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Canna seabird studies 2011

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Summary

- 1.1 Three summer visits were made to Canna during 2011 to count and ring seabirds, monitor their breeding success and collect food samples.
- 1.2 Based on chick size and the percentage of birds still on eggs in early July it was clear that following several years of late breeding seasons the timing of the 2011, like the 2010 breeding season, for all species was more typical of that seen in the 1980-2000 period and around two weeks earlier than the 2009 season.
- 1.3 Counts showed that the breeding populations of many seabird species on Canna remain at low levels, in comparison to the peak counts of the 1980s. Northern fulmar, European shag and herring gull continued their long term declines. Common guillemots and razorbills showed an increase on 2010 numbers, but the long term trend is one of decline, particularly for guillemots. Great black-backed gull and lesser black-backed gull remained relatively stable at historic low levels. Mew gull showed a small decline. Black guillemot numbers were exceptionally low, but this may have been due to undercounting. Only two species showed a significant increase in numbers, black-legged kittiwake and great skua, the latter reaching a new record high count.
- 1.4 Herring gulls recorded their highest productivity since monitoring began, though sample sizes were low. Northern fulmar, European shag, great black-backed gull and black-legged kittiwake all maintained the improvement in breeding productivity of the last three years, compared to the low period of much of the 2000s. Observations suggested that common guillemots also had good breeding success and guillemot chicks were significantly heavier than the 2005-08 cohorts.
- 1.5 A total of 174 fully grown seabirds and 1,312 seabird chicks were ringed with BTO metal rings and 544 fully grown birds were retrapped in breeding colonies.
- 1.6 Retrapping of adult common guillemots resulted in 109 birds ringed as chicks being located back in colonies for the first time. Four razorbills and four European shags that had been ringed as chicks were retrapped in colonies for the first time. An analysis of guillemot survival rates between 1983 and 2006 showed that adult survival rate was originally high (range 0.894-0.979) up till 1998 before declining. First year birds (age 0) had much lower and more variable rates (range 0.242-0.901). Age 1 birds showed a similar pattern to age 0 birds, but rates were higher, whilst age 2 and 3 birds showed a similar pattern to adults but rates were lower.
- 1.7 Forty-one fish being carried by adult common guillemots were collected and identified. The sample was dominated by sandeels (68%). The diet of European shags was mostly dominated by sandeels, and gadids. Black-legged kittiwakes samples contained a mixture of sandeel, gadids and clupeids.

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1 Introduction and objectives

The Joint Nature Conservation Committee (JNCC) has a responsibility to advise on the condition of the natural marine environment. Seabirds are an important component of this environment and Britain has internationally important populations of several species. The JNCC's Seabird Monitoring Programme has been designed to assess population changes and breeding success of selected species of seabird at a range of colonies. In addition, selected 'key site' colonies have been targeted for more detailed monitoring of breeding performance, annual survival rates and feeding ecology. These sites are geographically spread in order to give as full coverage as possible of British waters. Canna is a very suitable site off north-west Britain, situated in the Sea of the Hebrides.

This report covers seabird monitoring work on Canna during 2011, the 43rd year of the Highland Ringing Group's long-term seabird studies on the island. Since 1986, the Group has received funding support from JNCC (formerly NCC) for its seabird monitoring work on Canna.

During the period covered by this report the main aims were as follows:

- to continue seabird counts on the island;
- to monitor the breeding success of selected seabird species (northern fulmar *Fulmaris glacialis*, European shag *Phalacrocorax aristotelis*, herring gull *Larus argentatus*, great black-backed gull *Larus marinus* and black-legged kittiwake *Rissa tridactyla*);
- to continue the ringing programme in order to establish dispersal patterns from the island, survival rates and causes of mortality, and ages of return to the island and of first breeding;
- to collect biometric data (wing length and weight) from young common guillemots *Uria aalge*; and
- to collect, identify and measure diet samples from auks, black-legged kittiwakes, other gulls *Larus* spp. and European shags.

2 Methods

2.1 General

Three visits were made to Canna during 2011 to cover the seabird breeding season: 26-28 May, 1-9 July, 30 July - 6 August.

Visits to Canna are designed to conduct monitoring work at the optimum time and to give a degree of continuity from year to year. As there has been a trend in recent years for seabirds to start breeding later we have been visiting a week later than we did in the 1980s and 90s. We are very confident that no young guillemots had fledged prior to our early July visit to the island, though it is likely some razorbill and European shag chicks had fledged, which may affect the counts and productivity data for these two species.

2.2 Counts

Manx shearwaters

During late May, using tape playback methods (Walsh *et al.* 1995) three observers checked the known traditional Manx shearwater *Puffinus puffinus* breeding areas along the Tarbert Road and between the Nunnery and Garrisdale Point.

Common guillemot and razorbill

Counts were made of the number of occupied sites in accessible colonies at Geugasgor. Occupied common guillemot sites were recognised by the presence of an egg or chick. Occupied razorbill sites were recognised by an egg or eggshell, chick or dense mass of droppings in a crack or under a boulder.

Black guillemot

Black guillemots *Cephus grylle* were counted on various sections of the island on different days during the second visit. Counts were made in the late afternoon or evening. All birds seen on land or adjacent areas of sea were counted. This method is known to underestimate the true number of birds present.

Other seabirds

Whole island counts were conducted between 2 and 8 July. All counts were made from land with the exception of fulmars at Tialasgor and Geugasgor and kittiwakes at Geugasgor, which were made by boat. The units used differ from species to species and are indicated in the results section.

2.3 Monitoring breeding success

Northern fulmar

At the Sanday study plots the position of apparently occupied sites (AOS) were marked on a photograph in late May and the number of large chicks at these sites noted in early August. At Buidhe Sgor, the number of birds that had laid was noted in late May and the number of large chicks produced from these eggs was recorded in early August.

European shag

Due to the decline in numbers of this species on Canna most of our original study nests are now abandoned. We have adapted our methodology in order to continue monitoring breeding success of European shag. At Tallabric and Dun Mor area of Sanday and Rubha Langanais,

where birds have shifted to nesting on narrow ledges on the present sea cliff, the position of all nests was mapped on a sketch map in late May. All nests were checked a second time, in early July, to record nest contents including the number and ages of young that had hatched. In early August the nests were again checked so that the number of young actually fledging could be calculated. At Lamasgor the contents of all nests were noted in early July and rechecked in early August.

Herring gull

Due to the decline in herring gull numbers we have had to adapt our methodology to calculate breeding success. Swann 2004 gives details of the original methodology. Since 2007 a sample of nesting pairs were plotted on a map in late May. The sites were revisited in early and late July/early August to count the number of large young present.

Great black-backed gull

A sample of accessible pairs were plotted on a map in late May. The sites were revisited in early and late July/early August to count the number of large young present.

Black-legged kittiwake

In late May, apparently occupied nests (AON) at the study plots were marked on photographs. These were checked again in early July and late July/early August to see how many had eggs or chicks. The size and number of chicks was also noted.

3 Count results

A summary of the 2011 counts for each species and comparisons with past years are shown in Table 1. Further long-term analyses are detailed in Swann (2000).

Table 1. Counts of breeding seabirds on Isle of Canna 2003-2011.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	Peak (year)
Norther fulmar ¹	434	436	439	349	346	223	324	327	291	669 (1977)
European shag ²	603	495	327	349	361	375	324	305	226	1,753 (1984)
Great Skua ⁴	2	2	3	3	5	6	6	6	8	(2008)
Mew gull ⁴	5	6	9	7	13	13	21	20	16	21 (2009)
LBB gull ⁴	31	13	4	7	9	6	9	11	10	69 (1975)
Herring gull ⁴	587	372	112	96	74	70	66	70	63	1,525 (1988)
GBB gull ⁴	60	44	29	20	24	25	17	18	17	93 (1997)
Black-legged kittiwake ²	1,290	1,340	968	905	1,018	739	960	960	1,002	1,340 (2004)
Common tern ³	3	1	3	3	2	2	0	0	0	18 (1992)
Common guillemot ⁵	(881)	906	(79)	697	587	337	459	(291)	402	1,249 (2001)
Razorbill ⁵	-	169	(27)	273	288	170	288	209	245	520 (1985)
Black guillemot ⁶	36	44	47	49	68	68	63	78	40	137 (1986)

Notes: Units used are as follows:

1. Apparently occupied site for norther fulmar
2. Apparently occupied nests for European shag and black-legged kittiwake
3. Nest with egg or chick for common tern or herring gull (nest)
4. Apparently occupied territory for gulls and skuas
5. Egg or chick in study plot for common guillemot and razorbill
6. Individual bird for black guillemot

Counts in brackets are known to be underestimates.

Northern fulmar

A total of 291 apparently occupied sites were counted, suggesting a continued decline in the Canna population of this species (Figure 1).

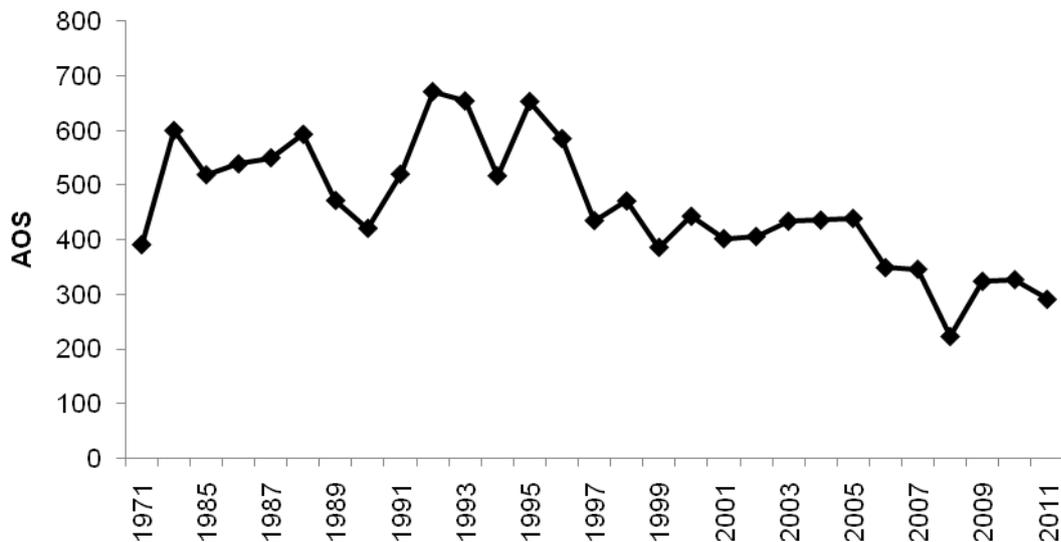


Figure 1. Number of apparently occupied Northern fulmar sites on Canna 1973-2011.

Manx shearwater

At the Tarbert Road colony two birds responded to taped calls from over 200 burrows checked in late May. At the Nunnery 30 burrows were checked, with no responses.

European shag

Numbers continue to decline with only 226 AONs counted (Figure 2), the lowest figure we have recorded. Many birds are starting to nest early and it is possible that our July counts missed some early nesters that failed, but did not relay. Some had also fledged prior to our arrival and there was evidence that some broods had been predated by white-tailed eagles *Haliaeetus albicilla*. Very heavy rain and gale force winds in late May also washed out nests. These factors are likely to mean that our count underestimated the true number of AONs.

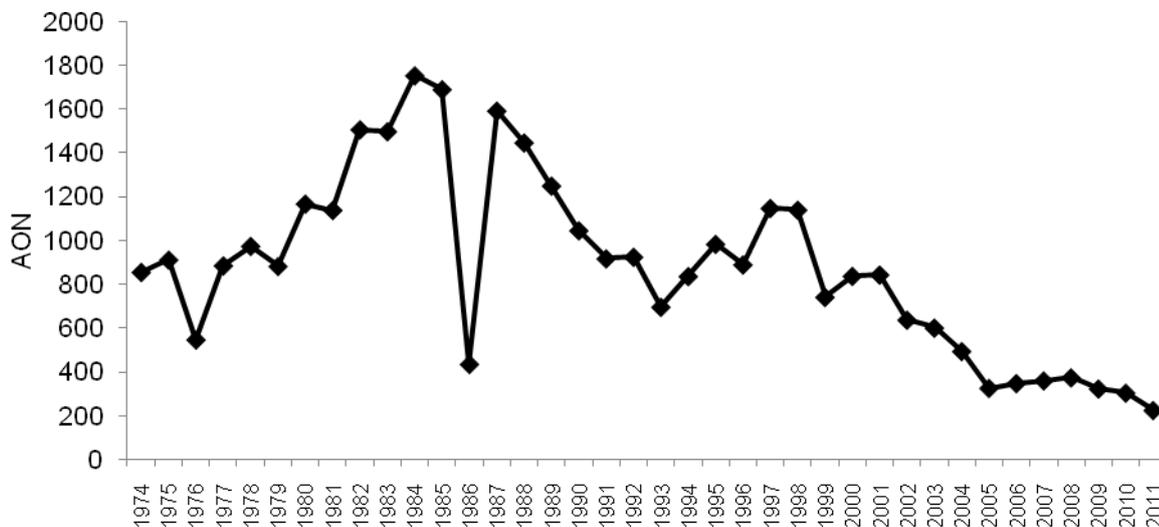


Figure 2. Number of apparently occupied European shag nests on Canna 1974-2011.

Great skua

Eight pairs of great skua *Stercorarius skua* were present on Sanday and six pairs laid eggs.

Mew gull

The number of mew gulls *Larus canus* remained high with 16 Apparently Occupied Territories (AOT) counted (Table 1).

Lesser black-backed gull

The number of lesser black-backed gulls *Larus fuscus* has declined dramatically since 2002 from about 40 AOTs to four in 2005. Numbers have since increased slightly with 10 AOTs in 2011 (Figure 3).

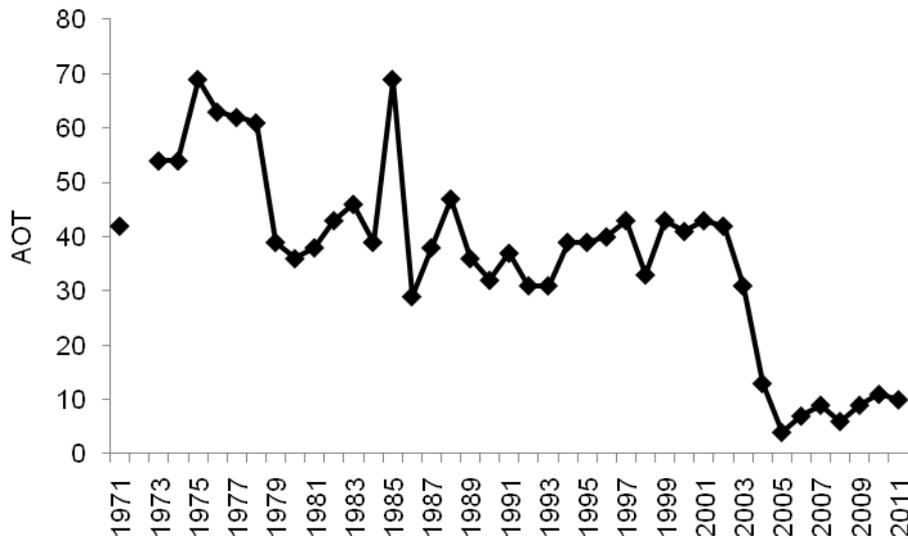


Figure 3. Number of apparently occupied Lesser Black-backed Gull territories on Canna 1971-2011.

Herring gull

There has been a notable decline in the number of AOTs on Canna since 2000. Numbers continued to decline with only 63 AOTs in 2011 (Figure 4). Most traditional herring gull colonies on the island have now been abandoned. Over the last few years many of the remaining gulls have switched to new nesting sites, particularly the scree slopes above the Tarbert road and cliff and moorland sites on Sanday and above Rubha Langanais. Only the small colonies at Rubha Langanais and Geugasgor occupy traditional sites.

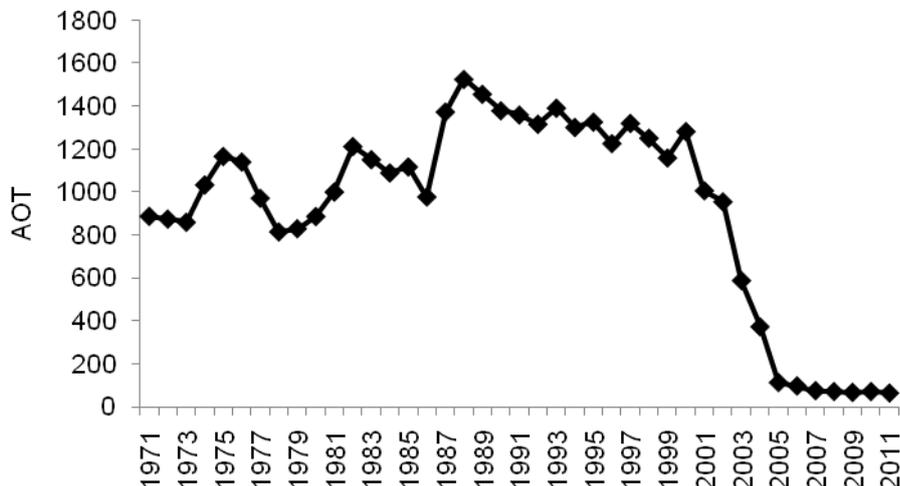


Figure 4. Number of apparently occupied herring gull territories on Canna 1971-2011.

Great black-backed gull

There has been a substantial decline in numbers on Canna since 2000. The count of only 17 AOTs in 2011 is the second lowest we have recorded (Figure 5).

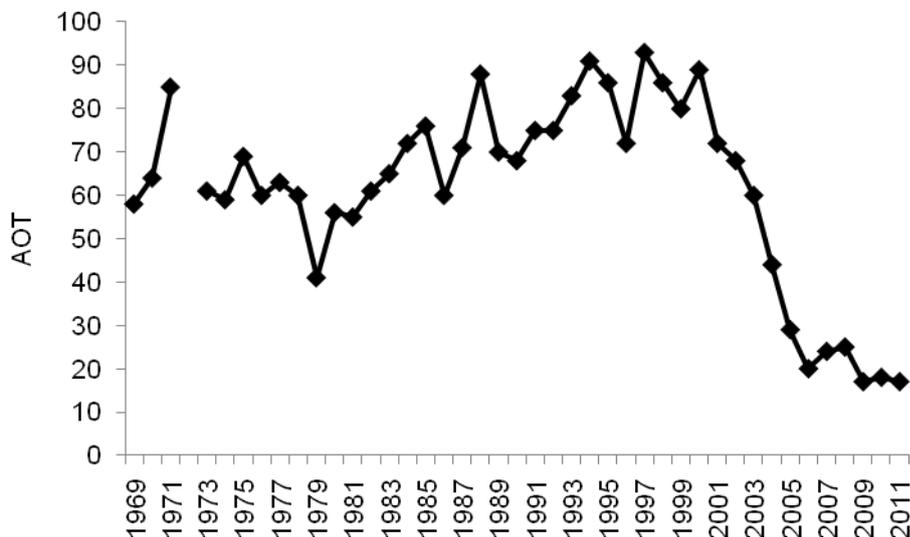


Figure 5. Number of apparently occupied great black-backed gull territories on Canna 1969 - 2011.

Black-legged kittiwake

Following the rise to the record count of 1,340 AONs in 2004, numbers decreased drastically in 2005 and since then have fluctuated (Figure 6). In 2011 there was a slight increase to 1,002 AONs, mostly occurring in the colonies on the north side if the island.

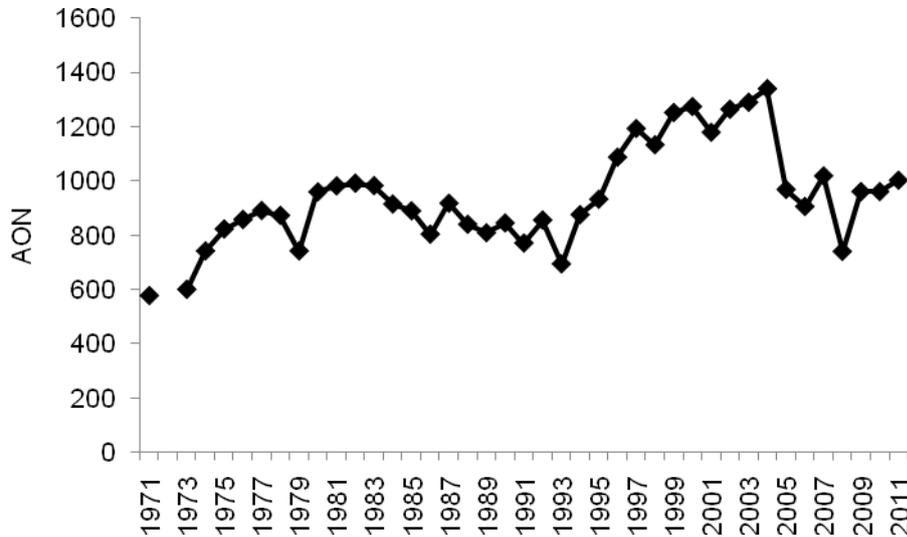


Figure 6. Number of apparently occupied black-legged kittiwake nests on Canna 1971-2011.

Common tern

No common terns *Sterna hirundo* nested in 2011.

Common guillemot

Common guillemot numbers peaked in 2001 when 1,249 ‘nests’ were counted in our studies areas. Since then, there has been a long term decline with only 402 ‘nests’ recorded in 2011 (Figure 7). We believe recent counts (2008-2011) may underestimate the actual number of birds attempting to breed as many of the more open colonies are apparently subject to more egg predation from common ravens *Corvus corax* and gulls than has previously been the case, and, in some cases, have been virtually abandoned by the time of our July visits.

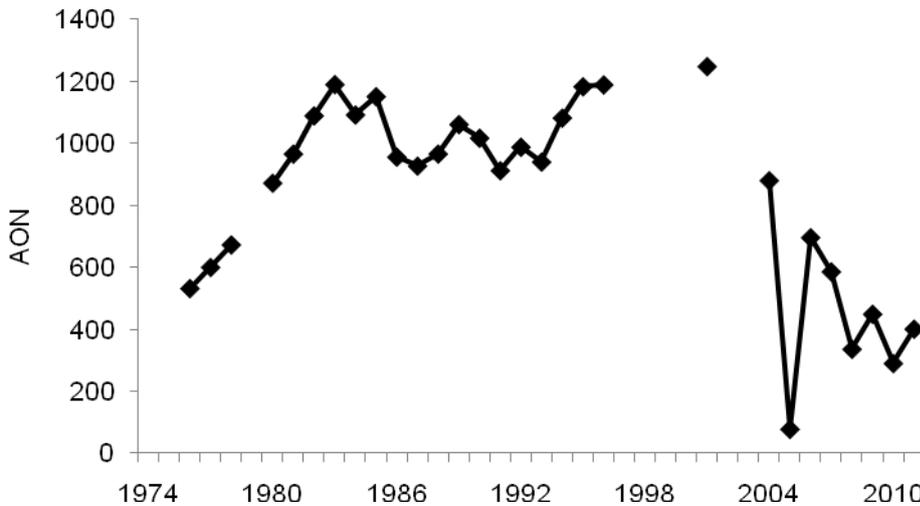


Figure 7. Number of common guillemot ‘nests’ in all study plots on Canna 1974-2011. Note gaps in data correspond with years when large number of chicks had fledged prior to our arrival on the island.

Razorbill

Razorbill numbers on Canna have undergone a long term decline since the early 1990s (Figure 8). In 2006 and 2007, numbers increased following the successful rat eradication campaign over winter 2005/06, with numbers back up to 2001 levels at Geugasgor (Bell et al 2006). Since then numbers have fluctuated. In 2011 245 ‘nests’ were counted, though this may have been an underestimate as some chicks had certainly fledged prior to our July visit.

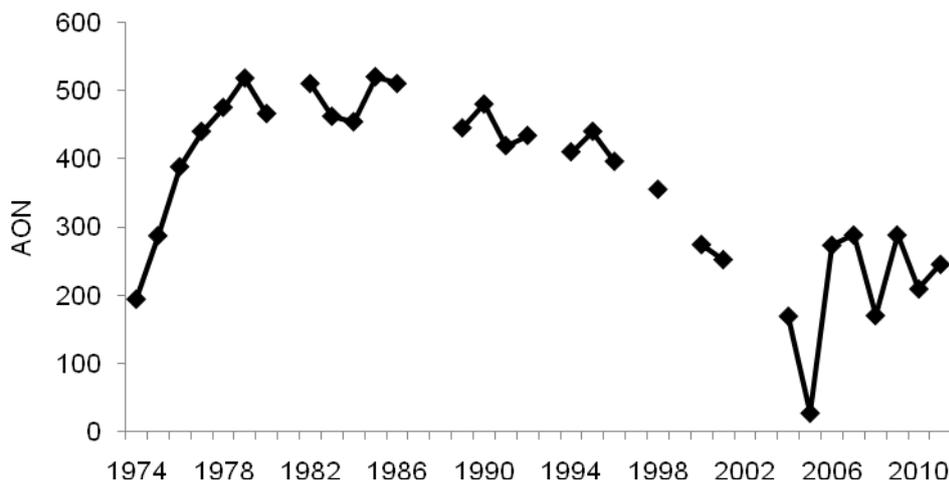


Figure 8. Number of razorbill ‘nests’ at Geugasgor and at all other sites on the island 1974-2011. Note gaps in data correspond with years when large number of chicks had fledged prior to our arrival on the island.

Black guillemot

Only 40 individual adult birds counted in 2011 (Table 1). As noted under Methods this underestimates the true number present. Rough seas on some of the count days also affected the count accuracy, but there was evidence that numbers had declined in some count sections.

Atlantic puffin

This species tends to nest on off shore stacks or inaccessible grassy slopes on steep cliffs and is therefore difficult to monitor on Canna. There has, however, been a notable apparent increase in numbers at Geugasgor, following the rat eradication in winter 2005/06 (Bell et al 2006). New burrows are appearing each year at several locations on the Geugasgor slopes.

4 Timing of breeding results

Weather data for the Canna area was extracted from Meteorological office anomaly maps (<http://www.metoffice.gov.uk/climate/uk/anomacts/#>) comparing 2011 data to the 1970-2000 mean. Following an exceptionally cold November and December, temperatures between January and March were close to average with well below average rainfall (50-75% of average). April had average rainfall but was 3°C warmer than average. May was 1°C warmer than average and very wet, with rainfall >200% of average. From June to August temperatures were close to average with rainfall 50-75% of average in June, 125-150% of average in July and close to average in August.

Unlike much of the latter 2000s when late breeding was the norm, 2011 like 2010 reverted back to more typical laying dates. In early July European shag and common guillemot had large chicks with only a small number still on eggs. There was evidence that some shag and razorbill chicks had fledged prior to our visit. Gull chicks were also large and close to fledging by the early July visit. Black-legged kittiwake nests mostly contained small young.

5 Breeding success results

A summary of the 2011 results for each species and comparisons with past years are shown in Table 2. Further long-term analyses are given in Swann (2000).

Table 2. Breeding success of selected seabirds on Canna 2002-2011.

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Northern fulmar	0.45	0.46	0.56	0.28	0.47	0.27	0.23	0.36	0.42	0.46
European shag ^a	0.26	0.16	0.01	0.7*	1.2*	1.4*	1.5*	1.8*		1.4
European shag ^b			1.4	0.7	0.7	1.0	0.3	0.7	1.5	0.8
Herring Gull	0.07	0.05	0.16	0.13	0.24	1.8	0.5	0.7	1.8	2.1
Great b-b gull	0.1	0.3	0.3	0.1	0.2	0.8	0.5	0.9	1.6	1.0
Blk-legged Kittiwake	0.6	1.0	0.8	0	0.45	0.3	0	1.1	0.8	0.7

Notes:

1. For northern fulmar and black-legged kittiwake, figures are overall breeding success across all plots, not means of individual plot figures.
2. Figures are large young per apparently occupied site or egg for northern fulmars, chicks fledged per nest in which eggs were laid for European shags, large chicks per occupied territory for great black-backed gulls and since 2006 for herring gull and chicks fledged per apparently occupied nest for black-legged kittiwakes.
3. For herring gull figure gives an estimate of chicks fledged per nest, based on various sub-colonies.
4. For European shag ^a refers to number of young fledged per marked nest in the boulder colonies, whilst ^b refers to number of young fledged per marked nest on sub-colonies on cliff ledges. * From 2005 onwards the boulder colonies surveyed were Lamasgor and/or Geugasgor, prior to that it was Garrisdale and the Nunnery.

Northern fulmar

Table 3 shows the breeding success from four study plots. This gives an overall success rate across all sites combined of 0.46 chicks per apparently occupied site, with big variations between study plots. It also represents a continued improvement in productivity from the low recorded in 2008.

Table 3. Northern fulmar breeding success on Canna in 2011

Study site	No. sites	No. young	Young per site
Sanday A	27	11	0.41
Sanday B (Dun Mor)	14	2	0.14
Buidhe Sgor	36	23	0.64
Nunnery	3	1	0.33
Total	80	37	0.46

Manx shearwater

Two occupied burrows that both contained an egg in late May both subsequently produced a large chick.

European shag

Table 4 gives details of the shag monitoring plots. There was considerable variation in the success of the cliff monitoring plots. The very low figure from Tallabric is almost certainly the consequence of its exposure to a vicious storm in late May when gale force SW winds created a huge swell which washed out many nests.

Table 4. European shag fledging success on Canna in 2011.

<i>Young fledged per nest laid in</i>	<i>Rubha Langanais*</i>	<i>Tallabric Sanday*</i>	<i>Dun Mor area, Sanday*</i>	<i>Lamasgor</i>
<i>No. nests</i>	8	10	8	61
0	4	9	1	19
1	1	0	3	7
2	3	1	3	27
3			1	8
Av young/AON	0.9	0.2	1.5	1.4

* = nests located on narrow cliff ledges.

Overall breeding success was 1.2 young per AON. The boulder site at Lamasgor had higher success (1.4) than the three cliff sites (0.8).

Great skua

Of the six pairs that nested four pairs reared a single chick and two pairs failed. Another two pairs were present but did not nest.

Herring gull

At Dun Mor on Sanday three pairs fledged two young and one pair three young (2.3 young/pair). At Rhu Langanais moor 21 chicks fledged from 9 nests (2.3) and at Rhu Langanais coast 19 chicks fledged from 10 nests (1.9). This gives an overall productivity of 2.1 young/nest, the highest figure since 2002 (Table 6).

Great black-backed gull

Sixteen pairs of great black-backed gull were monitored, five failed, seven produced one young, three produced two young and one produced three young, giving an overall average productivity of 1.0 young per nesting pair. This is the second highest productivity figure in recent years (Table 2).

Black-legged kittiwake

The results obtained from the study plots are detailed in Table 5.

Table 5. Number of occupied black-legged kittiwake nests and number of large young per nest in study plots in 2011.

	<i>Sanday,K1</i>	<i>Sanday,K2</i>	<i>Sanday,K3</i>	<i>Sanday,K4</i>	<i>Cave</i>	<i>opp Sec5</i>
<i>No. nests</i>	38	41	25	28	93	71
Empty	30	15	11	12	69	25
1 young	3	17	6	6	16	25
2 young	5	8	8	10	7	20
3 young	0	1	0	0	1	1
av. young per nest	0.3	0.9	0.9	0.9	0.4	1.0

On Sanday 132 monitored nests produced 97 young giving an overall average breeding success of 0.7 young per AON. On the north side of the island 101 young fledged from 164 nests giving an average of 0.6 per AON. Once again there was considerable variation between plots. The

overall average of 0.67 was lower than the figure for the last two years, but higher than the poor seasons of 2005-08 (Table 2).

Common tern

No Common terns nested on Canna in 2011.

Common guillemot

Seventy guillemot chicks were found with a wing length greater than 60mm, all were weighed (Appendix 1). The mean weight of 253.0 was significantly lighter than the 2010 sample ($z=-2.56$, $p<0.05$). They were significantly heavier than birds of similar size weighed in the poor years of 2005-08 ($z=4.92$, $p<0.01$), which had a mean weight of 229.8g., but significantly lighter than the pre 2005 birds, which had a median weight of 272g ($z=-5.39$, $p<0.01$).

Table 6. Weights of guillemot chicks (g.) with wing-length >60mm.

	2000	2001	2002	2003	2004	2005	2007	2008	2009	2010	2011
mean	274	250	258	274	270	238	239	213	255	264	253
n	60	56	54	50	50	30	17	25	25	77	70

The above accounts compare breeding output in 2011 with that recorded in the previous 2-4 years. Longer term trends in breeding output of the main study species on Canna are given in Table 2.

6 Ringing studies

Ringing totals

Table 7 shows the number of adults and chicks ringed during 2011 and the number of fully-grown birds that were re-trapped.

Table 7. Number of birds ringed and adults retrapped on Canna in 2011

	<i>Adults ringed</i>	<i>Chicks ringed</i>	<i>Full-grown retrapped</i>
Northern fulmar	10	23	6
Manx shearwater	0	2	0
European shag	3	144	6
Great skua	0	4	0
LBB Gull	0	7	0
Herring gull	0	25	0
GBB gull	0	4	0
Black-legged kittiwake	20	73	14
Common tern	0	0	0
Common guillemot	117	928	495
Razorbill	18	97	24
Atlantic puffin	6	5	0
Totals	174	1312	544

7 Return and survival rates results

Common guillemot

Four hundred and ninety-five adult common guillemots were retrapped in 2011, of which 109 were birds that had been ringed as chicks on Canna and were retrapped on the island for the first time. These included: one 3-year old, two 4-year olds, two 5-year olds, two 6-year olds, sixteen 7-year olds, six 8-year olds, seventeen 9-year olds and eight 10-year olds. Swann (2000) showed a negative correlation between the recovery rate of pullus guillemots ringed on Canna and found dead in their first year of life and subsequent return rates of surviving birds to the colony.

Table 8. Recovery rates and return rates of common guillemot chicks ringed on Canna.

Year	No. ringed	% recovered in 1st year	% back by 5th year	% back by 6 th year	% back by 7th year
1984	1,843	2.5	1.5	2.6	4.6
1985	2,224	3.6	0.6	1.3	2.1
1986	1,913	0.3	2.4	5.0	6.7
1987	1,080	2.4	0.7	1.2	2.6
1988	2,423	1.9	0.8	1.8	2.8
1989	2,392	2.8	0.6	1.0	1.4
1990	2,334	1.7	1.4	2.4	3.3
1991	2,299	0.3	2.0	3.1	6.0
1992	2,458	0.9	1.9	3.8	5.9
1993	1,947	0.7	1.8	3.7	7.0
1994	2,671	0.7	1.8	4.4	6.6
1995	2,843	1.4	1.3	2.5	3.9
1996	2,423	0.6	2.3	3.9	6.6
1997	819	1.0	1.0	2.3	3.9
1998	2,221	0.5	2.0	4.0	4.4
1999	2,157	1.3	1.5	2.4	4.0
2000	2,166	1.8	0.6	2.3	3.2
2001	2,217	0.5	1.1	2.3	2.4
2002	1,201	1.6	0.7	0.7	2.1
2003	1,911	0.5	0.4	2.0	2.4
2004	1,895	0.5	0.5	0.6	0.7
2005	550	0.4	0.2	0.5	
2006	1,161	0.4	0.3		

Recent high post-fledging mortality will likely disrupt this pattern in the future as shown by the very low return rate of the 2004 cohort, many of which perished in a massive wreck of NW Scotland in September of that year (Swann 2004). The increased tendency to apparent non-breeding by many adults may also explain why there has been a decline in the return rate in recent years.

The retrapping of ringed chicks and adults in subsequent years can be used to calculate annual survival rates. Reynolds *et al.* (2011) used data from 44,799 chicks and 4,298 adults ringed on Canna and the subsequent 6,078 and 5,357 live recoveries they generated along with the 939 and 97 recoveries of dead birds to calculate annual survival rates of first year birds (age 0), age 1 birds, age 2-3 birds and adult birds from 1983 to 2006.

First year birds had a highly variable annual survival rate varying from 0.242-0.901, with very low survival rates from 1987 to 1990 and very high rates from 1999 to 2002 (Figure 9a). Adult survival rate was very high between 1983 and 1998 (range 0.894-0.979) but declined from 1999 onwards

culminating in very low survival in 2004, the year of the large NW Scotland wreck (Figure 9d). The survival of age 1 birds showed a similar pattern to first year birds (Figure 9b) though with less fluctuations and higher rates (range 0.459-0.932). Age 2-3 birds had a higher rate still (0.712-0.958) and tended to follow a very similar pattern to adults (Figure 9c).

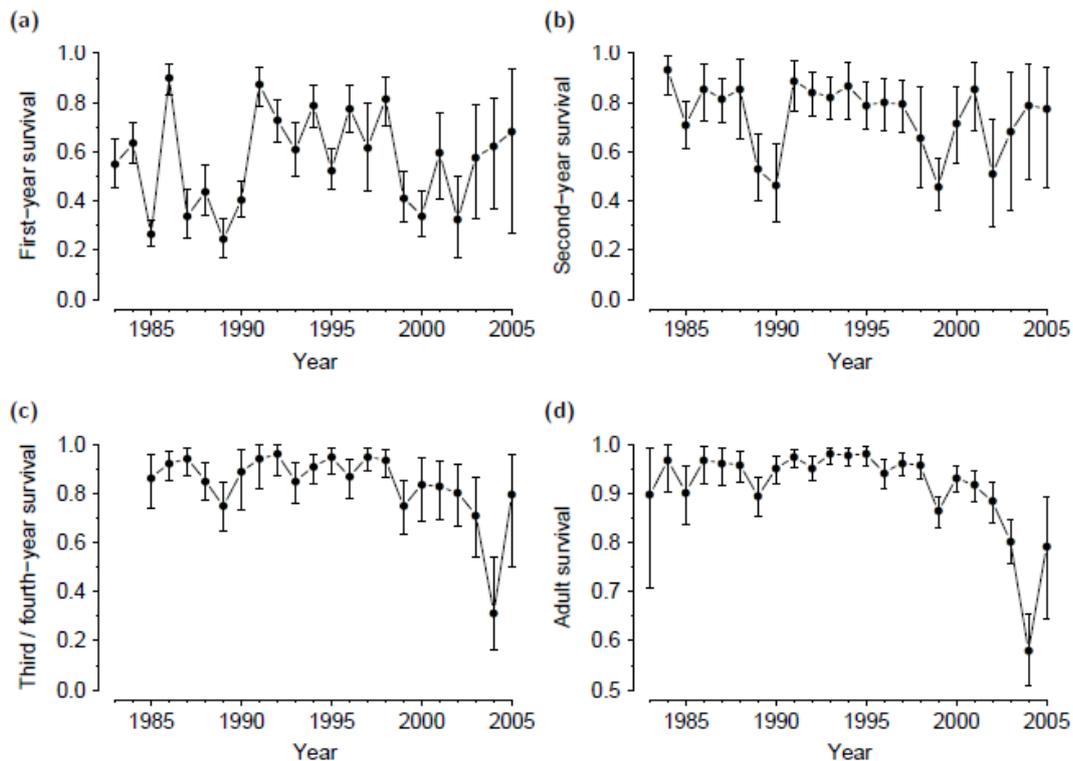


Figure 9. Posterior means and 95% CIs for survival probabilities of Canna guillemots (a) first years (age 0); (b) age 1; (c) age 2-3; (d) adults, (note the different scale on the Y-axis for this plot). Figure taken from Reynolds *et al.* (2011).

Reynolds *et al.* described how the survival rate of first year Canna birds followed a very similar pattern to Isle of May first year birds, whereas the survival pattern of adults from both colonies was very different. This appeared to be linked to first year birds sharing similar wintering areas, whereas there was little overlap in the wintering areas of adults from each colony. This suggested that some aspect of the winter environment is responsible for inter-annual variation in the survival of UK guillemots.

Razorbill

Four razorbills that had been ringed as chicks were re-trapped on the island for the first time in 2011. These included a 5-year old, an 11-year old and two over 15 year old birds. The lack of younger birds is likely a reflection of recent levels of low productivity combined with poor post fledging chick survival.

European shag

In 2011, four shags that had been ringed as chicks were retrapped on the island for the first time. All were breeders, being caught on nests, and composed one 3-year old, one 4-year old and two over 10 years old.

8 Feeding studies

Common guillemot

Forty-one fish were collected and/or identified from adult common guillemots on their return to the colony from fishing trips, 28 (68%) were sandeels *Ammodytes* spp with a single sprat and 12 gadids. Of the gadids 8 were whiting and four were unidentified. Details of the fish sampled are given in Appendix 2.

The mean length of the sandeels was 154.3mm (sd 35.9) not significantly smaller than the 2010 average (154.6mm, sd 28.4, $z = 0.026$, ns). Figure 9 shows that since 2002, there has been a significant decline in the percentage of sprats (*Sprattus sprattus*). Since 2005, common guillemot chick diet has been dominated by sandeels, with smaller numbers of gadids and very few sprats.

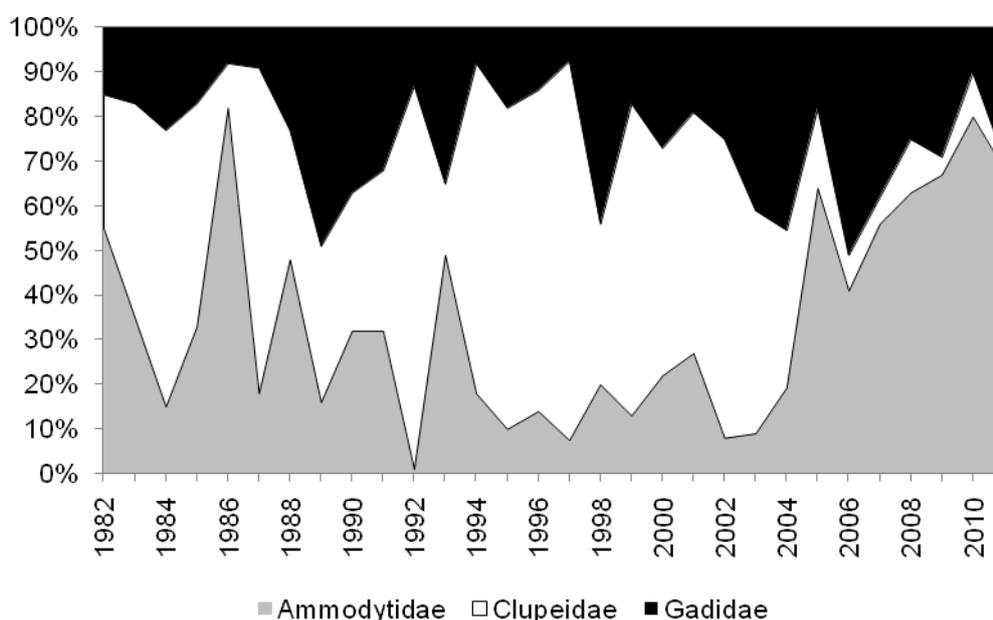


Figure 10. Proportion of fish species taken by common guillemots on Canna 1982-2011

European shags

Two regurgitations from young European shags were collected on 3rd July. The main prey species in these were 1+ age group sandeels. In addition one of the samples contained two whiting otoliths, 4 goby otoliths and octopus mouthparts. Only four pellets regurgitated by European shags were collected, all on 1st August. These mostly contained sandeel and gadidae otoliths (Table 9).

Table 9. Number of otoliths and other contents of regurgitations from young European shags and shag pellets.

Sample number	Sample type	Sandeel otoliths	Gadid otoliths	Other gadid otoliths	REMARKS + details of 'other' fish
		'0', 1+ group	Whiting, rockling		
1	Regurgitation	0,53	2	0	4 Goby, 1 Octopus mouthparts
2	pellet	2,19	38,0		11 clupeids
3	Pellet	36,0	67,0		1 dragonet
4	Pellet	2,7		2	
5	Pellet	0,0	0,8	36	

Black-legged Kittiwake

Seven food samples were analysed from regurgitations collected from black-legged kittiwake chicks on 5th July, containing a mixture of sandeels, clupeids and gadids (Table 10).

Table 10. Number of otoliths and other contents of regurgitations from black-legged kittiwake regurgitations.

Sample number	Sample type	sandeel otoliths	Gadid otoliths	Clupeids	REMARKS + details of 'other' items
		'0', 1+ group	Whiting, unidentified		
1	Regurgitation	2,1	0,0	19	
2	Regurgitation	0,0	31,0		
3	Regurgitation	0,0	2,0		
4	Regurgitation	0,0	0,2	2	shrimp
5	Regurgitation	0,0	2,0		
6	Regurgitation	14,0	0,0	4	
7	Regurgitation	10,1	0,0	25	

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10 Appendices

Appendix 1. Common guillemot chick weights

Weights in grammes									
266	216	232	252	232	242	258	284	232	230
242	246	282	240	232	234	210	259	226	272
283	212	289	248	252	292	250	262	230	208
242	204	270	264	290	234	236	238	254	252
192	228	262	218	228	262	310	230	244	244
292	282	278	284	268	282	278	268	242	222
248	257	272	252	242	288	284	294	252	310

Note: Weights taken only from chicks with a wing length of >60mm. Mean weight was 253.0g.

Appendix 2. Common guillemot diet samples

Details are given of the size (mm) of fish caught by adult guillemots on Canna in 2011.

Whiting: 8 measured							
<i>Length</i>	63	71	82	86	92	93	106
No. of fish	1	1	1	2	1	1	1

Sandeel: 12 measured								
<i>Length</i>	112	118	122	125	136	160	162	170
No. of fish	1	1	1	1	2	1	1	1
<i>Length</i>	186	196	222					
No. of fish	1	1	1					