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IN PREPARATION

Seabird monitoring on Skomer Island in 2010

J Baer, D Boyle, CM Perrins and C Taylor

The Wildlife Trust of South and West Wales
The Welsh Wildlife Centre
Cilgerran, Cardigan
SA43 2TB

CM Perrins

Edward Grey Institute
Department of Zoology
South Parks Road
Oxford OX1 3PS

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Summary

This report draws together the results of seabird monitoring on Skomer Island in 2010. This includes (among others) population counts, study plot counts, breeding success and adult survival estimates.

There whole island seabird population estimates are summarised below. There are no drastic changes in seabird populations on Skomer in 2010.

Whole Island Seabird population summary for 2010

	Total	% Change	5 Year % Change
Fulmar (AOS)	530	+0.6	-10.92
Cormorant(AON)	3		
Shag (AON)	2 (3?)		
Lesser Black Backed Gull (AOT)	10249	+0.29	-3.6
Herring Gull (AON)	431		
Greater Black Backed Gull (AON)	118	+11.32	-27.4
Black-legged Kittiwake (AON)	1922	-6.06	-7.01
Guillemot (IND)	19962	+5	+17.58
Razorbill (IND)	5391	+2.5	+18.2
Puffin (IND)	12577	-6.89	+15.64

Fulmar productivity in 2010 saw a big increase in fulmar productivity in comparison to the previous four years The mean breeding success of 0.41 per AOS has nearly doubled on 2009 (0.27), but is still below average between years 1986 to 2010 (0.48).

Herring Gull productivity was 0.56 per AON

Lesser Black-backed Gull productivity was relatively good with 0.89 chicks per AON.

Greater Black Backed Gull productivity slightly decreased to 1.03 per AON.

Kittiwake breeding of 0.65 chicks per AON was fairly average with the cyclical long term average (0.64 for the period 1989 - 2010).

Guillemot breeding success by the WTSWW/JNCC field assistant saw a mean productivity of 0.69 fledged birds per occupied site, a small decrease on 2009.

Razorbill breeding success has been very erratic over the last few years. This is probably down to methodological problems – the study plots do not account for birds that we can't see. Thus the study plots might be showing a low productivity where as there are plenty of birds breeding successfully underneath covered rocks, and boulders etc. I would suggest that the methodology for this is substantially reviewed as our current figures are not truly representative.

Puffin productivity was high (0.8) with the population fairly stable following a recent increase (15.5% increase on number of individual 5 years ago). Long term adult survival has seen a significant decline from 93% in the mid 1970s to around 87% currently.

Manx Shearwater study plots on Skomer suggested a large decrease in population (65% on last year). Over the years there has been a significant rise in the numbers of responses though this rise has not been steady and the between-year variation within individual plots has

sometime been surprisingly large. Last year's responses (1181) was 30% higher than the number in 2008, an increase hardly likely to be explained by a population rise in a species with as low as reproductive rate as a shearwater, so a reduction in the number of responses was to be expected. This decrease is not supported on other study birds on the island (the Isthmus)

1 Introduction

Seabirds are a significant component of the marine environment and Britain has internationally important populations of several species. A national Seabird Monitoring Programme, co-ordinated by the Joint Nature Conservation Committee (JNCC), includes a small number of "key site" seabird colonies where detailed monitoring of breeding success, annual survival rates and population trends is carried out. These sites are geographically spread to give as full coverage of British waters as possible.

Skomer Island is the most suitable site for this work in south-west Britain. It is a National Nature Reserve managed by The Wildlife Trust of South and West Wales (WTSWW) under a lease from the Countryside Council for Wales (CCW). Not only is Skomer the most important seabird colony in southern Britain, but the waters around the island have been designated a Marine Nature Reserve. Seabird monitoring fits within a broader framework of monitoring marine and terrestrial organisms on and around the island.

There is an impressive data set for seabirds on Skomer. This is especially important for species such as seabirds with long periods of immaturity and high adult survival rates. The Wildlife Trust has been monitoring seabirds on the island since the early 1960s. Additional detailed studies of particular species, annual adult survival rates, breeding success and other aspects of seabird ecology have been carried out for many years by other bodies.

In 2010, the whole island counts and study plot counts of common guillemot and razorbill, the whole island counts of northern fulmar and all breeding gulls (including black-legged kittiwake) and breeding success rates of fulmar, herring gull, great black-backed gull, kittiwake and guillemot were funded by JNCC. This work is carried out by the island Warden and a contract Field Assistant with additional help in some areas by the island Assistant Wardens and volunteers. Julia Baer was Field Assistant in 2009.

This report complements other seabird monitoring studies undertaken on Skomer by the Edward Grey Institute and Sheffield University.

1.1 Introduction to survival estimates

Survival rates were measured for a number of species on the island. Observations were made by David Boyle. I am grateful to Dr. Matt Wood for helping with the survival analyses in this report. It is also a pleasure to thank the warden, Chris Taylor for help with some aspects of this project.

The survival rate analyses presented have been made from a computer calculation of Maximum Likelihood Measurements (using the programme MARK) As with similar methods, two years of observations are needed to obtain the estimate for a given year, i.e. the 1999 estimate can only be obtained after observations in 2000 and 2001. Hence the survival figure for the last year (2009-10) is not comparable with the others and is not presented. The estimates for other more recent years are likely to change (hopefully not much) with the addition of further years of data. Years for which the survival rates are not given are ones in which estimates cannot be made; this is normally because they are very high and the upper confidence limits exceed 100.

The six graphs showing estimated survival rates of the species concerned are given under the individual species. A table listing the actual figures are in Appendix 5. Each graph has a line at 90% survival for ease of reading.

The biggest change on the Island last year was that over-winter 2007-2008 the rabbit population crashed and this lead to very strong growth of vegetation across the whole island, including especially in the Puffin study area, a dense luxurious growth of grasses, especially Yorkshire Fog. By the summer of 2010 the rabbit numbers seemed to have largely recovered and the vegetation was back to "normal" which meant seeing the rings on the Puffins and the Lesser Black-backed Gulls was easier again, as was locating Puffin and Shearwater burrows.

2 General methods

2.1 Whole island counts

The herring gull *Larus argentatus* and great black-backed gull *Larus marinus* censuses were carried out from mid to late May. The lesser black-backed gull *Larus fuscus* census followed the established method of counts from vantage points of sub-colonies (in the third week of May) corrected by a figure established from actual nest counts in sample areas (during the final week of May).

The whole island counts of the cliff-nesting species were largely carried out during the first week of June

Counting units and methods follows those recommended in Walsh *et al.* (1995), but note that the lesser black-backed gull census methodology has been developed on the island (see Sutcliffe 1993).

Graphs showing whole island populations since the 1960s are presented for each species. Note that in past years different counting units and methods have been used for some species, although those in recent years have been standardised. General trends can nonetheless be identified with some confidence.

2.2 Study plot counts of common guillemots Uria aalge and razorbills Alca torda

Counts were made during the first three weeks of June of the same study plots used in previous years, using methods outlined in Walsh *et al.* (1995). In mid-June 1999, black-and-white photographs were taken of all study plot sites; these are filed on the island.

2.3 Breeding success

Methodology follows that of Walsh *et al.* (1995). Brief details are given separately in each species account. Black-and-white photographs of the breeding success plots were taken in mid June 1999 and are filed on the island.

2.4 Adult survival estimates

The survival rate analyses presented have been made in the same way as in the other years since 1989, (but differ from those presented in earlier years) in that they have been made from a computer calculation of Maximum Likelihood Measurements and only one measure of survival for each year is presented. As with similar methods, two years of observations are needed to obtain the estimate for a given year, i.e. the 1999 estimate can only be obtained after observations in 2000 and 2001. Hence in this report estimates are given up to and including 2000. The most recent years are likely to change (probably only slightly) with the addition of further years of data.

2.5 Weather

There was no noticeable adverse weather which would have had a detriment to the health of the seabird colony on Skomer Island. There were only two instances which involved Manx Shearwater chicks evacuating burrows due to flooding.

3 Northern fulmar

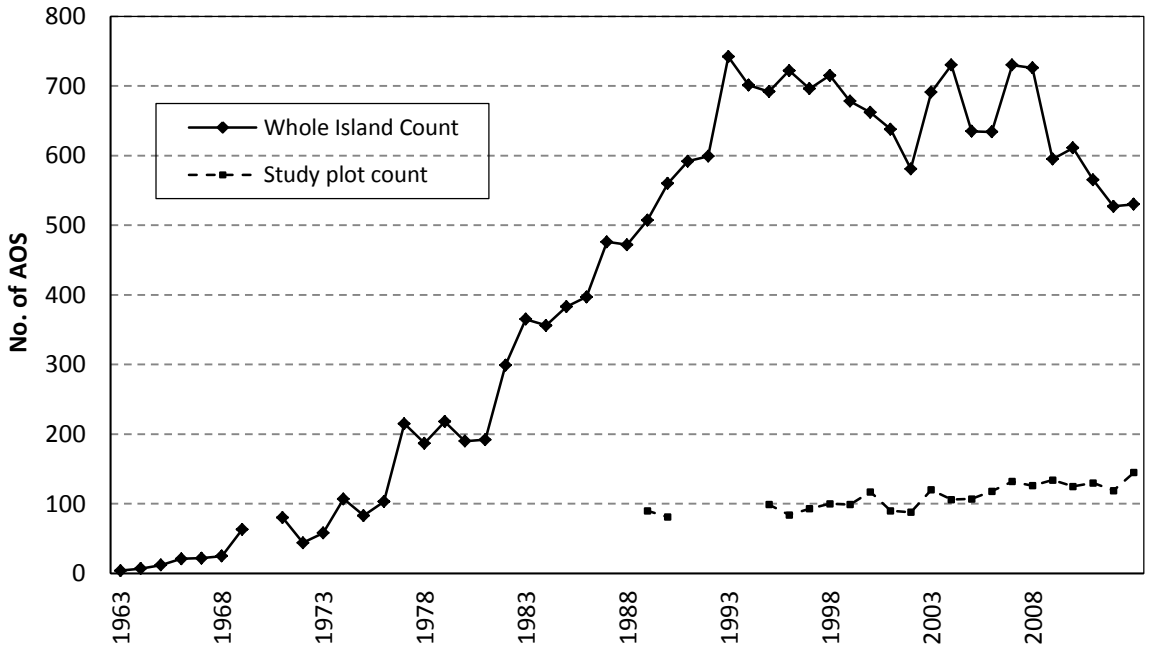
3.1 Breeding numbers - whole island counts

A mean total of 530 Apparently Occupied Sites (AOS) were counted in 2010. Fairly stable on previous year's figure (up 0.53%), thus slightly reducing the 5 year trend to a decrease of -10.92%. 145 AOS were identified in the study plots. There seems to be little correlation between the study plot count and the whole island count.

Table 1 Northern fulmar whole island count details 2004-2010

	Total	% Change	5 Year % Change
2004	730	+15.1	+5.6
2005	726	-0.5	-0.5
2006	595	-18.0	-6.3
2007	611	+2.7	-3.6
2008	565	-7.5	-22.6
2009	527	-6.7	-27.4
2010	530	+0.6	-10.92

Figure 1 Northern fulmar breeding numbers on Skomer Island 1963-2010.



3.2 Breeding success

3.2.1 Methods

Three visits were made to the seven fulmar study plots on 26th May, 29th May and 1st June to observe site occupancy. Sites were considered occupied if a bird appeared to be incubating or an egg was seen on two consecutive visits. Further visits were made between 28th July and 22nd August to determine the presence or absence of large chicks on the sites. All large chicks were assumed to have fledged.

3.2.2 Results

2010 saw a big increase in fulmar productivity in comparison to the previous four years. 145 AOS were identified in late May / early June. The mean breeding success of 0.41 per AOS has nearly doubled on 2009 (0.27), but is still below average between years 1986 to 2010 (0.48). The most successful site was at Basin East, with 0.64 fledging per AOS (Table 2). Three chicks fledged from Tom's House, a site which frequently experiences complete breeding failure (Table 2).

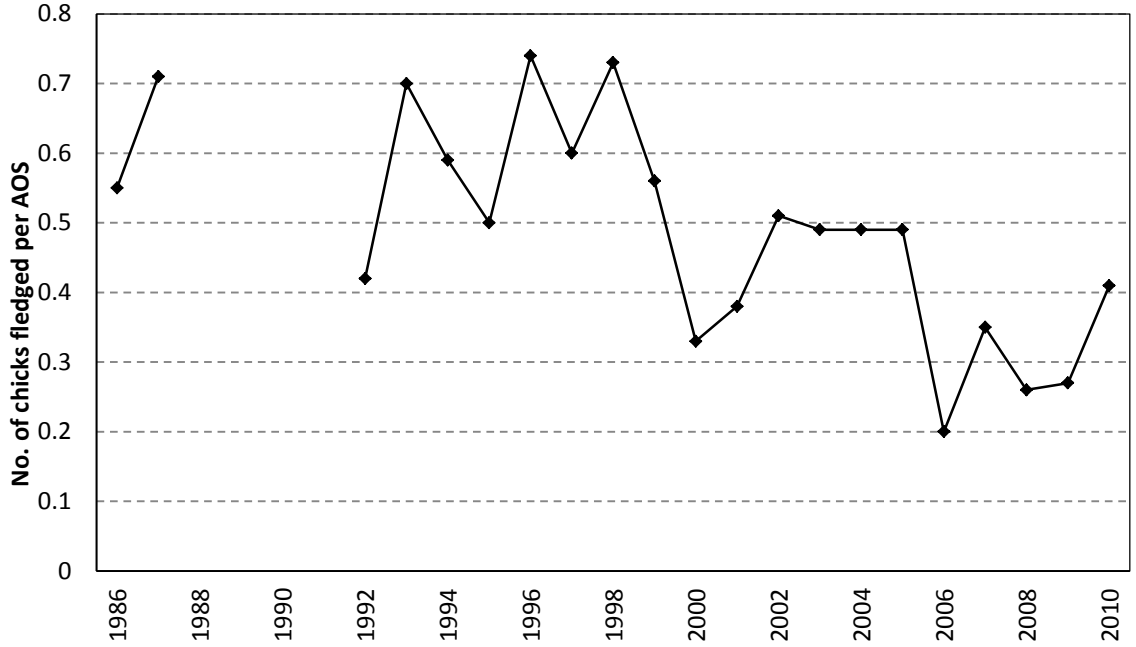
Table 2 Northern fulmar breeding success on Skomer Island 2010.

	No. site monitored	No. sites occupied	Chicks fledged	Breeding success
Tom's House	11	7	3	0.43
Basin (west)	50	26	10	0.38
Basin (east)	24	11	7	0.64
North Haven	81	46	18	0.39
South Haven	27	17	4	0.24
Castle Bay	30	18	6	0.33
Matthew's Wick	36	20	9	0.45
Mean				**0.41**
SD				0.13
SE				0.05

Table 3 Northern fulmar breeding success on Skomer Island 2005 - 2010.

	2005	2006	2007	2008	2009	2010
Tom's House	0.29	0	0	0	0.25	0.43
Basin (west)	0.59	0.18	0.38	0.21	0.32	0.38
Basin (east)	0.31	0.14	0.36	0.25	0.33	0.64
North Haven	0.41	0.3	0.26	0.37	0.34	0.39
South Haven	0.71	0.1	0.5	0.32	0.11	0.24
Castle Bay	0.5	0.29	0.43	0.38	0.25	0.33
Matthew's Wick	0.63	0.39	0.5	0.29	0.32	0.45
Mean	0.49	0.2	0.35	0.26	0.27	**0.41**
SE	0.06	0.05	0.07	0.05	0.03	**0.05**

Figure 2 Northern fulmar breeding success on Skomer Island 1986-87 and 1992-2010.



3.3 Timing of breeding

Time of breeding was recorded in 2010 and is detailed in Table 4.

Table 4 Northern fulmar timing of breeding on Skomer Island 2005 - 2010.

	2005	2006	2007	2008	2009	2010
First egg	20th May	1st June	Not recorded	23rd May	20th May	22nd May
First chick	3rd July	1st July	Not recorded	14th July	8th July	6th July

4 European storm-petrel

No surveys on Skomer have been carried out for European storm-petrel in 2010

5 Manx shearwater Puffinus puffinus

5.1 Study plot census

This is the 13th year in which the Oxford MSc students have carried out the counts of Manx Shearwaters in the study plots on Skomer. Tables 5 and 6 show the number of burrows found and the number of shearwater responses in from them. Over the years there has been a significant rise in the numbers of responses though this rise has not been steady and the between-year variation within individual plots has sometime been surprisingly large. Last year's responses (1181) was 30% higher than the number in 2008, an increase hardly likely to be explained by a population rise in a species with as low as reproductive rate as a shearwater, so a reduction in the number of responses was to be expected.

However, the number of responses this year was very much lower – only 65% of last year's responses and the lowest yet, though at 767 it was very similar to that in 2001 (789). However, the other island information does not support the possibility of a large decline in numbers. The numbers of birds breeding in the study plot on the Isthmus are similar to last year and although the over-winter survival rates from these are not yet available, the return rate to the intensively-studied burrows does not seem low. The number of burrows recorded was low, but not sufficiently so to account for the reduction in responses.

[Note: the same tapes and tape-recorders were used as in earlier years. The reduction is unlikely to be caused by change in personnel; each year the students are doing the project for the first time and it is unlikely that they were all much more inefficient than previously. Fifteen out of 16 plots had fewer responses than last year (this excludes the two very tiny plots, E & F).
Further, we had time to repeat six plots (Table 7) each repeat plot was done by a different group who did not know the previous count. The numbers were remarkably similar.

Table 5 Number of burrows recorded from Manx shearwater study plots 1998 - 2010

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	max	min
A	51	70	87	94	98	145	87	35	105	62	91	61	87	145	35
B	75	102	193	240	98	91	78	81	74	108	49	91	53	240	49
C	299	255	259	202	193	332	287	262	309	387	346	236	246	387	193
D	200	235	296	244	320	313	98	210	253	303	204	206	201	320	98
E	63	65	66	67	61	58	48	37	49	38	48	32	46	67	32
F	14	17	12	11	17	20	15	18	15	13	13	12	17	20	11
G	11	16	15	14	22	21	14	22	29	19	34	25	19	34	11
H	98	97	120	120	140	126	88	118	85	167	84	87	89	167	84
I	271	293	199	321	260	309	236	389	230	331	246	465	278	465	199
J	339	311	455	401	360	359	305	224	219	337	407	315	275	455	219
L	473	506	596	560	593	661	527	693	445	709	472	604	422	709	422
M	234	231	240	188	175	218	167	141	168	154	152	191	157	240	141
N	207	249	261	288	248	261	221	252	282	214	235	215	221	288	207
O	93	99	140	152	110	142	278	119	125	156	139	84	185	278	84
P	151	205	234	204	228	270	124	283	264	257	254	303	256	303	124
Q	84	82	77	95	85	71	112	132	108	119	85	111	77	132	71
R	190	235	329	236	214	314	278	276	279	197	158	167	189	329	158
S	97	187	127	237	213	274	241	244	286	344	260	311	248	344	97
TOTAL	2950	3255	3706	3674	3435	3985	3204	3536	3325	3915	3277	3516	3066		

Table 6 Number of responses from Manx shearwater study plots 1998 – 2010

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Max	Min
A	12	15	17	12	20	15	16	12	28	10	23	20	9	28	9
B	19	35	18	19	32	28	32	15	21	30	12	15	9	35	9
C	56	45	27	35	36	45	52	41	53	66	69	82	30	82	27
D	81	65	61	51	71	55	52	64	64	73	61	57	31	81	31
E	17	14	17	15	14	7	9	9	10	5	8	3	5	17	3
F	3	3	2	5	5	6	4	7	8	6	6	3	4	17	2
G	2	6	4	3	9	7	5	8	9	2	9	12	6	19	2
H	23	17	10	15	16	10	14	16	13	17	14	22	12	23	10
I	72	88	74	117	75	67	102	134	111	116	83	169	110	169	67
J	77	75	107	67	54	66	81	73	42	70	72	80	46	107	42
L	147	132	186	131	142	164	185	244	150	157	156	222	123	244	123
M	85	80	67	62	79	94	71	75	66	73	65	81	33	94	33
N	51	67	39	49	52	44	40	63	75	23	37	70	41	75	23
O	27	29	38	34	30	36	84	34	40	29	25	38	30	84	25
P	30	60	57	67	78	77	32	67	95	72	117	93	80	117	30
Q	34	26	17	17	29	26	32	32	32	31	20	65	20	65	17
R	48	44	65	39	56	83	91	92	72	65	62	53	65	92	39
S	37	67	45	51	63	75	63	65	55	73	69	96	87	96	37
TOTAL	821	868	851	789	861	905	965	1052	944	918	908	1181	767		

Table 7 Plots, Interval between counts (No. Days) and burrow and response counts for plots counted twice in 2010

	Interval	Burrows 1	Burrows 2	Response 1	Response 2
A	5	87	88	9	9
B	5	53	36	9	2
C	5	246	220	30	37
E	4	46	82	5	2
H	4	89	51	12	5
I	4	278	278	110	120

5.2 Breeding success

Manx Shearwater breeding success in The Isthmus study plot in 2010 is detailed in Tables 8 & 9 below.

Table 8 Breeding success of Manx Shearwaters 2010

	Number
Total Number of eggs laid	115
Number of eggs that hatched[1]	80
Number of chicks found dead	2
Number of missing chicks[2]	8
Number of chicks surviving to ringing age[3]	70
Hatching success[4]	70%
Fledging success[4]	88%
Number of fledged young per occupied burrow	**0.61**

Notes:
1) No chick was found in 35 burrows: 18 burrows are known to have failed at the egg stage (2 burrows were taken over by Puffins and in the other 16 burrows either cold abandoned eggs or broken eggs were found). The other 17 burrows were empty when they were checked for chicks in early July so it is not known if the egg failed or the chick died when very small; as in previous years it is assumed the eggs failed (but it is more likely they failed at the small chick stage).

2) These chicks definitely hatched, being recorded when small, but their burrows were empty when it came to ringing the chicks and they are assumed to have died.

3) Birds surviving to this stage are assumed to have fledged as they are not ringed until large.

4) Due to the 17 burrows that are assumed to have failed at the egg stage but could have actually failed when the chick was very small hatching success is a minimum and fledging success a maximum.

Table 9 Breeding of success of Manx Shearwaters 1995-2010

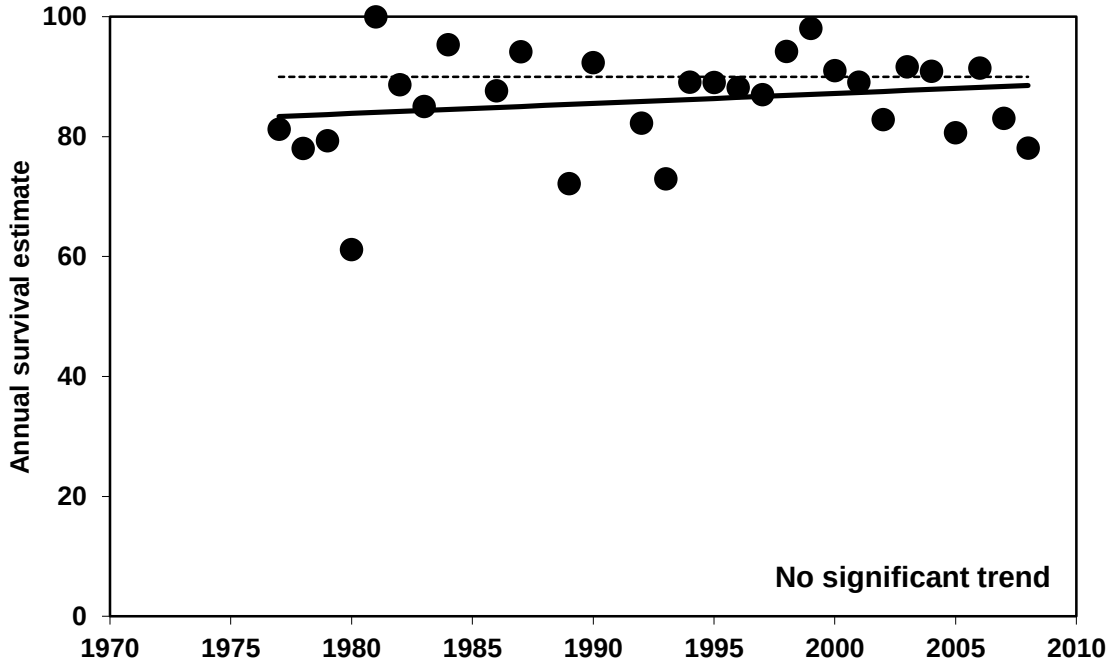
	N. Laid	**N. Hatch**	**N Fledge**	**%Hatched Fledged**	**%Eggs Fledged**
1995	82	58	56	0.97	0.68
1996	75	57	55	0.96	0.73
1997	82	58	52	0.90	0.63
1998	71	61	54	0.89	0.76
1999	84	58	56	0.97	0.67
2000	83	59	51	0.86	0.61
2001	98	62	42	0.68	0.43
2002	108	73	62	0.85	0.57
2003	104	78	73	0.94	0.70
2004	97	61	51	0.84	0.53
2005	122	82	68	0.83	0.56
2006	110	64	52	0.81	0.47
2007	108	71	55	0.77	0.51
2008	99	73	67	0.92	0.68
2009	114	73	67	0.92	0.59
2010	115	80	70	0.70	0.88

5.3 Adult survival

The shearwater survival estimates are based on birds that are marked in burrows on the Isthmus. All but a few of the nests are reached every year and the majority of the birds breeding in them are caught. In recent seasons, night searches for adults in the vicinity have turned up a few "missing" birds - birds that had survived, but were not breeding in the study burrows; presumably they were living nearby. As reported last year, a small patch of burrows, formerly monitored are now omitted due to the state of the ground.

Appendix 5 gives the estimated adult survival rates of Manx Shearwaters. As reported previously, these remain low, both in comparison with more detailed studies carried out earlier on Skokholm and with what one might expect for a bird with such a low reproductive rate, but there are no discernible long-term changes.

Figure 3 Trend of annual survival estimate of Manx Shearwater up to and including survival from "2008 to 2009"



6 Great cormorant

6.1 Breeding numbers

The number of breeding great cormorant on Skomer has fluctuated at a rather low level over the past four decades. In 2010 only three pairs were seen on the South side of the Mew Stone. As a result productivity was difficult to monitor. No pairs nested on the north side.

Figure 4 Great cormorant breeding numbers on Skomer Island 1960-2010

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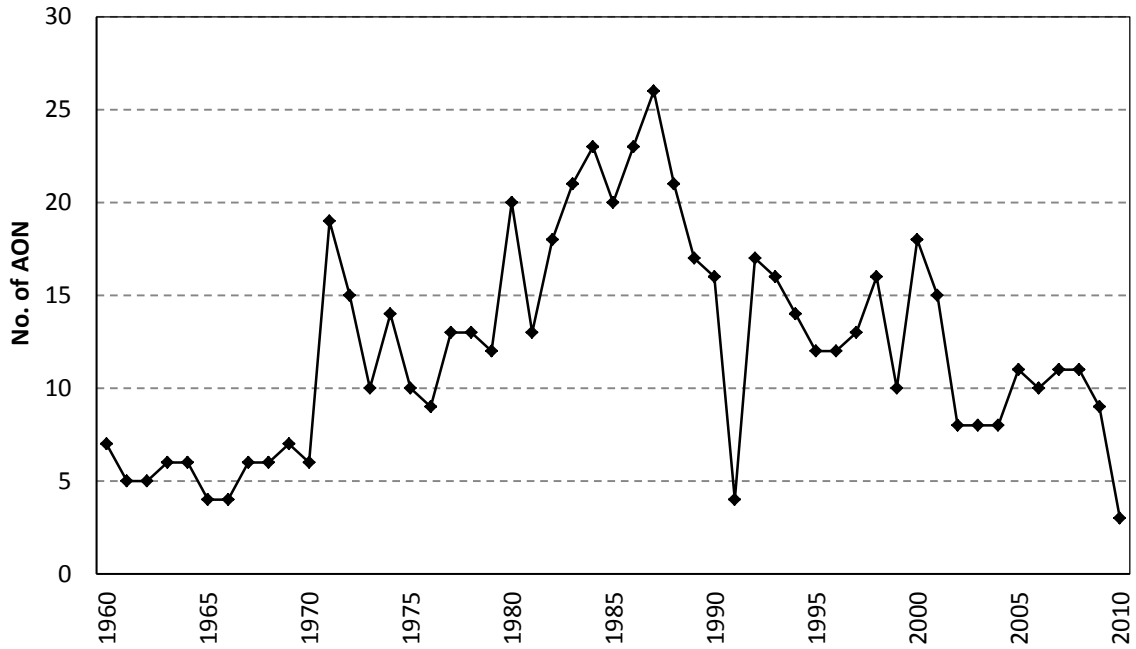


6.2 Breeding success

No record of productivity was made in 2010 because all three nests were on the South side of the Mew Stone.

7 European shag

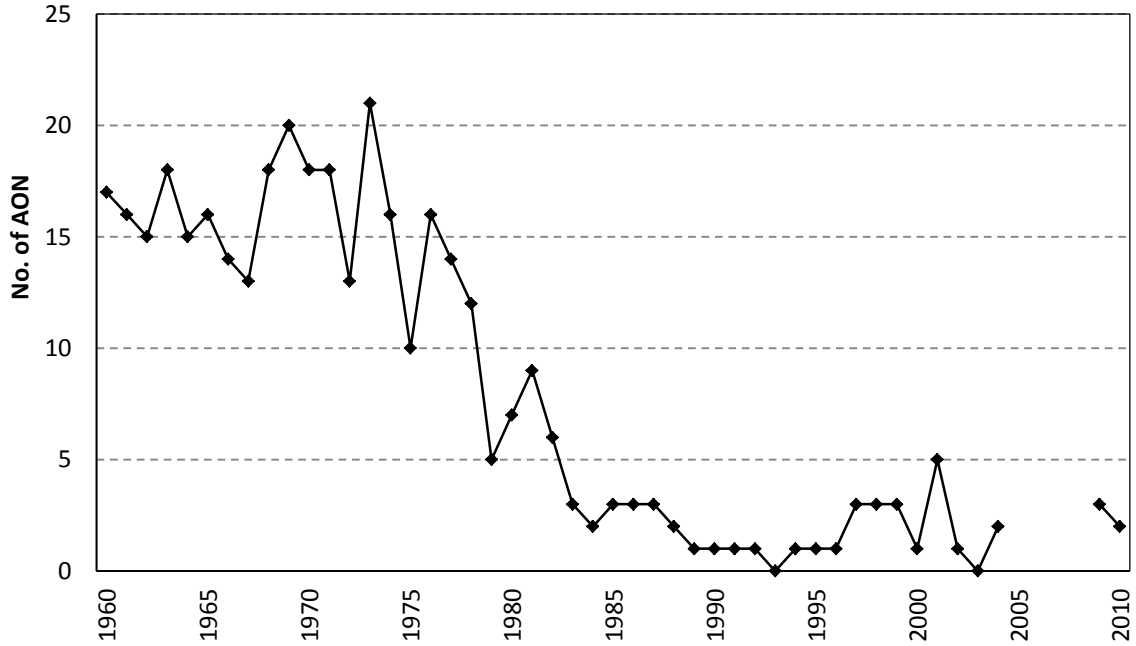
7.1 Breeding numbers

The number of European shags on Skomer has remained at very low levels since the early 1980s, only 2 pairs breed this year with a 3rd possible pair near High Cliff.

7.2 Breeding success

No consistent monitoring of the breeding success of European shags on Skomer took place in 2010, but young were seen during June cliff counts. On nearby Middleholm there were 52 Apparently Occupied Nests. 2.42 chicks per AON were raised (South Pembrokeshire Ringing Group, SPRG).

Figure 5 European shag breeding numbers on Skomer Island 1960-2010.



8 Lesser black-backed gull

8.1 Methods for estimating breeding numbers

Counts of AOS were made from various standardised viewpoints around the island. On most occasions a group of observers counted sub-colonies simultaneously (defined as the count 'event'); the mean counts from each event were then used to calculated the overall mean for each sub-colony. Nests, including empty nests, in selected sub-colonies were then systematically searched for, counted and marked with canes. The difference between the counts from viewpoints and the actual nest counts produced a mean adjustment factor, that was applied to the mean of the counts from viewpoints for the whole island. The method assumes that each pair built one nest. Applying a single correction factor to the whole range of sub-colonies, which vary in habitat type and breeding density, may lead to errors, although it is difficult to overcome this.

8.2 Breeding numbers – results

A mean total of 5551 Apparently Occupied Territories (AOT) were counted by eye from various standardised viewpoints around the island (Table 10). This count is then corrected for by nest searches in a selected sample of sub-colonies.

The number of nests, including empty (but active) nests, in selected sub-colonies were systematically counted physically using canes (Table 11.) The mean ratio of actual number of nests to "eye-counts" was 1.84. When multiplied by the eye-count this gives a population estimate of 10,249 breeding pairs (Figure 6) A figure marginally up (0.29%) on 2009

Table 12 and 13 shows an apparent increase of empty nests on previous records. This year the Gull count was a little earlier that previous years. This coupled with the fact that the gulls began breeding later than usual probably amounted to an increase in the number of empty nests for 2010.

Further work must be carried out in 2011 to ascertain the usage of empty nests by gulls – and thus the reliance on including empty nests in the total population figures.

Table 10 Lesser Black Backed Gull actual nest count, total in cane counted areas and cane:eye count ratio.

		Cane Count	2nd Cane Count	TOTAL	Eye count	Ratio
8 and 9	Garland stone	216	79	295	264	1.12
5	Bull hole	180	12	192	101	1.90
2	Marble Rocks	228	84	312	134	2.33
M and N	Wick	686	76	762	516	1.48
Y		379	28	407	169	2.41
Mean						**1.85**
SD						0.55

Table 11 Mean eye count totals of Lesser Black Backed Gull AOT in sub colonies

	2010
1 South Old Wall	95
2 Marble Rocks	134
3 Abyssinia + 24	136
4 Anvil Rock	148
5 Bull Hole	101
6 Pyramid Rock	114
7 North Plain	358
8 Sheer Face W	163
9 Sheer Face E	101
10 The Hill	9
11 Double Cliff	35
12 North slopes	78
13 N Valley Rise	322
14 Green Plain	586
15 S Neck - Thorn Rock	0
16 W/S Field	22
17 Saunders Fist	0
18 Harold Stone	0
19 Wick Cliff	10
20 Tom's House-Sk Head	6
21 colony now joined with X	134
22 Garland Stone	39
23 NW Neck	49
24 E of W Pond – see 3	
25 Toms House to Wick	30
A Lantern	0
B Neck E	85
C Neck main ridge	153
D South Castle	89
E Neck SW coast	36
F South Haven	152
G S Stream Cliff	88
H Welsh Way	59
I High Cliff	96
J S Wick Ridge	59
K Wick	0
L Welsh Way Ridge	151
M N Wick Ridge - S	342
N N Wick Ridge - N	174
O Moory Meadow	79
P South Stream	135
Q Bramble	36
R Lower Shearing Hays	261
S New Park	105
T Shearing Hays	81
U Captain Kites	80
V Wick Basin	33
W The Basin	96
X / 21 (see 21)	
Y Field 11	169
Z Basin-South Pond	148
Extra coastal	174
TOTAL	**5551**

Figure 6 Lesser black-backed gull breeding numbers on Skomer Island 1961-2010.

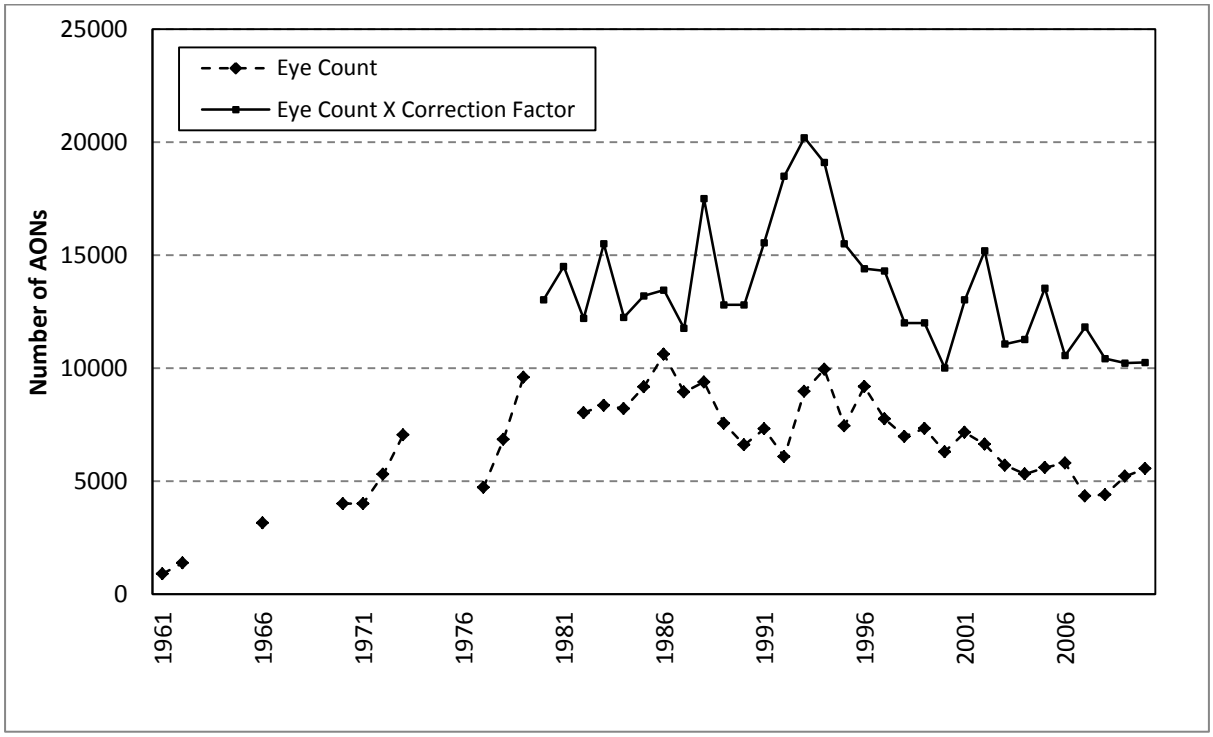


Table 12 Percentage of empty Lesser Black Backed Gull nests counted in May 2010

		TOTAL	Empty total	%empty
8 and 9	Garland stone	295	87	29.49
5	Bull hole	192	36	18.75
2	Marble Rocks	312	80	25.64
M and N	Wick	762	197	25.85
Y		407	53	13.02
Mean				**22.55**

Table 13 Lesser Black Backed Gull empty nest ratios 1998 - 2010

	1998	1999	2000	2001	2001	2003	2004	2005	2006	2007	2008	2009	2010
% Empty nests	14	20	24	16	31	36	19	19	19	28	19	10.8	22.5

8.3 Breeding success

The breeding success of Lesser Black-backed Gulls in the 2010 season was relatively good. We make an estimate of the total numbers by using a simple capture:recapture technique. To do this we ring some of the large fledglings and then count the ringed:unringed ratio when most of the chicks have fledged. Our normal target is to ring at least 300 large chicks. In a few years it has been difficult to find this number, but this year was better than usual and 484 were ringed. The ringed/resighting estimates based on these are shown in Table 5a and the productivity in Table 14.

Table 14 Estimated no. of fledglings

	No. RINGED FLEDGLINGS SEEN	No. UNRINGED FLEDGLINGS SEEN	TOTAL No. FLEDGLINGS SEEN	Est. No. OF FLEDGLINGS
28/07	45	511	556	5857
31/07	23	537	560	11541
01/08	34	599	633	8825
02/08	45	667	712	7500
03/08	26	615	641	11686
Mean				**9082**

Estimated No. of fledglings = No. fledglings ringed (474) x Total No. fledglings seen / No. ringed fledglings seen

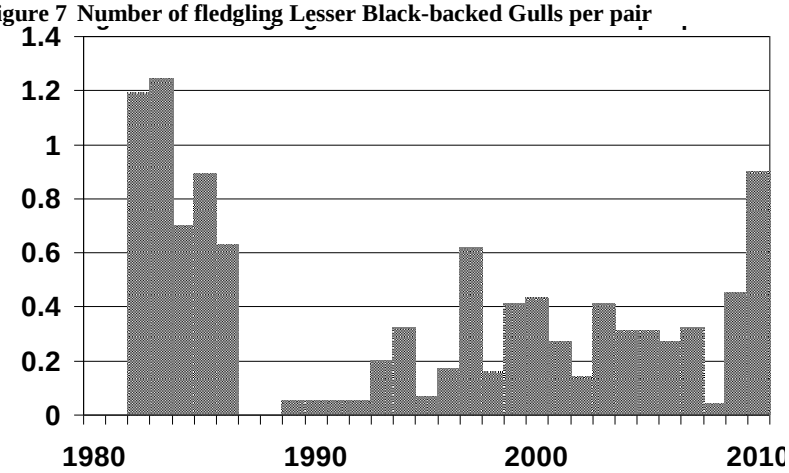
Table 15 Lesser Black-backed Gull productivity 2010

	Est No. of fledglings	Whole Island Productivity (Total AON = 10249)	Not including The Neck (Total AON = 9784)
Max Productivity	11686	1.1	1.2
Min. Productivity	5857	0.6	0.6
Mean	**9082**	**0.89**	**0.93**

Productivity = Est. No fledglings seen / Total Number of Apparently Occupied Nests

The estimated numbers on the five occasions are more varied than usual, but plainly the overall productivity was very high compared with recent years (Fig. 7).

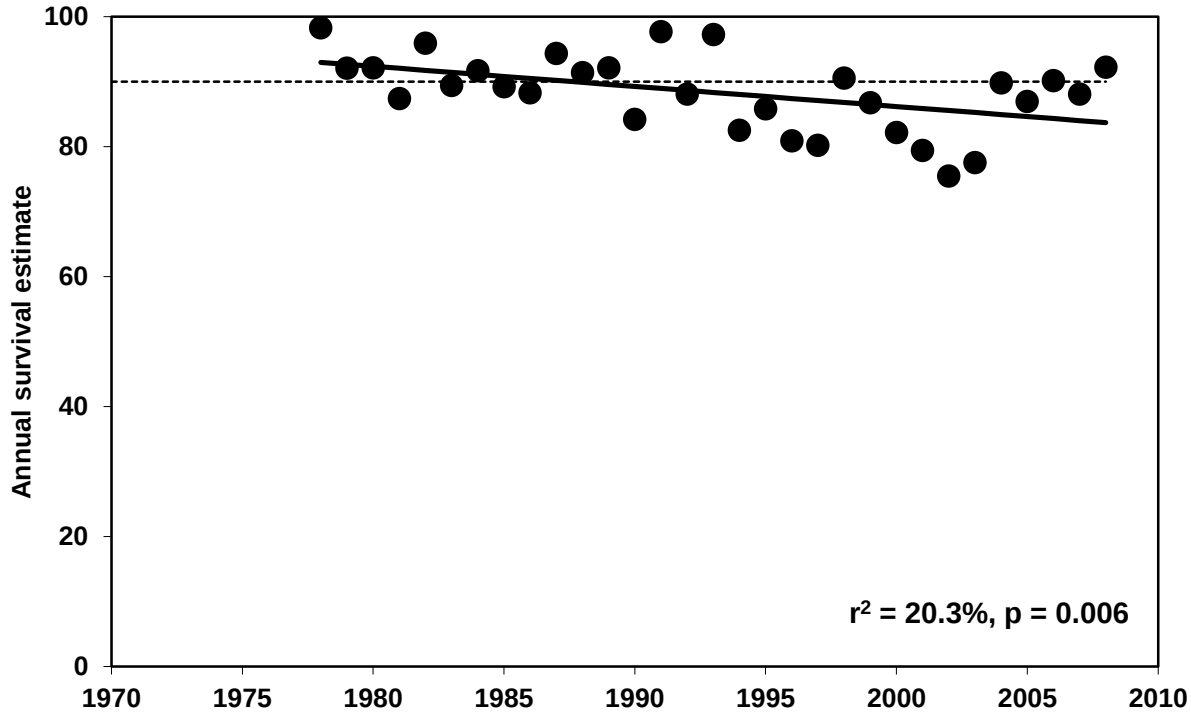
Figure 7 Number of fledgling Lesser Black-backed Gulls per pair



8.4 Adult survival

Appendix 5 gives the estimated survival rates. These birds are all from the study area in compartment 8. Previously, it has been noted that noted that there has been a decline in the breeding population in recent years, presumably due to the very poor breeding success.. There was also evidence for reduced adult survival over time. Over all years there was a significant decline in adult survival; inspection of the data suggested that survival stayed high in most years up to and including 1993, but had declined markedly since then. However, the mean survival for the last five years (88.77) is markedly better the preceding five (80.34).

Figure 8 Trend of annual survival estimate of Lesser black backed gull 1978 up to and including survival from "2008 to 2009".



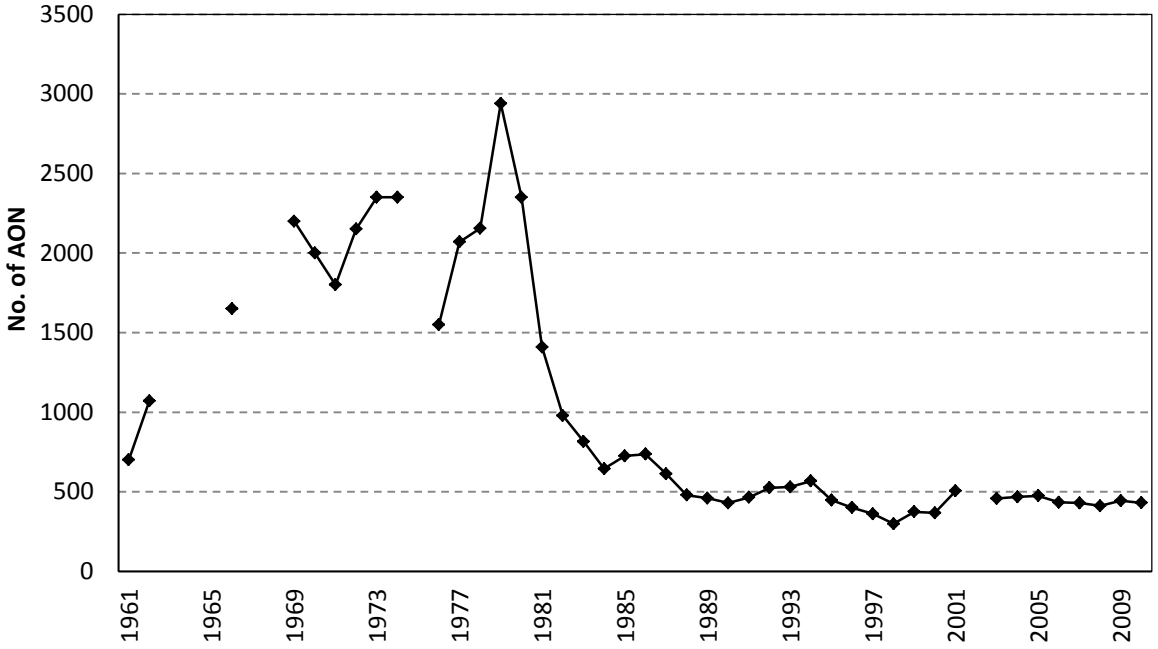
9 Herring gull

9.1 Breeding numbers

A total of 431 Apparently Occupied Nests were observed in 2010. This has been a similar figure for the past 10 years after a dramatic decline in the 1980s.

251 of these were coastal nesting birds with the remainder nesting inland (180). This meant 58% of Herring Gulls nested on the coast.

Figure 9 Herring gull breeding numbers on Skomer Island 1961-2010.



9.2 Breeding success

Breeding success has varied from year to year (Figure 10) but is significantly higher than that of the lesser black-backed gull.

The number breeding on the adjacent island of Middleholm increased between 1998 and 2001: 87 AOT in 1998, 104 in 1999, 113 in 2000 and 147 in 2001.

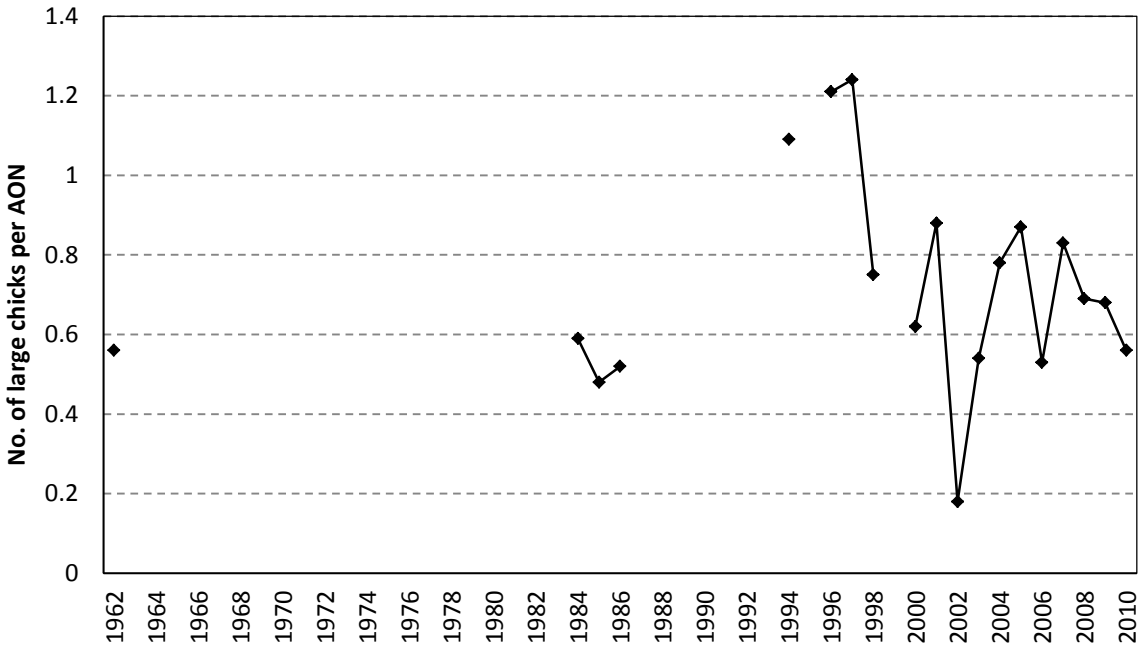
The ratio of coastal nesters to inland nesters was 80:20 in 1999, 80:20 in 2000 and 85:15 in 2001 (no census was possible in 2002, due to storms). The ratio has varied little each year since 1992.

Sites were visited on the 15th May to identify Apparently Occupied Nests and then again on 1st July and 4th July to check for large chicks/fledglings.

Table 16 Estimated productivity of herring gulls on Skomer, 2010

	AON	Large Chicks	Productivity
Tom's House	32	18	0.56
Waybench	Not recorded in 2010		

Figure 10 Breeding success of coast-nesting herring gulls on Skomer Island, 1962-2010.

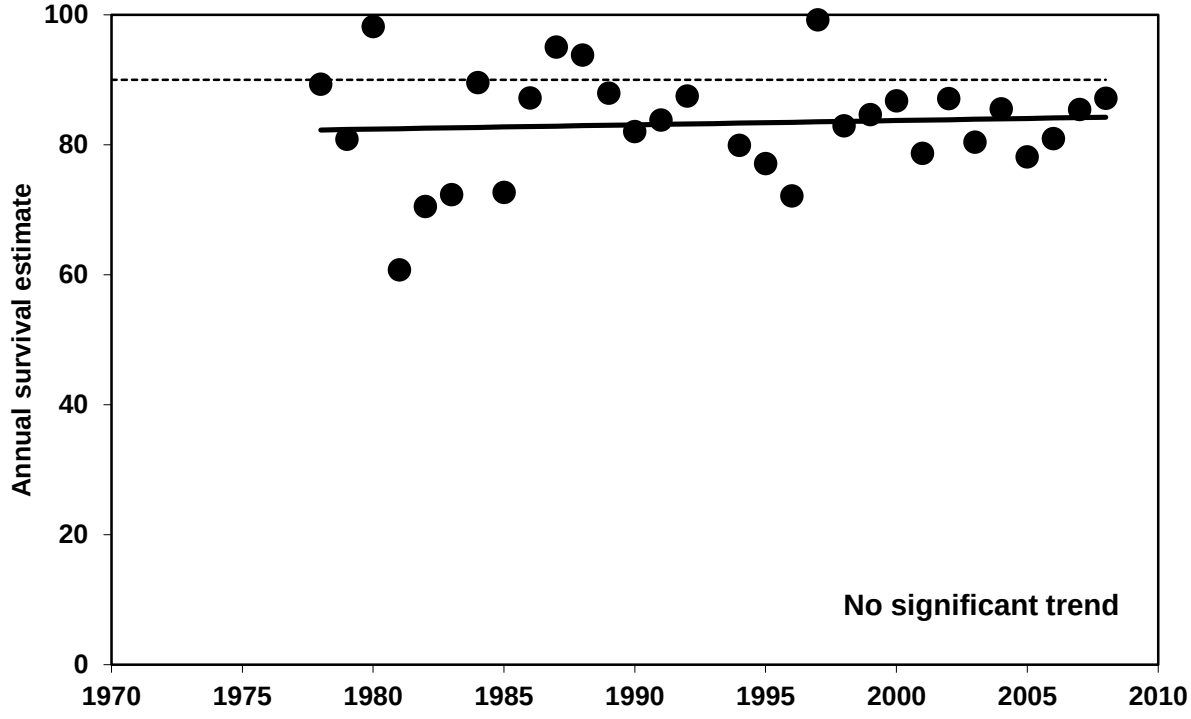


9.3 Adult survival

Appendix 5 gives the estimated survival rates. These were originally based mainly on birds nesting along the north coast, but because the population dropped so markedly, we had to open up a second study plot in the area from the Amos to Skomer Head. The samples are still smaller than desirable.

As reported before, the figures for this species start off with more or less normal survival rates for such a gull, but after the first three years, the survival rates plummeted in 1981-1983, were almost up to what might be expected for a normal Herring Gull population in four of the five years 1984-1988, but have been low again in most years since then, in line with the slow decline of this species on Skomer.

Figure 11 Trend of annual survival estimate of Herring gull 1978 up to and including survival from "2008 to 2009"

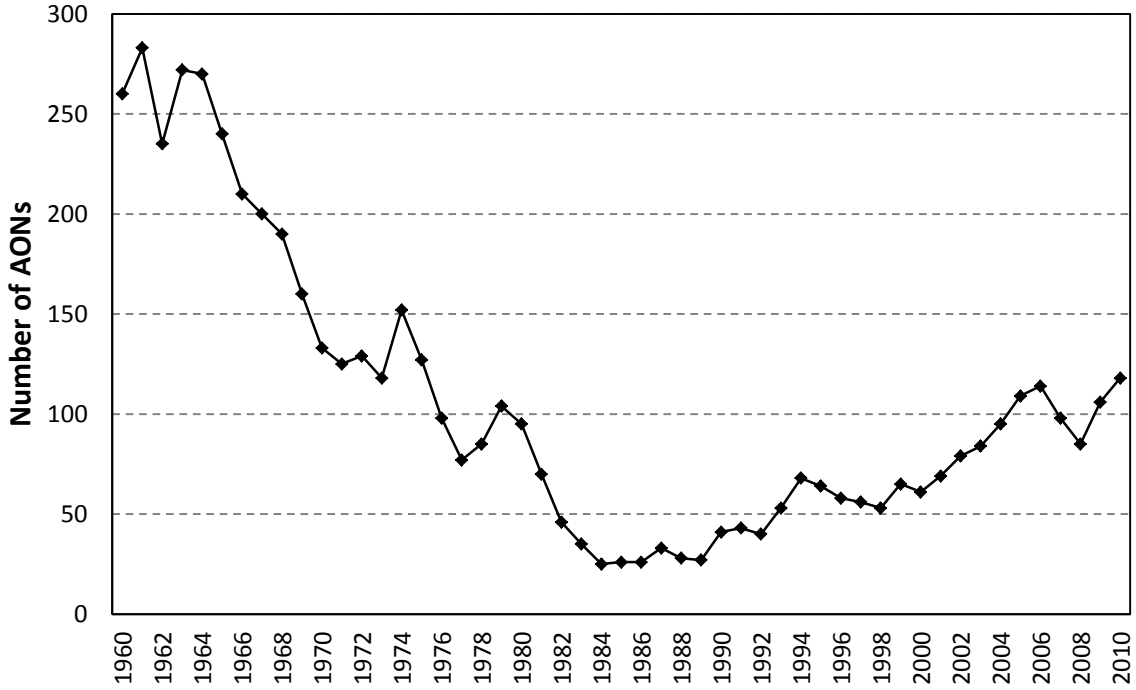


10 Great black-backed gull

10.1 Breeding numbers

In 2010, the breeding population of great black-backed gull on Skomer has continued its two year increase to 118 Apparently Occupied Nest in 2010 (+11.32% from 2009). It would seem the GBBG population has seen a recovery back to the 2006 figures. This would seem to correlate to the recovery of the rabbit population on Skomer since the outbreak of Myximitosis in 2006/2007 (see Figure 12).

Figure 12 Great black-backed gull breeding numbers on Skomer Island 1960-2010.



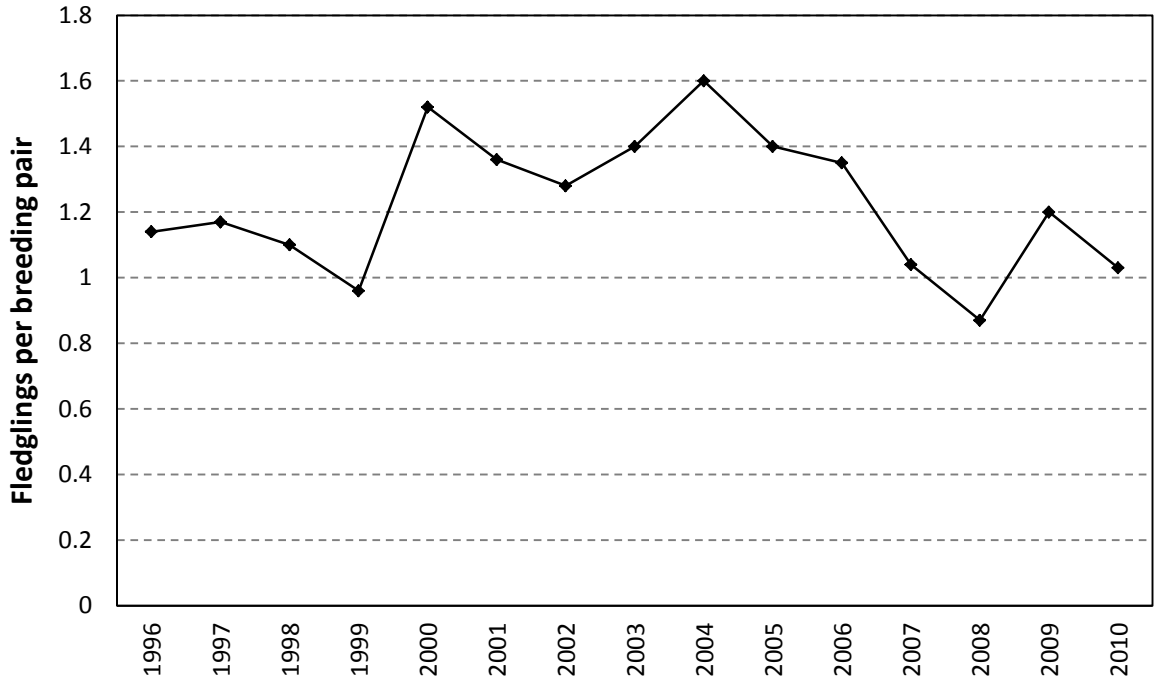
The decline has been attributed largely to control measures in the 1960s and 1970s that were implemented as a result of the species' perceived predatory impact on other seabirds. An outbreak of botulism in the early 1980s contributed to the decline (Sutcliffe 1997).

10.2 Breeding success

Monitoring of the breeding success of great black-backed gull was included in the JNCC contract from 1999.

26 AONs were identified between 28th of April and 15th of May. A total of 28 large chicks were recorded on 26th of June, giving a productivity of 1.03. This is a decrease on last years breeding success and below the 14 year average productivity of 1.22. (Fig 13).

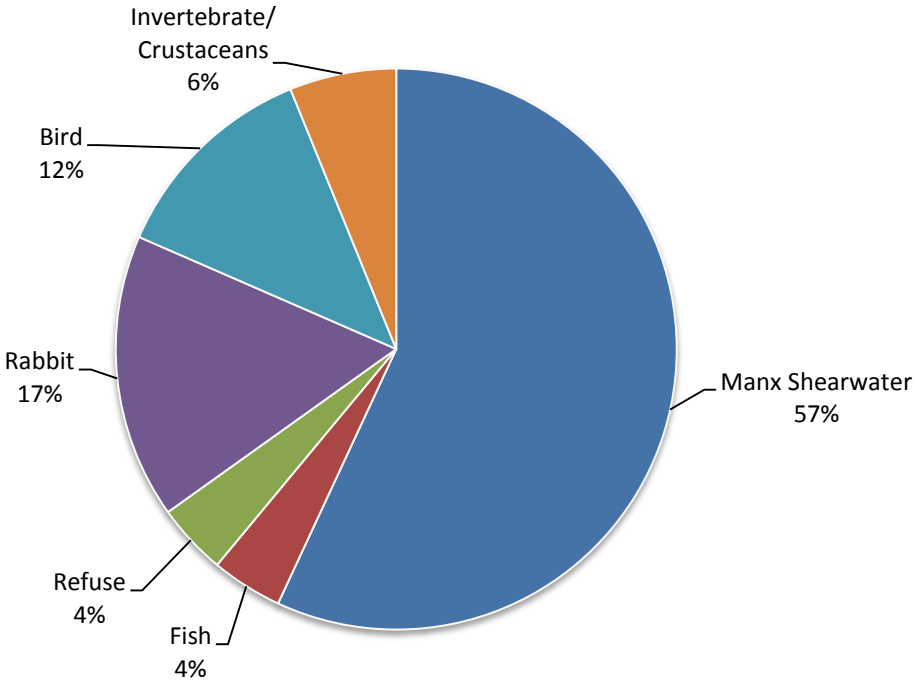
Figure 13 **Great black-backed gull breeding success on Skomer Island 1996-2010.**



10.3 Diet study

A trial study to monitor the diet of Great Black-backed Gulls was initiated in 2008 and continued in 2010. The prey remains around a sample of 30 nests were recorded. This sample represented nests from differing habitats and from areas of differing Shearwater densities. This work was carried out after chicks fledged (July 26th).

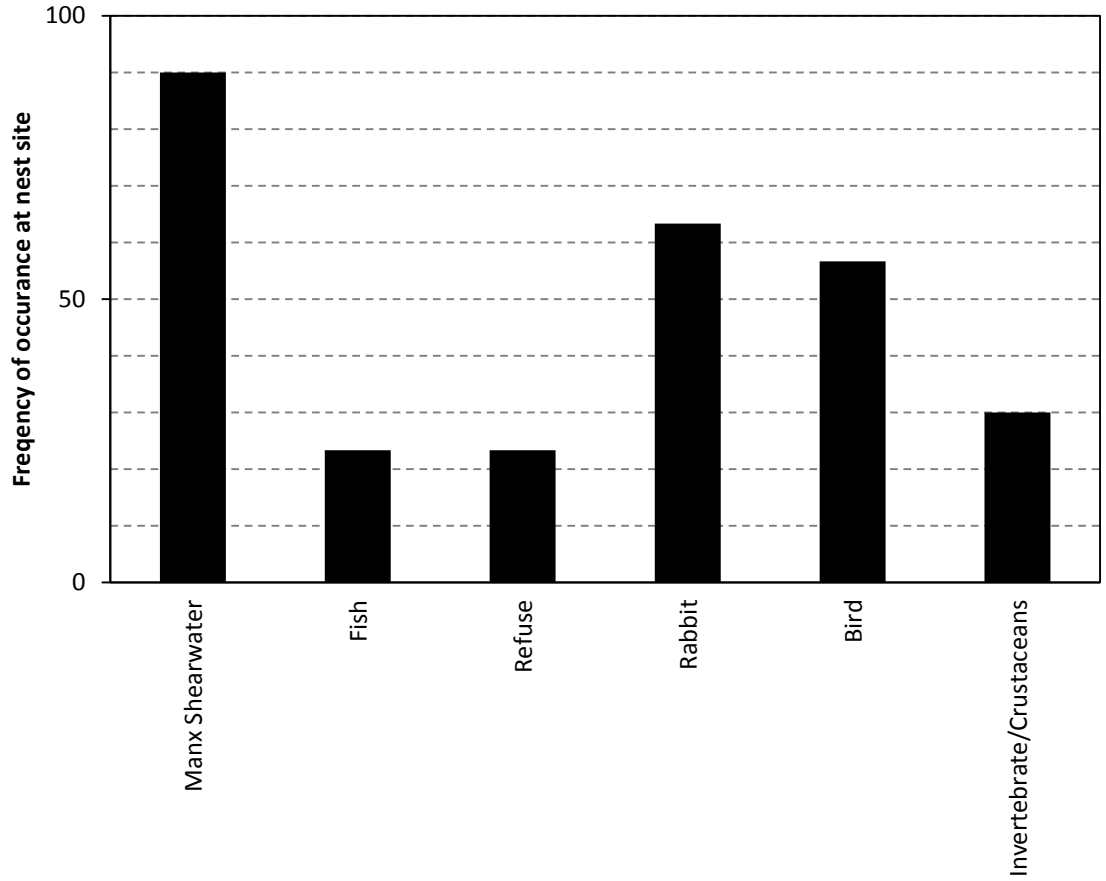
Figure 14 **Greater Blacked-backed Gull diet remains from 30 nests on Skomer Island 2010.**



More than half the prey items recorded were Shearwaters (fig 14 and 15), which is a 15% increase to last year. It is important to keep the timing of this study consistent as immature Shearwaters return to the island to prospect for burrows and mates, these birds spend a good deal of time on the surface of the island and are more vulnerable to predation. Shearwater carcasses will persist longer at a nest site than other potential prey items such as eggs or small young of other birds, which may have formed a larger percentage of the diet earlier in the season.

Manx shearwaters remains were recorded at 90% of the nests studied (fig 10). Rabbit was the second most prevalent prey item, being found at 63% of the nests. Refuse was found at 23% of the nests, a significant decrease from the previous year (70%). Other birds were found at 57% the nests. Other bird remains found at nests consisted of Razorbill, Lesser black-backed gulls and Puffins.

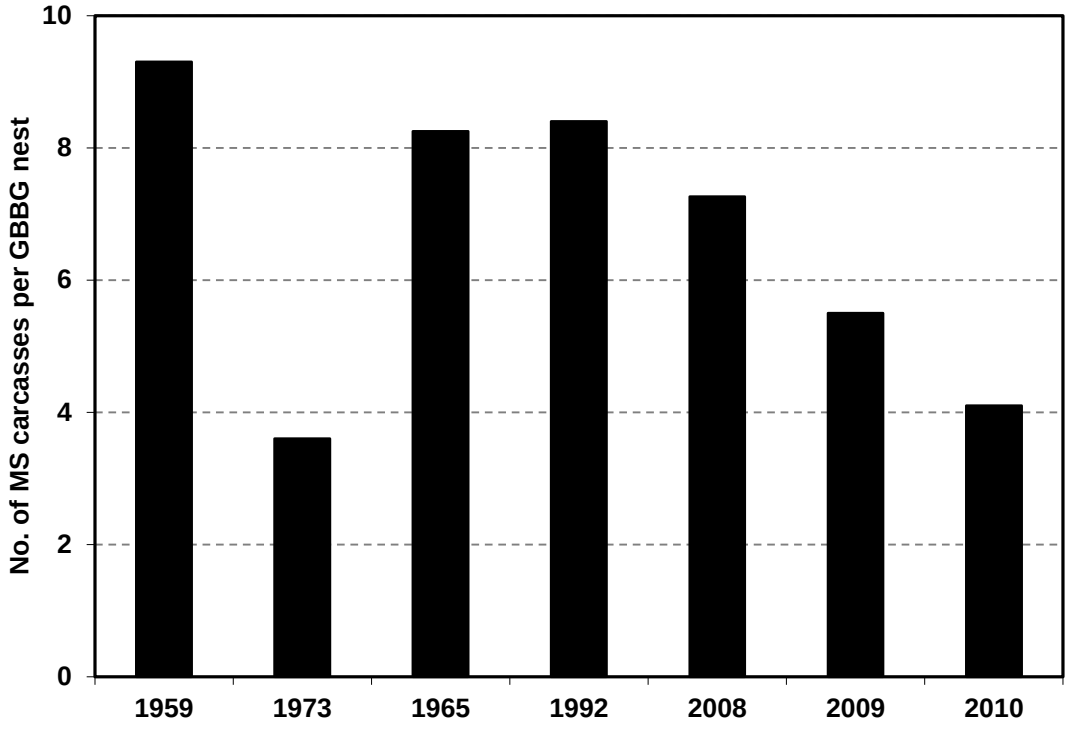
Figure 15 Frequency of occurrence of food items around 30 great black-backed gull nests in 2010.



Greater black-backed gull diet has been studied on Skomer five times in the past. Mylne (1960) looked mostly at predation on shearwaters, Harris (1965) examined stomach contents and Corkhill (1973) and Poole (1992) collected remains from nests sites throughout the season and hence were able to look at the changes in diet through the breeding season and in 2008 this study was begun.

The frequency of occurrence of Manx Shearwaters increased from 68% in 1973 (Corkhill 1973) to 80% in 1992 (Poole 1992) and again to 100% in 2008 and 2009. The increase from 1973 to 1992 is thought to be due to an apparent increase in Shearwater population from 95, 000 to 160, 000 respectively, and hence shearwaters being more available as a food source (Poole 1992). The increase to 100% in 2008 and 2009 may be due to the dramatic fall in rabbit population, and hence shortage of this food source. This is in accordance to a drop in percentage frequency of rabbit remains from 85.2% (2008) to 73% (2009). However, in 2010 both shearwater and rabbit prey items dropped in frequency in comparison to previous years, which may be a reflection of the poorer breeding success in 2010. It appears that there are a lot of potential variables that affect the food choice of GBBG which leads to speculation in the analysis of long term diet data sets. However, using the estimates of the number of actual shearwaters corpses represented at each site, a mean number of corpses per site can be worked out (fig 16), this can be compared back to previous studies.

Figure 16 Mean number of Shearwater corpses found at Greater black-backed gull nests in 1959, , 1965, 1973, 1992, 2008, 2009 and 2010.



In 2010 a total of 111 Shearwater corpses were estimated at the 30 nest sites, giving a mean of 4.1 corpses per nest site and is down on the mean number of 5.5 corpses in 2009.

11 Black-legged kittiwake

11.1 Breeding numbers

A mean of 1922 (Range 1882-1962) Apparently Occupied Nests were observed in 2010, a decrease of 6.06% on 2009.

Figure 17 Black-legged kittiwake breeding numbers on Skomer Island 1960-2010.

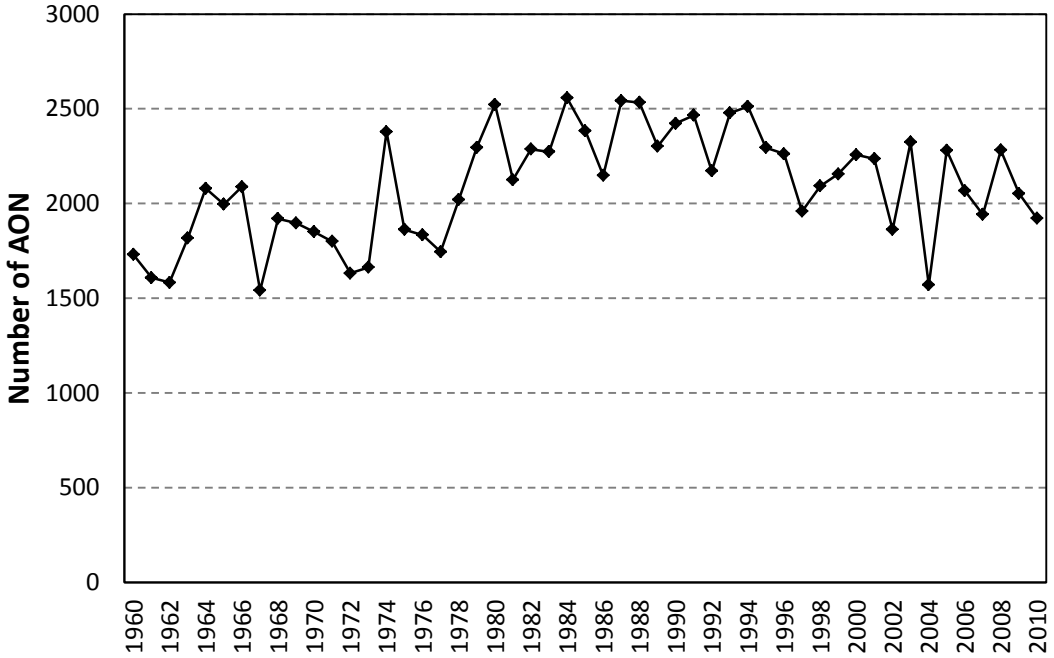


Table 17 Black-legged kittiwake whole island count details Skomer 2004-2010

	Total	% change	5 year % change
2004	1570	-32.4	-30.4
2005	2281	+45.3	+2
2006	2067	-9.4	+11
2007	1942	-6	-16.1
2008	2282	+17.5	+45.4
2009	2046	-10.3	-10.3
2010	1992	-6.06	-7.01

11.2 Breeding success

11.2.1 Methods

The breeding success of 746 kittiwake AONs was monitored at the same three sub-colonies studied since 1989 (but note some areas within the sub-colonies have been dropped since then), using the same methods as in previous years. Photographs of the cliffs were used and each nest marked on a transparent overlay. Visits were made to each sub-colony to monitor progress from nest construction to fledging. Six visits were made between 24th May and 1st August (see appendix 2 for details). All chicks that were large (in class 'd' and 'e' in Walsh *et al* 1995) on the final visit were assumed to fledge, with half of smaller chicks assumed to

fledge (as per Walsh *et al* 1995). First chicks were seen early this year (8th June) and at the point of the final visit (1st Aug) all chicks observed were of fledging size, with no late young chicks present. Standard recording sheets from the Seabird Monitoring Handbook (Walsh *et al* 1995) were used for data collection.

11.2.2 Results

In 2010, 746 nests were started in the study areas, which is a reduction by 42 nests to 2009. Study sites Wick 8 A+B were deserted this year, with no sign of breeding attempt (15 nests in 2009). The slight increase of productivity this year (+0.01) is most probably a reflection of a 5% AON decrease across all study sites, which has to be taken into account when interpreting this year's productivity data (Table 18).

The 662 AONs produced a minimum of 732 chicks. Because of the difficulty of recording small chicks in some of the plots this is likely to be an underestimate. 566 chicks survived to 'large' status, and 467 of these were thought to have fledged. An estimate of 15 nests were washed away at the lower ledges at the Wick.

The lowest breeding success (0.52) was again at the High Cliff sub-colony, with the highest (0.78) being at the Wick this year (South Stream 2009). (Table 18).

In 2010, 88% of AONs went on to apparently incubate eggs (94% in 2009), with 81% of these producing chicks (95% in 2009). 11% of pairs did not complete nests ('trace' nests only) (12% in 2009).

Table 18 Black-legged kittiwake breeding success (per Apparently Occupied Nest) on Skomer Island in 2010.

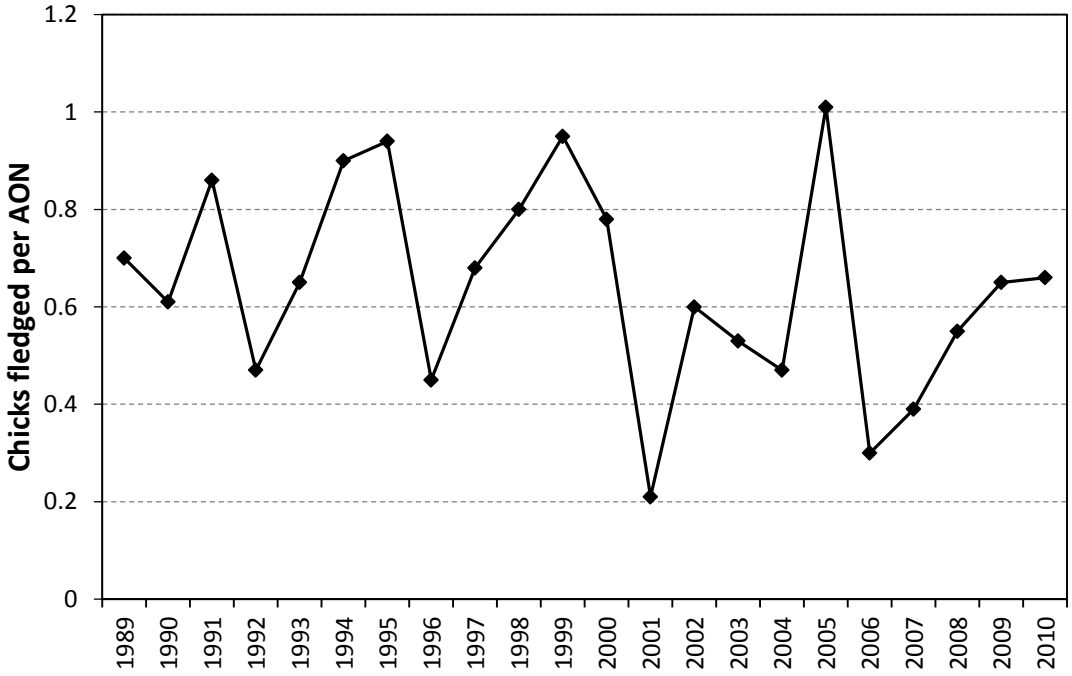
	Nests started	AON'S	Incubating Pairs	Nests w/chicks	Total chicks	Large chicks	Chicks fledged	Breeding Success
S.Stream	224	199	161	128	194	158	137	0.69
High Cliff	151	122	102	74	119	71	63	0.52
The Wick	371	341	323	273	419	337	267	0.78
Total	746	662	586	475	732	566	**Mean**	**0.66**
							SD	0.14
							SE	0.08

Table 19 Black-legged kittiwake breeding success (per AON) on Skomer Island in 1989-2010.

Year	Mean breeding success	Standard Error
1989	0.70	0.04
1990	0.60	0.07
1991	0.86	0.07
1992	0.47	0.12
1993	0.65	0.08
1994	0.90	0.14
1995	0.94	0.11
1996	0.45	0.06
1997	0.68	0.06
1998	0.79	0.09
1999	0.95	0.06
2000	0.78	0.08
2001	0.21	0.08
2002	0.61	0.07

2003	0.60	0.06
2004	0.53	0.08
2005	0.47	0.08
2006	1.01	0.16
2007	0.30	0.07
2008	0.39	0.13
2009	0.55	0.09
2010	0.65	0.06
Mean (SE)	**0.64**	**0.05**

Figure 18 Black-legged kittiwake breeding success on Skomer Island 1989-2010.



As in previous years, the relationship between breeding success and number of chicks hatched was examined (Table 20).

Bigger broods were again more successful than smaller ones in 2010, the success rate for one and two chicks per brood has increased, while there were fewer and less productive large (3) broods this year.

Table 20 Black-legged kittiwake fledging success in relation to the number of chicks hatched per nest on Skomer Island 1999-2002.

	No. of chicks in nest	No. of nests	Total no. of chicks	No. chicks fledged	Success rate per nest
2010	1	221	221	145	0.66
	2	251	502	318	1.27
	3	3	9	4	1.33

11.3 Timing of breeding

Nest building was first seen on the 30th April, same day as 2009 (see table 21). The first egg was seen on the 11th of May. The first chick was seen on the 8th of June. There is no major difference in the timing of breeding over the last 6 years.

Table 21 Black-legged kittiwake - timing of breeding on Skomer Island 2005 - 2010.

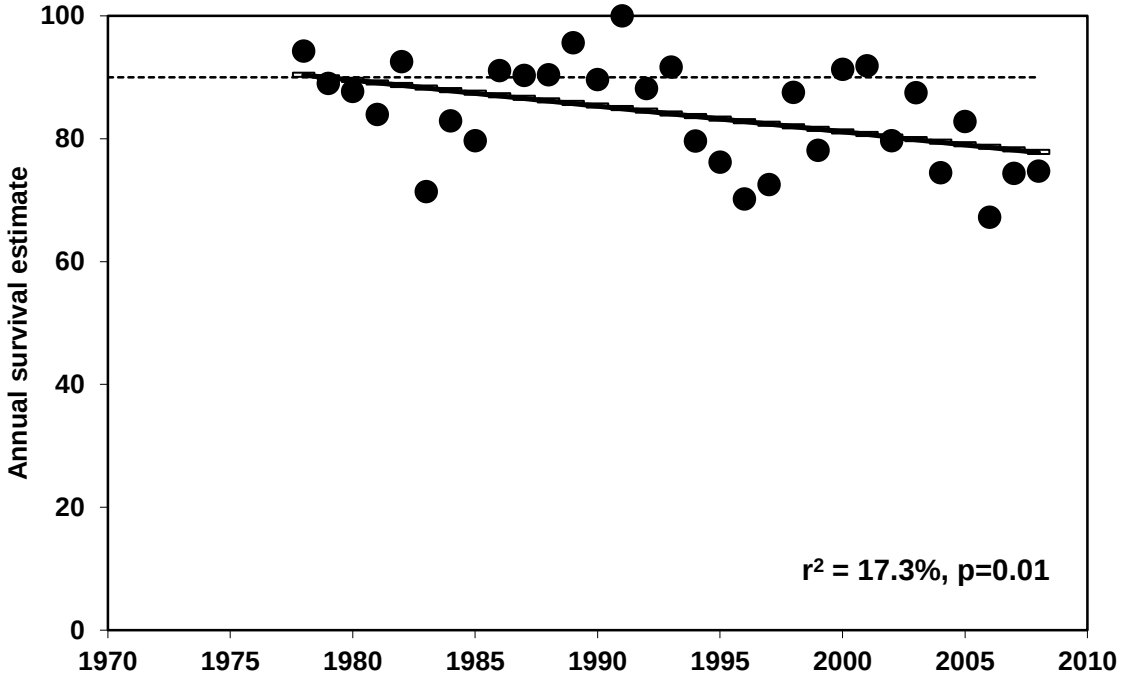
	2005	**2006**	**2007**	**2008**	**2009**	**2010**
Nest building start	29th April	7th May	7th May	8th May	30th April	30th April
First egg	18th May	23rd May	19th May	24th May	11th May	21st May
First chick	11th June	19th June	16th June	20th June	11th June	8th June

11.4 Adult survival

Appendix 5 gives the estimated survival rates of Kittiwakes. These are based on colour-ringed birds at two sites, Tom's House and South Cliff.

A time trend seems to becoming apparent in these survival rates with a significant decline in average survival rates of around 90% thirty years ago to one of just under 80% currently.

Figure 19 Trend of annual survival estimate of Black-legged kittiwake 1978 up to and including survival from 2008 to 2009.



12 Common guillemot

12.1 Breeding numbers - whole island counts

The whole-island population of common guillemots in 2010 increased at by 5% to 19962 (range 19401-20523) (Table 22, Figure 20).

Table 22 Common guillemot whole island counts on Skomer Island, 1995-2002.

	Land count	% change	Sea count	% change	Total count	% change	5-year % change
2004	11970	-8	2217	+32.7	14187	-3.33	+2.42
2005	16795	+40.3	2916	+31.5	19711	+38.94	+95.86
2006	13692	-18.5	3285	+12.7	16977	-13.87	+17.59
2007	15146	+10.6	2398	-27	17544	+3.34	+19.54
2008	11579	-23.6	5509	+56.5	17088	-2.60	+20.45
2009	14339	+23.8	5173	-6.10	19512	+14.19	-1.01
2010	15643	+9.09	4319	-16.51	19962	+2.31	+17.58

The dramatic changes in the percentages changes of birds counted by land and from sea is due to methodological counts on the north west coast. Up until 2008 Bull Hole to Garland Stone was counted from Payne's Rock. The past few years these have been counted by sea.

12.2 Breeding numbers - study plot counts

The study plots are thought to be representative of the whole colony (Wilson 1992) and may reflect any population change more accurately than the whole island counts, as repeated counts take account of variations in attendance that are thought to occur within colonies. For details of counts refer to Appendix 3.

The number of common guillemots within the study plots as a whole continued to increase during 1999-2002, although, as was seen in the whole-island counts, the rate of increase has tailed off, such that only the 1998-1999 comparison showed a statistically significant increase; by 2002 the increase compared with the previous year was just 0.7% (Table 22). It therefore appears that the study plots are representative of the whole-island population of common guillemots. There was some variation between the study plots (Table 23), with the sub-colony at South Cliff seeing a moderately large and statistically significant increase between 2001 and 2002, whereas numbers at other sites showed a slowing in the rate of increase or a decrease in number.

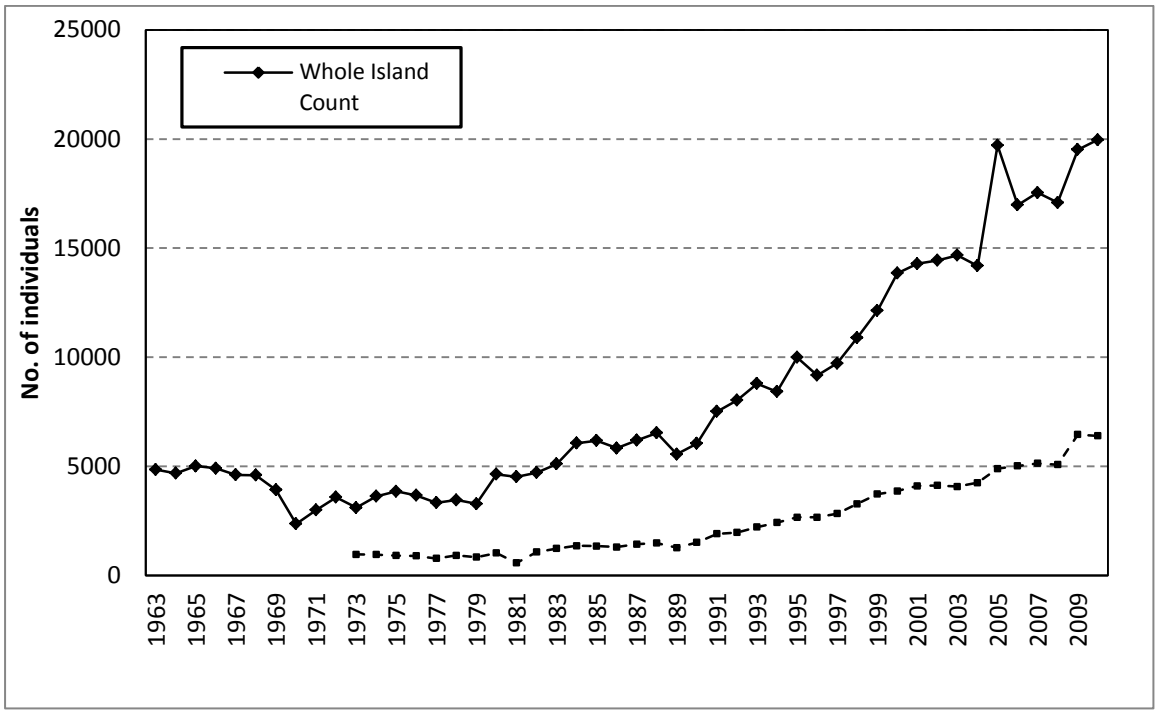
There was no significant difference in the number of birds attending the study plots in 2010. After a previous study plots increase in 2009 (Table 23) the total population declined only -0.9% overall.

Table 23 Common guillemot study plot totals on Skomer Island 2006-2010.

	Year	Mean	SD	SE	Signif	%change	5yr %change
Bull Hole	2006	2823.5	200.8	71.0	NS	+2.9	+17.5
	2007	2941.0	76.6	27.1	NS	+4.2	+21.9
	2008	2922.0	180.0	56.9	NS	-0.6	+26.1
	2009	3503.1	126.4	40.0	* *	+19.9	+27.7
	2010	3493.9	287.2	90.8	NS	-0.26	+23.7
High Cliff	2006	1501.6	87.5	31.0	NS	+0.3	+20.9
	2007	1525.0	73.3	25.9	NS	+1.6	+27.8
	2008	1510.0	81.0	25.6	NS	-0.98	+11.6
	2009	2057.8	105.3	33.3	* *	+36.3	+37.4
	2010	2024.1	158.6	50.2	NS	-1.6	+34.8
S.Stream	2006	713.4	65.5	23.2	NS	+8.7	+47.3
	2007	674.3	56.0	19.8	NS	-5.5	+44.2
	2008	646.0	59.3	18.7	NS	-4.2	+10.6
	2009	897.4	70.7	22.4	* *	+38.9	+36.7
	2010	882.4	98.3	31.1	NS	-1.7	+23.7
All	2006	5019.1	319.5	113.0	NS	+2.5	+21.6
	2007	5140.3	189.4	67.0	NS	+2.4	+26.2
	2008	5078.0	299.4	94.7	NS	-1.2	+19.4
	2009	6458.3	282.3	89.3	* *	+27.2	+31.9
	2010	6400.4	446.2	141.1	NS	-0.9	+27.5

Note: Significance between years in Table 16 established using the t-test for comparing the means of two small samples (two-tailed test, df=17). N.S. Not significant, * Statistically significant (P<0.05), **Statistically highly significant (P<0.01).

Figure 20 Common guillemot breeding numbers on Skomer Island 1963-2010.



12.3 Breeding success

12.3.1 Methods

The number of active and regularly occupied sites was established at study plots and their histories followed. The number of active and regularly occupied sites was established at study plots and their histories followed, using the methodology outlined in Walsh *et al.* (1995). Sites were visited every three to four days. The first recording visit was on 28th April, and the last visit 17th July. All sites were visited at similar frequency of 21-22 visits during the season.

12.3.2 Results

2010 saw a mean productivity of 0.69 fledged birds per active and regularly occupied site, which is a decrease of 0.04 to 2009 (Table 24 and 25, Fig 21), but matches the overall mean of 0.69 (1989 – 2010). The highest number of active + regular occupied sites (315) was recorded this year, following an overall trend of increased density at breeding sites between 1989 and 2010. However, only 90% of these sites were active, which leads to a relatively higher productivity quota of 0.76 for active sites only.

90% of chicks 'fledged' between 26th June and 9th July inclusive. The median fledge date was 12 days later than in 2009.

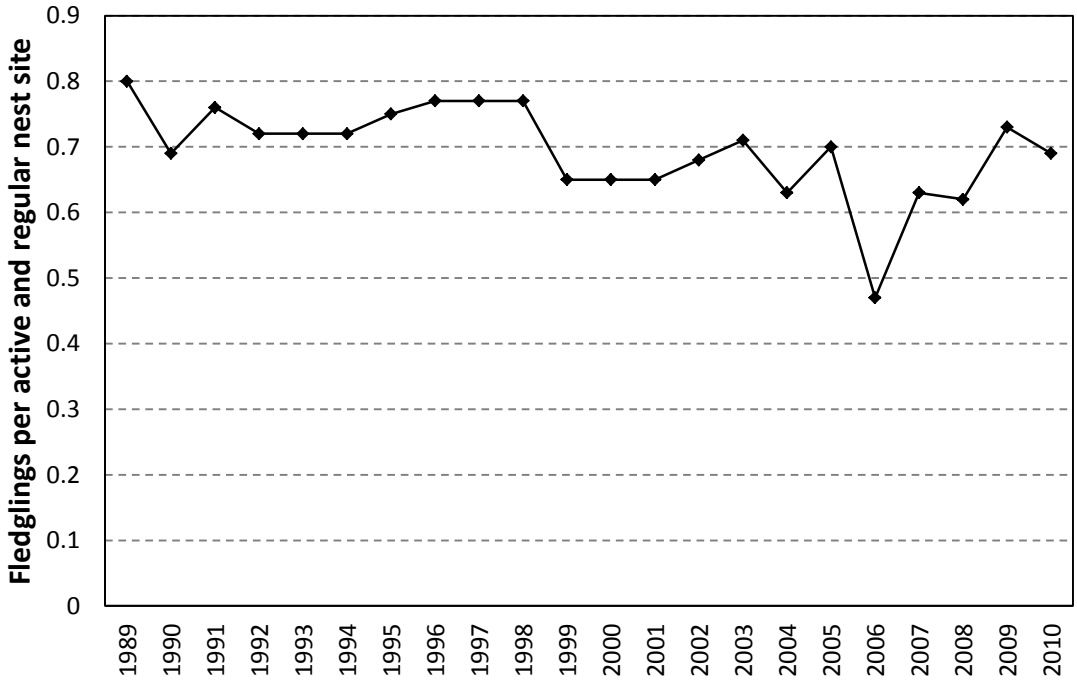
Table 24 Common guillemot breeding success (per active and regular sites) on Skomer Island 1989-2010.

Year	No. Sites	Large Chicks	Mean Productivity across sites	SE
1989	120	96	0.8	0.05
1990	112	80	0.69	0.05
1991	117	89	0.76	0.05
1992	169	121	0.72	0.04
1993	198	141	0.72	0.05
1994	187	131	0.72	0.03
1995	198	151	0.75	0.04
1996	210	161	0.77	0.02
1997	226	174	0.77	0.33
1998	201	154	0.77	0.04
1999	242	147	0.65	0.05
2000	227	143	0.65	0.08
2001	259	160	0.65	0.08
2002	259	170	0.68	0.03
2003	268	179	0.71	0.05
2004	292	184	0.63	0.01
2005	297	200	0.7	0.03
2006	287	142	0.47	0.07
2007	258	164	0.63	0.02
2008	269	164	0.62	0.06
2009	254	185	0.73	0.05
2010	315	211	**0.69**	**0.04**
		Mean (1989-2010)	0.69	0.06

Table 25 Guillemot breeding success (per active site and per active and regular site) on Skomer Island 2010.

	No. active + regular sites	No. active sites	Large chicks	Productivity (a+r)	Productivity (a only)
Wick 1G	61	54	41	0.67	0.76
Wick 2G	91	78	54	0.59	0.69
Wick Corner	103	99	73	0.71	0.74
Traverse Ledge	22	20	18	0.82	0.90
Bull Hole	38	34	25	0.66	0.74
			Mean	**0.69**	**0.76**
			SD	0.08	0.08
			SE	0.04	0.04

Figure 21 Common guillemot breeding success on Skomer Island 1989-2010.



12.4 Timing of breeding

The first egg was noted on 29th April at the Amos (4 days later than in 2009), the first chicks on the 31st of May and the first 'jumpling' on the 23rd of June at Traverse Ledge (12 days later than 2009). The last 'jumpers' were 17th-18th July at Wick 2G (exactly the same as in 2009).

Table 26 Common guillemot timing of breeding 2005-2010

	2005	2006	2007	2008	2009	2010
First egg	29th April	6th May	5th May	11th May	25th April	29th April
First chick	3rd June	11th June	8th June	14th June	26th May	31st May
First 'jumpling'	21st June	30th June	30th June	25th June	11th June	23rd June

12.5 Adult and juvenile survival

This and other common guillemot studies were undertaken by University of Sheffield in 2010. This report is attached in Appendix 7.

13 Razorbill

13.1 Breeding numbers - whole island counts

Due to difficulties in censusing the species (being less concentrated than common guillemots and often breeding in hidden sites amongst boulders and in burrows), the pattern of razorbill numbers on Skomer has at times been fairly erratic (Figure 22). In 2010 the total count mean was 5391 (Range 5413 – 5369) (Table 27). As with guillemot changes in percentages of land and sea are directly related the change in wardens.

Middleholm = 242 indivduals

Table 27 Razorbill whole island count details on Skomer Island, 2004-2010

	Land count	% change	Sea count	% change	Total count	% change	% 5-yr change
2004	2895	-8.6	1651	+53.7	4546	+7.2	+16.7
2005	3811	+31.6	1948	+18.0	5759	+26.7	+20.7
2006	2955	-22.5	1606	-17.6	4561	-20.8	-10.5
2007	3588	+21.4	1259	-21.6	4847	+6.3	+14.3
2008	2336	- 34.9	2637	+ 109.5	4973	+ 2.6	+ 2.6
2009	2970	+27.1	2292	-13.1	5262	+5.8	- 8.6
2010	2835	-4.55	2556	+11.6	5391	+2.5	+18.2

13.2 Breeding numbers - study plot counts

The Razorbill study plot counts are not thought to be as representative of the whole island population as those of Guillemots (Wilson 1992) although changes in the plot counts between years is still useful information.

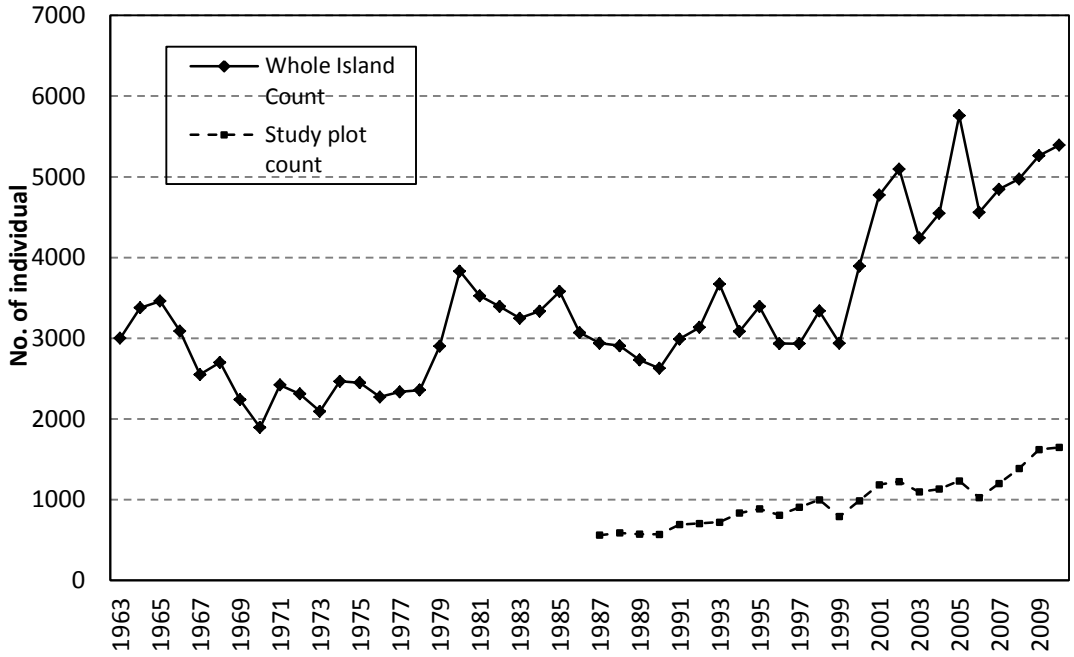
There were no significant changes at any of the study plots in comparison to 2009. Overall, numbers in study plots increased slightly by 1.7 % on 2009 (Table 28).

Table 28 Razorbill study plot totals on Skomer Island 1995-2002.

Study plot	Year	Mean	S.D.	S.E.	Significance	% change	5-year change
Bull Hole	2006	230.9	29.8	10.5	* *	-20.4	-13.4
	2007	319.3	50.8	19.2	* *	+38.3	+46.9
	2008	307.2	46.9	14.8	NS	-3.8	+35.8
	2009	390.1	32.8	10.4	* *	+27.0	+34.6
	2010	432.5	88.0	27.8	NS	+10.9	+87.3
High Cliff	2006	187.5	38.2	13.5	* *	-37.6	-32.4
	2007	251.6	55.0	20.8	*	+34.2	+1.3
	2008	276.2	47.1	14.9	NS	+9.8	+8.70
	2009	393.4	67.2	21.3	* *	+42.4	+31.0
	2010	380.2	63.4	20.0	NS	-3.4	+102.8
South Stream	2006	90.0	27.4	9.7	NS	-22.1	-21.5
	2007	94.0	34.0	12.8	NS	+4.4	-13.0
	2008	73.8	13.9	4.4	NS	-21.5	-17.2
	2009	97.4	17.8	5.6	* *	+32.0	-15.8
	2010	111.4	26.3	8.3	NS	+14.4	+23.8
The Wick	2006	515.1	39.5	14.0	NS	-2.2	-9.0
	2007	535.9	42.5	16.0	NS	+4.0	+2.6
	2008	727.8	35.8	11.3	NS	+35.8	+29.6
	2009	739.6	39.6	12.5	NS	+1.6	+40.5
	2010	723.8	33.1	10.5	NS	-2.1	+40.5
All plots	2006	1023.5	100.8	35.6	* *	-16.9	-16.4
	2007	1200.7	150.2	56.8	*	+17.3	+9.6
	2008	1385.0	68.2	21.6	NS	+15.4	+22.46
	2009	1620.5	105.21	33.27	* *	+17.0	+31.5
	2010	1647.9	184.7	58.4	NS	+1.7	+61.0

Note: Significance between years established using the t-test for comparing the means of two small samples (two-tailed test, df=16). N S Not significant, * Statistically significant ($P<0.05$), * * Statistically highly significant ($P<0.01$). See Appendix 9 for count details.

Figure 22 Razorbill breeding numbers on Skomer Island 1963-2002.



13.3 Breeding success

As with guillemot, sites were visited were every three to four days. The date of the first visit was on 25th April, with the last visit on 17th July. All sites were visited at similar frequency between 20 and 22 times.

Productivity was given as the number of fledged or apparently fledged chicks (last seen at 15 or more days old) per active and regularly occupied site and per active only site (as defined by Walsh *et al.* 1995). Results are presented in Table 29, 30 and Figure 23. The mean productivity per active and regular site was 0.40 (0.51 per active only site), a slight improvement on last years low productivity (Table 29).

The least productive site was Wick 3A (0.26), with the most productive Wick 3B (0.59) (Table 30).

84 % of chicks 'fledged' between 27th of June and 11th of July inclusive. The median fledge date was 10 days later than 2009.

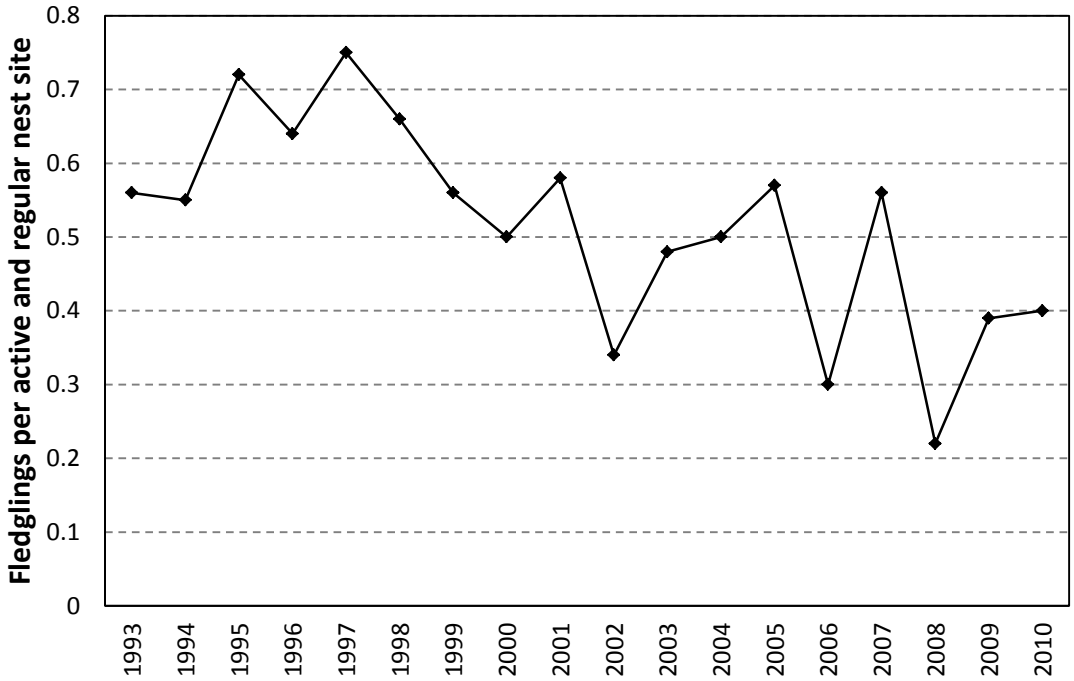
Table 29 Razorbill breeding success on Skomer Island 1993-2010

	Productivity per active site	**Productivity per active + regular site**
1993	-	0.56
1994	-	0.55
1995	0.79	0.72
1996	0.71	0.64
1997	0.73	0.75
1998	0.71	0.66
1999	0.74	0.56
2000	0.54	0.48
2001	0.64	0.58
2002	0.37	0.36
2003	0.61	0.48
2004	0.56	0.5
2005	0.64	0.57
2006	0.33	0.3
2007	0.62	0.56
2008	0.32	0.22
2009	0.47	0.39
2010	**0.51**	**0.40**
Mean	0.62	0.55

Table 30 Guillemot breeding success (per active site and per active and regular site) on Skomer Island 2010.

	No. active + regular sites	No. active sites	Large chicks	Productivity (a+r)	Productivity (a only)
High Cliff	160	115	62	0.39	0.54
Wick 1A	58	44	25	0.43	0.57
Wick 3A	106	80	28	0.26	0.35
Wick 3B	41	35	24	0.59	0.69
Bull Hole	101	79	32	0.32	0.41
			Mean	**0.40**	**0.51**
			SD	0.12	0.13
			SE	0.06	0.06

Figure 23 Razorbill breeding success on Skomer Island 1993-2010.



13.4 Timing of breeding

The first egg was noted at the Amos on 24th April (two days earlier than in 2009), the first chick was seen on 24th May at the Basin and the first 'jumplings' on 21st of June at High Cliff (8 days later than 2009). The last chicks jumped between 14th – 17th July (three days later than in 2009) at Wick 1A and High Cliff.

Table 31 Razorbill timing of breeding 2005 – 2010.

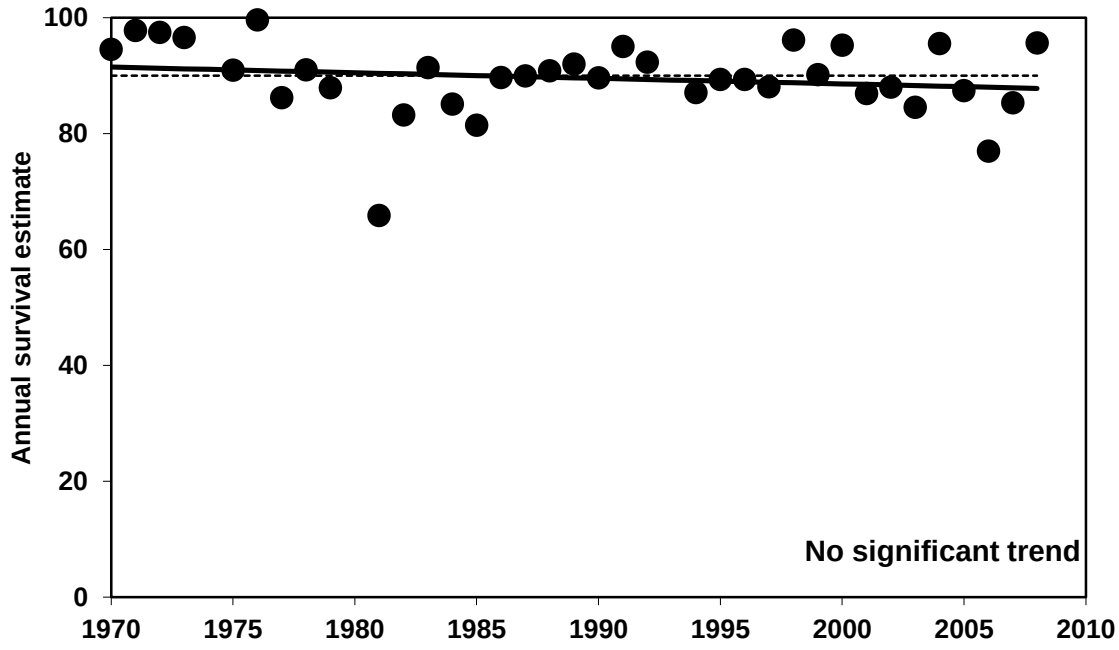
	2005	2006	2007	2008	2009	2010
First egg	25th April	4th May	1st May	6th May	26th April	24th April
First chick	3rd June	4th June	2nd June	5th June	24th May	3rd June
First 'jumpling'	20th June	25th June	23rd June	28th June	13th June	21st June

13.5 Adult survival

Appendix 5 gives the estimated survival rates of Razorbill. The main point to make about these data is the one made in previous reports, namely that they indicate that the survival rates, averaged over several years, for this species were higher in the early 1970s than they have been since. However, there is no significant downwards trend and there are no unusual figures in the last few years.

Razorbills are very difficult to census accurately and the change in the numbers recorded do not match the variations in survival rates.

Figure 24 **Trend of adult survival of Razorbill up to and including survival from "2008 to 2009".**



14 Atlantic puffin

14.1 Breeding numbers

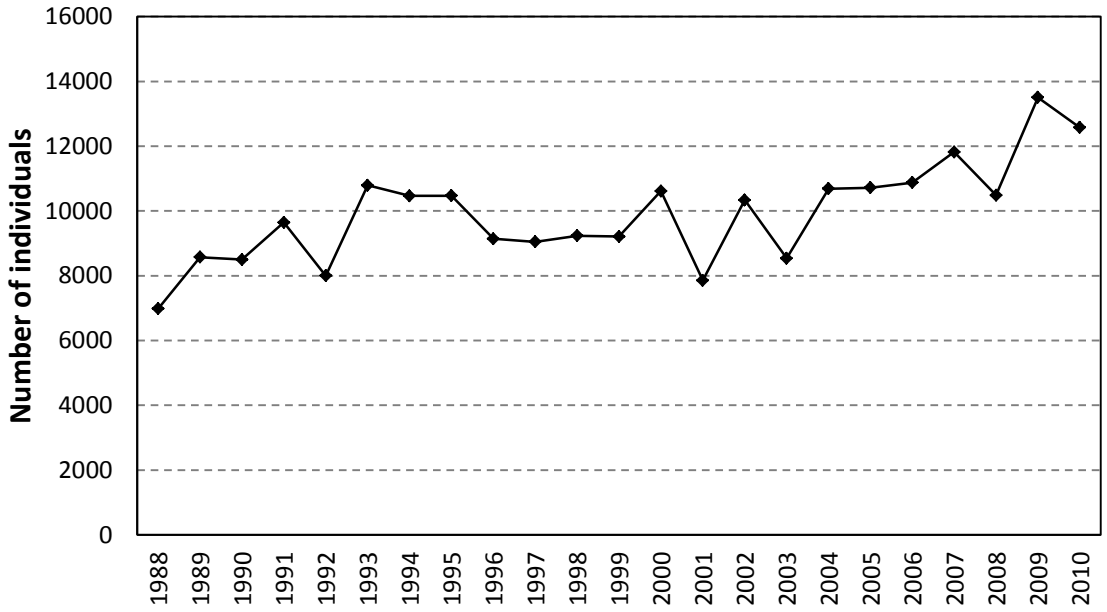
Whole island counts of birds on land and sea were made during late April/early May on evenings when numbers in North Haven were high. Count details are shown in Appendix 10.

Numbers have remained rather similar during the entire period from 1989 to present, considering the difficulties in estimating numbers of individuals (Table 32). The 2001 count was low and this is thought to have been due at least in part to there being no large evening gatherings of puffins in that year.

Table 32 Maximum spring counts of Atlantic puffin on Skomer Island and Middleholm 1989-2010.

Year	No. individual puffins	%change	5 year % change
2004	10688	+25.2	+0.7
2005	10717	+0.3	+36.5
2006	10876	+1.5	+5.5
2007	11821	+8.7	+38.5
2008	10487	-11.3	-1.9
2009	13508	+28.8	+26.0
2010	12577	-6.89	+15.64

Figure 25 Maximum spring counts of Atlantic puffin on Skomer Island 1989-2010.



14.2 Burrow occupancy and breeding success

Puffin burrow occupancy and breeding success in the South East Isthmus study plot for 2010 is shown in Table 33 below. Burrow occupancy was established over six evening watches, from 1830 to dusk, between the 3rd and 13th May. This is a little bit earlier than the guidelines recommend but as the first eggs are probably laid on Skomer in the second week of April it still seems late to be trying to establish burrow occupancy.

Breeding success (Table 33) was based on the number of burrows which adults brought food in to during two 24 hour watches, carried out from 1300-2215/0430-1300, immediately prior to the main fledging period. Two or more feeds had to be recorded at a burrow for it to be scored as successful.

The first adult Puffin was seen taking fish down a burrow on 24th May, with hundreds of birds starting to bring in food within the next couple of days. Feeding rates (Table 34, fig 26) were measured on two watches were carried out on 21st/22nd June and 2nd/3rd July. Due to bad weather the second watch was a little later than intended and a few early chicks fledged between the two watches.

Table 33 Burrow occupancy and breeding productivity of Puffins on Skomer 2010

Burrow distance from the cliff edge (m)	Total No. burrows	No. occupied burrows	% Occupied	No. of chicks based on 2 (3+) feeds	Max. Productivity
< 5	90	66	73%	52 (50)	0.79 (0.76)
5-10	49	44	90%	37 (36)	0.84 (0.82)
>10	43	27	63%	20 (18)	0.74 (0.67)
Total	**182**	**137**	**75%**	**109 (106)**	**0.8 (0.77)**

The increased number of burrows in the study area this year was due to a combination of the hard winter and the increased number of Rabbits. Over the winter snow seems to have flattened the tall Yorkshire Fog and the grass died back considerably, exposing unoccupied burrows that have been hidden for the last couple of years, and the massively increased Rabbit grazing kept the grass down throughout the season and the burrows exposed. The increased number of burrows has meant the percentage occupied has gone down but the actual number of occupied burrows was very slightly up on last year.

With an 80% success rate Puffins had another excellent breeding season on Skomer in 2010 and several other factors seemed to help make 2010 a good year for Puffins generally: The weather was reasonable throughout the breeding season, the lack of tall grass meant they could gather all over the slopes again and socialise in the evenings and there was no lack of food.

Another feature which will have had a small, but unquantifiable, beneficial effect on their breeding success relates to the increased rabbit population. With a shortage of rabbits in the past seasons, some of the Great Black-backed Gulls, which normally take many young rabbits, were taking more young Puffins. D. Boyle reported that while in 2009 he was seeing one or two chicks being taken every evening, in 2010 he only recorded two chicks being taken during the whole season. The more open terrain possibly also made it safer for the chicks when they were out exercising in the evenings.

14.3 Feeding rates

There was a marked early morning peak of feeding only in the first watch and birds were coming back in with fish earlier than usual – usually birds only really start coming in from about 05:30 but this year birds were coming in from 04:45.

Table 34 Feeding rates of Puffins in 2010

	21/22 June	2/3 July
Total No. burrows to which feeds were recorded	115	101
Total No. recorded feeds	558	338
Mean No. feeds per burrow (range)	4.8 (1-14)	3.3 (1-10)

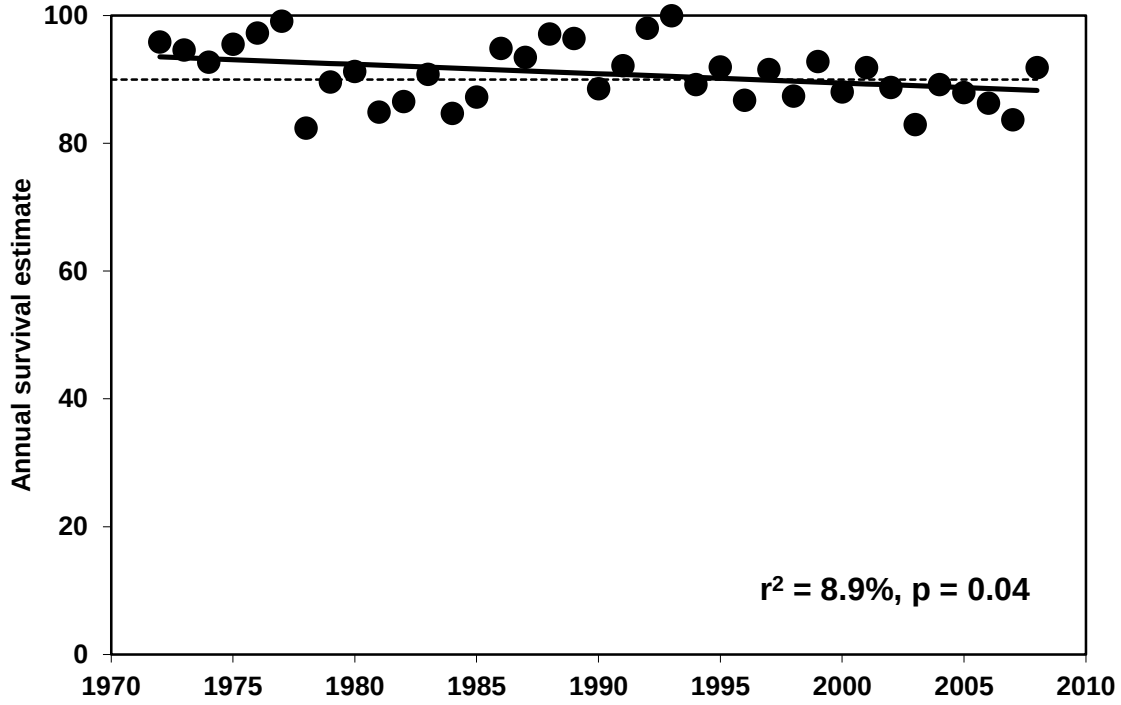
Note: Includes single feeds to 14 burrows considered unoccupied or unsuccessful and one burrow with two feeds

Figure 26 Feeding rates of Puffins in relation to time of day.

14.4 Adult survival

Appendix 5 gives the estimated survival rates of Puffins. As with Razorbills survival rates for the last few years show no unusual patterns. However, over the long-term, there has been a significant decline in adult survival rate: from c 93% in the mid 1970s to around 87% currently.

Figure 27 Trend of annual survival estimate of Atlantic puffin 1972 up to and including survival from "2008 to 2009".



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17 Appendices

Appendix 1 Mean seabird counts by section

	Counted from Sea or Land?	Fulmar - AOS	Kittiwake - AON	Guillemot - IND	Razorbill - IND
1	Sea	31	0	312	228
2	Sea	0	0	180	119
3	Sea	16	160	223	81
4	Sea	24	18	122	50
5	Sea	26	22	561	127
6	Sea	7	5	150	14
7	Sea	0	0	12	35
8	Land and sea	22	0	55	97
9	Land	10	0	92	57
10	Sea	0	0	13	12
11	Sea	22	0	143	97
12	Land	35	0	12	32
13	Land	0	0	0	22
14	Land	12	325	735	111
15	Sea	13	5	0	85
16	Land	33	180	1901	380
17	Sea	0	0	0	29
18	Sea	0	0	0	0
19	Sea	0	0	120	79
20	Sea	0	0	0	9
21	Land	0	0	13	35
22	Land	44	704	4633	724
23	Land	0	0	0	0
24	Sea	0	0	49	99
25	Sea	0	0	0	30
26	Land	49	0	310	268
27	Land	0	134	2967	203
28	Land	8	0	5	118
29	Sea	0	0	0	0
30	Land	0	0	258	32
31	Land	5	0	332	27
32	Land	0	0	152	45
33	Land	0	33	290	122
34	Land	2	0	423	212
35	Sea	2	0	188	120
36	Sea	6	0	493	140
37	Land	2	112	2788	350
38	Sea	0	224	501	97
39	Sea	39	0	730	246
40	Sea	0	0	232	74
41	Sea	33	0	95	90
42	Sea	51	0	370	198
43	Sea	36	0	201	112
44	Sea	2	0	210	311
45	Sea	0	0	91	74
TOTAL		**530**	**1922**	**19962**	**5391**

Appendix 2 Dates of visits to Black legged kittiwake sub-colonies.

1st visit	24-27 May	to identify nests sites
2nd visit	08-10 June	to record incubating birds / new sites
3rd visit	22-24 June	to record incubating birds / small chicks
4th visit	11-13 July	to record large chicks / site attendance
5th visit	22-25 July	to record early fledgers / site attendance
6th visit	31 Jul-01 Aug	to record fledgers / site attendance

Appendix 3 Guillemot and Razorbill Study Plots

Common guillemot study plot totals in 2010 (no. individuals)

		South Stream	High Cliff	Bull Hole	All Plots
02-Jun	SE 1	766	1893	3033	5692
03-Jun	SE 2	754	1882	3009	5645
04-Jun	SE 1	778	1905	3385	6068
05-Jun	E 1	868	1968	3908	6744
09-Jun	~	1049	2390	3461	6900
11-Jun	N 2	906	1978	3715	6599
13-Jun	N 1-2	954	2101	3591	6646
15-Jun	N 1-2	866	2178	3693	6737
17-Jun	N 1	891	1951	3562	6404
18-Jun	N 2	992	1995	3582	6569
	Mean	882.40	2024.10	3493.90	6400.40
	SD	98.28	158.64	287.20	446.23
	SE	31.08	50.17	90.82	141.11

Razorbill study plot totals in 2010 (no. individuals)

		South Stream	High Cliff	Bull Hole	Wick	All Plots
02-Jun	SE 1	73	262	296	664	1295
03-Jun	SE 2	111	323	294	692	1420
04-Jun	SE 1	119	354	333	682	1488
05-Jun	E 1	115	312	459	743	1629
09-Jun	~	157	405	504	736	1802
11-Jun	N 2	106	406	468	732	1712
13-Jun	N 1-2	112	442	481	728	1763
15-Jun	N 1-2	86	439	500	766	1791
17-Jun	N 1	87	420	491	752	1750
18-Jun	N 2	148	439	494	743	1824
	Mean	111.40	380.20	432.00	723.80	1647.40
	SD	26.32	63.40	87.50	33.14	184.21
	SE	8.32	20.05	27.67	10.48	58.25

Appendix 4 Spring Atlantic puffin counts on Skomer Island, 1999-2002.

	Count date	No. individual puffins
1999	30 April	7,578
	4 May	6,874
	12 May	9,213
	12 July	9,483
2000	22 April	7,761
	27 April	8,432
	9 May	9,278
	19 May	10,614
	26 July	14,638
2001	17 April	6,725
	2 May	6,981
	16 May	7,854
2002	23 April	10,338
	9 May	7,105
	16 May	10,154

Appendix 5 Mean annual estimated survival rates of seabirds on Skomer Island

Note: figures relate to estimated survival rate from the year in column one to the following year.

Skomer Seabird Survival Estimate to 2010

	Manx Shearwater	**Razorbill**	**Puffin**	**Kittiwake**	**LBBGull**	**Herring Gull**
1970		94.58				
1971		97.81				
1972		97.49	95.89			
1973		96.59	94.61			
1974			92.73			
1975		90.95	95.54			
1976		99.63	97.28			
1977	81.24	86.23	99.11			
1978	78.05	91.01	82.41	94.22	98.30	89.37
1979	79.31	87.91	89.61	88.98	92.11	80.87
1980	61.18		91.25	87.68	92.14	98.20
1981		65.88	84.90	83.90	87.41	60.55
1982	88.65	83.24	86.55	92.50	95.96	72.51
1983	85.06	91.43	90.81	71.35	89.43	72.61
1984	95.33	85.10	84.69	82.88	91.70	87.96
1985		81.49	87.27	79.66	89.23	72.70
1986	87.64	89.70	94.85	91.04	88.34	87.21
1987	94.20	89.97	93.49	90.27	94.37	95.07
1988		90.87	97.15	90.35	91.44	93.83
1989	72.62	92.01	96.40	95.56	92.17	87.97
1990	91.22	90.00	88.55	89.59	84.22	81.75
1991		93.77	92.17	99.98	97.75	84.08
1992	82.06	92.30	98.06	88.14	88.12	87.62
1993	72.94			91.62	97.27	
1994	89.04	86.96	89.12	79.58	82.55	79.99
1995	89.02	89.28	92.08	76.14	85.86	78.82
1996	87.80	89.25	86.52	70.17	80.91	72.04
1997	87.56	88.05	92.17	72.52	80.25	99.16
1998	94.22	96.08	87.02	87.53	90.59	83.28
1999	98.32	90.12	92.80	78.10	86.80	85.04
2000	90.97	95.13	88.08	91.25	82.35	87.00
2001	87.86	86.85	91.84	91.83	77.93	80.20
2002	81.64	87.70	88.74	79.66	75.39	81.85
2003	90.11	85.56	82.94	87.43	79.05	80.42
2004	90.46	95.74	89.23	74.42	87.84	85.56
2005	76.99	86.22	87.98	82.76	86.86	78.27
2006	87.99	76.87	86.60	67.18	90.07	77.78
2007	93.96	85.38	80.49	74.31	86.85	81.98
2008	78.11	95.68	91.87	74.67	92.24	87.17

Appendix 6 Ringing Totals for 2010.

	Adult	Pullus	Total
Manx Shearwater	98	69	+++
Puffin	37	118	155
Razorbill	27	64	91
Kittiwake	17		17
Lesser Black-backed Gull	13	474	487
Herring Gull	10		10

All birds ringed as part of Research Projects. Guillemots ringed by Prof T.R. Birkhead not included

Appendix 7 Skomer Island Guillemot Study 2010 (Birkhead, Hatchwell and Bowgen, 2010)

SKOMER ISLAND GUILLEMOT STUDY 2010

T. R. BIRKHEAD, B. J. HATCHWELL, K. M. BOWGEN

DEPARTMENT OF ANIMAL AND PLANT SCIENCES,
ALFRED DENNY BUILDING,
UNIVERSITY OF SHEFFIELD,
WESTERN BANK,
SHEFFIELD,
S10 2TN

Summary

1. 157 colour-ringed birds ringed as adults were recorded on the Amos. Annual survival, calculated as the number of birds re-sighted in 2010 that were ringed as adults in previous years was 98% (157/161).

2. 611 birds previously ringed as chicks were re-sighted. This was higher than number seen in 2009 (578).

3. 276 chicks and 37 adults were ringed on Skomer in 2010. In a separate project 28 adult guillemots at Amos area D were fitted with GLS devices (on brown and light green colour rings). In addition 10 of these birds carried GPS devices for several days of which 5 GPS devices were recovered.

4. 141 breeding sites were monitored for productivity on the Amos between 25 April and 22 July. These were in area A of the Amos with 110 of these pairs laying eggs and 77 chicks fledging from these sites. 31 pairs were excluded due to no signs of active breeding, as were 9 sites that failed during ringing, leaving a breeding success of 76% (77/101). This figure is lower than that of 2009 (84%).

5. The first egg was laid on 2 May. The median lay and hatch dates of first eggs laid at sites in the breeding sample were 6 May and 11 June respectively. Median fledge date was 29 June. The median lay date was 6 days later than in 2009, and the median hatch date was 9 days later.

6. Of 51 individuals monitored for breeding in both 2009 and 2010, 12 bred in 2009 but not 2010. The incidence of non-breeding was 23.5% (12/51).

7. Guillemot chicks were fed predominantly on sprats, which constituted 72.2% (482) of the 668 identified feeds. The remainder were 27.6% (184) sandeels and 0.3% (2) gadids. In addition, 95 unidentified fish were fed to observed chicks. The mean feeding rate per chick was 3.38 feeds/day and 0.2 feeds/hour over a 48 hour feeding watch during 20-22 June. Sandeel consumption (27.6% of all identified feeds) was higher this year than in 2009 (10.8%).

Introduction

The aims of the study were:

1. To monitor the survival of guillemots ringed as adults (adult survival)
2. To monitor the survival of guillemots ringed as chicks (juvenile survival)
3. To measure the timing and success of breeding
4. To ring both adult birds and chicks
5. To record the feeding rate and diet of guillemot chicks

Day to day fieldwork was carried out by Katharine Bowgen. Tim Birkhead visited Skomer between the 24-25 April, 1-2 June and the 25-29 June together with Ben Hatchwell to ring guillemot adults and chicks. .

All major guillemot colonies on Skomer (South Stream, High Cliff, The Wick, The Amos, Pigstone & Pigstone Bay, The Spit, Little Will Bench, The Table, Bull Hole, Payne's Ledge, North Haven, Shag Hole Bay, Amy's Reach, Matthew's Wick, Transverse Ledge and Surprise Ledge) were visited regularly and the presence of ringed birds noted. The smaller colonies on Middleholm and the North Coast were visited between one and twelve times during the field season.

Breeding success was monitored at the Amos. 141 pairs in sub-colony A of the Amos were monitored, with laying, hatching and fledging dates recorded where possible. The sites were mapped using acetates laid over photos of the colony, and positions were transferred to a computer database.

A 48 hour feeding watch was carried out at the Amos by Katharine Bowgen with the assistance of Chris Taylor, Jerry Gillham, Dave Boyle and Julia Baer (each of the latter taking one 4 hour watch). Birds within a study plot were watched during daylight hours from 10:00 on the 20 June until 10:00 on the 22 June, and the feeds brought to the chicks were recorded.

This was the fourth year in which a Personal Digital Assistant (PDA) was used to enter the data in the field, and download data automatically onto the computerized database designed by Ian Stevenson (Sunadal Data Solutions). This year, GLS devices fitted to adults at the Spit in 2009 were monitored and retrieved; and GPS and GLS devices were fitted to adults from area D on the Amos. This was done in collaboration with Prof Tim Guilford, University of Oxford.

Adult survival

Birds ringed as adults were traditionally ringed with a colour-ring combination. This is the fourth year that adult birds were ringed using a single uniquely numbered Darvic ring of the same design as those used for chicks. Whether birds were ringed as adults or chicks is recorded in the database, and can easily be extracted. Adult survival is estimated as the number of birds ringed as adults seen on the Amos in the current year as a proportion of the total number of birds ringed as adults known to be alive last year. This year, 157 birds ringed as adults were seen on the Amos, giving an annual survival estimate of 97.5% (157/161; Table 1), this is higher than the 2009 estimate (87%).

It should be noted that this is a preliminary estimate only. The calculations cannot include 'missed' birds, i.e., birds that were not seen in 2009 but that may be seen in subsequent years. A more accurate figure for survival can therefore only be made retrospectively. As Table 1 shows (for all years since 1986), the retrospective estimate and the current estimate do differ,

but the current estimate provides a useful first approximation of the direction of any survival trends.

Table 1: Annual adult survival estimates (1985 – 2010)

Year	Alive	Seen	Ringed	Total	Not Seen (%)	% Alive (estimated using No. birds 'seen')	% Alive (estimated using No. birds 'alive')
1986	64	63	9	73	1 (2%)	90%	91%
1987	70	70	9	79	0	96%	96%
1988	78	70	21	99	8 (10%)	87%	99%
1989	94	86	6	100	8 (9%)	87%	95%
1990	83	72	7	90	11 (13%)	72%	83%
1991	84	81	0	84	3 (4%)	90%	93%
1992	83	81	0	83	2 (2%)	96%	99%
1993	74	73	0	74	1 (1%)	88%	89%
1994	66	62	0	66	4 (6%)	83%	89%
1995	62	55	0	62	7 (11%)	83%	94%
1996	57	51	146	203	6 (11%)	82%	92%
1997	192	183	29	221	9 (5%)	90%	95%
1998	205	198	0	205	7 (3%)	90%	93%
1999	196	196	14	210	0	96%	96%
2000	191	179	20	211	12 (6%)	85%	91%
2001	212	201	7	219	11 (5%)	95%	100.5%†
2002	216	191	10	226	25 (12%)	87%	99%
2003	216	199	29	245	17 (8%)	88%	96%
2004	238	207	53	291	31 (13%)	84%	97%
2005	296	249	15	264	47 (16%)	86%	102%†
2006	245	225	2	227	20 (8%)	85%	93%
2007	212	205	25	231	7 (3%)	90%	92%
2008	199	184(176*)	1	185	15 (8%)	80% (76%*)	86%
2009	185	161	0	161	24 (13%)	87%	100%†
2010	*	**157**	**37**	**194**	*	**98%**	*

Alive: Number of previously ringed birds known to be alive in year n. This is calculated retrospectively; i.e. the number *alive* in a given year is estimated using the sum of the numbers '*seen*' and '*not seen*' that year.

Seen: Number of (previously) ringed birds seen in year n.

Ringed: Number of birds newly ringed in year n.

Total: Estimated total number of ringed birds in the study population; includes those newly ringed "at risk" at the end of year n.

Not Seen (%): Number of ringed birds *not* seen in year n but observed the following year (n+1), i.e. is determined retrospectively, as a percentage of the number of birds "alive" in year n.

% *Alive*: Percentage of ringed birds known to be alive in year n (proportion survived, using previous year's estimate of 'total' population). This is initially estimated using the number of birds *seen* in year n. A more realistic estimate is calculated (retrospectively) the following year, using the number of birds *alive* (i.e. takes into account any surviving birds *not seen* in year n).

† Individuals may be later re-sighted having not been seen for a number of years, i.e. the 'Total' study population size can be underestimated. Consequently, it is possible for the estimated number of birds alive in year n to exceed the estimated total population the previous year (n-1). This results in figures of over 100% when calculating the percentage alive.

* Database errors corrected in 2009 changed survival estimates from 2008

Annual survival rate has varied over the past 20 years (Figure 1). There is evidence that survival may be linked to large-scale climatic conditions such as the North Atlantic

Oscillation – climatic changes occurring over roughly a 10 year period which can affect fish stocks, and may in turn influence seabird annual survival (Thompson & Ollason, 2001). This is supported by an analysis of our guillemot data, using the programme MARK, that shows that survival is influenced by climate and oil pollution (Votier *et al*., 2005).

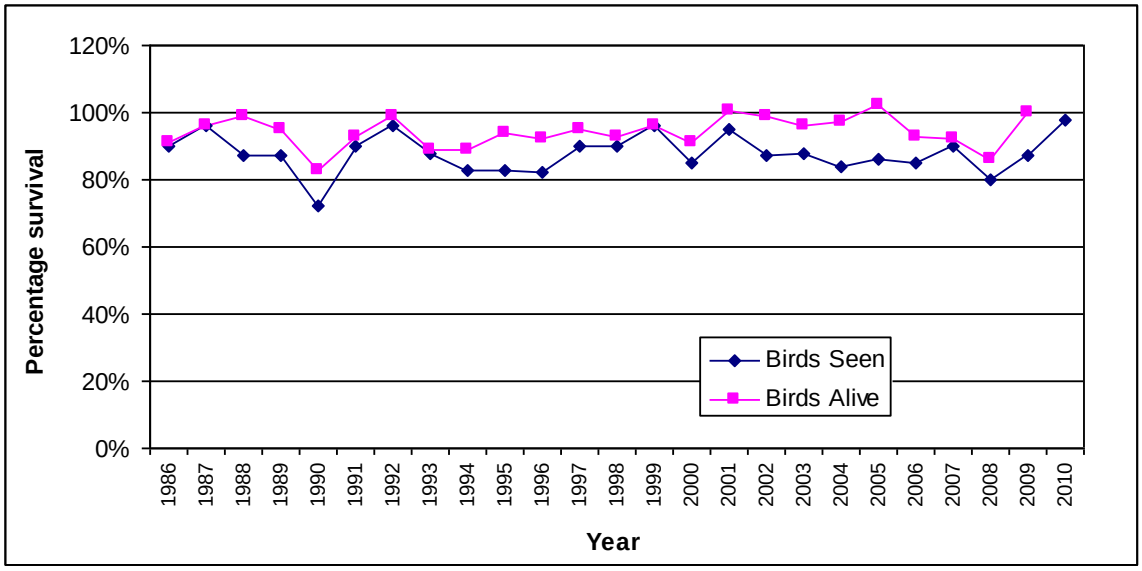

Figure 1: Annual survival (1986-2010) based on birds seen and birds known to be alive

Immature survival

When guillemot chicks fledge, they spend two years away from their natal colony before returning. When they return, young birds visit 'clubs' at many colonies around the island. 'Clubs' are gatherings of young birds on rocks at sea level, close to colonies. At around 7 years old they join the main colony and start breeding, although it is not unusual for them to do this earlier. This pattern of behaviour reduces the likelihood of seeing immature birds, hence any estimate of immature survival will tend to lack accuracy. Immature survival is estimated by the proportion of guillemots seen this year that were ringed as chicks in previous years.

The first 2-year-old bird was seen on the 26 May. This is within the range of first sightings in the previous 10 years (Table 2). Only 14 (5%) of the 270 chicks ringed in 2008 that are now 2 years old were re-sighted in 2010.

Table 2: Dates of first 2-yr-old sightings for the past 10 years

Year	Date 1st 2-yr-old seen
2010	26 May
2009	22 May
2008	11 June
2007	21 May
2006	29 May
2005	29 June
2004	30 April
2003	11 May
2002	18 May
2001	23 May
2000	21 May

612 guillemots ringed on Skomer as chicks were seen in 2010. The proportions of birds seen from each cohort are roughly the same as those seen last year (Figure 2; Table 3). Considerably more young birds from 2007 were seen in 2010 compared to 2009.

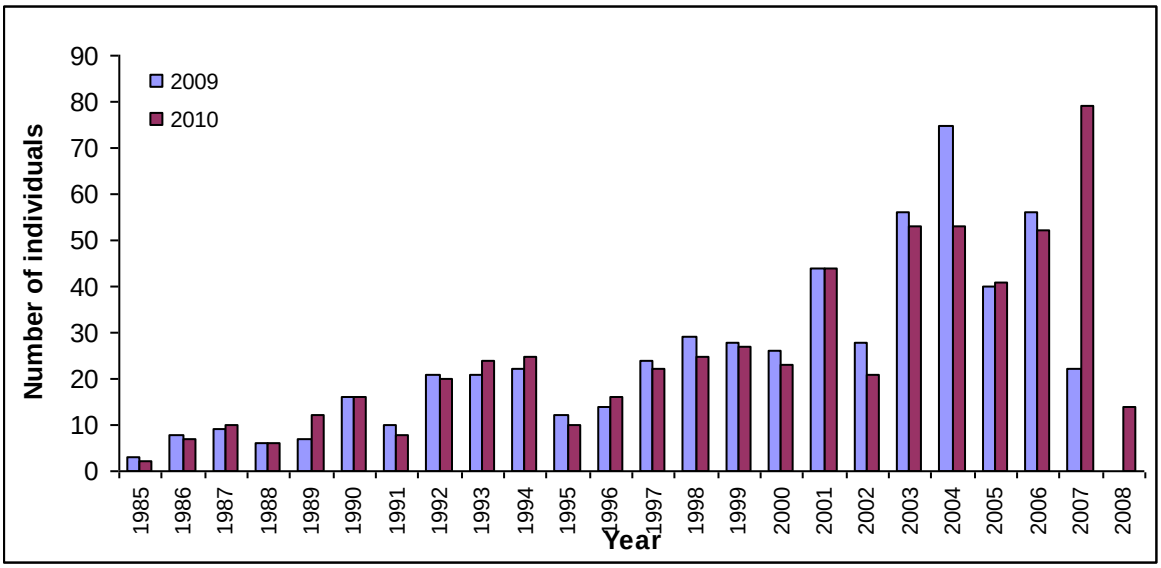

Figure 2: Percentage of birds ringed as chicks seen in 2009 and 2010, divided by year born or cohort.

Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1986	248																								
1987	-	312																							
1988	29	-	297																						
1989	68	9	-	299																					
1990	91	93	2	-	297																				
1991	71	115	70	12	-	300																			
1992	61	95	77	58	30	-	300																		
1993	50	80	64	65	103	25	-	298																	
1994	43	62	51	49	116	121	25	-	298																
1995	33	53	37	42	80	106	81	20	-	305															
1996	23	36	31	30	70	77	86	90	4	-	300														
1997	21	35	25	28	58	51	66	98	57	4	-	300													
1998	27	30	23	22	53	47	55	85	101	46	7	-	318												
1999	22	32	23	24	44	41	61	61	80	53	74	30	-	297											
2000	19	26	20	22	39	39	52	64	72	59	85	79	33	-	300										
2001	15	21	16	15	35	30	38	41	35	41	69	73	77	30	-	273									
2002	7	3	11	12	27	12	27	19	23	24	52	74	74	61	14	-	289								
2003	16	16	24	19	30	19	33	41	39	28	50	73	92	119	96	10	-	300							
2004	10	9	12	16	23	16	23	27	28	16	36	48	54	67	67	63	4	-	300						
2005	7	9	8	13	9	11	15	18	20	10	23	27	38	42	51	75	16	4	-	300					
2006	11	9	5	11	19	6	23	22	26	11	33	34	48	51	50	89	46	75	7	-	293				
2007	12	16	10	15	22	13	26	31	33	21	27	32	32	44	37	70	39	89	68	3	3	300			
2008	6	6	4	8	17	5	14	16	14	12	19	19	29	31	23	52	30	61	77	1	6	3	270		
2009	8	8	6	7	16	9	20	20	21	12	14	24	29	28	26	44	28	56	75	41	56	22	-	292	
2010	**7**	**10**	**6**	**12**	**16**	**8**	**20**	**24**	**25**	**10**	**16**	**22**	**25**	**27**	**23**	**44**	**21**	**53**	**53**	**41**	**52**	**79**	**14**	**-**	**276**

Ringing cohort

Table 3: Numbers of birds seen from each cohort, from 1986 to 2010

Monitoring productivity

Productivity was monitored at the Amos. Pairs at 141 sites were followed from 25 April to 22 July, and the presence or absence of an egg or chick was recorded. This number includes 31 pairs who did not breed this year despite initially showing behaviour characteristic of breeding pairs. Therefore, eggs were laid and breeding attempted at 110 of monitored sites.

Guillemots have a characteristic posture when incubating. Birds may, however, adopt this posture when 'brooding' pieces of eggshell, pebbles or other debris, so the lay date was always confirmed with a sighting of the egg. If a guillemot was seen to be adopting an 'incubating' posture but it was not possible to see the egg until the following day, then incubation was assumed to have started on the first day that the change in posture occurred.

Guillemots usually lay only one egg each breeding season. However, if that egg is lost then they may re-lay after a minimum of 12 days. If they also lose the second egg, only very rarely will they lay a third (Gaston & Jones, 1998).

Birds change posture when chicks hatch. For the first few days, the chick is brooded beneath the adult, and when larger tucked under the adult's wing, making it more challenging to sight chicks when first hatched. Care was taken therefore to gain definite sightings of eggs or chicks around the putative hatch day (day 33 after laying, with the lay day counted as day 1). Again, if a definite sighting was obtained only on the day following a change in posture, the day on which the posture change occurred was used as the hatching date.

The median time between hatching and fledging is 21 days. For this study if a chick was absent from the ledge on the 16 day after hatching (with hatch day as day 1) it was assumed to have fledged, if it was absent earlier the chick was assumed to have been predated or accidentally lost.

This year, in order to allow more time to search for colour ringed birds on other parts of the island, the focus of the productivity monitoring was on the breeding success of colour ringed birds in sub-colony A of the Amos i.e. whether chicks reached a minimum of 16 days old, with less importance placed on recording the exact laying, hatching and fledging dates. However, whenever possible laying, hatching and fledging dates were recorded. This meant that the size of the sample for timing of breeding was slightly smaller, and fewer exact dates were recorded than in previous years.

Timing of breeding

For the calculations of timing of breeding, two estimates were calculated for laying, hatching and fledging dates: the first using data accurate to within 24 hours (as described above) and the second, using estimated dates as well. The first egg seen on the Amos was laid on the 29 April. The first egg laid by a member of a ringed pair was recorded on the 2 May. Figure 3 shows the spread of lay dates for first eggs within the breeding sample. This year the tail end of the laying period was quite drawn out. Estimated lay dates, either estimated from hatching date or with some days uncertainty associated with the date, are shown separately. In addition to those dates illustrated in Figure 3, eight second eggs were recorded, three with estimated dates between 2 and 9 June and five with exact dates of 23 May and during 7 to 14 June. Two of these eggs failed

during the ringing session and though the others hatched the chicks were lost before they reached 16 days of age.

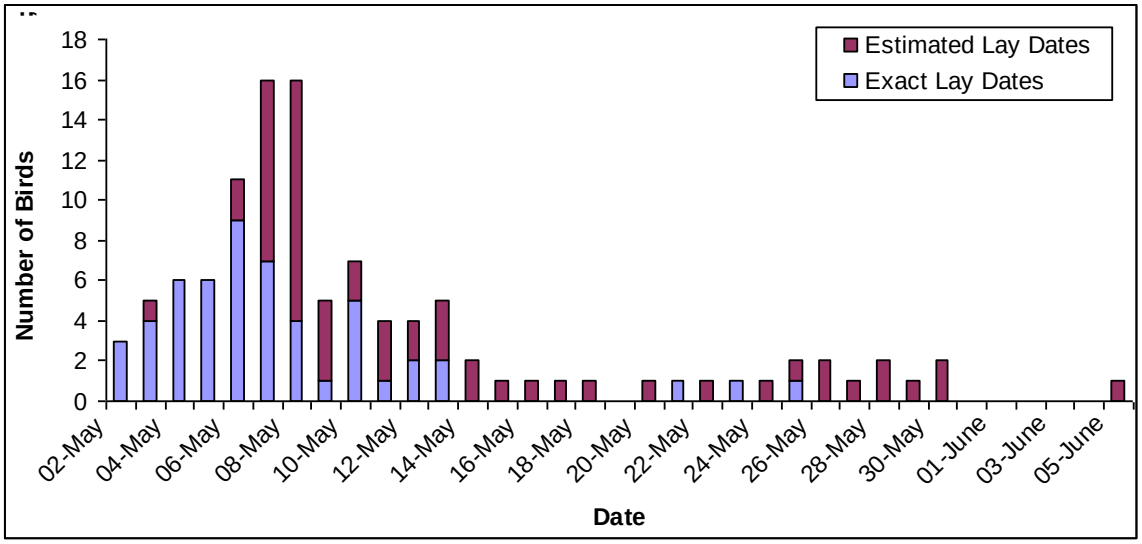

Figure 3: Laying distribution 2010

The first hatchling of a ringed bird was seen on 3 June. Table 4 shows the median dates and the range for laying, hatching and fledging (for first eggs only). To provide additional information, the data from estimated dates is also provided. Lay dates were estimated from either an exact hatch date or from an observation of a new egg which could not be guaranteed to have been laid in the last 24 hours. Hatch dates were estimated in a similar way from lay dates and fledging dates were estimated from the distribution of last sightings for all chicks over the age of 16 days. Table 5 provides a comparison with median lay dates for previous years.

Table 4: Summary of lay, hatch and fledge data for first eggs

	Median		Range		Sample size	
	Accurate	Estimated	Accurate	Estimated	Accurate	Estimated
Lay Dates	10 May	6 May	2 May-25 May	3 May-5 Jun	53	110
Hatch Dates	8 Jun	11 Jun	3 Jun-24 Jun	3 Jun-27 Jun	51	92
Fledge Dates	30 Jun	29 Jun	22 Jun-12 Jul	22 Jun-12 Jul	55	77

Table 5: Median laying dates for 2010 and previous breeding seasons

Year	Median lay date
1991	24 May
1992	18 May
1993	19 May
1994	24 May
1995	20 May
1996	24 May

1997	12 May
1998	16 May
1999	11 May
2000	8 May
2001	12 May
2002	10 May
2003	8 May
2004	9 May
2005	10 May
2006	14 May
2007	10 May
2008	19 May
2009	30 April
2010	**8 May**

Breeding success

141 sites were monitored at the Amos (sub-colony A) and of these 110 pairs laid eggs. A large number of birds this year did not breed though they were paired at the beginning of the season and many stayed around until near the end of the fledging period. It should be noted that these 31 non breeding pairs included 27 identifiable individuals, 17 of which had never bred before, 3 had not been seen breeding since changing mates, 6 had no consistent breeding record and 1 did not breed in 2009. In particular, OT/YW (X38586) did not breed in 2010 with a new unringed mate, though it had a record of 12 successful breeding events since it was ringed 14 years ago. Its previous colour ringed partner was not observed this year, leaving potential that this bird is now dead. Of the 110 eggs laid, 18 eggs were lost (including one overdue) and 92 chicks hatched. This gives a hatching rate of 84% (92/110).

Of the 92 chicks known to hatch, 15 were lost, 77 disappeared after 16 days of age (and were assumed to have fledged), and of these chicks, 49 had known fledging dates. Eight birds re-laid second eggs but all were unsuccessful (2 at the egg stage and 6 at the chick stage). The majority of these were laid towards the end of the breeding season and lost when the Amos was heavily reduced of birds and predation from gulls increased. Fledging success for 2010 was 84% (77/92).

An estimated productivity of 70% (77/110) for Amos sub-colony A can be calculated, excluding these breeding sites with non breeders. During the ringing session 9 sites were disturbed and eggs and chicks lost (5 eggs, 4 chicks) and if we take these into account the breeding success of sub-colony A was 76% (77/101). It should be noted that breeding attempts at the egg or early nestling stage (8 of these 9 sites) at the time of ringing have a negligible chance of successful fledging, so productivity is likely to be close to the lower estimate of 70%.

Table 6: Summary of breeding success data on the Amos

	Amos sub-colony A
No. Pairs Followed	141
No. Pairs that Laid Eggs	110
No. Pairs with Hatchlings	92 (84%)

No. Pairs that fledged Chicks	77 (84%)
Breeding Success (chicks fledged per *breeding* pair)	77/110 = 70%
Breeding Success (chicks fledge per *breeding* pair) excluding 9 sites lost during ringing	77/101 = 76%

During the season several rings from dead birds were found on Skomer and Grassholm. Early in the season R22480 (YBu/WT) was found in the Amos basin and later near the Amos hide R412, R417 and R496 a little over a week after the ringing session for 2010. Additionally Samantha Patrick found R363, R327 and N00961 in great black back gull nests on Grassholm in the first two weeks of July. No predation attempts on adult guillemots were seen on the Amos, but several predation attempts on chicks were observed and on most days in July at least two gulls (herring gull and great black-backed gull) were seen attacking and eating chicks and eggs on the ledges. All data was collected via casual observations.

Incidence of non-breeding

Incidence of non-breeding is usually calculated by the number of non-breeding pairs that bred in the previous year, divided by the total number of pairs monitored in both years. Twelve of 51 individuals monitored and observed with an egg or chick in 2009 were not seen breeding in 2010. The incidence of non-breeding is therefore calculated as 23.5% (12/51). These twelve individuals initially exhibited paired behaviour but were later observed alone.

Ringing

Ringing took place on 27 June at Payne's Ledge and Little Will Bench and at the Amos on 28 June. Of the 37 adults captured this year (all on the Amos), all were newly caught and had both BTO and Darvic rings attached. No blood samples were taken. The two adults ringed in 2009 were seen in 2010. A total of 276 chicks was ringed in 2010, at Payne's Ledge (40), Little Will Bench (16), and the Amos (221 at sub-colonies A, B, Gulley, Top, F) using red Darvics with white numbers (made from a new material from Poland; see Figure 4) which were of the sequence R301-R600.

Figure 4: New engraved Darvic ring for 2010

Adults were ringed at the Amos (37 in areas A and B) from the sequence Y001-Y060 (yellow with black numbers). One previously ringed adult was recaptured YT/OBu and had its yellow ring removed due to damage and was released with the remaining combination.

Table 7: Adult recapture and capture details for 2010

Date	Location	Recep/New	Previous rings	New Rings	Blood Taken ?
28/6/10	**Amos**	**R**	**X84527 YT/OBu**	**X84527 T/OBu**	**N**

On the 26 and 28 June, 28 adults were caught at area D on the Amos and had GPS and GLS devices fitted in collaboration with Prof. Tim Guilford, University of Oxford. The GLS devices were fitted to light green and brown colour rings. The GPS devices were fitted to 10 of these GLS birds and Tim Guilford and his team came back to the Amos on 28 and 30 June to recapture, remove and download the data from these individuals. Five birds were recaptured and the GPS devices were removed and downloaded. One device was waterlogged and the data could not be retrieved.

Of the 18 birds fitted with geolocator devices at the Spit in 2009 four were re-captured and had the data downloaded (one device was removed). A minimum of 10 GLS birds were seen at the site over the course of the 2010 breeding season with six confirmed BTO rings read and three partially recorded. Six birds were seen with an egg and from these, three chicks hatched, two eggs were lost and one had an unknown outcome. Over the whole area of the Spit, six chicks were seen with GLS parents with unknown fledging dates due to the disturbance of re-capture sessions and lack of accurate chick ages. Re-capture of GLS birds were made on the 25 and 27 June.

Chick diet

A 48-hour feeding watch was carried out at the Amos during daylight hours, from 10:00 20 June to 10:00 22 June, by Katharine Bowgen with the assistance of Chris Taylor, Dave Boyle, Jerry Gillham and Julia Baer. Each of the latter four took one 4 hour watch to relieve K. Bowgen. An area containing most of sub-colony A on the Amos was delineated and all feeds within this area were recorded. Each fish was classed as sprat (*Sprattus sprattus*), sandeel (*Ammodytes* sp.), gadid (*Gadidae*), or unidentified. The number of chicks within the area was counted and averaged 110. The weather was consistent with sunshine, clear skies and light winds. The median chick age was 12 days, (minimum 1, maximum 18), based on calculations from the 82 chicks of known age present at monitored breeding sites within the plot at the start of the feeding watch (28 of the 110 chicks in the feeding watch areas were of unknown age).

A total of 763 fish were fed to chicks during the feeding watch (668 identified), with 12 unknown events. Table 8 presents the species composition of feeds. Each chick received an average of 3.38 feeds/day (0.19 feeds/hour), this is very similar to the data for previous years (3.30 feeds/day in 2009 and 3.81 feeds/day in 2008). There was a substantial increase in the proportion of sandeels in the diet this year at 27.6% in comparison to previous years (10.8% in 2009, 2.8% 2008 and 3.6% 2007).

Table 8: Summary of species composition of feeds, calculated as the percentage of the total identified feeds

Species	Number of Feeds
Sprat	482 (72.2%)
Sandeel	184 (27.6%)
Gadid	2 (0.3%)
Unidentified	95
Total No. Feeds Fish species identified	668
Total No. Feeds Observed	763

Comparison with previous breeding seasons

Annual survival, (calculated as the number of birds ringed as adults seen on the Amos this year as a percentage of the total number known to be alive last year) was 98% (157/161) which is higher than 2009. Breeding success, calculated as the proportion of breeding pairs who had fledged a chick by the end of the monitoring period was 70% (77/110)† lower than that seen in 2009 (86%) (Table 9).

Table 9: Comparison of previous breeding seasons

Parameter	2010	2009	2008	2007	2006	2005	2004
Adult survival (estimated from birds '*seen*')*	98%	87%	80%‡ (76%)	90%	82%	86%	84%
Number of sites monitored for breeding success	141	113	64	102	245	199	204
Number of breeding pairs	110	113	64	98	230	180	182
Date first egg laid	2 May	26 Apr	12 May	5 May	7 May	3 May	1 May
Median lay date	6 May	30 Apr	19 May	10 May	14 May	10 May	9 May
Median hatch date	11 Jun	1 Jun	18 Jun	13 Jun	16.5 Jun	11 Jun	11 Jun
Median fledge date	29 Jun	24 Jun	12 Jul	7 Jul	7 Jul	2 Jul	4 Jul
% eggs hatched	84%	87%	80%	85%	84%	87%	94%

% chicks fledged	84%	97%	94%	94%	92%	90%	91.8 %
Breeding success (No. chicks fledged/breeding pair) †	0.76	0.86	0.75	0.80	0.81	0.78	0.86

†See page 11

‡ updated survival, correcting for database errors

Appendix

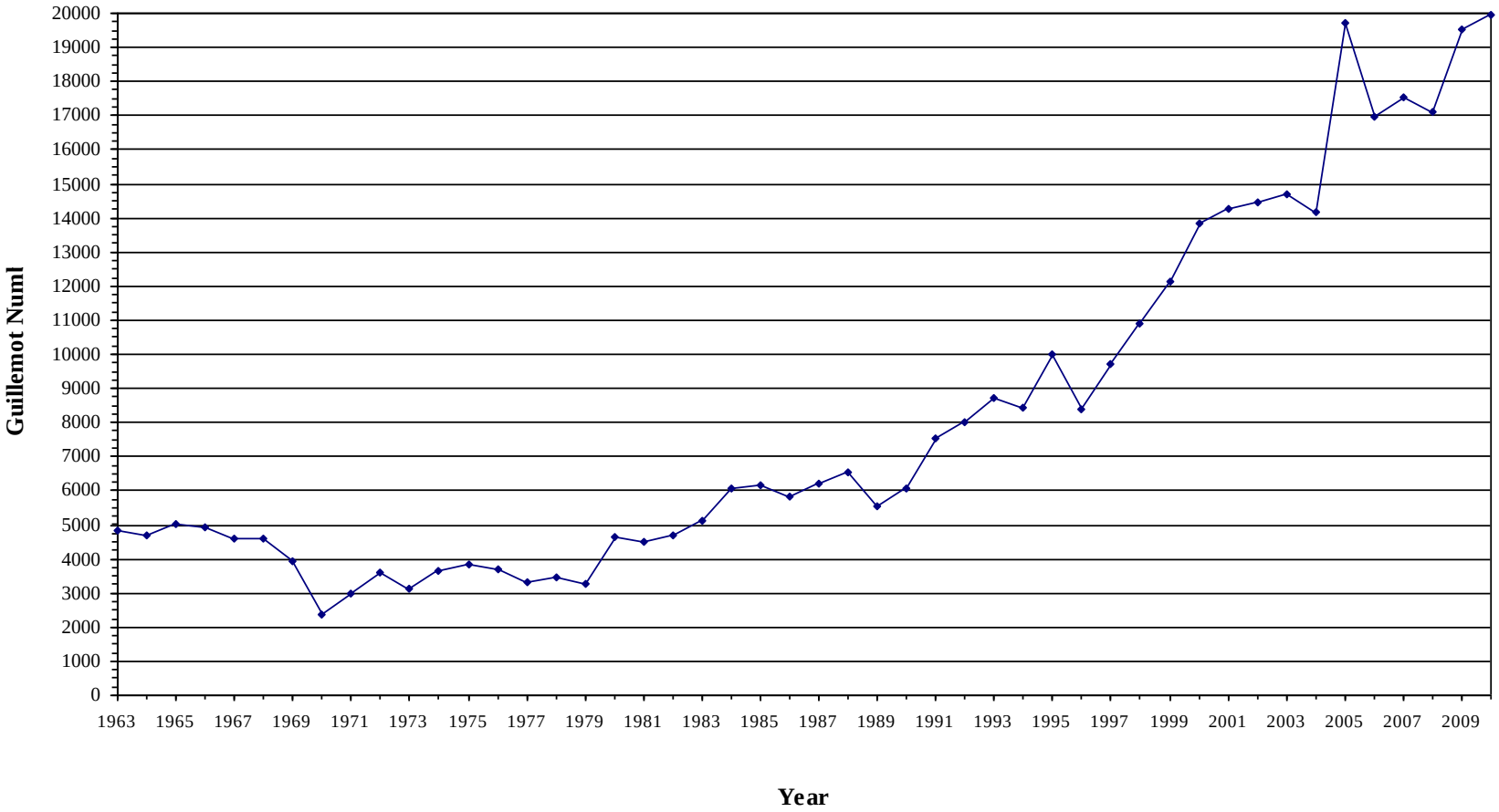

Figure 5: Guillemot numbers on Skomer from 1963 to 2010 (data provided by Chris Taylor, Skomer Island Head Warden). The whole island Guillemot count for 2010 was 19,962.

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