Data to be used in Conditioning the next Reference Set of Operating Models for the South African hake resource

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This paper summarises the proposed data to be included in the next Reference Set of Operating Models for the South African hake resource. Instances where further clarification/analysis is required before model conditioning (fitting) commences are highlighted.

This should be considered in the context of a likely guillotine data of early August 2009 for finalisation of these data.

The Reference Set will model the sexes separately, which requires fitting directly to age-length keys (ALKs) and length frequencies, and estimating sex-specific growth curves in the overall model fitting process.

Commercial data

Total catches

As was done previously, the species-split of the catches is carried out external to the model. The assumptions made to disaggregate the catches by species are summarised below (for more details, see Rademeyer *et al.*, 2008). The reported or assumed catches by fleet and species are given in Table 1.

- Offshore trawl fleet:
  From 1978 onwards, the catches made by the offshore trawl fleet are split by species by applying the size-based species proportion-by-depth relationships for the west and south coasts which were developed by Gaylard and Bergh (2004) from research survey data.

  Prior to 1978, there is no depth information recorded for the landings so that the proportion of *M. capensis* caught cannot be estimated using the method above. The catch data for the 1917-1977 period are split by assuming that the proportion of *M. capensis* caught follows a logistic function over this period, starting at 1 and then decreasing to stabilise at the 1978-1982 average value. As trawling was concentrated in inshore areas around Cape Town and to the east when the fishery began (i.e. probably catching *M. capensis* exclusively) and progressively moved offshore, this seems a defensible approach. To reflect a change from a *M. capensis* only fishery to the species ratio in the catch in 1978, the changing proportion with year y of *M. capensis* in the offshore trawl catch on coast c is modelled by:

$$prop_{cy}^{prop} = \frac{1-\Delta_c}{1+\exp[(y-P_1)/P_2]} + \Delta_c \qquad (1)$$

  where

  Δ_c is the average proportion of *M. capensis* in the offshore catch over the 1978-1982 period for coast c (24% and 60% for the west and south coasts respectively), and

  P_1, P_2 are parameters of the logistic function; P_1 is the year in which the proportion of *M. capensis* in the catch is mid-way between 100% and Δ_c, while P_2 determines how rapidly this change in proportion occurs.

  The baseline assessment assumes: P_1=1950 and P_2=1.5.

- Inshore trawl and handline fleets:

Catches made by these fleets are assumed to consist of *M. capensis* only, as they operate in relatively shallow water on the south coast.

- Longline fleet

  Longline catches on the west coast are assumed to consist of 30% *M. capensis* for the whole period, while on the south coast, catches by this fleet are assumed to consist of *M. capensis* exclusively (Andrew Penney, PISCES, pers. commn).

Although there is some uncertainty about the catches and species split for the longline and handline fisheries, they account for less than 10% of the total catch; hence this uncertainty would not have a large impact on assessment results.

Further work/data needed:

- Need 2007 catch update and 2008 estimates for each fleet.
- Offshore trawl catches disaggregated by depth strata as for surveys (though not immediately urgent - see further discussion below)

CPUE

The species-aggregated ICSEAF CPUE and the species-disaggregated GLM CPUE series will be used as in previous assessments (Table 2).

Further work/data needed:

- Need the GLM CPUE series updated to 2008 (note that these standardised CPUE values are readily disaggregated by depth strata if so required for future models)
- Investigate possible bias in GLM CPUE (*M. capensis* particularly) – possibly arising from not taking account of the effect of introduction of advanced navigational aids
- Is any work being done on the longline data and if yes, when would a CPUE series be available?
- Is any work being done on the inshore data and if yes, when would a CPUE series be available?

Catches-at-length

Commercial CAL cannot be disaggregated by species and sex. Species- and sex-aggregated CAL for all years and fleet combinations for which data are available are shown in Table 3.

Further work/data needed:

- Are there any further data available? (Note that information for some years is missing in Table 3.)

Age-length keys

Further work/data needed:

- No commercial ALKs (whether or not species are disaggregated) are available for the moment and will probably not be available by August for inclusion in the Reference Set.

Survey data

Currently, the survey information is used aggregated over all depth strata for the west and for the south coast. However future models will be spatially disaggregated at a finer scale than the current two-coast split. All survey information should therefore be provided disaggregated by depth strata, as is currently done. In such a spatially disaggregated model, the spring south coast surveys conducted in waters of <200m depth could be used.

Biomass estimates

The survey biomass estimates are shown in Table 4.

Further work/data needed:

- Estimates for South Coast spring 2008, West Coast summer 2009 and South Coast autumn 2009 are needed.
- If easily available, should we be using sex-disaggregated estimates? If yes, then this information needs to be available.
- Are South Coast estimates to be re-analysed based on a finer stratification by depth?
- Are survey estimates to be adjusted to take account of environmental co-variates?

Catches-at-length

When available, sex-disaggregated length frequencies from surveys will be used. For the rest, sex-aggregated data will be used. Table 5 summarises the data available and almost finalised.

Further work/data needed:

- Sex-disaggregated length frequencies for the new surveys can be used if available.

Age-length keys

Table 6 lists the surveys for which sex- and species-disaggregated ALKs are already available. ALKs aggregated over sex and species will not be used.

Further work/data needed:

- Sex-disaggregated ALKs as far back as possible, as become available until August 2009.

Other biological information

Maturity-at-age

- Use maturity-at-length rather than at-age; Tracey Fairweather has been asked to suggest one ogive to use from document 42 (Fairweather and Leslie, 2008)

Length-weight relationship

- Use the average of the south and west coast to get a coast-combined, sex-disaggregated length-weight relationship from Fairweather (2008).

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Table 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, cells that are shaded reflect information that is needed.

Offshore trawl catches ('000t)								
Year	*M. paradoxus*	*M. capensis*	Year	*M. paradoxus*	*M. capensis*	Year	*M. paradoxus*	*M. capensis*
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	?	?

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

Inshore trawl catches ('000t)					
Year	*M. capensis*	Year	*M. capensis*	Year	*M. capensis*
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	?
1975	6.372	1992	9.252		
1976	5.740	1993	8.870		

Table 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	*M. paradoxus*	*M. capensis*	Year	*M. paradoxus*	*M. capensis*	Year	*M. paradoxus*	*M. capensis*
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	?	?
1991	0.000	3.000	2000	3.456	3.558			

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

Handline catches ('000t)					
Year	*M. capensis*	Year	*M. capensis*	Year	*M. capensis*
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	?

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

	ICSEAF CPUE (tons/hr)			**GLM CPUE (kg/min)**		**GLM CPUE (kg/min)**	
	Species-aggregated			*M. capensis*	*M. paradoxus*	*M. capensis*	*M. paradoxus*
Year	South Coast	West Coast	Year	West coast		South coast	
1955		17.31	1978	?	?	?	?
1956		15.64	1979	?	?	?	?
1957		16.47	1980	?	?	?	?
1958		16.26	1981	?	?	?	?
1959		16.26	1982	?	?	?	?
1960		17.31	1983	?	?	?	?
1961		12.09	1984	?	?	?	?
1962		14.18	1985	?	?	?	?
1963		13.97	1986	?	?	?	?
1964		14.60	1987	?	?	?	?
1965		10.84	1988	?	?	?	?
1966		10.63	1989	?	?	?	?
1967		10.01	1990	?	?	?	?
1968		10.01	1991	?	?	?	?
1969	1.28	8.62	1992	?	?	?	?
1970	1.22	7.23	1993	?	?	?	?
1971	1.14	7.09	1994	?	?	?	?
1972	0.64	4.90	1995	?	?	?	?
1973	0.56	4.97	1996	?	?	?	?
1974	0.54	4.65	1997	?	?	?	?
1975	0.37	4.66	1998	?	?	?	?
1976	0.40	5.35	1999	?	?	?	?
1977	0.42	4.84	2000	?	?	?	?
			2001	?	?	?	?
			2002	?	?	?	?
			2003	?	?	?	?
			2004	?	?	?	?
			2005	?	?	?	?
			2006	?	?	?	?
			2007	?	?	?	?
			2008	?	?	?	?

Table 3a: South coast offshore trawl catches-at-length (species and sex combined).

	Offshore trawl South Coast Both species, sex-aggregated																					
Length	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
19	0	0	0	0	0	0	0	38911	0	57570	0	0	0	0	0	10694	0	4731	0	0	0	0
21	0	753275	8256	230733	0	0	45037	207856	59326	115171	0	0	0	33729	126680	96229	121400	94661	102344	44411	89694	28478
23	0	1027193	4128	629272	0	368767	281299	670410	156001	802839	59463	0	37813	267887	228024	403043	655603	598480	397394	214070	884628	262805
25	149765	2602221	74306	2328306	0	1355476	990805	1389265	1008833	1925468	262576	93113	172518	1412139	1634307	1159052	2477438	2426468	2059140	1130268	1724361	531938
27	688919	5409881	90818	5495641	0	4250691	1932316	3053498	2495720	6087779	1690618	599728	1582712	2440570	6856120	4485650	5791588	5591516	5049745	3276389	3642942	3205300
29	1597494	16914437	499501	11977141	33132	6926692	4572547	5486955	4150533	7924459	4274415	2443698	4058464	4382293	10828032	8238729	9975708	8147264	8164314	7095730	5080132	7168728
31	3504502	31158173	1515017	13634223	173942	9307137	5600541	6116344	4413558	8963639	7605077	5642291	5734353	5502206	14013209	9732587	13195591	10048881	9809930	10031876	9180227	14544603
33	4193421	24858059	1671885	11935189	554959	9142064	5020400	5177268	4894508	6698592	7928925	5544796	6079322	6102893	10649788	11176313	14899886	12413750	9722989	12012168	11002306	17601619
35	3584377	16982916	1948468	9040539	1532349	8303584	4997061	4417125	5890437	4730002	7040111	5833673	4372760	5963048	5856063	10359632	13287145	12503319	9165866	9020718	10741085	20493049
37	4263312	9929528	2423201	6691257	2277816	6301652	3331323	3275642	5129426	3501685	6820919	3813078	3613623	3755037	5197455	11712034	12274913	12273367	8789592	8509061	8987191	20413588
39	3424628	4999004	2472738	4530757	2402060	5760051	3634371	3090780	4338219	3550430	5808923	4590463	2601627	2637879	3859979	10654097	9483750	10420896	8710834	6683076	6038865	15649002
41	5032106	7464266	2617222	3440019	2062459	4942085	3063873	3082956	2895113	2710625	4058513	3529420	1776739	2240664	3057022	8536933	7495364	9120331	6294580	4751344	3449406	11547691
43	5181871	5478360	2299358	2810748	2137005	4363187	2555390	2517555	2422979	2632703	3165025	3435920	1817355	2342584	2725458	6879310	6304713	6489167	4950647	3262758	2958867	6811674
45	5181871	4999004	2055799	2286354	2087308	3710414	1904873	2098559	2120729	2121043	2328377	2757062	1845426	2171581	1903395	5725812	5198264	5002369	3528463	2832286	3298176	4586590
47	5711041	5957717	1407686	2328306	2683681	3004402	1820391	2047951	2264124	1663844	1998547	2350971	1821648	2051092	1715947	4461754	3826766	4048003	3030839	2661820	1792949	3261636
49	5101996	4725086	1205408	1720010	3354601	2424180	1426295	2034998	1993475	1304008	1899871	2064220	1767241	1959768	1340776	3254237	2849156	2975257	2267437	2315206	965779	2598903
51	5181871	2739180	1003131	1426350	3462280	2178375	1185673	1686079	1943562	1149452	1693719	1611798	1559268	1461289	1673715	2544488	2253885	2197020	1695461	2247298	1020709	1912565
53	4193421	1232631	891672	1174641	2700247	1522715	932637	1538473	1667760	1204069	1735036	1536598	1428678	1425646	1845283	2446985	2078550	2067372	1628038	1990983	1165926	2226718
55	4193421	684795	875160	880981	2957019	1244004	771367	1345279	1269090	1075958	1542306	1448898	1434995	1398055	1282422	1817591	1681721	1655036	1209219	1572296	1013868	2040210
57	3354737	479357	747188	566345	2460041	1131448	539362	1220107	1007385	861791	1372772	1323694	1231626	1103468	1355771	1717923	1628744	1597117	1200225	1314440	1602107	1869632
59	2366288	273918	730676	566345	2145288	1123086	555930	1209130	944141	716782	1172554	1360939	1105707	1199801	1219693	1248666	1261312	1202173	933481	910367	1307219	1403238
61	1827134	342398	800854	566345	1689725	829697	421436	1073889	833156	638954	884576	1149774	1023230	1006111	1293157	1229953	1197313	1135908	834098	912441	1228789	1318362
63	1218089	205439	606832	335612	1432953	707336	293918	828859	661865	510529	890581	913221	801777	774366	973217	1029751	1081215	942223	711372	701160	1262889	1069636
65	988449	136959	367402	398539	1159615	619325	250779	684377	561314	445264	870936	878618	559571	731143	791942	913556	900433	803084	602299	647958	1041723	854700
67	988449	205439	317865	251709	1242445	571860	162142	524646	358509	414956	624967	577368	450535	508944	563690	747045	772188	761984	557238	615548	878114	774064
69	838684	136959	2064055	209757	853146	430850	140496	391862	280742	380219	471396	377545	389122	377885	302831	517354	589536	642539	448889	515010	751249	558369
71	459279	136959	1490248	230733	795165	374904	133058	357919	182917	265174	492377	435281	322659	270405	282706	396211	412986	512284	342847	478688	729818	464890
73	459279	68480	1168255	188782	604657	299285	85046	261776	161793	189544	386847	377480	277817	153299	160567	253227	344177	397387	269116	329458	411924	354656
75	379405	68480	1498504	146830	414148	269026	61605	250292	85006	141554	238502	223279	196652	104254	119201	171867	218634	288172	184817	234465	312848	257621
77	379405	0	722419	125854	347885	192264	49807	163603	84240	99939	172750	241129	137618	82302	48227	100054	145108	184321	131455	140289	152092	160354
79	379405	0	24769	146830	298187	167961	34829	106238	58133	85114	83640	80484	104965	58015	55018	80271	103886	142446	90108	94975	133139	109575
81	379405	0	33025	125854	314753	105517	27032	59902	30877	61370	115938	58961	73847	39236	7108	35256	58572	83985	68790	70827	65143	107942
83	229640	0	0	41951	124244	104073	23493	31941	24148	26979	68433	51744	54718	15002	25336	24326	39022	65142	40394	36938	51266	41276
85	229640	0	4128	41951	149093	77062	18210	28576	15034	18122	62718	20620	32564	10307	0	14845	24655	41485	29641	27920	12032	24573
87	149765	0	0	41951	41415	7700	11490	16371	12010	19504	20417	7861	15526	5875	0	5939	10854	22481	13958	16424	5699	24944
89	149765	0	12384	41951	33132	3730	6309	12098	7410	8417	0	18494	10588	9258	0	5735	3712	13257	14707	13133	9190	16778
91	79875	0	8256	41951	74547	7399	3950	4380	6048	9548	0	10375	8541	5377	0	5871	5483	10212	6126	4888	12616	14402
93	0	0	0	0	33132	0	1026	4193	2811	4900	0	11019	7585	2072	0	657	3109	2951	2820	1924	9774	4751
95	0	0	0	0	0	3730	0	908	213	4177	0	9795	2113	498	0	1672	461	2260	1237	4268	0	2970
97	0	0	0	0	0	0	103	1923	511	1665	0	3093	2247	315	0	0	323	1587	1313	129	0	7053
99	0	0	0	0	0	0	0	1362	554	0	0	0	222	0	0	0	158	1113	55	0	0	0
101	0	0	0	0	0	0	0	0	2044	0	0	0	1068	0	0	0	0	83	828	0	0	2598
103	0	0	0	0	0	0	0	1496	767	0	0	0	178	0	0	0	257	409	85	1508	0	0
105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3b: West coast and coast combined offshore trawl catches-at-length (species and sex combined).

	Offshore trawl West Coast Both species, sex-aggregated																			Offshore trawl Both Coasts Both species, sex-aggregated		
Length	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2005	2006	2007
19	2519	994	58	0	0	0	0	0	30	0	0	8	0	0	0	118	36	26	16	15320	0	0
21	10130	7101	891	621	32	0	70	55	603	188	199	300	244	22	646	1076	575	418	265	146700	340993	0
23	22813	21690	3286	1935	194	383	893	2019	3607	1292	787	1755	469	210	4524	4817	3109	2281	1406	1947301	2420009	329913
25	46428	34058	9957	11959	768	1734	6249	7925	11272	3344	3140	7113	2398	922	8479	12505	7080	5322	3394	13414502	10114184	3341151
27	65374	43619	16452	23779	2634	6195	16788	23475	23559	14763	6985	15981	6725	4511	13033	16472	10636	8525	5780	33275953	19878889	12886979
29	61923	47372	19349	26770	7692	10639	27916	31020	32482	27127	10960	21167	12332	12876	17336	27569	16979	13788	9978	36836651	25382280	21131296
31	46657	37020	23381	29379	20321	19937	32923	34510	33039	33459	13142	21610	15612	19862	29580	33620	22842	21168	15156	37150093	28909583	24166107
33	33465	26354	23682	23429	25797	29028	32250	28429	24919	36191	14139	18683	14002	22027	28746	34957	20830	22423	15365	30298498	25782332	22961329
35	25308	16702	20481	19364	23450	31307	25192	22380	18097	32666	12628	14203	11719	13493	28899	31890	19531	22565	15069	23060176	20993022	21195853
37	18383	13076	16131	17198	21037	28483	17018	16304	13401	29429	12497	11817	11265	13404	26372	28070	17087	20516	13485	14081990	15576440	18526775
39	11948	7946	12060	12979	17014	23730	13758	10939	9134	20780	10733	9143	11980	11518	20610	23801	14006	16694	10952	11226958	11396663	16293899
41	9083	5147	8180	7571	12545	15984	10735	8376	6855	13965	9373	7870	10545	8957	11577	18021	9239	11404	7376	8381432	9452470	13611807
43	7548	4223	6332	6151	9271	10621	9258	6236	5295	10777	8961	6332	10632	7019	7869	12015	6425	8039	5235	9589056	8144595	10702986
45	4955	3481	5188	5288	6429	7117	8354	4360	4003	7743	7478	5408	10343	7123	8788	8958	5769	7292	4825	7778592	7113076	7348419
47	4173	3419	4409	4822	5117	5466	6752	3780	3587	5792	5854	5481	10866	7385	5702	6127	3693	4738	3289	8649677	6120703	6379690
49	3576	2730	3628	3946	4408	4107	6077	3246	2696	4131	4525	4482	8321	7647	3052	5408	2428	3219	2394	5482530	4830979	5267271
51	2870	2216	2745	2997	3230	3193	4513	2639	2032	2918	3424	3992	6239	7729	3842	3266	2177	2906	2268	4637750	4108786	3334680
53	2291	1653	2174	2167	2928	2332	3782	2441	1602	2512	2720	3925	5658	6937	3724	3419	2254	3050	2374	4123671	3555076	2520877
55	1953	1208	1706	1940	2476	1905	2743	2011	1449	1708	2006	2939	3752	4820	3373	2702	1927	2588	2064	4033206	3250875	2605755
57	1658	990	1254	1753	2368	1698	2273	1946	1356	1615	2030	2625	3040	3466	3660	2700	2069	2780	2201	3821585	3002475	1908180
59	1354	806	985	1510	1893	1348	1845	1645	1214	1153	1635	1897	1971	1989	3292	2429	1804	2358	1958	2943441	1978579	1299511
61	999	676	827	1216	1523	1219	1321	1639	1140	1123	1713	1609	1470	1787	2474	2089	1438	1844	1570	2808123	1804417	1470292
63	738	542	622	1023	1273	1205	985	1222	1034	912	1627	1205	1064	1019	2205	1555	1169	1438	1288	1947249	1680277	1084712
65	638	427	526	843	1130	1092	802	919	820	712	1468	966	804	762	1477	1351	847	976	965	2089726	1394477	1105531
67	478	305	407	676	844	1003	661	728	586	601	1213	834	693	593	1024	993	602	681	682	1451537	1210351	859275
69	400	241	323	496	830	769	533	520	436	437	931	713	534	481	791	816	472	517	545	1138007	905966	815793
71	316	183	268	373	662	760	415	348	302	354	750	566	392	418	784	620	409	440	471	775412	757464	524991
73	211	136	181	262	485	557	333	224	179	214	610	422	318	288	323	393	206	219	230	614793	439740	919148
75	147	100	154	191	301	438	252	167	115	129	437	302	207	196	248	309	159	169	177	306312	293611	782060
77	110	71	128	116	188	264	159	95	91	77	298	197	156	128	113	194	88	89	105	217081	154424	152939
79	73	59	95	81	139	215	154	73	54	57	209	155	107	87	103	126	66	69	75	105159	83279	128618
81	67	49	61	66	81	124	104	62	31	24	105	89	75	65	48	115	46	48	54	174162	72984	62199
83	43	22	48	38	47	84	79	36	18	16	93	68	48	32	40	49	25	27	29	19449	44491	35991
85	34	18	32	23	37	44	41	18	11	10	46	41	34	23	8	33	12	11	14	27914	31774	29354
87	25	16	16	18	16	39	38	18	4	3	21	25	17	17	4	26	8	8	10	7397	9825	25463
89	14	7	14	12	11	20	24	10	3	1	13	12	15	10	7	13	6	6	6	56178	9428	32283
91	7	5	7	6	24	12	12	6	1	2	13	9	7	6	10	7	5	6	5	15428	26237	5740
93	5	4	5	4	7	6	6	4	1	0	6	3	3	2	8	3	3	4	3	2497	1318	0
95	4	4	3	1	2	5	4	3	2	1	3	2	2	3	0	4	1	1	1	0	2277	10401
97	2	0	2	1	3	3	2	1	0	0	1	1	2	0	0	5	1	2	1	0	2936	0
99	0	0	1	0	1	1	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	4661
101	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	563	0
103	0	0	0	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
105	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2277	0

Table 3c: South coast inshore trawl and west and south coasts longline catches-at-length (species and sex combined).

	Inshore trawl South coast *M. capensis*, sex-aggregated																			Longline West Coast Both species, sex aggregated				Longline South Coast Both species, sex aggregated			
Length	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1998	1999	2000	1994	1995	1996	1997	1994	1995	1996	1997
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	476	0	0	2038	0	2491	0	2956	0	0	7	0	0	0	0	0	0	0	0
23	0	0	0	0	0	201	0	812	1509	0	1534	23529	5316	11762	631	13335	0	17	87	0	0	0	0	0	0	0	0
25	14616	16062	1284	0	313	1602	0	7356	29354	9528	7158	75833	23074	37210	12540	33519	123	260	286	0	0	0	0	0	0	0	0
27	43847	96373	4397	7510	1731	6750	3785	68805	126898	40966	29101	206519	66078	129081	66743	142764	672	1839	2893	0	0	0	0	0	0	0	0
29	204618	497928	43819	42362	17424	49482	34644	256192	376800	130026	96807	471296	177477	413794	220241	374605	3608	5604	6915	0	0	0	0	0	0	0	0
31	540775	1365287	191172	235286	63890	208646	113552	622506	790617	327387	225620	780278	408009	594437	511278	1123290	9163	14686	23628	0	0	0	0	0	0	0	0
33	1023088	2136273	419654	681695	174492	520621	329855	1148827	1268699	639278	430340	1030851	857019	944667	678386	1416520	13480	26140	51742	7	0	0	0	0	0	0	0
35	1476170	2312957	683207	1180629	381287	880580	688169	1190681	1506615	855448	648265	1103108	906225	1084873	1122760	1730262	23904	30927	68697	55	0	68	0	0	0	0	0
37	1710019	2007775	873549	1564328	580814	1100662	1124012	1143296	1582734	1005270	749132	1106201	1024749	1082382	1301061	2365581	21607	47060	87572	145	0	68	0	0	0	0	0
39	1739250	1798966	960018	1817904	725458	1039693	1247484	1043460	1584681	1271780	746227	1092738	1189227	996667	1296101	2141195	17230	49289	94726	290	151	204	0	219	206	0	0
41	1505401	1413474	1011188	1906240	878907	975200	1534650	1015551	1539677	1422316	765369	996872	1438669	937973	1328473	1615828	12457	39030	86133	642	227	511	668	109	309	0	173
43	1373861	1076167	1064233	1666818	1068546	779643	1274141	995372	1242325	1493287	797033	976731	1578168	892030	1277670	1687300	10559	36719	77626	980	113	1498	3339	1040	155	0	867
45	1096166	835234	1088795	1138668	1233793	720842	969945	844254	1008950	1198387	845097	887069	1217617	792275	1196409	1193531	10271	31818	64443	1180	605	2519	2893	1204	825	545	2139
47	876933	610364	995056	803947	1130354	642917	735431	761449	852735	1045890	829977	850176	910752	748711	1021539	929353	8023	26307	61067	1477	794	2927	7345	3394	1083	5447	3988
49	716162	465804	830025	592794	1030908	585256	623045	637884	811528	917402	766919	740623	780660	848961	922307	868211	7437	20811	48239	1801	1852	4867	10906	5858	2526	14434	9422
51	526160	369431	632843	479697	924507	596237	524386	580651	615548	710414	668220	677976	628866	676740	755210	635876	6024	13782	37447	2423	3591	7897	15135	11278	4898	21788	13814
53	453082	256995	479038	382114	667560	563458	455587	438897	491608	541756	585378	573456	440161	502551	573541	445092	4500	13632	28011	3299	6993	13105	26264	17902	9539	41397	21213
55	306926	192746	330390	306103	483651	511108	355258	378324	370729	423125	443501	445595	301622	458831	405267	342154	3584	8013	17537	4728	8278	20831	27822	28139	11292	58827	26473
57	248464	160622	233878	242642	345335	453663	292439	301004	359478	382472	393329	399664	280575	452575	337883	284329	2428	8179	14937	6074	16782	31315	45405	35201	22893	51473	34045
59	219233	112435	160384	214044	270558	390459	282002	263996	282147	292621	280113	303315	247039	401976	288524	242221	2006	4875	8355	6937	15837	44896	46296	41497	21604	65091	34738
61	160771	96373	111543	158277	208466	269362	261303	238268	247145	215170	210976	221635	170377	326948	259274	212955	1884	4360	7743	7716	20071	56299	45183	41661	27379	75712	40981
63	116924	64249	87219	118168	153740	180754	153010	119120	135459	158729	145028	148502	105027	220258	204248	156165	1228	3374	6229	8579	24455	63039	58760	45822	33360	93142	50576
65	87693	48187	61463	79663	108274	114094	108928	91704	96169	107143	107801	92577	71297	135238	161207	108933	1362	3153	5010	9525	21696	84959	67218	42373	29596	101313	59708
67	58462	32124	43058	49378	67904	74811	63570	63129	68034	68258	67617	64811	48223	79586	130930	67580	1015	2743	4463	11816	28273	80228	74340	40402	38567	118471	67916
69	43847	32124	28891	33978	45175	47366	40858	38916	42426	52119	50173	40210	32796	53727	85152	53292	627	2301	3212	13514	26799	80704	70334	39472	36557	122011	70575
71	29231	16062	19882	18260	28132	30239	30355	22497	26485	32767	34024	24744	23329	24118	56309	31220	508	2005	2963	13935	28689	83870	76121	33340	39135	125552	69766
73	14616	16062	16144	12982	20409	20971	18270	18390	17248	22125	24364	23082	14759	19716	31249	14698	321	1040	1398	14660	31372	73216	77456	30329	42795	121194	66644
75	14616	0	10668	8631	11917	13171	11837	10979	8122	15261	14711	13338	7695	11210	13535	6602	104	450	675	13983	23624	68757	68553	22719	32225	95594	60691
77	14616	0	6510	5822	9037	11994	11188	8588	4637	10725	8178	8877	4940	5803	6201	3071	20	185	222	12424	26081	58988	65437	18723	35577	79525	51790
79	14616	0	5112	4413	4880	7442	6010	4509	3270	5288	5177	6883	2937	3779	2512	2184	0	98	99	10588	22603	50342	49857	13413	30833	61550	37860
81	0	0	2908	2150	4141	4872	4690	3368	2720	3745	2108	3227	1481	1217	759	460	0	117	126	7710	18370	39859	38283	10402	25058	34043	23930
83	0	0	1704	1512	3724	3107	3669	3477	1962	2965	1557	2852	583	1118	684	0	0	51	47	7026	15535	30736	29603	7117	21191	32409	18092
85	0	0	466	1553	2164	2250	1254	155	245	434	417	0	73	665	214	0	0	51	0	4410	12020	25222	25819	5365	16396	17430	11445
87	0	0	704	905	866	864	1233	1150	1650	950	2182	760	401	255	0	0	0	0	78	3037	10508	15726	24038	4161	14334	9260	5664
89	0	0	648	658	358	477	328	283	639	313	402	313	49	0	0	0	0	0	0	2015	6312	11062	11574	3121	8611	3268	3295
91	0	0	136	288	478	693	394	0	282	0	45	197	0	255	0	0	0	26	0	1256	3251	7761	6010	2245	4434	4085	2312
93	0	0	114	82	119	37	430	73	134	0	0	0	36	0	0	0	0	0	0	1001	2419	4119	3561	1533	3300	1906	925
95	0	0	57	237	30	521	0	0	0	0	0	0	0	0	0	0	0	0	0	435	983	2757	2003	493	1341	1089	809
97	0	0	80	0	97	0	0	0	0	38	0	0	0	0	0	0	0	0	0	242	643	1123	668	328	877	272	173
99	0	0	0	134	97	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97	189	579	668	55	258	0	347
101	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	69	113	374	0	55	155	0	0
103	0	0	0	0	119	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	204	0	0	0	0	58
105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	34	0	0	0	0	0

Table 4a: 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. Here and in subsequent tables, the area shaded by dots represents the South coast spring surveys conducted in <200m, not used in current assessments.

	South coast				West coast					
Year	Spring (Sept)		Autumn (Apr/May)		Summer		Winter		*Nansen* 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)				
2009			**?**	?	**?**	?				

Table 4b: 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.

	South coast				West coast					
Year	Spring (Sept)		Autumn (Apr/May)		Summer		Winter		*Nansen* 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)	-	-	-	-
2009			**?**	?	**?**	?				

Table 5: Status of survey length-frequencies. The legends are as follow:

- ✓ Available
- X ? Does not exist?
- O Currently being processed

Year	South coast				West coast			
	Spring (Sept)		Autumn (Apr/May)		Summer		Winter	
	Sex-aggr.	By sex	Sex-aggr.	By sex	Sex-aggr.	By sex	Sex-aggr.	By sex
1985	-	-	-	-	✓	X ?	✓	X ?
1986	✓	X ?	-	-	✓	X ?	✓	X ?
1987	✓	X ?	-	-	✓	X ?	✓	X ?
1988	-	-	✓	X ?	✓	X ?	✓	X ?
1989	-	-	-	-	-	-	✓	X ?
1990			-	-	✓	X ?	✓	X ?
1991			✓	X ?	✓	X ?	-	-
1992		O	✓	X ?	✓	X ?	-	-
1993		O	✓	O	✓	✓	-	-
1994		O	✓	O	✓	✓	-	-
1995		O	✓	O	✓	✓	-	-
1996	-	-	✓	O	✓	✓	-	-
1997	-	-	✓	O	✓	✓	-	-
1998	-	-	-	-	-	-	-	-
1999	-	-	✓	O	✓	✓	-	-
2000	-	-	-	-	-	-	-	-
2001	✓	X ?	-	-	-	-	-	-
2002	-	-	-	-	✓	X ?	-	-
2003	✓	X ?	✓	X ?	✓	X ?	-	-
2004	✓	X ?	✓	X ?	✓	X ?	-	-
2005	-	-	✓	X ?	✓	X ?	-	-
2006	✓	O	✓	O	✓	✓	-	-
2007	✓	O	✓	O	✓	✓	-	-
2008	O	O	✓	O	✓	✓	-	-
2009			?	?	?	?	-	-

Table 6: Years for which species- and sex-disaggreagated ALKs from surveys are available as at May 2009.

	M. paradoxus	*M. capensis*
West coast summer	1999, 2007, 2008	1999, 2007, 2008
West coast winter	-	-
South coast spring	2007	2007
South coast autumn	2006, 2007, 2008	2006, 2007, 2008