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Seabird monitoring on Skomer Island in 2011

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Summary

This report draws together the results of seabird monitoring on Skomer Island in 2011. This includes (among others) population counts, study plot counts, breeding success and adult survival estimates.

There whole island seabird population estimates are summarised below. Some significant changes are noted in Fulmar.

Whole Island Seabird population summary for 2011

	Total	% Change	5 Year % Change
Fulmar (AOS)	474	-10.57	-22.42
Cormorant(AON)	0		
Shag (AON)	2		
Lesser Black Backed Gull (AOT)	10238	-0.11	-13.36
Herring Gull (AON)	420	-2.55	-.2.33
Greater Black Backed Gull (AON)	80	-32.20	+1.24
Black-legged Kittiwake (AON)	1837	-4.42	-5.41
Guillemot (IND)	21866	+8.65	+23.62
Razorbill (IND)	5118	-5.06	+5.59
Puffin (IND)	12577 (2010 figures)		+15.64

Fulmar productivity in 2011 was 0.33 per AON

Herring Gull productivity was 0.5 per AON, similar to 2010

Lesser Black-backed Gull productivity was low with 0.3 chicks per AON.

Greater Black Backed Gull productivity increased to 1.24 per AON. In the diet study around half the prey items recorded were Manx Shearwaters (Figs 14 and 15) compared to 58 % in 2010. There were more fish and more items of refuse at nests than in 2010 (when the figures were 4 % for both of these categories).

Kittiwake breeding of 0.52 chicks per AON was fairly consistent with the cyclical long term average (0.64 for the period 1989 - 2010).The lowest breeding success (0.33) was again at the High Cliff sub-colony, with the highest (0.68) at South Stream (in 2010 the highest success rate was at the Wick).

Guillemot breeding success measured by the WTSWW/JNCC field assistant was a mean productivity of 0.55 fledged birds per occupied site, a decrease for a third year in a row, and lower than the overall mean of 0.69 (1989 – 2011). The season was surprisingly early.

Puffin productivity was even higher than 2010 (0.8) with productivity at 0.84and the population fairly stable following a recent increase (15.5% increase on number of individuals 5 years ago). Long term adult survival has seen a significant decline from 93% in the mid 1970s to around 87% currently.

This year the Manx Shearwater annual study plots were much higher again, indeed the second highest recorded. So, the long-term increase in the population is still there, but not quite statistically significant (p=0.068, r^2= 18.6%). This is equivalent to a population increase of some 1.5% p.a. If the 2010 figure is excluded the figures are, of course, much higher (p=0.001, r^2=59.3%, rate of increase some 2.5%).

In 2011 a separate study of Guillemot productivity was run alongside the current JNCC commitments. The aim of the study were to assess the effectiveness of guillemot productivity monitoring using the JNCC method(as adapted for Skomer) vs the more intensive "Sheffield style" assessment. The results of which are given in a separate report. As a result of this the following changes were made to the studies in 2011:

(i) Razorbill productivity was not carried out in 2011
(ii) Study plot counts were carried out by the Warden

The first two weeks of June were exceptionally busy time with a whole island Manx Shearwater Census and some important media coverage. As a result not every section of the island was counted twice. The only areas counted twice (except the population Study Plots were the Wick).

The whole island Puffin count was unsuccessful due to lack of days where a peak spring count seemed suitable, until it was too late in the season when birds would have been on eggs/in burrows.

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 2011, 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. Richard Kipling was Field Assistant in 2011.

In 2011 a separate analysis of the effectiveness of the SMP method vs the Sheffield study method was carried out. The results of which are summarised in a separate report.

Also in 2011 a whole island Manx Shearwater census was carried out in June. The results are yet unpublished. (November 2011).

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

1.1 Introduction to survival estimates

The survival rate analyses presented have been made in the same way as in the other years since 1989, in that they have been made from a computer calculation of Maximum Likelihood Measurements (using the programme MARK) 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 the survival figure for the last year (2010-11) 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 accurately; this is normally because they are very high and the confidence limits exceed 100.

The six graphs showing estimated survival rates of the species concerned are presented under each species account. A table listing the actual figures, are given together in Appendix 5. Each graph has a line at 90% survival for ease of reading. For those species where a significant trend is apparent, the trend-line is also presented.

Survival rates were measured for a number of species on the island. Observations were made by David Boyle (EGI). We are grateful to Matt Wood for helping with the survival analyses in this report.

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. There were some Kittiwake nest losses at the Wick due to storms.

3 Northern fulmar *Fulmarus glacialis*

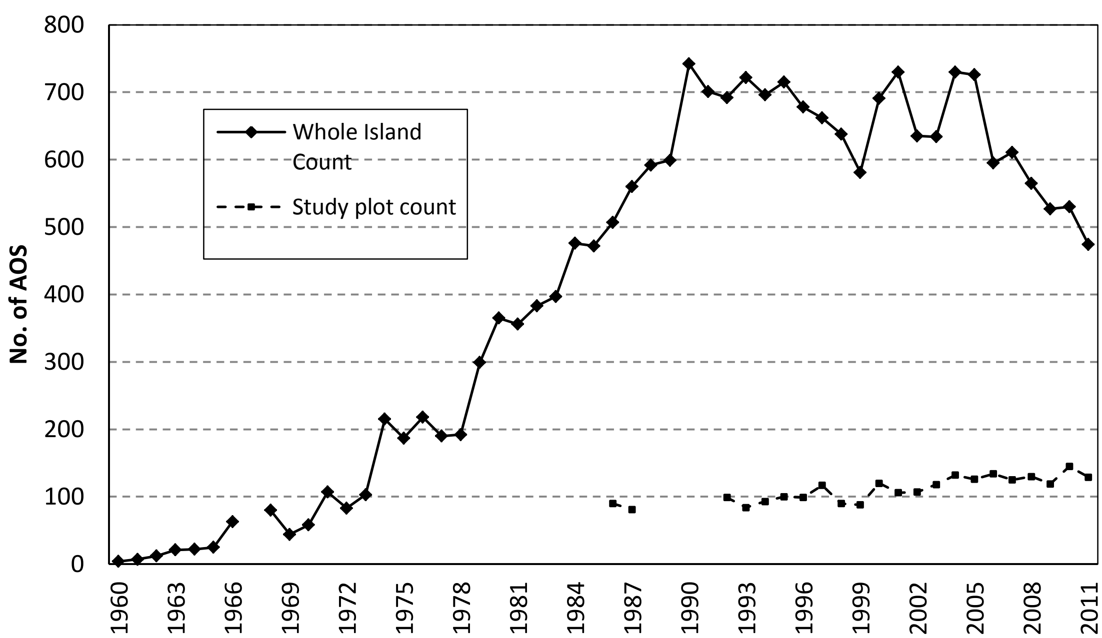
3.1 Breeding numbers - whole island counts

A mean total of 474 Apparently Occupied Sites (AOS) were counted in 2011 (see Table 1 and Figure 1). This represents a fairly steep decline since 2010, reducing the 5 year trend to a decrease of 22.42%. 129 AOS were identified in the study plots which seems to match the whole island decline this year but not over the long term.

Table 1 Northern fulmar whole island count details 2004-2011

	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
2011	474	-10.57	-22.42

Figure 1 Northern fulmar breeding numbers on Skomer Island 1963-2011.



3.2 Breeding success

3.2.1 Methods

Three visits were made to the seven fulmar study plots on 23rd May, 26th May and 29th May to observe site occupancy. Sites were considered occupied if a bird appeared to be incubating or an egg was seen on two consecutive visits. A further visit was made on the 6th 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

129 AOSs were identified in late May. The mean breeding success of 0.33 per AOS was below that for 2010 (0.41) but close to that found in 2009 (0.27). It was below the average for the period 1986 to 2011 (0.48). The most successful site was at Matthew's Wick, with 0.56 chicks fledging per AOS (Table 2). No chicks fledged from Tom's House, a site which frequently experiences complete breeding failure (Table 2).

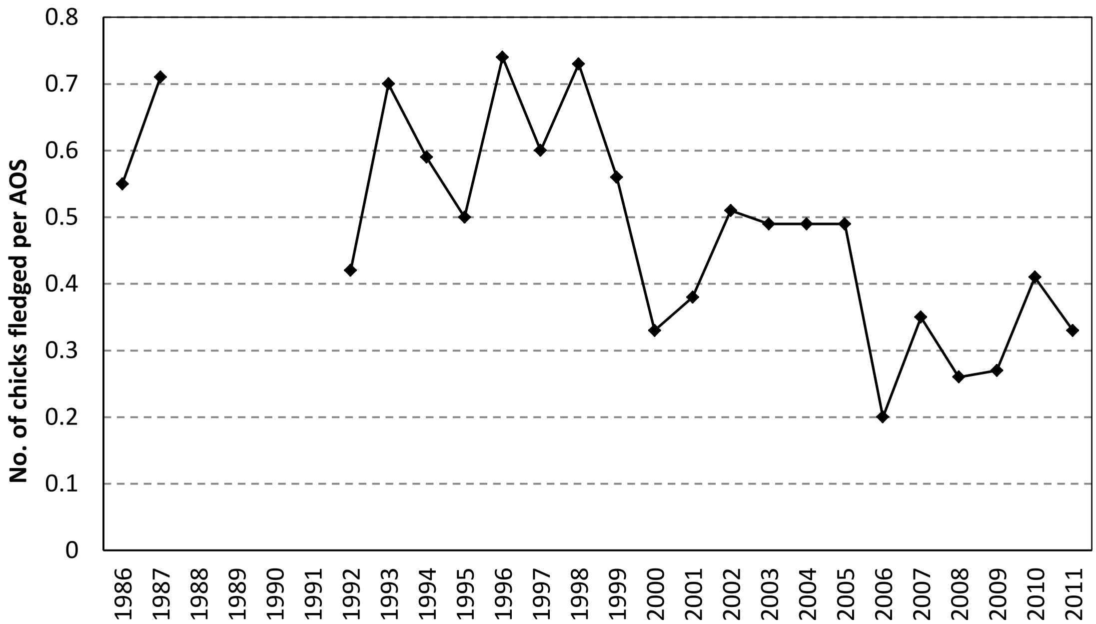
Table 2 Northern fulmar breeding success on Skomer Island 2011.

	No. site monitored	No. sites occupied	Chicks fledged	Breeding success
Tom's House	11	7	3	0.00
Basin (west)	50	26	10	0.38
Basin (east)	24	11	7	0.43
North Haven	81	46	18	0.25
South Haven	27	17	4	0.23
Castle Bay	30	18	6	0.44
Matthew's Wick	36	20	9	0.56
Mean				**0.33**
SD				0.17
SE				0.06

Table 3 Northern fulmar breeding success on Skomer Island 2005 - 2011.

	2005	2006	2007	2008	2009	2010	2011
Tom's House	0.29	0	0	0	0.25	0.43	0.00
Basin (west)	0.59	0.18	0.38	0.21	0.32	0.38	0.38
Basin (east)	0.31	0.14	0.36	0.25	0.33	0.64	0.43
North Haven	0.41	0.3	0.26	0.37	0.34	0.39	0.25
South Haven	0.71	0.1	0.5	0.32	0.11	0.24	0.23
Castle Bay	0.5	0.29	0.43	0.38	0.25	0.33	0.44
Matthew's Wick	0.63	0.39	0.5	0.29	0.32	0.45	0.56
Mean	0.49	0.2	0.35	0.26	0.27	0.41	**0.33**
SE	0.06	0.05	0.07	0.05	0.03	0.05	**0.06**

Figure 2 Northern fulmar breeding success on Skomer Island 1986-87 and 1992-2011.



3.3 Timing of breeding

Time of breeding was recorded in 2011 and is detailed in Table 4.

Table 4 Northern fulmar timing of breeding on Skomer Island 2005 - 2011.

	2005	2006	2007	2008	2009	2010	2011
First egg	20th May	1st June	Not recorded	23rd May	20th May	22nd May	9th May
First chick	3rd July	1st July	Not recorded	14th July	8th July	6th July	2nd July

4 European storm-petrel *Hydrobates pelagicus*

No surveys on Skomer have been carried out for European storm-petrel in 2011

5 Manx shearwater *Puffinus puffinus*

5.1 Study plot census

This is the 14th year in which the Oxford MSc students have carried out the counts of Manx Shearwaters in the study plots on Skomer. Tables 1 and 2 show the number of burrows found and the number of shearwater responses 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 plots has sometime been surprisingly large; we do not have an explanation for this. Only males respond to the tape (of a male call). The two members of a pair share incubation, roughly equally, each stint being around a week. It would therefore be possible for some of the variation to be due to variation in the proportion of the two sexes present, but the variation in the number of responses seems to be too large for this to be the only explanation.

This year the counts were much higher again (3854), indeed the second highest. So, the long-term increase in the population is still there, but not quite statistically significant ($p=0.068$, $r^2= 18.6\%$). This is equivalent to a population increase of some 1.5% p.a. If the 2010 figure is excluded the figures are, of course, much higher ($p=0.001$, $r^2=59.3\%$, rate of increase some 2.5%).

Table 5 Number of burrows recorded from Manx shearwater study plots 1998 - 2011

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	max	min
A	51	70	87	94	98	145	87	35	105	62	91	61	87	69	145	35
B	75	102	193	240	98	91	78	81	74	108	49	91	53	74	240	49
C	299	255	259	202	193	332	287	262	309	387	346	236	246	385	387	193
D	200	235	296	244	320	313	98	210	253	303	204	206	201	238	320	98
E	63	65	66	67	61	58	48	37	49	38	48	32	46	40	67	32
F	14	17	12	11	17	20	15	18	15	13	13	12	17	17	20	11
G	11	16	15	14	22	21	14	22	29	19	34	25	19	28	34	11
H	98	97	120	120	140	126	88	118	85	167	84	87	89	141	167	84
I	271	293	199	321	260	309	236	389	230	331	246	465	278	437	465	199
J	339	311	455	401	360	359	305	224	219	337	407	315	275	351	455	219
L	473	506	596	560	593	661	527	693	445	709	472	604	422	560	709	422
M	234	231	240	188	175	218	167	141	168	154	152	191	157	213	240	141
N	207	249	261	288	248	261	221	252	282	214	235	215	221	222	288	207
O	93	99	140	152	110	142	278	119	125	156	139	84	185	148	278	84
P	151	205	234	204	228	270	124	283	264	257	254	303	256	329	303	124
Q	84	82	77	95	85	71	112	132	108	119	85	111	77	106	132	71
R	190	235	329	236	214	314	278	276	279	197	158	167	189	287	329	158
S	97	187	127	237	213	274	241	244	286	344	260	311	248	209	344	97
TOTAL	2950	3255	3706	3674	3435	3985	3204	3536	3325	3915	3277	3516	3066	3854		

Table 6 Number of responses from Manx shearwater study plots 1998 – 2011

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Max	Min
A	12	15	17	12	20	15	16	12	28	10	23	20	9	13	28	9
B	19	35	18	19	32	28	32	15	21	30	12	15	9	18	35	9
C	56	45	27	35	36	45	52	41	53	66	69	82	30	66	82	27
D	81	65	61	51	71	55	52	64	64	73	61	57	31	80	81	31
E	17	14	17	15	14	7	9	9	10	5	8	3	5	5	17	3
F	3	3	2	5	5	6	4	7	8	6	6	3	4	3	17	2
G	2	6	4	3	9	7	5	8	9	2	9	12	6	7	19	2
H	23	17	10	15	16	10	14	16	13	17	14	22	12	18	23	10
I	72	88	74	117	75	67	102	134	111	116	83	169	110	135	169	67
J	77	75	107	67	54	66	81	73	42	70	72	80	46	95	107	42
L	147	132	186	131	142	164	185	244	150	157	156	222	123	159	244	123
M	85	80	67	62	79	94	71	75	66	73	65	81	33	95	94	33
N	51	67	39	49	52	44	40	63	75	23	37	70	41	82	75	23
O	27	29	38	34	30	36	84	34	40	29	25	38	30	51	84	25
P	30	60	57	67	78	77	32	67	95	72	117	93	80	107	117	30
Q	34	26	17	17	29	26	32	32	32	31	20	65	20	25	65	17
R	48	44	65	39	56	83	91	92	72	65	62	53	65	79	92	39
S	37	67	45	51	63	75	63	65	55	73	69	96	87	75	96	37
TOTAL	821	868	851	789	861	905	965	1052	944	918	908	1181	767	1113		

5.2 Breeding success

Manx Shearwater breeding success in The Isthmus study plot in 2011 is detailed in Tables 7 & 8 below. As reported last year, a small patch of burrows, formerly monitored is now omitted due to the state of the ground.

Table 7 Breeding success of Manx Shearwaters 2011

	Number
Total Number of eggs laid	99
Number of eggs that hatched[1]	68
Number of chicks found dead	3
Number of missing chicks[2]	6
Number of chicks surviving to ringing age[3]	61
Hatching success[4]	69%
Fledging success[4]	90%
Number of fledged young per occupied burrow	**0.62**

Notes:

1) No chick was found in burrows: 9 burrows are known to have failed at the egg stage (1 burrow was taken over by Puffins and in the other 8 burrows either cold, abandoned eggs or broken eggs were found). The other 22 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 probably 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 22 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 8 Breeding of success of Manx Shearwaters 1995-2011

	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

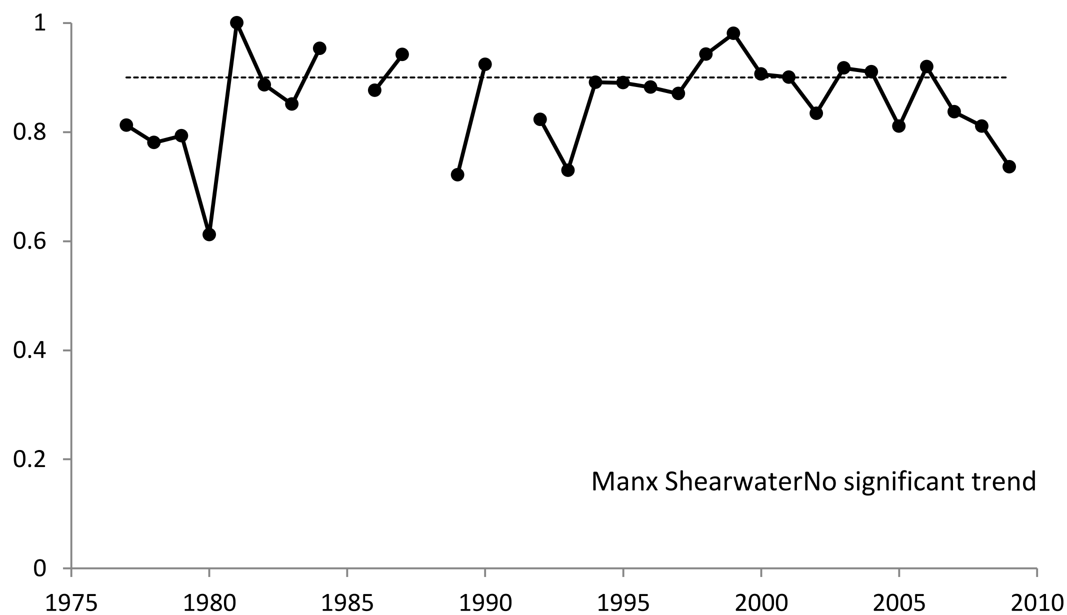
2009	114	73	67	0.92	0.59
2010	115	80	70	0.88	0.70
2011	99	68	61	0.90	0.69

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.

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 from 1997 to 2009

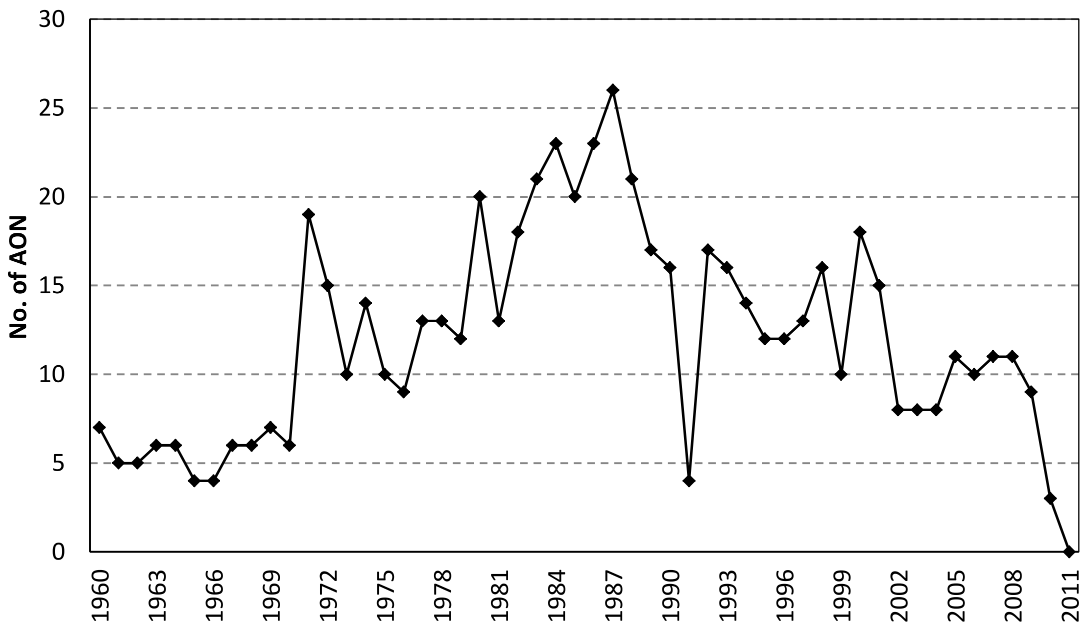


6 Great cormorant *Phalacrocorax carbo*

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 2011no pairs were seen regularly on the Mew Stone. As a result productivity was difficult to monitor.

Figure 4 Great cormorant breeding numbers on Skomer Island 1960-2011



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6.2 Breeding success

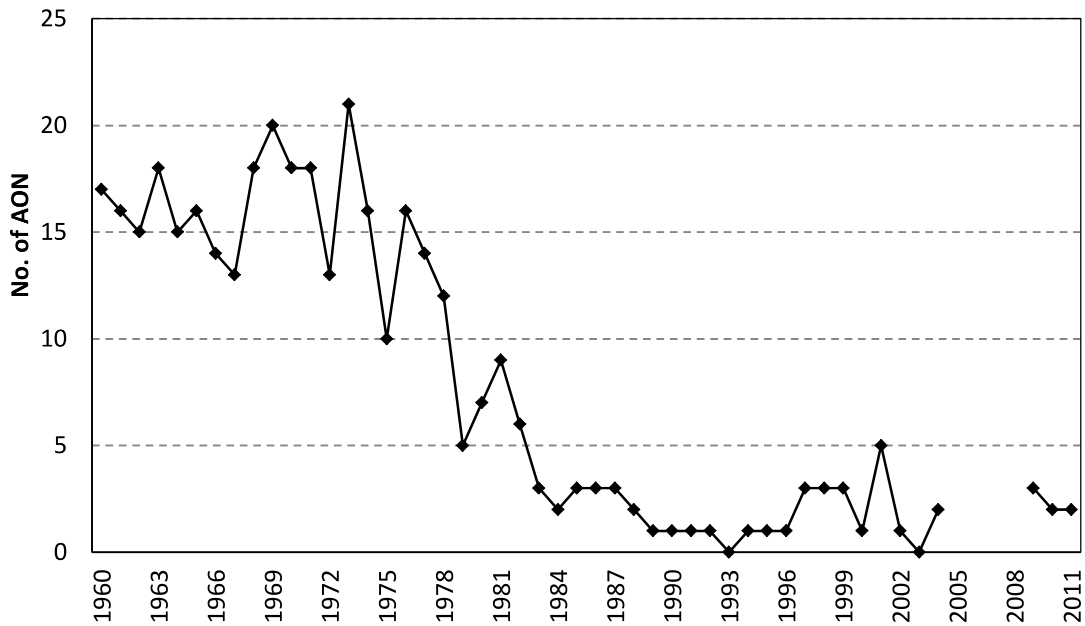
No record of productivity was made in 2011.

7 European shag *Phalacrocorax aristotelis*

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 on the north coast.

Figure 5 European shag breeding numbers on Skomer Island 1960-2011.



7.2 Breeding success

No consistent monitoring of the breeding success of European shags on Skomer took place in 2011, but young were seen during June cliff counts. On nearby Middleholm there were 53 Apparently Occupied Nests. 2.64 chicks per AON were raised (South Pembrokeshire Ringing Group, SPRG).

8 Lesser black-backed gull *Larus fuscus*

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 4016 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 9.) The mean ratio of actual number of nests to “eye-counts” was 2.55. When multiplied by the eye-count this gives a population estimate of 10,249 breeding pairs (Figure 6) A figure similar to 2009 (0.11% down). The low eye count was counteracted by a high cane:eye count ratio.

Table 11 and 12 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 2011.

Table 9 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, 9 + 10	Garland stone	279	**	279	167	1.67
5	Bull hole	173	**	173	60	2.88
2	Marble Rocks	221	**	221	118	1.87
M and N	Wick	*		*		*
Y		377	**	407	100	3.77
Mean						**2.55**
SD						0.97

* Area avoided due to high levels of burrow collapse
**In 2011 a slightly different method of cane counting was adopted in order to reduce disturbance due to fragile ground caused by a dry summer and high rabbit density. This method, used on Skokholm Island, involved just one pass of each area by a group which was slightly closer together but moving at a slower pace and communicating with each other to

ensure nests were not missed or double counted. The benefit being the terrain is only being passed over once, thus reducing burrow collapse. This also allows the gulls to return to their nests quicker.

Table 10 Mean eye count totals of Lesser Black Backed Gull AOT in sub colonies

	2011
1 South Old Wall	66
2 Marble Rocks	118
3 Abyssinia + 24	78
4 Anvil Rock	93
5 Bull Hole	60
6 Pyramid Rock	67
7 North Plain	219
8 Sheer Face W	93
9 Sheer Face E	68
10 The Hill	6
11 Double Cliff	30
12 North slopes	*78**
13 N Valley Rise	203
14 Green Plain	520
15 S Neck - Thorn Rock	*0**
16 W/S Field	15
17 Saunders Fist	0
18 Harold Stone	2
19 Wick Cliff	4
20 Tom's House-Sk Head	18
21 colony now joined with X	82
22 Garland Stone	26
23 NW Neck	48
24 E of W Pond – see 3	7
25 Toms House to Wick	24
26 Mew Stone	2
A Lantern	0
B Neck E	70
CNeck main ridge	126
D South Castle	83
E Neck SW coast	24
F South Haven	*152**
G S Stream Cliff	73
H Welsh Way	160
I High Cliff	56
J S Wick Ridge	58
K Wick	0
L Welsh Way Ridge	114
M N Wick Ridge - S	179
N N Wick Ridge - N	142
O Moory Meadow	52
P South Stream	58
Q Bramble	15
R Lower Shearing Hays	159
S New Park	65
T Shearing Hays	49
U Captain Kites	54
V Wick Basin	24
W The Basin	58
X / 21 (see 21)	-
Y Field 11	100
Z Basin-South Pond	98
Extra coastal	120
TOTAL	**4016**

* Those marked are figures used from the previous year. This was due to exceptionally fragile soil conditions not allow access to certain areas.

Figure 6 Lesser black-backed gull breeding numbers on Skomer Island 1961-2011.

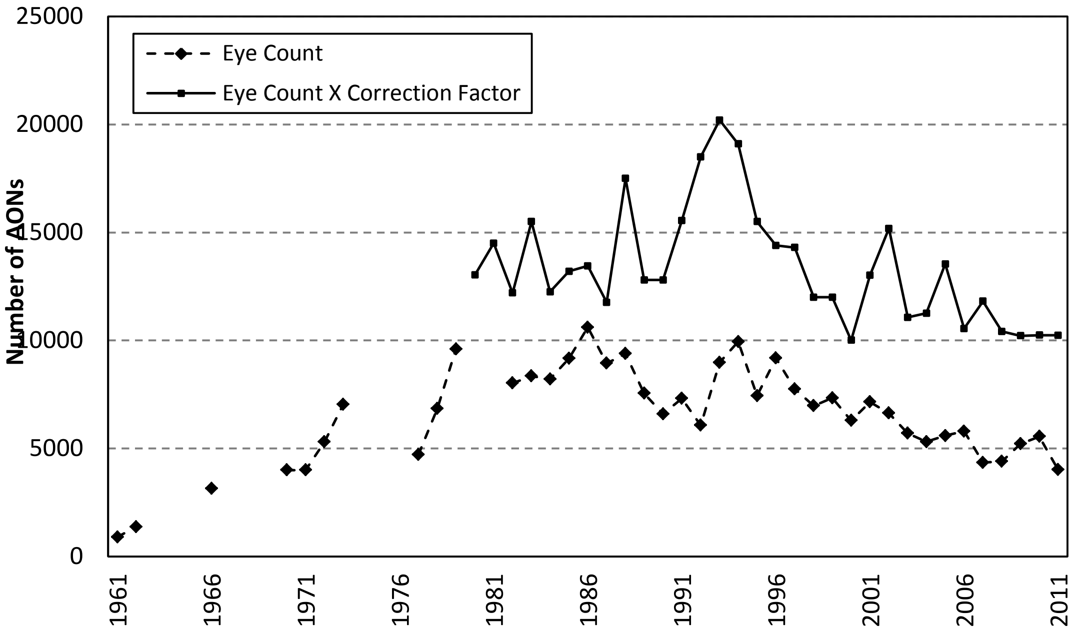


Table 11 Percentage of empty Lesser Black Backed Gull nests counted in May 2011

		TOTAL	Empty total	%empty
8, 9 + 10	Garland stone	295	89	31.90
5	Bull hole	192	64	36.99
2	Marble Rocks	312	42	19.00
M and N	Wick	762	197	25.85
Y		407	50	13.26
Mean				**25.29**

Table 12 Lesser Black Backed Gull empty nest ratios 1998 - 2011

	1998	1999	2000	2001	2001	2003	2004	2005	2006	2007	2008	2009	2010	2011
% Empty nests	14	20	24	16	31	36	19	19	19	28	19	10.8	22.5	25.29

8.3 Breeding success

The breeding success of Lesser Black-backed Gulls in the 2011 season was consist with productivity since mid 90s (Figure 7). 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 not particularly bad and 307 were ringed. The ringed/resighting estimates based on these are shown in Table 13 and the productivity in Table 14.

.

Table 13 Estimated number of fledglings 2011

	No. RINGED FLEDGLINGS SEEN	**No. UNRINGED FLEDGLINGS SEEN**	**TOTAL No. FLEDGLINGS SEEN**	**Est. No. OF FLEDGLINGS**
27/07	30	233	264	2702
30/07	33	285	318	2958
01/08	47	294	341	2227
02/08	42	309	351	2836
Mean	38	280	319	2681

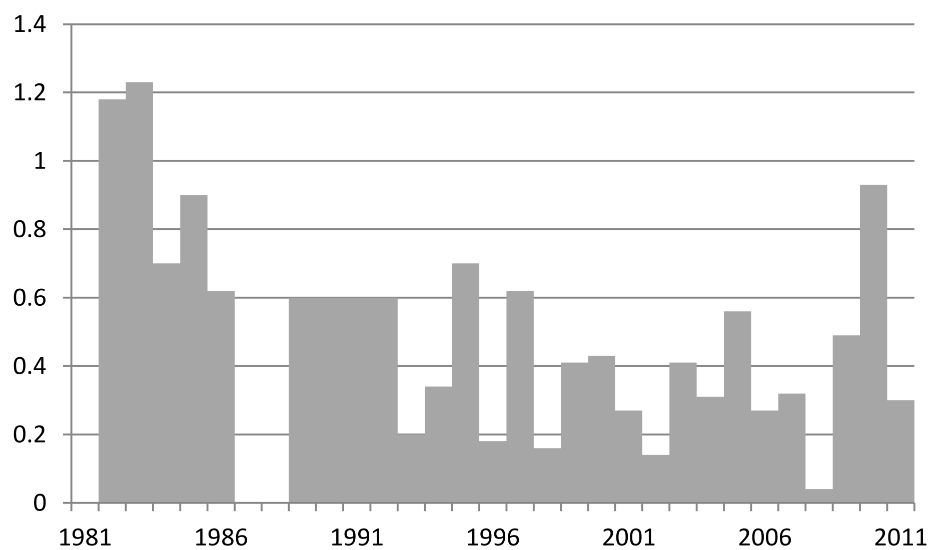
Estimated No. of fledglings = No. fledglings ringed (307) x Total No. fledglings seen / No. ringed fledglings seen

Table 14 Lesser Black-backed Gull productivity 2011

	Est No. of fledglings	**Whole Island Productivity (Total AON = 10249)**	**Not including The Neck (Total AON = 9784)**
Max Productivity	2958	0.3	0.3
Min. Productivity	2227	0.2	0.2
Mean	**2618**	**0.3**	**0.3**

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

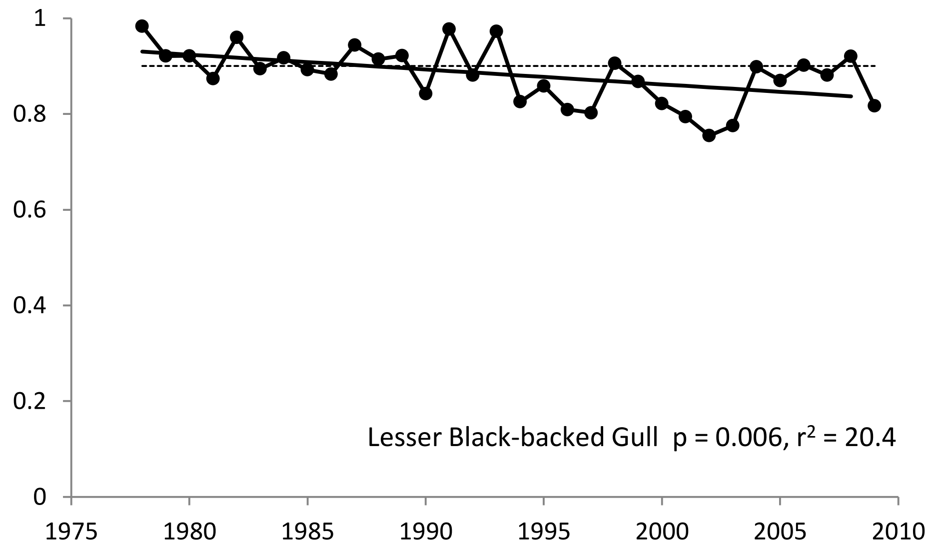
Figure 7 Number of fledgling Lesser Black-backed Gulls per pair



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; however 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 four years (87.9) is markedly better the preceding four (78.7).

Figure 8 Trend of annual survival estimate of Lesser blackbacked gull 1978 to 2009.



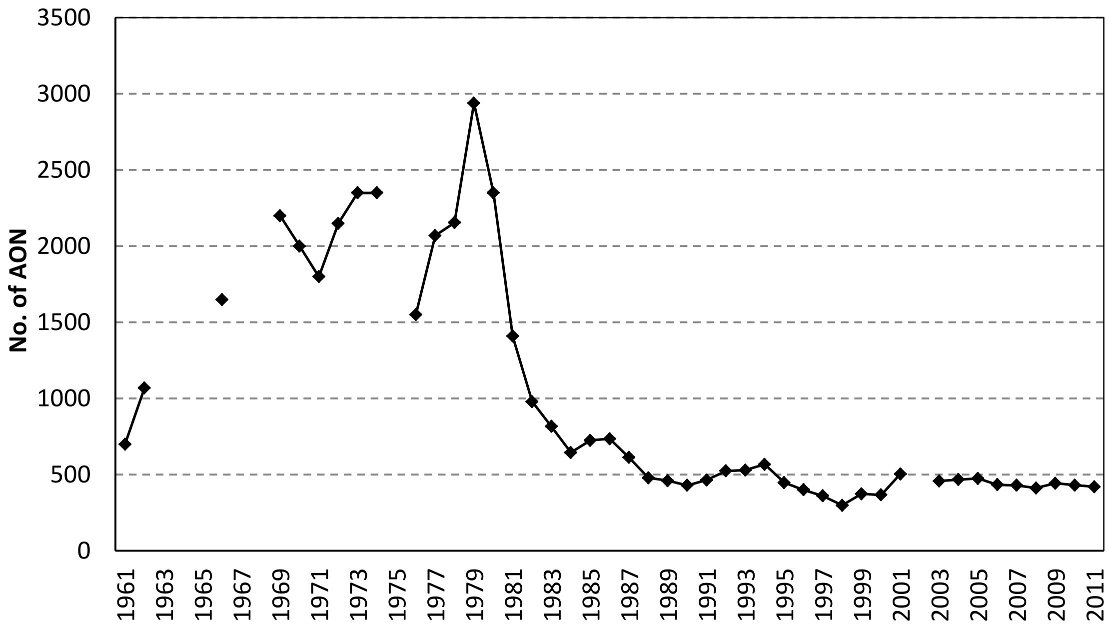
9 Herring gull *Larus argentatus*

9.1 Breeding numbers

A total of 420 Apparently Occupied Nests were observed in 2011. This has been a similar figure for the past 10 years after a dramatic decline in the 1980s.

273 of these were coastal nesting birds with the remainder nesting inland (147). This meant 65% of Herring Gulls nested on the coast. An increase on previous years

Figure 9 Herring gull breeding numbers on Skomer Island 1961-2011.



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.

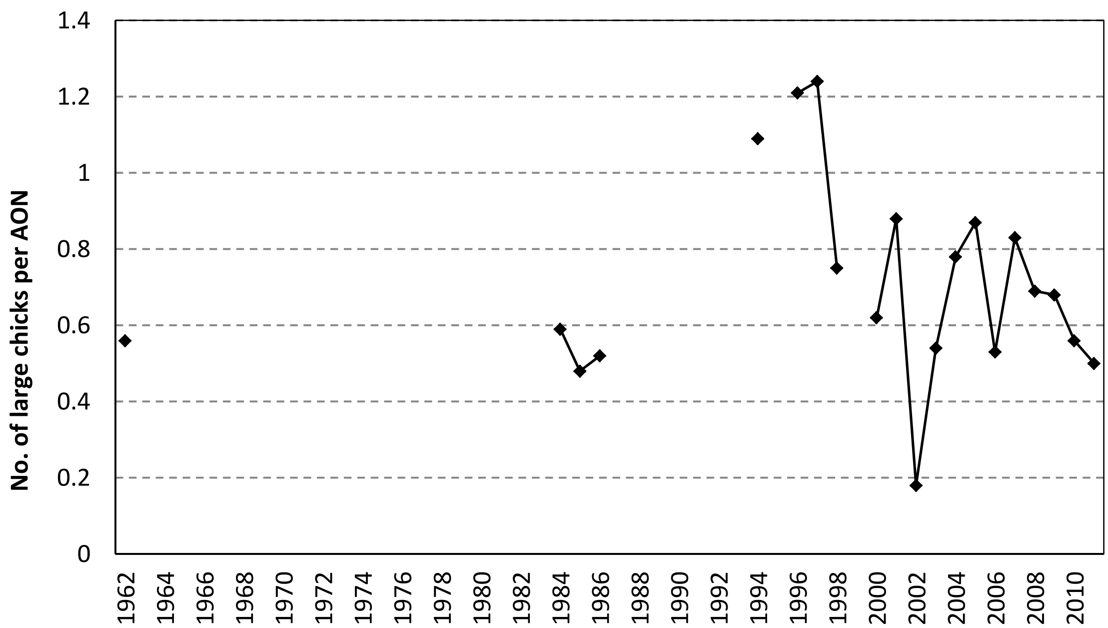
The ratio of coastal nesters to inland nesters was 80:20 in 1999, 80:20 in 2000 and 85:15 in 2001 (no census was possible in 2002, due to storms). The ratio has varied little each year since 1992.

Sites were visited on the 23rd May to identify Apparently Occupied Nests on the10th July to check for large chicks/fledglings.

Table 15 Estimated productivity of herring gulls on Skomer, 2011

	AON	Large Chicks	Productivity
Tom's House	24	12	0.50
Waybench	Not recorded in 2011		

Figure 10 Breeding success of coast-nesting herring gulls on Skomer Island, 1962-2011.

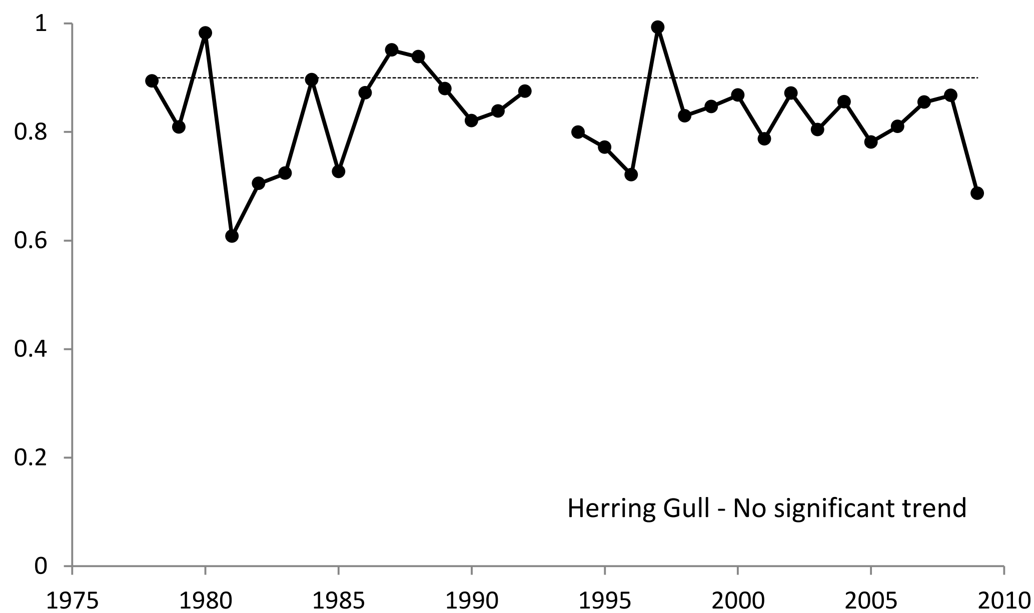


9.3 Adult survival

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 to 2009**

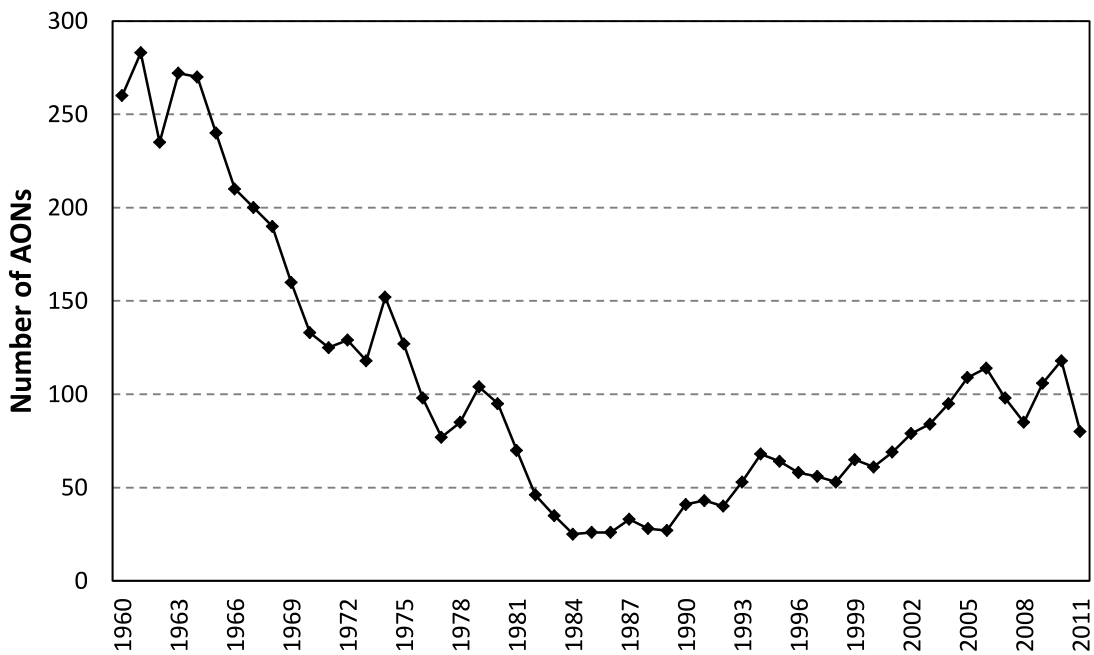


10 Great black-backed gull *Larus marinus*

10.1 Breeding numbers

In 2011, the breeding population of great black-backed gulls(GBBG) on Skomer appeared to decline by 32% from 2010 to 80 AONs. It would seem that the GBBG population has returned to its 2006level, yet there has been no apparent decline in the availability of prey (lack of food was a suggested cause of the decrease in the breeding population in 2007/8, when an outbreak of myxomatosis reduced the rabbit population)(see Figure 12).

Figure 12 **Great black-backed gull breeding numbers on Skomer Island 1960-2011.**



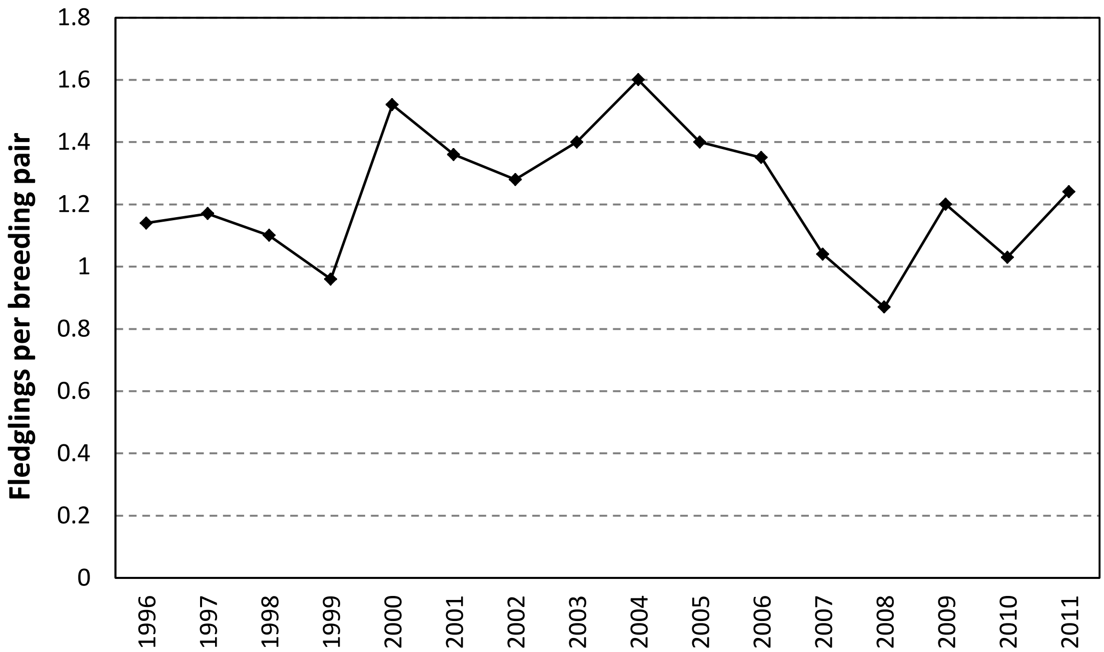
The decline has been attributed largely to control measures in the 1960s and 1970s that were implemented as a result of the species' perceived predatory impact on other seabirds. An outbreak of botulism in the early 1980s contributed to the decline (Sutcliffe 1997).

10.2 Breeding success

Monitoring of the breeding success of the GBBG was included in the JNCC contract from 1999.

Twenty five AONs were identified between 28th of April and 15th of May. A total of 31 large chicks were recorded between 28th June and 9st July, giving a productivity of 1.24. This is an increase on last year's breeding success and close to the 16 year average productivity of 1.23. (Fig 13).

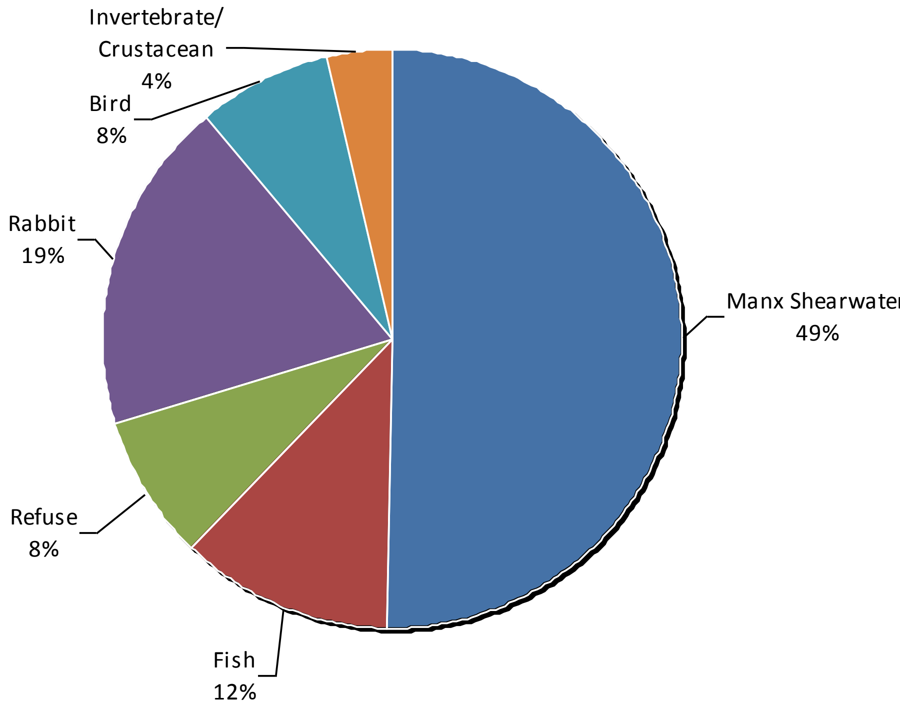
Figure 13: Great black-backed gull breeding success on Skomer Island 1996-2011.



10.3 Diet study

A trial study to monitor the diet of GBBGs was initiated in 2008 and continued in 2011. The prey remains around a sample of 25 nests were recorded. This sample represented nests from differing habitats and from areas of differing Shearwater densities. The survey was carried out after chicks fledged (August 6^{th}).

Figure 14 **Greater Blacked-backed Gull diet remains from 25 nests on Skomer Island 2011.**



Around half the prey items recorded were Manx Shearwaters (Figs 14 and 15) compared to 58 % in 2010. There were more fish and more items of refuse at nests than in 2010 (when the figures were 4 % for both of these categories).

Manx Shearwater remains were recorded at 100 % of the nests studied (Fig 10). Rabbit was the second most prevalent prey item, being found at 92 % of the nests. Refuse was found at 44 % of the nests, compared to only 23 % in 2010. Other birds were found at 48 % of nests and included Puffins and Guillemots.

In 2011 a total of 206 Shearwater corpses were estimated at the 25 nest sites, giving a mean of 8.2 corpses per nest site (Fig 16). This figure is double the 2010 mean of 4.1 corpses per nest site.

Figure 15 **Frequency of occurrence of food items around 25 great black-backed gull nests in 2011.**

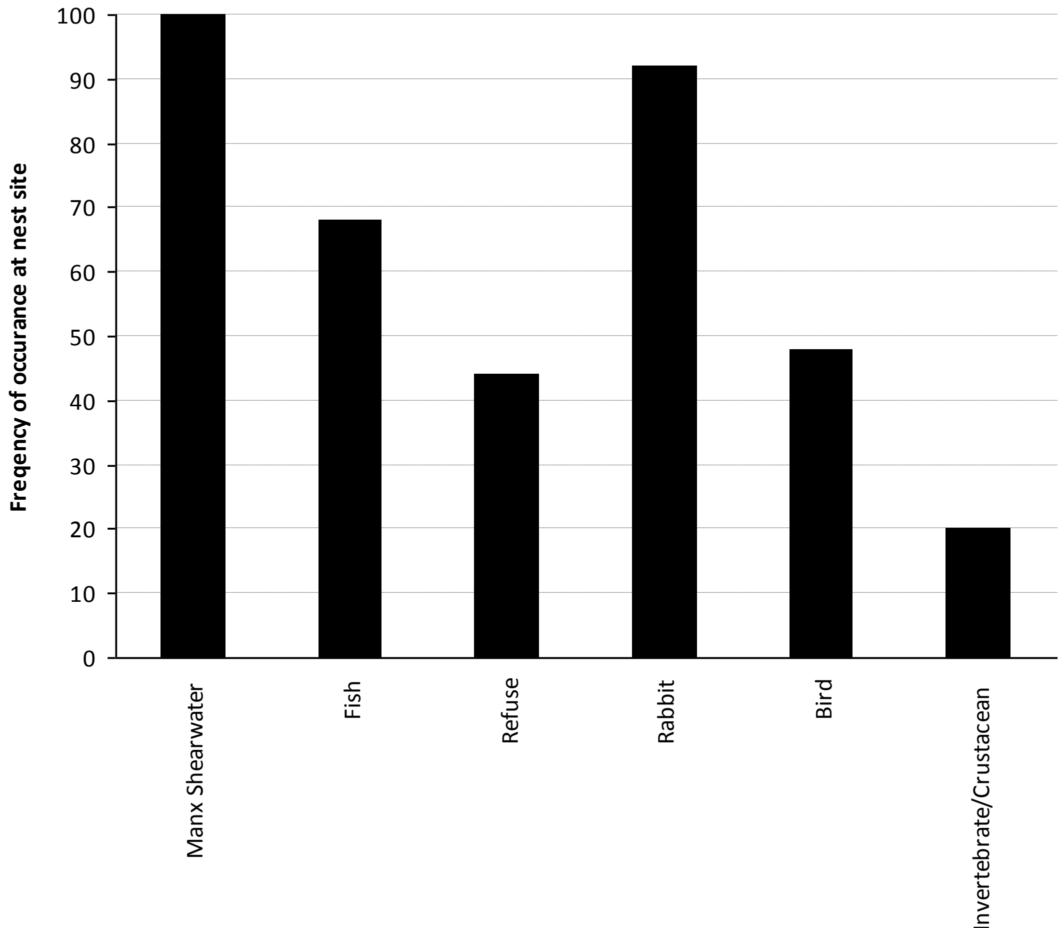
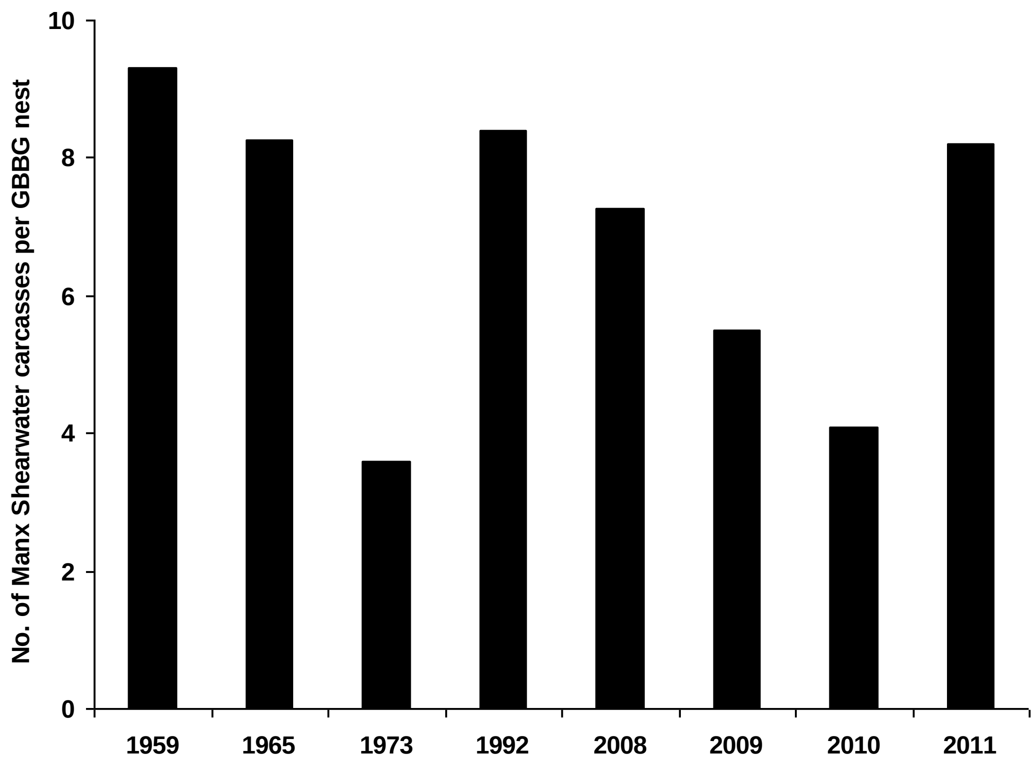


Figure 16: Mean number of Shearwater carcasses found at Greater black-backed gull nests in 1959, 1965, 1973, 1992, 2008, 2009, 2010 and 2011.



The diet survey methodology used here can produce only a broad estimate of GBBG diet, as quantification of remains in the field is to some extent subjective. For example, a single pellet may contain many fish, the number of which needs to be roughly estimated, while a scattered selection of bones could again represent one or many individual animals killed. In addition, along the rocky ridges on the island it is difficult to discern the area over which prey items have been scattered from a single nest. This ambiguity can lead to the inclusion of items predated by other birds, or the exclusion of remains that are in fact associated with the nest site. Finally, items of prey are likely to degrade and disappear from sites at different rates, so that the figures presented are likely to be skewed towards larger species with more robust skeletons.

Despite the limitations of the diet survey, it can provide an indicator of major changes in GBBG diet over time. In 2010 it was noted that the frequency of occurrence of Manx Shearwater in the sample had increased over time from 68 % in 1973 to 100 % in 2009. This year Manx Shearwater carcasses were found at 100 % of nest sites, despite an apparently high rabbit population (there had been speculation that there was an inverse relationship between the importance of rabbit and Shearwater in GBBG diet). In fact the frequency (Fig 15) and percentage (Fig 14) of rabbits found also increased in 2011. In 2010 the frequency of both rabbits and Shearwaters in the sample fell. These findings suggest that there is no simple trade-off mechanism governing the relative predation of rabbits and Shearwaters.

Using the estimates of the number of actual Shearwater corpses found at each site, a mean number of corpses per site can be worked out (Fig 16) and this can be compared with previous studies. The increase in the mean number of Shearwater corpses in 2011 interrupts a period of decline between 1992 and 2010.

11 Black-legged kittiwake *Rissa tridactyla*

11.1 Breeding numbers

A mean of 1837 (no range recorded for 2011) Apparently Occupied Nests were observed in 2011, a decrease of 4.02% on 2009.

Figure 17 **Black-legged kittiwake breeding numbers on Skomer Island 1960-2011.**

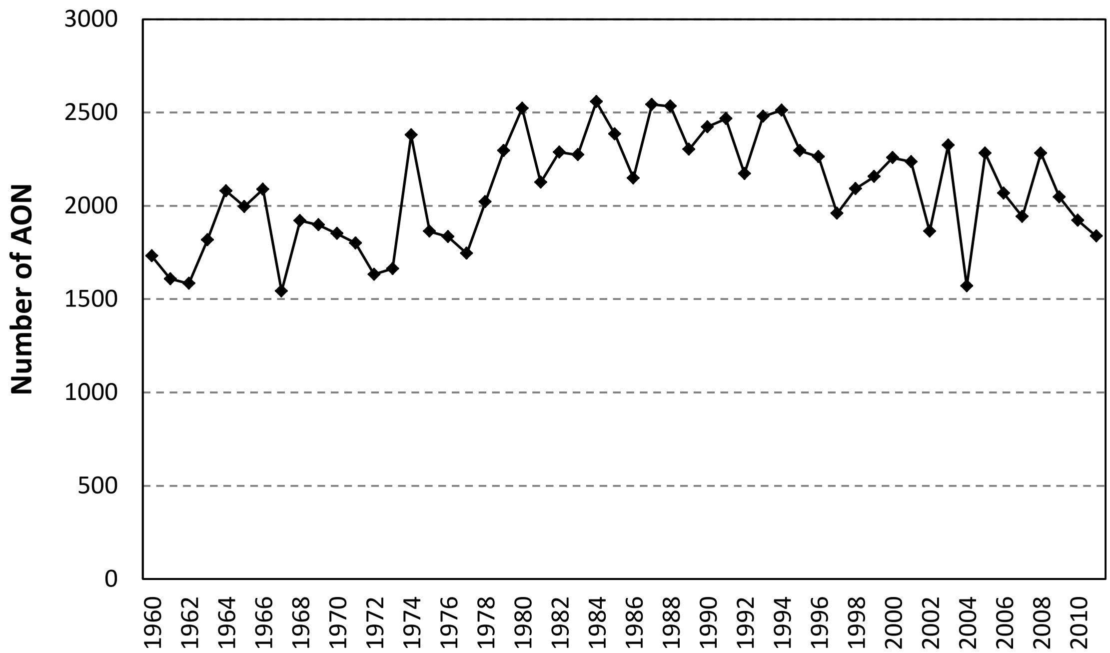


Table 16 Black-legged kittiwake whole island count details Skomer 2004-2011

	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
2011	1837	-4.02	-5.41

11.2 Breeding success

11.2.1 Methods

The breeding success of 702 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, with new photographs taken this year) 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 22nd July (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 have fledged. Fifteen nests with smaller chicks were rechecked on the 27th of July to ascertain if the chicks had reached size class 'd' or 'e'. Only one of these nests still contained small chicks on this visit, and the single chick observed was assumed not to have fledged. First chicks were seen early this year (10th June). Standard recording sheets from the Seabird Monitoring Handbook (Walsh *et al* 1995) were used for data collection.

11.2.2 Results

In 2011, 718 nests were started in the study areas, which is a reduction of 28 nests from 2010. However, new photographs were taken at all sites, and there were some boundary changes to plots as a result. These changes excluded some areas of cliff face and potentially a number of nest sites. Study sites Wick 8 A+B contained only one nest (in 8B) which was unsuccessful (there were no nests in these plots in 2010). The slight increase of productivity this year (+0.01) maybe 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 17).

The 702 AONs produced a minimum of 589 chicks. Because of the difficulty of recording small chicks in some of the plots this is likely to be an underestimate. 414 chicks survived to 'large' status, and 380 of these were thought to have fledged. An estimated 83 nests were washed away at the lower ledges at the Wick. Discounting these storm losses breeding success at the Wick would have been 0.67, giving an overall mean breeding success of 0.56 across all sites.

The lowest breeding success (0.33) was again at the High Cliff sub-colony, with the highest (0.68) at South Stream (in 2010 the highest success rate was at the Wick). (Table 17).

In 2011, 93% of AONs went on to apparently incubate eggs (88% in 2010), with 64% of these producing chicks (81% in 2010). 2% of pairs did not complete nests ('trace' nests only) (11% in 2010).

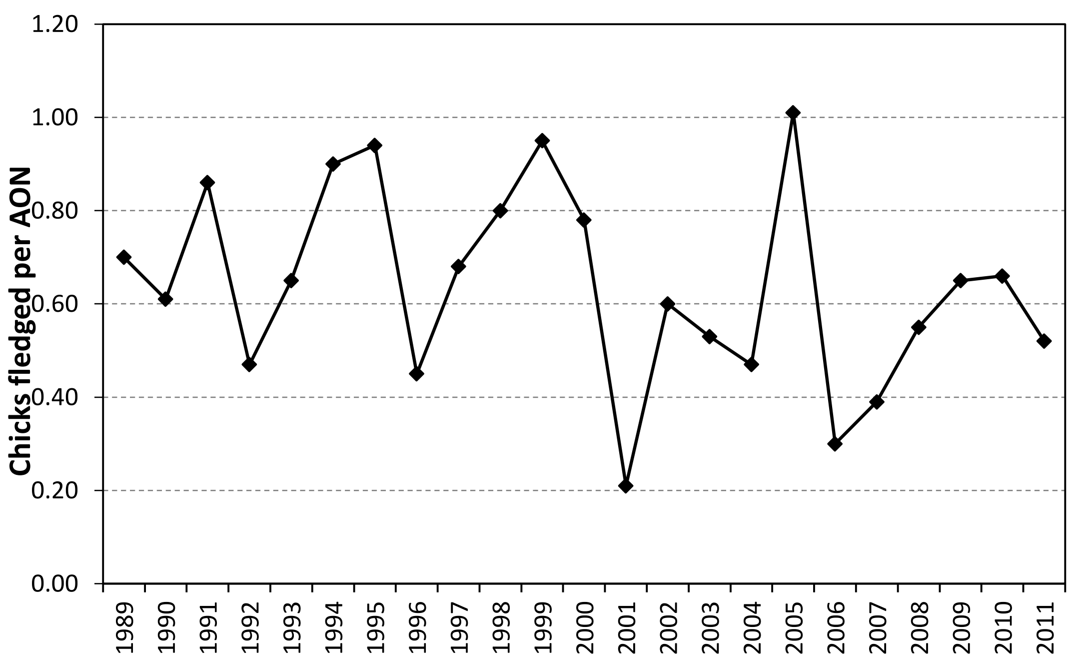
Table 17 Black-legged kittiwake breeding success (per Apparently Occupied Nest) on Skomer Island in 2011.

	Nests started	AON'S	Incubating Pairs	Nests w/chicks	Total chicks	Large chicks	Chicks fledged	Breeding Success
S.Stream	207	206	182	126	183	153	141	0.68
High Cliff	128	126	114	70	86	48	42	0.33
The Wick	383	370	356	224	320	213	197	0.53
Total	718	702	652	420	589	414	**Mean**	**0.52**
							SD	0.18
							SE	0.10

Table 18 Black-legged kittiwake breeding success (per AON) on Skomer Island in 1989-2011.

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
2011	**0.52**	**0.10**
Mean (SE)	**0.64**	**0.09**

Figure 18 **Black-legged kittiwake breeding success on Skomer Island 1989-2011.**



As in previous years, the relationship between breeding success and number of chicks hatched was examined (Table 19).

Bigger broods were again more successful than smaller ones in 2011. The success rate per brood for nests with one chick fell by three percent, while the success rate per brood for nests with two and three chicks increased. Only three nests had broods of three chicks, the same number as in 2010.

Table 19 Black-legged kittiwake fledging success in relation to the number of chicks hatched per nest on Skomer Island 2011.

	No. of chicks in nest	No. of nests	Total no. of chicks	No. chicks fledged	Success rate per nest
	1	275	275	183	0.63
2011	2	148	296	197	1.39
	3	3	9	5	1.67

11.3 Timing of breeding

Nest building was first seen on the 7th May. This was seven days later than in 2010 (see Table 20). The first egg was seen on the 13th of May with the first chick sighted on the 10th of June. There does not appear to be any major change in the timing of breeding over the last 7 years.

Table 20 Black-legged kittiwake - timing of breeding on Skomer Island 2005 - 2011.

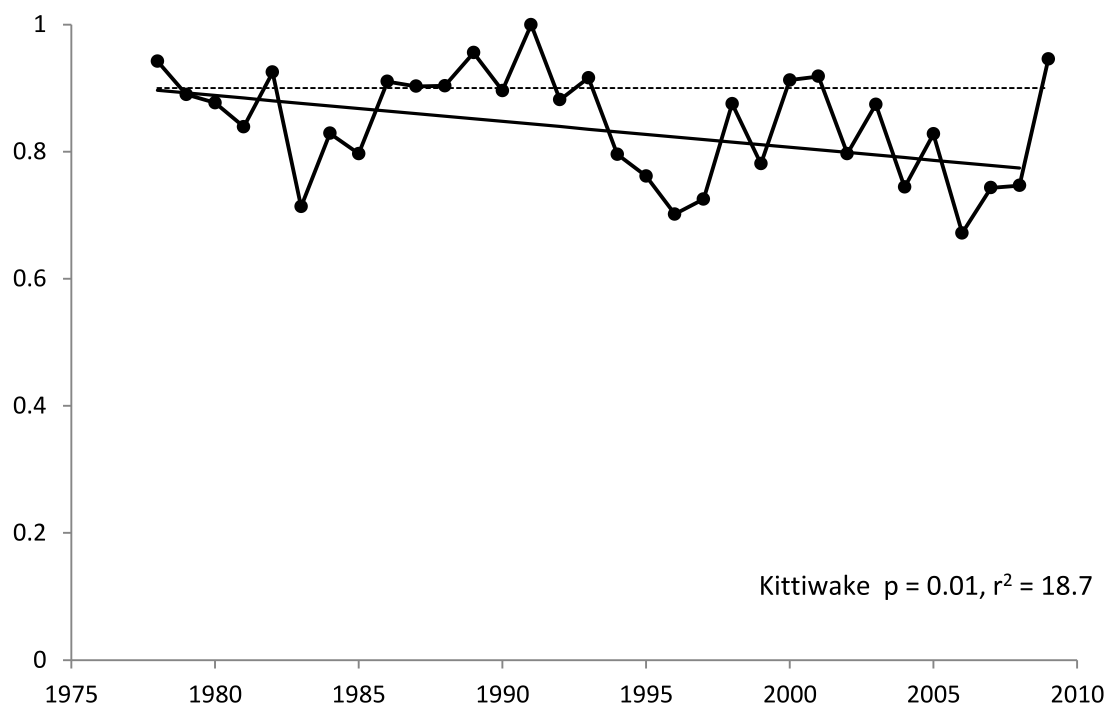
	2005	2006	2007	2008	2009	2010	2011
Nest building start	29th April	7th May	7th May	8th May	30th April	30th April	7th May
First egg	18th May	23rd May	19th May	24th May	11th May	21st May	13th May
First chick	11th June	19th June	16th June	20th June	11th June	8th June	10th June

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 be becoming apparent in these survival rates with a significant decline in average survival rates from around 90% thirty years ago to just under 80% currently.

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



Interestingly in John Coulson's new book The Kittiwake (Poyser 2011) has a graph in which he plots survival rates of Skomer Kittiwakes against that for North Shields. There seems to be a close match which suggest that some/much of the adult mortality acts on these population when they are mixed up together in the Ocean as opposed to at the colonies.

12 Common guillemot *Uria aalge*

12.1 Breeding numbers - whole island counts

The whole-island population of common guillemots in 2011 increased at by 8.65% to 21688 (No range for 2011) (Table 21, Figure 20).

Table 21 Common guillemot whole island counts on Skomer Island, 2004-2011.

	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
2011	15064	+8.65	6624	+53.37	21688	+8.65	_+23.62

The dramatic changes in the percentages of birds counted by land and from sea are due to methodological changes to counts on the north west coast. Up until 2008 Bull Hole to Garland Stone was counted from Payne's Rock. Over 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 21). 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 22), 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.

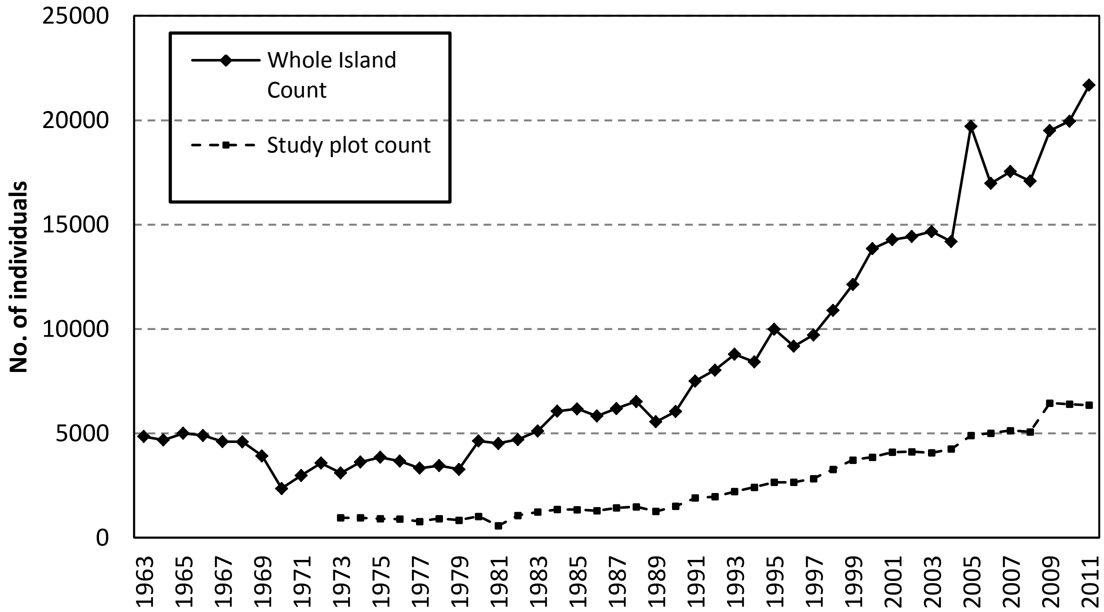
There was no significant difference in the number of birds attending the study plots in 2011. After a previous study plots increase in 2009 (Table 22) the total population declined only -0.9% overall.

Table 22 Common guillemot study plot totals on Skomer Island 2006-2011.

	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
	2011	3569.1	348.1	110.1	NS	+2.2	+21.36
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
	2011	2006.5	124.1	39.2	NS	-0.9	+31.6
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
	2011	804.1	47.3	15.0	*	-8.8	+19.26
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
	2011	6360.5	419.2	148.2	NS	-0.62	23.74

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 1963-2011.**



12.3 Breeding success

12.3.1 Methods

The number of active and regularly occupied sites was established at study plots and their histories were followed, using the methodology outlined in Walsh *et al.* (1995). Sites were visited every two to three days. The first recording visit was made on 24th April, and the last on the 16th July. All Wick sites were visited with a similar frequency of 31-32 visits during the season. At Bull Hole a more intensive methodology was followed, with 77 daily visits made (see separate report unpublished for details and a comparison of these two methods, with conclusions and recommendations for future surveys).

12.3.2 Results

2011 saw a mean productivity of 0.55 fledged birds per active and regularly occupied site, which is a decrease of 0.19 from 2010 (Table 23 and 24,Fig 21), and is lower than the overall mean of 0.69 (1989 – 2011). Two hundred and ninety two active and regular sites were recorded this year, 23 fewer than last year. However, only 89% of these sites were active, which leads to a relatively higher productivity quota for active sites only of 0.60.

90% of chicks ‘fledged’ between 26th June and 2nd July inclusive. The median fledge date was 28th June, 4 days earlier than in 2010.

Table 23 Common guillemot breeding success (per active and regular sites) on Skomer Island 1989-2011.

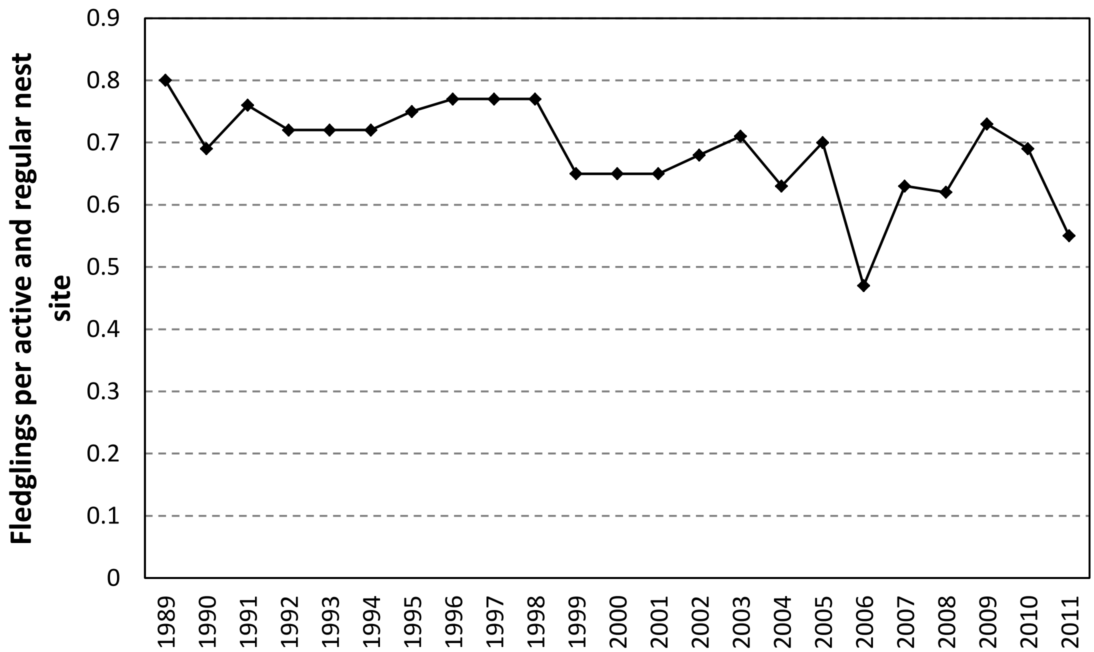
Year	No. Sites	Large Chicks	Mean Productivity across sites	SE
1989	120	96	0.8	0.05

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
2011	292	149	**0.55**	**0.06**
		Mean (1989-2011)	0.69	0.06

Table 24 Guillemot breeding success (per active site and per active and regular site) on Skomer Island 2011.

	No. active + regular sites	No. active sites	Large chicks	Productivity (a+r)	Productivity (a only)
Wick 1G	58	57	28	0.48	0.49
Wick 2G	91	79	42	0.46	0.53
Wick Corner	111	93	61	0.55	0.66
Bull Hole	32	31	22	0.69	0.71
			Mean	**0.55**	**0.60**
			SD	0.10	0.10
			SE	0.05	0.05

Figure 21 **Common guillemot breeding success on Skomer Island 1989-2011.**



12.4 Timing of breeding

The first egg was noted on 21st April at the Amos (8 days earlier than in 2010), the first chicks on the 26th of May and the first 'jumpling' on the 15th of June at Bull Hole (8 days earlier than in 2010). The last 'jumpers' were 13th-16th July, compared to 17th-18th July in 2010.

Table 25 Common guillemot timing of breeding 2005-2011

	2005	2006	2007	2008	2009	2010	2011
First egg	29th April	6th May	5th May	11th May	25th April	29th April	21st April
First chick	3rd June	11th June	8th June	14th June	26th May	31st May	26th May
First 'jumpling'	21st June	30th June	30th June	25th June	11th June	23rd June	15th June

12.5 Adult and juvenile survival

This and other common guillemot studies were undertaken by University of Sheffield in 2011. This report is attached in Appendix 7.

13 Razorbill *Alca torda*

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 (Figure22). In 2010 the total count mean was 5391 (Range 5413 – 5369) (Table 26). As with guillemot changes in percentages of land and sea are directly related the change in wardens.

Middleholm = 242 individuals

Table 26 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.

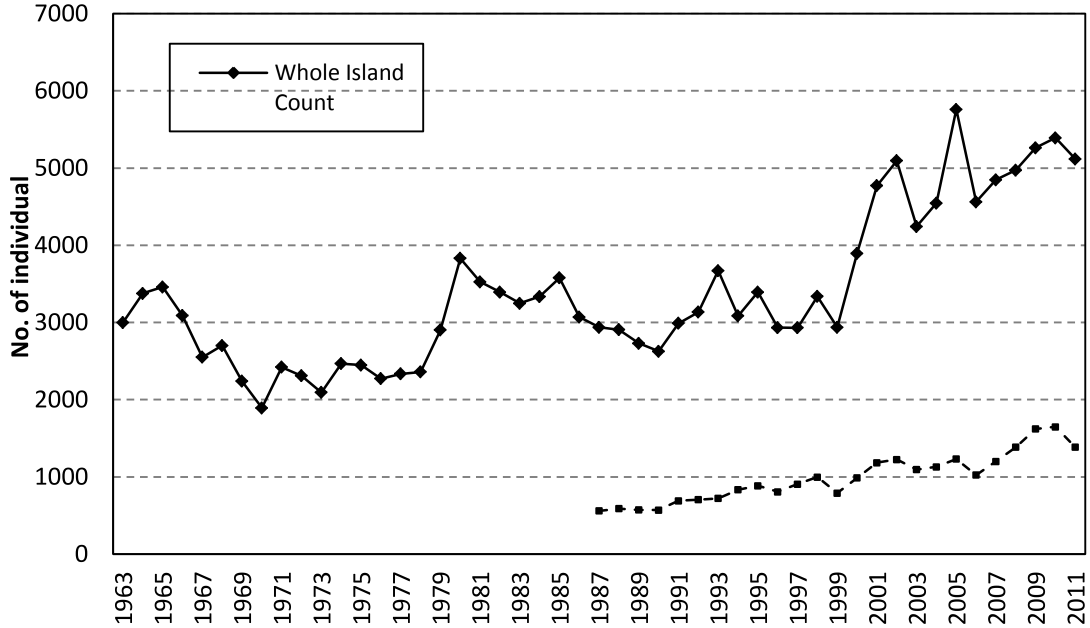
There were no significant changes at any of the study plots in comparison to 2009. Overall, numbers in study plots increased slightly by 1.7 % on 2009 (Table 27).

Table 27 Razorbill study plot totals on Skomer Island 2006 -2011.

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
	2011	304.3	45.4	14.3	*	-29.7	-4.71
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
	2011	292.1	54.8	17.3	*	-23.2	+16.11
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
	2011	72.0	24.7	7.8	NS	-35.4	-23.4
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
	2011	718.0	19.8	6.3	NS	-0.8	+33.98
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
	2011	1386	102	36	*	-15.89	+15.43

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 1963-2011**



13.3 Breeding success

As part of studies into the effectiveness of Guillemot productivity monitoring it was agreed by JNCC and CCW that we would omit Razorbill productivity for 2011. 2010 figures have been included for reference only. Refer to Baer, et al 2010 for details.

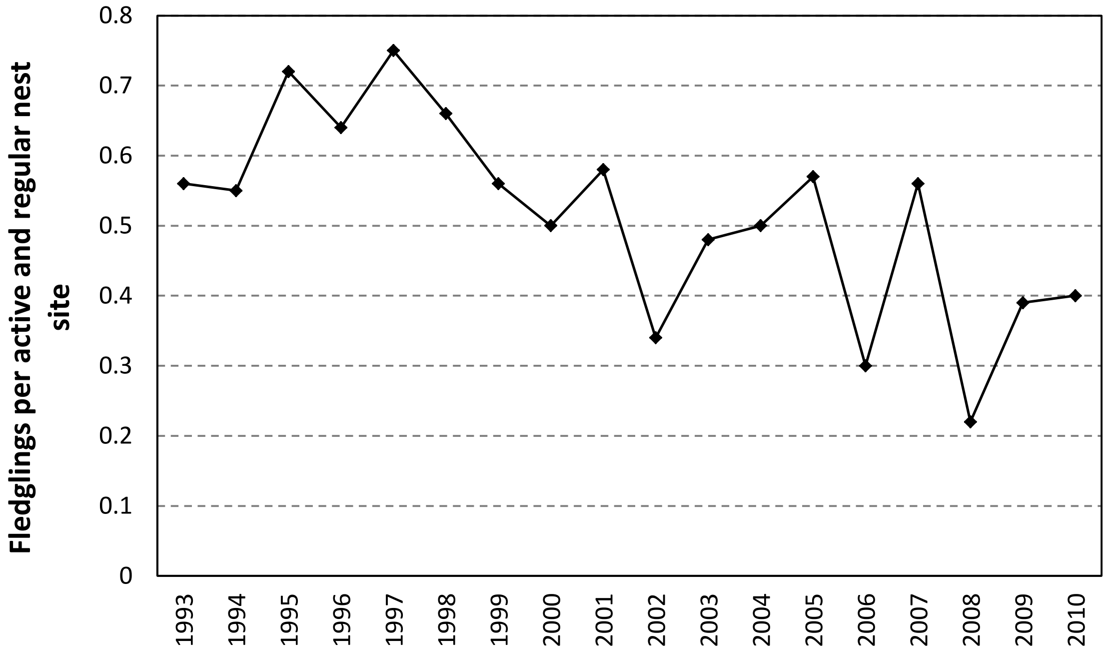
Table 28 Razorbill breeding success on Skomer Island 1993-2010

	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 29 Razorbill 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 22nd April, the first chick was seen on 18th May at the Basin and the first 'jumplings' on 17th of June at High Cliff.

Table 30 Razorbill timing of breeding 2005 – 2011.

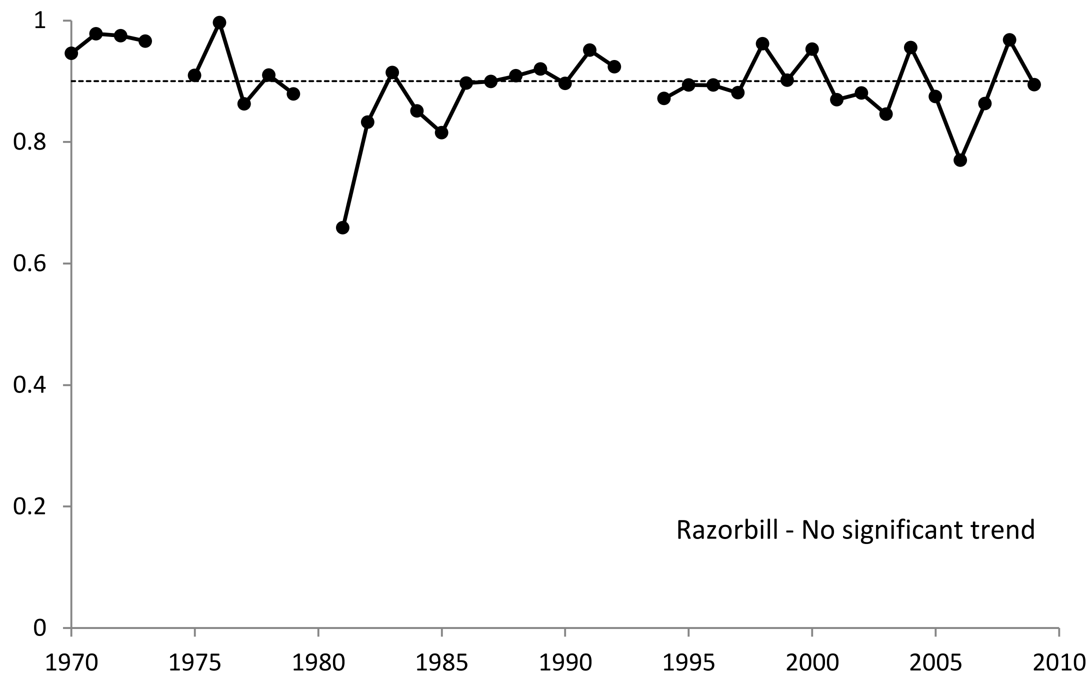
	2005	2006	2007	2008	2009	2010	2011
First egg	25th April	4th May	1st May	6th May	26th April	24th April	22nd April
First chick	3rd June	4th June	2nd June	5th June	24th May	3rd June	18th May
First 'jumpling'	20th June	25th June	23rd June	28th June	13th June	21st June	17th June

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.(see figure 24)

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 1979 to 2009



14 Atlantic puffin *Fratercula arctica*

14.1 Breeding numbers

Whole island counts were not completed this year due to no obvious evening gatherings until much later in the spring upon which it is not much use as bird might be down burrows, etc. With less activities planned for this time of year in 2012 the warden plans to develop a study plots approach to observe smaller areas in more detail. The warden also suggests some form of whole island census which involves physically observing burrows in small study plots to assess the true population on Skomer.

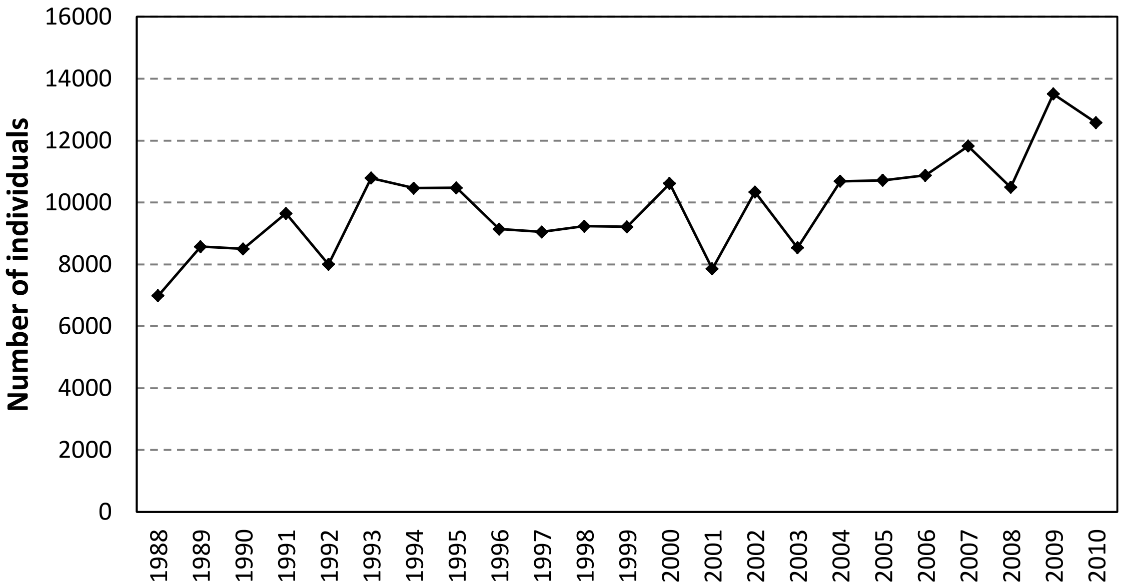
Figures for 2010 have been included.

Numbers have remained rather similar during the entire period from 1989 to present, considering the difficulties in estimating numbers of individuals (Table 31). 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 31 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 2011 is shown in the table 32, below.

Table 32 Burrow occupancy and breeding productivity of Puffins on Skomer 2011

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	91	66	73%	54 (51)	0.82 (0.77)
5-10	54	45	83%	40 (37)	0.89 (0.82)
>10	55	30	55%	25 (24)	0.83 (0.80)
Total	**200**	**141**	**71%**	**119 (112)**	**0.84 (0.79)**

Burrow occupancy was established over six evening watches, from 1830 to dusk, between the 2nd and 15th May. This is a earlier than the guidelines recommend but little nest building was seen after 5th May and the first eggs were probably laid in the second week of April so it still seems late to be trying to establish burrow occupancy.

Breeding success 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.

The first watch was carried out on 19-20 June, at about the peak of feeding activity.

The second watch was carried out on 3-4 July. The first adults were seen coming in with fish on 25 May so this should have been just before the earliest birds started fledging, assuming a 42 day fledging period. However a chick ready to fledge was caught on 27 June so there is a chance a few chicks fledged before the second watch, and conversely an adult was still bringing fish in to a burrow on 20 August and if this has been in the study area the egg would not have even hatched by the time of the second watch.

With an 84% success rate Puffins on Skomer had another excellent breeding season in 2011.

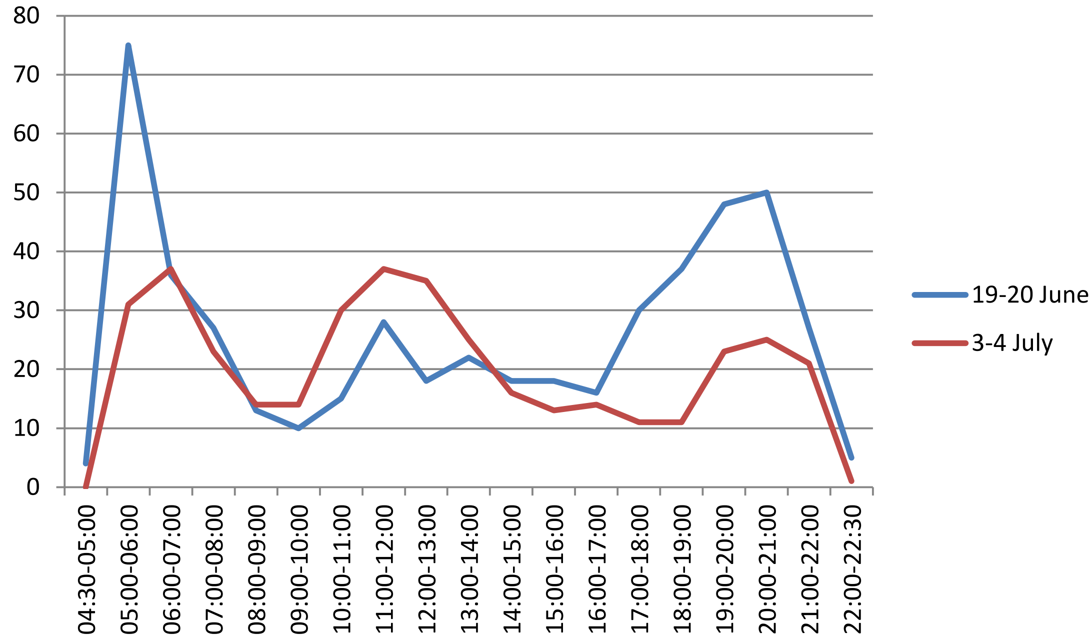
14.3 Feeding rates

Table 33 Feeding rates of Puffins in 2011

	19/20 June	3/4 July
Total No. burrows to which feeds were recorded*	119	109
Total No. recorded feeds	197	381
Mean No. feeds per burrow (range)	4.2 (1-10)	3.5 (1-10)

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

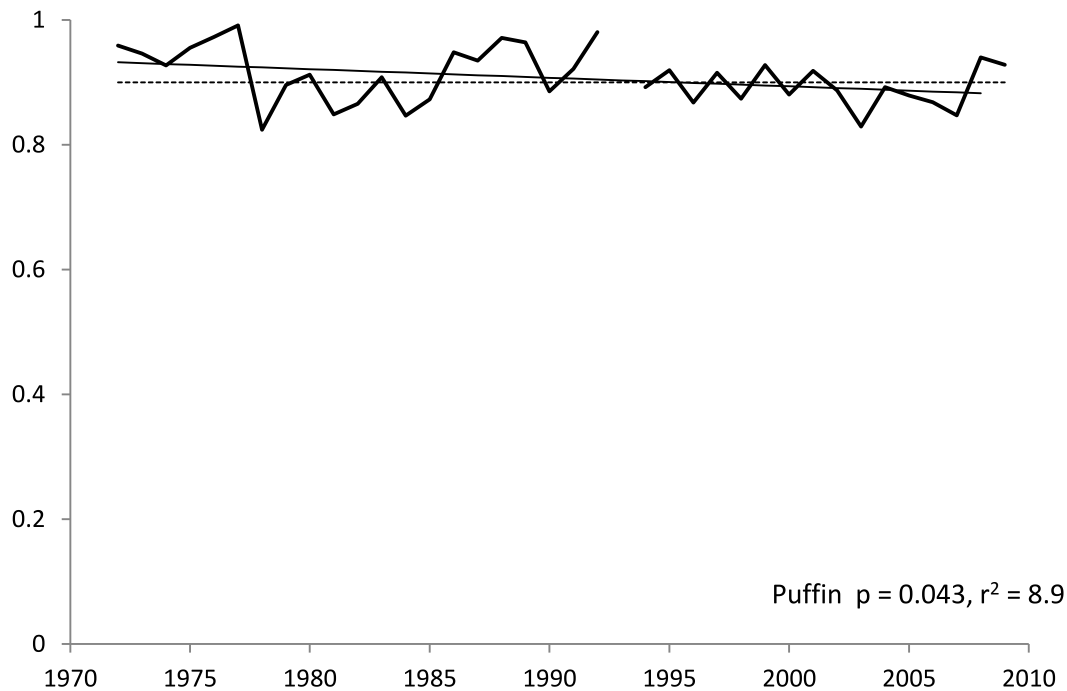
Figure 26 Feeding rates of Puffins in relation to time of day (Vertical axis = number of feeds)



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 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	12	0	612	220
2	Sea	0	0	244	53
3	Sea	9	110	225	94
4	Sea	15	12	213	68
5	Sea	12	28	500	54
6	Sea	28	0	211	79
7	Sea	0	0	20	18
8	Land and sea	23	0	114	56
9	Land	10	0	60	53
10	Sea	0	0	0	0
11	Sea	41	0	202	173
12	Land	17	0	9	29
13	Land	3	0	0	19
14	Land	5	270	804	72
15	Sea	10	0	0	44
16	Land	28	160	2007	292
17	Sea	0	0	0	25
18	Sea	0	0	0	0
19	Sea	0	0	287	182
20	Sea	0	0	0	12
21	Land	0	0	13	35
22	Land	65	759	4155	497
23	Land	0	0	0	0
24	Sea	0	0	49	99
25	Sea	0	0	0	30
26	Land	24	0	235	142
27	Land	0	150	2694	118
28	Land	6	0	8	118
29	Sea	0	0	0	0
30	Land	7	0	263	40
31	Land	3	0	278	38
32	Land	0	0	153	42
33	Land	0	0	302	85
34	Land	0	0	400	201
35	Sea	0	0	188	120
36	Sea	4	0	493	140
37	Land	3	165	3569	304
38	Sea	3	183	604	165
39	Sea	30	0	1077	312
40	Sea	6	0	610	214
41	Sea	27	0	95	90
42	Sea	40	0	370	198
43	Sea	40	0	201	112
44	Sea	3	0	358	300
45	Sea	0	0	65	175
TOTAL		**474**	**1837**	**21688**	**5118**

Appendix 2 Dates of visits to Black legged kittiwake sub-colonies 2011.

1st visit	23-28 May	to identify nests sites
2nd visit	09-11 June	to record incubating birds / new sites
3rd visit	21-23 June	to record incubating birds / small chicks
4th visit	07-09 July	to record large chicks / site attendance
5th visit	19-20 July	to record fledgers / site attendance
6th visit	22 Jul-27 July	to record fledgers / site attendance

Appendix 3 Guillemot and Razorbill Study Plots

Common guillemot study plot totals in 2011 (no. individuals)

		South Stream	High Cliff	Bull Hole	All Plots
28-May	SW 4	650	1990	3452	6092
29-May	SW4	800	1990	3374	6164
30-May	NW 2	806	2175	3272	6253
02-Jun	V 0	708	1799	3553	6060
06-Jun	S 2	795	2004	3182	5981
8-Jun	S 3	829	1881	3690	6400
13-Jun	W 3	841	2102	4285	7228
14-Jun	W 3	850	2111	3745	6706
-	-	-	-	-	-
-	-	-	-	-	-
	Mean	**2006.50**	**3569.13**	**804.14**	**6360.5**
	SD	124.09	348.10	47.31	419.19
	SE	39.24	110.08	14.96	148.21

Razorbill study plot totals in 2011 (no. individuals)

		South Stream	High Cliff	Bull Hole	Wick	All Plots
28-May	SW 4	44	256	265	688	1253
29-May	SW4	59	320	232	704	1315
30-May	NW 2	121	377	299	744	1541
02-Jun	V 0	84	304	278	724	1390
06-Jun	S 2	82	330	322	714	1448
8-Jun	S 3	50	201	316	700	1267
13-Jun	W 3	59	250	365	732	1406
14-Jun	W 3	77	299	357	738	1471
-	-	-	-	-	-	-
-	-	-	-	-	-	-
	Mean	**72.00**	**292.13**	**304.25**	**718.00**	**1386.38**
	SD	24.72	54.76	45.36	19.80	101.70
	SE	8.74	19.36	16.04	7.00	35.96

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

Count date	No. individual puffins
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.
SkomerSeabird Survival Estimate to 2009

	Herring Gull	LBB Gull	Kittiwake	Manx Shearwater	Puffin	Razorbill
1970						0.94578
1971						0.978084
1972					0.812449	0.97485
1973					0.780496	0.965922
1974					0.793091	
1975					0.611799	0.909474
1976					0.999969	0.996354
1977				0.812449	0.886432	0.862301
1978	0.893636	0.982994	0.942225	0.780496	0.850996	0.910111
1979	0.808636	0.921053	0.889759	0.793091	0.952885	0.879109
1980	0.981973	0.921385	0.876829	0.611799		
1981	0.60752	0.874093	0.838992	0.999969	0.876467	0.658835
1982	0.705047	0.959626	0.924952	0.886432	0.941915	0.832436
1983	0.723676	0.894276	0.713535	0.850996		0.914319
1984	0.895897	0.916989	0.8288	0.952885	0.721597	0.851039
1985	0.727001	0.892269	0.796659		0.92353	0.814889
1986	0.872074	0.883444	0.910362	0.876467		0.89698
1987	0.950722	0.943685	0.902703	0.941915	0.822643	0.899669
1988	0.938309	0.914419	0.903499		0.72981	0.908688
1989	0.879776	0.921698	0.95562	0.721597	0.890998	0.920145
1990	0.820424	0.842208	0.895948	0.92353	0.890223	0.896372
1991	0.838065	0.977466	0.999678		0.881846	0.95081
1992	0.875105	0.881207	0.881502	0.822643	0.870178	0.923561
1993		0.972753	0.916152	0.72981	0.942381	
1994	0.799631	0.825491	0.795762	0.890998	0.980606	0.87125
1995	0.771528	0.858629	0.761406	0.890223	0.905893	0.893752
1996	0.721272	0.809102	0.701659	0.881846	0.900375	0.89346
1997	0.992747	0.802537	0.725184	0.870178	0.834242	0.880899
1998	0.829612	0.905869	0.87536	0.942381	0.917231	0.961681
1999	0.846619	0.867963	0.780979	0.980606	0.910135	0.901658
2000	0.867764	0.82202	0.912547	0.905893	0.810511	0.952726
2001	0.787009	0.794448	0.918309	0.900375	0.919604	0.869431
2002	0.871336	0.75484	0.796615	0.834242	0.836697	0.880371
2003	0.804243	0.775457	0.874305	0.917231	0.810654	0.84558
2004	0.855648	0.898404	0.744156	0.910135	0.736188	0.955439
2005	0.781375	0.870038	0.827596	0.810511	0.812449	0.874478
2006	0.80988	0.90189	0.671765	0.919604	0.780496	0.769746
2007	0.854567	0.880984	0.743059	0.836697	0.793091	0.862853
2008	0.867229	0.920852	0.746713	0.810654	0.611799	0.967967
2009	0.686569	0.816773	0.945458	0.736188	0.999969	0.893978

Appendix 6 Ringing Totals for 2011.

	Adult	**Pullus**	**Total**
Manx Shearwater	226	265	491
Storm Petrel	25		25
Puffin	26	101	127
Guillemot	50*	300*	350*
Razorbill	16	69	85
Kittiwake	17		17
Lesser Black-backed Gull	13	307	320
Herring Gull	6		6

*All birds ringed as part of Research Projects. Guillemots ringed by Prof T.R. Birkhead are estimated

Appendix 7 Skomer Island Guillemot Study 2011 (Birkhead, Hatchwell and Meade, 2010)

SKOMER ISLAND GUILLEMOT STUDY 2011

T. R. BIRKHEAD, B. J. HATCHWELL, J. MEADE

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Summary

1. 196 colour-ringed birds ringed as adults were seen on the Amos. Annual survival, calculated as the number of birds re-sighted in 2011 that were ringed as adults in previous years was 87% (196/225).

2. 734 birds previously ringed as chicks were re-sighted.

3. 242 chicks were ringed on the Amos in 2011. In addition, 57 new adults were ringed and 6 more adults had rings replaced due to loss or damage.

4. 16 of 28 adult guillemots breeding in section D of the Amos carrying GLS devices were fitted with GPS data loggers. GLS were recovered from the captured birds, and the fitted GPS devices transmitted their data to a base station on the Amos so, unlike in 2010, recapture was not necessary to obtain the data (see Appendix 2).

5. 118 breeding sites were monitored for productivity on the Amos between16 April and 4 July, with 106 of these pairs laying eggs and 91 chicks fledging from these sites. Breeding success was 87% (91/105 one pair had an unknown outcome). This figure is higher than that of 2010 (76%), but similar to that of 2009 (84%).

6. The first egg was laid on 21 April, this is the earliest ever lay date on the Amos. The median lay, hatch and fledge dates of the breeding sample were 1 May, 2 June and 25 June respectively. This was approximately 7 days earlier than in 2010.

7. Breeding productivity was also monitored intensively at Bull Hole section B. 178 sites were monitored and 152 pairs laid eggs. Of the 129 chicks hatched 119 fledged successfully, 3 had unknown survival due to late fledging and 7 failed. Breeding success was 80% (119/149).

8. Three of 72 pairs of guillemots monitored both in 2010 and 2011 bred in 2010 but not 2011. The incidence of non-breeding was therefore 4.1 % (3/72).

9. Guillemot chicks were fed predominantly on sprats, which constituted 92.4% (526) of the 561 identified feeds. The remainder were 0.2% (1) gadid and 7.4% (42) sandeels. The mean feeding rate per chick was 3.08 feeds/day.

Crynodeb 2011

1. Recordiwyd 196 o adar a gawsanteulliw-modrwyofeloedoliongeryr Amos. Y goroesiadblynyddoloedd 87% (196/225). Cyfrifwydgoroesiadblynyddoltrwynodi y nifer o adar a ail-welwydyn 2011 o'rrheini a gawsanteumodrwyofeloedolionyn y blynyddoeddblaenorol.

2. Fe ail-welwyd 734 o adar a gawsanteumodrwyotrayngywion.

3. Modrwywyd 242 o gywionaryr Amos ynystod 2011. Ynychwanegol, modrwywyd 57 ooedolionnewydd, ac feail-fodrwywyd 6 o oedoilionoeddnaill au wedicollieumodrwyau, neu a modrwyau a namarnynt.

4. Allan o 28 o WylogiaidoedolusynbridioynardalD o'r Amos, 'roedd 16 ohonyntwedieuharwisgo a dyfeision G.L.S. Y rhai a oeddynteisoesyngwisgodyfeision G.L.S., cawsanteuharwisgoynychwanegol a 'data loggers' G.P.S. Adenillwyddyfeision G.L.S. o'radar a ail-drapiwyd, a trosglwyddwyd y gwybodaethdigidolo'rdyfeision G.P.S. arnyntiganolfanaryr Amos. Felly nidoeddangen ail-drapiofelyn 2010, iadenill y gwybodaeth.

5. Arolygwyd 118 o fagwrfeydd am gynhercheddaryr Amos rhwng 16 Ebrill a 4 Gorffennaf, gyda 106 o barauyndodwy, yncanlynumewn 91 o gywion. Llwyddiant y fagwraethoedd 87% (91/105 hebddim son am hanes un par). Mae'rffigwrhynynuwch nag yn 2010 (76%), ac yndebycachi 2009.

6. Dodwydyrwycyntafar 21 Ebrill,- y dyddiadcynharaf a recordiwyderioedaryr Amos. Y dyddiadaucanolrifolargyferdodwy, deor ac hedfano'rnytho'rsamplbridiooedd: 1 Mai, 2 Mehefin a 25 Gorffennafynol y drefnhonno,- tua 7 diwrnodyngynharachnacyn 2010.

7. Arolygwydynfrwdfrydiggynherchedd y bridiogerDwll y Tarw (Bull Hole) section B. Arolygwyd 178 o safleyddlledodwydgan 152 o barau. Bu hedfanllwyddianusi 119 o gywionallan o 129. 'Doedd dim hanes o 3 oherwyddiddynthedfano'rnythynhwyr, a bufarw 7. Cyfrifwydllwyddiant y bridioyn 80% (119/149).

8. Arolygwyd 72 o barau o Wylogiaidyn 2010 a 2011, ondnifridiodd 3 par allano'r 72 yn 2011. Cyfrifmethiantbridio felly oedd 4.1% (3/72).

9. Mwyafrifbwydcywion y GwylogiaidoeddGorbenwaig: 92.4% (526) o'r 561 achlysuronbwydo a gofnodwyd. Y gweddillyncynnwys: 0.2% (1) Gadid, a 7.4% (42) Llymyriaid. Cymedr y raddfabwydoi bob cywoedd 3.08 o achlysuronbwydo/dydd

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 Jessica Meade. Tim Birkhead visited Skomer on 7-9 May, 1-3 June and 15-20 June to ring guillemot adults and chicks and help with GPS deployments.

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 of the North Coast were visited once during the field season.

Breeding success was monitored at the Amos.118pairs were monitored daily, 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.

Breeding success at the Bull Hole colony, sub site B was monitored in a similarly intensive way by the trust field assistant. Sites were monitored daily, and where possible lay, hatch and fledge dates were recorded accurate to 24 hrs.

A 48 hour feeding watch was carried out at the Amos by Jessica Meade and Jodie Crane. Birds within a study plot were watched during daylight hours from 15:00 on the 12 June until 15:00 on the 14 June, and the feeds brought to the chicks were recorded.

In 2010 and 2011 Polish engraved rings (yellow on black) rather than Darvic rings were used to ring chicks (2011) and adults (2010 &11).

This was the fifth 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 GPS and GLS devices were fitted to adults from area D on the Amos. This was done in collaboration with Prof Tim Guilford and Dr Robin Freeman, University of Oxford.

Adult survival

Birds ringed as adults were traditionally ringed with a colour-ring combination, but in the last 5 years adults have been ringed with a single engraved ring. 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 in the previous year. This year, 196 birds ringed as adults were seen on the Amos, giving an annual survival estimate of 87% (196/225; Table 1), this is similar to the 2010 estimate (83%).

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 2011 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 1997), the current estimate is usually an underestimate of survival, but the current estimate provides a useful first approximation of the direction of any survival trends.

Table 1: Annual adult survival estimates (1997 – 2011)

Year *n*	**Seen**	**New birds (includes birds added by PDA)**	**Missed birds (birds seen in year *n*+1 not year *n*)**	**Alive (seen + missed)**	**Total (alive + new birds)**	**Survival rate[1] (seen/total in year n-1)**	**Survival rate[2] (alive/total in year n-1)**
1997	138	28	19	157	185	-	-
1998	167	1	12	179	180	90%	97%
1999	160	15	7	167	182	89%	93%
2000	153	23	12	165	188	84%	91%
2001	172	7	14	186	193	91%	99%
2002	157	9	31	188	197	81%	97%
2003	168	24	29	197	221	85%	100%
2004	184	51	19	203	254	83%	92%
2005	197	17	46	243	260	78%	96%
2006	228	2	18	246	248	88%	95%
2007	197	29	10	207	236	79%	83%
2008	182	7	17	199	206	77%	84%
2009	161	6	24	185	191	78%	90%
2010	158	37	30	188	225	83%	98%
2011	196	57				87%	

Seen – The number of birds ringed as adults seen on the Amos in year *n*.

New birds – The number of new adults ringed on the Amos in year *n*. May also include birds added by the PDA, i.e. birds that are unknown due to missing colour rings.

Missed birds – This is calculated retrospectively. Birds not seen in year *n* that are seen in year *n*+1. Use the sighting history from the database and the 'survival data' excel file for this.

Alive – This is calculated retrospectively to provide an estimate of birds that were alive and available to be seen in year *n*. It is the sum of 'seen' and 'missed' birds. E.g. in 2010 'Alive' = 158 + 30.

Total – Calculated retrospectively. It is the sum of 'alive' and 'new' birds in year *n*. E.g. in 2010 'Total' = 188 + 37.

Survival rate[1] – This is the number of birds seen in year *n* divided by the total number of birds available to be seen at the end of year *n*-1. E.g. in 2010 'Survival rate[1]' = 158 / 191.

Survival rate[2] – Calculated retrospectively. This is the number of birds 'alive' in year *n* divided by the total number of birds available to be seen at the end of year *n*-1. E.g. in 2010 'Survival rate[2]' = 188 / 191. This is likely to be a more accurate measure of survival.

Annual survival rate has fluctuatedover the past 15 years (Figure 1). There is evidence to suggest 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 a computer analysis of our guillemot data, using the programme MARK, showing that survival is influenced by climate and oil pollution (Votier*et al*., 2005).

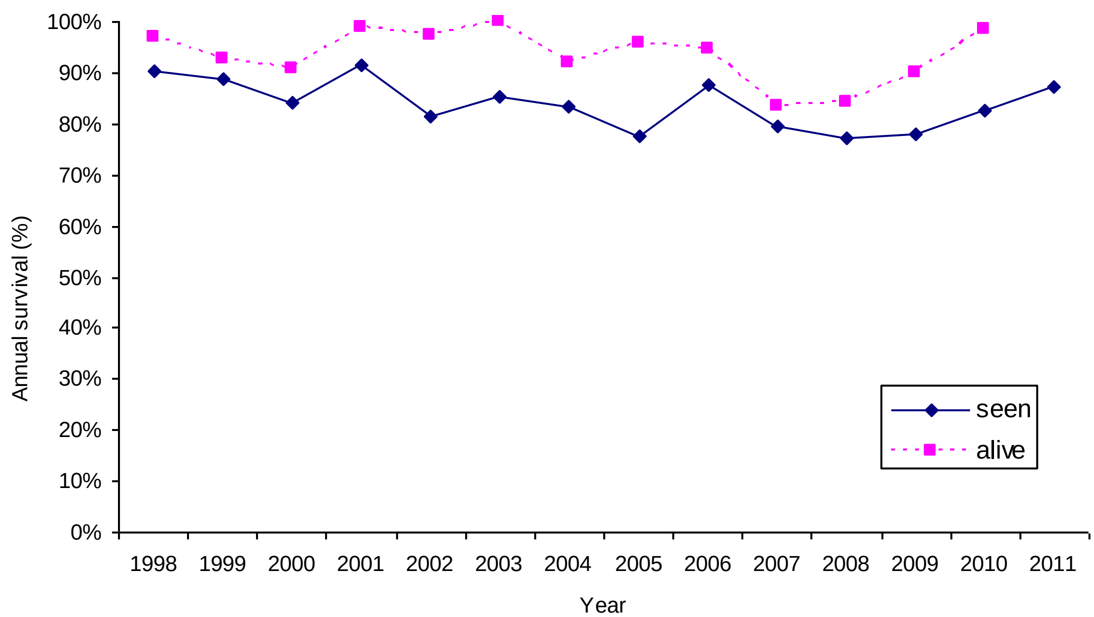

Figure 1: Annual survival (1997-2011) based on birds seen and birds known to be alive (from data in table1)

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. From 5-7 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 5May. This is within the range of first sightings in the previous 10 years (Table 2). 50 (17%) of the 292 chicks ringed in 2009 that are now 2 years old were re-sighted in 2011.

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

Year	Date 1st 2-yr-old seen
2011	**5 May**
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

734 guillemots ringed on Skomer as chicks were seen in 2011. The proportion of birds seen from each cohort followed a similar trend to last year (Figure 2; Table 3).
One bird ringed as a chick in 1983 (X38634, BuT/LG) was resighted at sub site A of the Amos, making it the oldest ringed bird on the island at 28. The oldest on record with the BTO is 31.

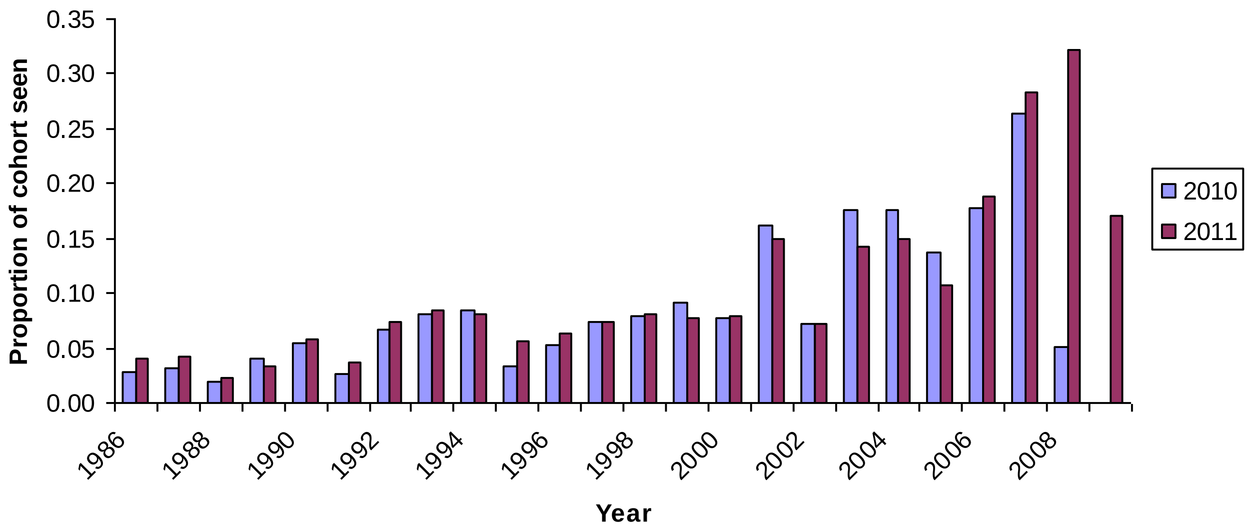

Figure 2: Proportions of each cohort seen in 2010 and 2011 (number seen divided by the total number in the cohort).

Table 3: Numbers of birds seen from each cohort, from 1986 to 2011

Ringing 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**	**2011**
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	
2011	**10**	**13**	**7**	**10**	**17**	**11**	**22**	**25**	**24**	**17**	**19**	**22**	**26**	**23**	**24**	**41**	**21**	**43**	**45**	**32**	**55**	**85**	**87**	**50**	**-**	**242**

Monitoring productivity

Productivity was monitored at the Amos. Pairs at 118 sites were followed from 16 April to 4July. Pairs were observed daily using the full-scale method (Birkhead&Nettleship, 1980) and the presence or absence of an egg or chick was recorded. 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 again 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 the focus of the productivity monitoring was on the breeding success of colour ringed birds in sub-colony A of the Amos. Where possible, exact (accurate to within 24 hrs) laying, hatching and fledging dates were recorded.

Timing of breeding

For the calculations of timing of breeding, only lay, hatching or fledging dates accurate to within 24 hours (as described above) were included. The first egg seen on the Amos was laid on the21April. The first egg laid by a member of a ringed pair was recorded on the23April. Figure 3 shows the spread of lay dates for 1st and 2nd eggs within the breeding sample.

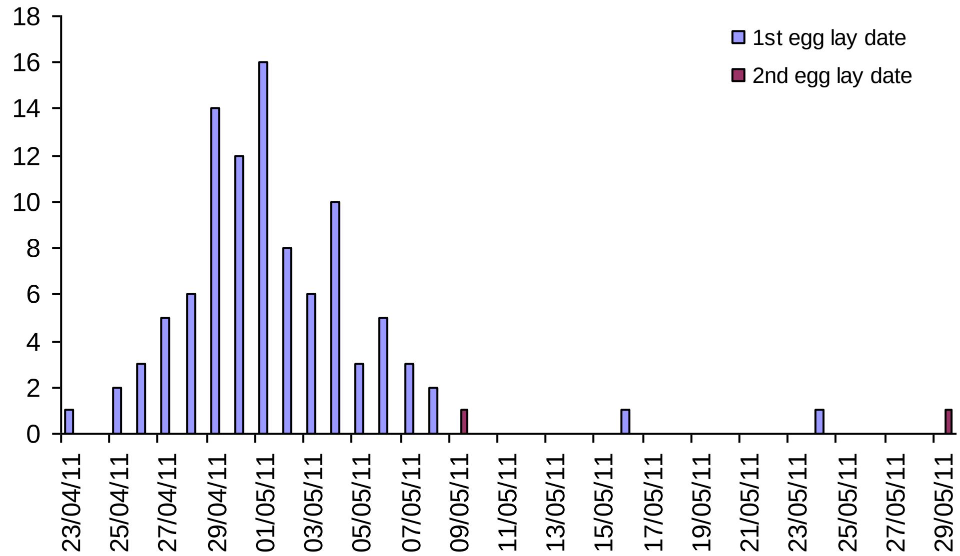

Figure 3: Laying distribution for first and second eggs

The first hatchling of a ringed bird was seen on the 26May. Table 4 shows the median dates and the range for laying, hatching and fledging (for first eggs only), andTable 5 provides a comparison with median lay dates for previous years.

Table 4: Summary of lay, hatch and fledge data for first eggs in 2011

	Median	Range	Sample size
Lay Dates	**1 May**	**23 April – 24May**	**98**
Hatch Dates	**2 June**	**26 May – 30 June**	**72**
Fledge Dates	**25 June**	**15 June – 30 June**	**78**

*Dates accurate to 24 hours

Table 5: Median laying dates for previous breeding seasons

Year	Median lay date	Year	Median lay date

1991	24 May	2002	10 May
1992	18 May	2003	8May
1993	19 May	2004	9 May
1994	24 May	2005	10 May
1995	20 May	2006	14 May
1996	24 May	2007	10 May
1997	12 May	2008	19 May
1998	16 May	2009	30 April
1999	11 May	2010	8May
2000	8May	**2011**	**1 May**
2001	12 May		

Breeding success

118 sites were monitored at the Amos, and 106 of these pairs laideggs. Of those, 8birds failed at the egg stage and 98 chicks hatched, giving a 92% hatching rate.

Of the 98 chicks hatched, 91 fledged successfully, one had an unknown survival rate due to late fledging, and 6 failed. This gives a post hatching success rate of94% (91/97).

Table 6: Summary of breeding success data on the Amos in 2011

	n
No. Pairs Followed	112
No. Pairs That Laid Eggs	106
No. Pairs with Hatchlings	98 (92%)
No. Pairs that Fledged Chicks	91
Breeding Success (chicks fledged per *breeding* pair)	0.87

One Darvic ring (R565) was found in a great black backed gull nest by Richard Kipling. This was of a chick ringed in 2010. No attempts on adult guillemots were seen on the Amos but several were seen towards chicks, and gulls were seen eating chicks and eggs. 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. Of the 118 pairs monitored, 72 were followed both in 2010 and 2011. Of these, 3 made a breeding attempt in 2010 but did not breed in 2011. The incidence of non-breeding is therefore 4% (3/72), which is similar to 2006& 2007 (2.8%, 3.7% respectively).

Table 7: Non-breeding pairs in 2011

Individual	Mate	Last recorded breeding
G87K	Un-ringed	Never bred
Bu15Z	Un-ringed	Never bred
W30X	Un-ringed	Never bred
Y09K	Un-ringed	2010
G06X	Un-ringed	2009
G69A	Un-ringed	Never bred
G70A	Un-ringed	Never bred
GT/RG	Un-ringed	2010
O/LT	Un-ringed	2010
RR/GT	Un-ringed	2008
W93A	Un-ringed	Never bred

Productivity at Bull Hole

Breeding productivity was also monitored using the full scale method (Birkhead&Nettleship, 1980) at Bull Hole, sub site B, though with unmarked individuals. 178 sites were monitored and 152 pairs laid eggs. Of these, 129 chicks hatched, giving an 85% hatching rate. Of the 129 chicks hatched 119 fledged successfully, 3 had unknown survival due to late fledging and 7 failed. This gives a post-hatching success rate of 94% (119/126).

Table 8: Summary of breeding success data at Bull Hole B

	n
No. Pairs Followed	178
No. Pairs That Laid Eggs	152
No. Pairs with Hatchlings	129 (85%)
No. Pairs that Fledged Chicks	119*
Breeding Success (chicks fledged per *breeding* pair)	0.80

* 3 removed from sample due to late fledging

Table 9: Summary of lay, hatch and fledge data for first eggs at Bull Hole B

	Median	**Range**	**Sample size**

Lay Dates	**3 May**	**29 April – 4June**	**98**
Hatch Dates	**4 June**	**28 May – 17 June**	**54**
Fledge Dates	**27 June**	**18 June – 1 July**	**59**

*Dates accurate to 24 hours

Breeding success rate at Bull Hole is somewhat lower than at the Amos (80% vs 87%), but at 94% the post-hatching success rate is the same. The timing of breeding at Bull Hole (calculated using only dates accurate to 24 hrs) is approximately 3 days later than at the Amos.

Chick diet

A 48-hour feeding watch was carried out at the Amos during daylight hours, from 15:00 12 June to 15:00 14 June, by Jessica Meade and Jodie Crane. 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 (*Sprattussprattus*), sandeel (*Ammodytes* sp.), gadid (*Gadidae*), or unidentified. The number of chicks within the area were counted and averaged 112. The weather was changeable, with occasional heavy rain and strong south-westerly winds. The median chick age was 11 days, (minimum 2, maximum 16), based on calculations from the 38 chicks present at monitored breeding sites within the plot at the start of the feeding watch.

A total of 689 fish were fed to chicks during the feeding watch. Table 8 presents the species composition of feeds. Each chick received an average of 3.08 feeds/day; this is similar to the data for previous years (3.38 feeds/day in 2010 and 3.30 feeds/day in 2009). At 7.4%, the proportion of sandeels was lower than that reported in 2010 (23.7%) and approximated the levels recorded in 2008 and 2009 (2.8% & 10.8% respectively).

Table 10: Summary of species composition of feeds, calculated as the percentage of the total identified feeds

Species	**Number of Feeds**
Sprat	526 (92.4)

Sandeel	42 (7.4%)
Gadid	1 (0.2%)
Unidentified	120
Total No. Feeds Identified	569
Total No. Feeds Observed	689

Adult Ringing

Ringing was carried out on 16 June by TRB and Dave Boyle with JM helping. Of the 62 adults captured this year, 57 were new captures,four had previously been captured on Skomer and the sixth had a BTO ring from elsewhere (R56488) for which we are awaiting recovery information. These recaptured birds had missing or damaged rings replaced or new rings added. Of the 62 birds with new engraved rings 39 were observed from the hide after ringing.

Table 11: Adult recapture and capture details for 2011

Date	Location	Recapture/ New	Previous rings	New rings		Breeding status	Other obs	Resighted Y/N
16/6	Amos A/B	N	R56488	R56488	Y074	Unknown		Y
16/6	Amos A/B	N		R68851	Y062	Unknown		Y
16/6	Amos A/B	N		R68852	Y063	Unknown		Y
16/6	Amos A/B	N		R68853	Y065	Unknown		Y
16/6	Amos A/B	N		R68854	Y066	Unknown		Y
16/6	Amos A/B	N		R68855	Y067	On chick		Y
16/6	Amos A/B	N		R68856	Y068	On chick		Y
16/6	Amos A/B	N		R68857	Y070	On chick		Y
16/6	Amos A/B	N		R68858	Y072	Unknown		N
16/6	Amos A/B	N		R68859	Y069	Unknown		N
16/6	Amos A/B	N		R68860	Y073	Unknown		N
16/6	Amos A/B	N		R68861	Y083	On chick		N
16/6	Amos A/B	N		R68862	Y084	On chick		Y
16/6	Amos A/B	N		R68863	Y085	On chick		N
16/6	Amos A/B	N		R68864	Y088	On chick		N
16/6	Amos A/B	N		R68865	Y089	On chick	Bridled	Y
16/6	Amos A/B	N		R68866	Y094	Unknown		Y
16/6	Amos A/B	N		R68867	Y090	Unknown	Bridled	Y
16/6	Amos A/B	N		R68868	Y093	Unknown		N
16/6	Amos A/B	R	X38958	R68869	Y091	On chick		Y
16/6	Amos A/B	N		R68870	Y092	Unknown		Y
16/6	Amos A/B	N		R68871	Y095	Unknown		Y
16/6	Amos A/B	N		R68872	Y099	Unknown		Y
16/6	Amos A/B	N		R68873	Y097	Unknown		Y
16/6	Amos A/B	N		R68874	Y096	On chick		Y
16/6	Amos A/B	N		R68875	Y098	Unknown		Y
16/6	Amos A/B	N		R68876	Y101	Unknown		N
16/6	Amos A/B	N		R68877	Y100	Unknown		Y
16/6	Amos A/B	N		R68878	Y104	Unknown		N
16/6	Amos A/B	N		R68879	Y103	Unknown		Y
16/6	Amos A/B	N		R68880	Y105	Unknown		Y
16/6	Amos A/B	N		R68881	Y109	Unknown		N
16/6	Amos A/B	N		R68882	Y106	Unknown		N
16/6	Amos A/B	N		R68883	Y108	Unknown		Y
16/6	Amos A/B	N		R68884	Y107	Unknown		N
16/6	Amos A/B	N		R68885	Y111	Unknown		N
16/6	Amos A/B	N		R68886	Y110	Unknown		Y
16/6	Amos A/B	N		R68887	Y114	Unknown		Y
16/6	Amos A/B	N		R68888	Y113	Unknown		N
16/6	Amos A/B	N		R68889	Y112	Unknown		N

16/6	Amos A/B	N		R68890	Y118	Unknown		Y
16/6	Amos A/B	N		R68891	Y116	Unknown		Y
16/6	Amos A/B	N		R68892	Y115	Unknown		Y
16/6	Amos A/B	N		R68893	Y117	Unknown		Y
16/6	Amos A/B	N		R68894	Y120	Unknown		N
16/6	Amos A/B	N		R68895	Y121	On chick		Y
16/6	Amos A/B	N		R68896	Y123	Unknown		N
16/6	Amos A/B	N		R68897	Y125	On chick		Y
16/6	Amos A/B	N		R68898	Y127	Unknown		N
16/6	Amos A/B	N		R68899	Y124	Unknown		Y
16/6	Amos A/B	N		R68900	Y126	Unknown		N
16/6	Amos A/B	N		R68943	Y064	Unknown		N
16/6	Amos A/B	N		R68944	Y075	On chick		Y
16/6	Amos A/B	N		R68945	Y077	Unknown		N
16/6	Amos A/B	R	R22194	R68946	Y076	On chick		N
16/6	Amos A/B	N		R68947	Y079	On chick		Y
16/6	Amos A/B	N		R68948	Y080	On chick		Y
16/6	Amos A/B	N		R68949	Y081	Unknown		N
16/6	Amos A/B	N		R68950	Y082	On chick		Y
16/6	Amos A/B	R	X38965	X38965	Y102	On chick		Y
19/6	Amos D	R	R58300	R58300	Y128	On chick		Y

Guillemot tracking

In 2010 28 birds on section D of the Amos were fitted with GLS devices which measure position based on timing of sunrise and sunset. These devices are designed to remain on birds for several years but need to be recovered in order to obtain the data. In addition these devices have salt water loggers, from which birds' behaviour (on/off sea) can be determined. On 16 June 16 of these birds were recaptured and fitted with high resolution GPS devices. The combination of these two forms of trackers can potentially provide excellent information about the foraging behaviour of chick-rearing birds. This year the GPS trackers transmitted their data to a base station on the Amos so, unlike in 2010, recapture was not necessary to obtain the data.

Chick Ringing

Ringing was carried out by TRB, Dave Boyle, Holly Kirk and Ben Dean with JM assisting. 242 chicks were ringed in total on the Amos in sub-colonies D, E, End and Top. Yellow Darvic rings were used: Y129 – Y400 (some Darvic rings in this sequence broke and some were used on adults).

Comparison between 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 >100% (196/194)*, higher than in 2010. The timing of breeding was approximately 7 days earlier than in 2010. Breeding success, calculated as the proportion of breeding pairs who had fledged a chick by the end of the monitoring period was 0.87 (91/105), higher than in 2010 (0.70), but comparable to 2009 (0.84) (Table 10).

Table 12: Comparison of previous breeding seasons

Parameter	2011	2010	2009	2008	2007
Adult survival (estimated from birds '*seen*')*	79%	77%	78%	83%	87%
Number of sites monitored for breeding success	118	141	113	64	106
Number of breeding pairs	106	110	113	64	102
Date first egg laid	21 Apr	2 May	26 Apr	12May	5 May
Median lay date	1 May	6 May	30 Apr	19 May	10 May
Median hatch date	2 Jun	11 Jun	1 Jun	18 Jun	13 June
Median fledge date	25 Jun	29 Jun	24 Jun	12Jul	7 July
% eggs hatched	92%	84%	87%	80%	85%
% chicks fledged	94%	84%	97%	94%	92%
Breeding success (No. chicks fledged/ breeding pair) †	0.87	0.76	0.86	0.75	0.80

*See page 5

Appendix 1.

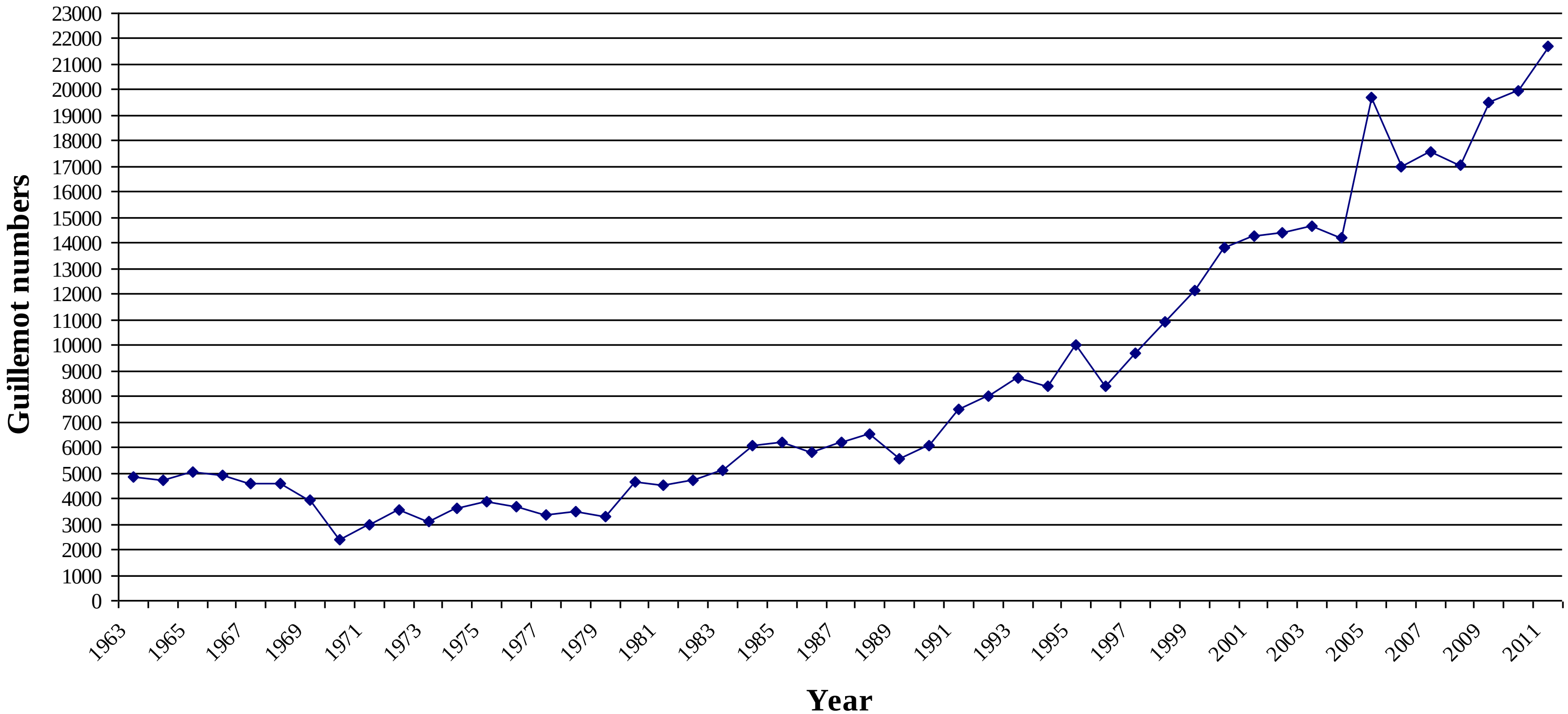

Figure 4: Guillemot numbers on Skomer from 1963 to 2011 (data provided by Chris Taylor, Skomer Island Head Warden). The whole island Guillemot count for 2011 was 21688.

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