2011 Routine Update of the South African Hake Base Reference Case Assessment

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As required under the annual OMP review process, this paper presents a routine update of the South African hake Reference Case assessment (RS1) (Rademeyer and Butterworth, 2010), including new commercial (catches and CPUE) and survey (abundance estimates) data. This analysis does not include updated length distribution data.

METHODOLOGY and DATA

The methodology is as detailed in Rademeyer and Butterworth (2010). The updated data are listed in Appendix A.

RESULTS AND DISCUSSION

Two assessments are compared:

1) the Reference Case assessment, with data to 2009, named here RS1-2009; and
2) the comparable assessment with the data updated to 2011, named here RS1-2011;

Table 1 compares estimates of management quantities for these two assessments, while Fig. 1 plots the spawning biomass trajectories.

Figs 2 and 3 show the fits to the CPUE and survey abundance indices. Fig. 4 compares the standardised stock-recruitment residuals for RS1-2009 and RS1-2011 assessments and plots the estimated stock-recruitment relationship.

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Glazer JP. 2011a. Separating the offshore hake catches by coast and species. Unpublished report: FISHERIES/2011/SEPT/SWG-DEM/xx.

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Table 1: Comparison of estimates of management quantities of the *M. paradoxus* and *M. capensis* coast-combined resources for RS1-2009 and RS1-2011. *MSY* and associated quantities are given for the offshore trawl fleet. Biomass units are thousand tons. Note that the –lnL values are not comparable given that different data are used. K^{sp} and B_y^{sp}/K^{sp} are for both genders combined, while B_{MSY}^{sp}/K^{sp} and B_y^{sp}/B_{MSY}^{sp} are in terms of the female only spawning biomass.

		RS1-2009	RS1-2011
	-lnL total	-94.5	-103.0
M. paradoxus	K^{sp}	1363	1358
	h	1.08	1.09
	B^{sp}_{2009}/K^{sp}	0.15	0.18
	B^{sp}_{2011}/K^{sp}	-	0.21
	B^{sp}_{MSY}/K^{sp}	0.24	0.24
	$B^{sp}_{2009}/B^{sp}_{MSY}$	0.59	0.66
	$B^{sp}_{2011}/B^{sp}_{MSY}$	-	0.88
	MSY	113	113
M. capensis	K^{sp}	516	506
	h	1.01	1.37
	B^{sp}_{2009}/K^{sp}	0.54	0.54
	B^{sp}_{2011}/K^{sp}	-	0.68
	B^{sp}_{MSY}/K^{sp}	0.47	0.36
	$B^{sp}_{2009}/B^{sp}_{MSY}$	1.12	1.45
	$B^{sp}_{2011}/B^{sp}_{MSY}$	-	1.82
	MSY	69	70

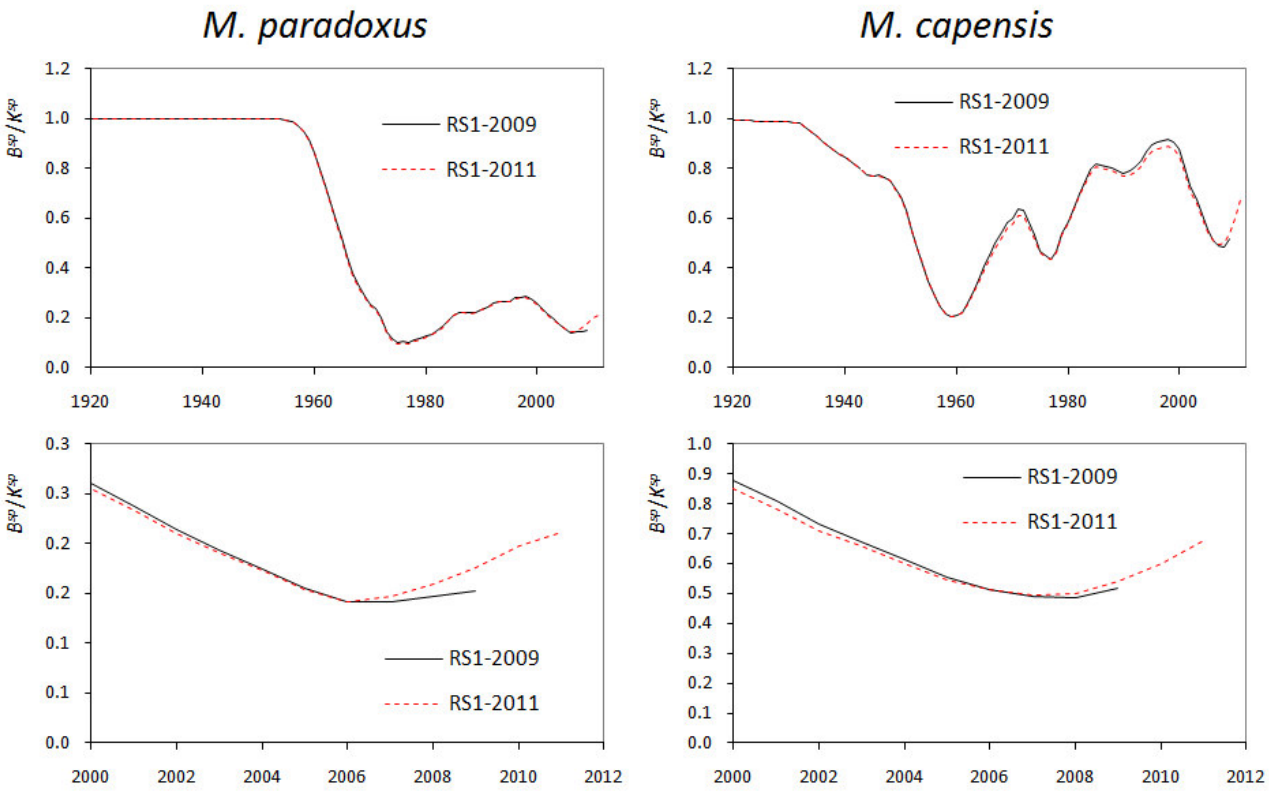

Fig. 1: Trajectories of gender-aggregated spawning biomass (in terms of the pre-exploitation level) for the RS1-2009 and RS1-2011 assessments.

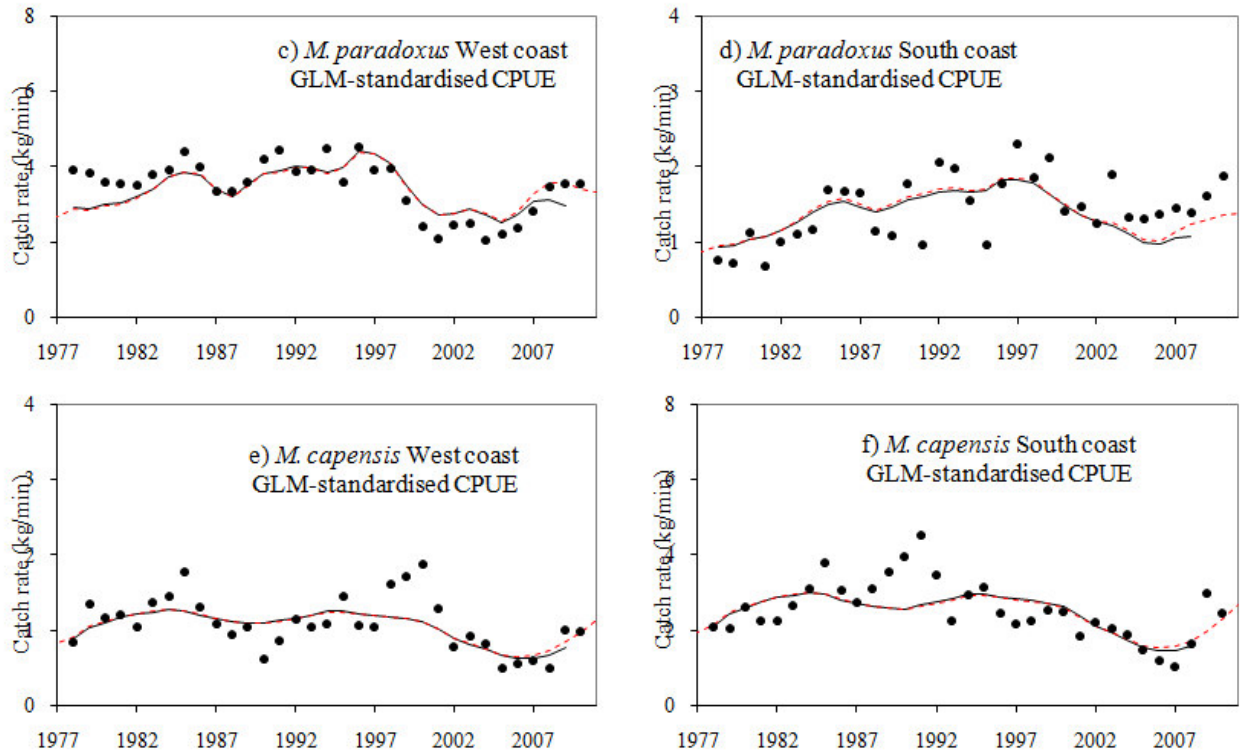

Fig. 2: Fits to the CPUE abundance indices for the RS1-2009 (solid black line) and RS1-2011 (dashed red line).

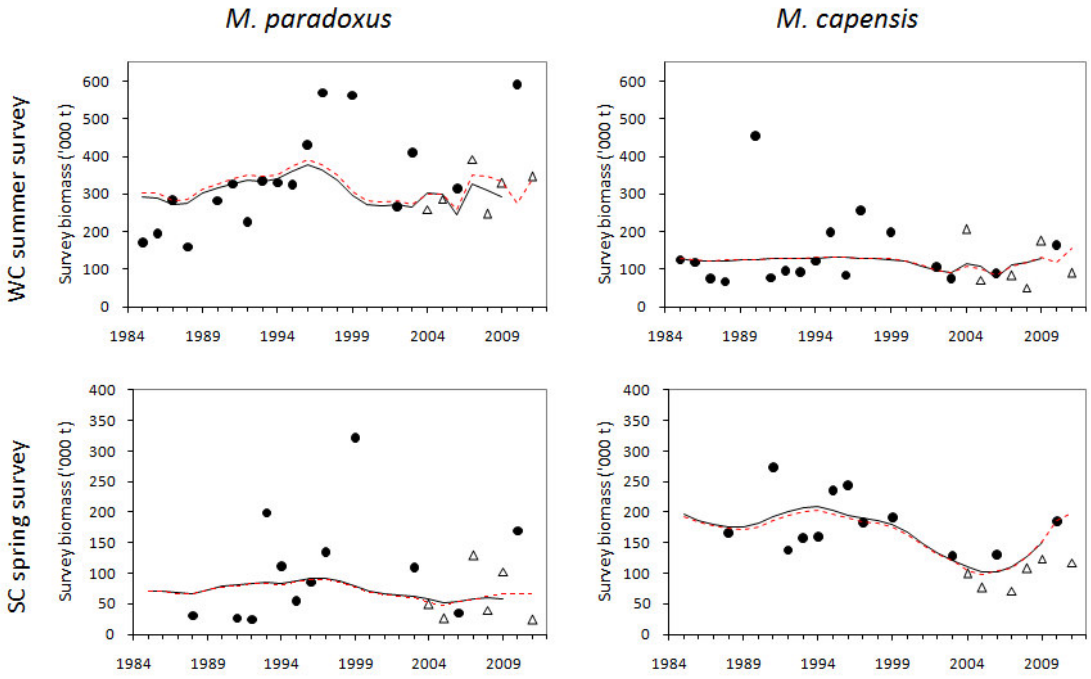

Fig. 3: Fits to the west coast summer and south coast autumn abundance series from surveys by *Africana* (the two longest series) for the RS1-2009 (solid black line) and RS1-2011 (dashed red line) assessments. The observed values shown as Δ were conducted by the *Africana* with the new gear and have been rescaled by the agreed calibration factor for the species concerned.

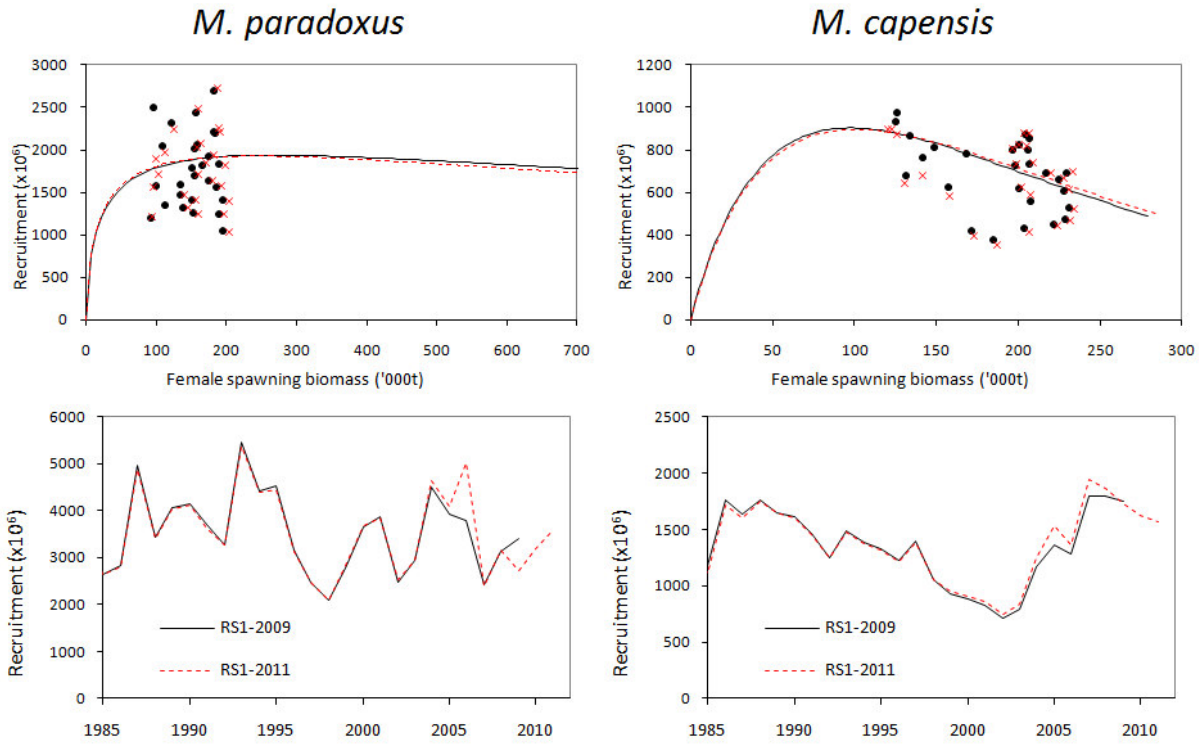

Fig. 4: Estimated stock-recruitment relationships for RS1-2009 (solid black line and solid dots) and RS1-2011 (dashed red line and red crosses) and time series of recruitment. Note that the decrease in σ_R from 0.25 to 0.1 has been moved two years forward for RS1-2011 compared to RS1-2009.

Appendix A - Data Tables

Only the data series that have been updated from the Rademeyer and Butterworth (2010) assessment are presented.

Table App.A.1: Species-disaggregated catches (in thousand tons) by fleet of South African hake from the south and west coasts. Here and in the rest of the document, data that are shaded represent new or updated information since the 2010 assessment (Rademeyer and Butterworth, 2010). The updated offshore trawl catches are from Glazer (2011a) and the updated inshore, longline and handline catches are from Rob Cooper (pers. commn). The baseline assessment assumes 1958 as the centre year of the shift from a primarily *M. capensis* to a primarily *M. paradoxus* in the offshore trawl catches. For 2011, the catches are taken as the 2011 TAC with the same proportion by species and fleet as in 2009.

	M. paradoxus			*M. capensis*					
	Offshore		Longline	Offshore		Inshore	Longline		Handline
	WC	SC	WC	WC	SC	SC	WC	SC	SC
1978	103.665	3.830	-	23.847	3.755	4.931	-	-	-
1979	93.711	2.653	-	39.811	4.266	6.093	-	-	-
1980	100.723	2.833	-	32.805	3.628	9.121	-	-	-
1981	90.572	1.208	-	30.358	4.277	9.400	-	-	-
1982	84.030	4.063	-	29.319	7.294	8.089	-	-	-
1983	71.628	5.920	0.161	22.805	6.596	7.672	0.069	-	-
1984	82.940	4.689	0.256	28.316	6.246	9.035	0.110	0.016	-
1985	93.192	10.054	0.817	31.878	9.962	9.203	0.350	0.292	0.065
1986	105.097	9.974	0.965	28.708	5.991	8.724	0.413	0.302	0.084
1987	95.954	9.495	2.500	21.571	6.189	8.607	1.071	0.353	0.096
1988	83.910	7.184	3.628	22.672	7.332	8.417	1.555	0.331	0.071
1989	84.719	6.919	0.203	22.541	11.993	10.038	0.087	0.032	0.137
1990	89.976	11.636	0.270	13.660	11.155	10.012	0.116	-	0.348
1991	92.787	9.604	-	13.663	12.470	8.206	-	3.000	1.270
1992	89.638	19.260	-	13.649	7.202	9.252	-	1.500	1.099
1993	107.370	11.143	-	10.694	3.117	8.870	-	0.000	0.278
1994	112.355	7.842	1.130	11.512	3.210	9.569	0.484	0.626	0.449
1995	104.842	4.486	0.670	16.055	2.664	10.630	0.287	0.650	0.756
1996	119.889	10.467	1.676	9.286	2.822	11.062	0.718	1.828	1.515
1997	108.917	12.902	1.806	8.237	2.934	8.834	0.774	1.872	1.404
1998	115.290	11.165	0.647	12.363	2.988	8.283	0.277	1.471	1.738
1999	90.030	12.749	1.963	13.731	2.597	8.595	0.841	4.144	2.749
2000	91.437	8.772	3.456	26.264	4.758	10.906	1.481	2.077	5.500
2001	98.133	8.226	2.793	19.463	7.931	11.836	1.197	1.688	7.300
2002	95.115	13.630	4.772	9.815	4.954	9.581	2.045	3.945	3.500
2003	95.035	20.503	4.668	10.342	4.530	9.883	2.000	4.878	3.000
2004	85.893	28.817	3.758	12.338	5.953	10.004	1.611	4.429	1.600
2005	88.595	24.383	4.172	6.673	4.863	7.881	1.788	4.559	0.700
2006	84.902	19.915	3.592	8.595	4.712	5.524	1.539	4.032	0.400
2007	96.408	14.916	3.151	12.461	2.328	6.350	1.350	3.834	0.400
2008	92.405	13.862	2.170	6.970	3.644	5.496	0.930	2.740	0.231
2009	73.183	12.534	2.434	7.316	3.166	5.639	1.043	3.841	0.265
2010	71.443	17.264	2.403	7.795	2.905	5.472	1.030	3.829	0.275
2011	83.749	20.237	2.817	9.138	3.406	6.415	1.207	4.489	0.322

Table App.A.2: South and west coast GLM standardized CPUE data (Glazer, 2011b) for *M. paradoxus* and *M. capensis*.

	GLM CPUE (kg min^{-1})			
	M. paradoxus		*M. capensis*	
Year	West Coast	South Coast	West Coast	South Coast
1978	3.90	0.76	0.85	2.09
1979	3.84	0.71	1.36	2.07
1980	3.60	1.12	1.17	2.60
1981	3.57	0.69	1.21	2.24
1982	3.50	1.00	1.05	2.27
1983	3.79	1.11	1.38	2.67
1984	3.92	1.17	1.46	3.12
1985	4.40	1.69	1.77	3.81
1986	3.99	1.67	1.32	3.08
1987	3.33	1.65	1.08	2.73
1988	3.36	1.16	0.94	3.11
1989	3.59	1.10	1.04	3.54
1990	4.21	1.77	0.62	3.95
1991	4.46	0.96	0.87	4.52
1992	3.86	2.07	1.15	3.47
1993	3.91	1.97	1.04	2.27
1994	4.49	1.55	1.08	2.95
1995	3.60	0.96	1.45	3.13
1996	4.54	1.78	1.06	2.46
1997	3.91	2.31	1.04	2.16
1998	3.98	1.85	1.61	2.24
1999	3.10	2.12	1.71	2.54
2000	2.43	1.41	1.89	2.51
2001	2.10	1.47	1.28	1.86
2002	2.47	1.25	0.78	2.20
2003	2.48	1.90	0.93	2.03
2004	2.06	1.32	0.83	1.89
2005	2.21	1.31	0.49	1.49
2006	2.36	1.37	0.56	1.19
2007	2.80	1.44	0.60	1.04
2008	3.46	1.39	0.50	1.63
2009	3.54	1.61	1.01	2.96
2010	3.55	1.89	0.99	2.46

Table App.A.3a: 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 (updated values from Fairweather, 2011 and Durholtz, 2011). Values in bold are for the surveys conducted by the *Africana* with the new gear.

	West coast				South coast			
Year	Summer		Winter		Spring (Sept)		Autumn (Apr/May)	
	Biomass	(s.e.)	Biomass	(s.e.)	Biomass	(s.e.)	Biomass	(s.e.)
1985	169.959	(36.680)	264.839	(52.949)	-	-	-	-
1986	196.111	(36.358)	172.477	(24.122)	13.758	(3.554)	-	-
1987	284.805	(53.101)	195.482	(44.415)	21.554	(4.605)	-	-
1988	158.758	(27.383)	233.041	(64.003)	-	-	30.316	(11.104)
1989	-	-	468.780	(124.830)	-	-	-	-
1990	282.174	(78.945)	226.862	(46.007)	-	-	-	-
1991	327.020	(82.180)	-	-	-	-	26.638	(10.460)
1992	226.687	(32.990)	-	-	-	-	24.304	(15.195)
1993	334.151	(50.234)	-	-	-	-	198.849	(98.452)
1994	330.270	(58.319)	-	-	-	-	111.469	(34.627)
1995	324.554	(80.357)	-	-	-	-	55.068	(22.380)
1996	430.908	(80.604)	-	-	-	-	85.546	(25.484)
1997	569.957	(108.200)	-	-	-	-	135.192	(51.031)
1998	-	-	-	-	-	-	-	-
1999	562.859	(116.302)	-	-	-	-	321.478	(113.557)
2000	-	-	-	-	-	-	-	-
2001	-	-	-	-	19.929	(9.956)	-	-
2002	267.487	(35.068)	-	-	-	-	-	-
2003	411.177	(69.431)	-	-	**88.442**	(36.051)	108.857	(37.528)
2004	**259.527**	(56.021)	-	-	**63.900**	(17.894)	**48.898**	(20.343)
2005	**286.416**	(39.849)	-	-	-	-	**26.605**	(7.952)
2006	315.310	(49.490)	-	-	72.415	(15.500)	34.799	(8.325)
2007	**392.812**	(70.043)	-	-	**52.287**	(19.231)	**129.646**	(60.661)
2008	**246.542**	(51.973)	-	-	**24.816**	(8.775)	**39.505**	(11.408)
2009	**330.235**	(28.526)	-	-	-	-	**102.834**	(28.670)
2010	592.571	(87.610)	-	-	-	-	169.560	(67.650)
2011	**347.082**	(92.540)	-	-	-	-	**24.105**	(7.089)

Table App.A.3b: 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 (updated values from Fairweather, 2011 and Durholtz, 2011). Values in bold are for the surveys conducted by the *Africana* with the new gear.

	West coast				South coast			
Year	Summer		Winter		Spring (Sept)		Autumn (Apr/May)	
	Biomass	(s.e.)	Biomass	(s.e.)	Biomass	(s.e.)	Biomass	(s.e.)
1985	124.647	(22.707)	181.487	(27.476)	-	-	-	-
1986	117.810	(23.636)	119.587	(18.489)	121.197	(16.625)	-	-
1987	75.693	(10.241)	87.391	(11.198)	159.088	(17.233)	-	-
1988	66.725	(10.765)	47.120	(9.568)	-	-	165.939	(21.871)
1989	-	-	323.833	(67.295)	-	-	-	-
1990	455.798	(135.237)	157.800	(23.561)	-	-	-	-
1991	77.357	(14.995)	-	-	-	-	274.298	(44.395)
1992	95.407	(11.744)	-	-	-	-	138.085	(15.357)
1993	92.598	(14.589)	-	-	-	-	158.340	(13.733)
1994	121.257	(35.951)	-	-	-	-	160.555	(23.701)
1995	199.142	(26.812)	-	-	-	-	236.025	(31.840)
1996	83.337	(9.285)	-	-	-	-	244.410	(25.107)
1997	257.293	(46.056)	-	-	-	-	183.087	(18.906)
1998	-	-	-	-	-	-	-	-
1999	198.716	(32.467)	-	-	-	-	191.203	(14.952)
2000	-	-	-	-	-	-	-	-
2001	-	-	-	-	133.793	(20.858)	-	-
2002	106.253	(15.813)	-	-	-	-	-	-
2003	75.960	(13.314)	-	-	**82.928**	(9.010)	128.450	(20.062)
2004	**205.939**	(33.216)	-	-	**106.119**	(15.596)	**99.902**	(12.027)
2005	**70.983**	(13.845)	-	-	-	-	**76.932**	(5.965)
2006	88.420	(22.851)	-	-	99.867	(9.803)	130.900	(14.816)
2007	**82.270**	(11.441)	-	-	**74.615**	(7.383)	**70.940**	(5.615)
2008	**50.877**	(5.355)	-	-	**94.232**	(11.456)	**108.195**	(9.978)
2009	**175.289**	(39.920)	-	-	-	-	**124.004**	(11.808)
2010	164.660	(34.710)	-	-	-	-	184.960	(37.720)
2011	**89.282**	(23.219)	-	-	-	-	**117.222**	(11.857)