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Canna seabird studies 2007

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Summary

1.1 Three visits were made to Canna during 2007 to count and ring seabirds, monitor their breeding success and collect food samples.

1.2 The timing of the 2007 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 and herring gull continued to decline to new record low levels. Common guillemot numbers also declined. European shag, great black-backed gull, mew gull, lesser black-backed gull, razorbill and black guillemot all showed slight increases in breeding numbers, whilst black-legged kittiwake numbers showed a marked increase.

1.4 Breeding success for most species was poor in comparison with 2006. The exceptions were herring gull and great black-backed gull, where chick production increased dramatically and European shags which saw a slight improvement in output. Northern fulmar and black-legged kittiwakes productivity was very low. Observations suggested that common guillemots and razorbills also had poor breeding success.

1.5 Totals of 297 fully grown and 1378 pullus seabirds were ringed with BTO metal rings and 667 fully grown birds were retrapped in breeding colonies.

1.6 Retrapping of adult common guillemots resulted in 167 birds ringed as chicks being located back in colonies for the first time. Four 3-year olds, four 4-year olds, four 5-year olds and 27 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 and 2000 cohorts are showing much lower return rates. Only eight razorbills and five European shags that had been ringed as chicks were retrapped in colonies for the first time.

1.7 Only 16 fish were collected from adult common guillemots. Once more low numbers of sprats *Sprattus sprattus* were recorded, comprising only 6% of the total. Sandeels dominated in number (56%) followed by Gadoids (38%), mainly whiting *Merlangius merlangus*, European shags mostly fed on gadoids. Black-legged kittiwakes were taking gadids and sandeels and for the first time pipefish were also recorded.

1.8 Following the rat eradication campaign carried out on Canna over the 2005/06 winter there were no signs of rat predated eggs or chicks. The numbers of European shags and razorbills continue to increase as did Atlantic puffins. White-tailed eagles and golden eagles were predating adult northern fulmars in large numbers.

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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 2007, the 39th 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 2007 to cover the seabird breeding season: 25-28 May, 29 June-7 July and 27 July -3 August.

In 2007, as in 2006, we are very confident that no young auks had fledged prior to our early July visit to the island.

2.2 Counts

Manx shearwaters

During late May, using tape playback methods (Walsh *et al* 1995) three 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 *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 between 29 June and 7 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 the Nunnery, Tallabric and Dun Mor area of Sanday and Rubha Langanais, where birds have shifted to nesting on narrow ledges on the present sea cliff, the position of all nests was mapped on a sketch map in late May. At 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

The severe decline in herring gull numbers has led to a change in methodology to calculate breeding success. 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.

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 late July/early August to see how many had eggs or chicks. The size and number of chicks was also noted.

3 Count results

A summary of the 2007 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 1999-2007.

	1999	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*Peak (year)*
Norther fulmar [1]	386	443	402	406	434	436	439	349	346	669 (1977)
European shag [2]	742	838	844	638	603	495	327	349	361	1,753 (1984)
Great Skua [4]	0	0	2	2	2	2	3	3	5	3 (2005)
Mew gull [4]	14	15	10	8	5	6	9	7	13	18 (1983)
LBB gull [4]	42	41	43	42	31	13	4	7	9	69 (1975)
Herring gull: pairs [4]	1,159	1,282	1006	862	587	372	112	96	74	1,525 (1988)
Herring gull: nests [3]	640	610	525	381	292	182	76	50	30	809 (1988)
GBB gull [4]	80	89	72	68	60	44	29	20	24	93 (1997)
Black-legged kittiwake [2]	1,252	1,274	1,179	1,264	1,290	1,340	968	905	1018	1,340 (2004)
Common tern [3]	7	3	0	0	3	1	3	3	2	18 (1992)
Common guillemot [5]	(996)	(950)	1,249	-	(881)	906	(79)	697	587	1,249 (2001)
Razorbill [5]	-	(274)	252	-	-	169	(27)	273	288	520 (1985)
Black guillemot [6]	73	(54)	67	35	36	44	47	49	68	137 (1986)

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

Counts in brackets are known to be underestimates.

Northern fulmar

A total of 346 apparently occupied sites were counted. This represents a marked decrease on the 2003-2005 counts (Figure 1), though similar to the 2006 count, and is the lowest total since monitoring began. Once again, in the early part of the season, there was very heavy predation on fulmars by both golden eagles and white-tailed eagles.

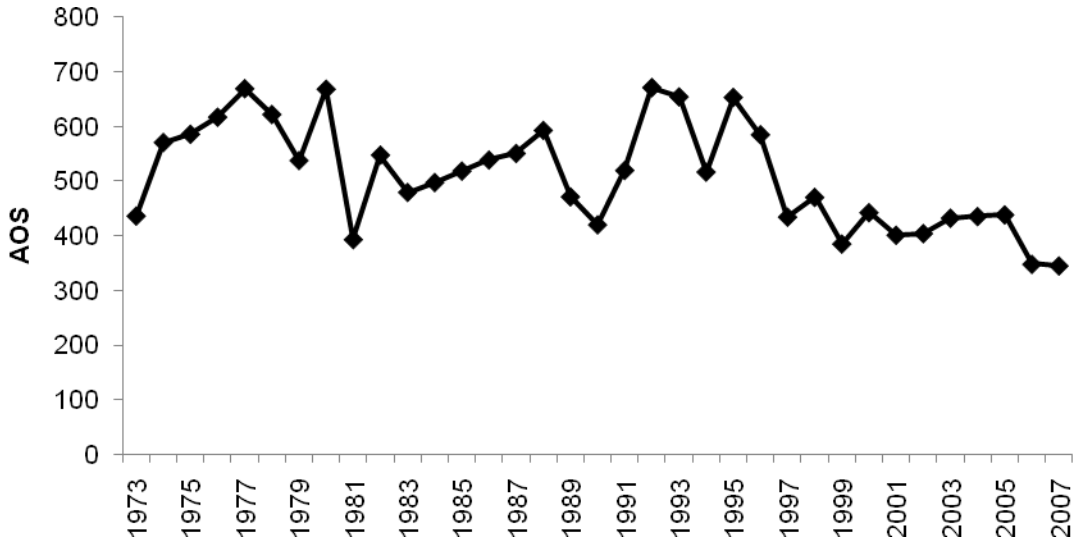

Figure 1. Number of apparently occupied Northern fulmar sites on Canna 1973-2007.

Manx shearwater

At the former Tarbert Road colony no birds responded to taped calls from over 400 burrows checked in late May. Several birds, however, were heard calling over this site at night in early April and early May. One bird responded to a taped call from 20 burrows checked at the Nunnery. Between Bresgor and Garrisdale Point, over 100 burrows were checked but no birds responded to tape playback. The remains of two predated birds were found close to a Peregrine site at Garrisdale, indicating that birds are probably still prospecting this former sub-colony and birds were heard calling at night in mid July. In addition two predated adults were found at Buidhe Sgor in late July.

European shag

Numbers increased slightly in 2007, to 361 apparently occupied nests (AON), an increase from the 327 AONs recorded in 2005.

Figure 2. Number of apparently occupied European shag nests on Canna 1974-2007.

Great skua

Five pairs of great skua *Catharacta skua* were present on Sanday and at least three pairs laid eggs.

Mew gull

The number of mew gulls *Larus canus* increased sharply in 2007, with 13 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 AOTs in 2005. Numbers since have increased slightly with 9 AOTs in 2007 (Figure 3).

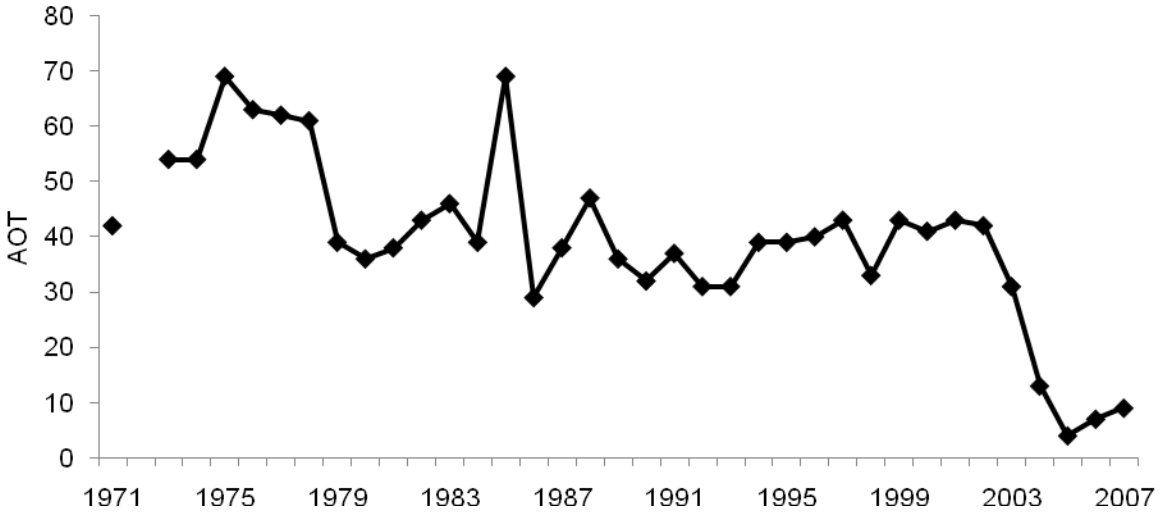

Figure 3. Number of apparently occupied Lesser Black-backed Gull territories on Canna 1971-2007.

Herring gull

A total of only 74 apparently occupied territories were counted, a continuation of a long-term decline that started in 1989 (Figure 4). 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. Over the last few years, many of the remaining gulls have switched to new nesting sites, particularly the scree slopes above the Tarbert road and cliff and moorland sites on Sanday. Only the small colonies at Tallabric, Grunavik and Geugasgor occupy traditional sites. The population is now at the lowest level since monitoring started in 1971.

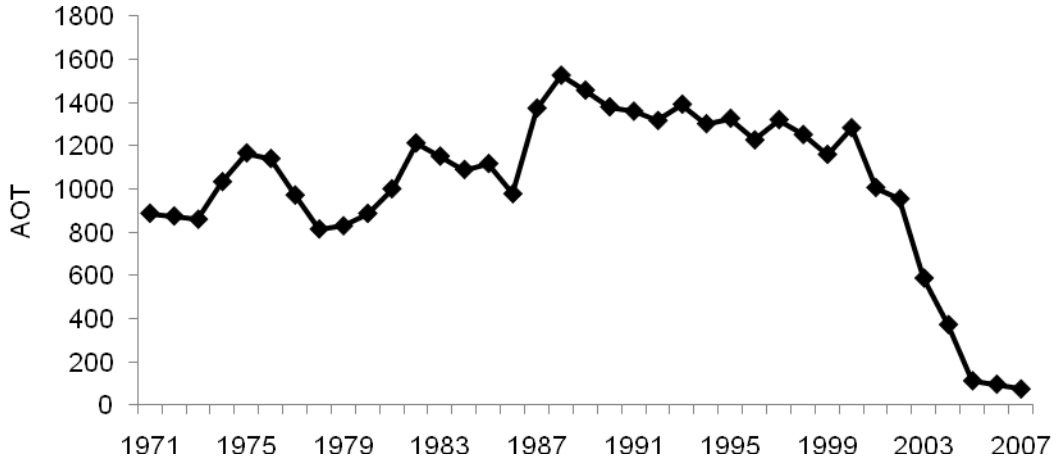

Figure 4. Number of apparently occupied herring gull territories on Canna and nest counts in sample study colonies 1971-2007.

Great black-backed gull

There has been a substantial decline in numbers on Canna since 2000, with 20 apparently occupied territories in 2006. This increased slightly to 24 AOTs in 2007 (Figure 5).

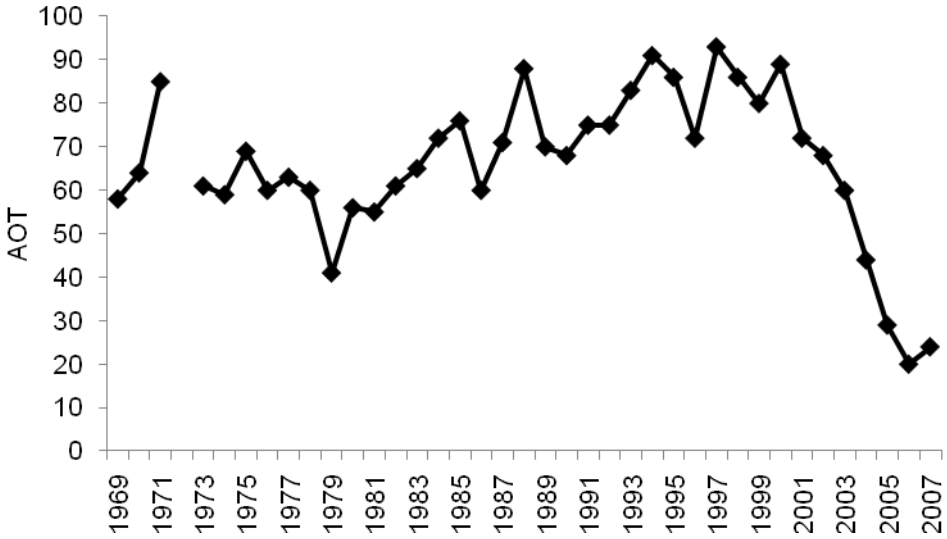

Figure 5. Number of apparently occupied great black-backed gull territories on Canna 1969-2007.

Black-legged kittiwake

Following the rise to the record count of 1,340 AON in 2004, numbers dropped sharply down to 905 AONs in 2006. 2007 saw a welcome increase to 1,018 AONs, with increases at the Sanday sub-colony and sub-colonies on the north side of Canna (Figure 6).

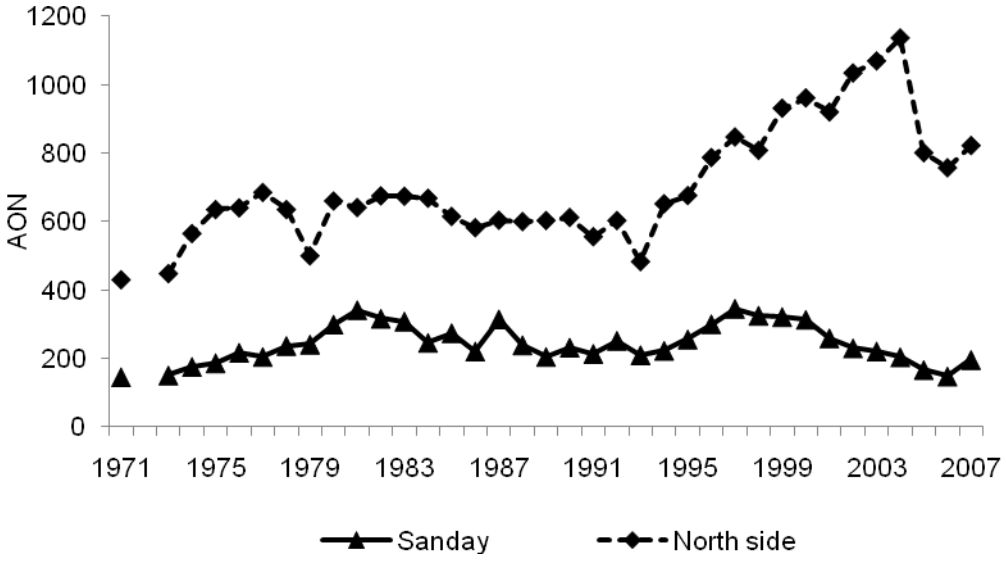

Figure 6. Number of apparently occupied black-legged kittiwake nests on Sanday and north side of Canna 1971-2007.

Common tern

Two pairs of common tern *Sterna hirundo* nested in 2007.

Common guillemot

Common guillemot numbers peaked in 2001 when 1249 ‘nests’ were counted in the study area. Of those counted, 655 ‘nests’ were 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. This ‘recovery’ was reversed in 2007, when only 587 ‘nests’ were counted, with 387 in the core area (Figure 7). Once again there was much evidence that many adults had returned but had not attempted to breed as at some sub-colonies, large numbers of adults were occasionally present, but very few were incubating eggs or brooding young.

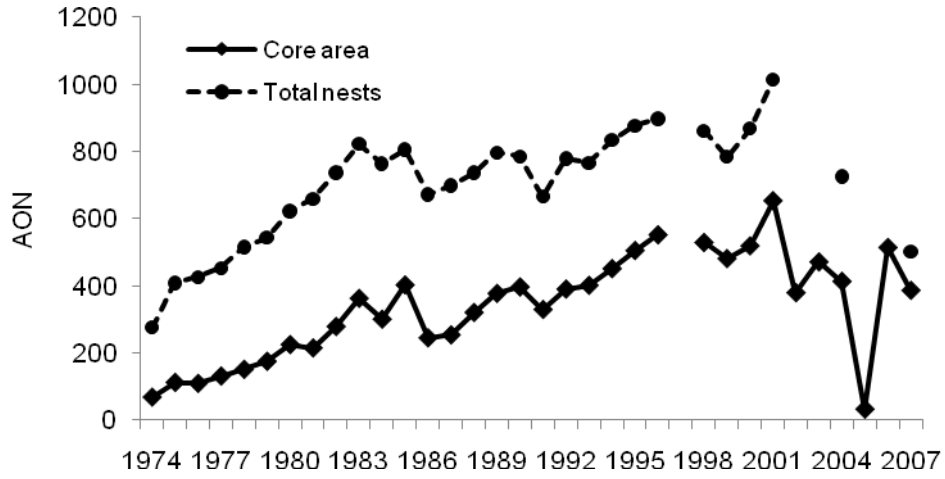

Figure 7. Number of common guillemot ‘nests’ in all study plots on Canna and in the section 1-4 plots only 1974-2007.

The overall decline is less in the core area, where the guillemots nest in small groups amongst boulders along with shags and razorbills. Major declines have occurred in some of the larger more exposed sub-colonies.

Razorbill

Razorbill numbers on Canna have undergone a long term decline since the early 1990s (Figure 8). 2006 saw a welcome increase in numbers following the rat eradication campaign over winter 2005/06 (Bell et al 2006), with numbers back up to 2001 levels at Geugasgor. This trend continued with 288 ‘nests’ being counted in our study plots in 2007.

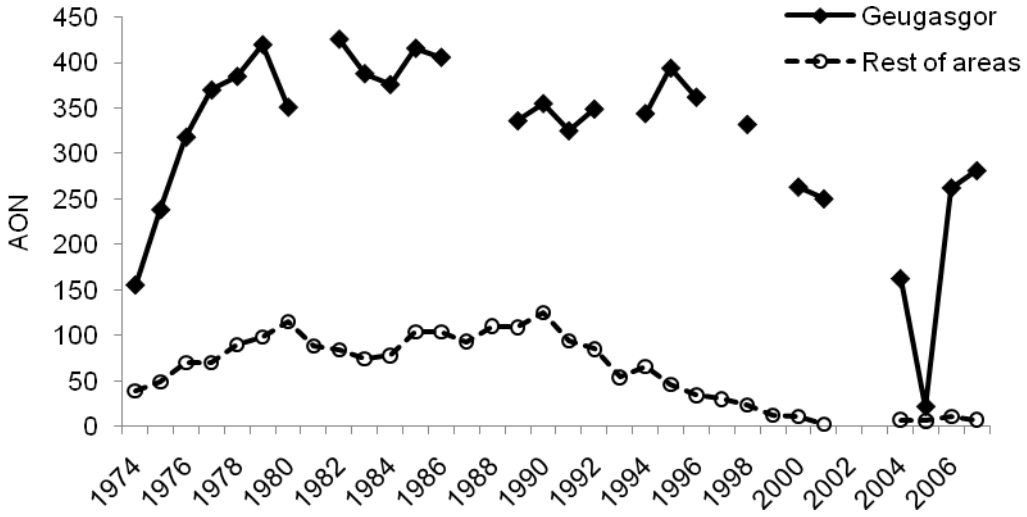

Figure 8. Number of razorbill ‘nests’ at Geugasgor and at all other sites on the island 1974-2007.

There has also been a decline in the number of predated adults found in the colony from 7 in 2004 to a peak of 24 in 2005, to 10 in 2006 and none in 2007.

Black guillemot

There was a welcome increase to 68 individual adult birds counted in 2007, the highest count since 2001 (Table 1). As noted under Methods this under-estimates the true number present.

Atlantic puffin

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

4 Timing of breeding results

January to March was warmer than average, but with above average rainfall. April was very warm (3ºC above average) with just below average rainfall. May had average temperatures, but above average rainfall, though mainly in the form of occasional heavy showers, rather than days of continuous rain. June and July had above average temperatures and below average rain.

Following very mild winters, there is a tendency for birds to lay earlier than normal. This was not the case in 2007. In the early July visit, most European shags were still on eggs or very small young. This was also the case with Black-legged kittiwakes, whilst most Guillemot chicks were less than half grown. There was no evidence of auk chicks having left the island prior to our visit. It is suspected that poor food supplies may have once again delayed birds attaining breeding condition. Only herring gulls appeared to have laid early with most chicks being close to fledging in early July.

5 Breeding success results

A summary of the 2007 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 1998-2007.

	1998	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*
Northern fulmar	0.33	0.27	0.44	0.48	0.45	0.46	0.56	0.28	0.47	0.27
European shag [a]	1.32	0.91	0.80	0.10	0.26	0.16	0.01	0.7*	1.2*	1.4*
European shag [b]							1.4	0.7	0.7	1.0
Herring gull [a]	53%	11%	63%	10%	4.5%	2%	3%	4%	2%	-
Herring gull [b]	0.7	0.4	0.4	0.1	0	0	0.4	0	0	(1.5)
Herring Gull [c]					0.07	0.05	0.16	0.13	0.24	1.8
Great b-b gull	1.3	1.1	1.3	0.3	0.1	0.3	0.3	0.1	0.2	0.8
Blk-legged Kittiwake	0.95	0 64	0 51	0.83	0.61	1.01	0.78	0	0.45	0.33

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 (Tallabric), 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 colonies, whilst [b] refers to number of young fledged per marked nest on sub-colonies on cliff ledges. * From 2005 onwards the boulder colonies surveyed were Lamasgor and/or Geugasgor, prior to that it was Garrisdale and the Nunnery.

Northern fulmar

Table 3 shows the breeding success of northern fulmar from four study plots. This gives an overall success rate across all sites combined of 0.27 chicks per apparently occupied site. There was great variability between plots, with success being lowest on the Sanday A cliff site. The overall success rate was much lower than the 0.47 recorded in 2006, and was the lowest figure recorded since 1999.

Table 3. Northern fulmar breeding success on Canna in 2007.

Study site	*No. sites*	*No. young*	*Young per site*
Sanday A	26	2	0.08
Sanday B (Dun Mor)	17	6	0.35
Nunnery/Garrisdale	2	1	
Buidhe Sgor	34	12	0.35
Total	79	21	0.27

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 2007.

Young fledged per nest laid in	*Lamasgor*	*Garrisdale**	*Nunnery**	*Rubha Langanais**	*Tallabric Sanday**	*Dun Mor area, Sanday**
No. nests	*59*	*10*	*15*	*23*	*16*	*15*
0	19	9	12	4	3	6
1	6	0	0	5	8	6
2	27	1	2	11	3	3
3	7	0	1	3	2	0
Av young/AON	1.4	0.2	0.5	1.6	1.2	0.8

* = nests located on narrow cliff ledges.

Success was again highly variable between colonies. Birds nesting on open cliff sites at Garrisdale and the Nunnery again 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 more successful. Overall cliff nesting birds produced 0.97 young per nest. At Lamasgor where many birds still nest under boulders, success rates were higher at 1.4 young per nest. The overall success rate was 1.14 young per nest, similar to 2006.

Great skua

Of the five pairs that nested three failed to rear young and the other two pairs each reared a single chick.

Herring gull

Nineteen pairs of herring gull were monitored in two sub colonies. The results are shown in Table 5.

Table 5. Herring gull productivity at two sub-colonies on Canna in 2007.

	Dun Mor, Sanday	*Tarbert Road*
No nests	*8*	*11*
Failed	1	2
One young	2	0
Two young	2	7
Three young	3	2
Average young/pair	1.9	1.8

This gives an overall productivity of 1.8 young per pair, the highest we have recorded since 2000. At the Tallabric sub colony it was estimated that at least 15 chicks fledged from 10 nests. The herring gull population is, possibly, now back in sync with the much reduced food supply, and also benefiting from the rat eradication programme.

Great black-backed gull

Nineteen pairs of great black-backed gull were monitored, 11 of which failed, two produced one young, five produced two young and one produced three young, giving an overall productivity of 0.8 young per pair. This is highest figure recorded since 2000 (Table 6).

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Black-legged kittiwake

The results obtained from the four Sanday sub colonies and the cave and Buidhe Sgor on the north side of Canna are detailed in Table 6.

Table 6. Number of occupied black-legged kittiwake nests and number of large young per nest in study plots in 2007.

	Sanday,K1	*Sanday,K2*	*Sanday,K3*	*Sanday,K4*	*Cave*	*Buidhe Sgor*
No. nests	*43*	*33*	*40*	*25*	*114*	*60*
empty	39	24	30	10	87	29
One young	3	8	10	12	26	30
Two young	1	1	0	2	1	1
Three young	0	0	0	1	0	0
av. young per nest	0.12	0.30	0.25	0.76	0.25	0.53

Breeding success was highly variable between sub-colonies. The overall average across all colonies of 0.33 young per AON was down on 2006 and was the second lowest figure we have recorded on Canna since monitoring began in 1987.

Common tern

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

Common guillemot

Only 17 guillemot chicks were found with a wing length greater than 60mm, all were weighed. The mean weight of 239.1g was not significantly different from the mean of 239.7 from the 2005 sample ($t=0.085$, $df45$, $p>0.05$). No birds were weighed in 2006. The median weight of the 2005 and 2007 cohorts was significantly lighter than the pre 2005 birds, which had a median weight of 272g ($U=8028.0$, $p<0.05$, Mann-Whitney U test).

Razorbill

General observations suggested that breeding success was much higher than in 2005, but poorer than 2006. A large number of chicks appeared malnourished and were continually calling for food.

6 Ringing studies

6.1 Ringing totals

Table 7 shows the number of adults and chicks ringed during 2007 and the number of fully-grown birds that were re-trapped.

Table 7. Number of birds ringed and adults retrapped on Canna in 2007.

	Adults ringed	*Chicks ringed*	*Full-grown retrapped*
Northern fulmar	6	14	11
European shag	12	364	11
Great skua	0	3	0
Mew Gull	0	2	0
Herring gull	0	65	0
GBB gull	0	10	0
Black-legged kittiwake	20	61	5
Common tern	0	3	0
Common guillemot	213	707	613
Razorbill	36	145	27
Black guillemot	0	2	0
Atlantic puffin	10	2	0
Total	**297**	**1378**	**667**

6.2 Ringing recoveries

Only one (0.2%) of the 550 Guillemot chicks ringed in 2005 was 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. The 2006 first year recovery rate was only 0.4% (5 from 1161), again suggesting a low post-fledging survival rate.

7 Return and survival rates results

Common guillemot

Of the 613 adult guillemots that were retrapped in 2006,167 were birds that had been ringed as chicks on Canna and were retrapped on the island for the first time. These included: four 3-year olds, four 4-year olds, four 5-year olds, 27 6-year olds, 20 7-year olds, 25 8-year olds, 13 9-year olds and four 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 the subsequent return rates of surviving birds to the colony. Data collected in 2007 illustrate this further (Table 8).

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

Year	*No. ringed*	*% recovered in 1st year*	*% back by 5th year*	*% back by 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	
2002	1,201	1.6	0.7		

The 1996 and 1998 cohorts, with their very low first year recovery rates, showed high return rates as expected, whilst the 1997 and 2000 cohorts, which had higher first year recovery rates, showed relatively low return rates. Recent high post-fledging mortality will likely disrupt this pattern in the future.

Razorbill

For the seventh 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. Only eight razorbills that had been ringed as chicks were re-trapped on the island for the first time in 2007. These included one 6-year old, one 8-year old and three 11-year olds.

European shag

Five shags that were ringed as chicks were retrapped on the island for the first time in 2007. All were breeders, being caught on nests, and comprised two 5-year olds, one 7-year old and two 8-year olds.

8 Feeding studies

Common guillemot

Only 16 fish were collected from adult common guillemots on their return to the colony from fishing trips, partly as a result of low breeding success and low food supplies. One (6%) was a clupeid, *Sprattus sprattus*, 9 (56%) sandeels *Ammodytes* spp. and 6 (38%) Gadidae. Of the Gadidae four were whiting *Merlangius merlangus,* and two were unidentified (Appendix 2). Figure 9 shows that since 2002 there has been a significant decline in the percentage of sprats. This has been compensated for by more sandeels.

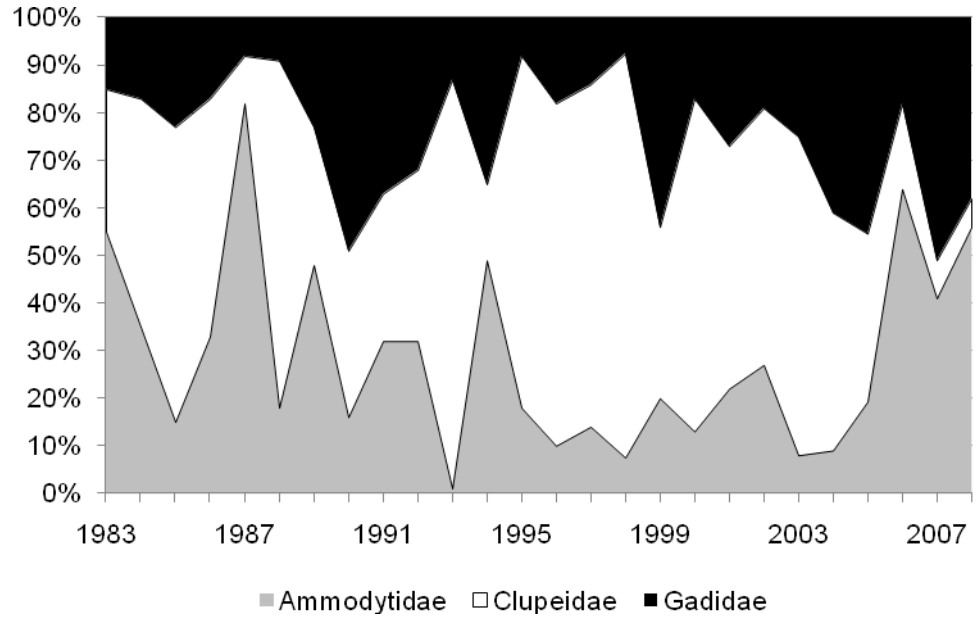

Figure 9. Proportion of fish species taken by common guillemots on Canna 1982-2007.

European shags

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

1. small Gadidae, 1 large O group sandeel
2. small Gadidae, bones of small pipefish
3. two small Gadidae

Thirty three pellets regurgitated by European shags were also collected (Table 9). Pellets 1-13 were collected in early July and pellets 14 -33 in late July. The counts in Table 9 refer to the number of otoliths per pellet. The *Trisopterus* will be fish 15-20 cm long, the other gadids 10-15cm and the other otoliths will be very small fish about 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. Once again the diet is dominated by gadids.

Table 9. Contents of regurgitated shag pellets.

Pellet number	**Trisopterus** otoliths	other Gadidae otoliths	Sandeel otoliths	Wrasse otoliths	Other Otoliths	REMARKS + details of 'other' fish
1	42	20	1			1 butterfish
2	3	2				
3		250			20	pipefish vertebrae
4	3					Cephalopod (octopus?) beak
5	3	130				
6	4	30				
7	19	135		2		
8	21	34	1	2		
9	10	22				
10	2		60			
11		390				
12	33	120		1		2 butterfish, small pipefish
13	4	36		2		
14	21	11			5	
15		180	30		10	
16	20	190			5	
17	15	32				
18		70	30			
19	4	42	20	1	10	
20	1	400			50	
21	8	220				
22		96				1 butterfish
23	17	10			5	
24	18	80				
25	34	64				1 eelpout
26	6	64			4	
27		208			10	
28	26	30				
29	60	10				
30	8	30				
31	45	60				
32	34	2				Small cephalapod beak
33	8	110				Cottidae bones, small crab

Black-legged Kittiwake

Four food samples were analysed from regurgitations from young black-legged kittiwakes. Full details are:

1. very small sandeels
2. very small sandeels + very small pipefish
3. Gadidae sp (not whiting nor *Trisopterus*)
4. very small sandeels + a small c10cm pipefish + very small whiting

Several black-legged kittiwake nests contained discarded pipefish, the first year they have been recorded as food items on Canna.

9 References

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10 Appendices

Appendix 1. Common guillemot chick weights

Weights in grammes

250	220	246	228	254	246	248	228	236	250
242	214	220	274	214	220	274			

Note: Weights taken only from chicks with a wing length of >60mm. Mean weight was 239.1g.

Appendix 2. Diet samples

Common guillemot

Details are given of the size (mm) of fish caught by adult guillemots on Canna in 2007.

Sprats: 1 measured

Length	119
No.of fish	1

Sandeels: 4 measured

Length	135	140	155	177
No. of fish	1	1	1	1

Gadoid: 5 measured (whiting in bold, others unidentified gadids)

Length	**52**	**66**	76	**80**	86
No. of fish	**1**	**1**	1	**1**	1