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Canna seabird studies 2006

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Summary

- 1.1 Three visits were made to Canna during 2006 to count and ring seabirds, monitor their breeding success and collect food samples.
- 1.2 The timing of the 2006 breeding season was later than average for shags, auks and black-legged kittiwakes.
- 1.3 Counts showed that the breeding populations of many seabird species on Canna remain at very low levels. Northern fulmar, herring gull, and great black-backed gull continued to decline to new record low levels. Black-legged kittiwakes, following years of increase, continued to decline, though not as severely as in 2005. European shag and lesser black-backed gulls showed a slight increase in breeding numbers, whilst common guillemot and razorbill showed significant increases on 2005 counts, with razorbill recovering to levels last recorded in 2001.
- 1.4 Breeding success was markedly improved for most species on 2005. The exceptions were herring gull and great black-backed gull, where chick production continues to be exceptionally low, with most pairs failing to rear chicks. Black-legged kittiwakes productivity, though higher than 2005 was still well below average. Breeding success was average for northern fulmars and European shags. Observations suggested that common guillemots and razorbills appeared to have reasonable breeding success.
- 1.5 Totals of 367 fully grown and 1661 pullus seabirds were ringed with BTO metal rings and 1175 fully grown birds were retrapped in breeding colonies.
- 1.6 Retrapping of adult common guillemots resulted in 316 birds ringed as chicks being located back in colonies for the first time. One 2-year old, one 3-year old, two 4-year olds, 21 5-year olds and thirty five 6-year olds were amongst those caught. The 1996 and 1998 cohorts, of which very few were reported as dead in their first year of life, continue to show high return rates. The 1997, 1999 and 2000 cohorts are showing much lower return rates. Twenty seven razorbills and thirteen European shags that had been ringed as chicks were also retrapped in colonies for the first time.
- 1.7 Thirty nine fish were collected from adult common guillemots. Unusually low numbers of sprats *Sprattus sprattus* were recorded, comprising only 8% of the total. Gadoids, mainly *Trisopterus* sp with a few whiting *Merlangius merlangus*, dominated in number (51%), followed by sandeels (41%). The sandeels were significantly larger in size compared to the 2001-05 average, but the gadoids were smaller than average. European shags mostly fed on gadoids, dominated by *Trisopterus* sp., with very few sandeels.
- 1.8 Following the rat eradication campaign carried out on Canna over the 2005/06 winter there were no signs of rat predated eggs. The numbers of Razorbills increased markedly. Many guillemots and European shags, which had switched from nesting under boulders to nest in more open sites, to escape predation by brown rats *Rattus norvegicus*, continue to be subject to high levels of predation by gulls and common ravens. White-tailed and golden eagles were predated adult northern fulmars in unusually high numbers throughout the summer.

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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 2006, the 38th 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, rates and causes of mortality, and ages of return to the island and of first breeding;
- to collect biometrics data from young common guillemots *Uria aalge*; and
- to collect, identify and measure food 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 2006 to cover the seabird breeding season: 26-31 May, 30 June-8 July and 28 July -4 August.

Since 1997 we have been forced by circumstances beyond our control to arrange our second visit to the island a few days later than normal (i.e. from late June into early July). This, combined with a series of earlier than average breeding seasons, meant that in some years many razorbills and a few common guillemots had left the island prior to our arrival, thus affecting the validity of our counts for these two species. In 2006 we are very confident that no young auks had fledged prior to our early July visit to the island. The location of the study sites named in the text is shown in Figure 1.

2.2 Counts

Manx shearwaters

During May 2006, using tape playback methods (Walsh *et al* 1995) two observers checked the known traditional shearwater areas along the Tarbert Road and between the Nunnery and Garrisdale, with tapes played at burrow entrances.

Common guillemot and razorbill

Counts were made of the number of occupied sites in accessible colonies at Geugasgor and other smaller colonies. Occupied 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 30 June 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, Nunnery and Garrisdale, 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 dramatic decline in numbers of this species on Canna most of our original study nests are now abandoned. We have therefore altered our methodology to monitor breeding success of European shag. At Garrisdale, the Nunnery, 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. At Geugasgor and Lamasgor all nests were individually marked. 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 late July-early August the nests were again checked so that the number of young actually fledging could be calculated.

Herring gull

Nest counts were made in five sub-colonies scattered throughout the island. Two were counted in late May to provide details on clutch size. All were counted in early July and checked for signs of hatching (e.g. copious droppings, food remains, chicks). Nests with no such signs were classed as having failed. In order to estimate breeding success, nests were counted in late May. On the first sweep through the colony all nests were marked with a plastic coloured tag. On the second sweep each nest found with a tag was given a second tag and those without were given a different coloured tag. Using the information from the second sweep we can calculate our efficiency in finding nests and estimate the total number of nests in the colony.

Great black-backed gull

Accessible 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.

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 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 2006 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 1997-2006.

	1997	1997	1998	1999	2000	2001	2002	2003	2004	2006	Peak (year)
Northern fulmar ¹	435	471	386	443	402	406	434	436	439	349	669 (1977)
European shag ²	1,148	1,140	742	838	844	638	603	495	327	349	1,753 (1984)
Mew gull ⁴	0	0	0	0	2	2	2	2	3	3	3 (2005)
LBB gull ⁴	13	18	14	15	10	8	5	6	9	7	18 (1983)
Herring gull: pairs ⁴	43	(33)	42	41	43	42	31	13	4	7	69 (1975)
Herring gull: nests ³	1,320	(1,251)	1,159	1,282	1006	862	587	372	112	96	1,525 (1988)
GBB gull ⁴	729	748	640	610	525	381	292	182	76	50	809 (1988)
Blk-leg'd kittiwake ²	93	86	80	89	72	68	60	44	29	20	93 (1997)
Common tern ³	1,193	1,133	1,252	1,274	1,179	1,264	1,290	1,340	968	905	1,340 (2004)
Common guillemot ⁵	1	1	7	3	0	0	3	1	3	3	18 (1992)
Razorbill ⁵	-	(991)	(996)	(950)	1,249	-	(881)	906	(79)	697	1,249 (2001)
Black guillemot ⁶	-	(355)	-	(274)	252	-	-	169	(27)	273	520 (1985)

Notes: Units used are as follows:

1. Apparently occupied site for northern 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 349 apparently occupied sites were counted. This represents a marked decrease on the 2003-2005 counts (Figure 2) and is the lowest total since monitoring began. In the early part of the season there was very heavy predation on fulmars by both golden eagles and white-tailed eagles.

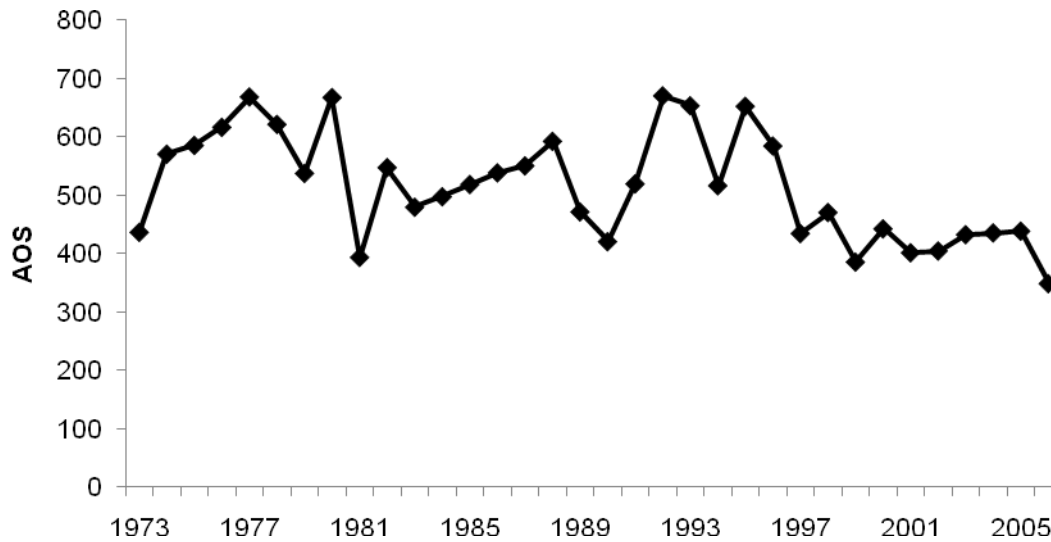


Figure 1. Number of apparently occupied Northern fulmar sites on Canna 1973-2006.

Manx shearwater

At the former Tarbert Road colony one bird responded to taped calls from over 200 checked burrows in late May. In early April, several birds were heard calling over this site at night and a single bird was heard calling in late May. Another bird responded to a taped call from 30 burrows checked at the Nunnery. At Garrisdale, no birds responded to tape playback from 50 burrows. The remains of four plucked birds were found close to a Peregrine site at Garrisdale, indicating that birds are probably still prospecting this former sub-colony.

European shag

Numbers increased slightly in 2006, to 348 apparently occupied nests (AON), compared with the 327 in 2005. This is the first increase in numbers since 2000 (Figure 3). Decreases are continuing to take place at the Nunnery and Garrisdale (Figure 4), where the remaining birds nest on narrow cliff ledges. A slight increase occurred at Geugasgor and a significant increase from 48 to 72 AONs occurred at Lamasgor.

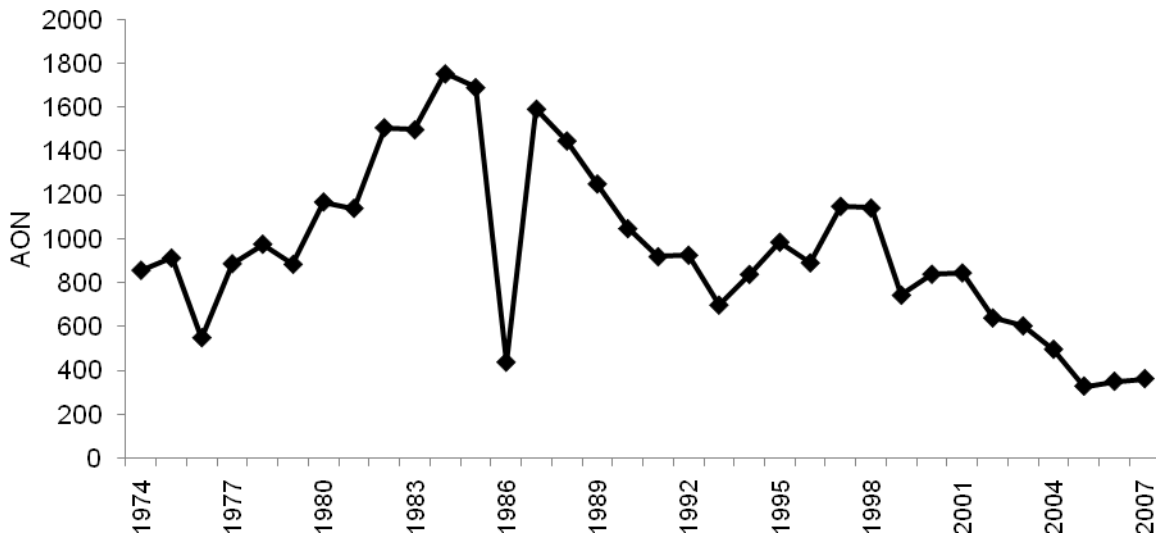


Figure 2. Number of apparently occupied European shag nests on Canna 1974-2006.

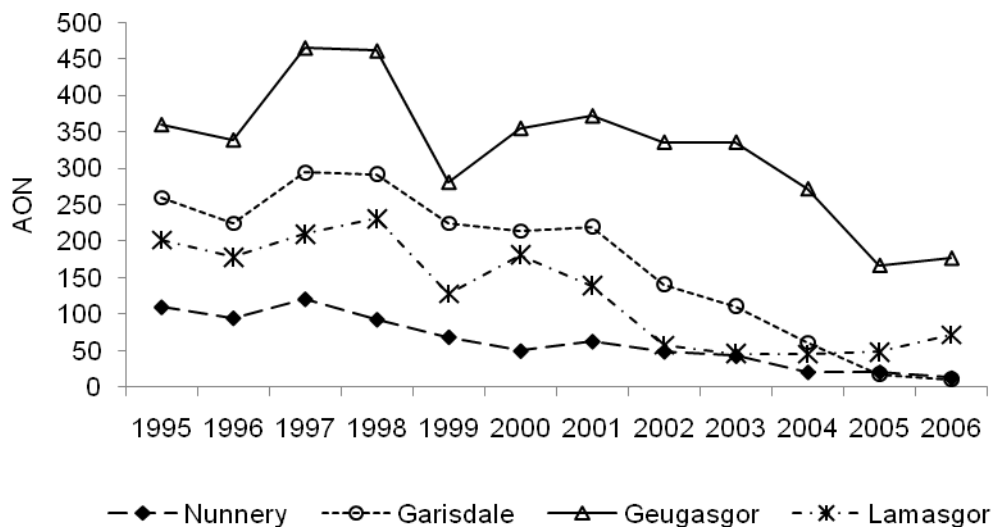


Figure 3. The recent changes in the number of apparently occupied European shag nests at the main sub-colonies on Canna.

Great skua

Three pairs of great skua *Catharacta skua* bred on Sanday and a 4th non-breeding pair turned up in July.

Mew gull

The number of mew gulls *Larus canus* was again very low in 2006, with only 7 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 4 in 2005. Numbers increased slightly to 7 AOTs in 2006 (Figure 4).

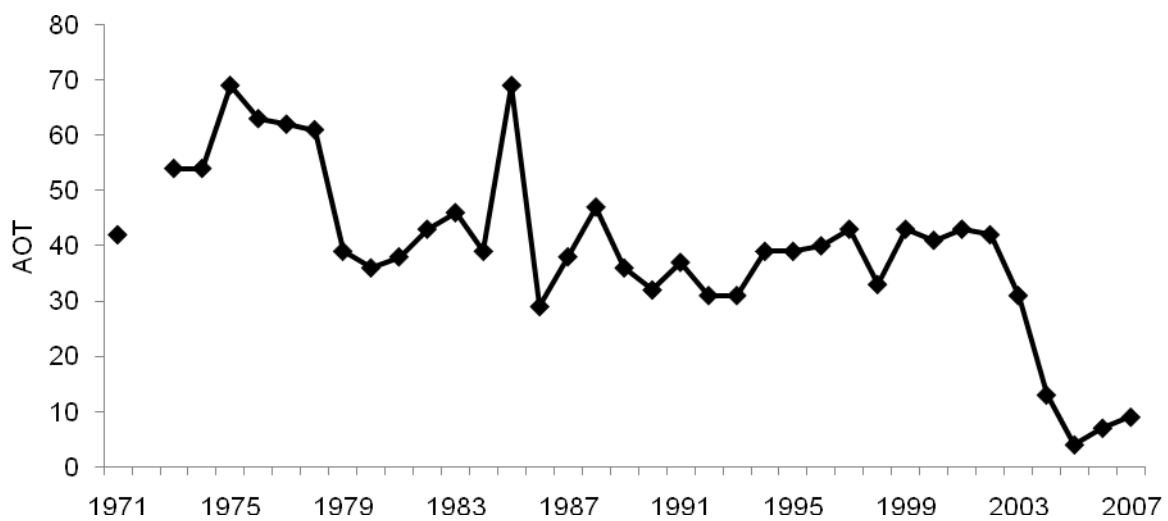


Figure 4. Number of apparently occupied Lesser Black-backed Gull territories on Canna 1971-2006.

Herring gull

A total of only 96 apparently occupied territories were counted, and in the study colonies 50 nests were counted. This is a continuation of a long-term decline that started in 1989 (Figure 6). Most traditional herring gull sub-colonies on the island have now been totally abandoned, in particular there are now no colonies left on the western half of the island. The population is now at the lowest level since monitoring started in 1971.

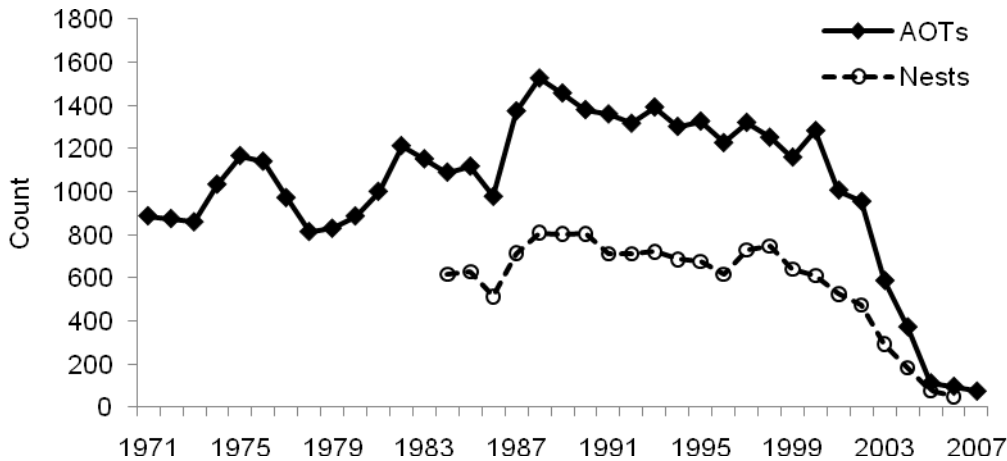


Figure 5. Number of apparently occupied herring gull territories on Canna and nest counts in sample study colonies 1971-2006.

Great black-backed gull

There has been a substantial decline in numbers on Canna since 2000 with only 20 apparently occupied territories in 2006 (Figure 6).

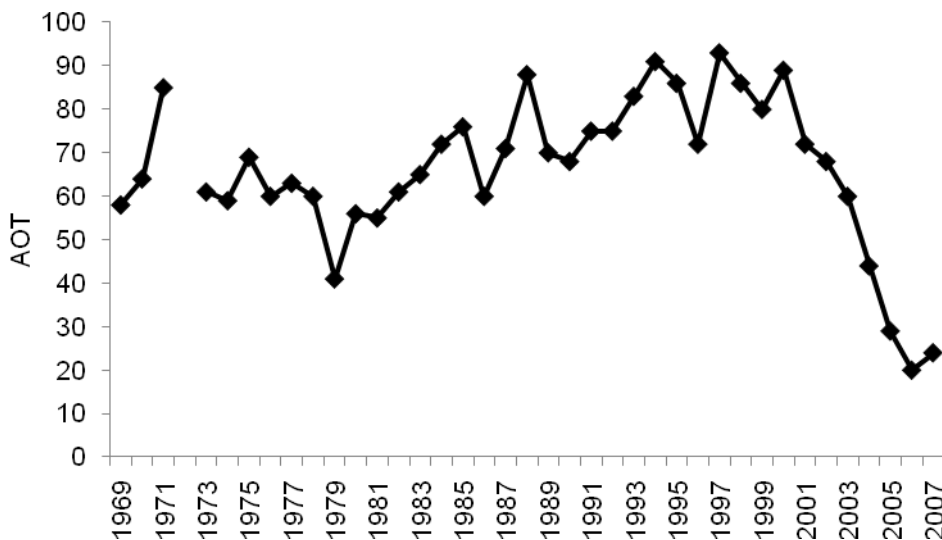


Figure 6. Number of apparently occupied great black-backed gull territories on Canna 1969-2006.

Black-legged kittiwake

Following the rise to the record count of 1,340 AON in 2004, numbers dropped sharply in 2005 to 968 AONs, this decline continued in 2006 to 905 AONs (Figure 7).

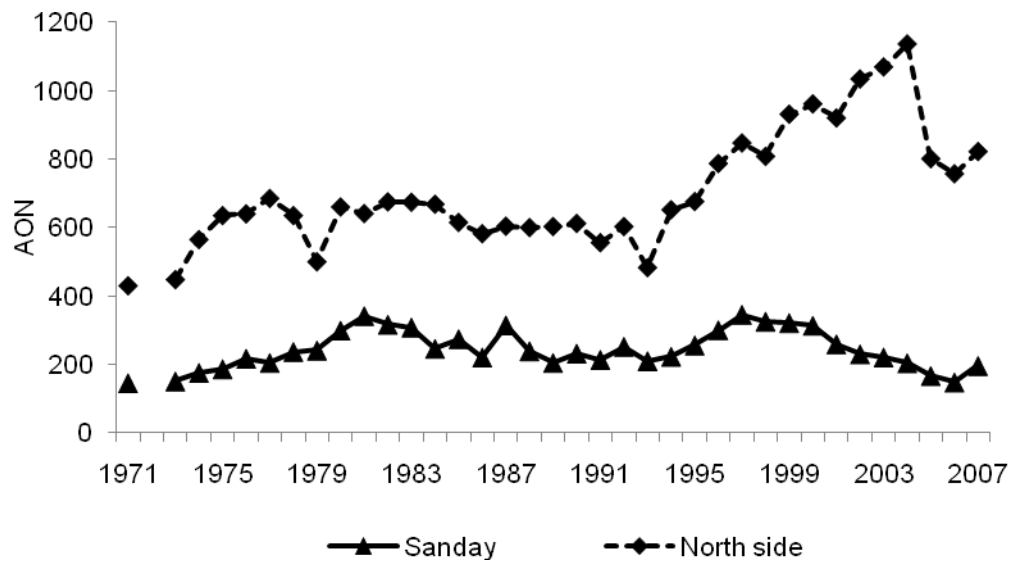


Figure 7. Number of apparently occupied black-legged kittiwake nests on Sanday and north side of Canna 1971-2006.

Common tern

Three pairs of common tern *Sterna hirundo* nested in 2006.

Common guillemot

Common guillemot numbers peaked in 2001 when 1249 'nests' were counted in our studies areas with 655 'nests' in the core area. Numbers then started to decline with only 906 nests counted in 2004 with 414 in the core area. In 2005, as a result of food shortages, there was a dramatic decline. Only 79 'nests' were counted overall, with only 32 in the core area. In 2006 numbers recovered with 697 'nests' overall with 515 in the core area (Figure 8). There was some evidence that many adults had returned but had not attempted to breed. At some colonies lots of adults were occasionally present, but very few were incubating eggs or brooding young.

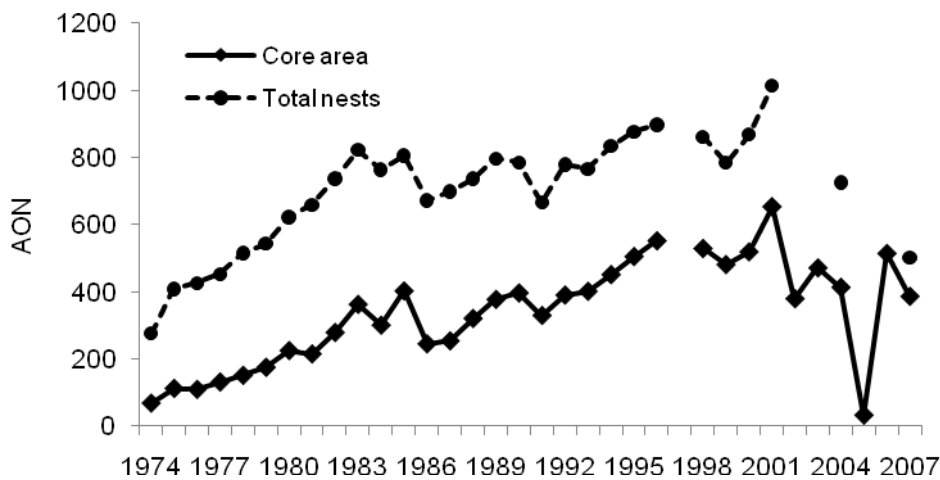


Figure 8. Number of common guillemot 'nests' in all study plots on Canna and in the section 1-4 plots only 1974-2006.

Razorbill

Razorbills numbers on Canna have undergone a long term decline since the early 1990s (Figure 9). 2006 saw a welcome increase in numbers following the rat eradication campaign over winter 2005/06, with numbers back up to 2001 levels at Geugasgor. Fewer ringed predated adults were found in 2006, only 10 compared to the 24 found in 2005.

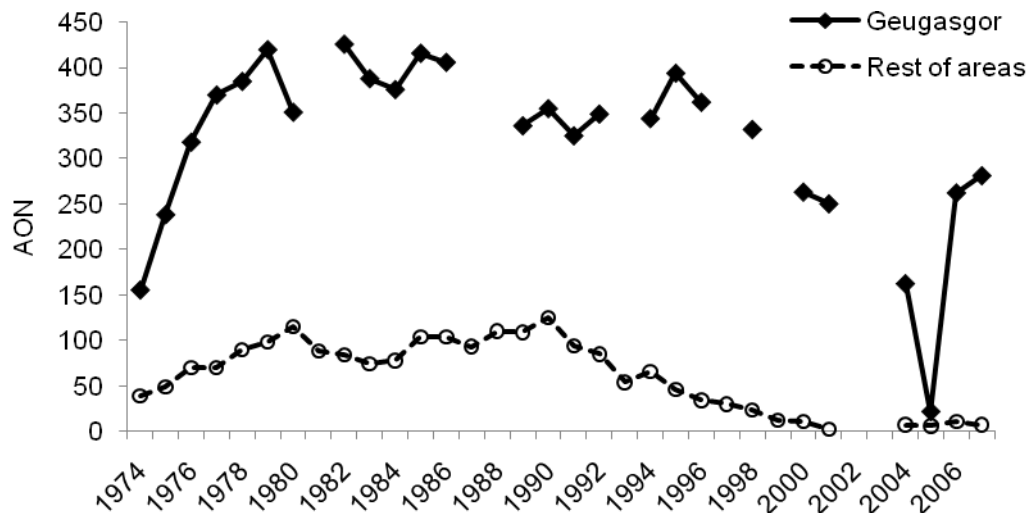


Figure 9. Number of razorbill 'nests' at Geugasgor and at all other sites on the island 1974-2006.

Black guillemot

Only 49 individual adult birds were counted in 2006 (Table 1). As noted under Methods this under-estimates the true number present. It was, however, another low figure and may suggest that this species has declined as a breeding species on the island.

4 Timing of breeding results

January and February were warmer than average, but with average rainfall. March was colder than average with northerly winds, resulting in frosts and occasional snow cover. April and May were characterised by average temperatures, but above average rainfall. June was slightly warmer and wetter than average, whilst July was hotter and drier.

The cold spell in March led to many birds laying later than normal. Of 228 occupied European shag nests checked in early July 27% still contained eggs, with most of the rest containing very small, recently hatched chicks. This compares with 10% of nests with eggs in 2005, 27% in 2004, 20% 2003, 7% in 2002, 11% in 2001, 14% in 2000, 12% in 1999, 19% in 1998, 24% in 1997, 68% in 1996 and 50% in 1995. Other seabirds, also laid much later than normal. Most kittiwake nests still contained eggs in early July. In guillemot colonies the percentage of eggs was unusually high (30-48%) and most chicks were less than half-grown. There was no evidence of auk chicks having left the colony prior to our July visit.

5 Breeding success results

A summary of the 2006 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 1996-2006.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Northern fulmar	0.33	0.33	0.27	0.44	0.48	0.45	0.46	0.56	0.28	0.47
Manx shearwater	0.08	-	-	-	-	-	-	-	-	-
European shag ^a	1.75	1.32	0.91	0.80	0.10	0.26	0.16	0.01	0.7*	1.2*
European shag ^b								1.4	0.7	0.7
Herring gull ^a	78%	53%	11%	63%	10%	4.5%	2%	3%	4%	2%
Herring gull ^b	1.3	0.7	0.4	0.4	0.1	0	0	0.4	0	0
Herring Gull ^c						0.07	0.05	0.16	0.13	0.24
Great b-b gull	1.5	1.3	1.1	1.3	0.3	0.1	0.3	0.3	0.1	0.2

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 fulmars, chicks fledged per egg laid for Manx shearwaters, chicks fledged per nest in which eggs were laid for shags, large chicks per occupied territory for great black-backed gulls and chicks fledged per apparently occupied nest for black-legged kittiwakes.
3. For herring gull ^a refers to percentage of nests which produced chicks, ^b refers to young fledged per nest based on capture-recapture at sub-colony A., whilst ^c gives an all-island estimate of chicks per nest.
4. For shag ^a refers to number of young fledged per marked nest in the boulder colony at Garrisdale and Nunnery, whilst ^b refers to number of young fledged per marked nest on sub-colonies on cliff ledges. * In 2005 and 2006 the boulder colonies surveyed were Lamasgor and 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 0.47 chicks per apparently occupied site, much higher than the 2005 figure (0.28). There was great variability between plots, with success being highest on the Sanday cliff sites and at Buidhe Sgor. The very low success at Nunnery/Garrisdale was probably exacerbated by a pair of White-tailed Eagles, which were preying large numbers of adult birds in this part of the island.

Table 3. Northern fulmar breeding success on Canna in 2006.

<i>Study site</i>	<i>No. sites</i>	<i>No. young</i>	<i>Young per site</i>
Sanday A	28	12	0.43
Sanday B	18	10	0.55
Nunnery/Garrisdale	9	0	0
Buidhe Sgor	35	20	0.57
Total	90	42	0.47

Manx shearwater

There are now too few occupied burrows to monitor this species adequately on Canna.

European shag

As stated in the methods section, we have been forced to alter our methods of monitoring European shag breeding performance.

Table 4. European shag fledging success on Canna in 2006.

<i>Young fledged per nest laid in</i>	<i>Geugasgor</i>	<i>Lamasgor</i>	<i>Garrisdale*</i>	<i>Nunnery*</i>	<i>Rubha Langanais*</i>	<i>Dun Mor area, Sanday*</i>
<i>No. nests</i>	173	72	11	13	16	10
0	66	28	10	13	6	4
1	26	10	0	0	2	2
2	59	25	0	0	6	3
3	24	12	1	0	2	1
Av young/AON	1.2	1.3	0.3	0	1.3	1.1

* = nests located on narrow cliff ledges.

Success was again highly variable between colonies. Birds nesting on open cliff sites at Garrisdale and the Nunnery suffered high levels of egg predation from common ravens, which led to an almost complete breeding failure. Birds on cliff sites at Sanday and Rubha Langanais were far more successful. At Geugasgor and Lamasgor where many birds still nest under boulders, success rates were fairly high, though birds nesting in more open sites were prone to predation of eggs by gulls. Success however at both these colonies was much improved on 2005 (0.7 young per nest) but lower than 2004 when Geugasgor produced c.1.5 chicks per nest and Lamasgor c.1.6 chicks per nest. The overall success rate in 2006 was 1.17 young per AON.

Great skua

Of the three pairs that nested, one failed, one pair reared a single chick and one pair reared two chicks.

Herring gull

The frequency distribution of clutch sizes recorded in two sub-colonies in late May is shown in Table 5 and information on hatching success in five sub-colonies observed in early July is shown in Table 6.

Table 5. Herring gull clutch size in late May at two study colonies on Canna in 2006.

	<i>Sub-colony</i>	
	A	B
Empty	1	0
1 egg	1	1
2 eggs	2	2
3 eggs	17	4

Mean clutch size (excluding empty nests) was average, at 2.7. Due to the decline in the population of this species on Canna sample sizes are now very small.

Table 6. Number of herring gull nests that showed signs of success or failure on Canna in 2006.

	<i>Sub-colony</i>				
	A	B	C	D	E
With chicks	0	0	1	0	0
Failed	21	7	12	3	7

Of the 50 nests checked, only 2% produced chicks, indicating another very poor breeding season for this species with an almost total failure in all colonies on the island. At sub-colony A, the number of fledged chicks is estimated by capture-recapture (see Methods). No chicks were found at this colony, indicating a total breeding failure. Only two sub-colonies appeared to raise chicks to fledging. At the Tarbert Road, where birds have relocated from the shoreline to nesting on screes below the raised cliff, 13 pairs reared 15 young. At Geugasgor, by the main seabird colony, 19 pairs reared 7 young. We estimate that the 96 pairs on the whole island produced a maximum of 23 chicks (0.24 chicks per pair), with most nests, again, appearing to have failed at the egg stage.

Great black-backed gull

Eighteen pairs of great black-backed gull were monitored, 16 of which failed, one produced two young and one a single young, giving an overall productivity of 0.17 young per pair.

Black-legged kittiwake

The results obtained from the four Sanday sub colonies, and the cave on the north side of Canna, are detailed in Table 7.

Table 7. Number of occupied black-legged kittiwake nests and number of large young per nest in study plots in 2006.

	<i>Sanday,K1</i>	<i>Sanday,K2</i>	<i>Sanday,K3</i>	<i>Sanday,K4</i>	<i>Cave</i>
<i>No. nests</i>	36	26	23	22	129
empty	14	10	15	8	92
One young	19	15	8	13	32
Two young	3	1		1	5
av. young per nest	0.69	0.65	0.35	0.68	0.33

Success, though highly variable between sub-colonies, was much improved compared to 2005, when there was an almost total breeding failure. At 0.45 young per AON, it was the third lowest figure we have recorded on Canna since monitoring began in 1987 and well below average productivity for this colony. This, plus the large drop in breeding numbers, suggests that conditions for these birds were not very favourable in the early part of the season, resulting in very late laying. Conditions appeared, however, to improve late in the summer, resulting in surviving chicks subsequently fledging successfully.

Common tern

Three pairs of common tern nested, one failed, the other two pairs both reared two young to fledging.

Common guillemot

Most guillemot chicks were small, none with a wing greater than 60mm, so we were unable to weigh a sample to assess their condition. General observations suggested that breeding success was much higher than in 2005.

Razorbill

General observations suggested that breeding success was much higher than in 2005. No starving chicks were noted and very few depredated eggs found.



Figure 10. A decline in rat numbers appeared to result in a large increase in the number of razorbill chicks observed.

6 Ringing studies

6.1 Ringing totals

Table 8 shows the number of adults and chicks ringed during 2006 and the number of fully-grown birds that were re-trapped.

Table 8. Number of birds ringed and adults re-trapped on Canna in 2006.

	<i>Adults ringed</i>	<i>Chicks ringed</i>	<i>Full-grown re-trapped</i>
Northern fulmar	6	20	6
European shag	27	262	19
Great skua	0	2	0
LBB Gull	0	0	0
Herring gull	0	21	0
GBB gull	0	2	0
Black-legged kittiwake	21	9	12
Common tern	0	4	0
Common guillemot	271	1161	1067
Razorbill	31	179	68
Atlantic puffin	11	1	3
Total	367	1661	1175

6.2 Ringing recoveries

None of the 550 Guillemot chicks ringed in 2005 were subsequently reported to the BTO ringing scheme. The average first year recovery rate is 0.8%. This suggests that most of these chicks, many of which were significantly lighter than usual, perished shortly after fledging.

7 Return and survival rates results

Common guillemot

Of the 1067 adult guillemots that were retrapped in 2006, 316 were birds that had been ringed as chicks on Canna and were retrapped on the island for the first time. These included: one 2-year old, one 3-year old, two 4-year olds, 21 5-year olds, 35 6-year olds, 35 7-year olds, 31 8-year olds, 13 9-year olds and 44 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. Data collected in 2006 illustrate this further (Table 9).

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	
2001	2,217	0.5	1.1		

The 1996 and 1998 cohorts, with their very low first year recovery rates, showed high return rates as expected, whilst the 1997, 1999 and 2000 cohorts, which had a higher first year recovery rate, showed a relatively low return rate.

Razorbill

For the sixth year running a fleyg net was used to capture adult razorbills. This results in the capture of both breeders and non-breeders so the results are not entirely comparable with figures prior to 2001. Twenty seven razorbills that had been ringed as chicks were retrapped on the island for the first time in 2006. These included one 4-year old, one 5-year old, three 6-year olds, one 7-year old, two 8-year olds, and five 10-year olds.

European shag

Thirteen shags that were ringed as chicks were retrapped on the island for the first time in 2006. All were breeders, being caught on nests, and comprised one 4-year old, one 5-year old, two 6-year old, three 7-year old, four 8-year olds, one 9-year old and one 12-year old.

8 Feeding studies

Common guillemot

Thirty nine fish were collected from adult common guillemots on their return to the colony from fishing trips; three (8%) were Clupeidae, *Sprattus sprattus*, 16 (41%) sandeels *Ammodytes* spp. and 20 (51%) Gadidae. Details of the fish sampled are given in Appendix 2. The mean length of the sandeels was 153.9mm (sd 26.6) significantly larger than the 2001-05 average (121.4mm, sd 37.27, $z = 3.95$, $p < 0.01$). Of the Gadidae only 5 were whiting *Merlangius merlangus*, 14 were *Trisopterus* sp. and one unidentified. The average size of the whiting was 75.6 mm (sd 20.64) and the average size of *Trisopterus* sp. was 80.7 (sd 5.89). The whiting were smaller than the 2001-05 average (90.0mm, sd 12.1).

Figure 11 shows that since 2002 there has been a significant decline in the percentage of sprats brought in. This has been compensated for by more sandeels and in 2006 more gadoids. Gadoids do not have as high a calorific value as sprats.

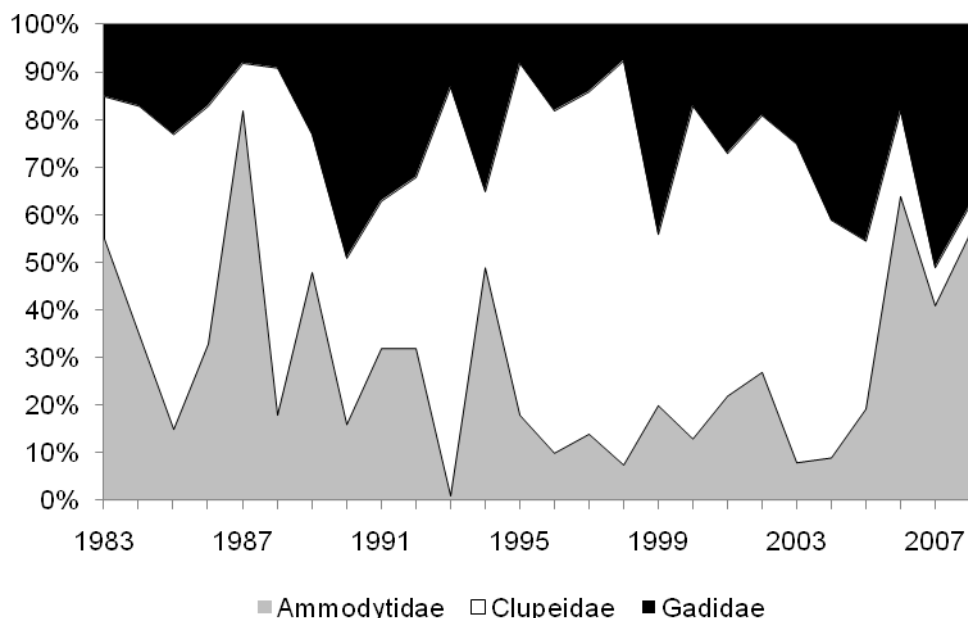


Figure 11. Proportion of fish species taken by common guillemots on Canna 1982-2006.

European shags

Six food samples were analysed from regurgitations from young European shags. These mostly contained otoliths from gadoids. Full details are:

- 2 *Trisopterus* sp., 1 whiting
- 1 *Trisopterus* sp., 2 Gadidae (not whiting)
- 2 *Trisopterus* sp., 1 very small crab
- 2 large *Trisopterus* sp.
- 6 small *Trisopterus* sp., 4 small whiting
- 1 large sandeel (c.185mm)

Twenty six pellets regurgitated by European shags were also collected. Pellets 1-4 were collected in early July and pellets 5-26 in late July. The counts in the table below are for otoliths. The *Trisopterus* will be fish 15-20 cm long, the other Gadids 10-15cm and the very small Gadids will be 5-10cm. The latter two categories will include small *Trisopterus*, which are difficult to separate from other gadids when small, but there are obviously many non-*Trisopterus* in the samples (see remarks). The main point of interest is the near absence of sandeels.

Table 10. Contents of regurgitated shag pellets.

Pellet number	<i>Trisopterus</i> otoliths	other Gadidae otoliths	REMARKS + details of 'other' fish
1	0	120	Very small
2	15	80	1 wrasse
3	14	150	
4	0	200	small
5	84	15	Gadoids include 4 whiting
6	0	28	
7	11	96	
8	20	160	
9	20	60	1 wrasse
10	20	70	rockling
11	30	90	1 dragonet
12	30	34	1 rockling
13	20	4	Bull-rout (cottidae)
14	50	150	
15	10	180	
16	10	220	
17	10	220	Few small probably gobies
18	40	210	Gadoids include 4 whiting
19	20	150	Large sandeel
20	0	30	All very small
21	10	30	30 flatfish, 4 dragonet
22	20	40	
23	38	54	
24	16	120	1 ling/rockling
25	0	250	
26	5	40	2 large sandeel, 1 flatfish

9 References

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10 Appendices

Appendix 1. Common guillemot chick weights

No chicks were found with a wing length of over 60mm, so none were weighed.

Appendix 2. Diet samples

Common guillemot

Details are given of the size (mm) of fish caught by adult guillemots on Canna in 2006.

Sprats: 3 measured

<i>Length</i>	100	116
No. of fish	1	2

Sandeels: 16 measured

<i>Length</i>	94	126	131	137	140	147	153	157	160
No. of fish	1	1	1	1	1	2	1	1	3

<i>Length</i>	175	184	185	206
No. of fish	1	1	1	1

Tisopterus sp: 14 measured

<i>Length</i>	67	73	77	78	81	82	83	84	85
No. of fish	1	1	2	1	2	1	1	1	1

<i>Length</i>	87	88
No. of fish	2	1

Whiting: 5 measured

<i>Length</i>	42	73	82	84	97
No. of fish	1	1	1	1	1