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Canna seabird studies 2013

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Summary

Four summer visits were made to Canna during 2013 to count and ring seabirds, monitor their breeding success and collect food samples.

Based on chick size and the percentage of birds still on eggs in early July it was clear that some species, particularly black-legged kittiwake, common guillemot and razorbill had a very late breeding season.

Counts showed that the breeding populations of many seabird species on Canna remain at low levels when compared to the peak counts of the 1980s. Northern fulmar continued their long term decline. European shags, common guillemots, razorbills, great black-backed gull and lesser black-backed gull remained relatively stable at historic low levels. Mew gull and herring gull showed increases in breeding numbers, whilst black-legged kittiwakes showed a sharp decline.

Only herring gull had above average breeding productivity. European shag, great black-backed gulls and black-legged kittiwakes all had productivity figures below their long term averages. The northern fulmar figure equalled its long term average. A high number of common guillemot eggs were predated by gulls and both adults and chicks had weights below their long term average. Razorbills laid late and many failed at the egg stage.

A total of 225 fully grown seabirds and 900 seabird chicks were ringed with BTO metal rings and 605 fully grown birds were re-trapped in breeding colonies. A high number of ringed adult birds were found predated in colonies on Canna in 2013.

Re-trapping of adult common guillemots resulted in 86 birds ringed as chicks being located back in colonies for the first time. Eleven razorbills and thirteen European shags that had been ringed as chicks were re-trapped in colonies for the first time. Return rates of the 2004-08 auk cohorts are unusually low.

Thirty-three fish being carried by adult common guillemots were collected and identified. The sample was dominated by sandeel (49%). The European shag regurgitations and pellets collected mainly contained gadid otoliths, with a few sandeel, goby and wrasse. Black-legged kittiwakes regurgitations were dominated by rockling otoliths.

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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 2013, the forty-fifth 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 counts of all seabird species breeding 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

Four visits were made to Canna during 2013 to cover the seabird breeding season: 29 May - 1 June, 28 June - 6 July, 19 - 20 July, 26 July - 2 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. 2013 was a very late season for some species so an extra trip in the third week of July was required to complete our auk monitoring work. The locations of the study sites named in the text are shown in Figure 1.

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. Count methods differ from those prescribed in Walsh *et al* (1995). Due to the fragmented nature of the colonies on Canna it is possible to visit each colony and count the numbers of chicks or eggs at each site. 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. In addition on 25 and 27 April birds were counted on the water below the cliffs between 0800 and 0900 (Swann 2013).

Other seabirds

Whole island counts were conducted between 28 June and 5 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 and the Nunnery, 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

At Tallabrig, the Dun Mor area of Sanday and Rubha Langanais, where birds nest 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. In late July the nests were again checked so that the number of young fledging could be calculated.

Herring gull

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

Great black-backed gull

A sample of accessible pairs was 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 then late July to see how many had eggs or chicks. The size and number of chicks was also noted.

3 Results

3.1 Breeding seabird counts

Details are given of the 2013 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 2005-2013. Counts in brackets are known to be underestimates.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	Peak (year)
Norther fulmar ¹	439	349	346	223	324	327	291	222	182	669 (1977)
European shag ²	327	349	361	375	324	305	(226)	270	255	1,753 (1984)
Great Skua ⁴	3	3	5	6	6	6	8	8	9	9 (2013)
Mew gull ⁴	9	7	13	13	21	20	16	25	30	30 (2013)
LBB gull ⁴	4	7	9	6	9	11	10	10	11	69 (1975)
Herring gull ⁴	112	96	74	70	66	70	63	83	95	1,525 (1988)
GBB gull ⁴	29	20	24	25	17	18	17	18	15	93 (1997)
Black-legged kittiwake ²	968	905	1,018	739	960	960	1002	1083	820	1,340 (2004)
Common tern ³	3	3	2	2	0	0	0	0	0	18 (1992)
Common guillemot ⁵	(79)	697	587	337	459	(291)	402	423	373	1,249 (2001)
Razorbill ⁵	(27)	273	288	170	288	209	245	(206)	194	520 (1985)
Black guillemot ⁶	47	49	68	68	63	78	40	47	59	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

3.1.1 Northern fulmar

A total of only 182 apparently occupied sites were counted, showing the Canna population continues to decline and is now at the lowest level since our monitoring work began in 1969 (Figure 1). It was evident during checks of the study plots that at times very few non-breeding birds were present on the ledges.

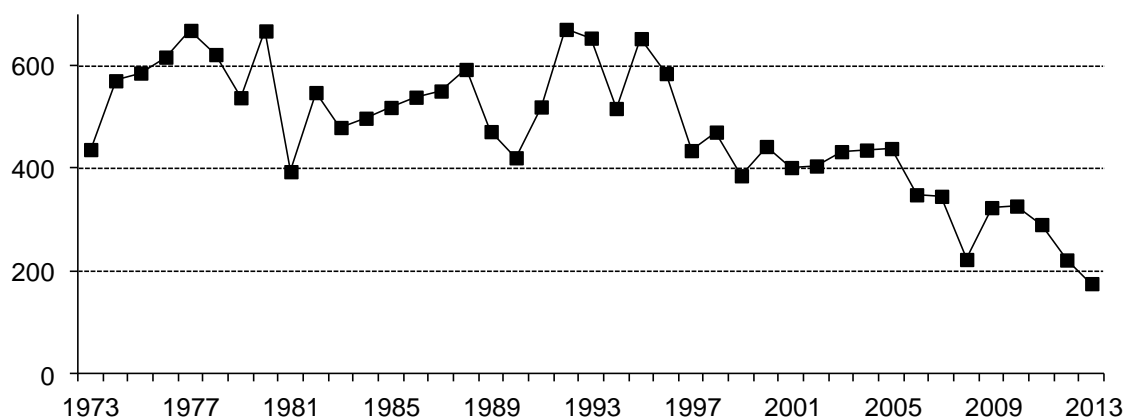


Figure 1. Number of apparently occupied northern fulmar sites on Canna 1973-2013.

3.1.2 Manx shearwater

At the Tarbert Road colony one bird responded to taped calls from over 500 burrows checked in late May. At the Nunnery 50 burrows were checked, with three birds responding. No birds were located at Garrisdale, despite 250+ burrows being checked.

3.1.3 European shag

With 255 AONs counted (Figure 2) numbers remain very low. Some birds nested very early and it is possible that our July counts again missed some early nesters that failed, but did not relay.

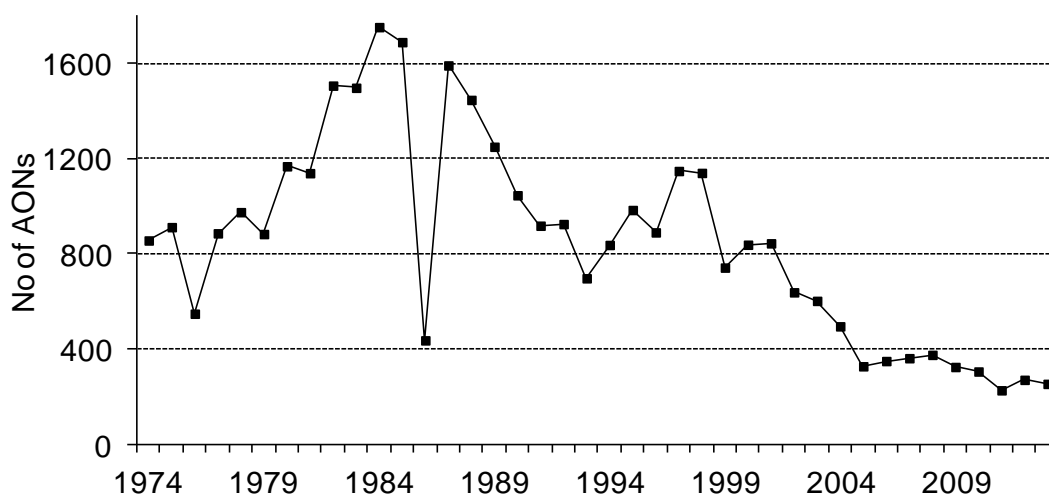


Figure 2. Number of apparently occupied European shag nests on Canna 1974-2013.
Note: 1985 was a non-breeding year for shags.

3.1.4 Great skua

Nine pairs of great skua *Stercorarius skua* were present and eight pairs laid eggs. One pair nest near Rhu Langanes on Canna, the rest were on Sanday.

3.1.5 Mew gull

The number of mew gulls *Larus canus* increased with 30 Apparently Occupied Territories (AOT) counted (Table 1), a new highest count.

3.1.6 Lesser black-backed gull

The number of lesser black-backed gulls *Larus fuscus* has declined dramatically since 2002 from about 40 AOTs to 4 in 2005. Numbers have since increased slightly since 2005 and appear to have levelled out at a new lower level. There were 11 AOTs in 2013 (Figure 3).

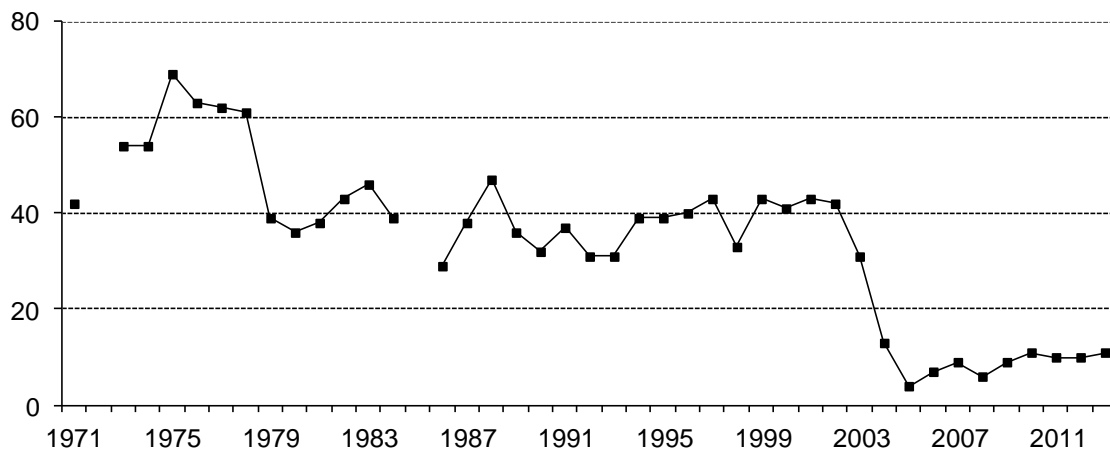


Figure 3. Number of apparently occupied Lesser Black-backed Gull territories on Canna 1971-2013

3.1.7 Herring gull

There was a notable decline in the number of AOTs on Canna between 2000 and 2005. Since then numbers have remained at a very low level reaching a record low of 63 AOTs in 2011. There has since been a slight increase to 95 AOTs in 2013 (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, cliff and moorland sites on Sanday and above Rubha Langanais. Only the small colonies at Rubha Langanais and Geugasgor occupy traditional sites.

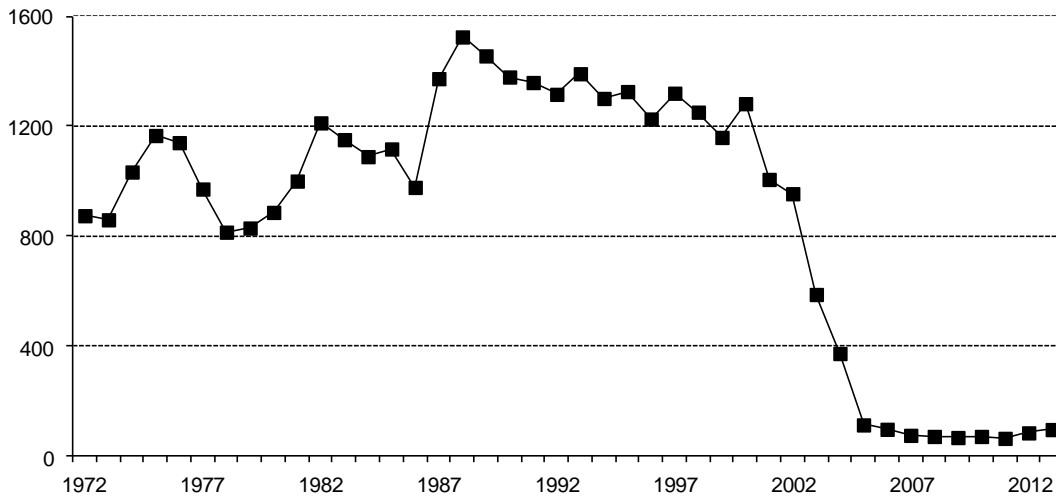


Figure 4. Number of apparently occupied herring gull territories on Canna 1971-2013.

3.1.8 Great black-backed gull

As with other large gull species there was a substantial decline in numbers on Canna between 2000 and 2005. Numbers now appear to have levelled out at a low level with only 15 AOTs in 2013 (Figure 5).

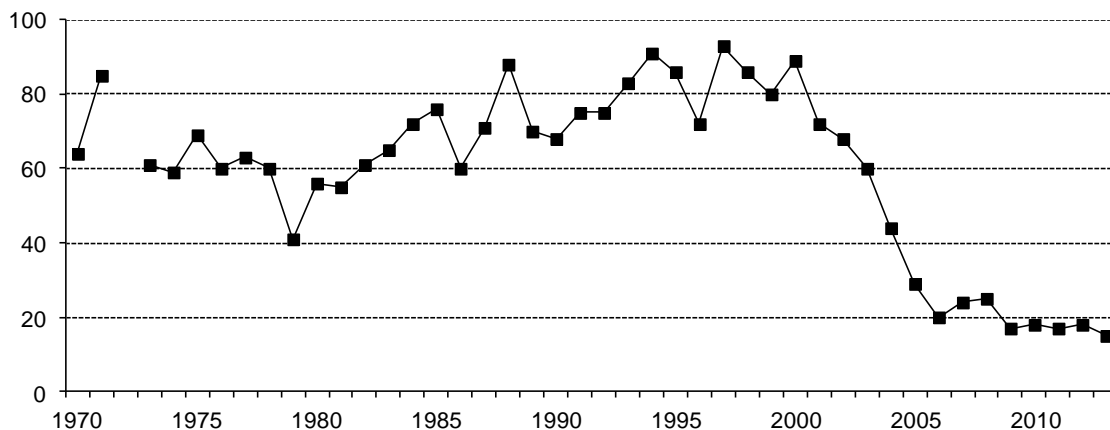


Figure 5. Number of apparently occupied great black-backed gull territories on Canna 1969-2013.

3.1.9 Black-legged kittiwake

In the late 1970s and 1980s Kittiwake numbers fluctuated around 840 AONs. They then increased to reach a peak of 1,340 AONs in 2004. Since then there has been much variability in numbers with the 2013 count showing a steep decline from the 1,083 AONs recorded in 2012 to 820 AONs (Figure 6).

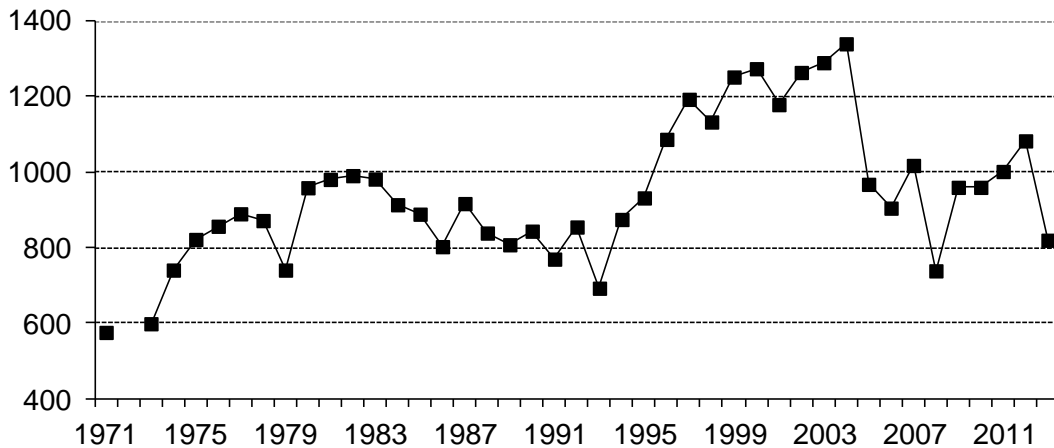


Figure 6. Number of apparently occupied black-legged kittiwake nests on Canna 1971-2013.

3.1.10 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 down to 291 ‘nests’ in 2010 (Figure 7). Since then numbers have fluctuated at a very low level with only 373 ‘nests’ counted in 2013. We believe recent counts (2008-2013) may have underestimated the actual number of birds attempting to breed as many of the more open colonies are virtually abandoned by the time of our July visits, with many predated eggs being observed.

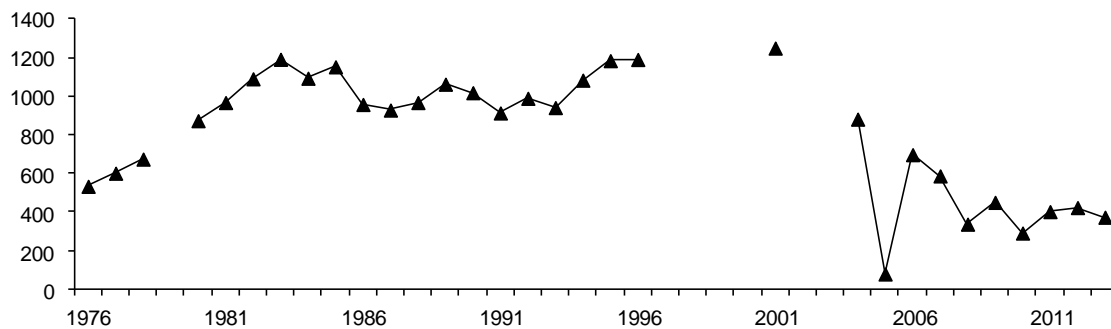


Figure 7. Number of common guillemot ‘nests’ in all study plots on Canna 1974-2013. *Note gaps in data correspond with years when large number of chicks had fledged prior to our arrival on the island and no population estimate could be calculated*

3.1.11 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. Since then numbers have fluctuated and shown a further slow decline. This continued in 2013 with only 194 'nests' counted.

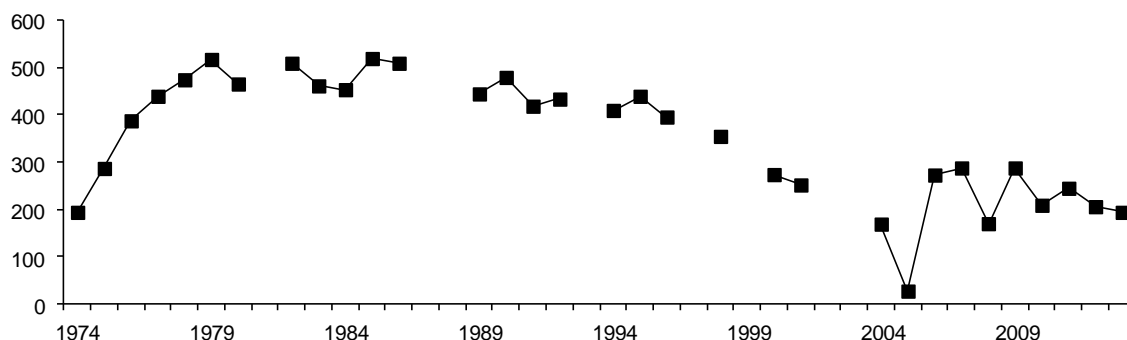


Figure 8. Number of razorbill 'nests' at Geugasgor and at all other sites on the island 1974-2013. Note gaps in data correspond with years when large number of chicks had fledged prior to our arrival on the island and no population estimate could be calculated.

3.1.12 Black guillemot

A total of 59 individual adult birds were counted in 2013 (Table 1). As noted under Methods this under-estimates the true number present and does not follow the methodology suggested by Walsh *et al* (1995). In late April 2013 a survey was conducted following the guidelines in Walsh *et al* (1995). 215 birds were counted, including one immature. Totals from previous counts, conducted in a similar manner were 211 in 2000 and 204 in 1989. This suggests that the Canna population has remained quite stable over this period, despite the summer counts showing a long term decline.

3.1.13 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. Through visual observations there has, however, been a notable apparent increase in numbers at Geugasgor, following the rat eradication in winter 2005/06. New burrows are appearing each year at several locations on the Geugasgor slopes. There was a marked increase in numbers in these areas in 2013.

3.2 Timing of breeding

Weather data for the Canna area was extracted from Meteorological office anomaly maps (<http://www.metoffice.gov.uk/climate/uk/anomacts/#>) comparing 2013 data to the 1981-2010 mean. Winter temperatures between December and February were average though with below average rainfall (70-90% of average). March and April were very cold with temperatures 2°C below average. May was wetter than average (175%) but otherwise summer rainfall and temperatures were close to average.

2013 was a mixed year, some species in particular European shag began to nest very early. Others, however, such as black-legged kittiwake, common guillemot and razorbill nested very late, possibly as a result of the unusually low spring temperatures with north and northeast winds. Common guillemots were c.3 weeks later than normal, necessitating a

return visit on 19-20 July, when most chicks were still less than half grown. In early July 65% of razorbills were still on eggs and most black-legged kittiwakes.

3.3 Breeding success

A summary of the 2013 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 2004-2013.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Northern fulmar	0.56	0.28	0.47	0.27	0.23	0.36	0.42	0.46	0.37	0.37
European shag ^a	0.01	0.7*	1.2*	1.4*	1.5*	1.8*		1.4*		1.0*
European shag ^b	1.4	0.7	0.7	1.0	0.3	0.7	1.5	0.8	1.6	1.0
Herring gull	0.16	0.13	0.24	1.8	0.5	0.7	1.8	2.1	1.6	1.6
Great black-backed gull	0.3	0.1	0.2	0.8	0.5	0.9	1.6	1.0	2.2	0.7
Black-legged kittiwake	0.8	0	0.45	0.3	0	1.1	0.8	0.7	1.1	0.5

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, large chicks per nest for European shags and black-legged kittiwakes, large chicks per occupied territory for great black-backed gulls and since 2006 for herring gull. For pre 2006 methodology see Swann (2000).
3. For European shag ^a refers to no 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.

3.3.1 Northern fulmar

Table 2 shows the breeding success from four study plots. This gives an overall success rate across all sites combined of 0.37 chicks per apparently occupied site, with big variations between study plots. This is a similar figure to that recorded in 2012 (0.37) and is equal to the long term average figure.

Table 3. Northern fulmar breeding success on Canna in 2013.

<i>Study site</i>	<i>No. sites</i>	<i>No. young</i>	<i>Young per site</i>
Sanday A	21	5	0.24
Sanday B (Dun Mor)	11	4	0.36
Buidhe Sgor	33	16	0.48
Nunnery	3	0	0
Total	68	25	0.37

3.3.2 Manx shearwater

Four known occupied burrows were checked, two were known to contain an egg in late May. In early August both of these burrows contained a large chick.

3.3.3 European shag

There was much variation in productivity between the four monitored plots, particularly at the three cliff sites (Table 4).

Table 4. European shag fledging success on Canna in 2013.

<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>Total No. of nests</i>	14	10	8	45
0 young	5	9	2	24
1 young	3	0	1	2
2 young	5	1	2	12
3 young	1	0	3	7
Av young/AON	1.14	0.2	1.75	1.04

* = nests located on narrow cliff ledges.

Overall 52% of all nests failed to produce any young, resulting in a productivity figure of just 1.03 young per AON. This was below the long-term average of 1.3 young/AON. High predation rates of adult birds (see Table 8) may have exacerbated the high nest failure rate.

3.3.4 Great skua

Of the eight pairs that nested one pair reared two chicks, four pairs single chicks and three pairs failed. Another pair was present but did not nest.

3.3.5 Herring gull

On Sanday five pairs fledged two young, two pairs fledged three young and two pairs failed (1.8 young/nest). On the Tarbert Road screes three pairs fledged one young, one pair two young, one pair three young and two pairs failed (1.1 young/nest). This gives an overall productivity of 1.6 young/nest.

3.3.6 Great black-backed gull

Thirteen pairs of great black-backed gull were monitored, six pairs failed, five pairs produced one young and two pairs produced two young, giving an overall average productivity of 0.7 young per nesting pair. This is the lowest productivity figure we have recorded since 2008 (Table 6).

3.3.7 Black-legged kittiwake

The results obtained from the study plots are detailed in Table 4.

Table 5. Number of occupied black-legged kittiwake nests and number of large young per nest in study plots in 2013.

	<i>Sanday, K1</i>	<i>Sanday, K2</i>	<i>Sanday, K3</i>	<i>Sanday, K4</i>	<i>Buidhe Sgor</i>	<i>Cave</i>
<i>No. nests empty</i>	38	33	19	23	69	36
1 young	12	22	13	14	28	26
2 young	23	8	6	8	37	10
3 young	3	3	0	1	4	0
av. young per nest	0.76	0.42	0.32	0.43	0.65	0.28

There was much variation in breeding productivity between the different study plots, ranging from 0.28 young per AON at the cave to 0.76 at K1 on Sanday. Overall the mean number of young fledged per AON was 0.52, the lowest figure since the complete breeding failure in 2008 (Table 6) and below the long term average of 0.67.

3.3.8 Common tern

No Common terns nested on Canna in 2013.

3.3.9 Common guillemot

Fifty two guillemot chicks with a wing length greater than 60mm were weighed (Appendix 1). The mean weight of 252.3g was significantly lighter than the pre 2013 sample ($z = -4.14$, $p < 0.01$), which had a mean weight of 268g. A sample of 30 adult birds were also weighed. Their mean weight of 865.3g ($n = 30$) was significantly lighter than the 912.9g recorded on a sample of 31 birds weighed opportunistically in July between 1976 and 1983 ($t = 3.677$, $p < 0.01$). This suggests that birds were in poorer condition in 2013. A large number of adults were found predated in the colonies (see Table 8).

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

	2002	2003	2004	2005	2007	2008	2009	2010	2011	2012	2013
mean	258	274	270	238	239	213	255	264	253	291	252
n	54	50	50	30	17	25	25	77	70	66	52

3.3.10 Razorbill

Although we do not monitor Razorbill breeding success it was apparent that a large number of nests failed at the egg stage. Birds laid very late and subsequent follow up visits found very few chicks. In all only 61 chicks were ringed, one of our lowest ever totals and well below the 135 ringed in 2012. A high number of adult birds were found predated in the colony (see Table 8).

The above accounts compare breeding output in 2013 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 6.

3.4 Ringing studies

3.4.1 Ringing totals

Table 7 shows the number of adults and chicks ringed during 2013 and the number of fully-grown birds that were re-trapped.

Table 7. Number of birds ringed and adults retrapped on Canna in 2013.

	<i>Adults ringed</i>	<i>Chicks ringed</i>	<i>Full-grown retrapped</i>
Northern fulmar	6	17	9
Manx shearwater	0	2	1
European shag	7	157	18
Great skua	0	8	0
Mew gull	0	2	0
Lesser Black-backed gull	0	4	0
Herring gull	0	73	0
Greater black-backed gull	0	6	0
Black-legged kittiwake	20	6	22
Common guillemot	88	556	515
Razorbill	61	61	38
Atlantic puffin	43	8	2
Totals	225	900	605

Each year we find ringed birds that have been predated, mainly by gulls. The number found varies greatly from year to year but was particularly high for European shags, razorbills and common guillemots in 2013 (Table 8).

Table 8. Number of ringed predated adult seabirds found in colonies according to year.

	European shag	razorbill	common guillemot
2000	1	1	8
2001	2	1	30
2002	3	2	13
2003	5	2	28
2004	6	7	23
2005	3	24	10
2006	2	14	17
2007	0	0	23
2008	0	0	4
2009	3	2	16
2010	0	4	20
2011	5	3	11
2012	4	5	13
2013	12	12	30

The high number of adults predated in 2013 was probably linked to the observed high nest failure rates in all three species.

3.5 Return and survival rates

3.5.1 Common guillemot

515 adult common guillemots were re-trapped in 2013, of which 86 were birds that had been ringed as chicks on Canna and were re-trapped on the island for the first time. These included: eight 4-year olds, one 6-year old, one 8-year old, thirteen 9-year olds and five 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 9. Recovery rates and return rates of common guillemot chicks ringed on Canna.

<i>Year</i>	<i>No. ringed</i>	<i>% recovered in 1st year</i>	<i>% back by 5th year</i>	<i>% back by 6th year</i>	<i>% back by 7th year</i>
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	0.7
2006	1161	0.4	0.3	0.5	0.6
2007	707	0.8	0.8	0.8	
2008	271	0	0.7		

Recent high post-fledging mortality appears to have disrupted this pattern, with very low return rates from the 2004 cohort, many of which perished in a massive wreck off North-west Scotland in September of that year (Swann 2004) and of the 2005-2008 cohorts, whose pre-fledging weights were well below average (Table 9). Evidence from the 2009 cohorts suggests that recruitment rates may be starting to improve. The first year recovery rate of these birds was 0.5% and 1.2% had been re-trapped in the colony by age 4.

3.5.2 Razorbill

Eleven razorbills that had been ringed as chicks were re-trapped on the island for the first time in 2013. These were one 2-year old, six 4-year olds, a 5-year old, two 15-year olds and a 17-year old bird. As with guillemots there has been a major decline in return rates. The

1995-2002 cohorts had a return rate of 6.1% by age 5. For the 2003-08 cohorts the return rate has slumped to 0.3%, probably a reflection of a large increase in post fledging mortality of underweight chicks.

3.5.3 European shag

In 2013 thirteen shags, which had been ringed as chicks, were re-trapped on the island for the first time. All were breeders, being caught on nests, and composed one 3-year old, three 4-year olds, a 5-year old, two 6-year olds, a 7-year old and five over 10 year old.

3.6 Feeding studies

3.6.1 Common guillemot

Thirty-three fish were collected and/or identified from adult common guillemots on their return to the colony from fishing trips, 16 (49%) were sandeels *Ammodytes* spp with 10 (30%) gadids and seven sprats *Sprattus sprattus* (21%). Of the identified gadids eight were probable whiting and one a probable haddock. Details of the fish sampled are given in Appendix 2. The mean length of sandeels was 151.2mm (sd 32.1) not significantly smaller than the 2012 average (168.8mm, sd 32.1, $z = 1.47$, ns). Figure 9 shows that since 2002 there had been a significant decline in the percentage of Clupeidae (sprats) brought in and that since 2005 common guillemot chick diet has been dominated by sandeels, with smaller numbers of gadids.

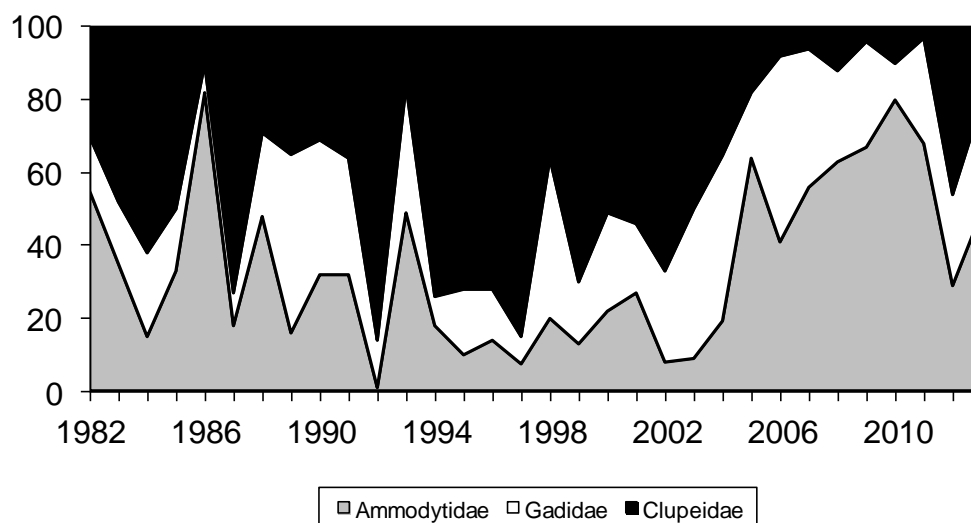


Figure 9. Proportion of fish species taken by common guillemots on Canna 1982-2013.

3.6.2 European shag

Eight regurgitations from chicks were collected (samples 1-4 on 3 July, 5 on 1 July and 6-8 on 29 June). Ten pellets were collected on 28 July. The samples mostly contained gadidae with some sandeel, goby and wrasse otoliths (Table 10).

Table 10. Number of otoliths and other contents of regurgitations from young European shags and shag pellets.

Sample number	Sample type	Sandeel otoliths '0', 1+ group	Gadid otoliths Whiting, rockling	Other gadid otoliths	REMARKS + details of other 'fish'
1	regurgitation	0,10	0,0	4	
2	regurgitation	0,15	0,0	36	
3	regurgitation	0,3	0,1	24	4 dragonet, 4 flatfish, 2 urchin
4	regurgitation	35,0	0,0	42	2 flatfish, dragonet bones
5	regurgitation	0,0	0,0	5	3 butterflyfish
6	regurgitation	0,0	0,0	13	3 goby, wrasse bones
7	regurgitation	1,0	0,0	54	15 goby, 2 Cottidae
8	regurgitation	0,0	0,0	1	
9	pellet	0,3	0,9	66	9 goby, 2 wrasse
10	pellet	0,3	0,0	16	10 goby, 1 wrasse
11	pellet	0,0	0,0	65	18 goby, 2 wrasse, octopus
12	pellet	0,0	0,4	19	5 goby, 1 wrasse
13	pellet	0,0	0,0	27	6 goby, 7 wrasse, 5 mollusc
14	pellet	0,0	0,0	78	6 goby, 1 wrasse
15	pellet	0,0	0,0	16	1 goby, 2 mollusc, dragonet bones
16	pellet	0,2	0,2	32	14 goby
17	pellet	0,0	0,2	71	13 goby, 3 wrasse
18	Pellet	0,3	0,0	14	

3.6.3 Black-legged kittiwake

Four food samples were analysed from regurgitations collected from black-legged kittiwake chicks on 29 June, all containing rockling (Table 11).

Table 11. Number of otoliths and other contents of regurgitations from black-legged kittiwake regurgitations.

Sample number	Sample type	sandeel otoliths '0', 1+ group	Gadid otoliths Rockling, unidentifield	Clupeids	REMARKS + details of 'other' items
1	Regurgitation	0,0	51,0	0	
2	Regurgitation	0,0	34,0	0	
3	Regurgitation	0,0	49,0	0	
4	Regurgitation	0,0	87,0	0	

4 Acknowledgements

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Appendices

5.1 Appendix 1. Common guillemot chick weights

Weights in grammes									
212	212	214	216	220	224	226	226	227	228
230	230	230	233	233	234	234	235	245	246
247	250	250	252	253	254	254	254	254	255
256	256	260	262	263	264	265	265	268	268
270	270	270	272	274	282	288	288	292	320
332	252								

Note: Weights taken only from chicks with a wing length of >60mm, which are assumed to be pre-fledging weights. Mean weight was 252.3g.

5.2 Appendix 2. Common guillemot diet samples

Details are given of the size (mm) of fish caught by adult guillemots on Canna in 2013.

Whiting: 8 measured							
<i>Length</i>	62	64	85	86	87	88	97
No. of fish	1	1	2	1	1	1	1

Sandeel: 12 measured										
<i>Length</i>	88	125	132	134	146	155	185	186	188	195
No. of fish	1	1	2	2	1	1	1	1	1	1

Sprat: 5 measured				
<i>Length</i>	112	117	120	123
No. of fish	2	1	1	1