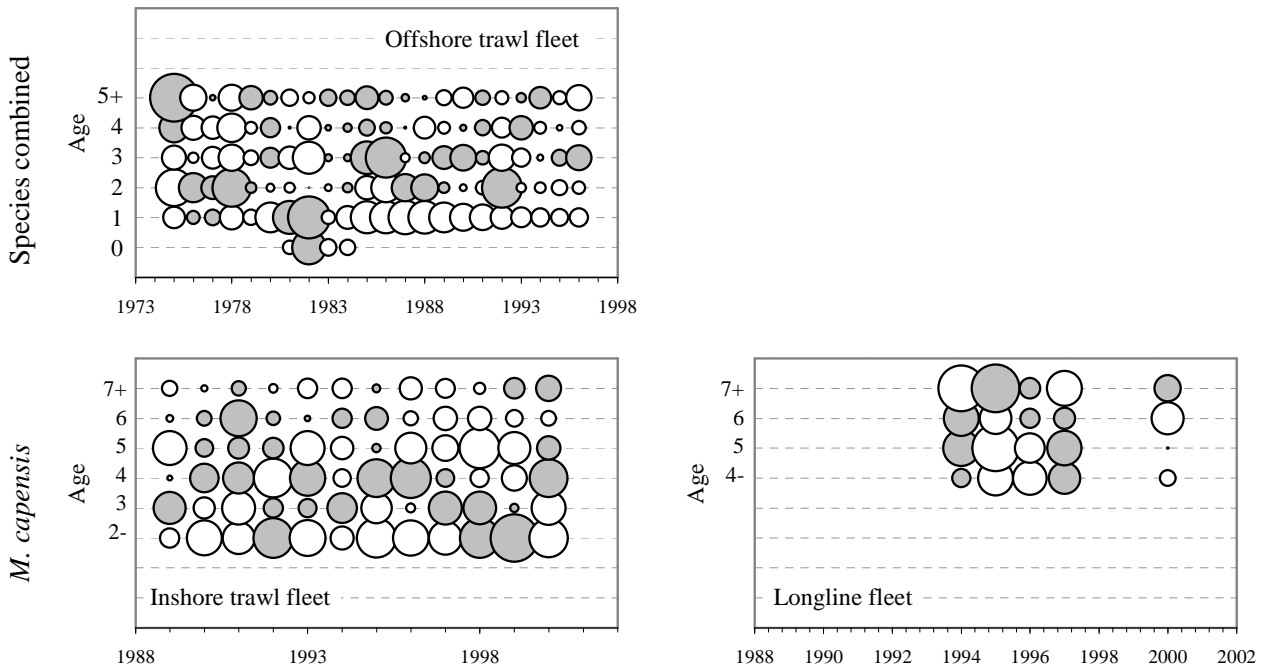


Fig. 5: ‘Bubble plots’ of the commercial catches-at-age standardised residuals for the 2008 baseline assessment (D). The size (area) of the bubble is proportional to the magnitude of the corresponding standardised residuals. For positive residuals the bubbles are grey, whereas for negative residuals the bubbles are white.

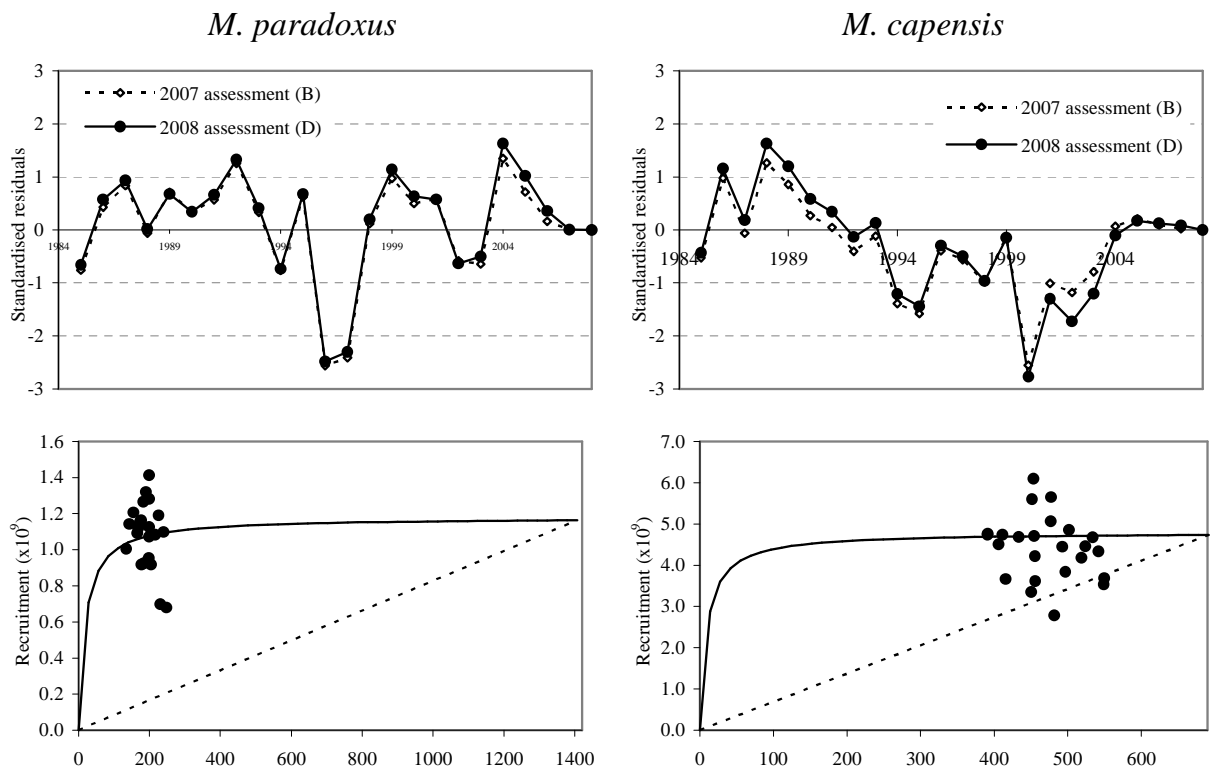


Fig. 6: Time series of standardised stock-recruitment residuals for the 2007 (B) and 2008 (D) baseline assessments and estimated stock-recruitment relationships for the 2008 baseline assessment. Note that the decrease in σ_R from 0.25 to 0.1 has been moved one year forward for the 2008 assessment.

Appendix A - Data Tables

Table App.A.1a: Species-disaggregated offshore trawl catches of South African hake from the south and west coasts combined. For 1917 to 1977, the split by species assumes that the proportion of *M. capensis* caught follows a logistic function over this period. From 1978 onwards, this split is obtained by applying the size-based species proportion-by-depth relationships for the west and south coasts developed by Gaylard and Bergh (2004) from research survey data. Here and in the rest of the document, data that are shaded represent new or updated information since the 2007 assessment. For 2008, the catches are taken as the 2008 TAC with the same proportion by species and fleet as in 2007.

Offshore trawl catches ('000t)								
Year	<i>M. paradoxus</i>	<i>M. capensis</i>	Year	<i>M. paradoxus</i>	<i>M. capensis</i>	Year	<i>M. paradoxus</i>	<i>M. capensis</i>
1917	-	1.000	1948	9.304	49.496	1978	108.110	26.988
1918	-	1.100	1949	14.770	42.630	1979	98.133	42.309
1919	-	1.900	1950	27.306	44.694	1980	103.714	36.274
1920	-	0.000	1951	44.856	44.644	1981	92.900	33.516
1921	-	1.300	1952	53.304	35.496	1982	89.230	35.477
1922	-	1.000	1953	62.466	31.034	1983	77.325	29.624
1923	-	2.500	1954	74.752	30.648	1984	86.647	35.543
1924	-	1.500	1955	84.517	30.883	1985	101.532	43.554
1925	-	1.900	1956	88.043	30.157	1986	113.619	36.151
1926	-	1.400	1957	94.982	31.418	1987	103.993	29.216
1927	-	0.800	1958	98.660	32.040	1988	90.389	30.709
1928	-	2.600	1959	110.468	35.532	1989	90.162	36.009
1929	-	3.800	1960	121.131	38.769	1990	88.679	37.749
1930	-	4.400	1961	112.716	35.984	1991	100.148	28.376
1931	-	2.800	1962	111.918	35.682	1992	101.802	27.947
1932	-	14.300	1963	128.545	40.955	1993	113.050	19.275
1933	-	11.100	1964	123.095	39.205	1994	111.927	22.992
1934	-	13.800	1965	153.970	49.030	1995	97.884	30.163
1935	0.001	14.999	1966	147.905	47.095	1996	119.576	22.888
1936	0.001	17.699	1967	139.687	51.199	1997	111.776	21.214
1937	0.003	20.197	1968	120.057	51.451	1998	121.650	20.156
1938	0.005	21.095	1969	140.365	62.666	1999	99.942	19.165
1939	0.010	19.990	1970	117.553	48.670	2000	103.980	27.252
1940	0.028	28.572	1971	165.235	66.880	2001	114.228	19.525
1941	0.057	30.543	1972	203.658	86.971	2002	102.197	21.318
1942	0.126	34.374	1973	148.551	81.587	2003	115.317	15.092
1943	0.268	37.632	1974	129.550	84.303	2004	115.003	17.998
1944	0.465	33.635	1975	94.895	62.185	2005	111.081	13.432
1945	0.763	28.437	1976	129.867	65.957	2006	104.599	12.334
1946	1.991	38.409	1976	129.867	65.957	2007	111.152	15.044
1947	3.743	37.657	1977	92.370	46.930	2008	102.670	13.896

Table App.A.1b: Inshore trawl catches of South African hake (assumed to be *M. capensis* exclusively) from the south coast.

Inshore trawl catches ('000t)					
Year	<i>M. capensis</i>	Year	<i>M. capensis</i>	Year	<i>M. capensis</i>
1960	1.000	1977	3.500	1994	9.569
1961	1.308	1978	4.931	1995	10.630
1962	1.615	1979	6.093	1996	11.062
1963	1.923	1980	9.121	1997	8.834
1964	2.231	1981	9.400	1998	8.283
1965	2.538	1982	8.089	1999	8.595
1966	2.846	1983	7.672	2000	10.906
1967	3.154	1984	9.035	2001	11.836
1968	3.462	1985	9.203	2002	9.581
1969	3.769	1986	8.724	2003	9.883
1970	4.077	1987	8.607	2004	10.004
1971	4.385	1988	8.417	2005	7.881
1972	4.692	1989	10.038	2006	5.524
1973	5.000	1990	10.012	2007	6.350
1974	10.056	1991	8.206	2008	5.865
1975	6.372	1992	9.252		
1976	5.740	1993	8.870		

Table App.A.1c: Species-disaggregated longline trawl catches of South African hake from the south and west coasts combined. The split by species assumes the catches consist of 30% and 100% *M. capensis* on the west and south coasts respectively.

Longline catches ('000t)								
Year	<i>M. paradoxus</i>	<i>M. capensis</i>	Year	<i>M. paradoxus</i>	<i>M. capensis</i>	Year	<i>M. paradoxus</i>	<i>M. capensis</i>
1983	0.161	0.069	1992	0.000	1.500	2001	2.793	2.885
1984	0.256	0.126	1993	0.000	0.000	2002	4.772	5.990
1985	0.817	0.642	1994	1.130	1.111	2003	4.668	6.878
1986	0.965	0.715	1995	0.670	0.938	2004	3.758	6.039
1987	2.500	1.424	1996	1.676	2.546	2005	4.172	6.347
1988	3.628	1.886	1997	1.806	2.646	2006	3.592	5.571
1989	0.203	0.119	1998	0.647	1.748	2007	3.151	5.184
1990	0.270	0.116	1999	1.963	4.985	2008	2.910	4.789
1991	0.000	3.000	2000	3.456	3.558			

Table App.A.1d: Handline trawl catches of South African hake (assumed to be *M. capensis* exclusively) from the south coast.

Handline catches ('000t)					
Year	<i>M. capensis</i>	Year	<i>M. capensis</i>	Year	<i>M. capensis</i>
1985	0.065	1993	0.278	2001	7.300
1986	0.084	1994	0.449	2002	3.500
1987	0.096	1995	0.756	2003	3.000
1988	0.071	1996	1.515	2004	1.600
1989	0.137	1997	1.404	2005	0.700
1990	0.348	1998	1.738	2006	0.400
1991	1.270	1999	2.749	2007	0.400
1992	1.099	2000	5.500	2008	0.369

Table App.A.2: South and west coast historic and coast-combined GLM standardized CPUE data (Glazer, 2008) for *M. paradoxus* and *M. capensis*. The historic CPUE series are for *M. capensis* and *M. paradoxus* combined.

Year	ICSEAF CPUE (tons/hr)		Year	GLM CPUE (kg/min)	
	South Coast	West Coast		<i>M. capensis</i>	<i>M. paradoxus</i>
1955		17.31	1978	3.17	5.93
1956		15.64	1979	3.58	5.75
1957		16.47	1980	4.06	6.02
1958		16.26	1981	3.63	5.50
1959		16.26	1982	3.60	5.82
1960		17.31	1983	4.27	6.25
1961		12.09	1984	4.93	6.40
1962		14.18	1985	6.05	7.66
1963		13.97	1986	4.90	7.17
1964		14.60	1987	4.40	6.25
1965		10.84	1988	4.36	5.71
1966		10.63	1989	4.80	5.91
1967		10.01	1990	5.33	6.57
1968		10.01	1991	5.30	7.29
1969	1.28	8.62	1992	5.20	7.01
1970	1.22	7.23	1993	4.24	6.63
1971	1.14	7.09	1994	4.94	6.76
1972	0.64	4.90	1995	5.14	5.13
1973	0.56	4.97	1996	4.98	6.92
1974	0.54	4.65	1997	4.36	6.74
1975	0.37	4.66	1998	4.57	6.85
1976	0.40	5.35	1999	4.55	6.40
1977	0.42	4.84	2000	5.23	6.18
			2001	4.52	5.67
			2002	4.91	4.90
			2003	4.74	5.79
			2004	4.04	5.61
			2005	3.24	5.43
			2006	3.02	5.44
			2007	1.56	5.75

Table App.A.3: Survey abundance estimates and associated standard errors in thousand tons for *M. paradoxus* for the depth range 0-500m for the south coast and for the west coast (Leslie and Fairweather, 2008). Values in bold are for the surveys conducted by the *Africana* with the new gear.

Year	South coast				West coast					
	Spring (Sept)		Autumn (Apr/May)		Summer		Winter		<i>Nansen</i> summer	
	Biomass	(s.e.)	Biomass	(s.e.)	Biomass	(s.e.)	Biomass	(s.e.)	Biomass	(s.e.)
1985	-	-	-	-	168.139	(36.607)	264.916	(52.968)	-	-
1986	23.049	(5.946)	-	-	196.151	(36.366)	172.522	(24.129)	-	-
1987	21.545	(4.601)	-	-	284.859	(53.108)	195.530	(44.425)	-	-
1988	-	-	30.236	(11.084)	158.796	(27.390)	233.103	(64.016)	-	-
1989	-	-	-	-	-	-	468.928	(124.878)	-	-
1990	-	-	-	-	282.225	(78.956)	226.910	(46.016)	-	-
1991	-	-	26.604	(10.431)	327.105	(82.209)	-	-	-	-
1992	-	-	24.305	(15.197)	234.699	(33.963)	-	-	-	-
1993	-	-	198.403	(98.423)	321.782	(48.799)	-	-	-	-
1994	-	-	111.354	(34.622)	329.927	(58.332)	-	-	-	-
1995	-	-	44.618	(19.823)	324.626	(80.370)	-	-	-	-
1996	-	-	85.530	(25.485)	430.971	(80.614)	-	-	-	-
1997	-	-	134.656	(50.922)	570.091	(108.230)	-	-	-	-
1998	-	-	-	-	-	-	-	-	-	-
1999	-	-	321.328	(113.520)	562.988	(116.322)	-	-	-	-
2000	-	-	-	-	-	-	-	-	326.994	(36.816)
2001	19.930	(9.957)	-	-	-	-	-	-	276.604	(34.833)
2002	-	-	-	-	272.172	(35.586)	-	-	-	-
2003	88.431	(36.054)	108.845	(37.529)	405.457	(68.882)	-	-	-	-
2004	63.606	(17.832)	55.848	(23.923)	259.566	(56.034)	-	-	-	-
2005	-	-	25.834	(8.547)	281.990	(40.328)	-	-	-	-
2006	72.793	(15.599)	35.038	(8.981)	313.456	(47.265)	-	-	-	-
2007	52.290	(19.234)	148.853	(70.488)	399.908	(70.016)	-	-	-	-
2008	-	-	39.490	(11.405)	246.600	(51.981)	-	-	-	-

Table App.A.4: Survey abundance estimates and associated standard errors in thousand tons for *M. capensis* for the depth range 0-500m for the south coast and for the west coast (Leslie and Fairweather, 2008). Values in bold are for the surveys conducted by the *Africana* with the new gear.

Year	South coast				West coast					
	Spring (Sept)		Autumn (Apr/May)		Summer		Winter		<i>Nansen</i> summer	
	Biomass	(s.e.)	Biomass	(s.e.)	Biomass	(s.e.)	Biomass	(s.e.)	Biomass	(s.e.)
1985	-	-	-	-	124.652	(22.709)	181.517	(27.480)	-	-
1986	202.871	(27.845)	-	-	117.829	(23.639)	119.609	(18.492)	-	-
1987	162.282	(17.512)	-	-	75.705	(10.242)	87.407	(11.201)	-	-
1988	-	-	165.184	(21.358)	66.737	(10.767)	47.129	(9.570)	-	-
1989	-	-	-	-	-	-	323.879	(67.303)	-	-
1990	-	-	-	-	455.861	(135.253)	157.826	(23.565)	-	-
1991	-	-	273.897	(44.363)	77.369	(14.997)	-	-	-	-
1992	-	-	137.798	(15.317)	95.568	(11.753)	-	-	-	-
1993	-	-	156.533	(13.628)	94.564	(17.346)	-	-	-	-
1994	-	-	158.243	(23.607)	120.206	(35.885)	-	-	-	-
1995	-	-	233.359	(31.862)	199.173	(26.816)	-	-	-	-
1996	-	-	243.934	(25.035)	83.347	(9.287)	-	-	-	-
1997	-	-	182.157	(18.601)	257.332	(46.062)	-	-	-	-
1998	-	-	-	-	-	-	-	-	-	-
1999	-	-	190.864	(14.929)	198.748	(32.471)	-	-	-	-
2000	-	-	-	-	-	-	-	-	316.105	(42.077)
2001	133.533	(20.845)	-	-	-	-	-	-	191.068	(25.780)
2002	-	-	-	-	108.025	(16.086)	-	-	-	-
2003	82.726	(8.994)	128.152	(20.000)	74.771	(12.989)	-	-	-	-
2004	93.338	(8.813)	103.085	(12.593)	205.976	(33.221)	-	-	-	-
2005	-	-	77.025	(5.977)	71.272	(13.861)	-	-	-	-
2006	102.132	(9.937)	132.202	(14.883)	88.357	(22.748)	-	-	-	-
2007	75.084	(7.397)	70.154	(5.561)	81.990	(11.405)	-	-	-	-
2008	-	-	107.953	(9.958)	50.885	(5.356)	-	-	-	-

Table App.A.5: Summer survey catches-at-age (proportions) of *M. capensis* and *M. paradoxus* on the west coast for the 0-500m depth range.

Age	<i>M. capensis</i>								<i>M. paradoxus</i>					
	0	1	2	3	4	5	6	7+	0	1	2	3	4	5+
1986	0.034	0.230	0.603	0.085	0.023	0.014	0.008	0.003	-	-	-	-	-	-
1987	0.024	0.113	0.465	0.223	0.139	0.022	0.010	0.004	-	-	-	-	-	-
1988	0.280	0.483	0.135	0.059	0.018	0.015	0.009	0.002	-	-	-	-	-	-
1989	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1990	0.004	0.325	0.635	0.023	0.009	0.003	0.001	0.000	0.029	0.310	0.492	0.158	0.009	0.002
1991	0.072	0.122	0.644	0.097	0.038	0.017	0.009	0.002	0.018	0.278	0.561	0.107	0.024	0.008
1992	0.131	0.260	0.313	0.162	0.078	0.025	0.019	0.010	0.010	0.383	0.485	0.082	0.023	0.012
1993	0.038	0.176	0.207	0.399	0.088	0.057	0.024	0.011	0.009	0.200	0.547	0.187	0.044	0.010
1994	0.081	0.253	0.208	0.262	0.075	0.054	0.048	0.020	0.011	0.244	0.551	0.166	0.017	0.008
1995	0.001	0.147	0.739	0.066	0.021	0.018	0.005	0.003	0.065	0.191	0.444	0.258	0.028	0.010
1996	0.065	0.368	0.205	0.237	0.066	0.023	0.025	0.011	0.057	0.394	0.302	0.210	0.030	0.005
1997	0.036	0.141	0.384	0.407	0.014	0.010	0.004	0.003	0.006	0.171	0.546	0.256	0.016	0.003
1998	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999	0.867	0.059	0.024	0.026	0.011	0.008	0.005	0.001	0.161	0.410	0.336	0.081	0.008	0.003
2000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2001	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2002	0.198	0.441	0.230	0.070	0.032	0.019	0.007	0.002	0.076	0.373	0.380	0.132	0.028	0.012
2003	0.247	0.209	0.254	0.156	0.046	0.047	0.032	0.009	0.063	0.322	0.400	0.181	0.023	0.012
2004	0.110	0.457	0.359	0.064	0.007	0.002	0.001	0.001	0.175	0.307	0.321	0.152	0.035	0.011
2005	0.679	0.092	0.133	0.076	0.012	0.005	0.002	0.001	0.218	0.493	0.208	0.069	0.009	0.003
2006	0.446	0.325	0.169	0.042	0.008	0.005	0.003	0.001	0.073	0.321	0.440	0.144	0.017	0.005
2007	0.057	0.144	0.533	0.236	0.018	0.006	0.003	0.003	0.074	0.341	0.372	0.175	0.031	0.008

Table App.A.6: Winter survey catches-at-age (proportions) of *M. capensis* on the west coast for the 0-500m depth range.

Age	<i>M. capensis</i>							
	0	1	2	3	4	5	6	7+
1986	0.005	0.305	0.267	0.318	0.051	0.027	0.017	0.010
1987	0.010	0.477	0.202	0.171	0.072	0.048	0.011	0.009
1988	0.031	0.432	0.388	0.063	0.042	0.029	0.012	0.004
1989	0.079	0.676	0.213	0.022	0.008	0.001	0.001	0.000
1990	0.006	0.267	0.514	0.098	0.052	0.042	0.013	0.008

Table App.A.7: Nansen summer survey catches-at-age (proportions) of *M. capensis* and *M. paradoxus* on the west coast for the 0-500m depth range.

Age	<i>M. capensis</i>								<i>M. paradoxus</i>					
	0	1	2	3	4	5	6	7+	0	1	2	3	4	5+
2000	0.393	0.336	0.147	0.111	0.007	0.004	0.002	0.001	0.261	0.460	0.204	0.056	0.015	0.004
2001	0.493	0.109	0.157	0.157	0.050	0.018	0.009	0.007	0.199	0.378	0.237	0.143	0.031	0.011

Table App.A.8: Spring survey catches-at-age (proportions) of *M. capensis* and *M. paradoxus* on the south coast for the 0-500m depth range.

Age	<i>M. capensis</i>								<i>M. paradoxus</i>					
	0	1	2	3	4	5	6	7+	0	1	2	3	4	5+
2001	0.158	0.106	0.091	0.171	0.264	0.139	0.039	0.033	0.007	0.085	0.518	0.369	0.015	0.006
2002	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003	0.192	0.139	0.151	0.163	0.170	0.117	0.039	0.029	0.000	0.026	0.448	0.463	0.035	0.029
2004	0.457	0.103	0.109	0.122	0.104	0.067	0.021	0.016	0.034	0.034	0.358	0.499	0.042	0.033

Table App.A.9: Autumn survey catches-at-age (proportions) of *M. capensis* and *M. paradoxus* on the south coast for the 0-500m depth range.

Age	<i>M. capensis</i>								<i>M. paradoxus</i>					
	0	1	2	3	4	5	6	7+	0	1	2	3	4	5+
1991	0.011	0.111	0.126	0.173	0.215	0.181	0.112	0.073	0.004	0.010	0.522	0.292	0.116	0.056
1992	0.015	0.203	0.358	0.145	0.118	0.110	0.038	0.014	0.000	0.001	0.370	0.541	0.065	0.024
1993	0.001	0.083	0.120	0.171	0.373	0.143	0.068	0.042	0.000	0.005	0.416	0.544	0.026	0.010
1994	0.061	0.140	0.123	0.219	0.137	0.159	0.116	0.045	0.005	0.090	0.656	0.186	0.017	0.046
1995	0.019	0.121	0.225	0.189	0.202	0.149	0.066	0.029	0.000	0.000	0.124	0.773	0.089	0.014
1996	0.005	0.104	0.188	0.192	0.288	0.131	0.061	0.031	0.000	0.000	0.097	0.749	0.100	0.054
1997	0.064	0.134	0.105	0.187	0.216	0.175	0.067	0.052	0.000	0.001	0.111	0.581	0.105	0.202
1998	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999	0.159	0.140	0.281	0.145	0.117	0.087	0.040	0.030	0.000	0.014	0.216	0.527	0.190	0.054
2000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2001	0.149	0.112	0.085	0.175	0.279	0.137	0.036	0.027	0.006	0.053	0.444	0.462	0.027	0.007
2002	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003	0.109	0.214	0.195	0.142	0.161	0.116	0.035	0.028	0.008	0.023	0.385	0.530	0.034	0.020
2004	0.130	0.103	0.132	0.187	0.228	0.141	0.045	0.034	0.029	0.115	0.350	0.438	0.060	0.008
2005	0.110	0.159	0.169	0.161	0.216	0.126	0.035	0.023	0.065	0.142	0.240	0.370	0.130	0.053
2006	0.030	0.072	0.194	0.264	0.232	0.123	0.047	0.037	0.001	0.012	0.314	0.582	0.073	0.018
2007	0.250	0.250	0.169	0.157	0.112	0.044	0.011	0.008	0.050	0.039	0.191	0.501	0.197	0.022

Table App.A10: Offshore trawl fleet catches-at-age (*M. capensis* and *M. paradoxus* combined) for west coast.

Age	Species-aggregated							
	0	1	2	3	4	5	6	7+
1975	0.000	0.038	0.151	0.242	0.249	0.189	0.058	0.073
1976	0.000	0.076	0.435	0.302	0.120	0.035	0.022	0.010
1977	0.000	0.119	0.499	0.223	0.081	0.051	0.023	0.005
1978	0.000	0.069	0.683	0.174	0.046	0.018	0.007	0.003
1979	0.000	0.095	0.468	0.218	0.095	0.078	0.029	0.016
1980	0.000	0.048	0.458	0.284	0.120	0.053	0.023	0.014
1981	0.004	0.204	0.459	0.184	0.092	0.034	0.015	0.008
1982	0.030	0.248	0.469	0.130	0.056	0.038	0.020	0.009
1983	0.001	0.097	0.457	0.256	0.099	0.056	0.025	0.010
1984	0.002	0.068	0.460	0.265	0.111	0.052	0.028	0.014
1985	0.000	0.007	0.347	0.380	0.135	0.077	0.036	0.019
1986	0.000	0.011	0.315	0.446	0.119	0.055	0.033	0.019
1987	0.000	0.019	0.502	0.273	0.109	0.059	0.025	0.013
1988	0.000	0.018	0.551	0.265	0.075	0.050	0.028	0.011
1989	0.000	0.011	0.411	0.399	0.097	0.049	0.026	0.008
1990	0.000	0.002	0.282	0.470	0.167	0.050	0.020	0.008
1991	0.000	0.003	0.264	0.379	0.213	0.079	0.045	0.018
1992	0.000	0.010	0.380	0.328	0.149	0.084	0.035	0.014
1993	0.000	0.002	0.152	0.407	0.286	0.112	0.031	0.011
1994	0.000	0.001	0.158	0.468	0.191	0.140	0.032	0.011
1995	0.000	0.001	0.107	0.533	0.218	0.074	0.049	0.018
1996	0.000	0.001	0.096	0.533	0.260	0.066	0.032	0.013

Table App.A11: Longline fleet catches-at-age (assumed to consist of *M. capensis* only) on the south coast.

Age	<i>M. capensis</i>							
	0	1	2	3	4	5	6	7+
1994	0.000	0.000	0.000	0.001	0.030	0.248	0.404	0.318
1995	0.000	0.000	0.000	0.000	0.006	0.093	0.262	0.638
1996	0.000	0.000	0.000	0.000	0.007	0.134	0.297	0.561
1997	0.000	0.000	0.000	0.002	0.036	0.201	0.298	0.464
1998	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-
2000	0.000	0.000	0.001	0.003	0.020	0.148	0.203	0.626

Table App.A.12: Inshore fleet catches-at-age (assumed to consist of *M. capensis* only) on the south coast.

Age	<i>M. capensis</i>							
	0	1	2	3	4	5	6	7+
1989	0.000	0.000	0.081	0.478	0.285	0.109	0.039	0.008
1990	0.000	0.000	0.055	0.279	0.439	0.171	0.045	0.011
1991	0.000	0.000	0.053	0.281	0.367	0.219	0.067	0.014
1992	0.000	0.001	0.151	0.371	0.237	0.184	0.048	0.009
1993	0.000	0.000	0.026	0.332	0.457	0.139	0.039	0.006
1994	0.000	0.000	0.060	0.380	0.304	0.183	0.067	0.007
1995	0.000	0.000	0.015	0.232	0.455	0.209	0.072	0.018
1996	0.000	0.000	0.024	0.327	0.457	0.140	0.043	0.008
1997	0.000	0.000	0.034	0.369	0.394	0.159	0.034	0.011
1998	0.000	0.008	0.166	0.377	0.284	0.116	0.034	0.015
1999	0.000	0.012	0.190	0.365	0.248	0.116	0.044	0.024
2000	0.000	0.000	0.022	0.244	0.476	0.196	0.034	0.028

Table App.A.13: Estimates of the parameter values of the von Bertalanffy growth-equation (from Punt and Leslie, 1991) and mass-at-length equation (from Fairweather, 2008).

	Coast- and sex- combined	
	<i>M. capensis</i>	<i>M. paradoxus</i>
α (in gm)	0.0059	0.0065
β	3.081	3.032
l_{inf} (in cm)	270.6	219.4
κ	0.039	0.049
t_0	-0.730	-0.914

Fig. App.A.1: Estimated mass-at-age from the parameter values in Table App.A.13 compared to that previously used.

