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Canna seabird studies 2014

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Summary

Three summer visits were made to Canna during 2014 to count and ring seabirds, monitor their breeding success and collect food samples.

Although 2014 was another later than normal breeding season for most species, there was a high degree of laying synchrony in most colonies.

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. European shags continued their long term decline. Northern fulmars, great black-backed gull, lesser black-backed gull and herring gull remain at very low levels. Common guillemots, razorbills and black-legged kittiwakes showed small increases in numbers and mew gull reached a new record high count.

Northern fulmar, European shag, great black-backed gull, herring gull, and great skua had breeding success figures below their long term averages. Black-legged kittiwakes, despite much variation between sub-colonies, overall had above average breeding success. Auks appeared to have had a good breeding season with good numbers of chicks present and most being in good condition, as witnessed by well above average mean weights of a sample of large guillemot chicks.

A total of 328 fully grown seabirds and 1,863 seabird chicks were ringed with BTO metal rings and 871 fully grown birds were re-trapped in breeding colonies. In addition 100 geolocators, provided by Marine Scotland were fitted to adults (10 northern fulmar, 30 black-legged kittiwake, 30 razorbill, 30 common guillemot).

Re-trapping of adult common guillemots resulted in 120 birds ringed as chicks being located back in colonies for the first time. Nine razorbills and six European shags that had been ringed as chicks were also re-trapped in colonies for the first time. Following the very low return rates of the 2004-2008 auk cohorts, there are signs of improved recruitment from the 2009 and 2010 cohorts, suggesting improved survival of young produced from these years.

Twenty-six fish being carried by adult common guillemots were collected and identified. The sample was dominated by gadids (42%). European shag regurgitations and pellets mainly contained 0 group sandeel and gadid otoliths. Black-legged kittiwakes regurgitations were similar, though one third contained a high percentage of crustaceans.

Contents

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 2014, the forty-sixth 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 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 2014 to cover the seabird breeding season: 28 - 31 May, 4 - 12 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. 2014 was another late season for some species so we delayed our main July visit by one week.

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 suitable breeding location.

Black guillemot

Black guillemots *Cepphus 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 on various occasions between 28 May and 8 July. All counts were made from land with the exception of northern fulmars at Tialasgor and Geugasgor and black-legged 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 late July/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 late July/early August.

European shag

At Tallabric, the Dun Mor area of Sanday and Rubha Langanais, where birds nest on narrow cliff ledges, 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, when nests at Lamasgor were also checked. 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. The nests were checked again in early then late July to see how many contained eggs or chicks. The size and number of chicks was also noted.

3 Results

3.1 Breeding seabird counts

Details are given of the 2014 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 2006-2014. Counts in brackets are known to be underestimates.

	2006	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*Peak (year)*
Norther fulmar [1]	349	346	223	324	327	291	222	179	184	669 (1977)
European shag [2]	349	361	375	324	305	(226)	270	255	191	1,753 (1984)
Great skua [4]	3	5	6	6	6	8	8	9	9	9 (2013)
Mew gull [4]	7	13	13	21	20	16	25	30	33	33 (2014)
Lesser black-backed gull [4]	7	9	6	9	11	10	10	11	9	69 (1975)
Herring gull [4]	96	74	70	66	70	63	83	95	75	1,525 (1988)
Greater black-backed gull [4]	20	24	25	17	18	17	18	15	16	93 (1997)
Black-legged kittiwake [2]	905	1,018	739	960	960	1002	1083	820	935	1,340 (2004)
Common tern [3]	3	2	2	0	0	0	0	0	0	18 (1992)
Common guillemot [5]	697	587	337	459	(291)	402	423	373	460	1,249 (2001)
Razorbill [5]	273	288	170	288	209	245	(206)	194	213	520 (1985)
Black guillemot [6]	49	68	68	63	78	40	47	59	78	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 184 apparently occupied sites were counted, showing the Canna population remains at a very low level (Figure 1).

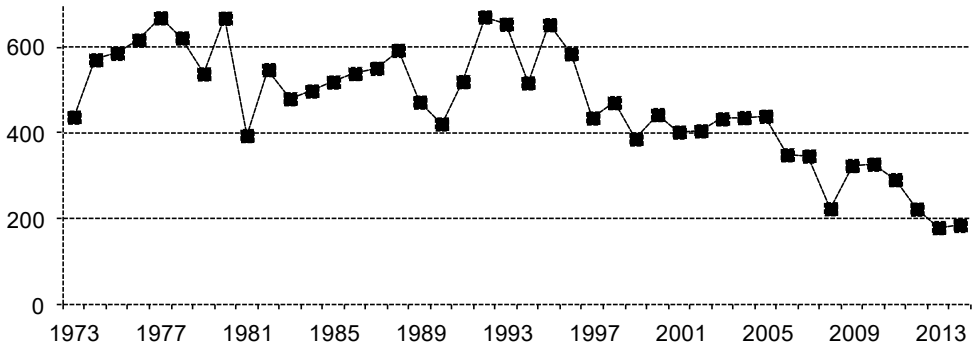

Figure 1. Number of apparently occupied northern fulmar sites on Canna 1973-2014.

3.1.2 Manx shearwater

At the Tarbert Road colony one occupied burrow was confirmed from over 500 burrows checked in late May. At the Nunnery 50 burrows were checked, with three birds responding to taped calls. One bird was located at Garrisdale from over 150 checked burrows, the first we have recorded at this site since the rat eradication project.

3.1.3 European shag

Numbers continue to decline on Canna reaching a new low of only 191 AONs counted (Figure 2). The biggest decline was at the Geugasgor colony which dropped from 142 AONs in 2013 to only 99 AONs in 2014.

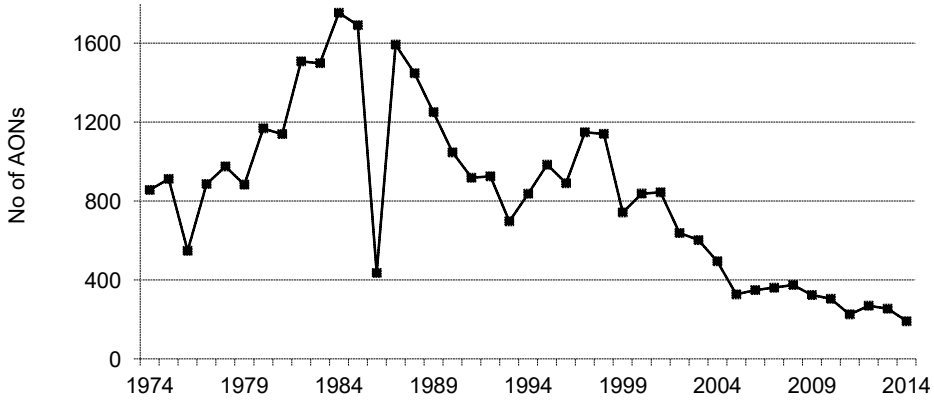

Figure 2. Number of apparently occupied European shag nests on Canna 1974-2014.
Note: 1985 was a non-breeding year for shags.

3.1.4 Great skua

Nine pairs of great skua *Stercorarius skua* were present and eight pairs were known to have laid eggs. One pair nested west of Tarbert on Canna, the rest were on Sanday.

3.1.5 Mew gull

The number of mew gulls *Larus canus* increased with 33 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 9 AOTs in 2014 (Figure 3).

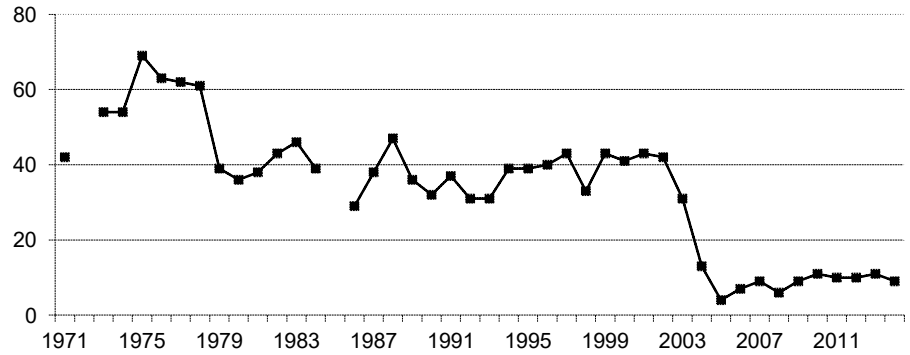

Figure 3. Number of apparently occupied Lesser Black-backed Gull territories on Canna 1971-2014

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 broadly stable. The lowest level of 63 AOTs was recorded in 2011. In 2014 75 AOTs were counted, down from 95 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 apparently 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.

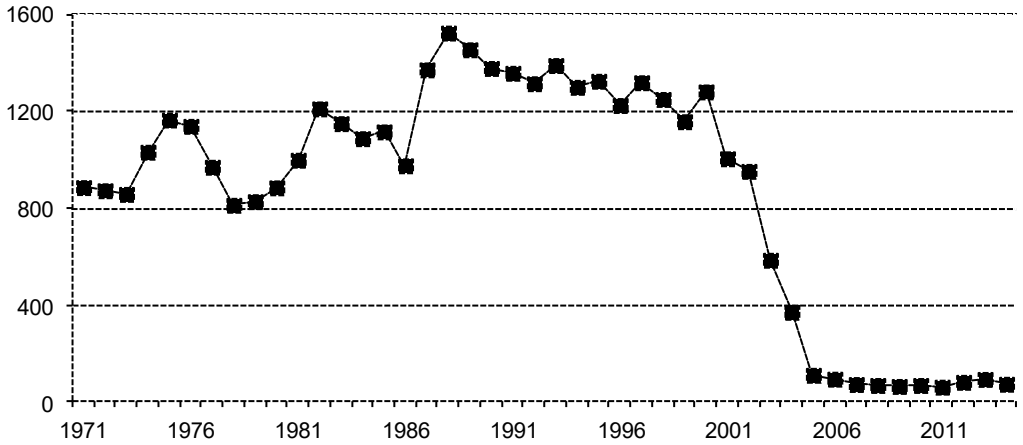

Figure 4. Number of apparently occupied herring gull territories on Canna 1971-2014.

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 stable at a low level with only 16 AOTs in 2014 (Figure 5).

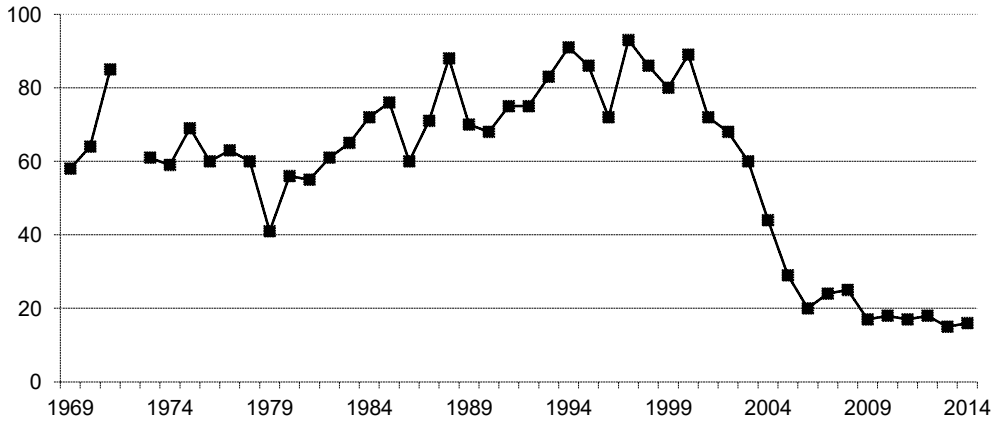

Figure 5. Number of apparently occupied great black-backed gull territories on Canna 1969 -2014.

3.1.9 Black-legged kittiwake

In the late 1970s and 1980s black-legged kittiwake numbers fluctuated around 840 AONs. They then increased reaching a peak of 1,340 AONs in 2004. Since then there has been a decline associated with much variability in numbers with the 2014 count of 935 AONs showing an increase on the 820 AONs counted in 2013 (Figure 6).

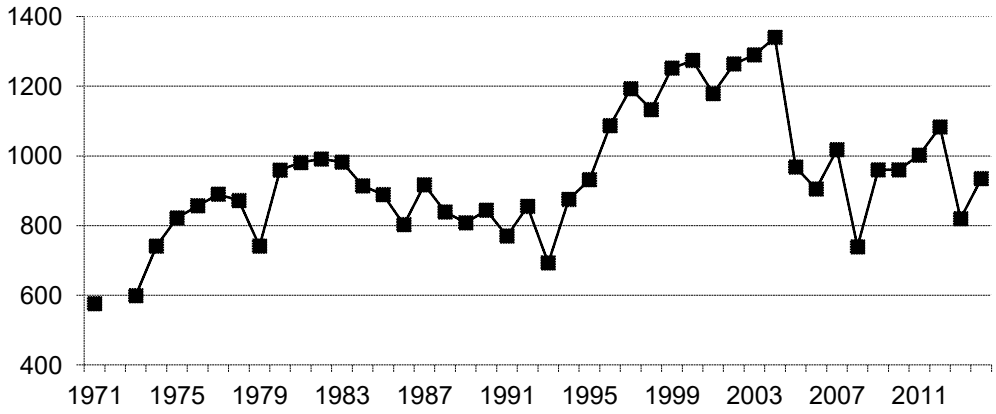

Figure 6. Number of apparently occupied black-legged kittiwake nests on Canna 1971-2014.

3.1.10 Common guillemot

Common guillemot numbers peaked in 2001 when 1,249 ‘nests’ were counted in our studies areas. There was then a long term decline down to 291 ‘nests’ in 2010 (Figure 7). Since then numbers have fluctuated at a very low level with 460 ‘nests’ counted in 2014. We believe that some 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. There was less evidence of this in 2014.

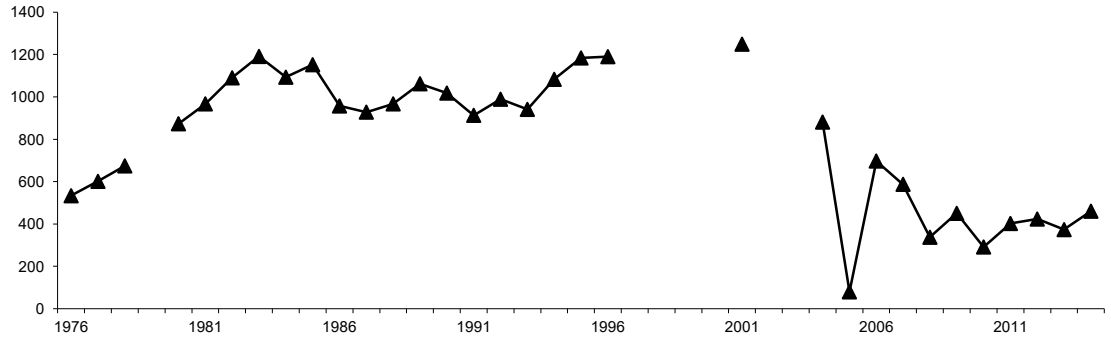

Figure 7. Number of common guillemot 'nests' in all study plots on Canna 1976-2014.
Note gaps in data correspond with years when large number of chicks had fledged prior to our arrival on the island and no population estimate could be calculated

As part of a national survey we recorded the percentage of Common Guillemots that were of the bridled form. This was done at two locations. On Sanday of 54 birds checked on 10 July at three small cliff colonies seven (13%) were bridled. On the north cliffs of Canna, 984 adults were caught between 7 and 9 July and 75 were bridled (8%). It is known that the percentage of bridled birds can differ markedly between sites, even within a colony.

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 but remain low with only 213 'nests' counted in 2014.

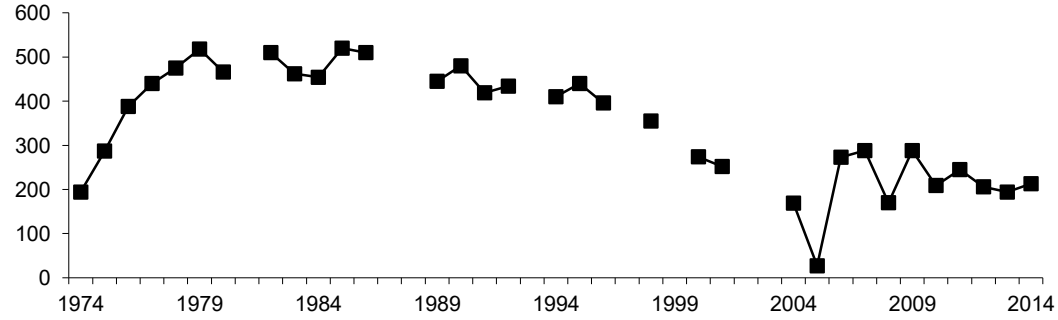

Figure 8. Number of razorbill 'nests' at Geugasgor and at all other sites on the island 1974-2014.
Note gaps in data correspond with years when large number of chicks had fledged prior to our arrival on the island and no population estimate could be calculated.

3.1.12 Black guillemot

A total of 78 individual adult birds were counted in 2014 (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).

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 annual increase in numbers at Geugasgor, following the rat eradication in winter 2005/06 and 2014 was no exception.

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/summaries/anomacts) comparing 2014 data to the 1981-2010 mean. Winter temperatures between December and March were generally 1°C to 2°C above average, with above average rainfall. April to July were also 1°C to 2°C above average, though with normal rainfall, apart from June which was very dry (33-50% below average).

2014 was another late year for many species, though not as late as 2013. We visited the island a week later than normal in order to compensate for this. Laying appeared to be more synchronised than usual with only 11% of European shags, 13% of razorbills and 17% of common guillemots still being on eggs in the second week of July.

3.3 Breeding success

A summary of the 2014 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 2005-2014.

	2005	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*
Northern fulmar	0.28	0.47	0.27	0.23	0.36	0.42	0.46	0.37	0.37	0.23
European shag [a]	0.7*	1.2*	1.4*	1.5*	1.8*		1.4*		1.0*	1.5*
European shag [b]	0.7	0.7	1.0	0.3	0.7	1.5	0.8	1.6	1.0	0.7
Herring gull	0.13	0.24	1.8	0.5	0.7	1.8	2.1	1.6	1.6	1.1
Greater black-backed gull	0.1	0.2	0.8	0.5	0.9	1.6	1.0	2.2	0.7	0.9
Black-legged kittiwake	0	0.45	0.3	0	1.1	0.8	0.7	1.1	0.5	0.9

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 (2004-11).
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 3 shows the breeding success from three study plots. This gives an overall success rate across all sites combined of 0.23 chicks per apparently occupied site, with large variations between study plots. This is lower than the 2013 figure (0.37) and well below the long term average of 0.38.

Table 3. Northern fulmar breeding success on Canna in 2014.

Study site	*No. sites*	*No. young*	*Young per site*
Sanday A	23	3	0.13
Sanday B (Dun Mor)	17	3	0.18
Buidhe Sgor	26	10	0.38
Total	68	16	0.23

3.3.2 Manx shearwater

Of five known occupied burrows, three were known to contain an egg in late May. In early August only one of these burrows contained a large chick, the other two failing at the small chick stage.

3.3.3 European shag

There was much variation in productivity between the four monitored plots (Table 4). In particular one of the cliff plots had particularly low productivity.

Table 4. European shag fledging success on Canna in 2014.

Young fledged per nest laid in	*Rubha Langanais**	*Tallabric Sanday**	*Dun Mor area, Sanday**	*Lamasgor*
Total No.of nests	*13*	*4*	*7*	*37*
0 young	11	1	2	10
1 young	2	2	1	6
2 young	0	1	3	13
3 young	0	0	1	8
Av young/AON	0.15	1.0	1.43	1.51

* = nests located on narrow cliff ledges.

Overall 39% of all nests failed to produce any young, resulting in a productivity figure of 1.18 young per AON. Although an improvement on 2013 (1.03), it was still below the long-term average of 1.31 young/AON.

3.3.4 Great skua

Of the eight pairs that nested one pair reared two chicks, one pair a single chick and six pairs failed. Another pair was present but did not nest. This resulted in a particularly poor season for this species on Canna.

3.3.5 Herring gull

On Sanday one pair fledged one young, three pairs fledged two young and two pairs failed (1.2 young/nest). At various monitored sites on Canna three pairs fledged one young, four

pairs fledged two young and three pairs failed (1.1 young/nest). This gives an overall productivity of 1.1 young/nest, the lowest recorded since 2009 (Table 6).

3.3.6 Great black-backed gull

Fourteen pairs of great black-backed gull were monitored, five pairs failed, six pairs produced one young, two pairs produced two young and one pair produced three young, giving an overall average productivity of 0.9 young per nesting pair. Although an improvement on 2013 (0.7) this is the second lowest productivity figure we have recorded since 2008 (Table 6).

3.3.7 Black-legged kittiwake

There was much variation in breeding productivity between the different study plots, ranging from 0.29 young per AON at the cave to 1.24 at K1 on Sanday. Overall the mean number of young fledged per AON was 0.87, above the long term average of 0.66. 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 2014.

	Sanday,K1	*Sanday,K2*	*Sanday,K3*	*Sanday,K4*	*Buidhe Sgor*	*Cave*
No. nests	*34*	*31*	*19*	*23*	*77*	*41*
empty	6	8	13	14	15	33
1 young	14	16	6	7	28	4
2 young	14	7	0	2	33	4
av. young per nest	**1.24**	**0.97**	**0.32**	**0.47**	**1.22**	**0.29**

3.3.8 Common tern

No Common terns nested on Canna in 2014.

3.3.9 Common guillemot

Seventy one guillemot chicks with a wing length greater than 60mm were weighed (Appendix 1). The mean weight of 281.85 was significantly higher than the pre 2014 sample ($U = 31250.5$, $p<0.05$), which had a mean weight of 266g. A sample of 45 adult birds were also weighed. Their mean weight of 888.56g was significantly heavier than the 2013 sample, which had a mean weight of 865.3g ($t=2.111$, $df = 73$, $p<0.05$) but still significantly lighter than the 912.9g recorded on a sample of 31 birds weighed opportunistically in July between 1976 and 1983 ($z= -1.99$, $p<0.05$).

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

	2003	2004	2005	2007	2008	2009	2010	2011	2012	2013	2014
mean	274	270	238	239	213	255	264	253	291	252	282
n	50	50	30	17	25	25	77	70	66	52	71

3.4 Ringing studies

3.4.1 Ringing totals

Table 7 shows the number of adults and chicks ringed during 2014 and the number of fully-grown birds that were re-trapped.

Table 7. Number of birds ringed and adults re-trapped on Canna in 2014

	Adults ringed	*Chicks ringed*	*Full-grown re-trapped*
Northern fulmar	5	12	13
Manx shearwater	1	1	1
European shag	2	199	11
Great skua	0	2	0
Mew gull	0	0	0
Lesser black-backed gull	0	0	0
Herring gull	0	66	0
Greater black-backed gull	0	4	0
Black-legged kittiwake	43	104	26
Common guillemot	194	1363	797
Razorbill	49	104	23
Atlantic puffin	34	8	0
Totals	**328**	**1863**	**871**

In addition to metal rings a plastic ring with an attached geolocator was added to 100 adult birds, comprising 10 northern fulmar, 30 black-legged kittiwake, 30 common guillemot and 30 razorbills. These were supplied by Marine Scotland. Much effort will need to be put in during the 2015 nesting season to retrieve as many of these devices as possible to down load the data gathered over the intervening period.

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
2014	1	3	6

The number of predated birds found in 2014 was the lowest that we have recorded for some time and was probably reflected in the higher breeding success of these species.

3.5 Return and survival rates

3.5.1 Common guillemot

797 adult common guillemots were re-trapped in 2014, of which 120 were birds that had been ringed as chicks on Canna and were re-trapped on the island for the first time. These included: three 3-year olds, two 4-year olds, fifteen 5-year old, five 7-year old, three 8-year olds, one 9-year old and two 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.

Year	*No. ringed*	*% recovered in 1st year*	*% back by 5th year*	*% back by 6th 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	0.7
2006	1,211	0.5	0.3	0.5	0.6
2007	707	0.8	0.8	0.8	1.6
2008	271	0	0.7	0.7	
2009	966	0.5	2.8		

High post-fledging mortality between 2004 and 2008 appeared to disrupt 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 5). Evidence from the 2009 cohorts suggests that recruitment rates are showing a marked improvement. This also looks to be true of the 2010 cohort, 1.9% of which had been re-trapped in the colony by age 4.

3.5.2 Razorbill

Nine razorbills that had been ringed as chicks were re-trapped on the island for the first time in 2014. These were two 3-year olds, two 5-year old and five that were over 10-years old. 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. The 2009 cohort, however, showed a marked improvement with 6.3% returning by age 5.

3.5.3 European shag

In 2014 six 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 of three 5-year olds, a 6-year old, a 10-year old and a 12-year old.

3.6 Feeding studies

On Canna we aim to collect diet samples from shags, guillemots and kittiwakes to help assess changes in the main food species being exploited by breeding birds.

3.6.1 Common guillemot

Twenty-six fish were collected and/or identified from adult common guillemots on their return to the colony from fishing trips, seven (27%) were sandeels *Ammodytes* spp, seven were sprats *Sprattus sprattus* (27%), 11 were gadoids (42%) and one Herring *Clupea harengus .* Of the identified gadids all were probable whiting. Details of the fish sampled are given in Appendix 2.

The mean length of sandeels was 105.1mm (sd 18.65) significantly smaller than the 2013 average (151.2mm, sd 32.1, $z = 5.19$, $p<0.05$) and below the long term average of 149.3mm ($z=5.19$, $p<0.01$. Sprats averaged 108.7mm (sd 5.47), smaller than the long term average of 116.6mm. Whiting, however, averaged 94.7mm (sd 17.23mm) significantly larger than the long term average of 83.7 ($z=1.99$, $p<0.05$).

Figure 9 shows that between 2002 and 2011 there had been a decline in the percentage of *Clupeidae* (sprats) brought in resulting in common guillemot chick diet being dominated by sandeels, with smaller numbers of gadids. Since 2012, sprats have once again increased in the diet, whilst sandeels have declined.

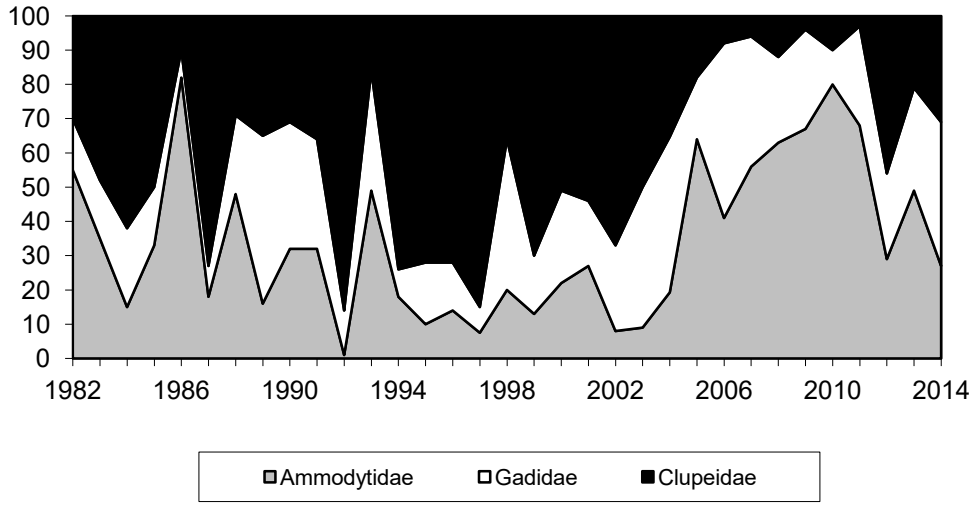

Figure 9. Proportion of fish species taken by common guillemots on Canna 1982-2014.

3.6.2 Razorbill

No data was collected for razorbill in 2014.

3.6.3 European shag

Two regurgitations from chicks were collected (sample 1 on 6 July and sample 2 on 28 July). Four pellets were collected 28-29 July. The samples mostly contained gadid and '0' group sandeel 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	unidentified gadid otoliths	REMARKS + details of other 'fish'
1	regurgitation	10,0	0,0	9	
2	regurgitation	0,0	0,0	7	
3	pellet	0,0	0,2	121	Wrasse bones
4	pellet	0,0	0,0	104	
5	pellet	141,0	0,0	7	2 flatfish otoliths
6	pellet	115,2	0,0	18	

3.6.4 Black-legged kittiwake

Eleven food samples were analysed from regurgitations collected from black-legged kittiwakes from 6 to 10 July. These mainly comprised '0' group sandeels and unidentified gadids, with around a third containing a high percentage of crustaceans. (Table 11).

Table 11. Number of otoliths and other contents of regurgitations from black-lgged 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	0,5	0	90% sample crustaceans
2	Regurgitation	2,0	0,0	0	
3	Regurgitation	4,0	0,0	0	
4	Regurgitation	5,0	0,4	0	50% sample crustaceans
5	Regurgitation	0,0	0,6	0	90% sample crustaceans
6	Regurgitation	0,0	0,2	0	
7	Regurgitation	2,0	0,4	0	
8	Regurgitation	13,0	0,0	6	
9	Regurgitation	0,0	0,2	2	
10	Regurgitation	4,0	0,5	0	3 molluscs
11	Regurgitation	0,0	0,0	0	100% sample crustaceans

4 Acknowledgements

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5 References

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Appendices

5.1 Appendix 1. Common guillemot chick weights

Weights in grammes									
237	243	246	246	246	253	255	258	258	258
259	262	263	264	266	268	268	268	268	270
270	270	270	270	272	272	274	274	274	276
278	278	280	280	280	280	280	280	282	282
284	284	285	285	287	289	289	290	290	290
292	294	295	298	298	300	300	300	302	305
306	310	310	315	315	320	320	320	320	320
320									

Note: Weights taken only from chicks with a wing length of >60mm, which are assumed to be pre-fledging weights. Mean weight was 281.5g.

5.2 Appendix 2. Common guillemot diet samples

Details are given of the size (mm) of fish caught by adult guillemots on Canna in 2014.

Whiting: 11 measured											
Length	70	72	83	84	87	93	98	108	112	116	119
No. of fish	1	1	1	1	1	1	1	1	1	1	1

Sandeel: 7 measured						
Length	94	97	98	99	103	147
No. of fish	1	1	2	1	1	1

Sprat: 7 measured							
Length	100	106	107	109	110	111	118
No. of fish	1	1	1	1	1	1	1

There was also one 84mm Herring.