

PELAGIC SCIENTIFIC WORKING GROUP
BRANCH: FISHERIES MANAGEMENT

The current set of available data for evaluation of the Island Closure Feasibility study
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The following data series have been provided to DAFF as the basis for analyses of the Island Closure Feasibility Study. Please note that restrictions on the dissemination and publication of *some* data (greyed out) are in place until 1 September 2016.

Table 1: Fledging success

Data provider: DEA/Richard Sherley

Year	Robben (series 1)	Robben (series 1) n	Robben (series 2)	Robben (series 2) n	Dassen	Dassen n
1989	0.415	65				
1990	0.319	47				
1991	0.592	71				
1992	0.590	61				
1993	0.535	71				
1994	0.446	74				
1995	0.383	47			0.825	174
1996	0.654	81			1.022	101
1997	0.968	124			1.180	149
1998	0.748	119			1.343	133
1999	0.600	130			1.376	74
2001			0.90	10		
2002			0.38	13		
2003			0.42	59		
2004			0.54	87		
2005			0.96	45		
2006			0.67	63		
2007			1.18	160		
2008			1.08	95	1.010	
2009			0.93	86	1.060	
2010			1.06	86	0.909	
2011			1.04	109	1.136	
2012			1.14	77		

Table 2: Chick growth rates

Data provider: DEA/Richard Sherley

Year	Island	Growth rate (median growth coefficient)	Growth rate [*] (mean)	SE	Sample size (no. of chicks)
1989	Dassen	0.0317		0.0011	86
1995	Dassen	0.0374		0.0009	111
1996	Dassen	0.0400		0.0009	145
1997	Dassen	0.0446		0.0009	136
1998	Dassen	0.0395		0.0017	46
2008	Dassen	0.0268		0.0028	14
2009	Dassen	0.0315		0.0019	70
2010	Dassen	0.0328		0.0017	45
2011	Dassen	0.0288		0.0030	19
2012	Dassen			0.0015	126
2013	Dassen			0.0023	70
2014	Dassen			0.0032	30
2004	Robben	0.0461		0.0008	142
2008	Robben	0.0369		0.0025	50
2009	Robben	0.0312		0.0016	88
2011	Robben	0.0329		0.0020	54
2012	Robben	0.0347		0.0029	80
2013	Robben			0.0019	75
2014	Robben			0.0030	39

^{*}Note that previous growth rates reported were median growth coefficients. Mean growth rate is now reported. Note that because these are new data, they qualify for a year's confidentiality (up until 1 September 2016) to protect first publication rights.

Table 3: Active and potential nests

Data provider: DEA/CapeNature

Year	Proportion of total nests which are active			
	Dassen	Dassen (n)	Robben	Robben (n)
1999	0.95	15155	-	-
2000	0.92	17042	0.96	5407
2001	0.85	21410	0.95	6427
2002	0.80	22681	0.94	7099
2003	0.66	20196	0.97	5968
2004	0.54	24901	0.88	7798
2005	0.49	22687	0.79	7152
2006	0.40	13283	0.86	3697
2007	0.43	11785	0.82	5935
2008	0.61	5719	0.99	2234
2009	0.48	5145	0.83	2415
2010	0.40	4929	0.77	2628
2011	0.43	3896	0.66	1817
2012	0.56	2678	0.73	1669

Table 4: Foraging path length

Data provider: DEA/UCT/Cape Nature

Year	Das	Das n	Das SE	Rob	Rob n	Rob SE	St Croix	St Croix n	St Croix SE	Bird	Bird n	Bird SE
2003	33.6	3	1.56	31.2	9	3.10						
2004	21.2	29	1.54									
2007										57.8	15	4.39
2008	57.1	10	7.86	42.7	9	2.78	69.3	18	6.74	36.5	30	1.83
2009	49.1	3	4.38				50.2	14	4.54	40.0	29	2.30
2010	56.9	14	6.85	49.2	11	5.51	69.2	21	5.67	52.1	31	4.35
2011	74.0	22	8.94	55.2	25	7.13	67.8	23	3.32	55.7	53	4.67
2012	50.7	37	4.35	34.3	35	1.55	102.5	20	8.52	62.6	55	2.78
2013	43.2	21	2.06	71.8	12	19.99	77.9	70	2.69	40.4	77	1.80

Note: Text in red has changed since the last version of this document following data checks by Antje Steinfurth and Kate Robinson. No checks to the St Croix and Bird Island data have been done – these are as were reported in doc Peng/C4 of 2014.

Table 5: Foraging trip duration

Data provider: DEA/UCT/Cape Nature

Year	Das	Das n	Das SE	Rob	Rob n	Rob SE	St Croix	St Croix n	St Croix SE	Bird	Bird n	Bird SE
2003	9.6	3	1.04	11.0	9	0.60						
2004	12.5	29	0.84									
2007										20.3	15	1.32
2008	22.6	10	3.66	25.76	10	0.65	22.5	18	1.70	15.3	30	0.75
2009	17.0	3	1.92				17.1	14	1.07	18.4	29	1.08
2010	13.8	14	1.75	18.0	10	2.89	27.1	21	2.12	20.5	31	1.24
2011	17.6	22	2.19	16.8	25	2.12	20.1	24	1.00	23.4	54	1.48
2012	12.7	37	1.18	11.0	35	0.52	27.1	20	2.28	20.0	55	0.57
2013	10.7	21	0.31	19.3	12	4.55	22.2	70	0.85	13.2	77	0.56

Note: Text in red has changed since the last version of this document following data checks by Antje Steinfurth and Kate Robinson. No checks to the St Croix and Bird Island data have been done – these are as were reported in doc Peng/C4 of 2014.

Table 6: Chick condition

Data provider: DEA/CapeNature

Year	Robben	Robben n	Robben SE	Dassen	Dassen n	Dassen SE
2004	0.51	1168	0.009			
2008	0.27	762	0.013	0.32	393	0.023
2009	0.30	1176	0.011	0.28	947	0.014
2010	0.32	397	0.021	0.31	583	0.018
2011	0.24	464	0.018	0.27	717	0.015
2012	0.50	772	0.015	0.30	673	0.016
2013						

Note: 2013 data have been afforded confidentiality up until 1 September 2016 to protect first publication rights.

Table 7: Small Pelagic Fishing Blocks used in the aggregation of pelagic catches within 10, 20 and 30 nm of the Islands. See reference maps included as appendix A for positioning of PFB along the South African Coast and their proximity to islands.

Data provider: Jan van der Westhuizen (DAFF)

Robben			Dassen			St Croix			Bird		
10	20	30	10	20	30	10	20	30	10	20	30
4953	4902	4901	4931	4820	4810	4655	4600	4600	4702	4701	4600
	4903	4902		4830	4815		4605	4605		4702	4650
	4942	4903		4840	4820		4650	4650		4703	4701
	4943	4931		4921	4825		4655	4655		4751	4702
	4952	4932		4931	4830			4701		4752	4703
	4953	4941		4932	4835			4751		4753	4704
		4942		4941	4840			5610		5711	4751
		4943		4942	4845			5614		5712	4752
		4951			4850			5615		5713	4753
		4952			4855			5711			4754
		4953			4911						5610
		5911			4921						5620
		5912			4931						5711
		5913			4932						5712
					4941						5713
					4942						5714
					4943						5721
					4951						5722
					4952						5723
					4953						5724

Note: Catch per set and catch per trip data from 1987 to 2014 is also available from Jan van der Westhuizen on request. The large number of records precludes their listing in this document.

Table 8: Catches taken by the purse-seine fishery within 10 nm of the islands.

Data provider: Jan van der Westhuizen (DAFF)

10nm Year	Dassen			Robben			St Croix			Bird		
	Anchovy	Sardine	Total	Anchovy	Sardine	Total	Anchovy	Sardine	Total	Anchovy	Sardine	Total
1987	5333	567	5899	8353	198	8551	0	0	0	0	0	0
1988	1515	1631	3146	10734	977	11711	0	0	0	0	0	0
1989	2430	606	3037	12646	657	13303	0	0	0	0	0	0
1990	1437	1952	3389	817	1157	1974	0	0	0	0	13	13
1991	917	1267	2184	6151	478	6629	0	62	62	0	0	0
1992	5938	1447	7385	7157	1219	8375	0	0	0	0	7	7
1993	2501	1557	4058	1322	423	1745	0	0	0	0	0	0
1994	4955	837	5792	6447	1381	7828	0	0	0	0	31	31
1995	2668	1204	3872	1420	233	1653	0	0	0	0	0	0
1996	787	4323	5110	2471	1634	4105	0	0	0	0	0	0
1997	475	652	1126	2008	931	2939	0	0	0	0	0	0
1998	283	2668	2951	1198	687	1885	0	38	38	0	0	0
1999	8379	3918	12297	4674	793	5468	0	0	0	0	0	0
2000	7658	914	8572	2983	15	2999	0	0	0	0	0	0
2001	9554	682	10236	2891	129	3021	0	18	18	0	0	0
2002	8985	4624	13609	6870	2836	9706	0	0	0	0	0	0
2003	8053	5188	13241	12835	7016	19851	0	33	33	0	0	0
2004	5342	715	6056	8906	376	9282	0	0	0	0	21	21
2005	19698	606	20303	5922	168	6089	0	0	0	0	9	9
2006	11368	1014	12382	12443	1350	13794	0	64	64	0	167	167
2007	11149	365	11514	13151	446	13597	0	309	309	0	912	912
2008	197	67	264	18111	127	18238	0	28	28	0	326	326
2009	15	14	29	19022	132	19153	0	0	0	0	742	742
2010	6166	846	7012	3889	314	4204	0	0	0	0	32	32
2011	5009	904	5913	0	0	0	0	0	0	0	0	0
2012	12570	143	12713	0	0	0	0	271	271	0	0	0
2013	7530	147	7677	0	0	0	6	164	170	0	0	0
2014	0	0	0	6460	431	6891	0	0	0	0	0	0

Table 9: Catches taken by the purse-seine fishery within 20 nm of the islands.

Data provider: Jan van der Westhuizen (DAFF)

20nm Year	Dassen			Robben			St Croix			Bird		
	Anchovy	Sardine	Total	Anchovy	Sardine	Total	Anchovy	Sardine	Total	Anchovy	Sardine	Total
1987	55122	7280	62401	37283	1733	39016	0	0	0	0	0	0
1988	37539	11539	49077	47413	3222	50635	0	0	0	0	0	0
1989	30498	5038	35536	32766	2653	35419	0	12	12	0	0	0
1990	10028	12548	22575	6224	6784	13008	0	163	163	0	40	40
1991	11977	5285	17262	17309	3092	20400	0	471	471	0	16	16
1992	46421	7886	54307	35917	4465	40382	0	231	231	0	58	58
1993	16144	11818	27961	8960	3757	12718	0	143	143	0	0	0
1994	35678	7638	43316	26707	5594	32301	0	355	355	0	31	31
1995	24930	13536	38467	9911	3087	12998	0	509	509	0	0	0
1996	8353	28978	37331	4665	6147	10812	0	614	614	0	0	0
1997	3672	9730	13402	8351	10168	18519	0	36	36	0	0	0
1998	3635	25706	29341	3595	9301	12896	0	2660	2660	0	0	0
1999	41325	33526	74851	18767	9588	28355	0	1482	1482	0	0	0
2000	35551	8916	44467	14096	2112	16208	0	668	668	0	0	0
2001	57509	8518	66027	13282	3982	17263	0	1100	1100	0	20	20
2002	39423	27062	66485	18975	21328	40303	0	4105	4105	0	12	12
2003	36957	21528	58486	35309	25545	60853	0	14818	14818	0	0	0
2004	30179	2911	33091	20957	2336	23293	0	3976	3976	0	90	90
2005	61371	1862	63233	12943	486	13430	0	1071	1071	0	125	125
2006	43067	4004	47071	23764	2760	26523	0	9485	9485	0	5570	5570
2007	45981	5278	51260	40881	2036	42917	0	2606	2606	0	5854	5854
2008	21071	3324	24395	53327	802	54129	0	491	491	2	3600	3602
2009	5256	420	5676	34991	1315	36306	0	320	320	1	3214	3215
2010	22264	5337	27601	20145	2487	22632	0	1736	1736	0	2028	2028
2011	14888	5355	20243	2558	1143	3701	0	678	678	0	68	68
2012	45743	2071	47814	21049	983	22032	5	4466	4471	0	205	205
2013	10668	831	11499	0	18	18	21	3283	3303	0	420	420
2014	3063	874	3937	11580	1340	12920	0	479	479	0	9	9

Table 10: Catches taken by the purse-seine fishery within 30 nm of the islands.

Data provider: Jan van der Westhuizen (DAFF)

30nm Year	Dassen			Robben			St Croix			Bird		
	Anchovy	Sardine	Total	Anchovy	Sardine	Total	Anchovy	Sardine	Total	Anchovy	Sardine	Total
1987	86864	14422	101286	66013	3702	69715	0	0	0	0	0	0
1988	95111	18313	113425	70147	7524	77672	0	0	0	0	0	0
1989	66531	10620	77152	53854	4961	58815	0	12	12	0	12	12
1990	21891	17610	39501	10671	10960	21631	0	220	220	0	144	144
1991	23440	9409	32849	24133	7098	31232	0	500	500	0	211	211
1992	69627	12602	82228	64193	8619	72812	0	778	778	0	351	351
1993	20260	17881	38142	18919	10385	29303	0	244	244	0	60	60
1994	49627	15499	65126	41629	9778	51407	0	1271	1271	0	194	194
1995	35136	21854	56990	22973	8126	31099	0	1548	1548	0	281	281
1996	15911	42300	58211	8806	20291	29096	0	1596	1596	0	326	326
1997	7072	27355	34427	12393	23327	35720	0	209	209	0	8	8
1998	6575	48784	55360	4546	31819	36365	0	3272	3272	0	694	694
1999	59061	55403	114465	37722	34134	71855	0	2796	2796	0	825	825
2000	50397	26860	77257	31168	13687	44855	0	875	875	0	196	196
2001	76641	19972	96613	34875	18082	52958	0	2333	2333	0	20	20
2002	56635	52559	109195	34561	53139	87700	0	5706	5706	0	74	74
2003	59216	47771	106987	66775	59125	125900	0	15754	15754	0	483	483
2004	44065	7107	51172	41472	13944	55416	0	7666	7666	0	936	936
2005	74423	2241	76664	49668	1742	51410	0	7029	7029	0	2851	2851
2006	62184	6033	68218	49640	6035	55675	0	21855	21855	0	15895	15895
2007	72429	10618	83047	83681	6403	90083	0	7353	7353	0	8339	8339
2008	60033	8284	68317	91143	3468	94610	2	3471	3473	2	5529	5531
2009	34281	1608	35888	54009	5380	59390	1	3366	3367	1	5346	5348
2010	34357	13290	47647	48946	9879	58825	0	3974	3974	0	3235	3235
2011	23924	10640	34564	17291	5939	23229	0	1982	1982	0	350	350
2012	68824	3791	72615	85268	5200	90469	8	5067	5075	9	752	761
2013	10737	1612	12349	16394	1360	17754	33	3703	3736	6	1839	1844
2014	12269	1596	13865	18951	1883	20834	0	516	516	0	422	422

Table 11: Biomass of anchovy and sardine measured during the October-December acoustic survey to the west and east of Cape Agulhas (tonnes).

Data provider: Janet Coetzee (DAFF)

Year	Biomass West of Agulhas			Biomass East of Agulhas		
	Anchovy	Sardine	Total	Anchovy	Sardine	Total
1984	631327	48009	679336	734206	369	734575
1985	1014215	25457	1039672	352080	19556	371635
1986	1978652	238230	2216883	589968	61566	651535
1987	1866430	94165	1960595	242341	17120	259461
1988	1289624	128043	1417668	317436	6319	323754
1989	517293	198328	715622	234236	58327	292562
1990	342812	248855	591667	308899	41020	349919
1991	1254359	517180	1771539	1073476	80678	1154153
1992	1036580	247756	1284337	1051445	246401	1297846
1993	439121	480822	919942	477238	79198	556436
1994	309981	389730	699711	307294	128624	435918
1995	468678	363542	832221	132593	480402	612995
1996	29748	257763	287511	132300	271693	403993
1997	377663	964835	1342498	1104969	259797	1364767
1998	206586	1082547	1289132	1022547	524781	1547328
1999	741961	708029	1449990	1310195	927381	2237576
2000	1960122	726230	2686351	2693657	1566150	4259807
2001	2301999	669617	2971617	4418288	1639983	6058270
2002	2018570	1184713	3203283	1849079	3021538	4870617
2003	1181111	1343118	2524229	2447010	2221053	4668063
2004	736973	292522	1029495	1374701	2323193	3697894
2005	670730	75604	746334	2408227	973386	3381614
2006	1027009	177889	1204898	1079264	534667	1613932
2007	887831	53138	940969	1617824	199061	1816886
2008	1421593	211871	1633464	2325002	172209	2497211
2009	2098253	262175	2360428	1694294	239400	1933695
2010	354149	309465	663614	1723266	198927	1922193
2011	173390	182825	356215	580734	854235	1434970
2012	1022472	186109	1208580	2165493	158945	2324438
2013	1161192	467613	1628805	2658474	114150	2802625
2014	1298929	195786	1494714	1671831	248715	1920546

Table 12: Recruitment estimates (May/June) for the standard survey area up to Cape Infanta. Biomass data are in tonnes and numbers are in billions.

Data provider: Janet Coetzee (DAFF)

Year	ANCHOVY			SARDINE		
	Biomass	CV	Numbers	Biomass	CV	Numbers
1985	344245.3	0.262	83.45	37635.61	0.397	3.592
1986	617424.9	0.171	139.31	43239.59	0.343	3.677
1987	687635.7	0.158	124.45	89502.3	0.393	7.352
1988	561356.6	0.155	129.02	4724.404	0.410	0.439
1989	162131.9	0.193	33.13	46238.81	0.277	2.129
1990	169586.7	0.217	51.14	28176.57	0.658	2.492
1991	521418	0.141	113.58	22769.21	0.228	1.915
1992	438584.1	0.153	93.68	69607.89	0.273	5.633
1993	445793.8	0.254	115.06	109591	0.234	15.238
1994	135022.7	0.174	30.55	57208.2	0.259	2.654
1995	391748.7	0.168	110.44	194506.3	0.216	25.388
1996	72076.83	0.212	25.77	48154.23	0.349	3.204
1997	402624.2	0.175	90.21	342362.8	0.262	36.856
1998	451211.2	0.150	136.52	129663.8	0.360	10.716
1999	812242.2	0.158	199.23	219249	0.376	10.378
2000	2474927	0.168	624.68	264452.3	0.390	20.002
2001	1946112	0.135	627.20	559078.7	0.287	60.065
2002	1543397	0.115	520.41	595913.3	0.182	49.153
2003	1396638	0.189	430.31	501623.6	0.209	36.448
2004	1058653	0.219	238.57	26002.97	0.342	4.089
2005	550234.9	0.273	176.92	16895.73	0.343	2.874
2006	263888.6	0.174	117.46	50067.02	0.381	9.564
2007	1505898	0.184	506.70	32777.26	0.343	2.937
2008	1426705	0.202	563.16	19610.14	0.266	3.852
2009	1306045	0.189	363.39	55111.23	0.776	9.207
2010	1667994	0.267	383.33	479609.5	0.473	35.569
2011	281260.2	0.283	104.17	53680.91	0.475	5.470
2012	971349.9	0.137	209.21	113186.98	0.305	7.524
2013	1164278	0.182	352.99	102169.3	0.416	12.124
2014	544509.5	0.340	179.47	25072.7	0.622	1.985

Table 13: Small scale acoustic survey estimates of pelagic fish biomass (tonnes) in the upper 50 m of the water column.

Data provider: Janet Coetzee (DAFF)

Robben Island			Dassen Island			Bird Island			St Croix Island		
Date start	Biomass	CV	Date start	Biomass	CV	Date start	Biomass	CV	Date start	Biomass	CV
05/04/2009	1 703.5	0.62	02/06/2010	154 182.1	0.48	25/03/2010	16 315.7	0.23	16/01/2010	50 940.8	0.22
19/04/2009	1 004.0	0.65	20/07/2010	146 027.1	0.51	13/04/2010	47 795.3	0.30	13/02/2010	62 866.6	0.29
04/05/2009	4 879.6	0.38	07/09/2010	5 178.5	0.46	26/04/2010	16 225.2	0.47	05/03/2010	56 173.2	0.30
29/06/2009	4 456.5	0.27	28/02/2011	45 381.1	0.24				21/03/2010	44 355.3	0.29
27/07/2009	16 320.1	0.43	10/05/2011	28 608.4	0.23				14/04/2010	55 219.5	0.19
07/08/2009	12 996.3	0.42	05/07/2011	63 748.9	0.56				27/04/2010	26 637.9	0.15
03/02/2010	0.0	0.00	19/07/2011	19 172.2	0.50						
30/06/2010	64 846.7	0.36	10/08/2011	9 808.2	0.62						
02/08/2010	81 620.7	0.32	19/09/2011	3 906.6	0.49						
02/09/2010	41 309.0	0.32	28/02/2012	38 496.4	0.33						
06/10/2010	2 584.9	0.54	25/04/2012	20 252.8	0.37						
08/03/2011	49 289.0	0.30	15/06/2012	163 258.5	0.34						
16/05/2011	4 405.7	0.20	24/07/2012	42 778.8	0.47						
27/06/2011	48 962.2	0.70									
26/07/2011	548.6	0.25									
16/08/2011	7 556.3	0.84									
26/09/2011	657.2	0.35									
26/03/2012	41 705.0	0.38									
27/04/2012	72 711.2	0.35									
17/07/2012	159 039.0	0.28									
02/08/2012	187 249.4	0.32									
05/09/2012	31 692.8	0.58									
15/05/2013	7 159.2	0.32									

Table 14: Schedule of closures around breeding colony islands.

Island	2008	2009	2010	2011	2012	2013	2014	2015
Dassen Island	X	X					X	X
Robben Island				X	X	X		
St Croix Island		X	X	X				X
Bird Island					X	X	X	
X = closed								
In all instances a circle of 20km radius around the island (measured from the centre of the island, see Table 16) was closed to fishing. An additional area with a radius of 5km was closed around Riy Banks in Algoa Bay as part of the St Croix Island closure).								

Table 15: Catches taken within a 20 km radius around each of the breeding colony islands. Grey shaded blocks indicate closure around a particular island has been in effect.

20km	Dassen			Robben			St Croix			Bird		
Year	Anchovy	Sardine	Total	Anchovy	Sardine	Total	Anchovy	Sardine	Total	Anchovy	Sardine	Total
1987	36574	2660	39234	29706	1035	30741	0	0	0	0	0	0
1988	22770	5605	28375	36022	2283	38305	0	0	0	0	0	0
1989	14505	2102	16607	25352	1908	27260	0	10	10	0	0	0
1990	5920	5788	11708	3791	3502	7293	0	145	145	0	25	25
1991	6926	2852	9777	13720	2126	15847	0	443	443	0	8	8
1992	29353	3944	33297	23798	3224	27022	0	205	205	0	51	51
1993	10785	4869	15654	5520	1922	7442	0	132	132	0	0	0
1994	18893	3029	21922	15885	3826	19711	0	332	332	0	0	0
1995	12531	5332	17862	6933	1490	8423	0	457	457	0	0	0
1996	5024	13103	18128	3596	4149	7745	0	588	588	0	0	0
1997	2498	3488	5986	6830	5291	12121	0	35	35	0	0	0
1998	1738	10524	12263	2693	5461	8154	0	2483	2483	0	0	0
1999	25211	13490	38701	13308	4906	18214	0	1321	1321	0	0	0
2000	19555	3251	22806	10034	1055	11088	0	619	619	0	0	0
2001	36511	3216	39727	9250	2302	11551	0	1054	1054	0	0	0
2002	26967	12825	39792	13879	12909	26789	0	3929	3929	0	12	12
2003	21853	10409	32262	24935	18286	43221	0	14142	14142	0	0	0
2004	17794	1579	19374	14847	1175	16021	0	3765	3765	0	69	69
2005	42711	1134	43845	9048	290	9338	0	1001	1001	0	41	41
2006	30861	2409	33270	18267	2150	20418	0	8526	8526	0	715	715
2007	28430	2045	30475	27874	1279	29153	0	2316	2316	0	2232	2232
2008	5429	735	6164	38219	532	38751	0	438	438	0	1304	1304
2009	1441	211	1652	28703	857	29560	0	286	286	0	540	540
2010	12292	2194	14486	11573	1642	13215	0	1540	1540	0	812	812
2011	8169	2101	10270	0	96	0	0	157	0		45	0
2012	26664	1114	27778	1811	39	0	0	3739	0		40	0
2013	10051	192	10243	0	0	0	0	2506	0		12	0
2014	1046	308	1353	8228	582	0	0	456	0		0	0

Note: Accurate catch positions have only been reported since mid-2011. A time-series of catches taken within a 20 km radius of each closed island for earlier years has been generated as follows:

For each 10 nm pelagic fishing block used to calculate catches within 20 nm (see Tables 7 and 9), the average over the recent years for which accurate catch positions are available of the proportion of the catch within a 20 km radius of the island concerned was calculated. These average values were applied to the 20 nm catch blocks to derive a catch for each year that fell within a 20 km radius.

- Skipper GPS positions and (where these were not available or inaccurate) VMS positions were used to compile a list of sets within 10.799 nautical miles of Dassen, Robben, St Croix and Bird Island. Although VMS data are precise, the reporting frequency is insufficient to ensure complete matching of reported catch and VMS data by time. VMS data were therefore linked to the skipper reported catches by date and time, rounded to 15 minutes. The first match found was used and in instances where no match was found, the search window was extended by 15 minutes on either side of the reported catch time.
- The true distance (d) of each catch position from each island's centre was determined as

$$d = \sqrt{60(lat_i - lat_c)^2 + [60(long_i - long_c)\cos lat_i]^2}$$

Where lat_i and $long_i$ are the decimalised latitude and longitude of the centre of each island concerned (see Table 16) respectively and lat_c and $long_c$ are the decimalised latitude and longitude of the reported catch position respectively.

Also note: Catches are reported in degrees and minutes, without seconds (1 nm or 1.852 km accuracy). This, together with the need to match catch time to approximate VMS position in cases where catch positions were obviously incorrectly reported or missing, results in some catches being placed within the 20 km radius during periods of closure. For this reason, a second catch series similar

to that reported above, but within an 18.148 km radius of each island has been created. This reflects catches that were definitely within the 20 km radius closure after accounting for the accuracy of reported positions.

Table 16: Catches taken within an 18.148 km radius around each of the breeding colony islands. Grey shaded blocks indicate closure around a particular island has been in effect.

20km	Dassen			Robben			St Croix			Bird		
Year	Anchovy	Sardine	Total	Anchovy	Sardine	Total	Anchovy	Sardine	Total	Anchovy	Sardine	Total
1987	33711	1926	35636	27954	943	28897	0	0	0	0	0	0
1988	20815	4477	25292	34712	1994	36706	0	0	0	0	0	0
1989	12811	1475	14286	23777	1699	25476	0	8	8	0	0	0
1990	5311	4454	9765	3088	2591	5679	0	127	127	0	25	25
1991	6185	2127	8311	12747	2033	14781	0	402	402	0	8	8
1992	26656	3094	29750	21676	3063	24738	0	175	175	0	51	51
1993	9940	3538	13478	4966	1666	6631	0	115	115	0	0	0
1994	16279	2253	18533	12666	3275	15941	0	294	294	0	0	0
1995	9845	3668	13513	6389	1349	7737	0	390	390	0	0	0
1996	4574	10421	14995	3142	3809	6951	0	534	534	0	0	0
1997	2309	2449	4758	6437	4932	11370	0	32	32	0	0	0
1998	1513	7518	9031	2399	5041	7440	0	2209	2209	0	0	0
1999	23309	9146	32455	12290	4399	16689	0	1204	1204	0	0	0
2000	17011	2096	19107	9358	944	10302	0	544	544	0	0	0
2001	33915	2187	36102	8462	2149	10611	0	957	957	0	0	0
2002	25133	9905	35038	12391	11701	24091	0	3567	3567	0	12	12
2003	19548	8406	27955	21311	17168	38479	0	12802	12802	0	0	0
2004	15962	1146	17108	13016	1080	14096	0	3382	3382	0	69	69
2005	40408	1005	41412	7996	243	8239	0	889	889	0	41	41
2006	28804	2084	30888	16147	1925	18072	0	7447	7447	0	715	715
2007	25956	1552	27507	24434	1196	25630	0	2041	2041	0	2232	2232
2008	3867	372	4239	34331	490	34821	0	382	382	0	1304	1304
2009	914	175	1089	26356	834	27190	0	242	242	0	540	540
2010	10831	1717	12548	9470	1525	10995	0	1392	1392	0	812	812
2011	7438	1645	9083	0	48	49	0	149	149	0	45	45
2012	24337	896	25234	521	14	534	0	2759	2759	0	40	40
2013	10039	191	10230	0	0	0	0	1991	1991	0	0	0
2014	522	205	727	7305	528	7833	0	407	407	0	0	0

Table 17: Decimalised positions used as the centre of each island in calculating catches within a 20 km radius

Island	Latitude	Longitude
Dassen	-33.4320	18.0890
Robben	-33.8052	18.3695
St Croix	-33.7990	25.7690
Bird	-33.8417	26.2867
Riy Banks	-33.9919	25.8749

Appendix A. Small pelagic fishing block position reference maps.

