

**JNCC Report**

**No. 337**

**Canna seabird studies 2002**

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# 1. Summary

- 1.1 Three visits were made to Canna during 2002 to count and ring seabirds, monitor breeding success and collect food samples.
- 1.2 The timing of the 2002 breeding season was slightly earlier than average for most species.
- 1.3 Counts showed that many seabird species are undergoing major declines on Canna. This trend continued in 2002 with shag, herring gull, great black-backed gull and mew gull all showing substantial declines in numbers. Fulmar numbers stabilised, but at a low level. Only kittiwake numbers remain high, with a small increase occurring in 2002. Great skua bred on the island for the first time in 2002.
- 1.4 Breeding success was again exceptionally low in shags, herring and great black-backed gulls, in which mass failures occurred; for kittiwakes it was below average and for fulmar above average.
- 1.5 A total of 500 fully grown and 1,827 pullus seabirds were ringed with BTO metal rings and 737 fully grown birds were retrapped in breeding colonies. These figures were lower than usual due to the poor breeding success of some species and the early departure of auks from the island.
- 1.6 Retrapping of adult guillemots resulted in 214 birds ringed as chicks being located back in colonies for the first time. Two 3-year olds, 15 4-year olds and 35 5-year olds were amongst those caught. The 1991 to 1994 and 1996 cohorts, of which very few were reported as dead in their first year of life, were showing high return rates. Sixty-six razorbills and five shags that had been ringed as chicks were also retrapped in colonies for the first time.
- 1.7 Only 24 fish were collected from adult guillemots. Sprats dominated in number (66%), followed by Gadidae (25%) and sandeels (8%). Sprats were smaller in size compared with the long term average. The Gadidae were all whiting. Shag regurgitates contained sandeels, whilst their pellets contained a mixture of sandeels and Gadidae. Kittiwake samples were dominated by 0-group sandeels, with a few sprats.
- 1.8 Predation continued to be a major phenomenon in some seabird colonies on Canna, affecting breeding success and overall numbers attempting to breed. Brown rats *Rattus norvegicus* were implicated in these declines, particularly with regard to the extinction of the Manx shearwater colony. The low breeding success in the colonies at the Nunnery, Lamasgor and at Garrisdale is also thought to be partly due to rat predation, though gulls were also implicated. The arrival of great skuas on the island has led to increased predation on puffins and kittiwakes on Sanday.

## 2. 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 2002, the 34th 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, and this is the third year of the current three-year contract with JNCC.

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

1. to continue seabird counts on the island;
2. 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*);
3. 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;
4. to collect biometrics data from young common guillemots *Uria aalge*; and
5. to collect, identify and measure food samples from auks, black-legged kittiwakes, other gulls *Larus* spp. and European shags.

## 3. Methods

### General

Three visits were made to Canna during 2002 to cover the seabird breeding season: 25-29 May, 5-13 July and 26 July-3 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 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; this was very evident in 2002. The location of the study sites named in the text are shown in Figure 1.

### Counts

#### Manx shearwaters

In 1997, a full census of the Manx shearwater *Puffinus puffinus* colony indicated that fewer than 100 occupied burrows remained on Canna (Swann 1997). Subsequently, former core areas have been monitored annually using tape playback methods (Walsh *et al.* 1995) to provide an indication of colony status (Swann 1998). On the first visit to the island in 2002, two observers checked the known traditional shearwater areas between the Nunnery and Garrisdale, with tapes played at 100 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 5 July and 11 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.

### 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**

There were 60 marked sites scattered throughout the large colony at Boro'osgor (or Garrisdale) and 24 at the Nunnery colony. These sites were checked in late May to see how many had been occupied and held nests in which eggs had been laid. The nests were checked a second time, in early July, to record the numbers and ages of young that had hatched. In late July, the nests were again checked to count the number of large young and to record the remains of dead chicks, so that the number of young actually fledging could be calculated.

### **Herring gull**

Nest counts were made in 12 sub-colonies scattered throughout the island. Six were counted in late May to provide details on clutch size. The remainder was counted in early July. Nests in six of these were 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 in colony A 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. In early July the colony was visited to ring the chicks. The colony was re-visited a few days later and the number of ringed chicks caught was noted as were all newly ringed ones. This was used to estimate the total number of chicks. Finally, the colony was revisited in early August to count dead young.

### **Great black-backed gull**

Accessible pairs were plotted on a map in late May. The sites were revisited in early 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 on 6 July and 27 July to see how many had eggs or chicks. The size and number of chicks was also noted.

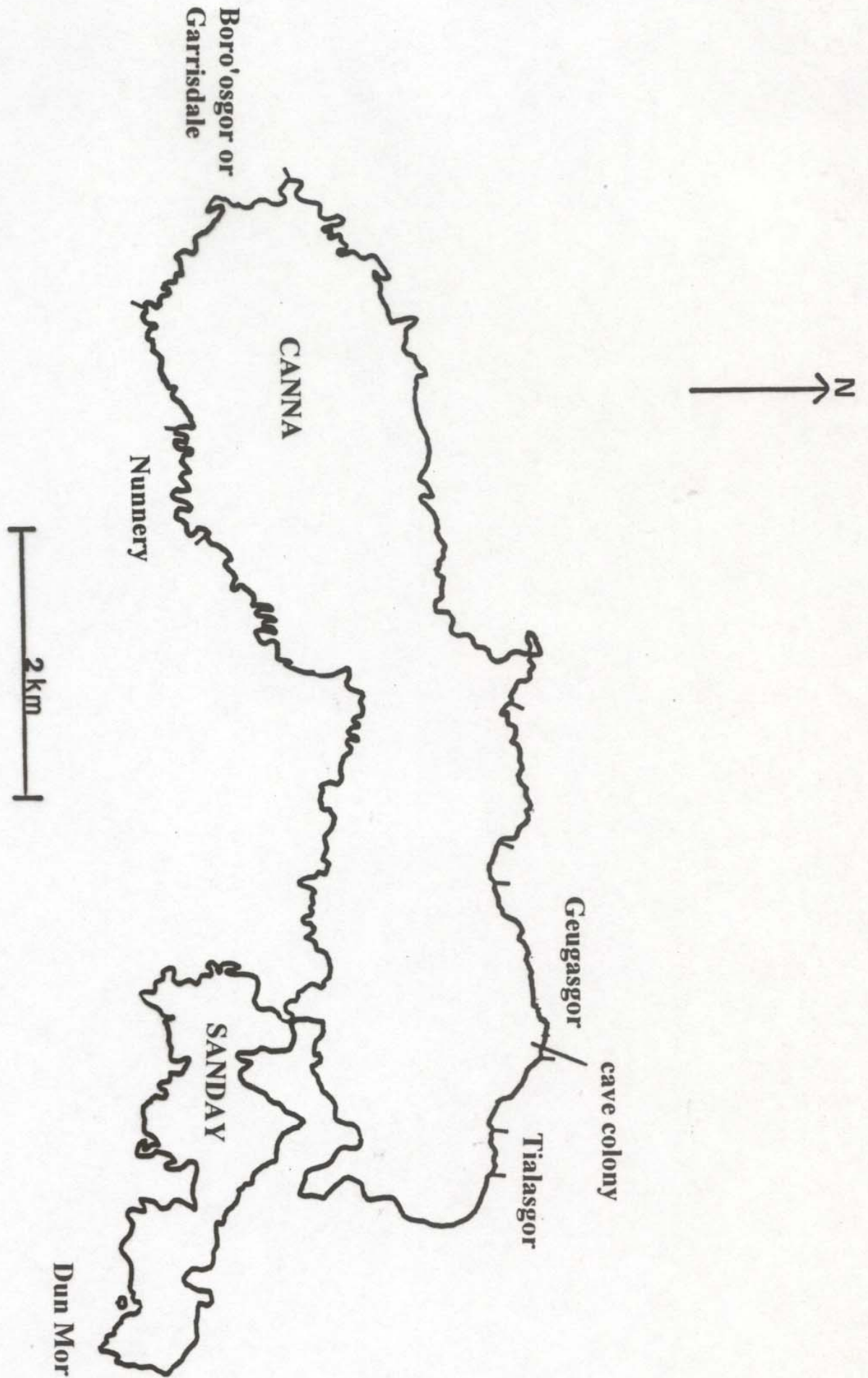


Figure 1 Outline map of Canna and Sanday showing study sites.



## 4. Count results

Details are given of the 2002 counts for each species and comparisons with past years are shown in Table 1. Further long-term analyses are detailed in Swann (2000).

### Northern fulmar

A total of 406 apparently occupied sites was counted. This is similar to the 2001 count and suggests that the steady decline in numbers noted since the mid 1990s has not been reversed.

### Manx shearwater

No birds responded to taped calls from the 100 burrows checked between the Nunnery and Garrisdale. No other signs of Manx shearwaters (e.g. depredated adults) were noted on the island.

### European shag

Numbers dropped markedly in 2002 to 638 apparently occupied nests, compared with the 844 in 2001. This is the third lowest figure recorded since 1974 (Figure 2), though it probably underestimates the true number as we know that many nests that contained eggs in late May had 'disappeared' by early July.

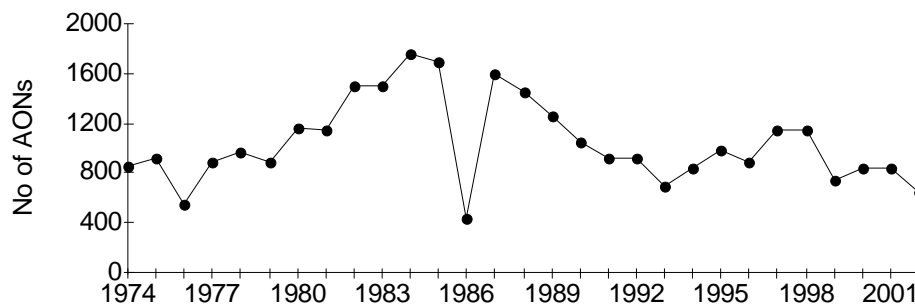


Figure 2. Number of apparently occupied European shag nests on Canna 1974-2002.

### Great skua

A pair of great skua *Catharacta skua* bred for the first time on Canna on an area of moorland towards the eastern end of Sanday. Later in the summer they were joined by a second pair.

### Mew gull

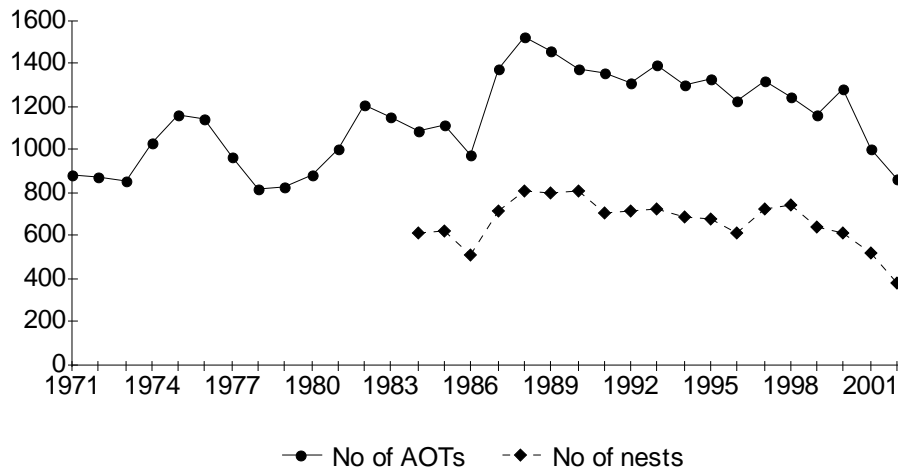
Numbers of mew gulls *Larus canus* were very low in 2002, with only eight Apparently Occupied Territories (AOT) counted, even lower than in 2001 when just 10 were recorded.

### Lesser black-backed gull

Numbers of lesser black-backed gulls *Larus fuscus* remained fairly stable in 2002, with 42 AOT, compared with 43 in 2001.

### Herring gull

A total of 862 apparently occupied territories was counted, and in the study colonies 381 nests were counted. This is a continuation of a long term decline that started in 1989 (Figure 3). Several traditional Herring Gull sub-colonies on the island have now been abandoned.



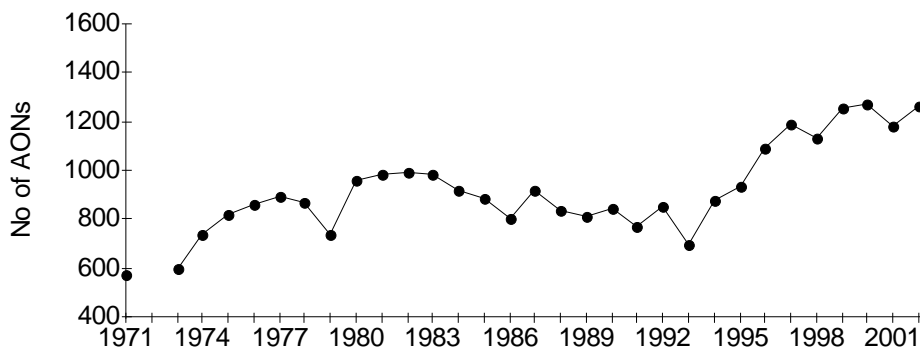
**Figure 3.** Number of apparently occupied herring gull territories on Canna and nest counts in sample study colonies 1971-2002.

### Great black-backed gull

There was a further decrease in 2002 to 68 apparently occupied territories, compared with 72 in 2001 (Table 1).

### Black-legged kittiwake

Numbers continued to remain very high, at 1,264 AON; close to the record peak of 1,274 in 2000 (Figure 4). These increases all occurred in the colonies on the north side of the island. The colonies on Sanday have shown a decline since 1997.



**Figure 4.** Number of apparently occupied black-legged kittiwake nests on Canna 1971-2002

### Common tern

A few common terns *Sterna hirundo* were present in late May, though no nesting attempts took place in 2002.

**Common guillemot**

Too many birds had left the colony prior to our visit to give an accurate count of the numbers present in 2002. The presence of birds in new sections on Geugasgor would suggest that numbers continue to increase.

**Razorbill**

As with guillemot too many birds had left the colonies prior to our July visits to give an accurate count in 2002.

**Black guillemot**

Only 35 individual adult birds were counted in 2002 (Table 1). As the method section noted this under-estimates the true number present. It was, however, the lowest figure we have ever recorded on Canna and may suggest that this species is also declining on the island.

**Table 1.** Counts of breeding seabirds on Isle of Canna 1993-2002

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Peak (year)
Fulmar <sup>1</sup>	654	517	653	585	435	471	386	443	402	406	669 (1977)
Shag <sup>2</sup>	697	837	984	890	1,148	1,140	742	838	844	638	1,753 (1984)
Mew gull <sup>4</sup>	15	8	17	14	13	18	14	15	10	8	18 (1983)
LBB gull <sup>4</sup>	31	39	39	40	43	(33)	42	41	43	42	69 (1975)
Herring gull: pairs <sup>4</sup>	1,391	1,301	1,326	1,226	1,320	(1,251)	1,159	1,282	1006	862	1,525 (1988)
Herring gull: nests <sup>3</sup>	721	686	675	615	729	748	640	610	525	381	809 (1988)
GBB gull <sup>4</sup>	83	91	85	72	93	86	80	89	72	68	93 (1997)
Kittiwake <sup>2</sup>	693	875	932	1,087	1,193	1,133	1,252	1,274	1179	1264	1,274 (2000)
Common tern <sup>3</sup>	3	6	3	0	1	1	7	3	0	0	18 (1992)
Guillemot <sup>5</sup>	941	1,084	1,184	1,190	-	(991)	(996)	(950)	1249	-	1,191 (1983)
Razorbill <sup>5</sup>	(314)	410	441	396	-	(355)	-	(274)	252	-	520 (1985)
Black guillemot <sup>6</sup>	48	86	85	88	75	58	73	(54)	67	35	137 (1986)

Notes: Units used are as follows:

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

Counts in brackets are known to be underestimates.

## 5. Timing of breeding

The late winter in north-west Scotland was mild and very wet and windy. April and early May were warm and sunny. These conditions probably resulted in above average sea temperatures at the start of the breeding season. Late May to July was cool and fairly unsettled period with much wind and rain. Most seabirds bred earlier than normal; for instance, 7% of 303 occupied European shag nests contained eggs in early July (compared to 11% in 2001, 14% in 2000, 12% in 1999, 19% in 1998, 24% in 1997, 68% in 1996 and 50% in 1995). It was also obvious that a large percentage of auks had already left the colonies by early July.

## 6. Breeding success

Details are given of the 2002 results for each species and comparisons with past years are shown in Table 7. Further long-term analyses are given in Swann (2000).

### Northern fulmar

Table 2 shows the breeding success from four study plots. This gives an overall success rate across all sites combined of 0.45 chicks per apparently occupied site and a mean rate of 0.44 (s.e.  $\pm$  0.20), slightly lower than the 2001 figure (0.48). There was great variability between plots, with success being highest on the north side of the island at Buidhe Sgor and lowest at the Nunnery, where predation of eggs and small young was suspected.

**Table 2.** Northern fulmar breeding success on Canna in 2002

<i>Study site</i>	<i>No. sites</i>	<i>No. young</i>	<i>Young per site</i>
Sanday A	24	10	0.42
Sanday B	19	11	0.58
Nunnery/Garrisdale	17	1	0.06
Buidhe Sgor	20	14	0.70
Total	80	36	0.45

### Manx shearwater

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

### European shag

Full clutch size was recorded for 37 of the 46 study nests in which eggs were laid (Table 3). Average clutch size in these nests was 2.86, similar to that recorded in 2001.

**Table 3.** European shag breeding success on Canna in 2002.

a) Clutch size		b) Fledging success		
<i>Clutch size</i>	<i>No. nests</i>	<i>Young fledged per nest laid in</i>	<i>Number of nests</i>	
			<i>Nunnery</i>	<i>Garrisdale</i>
1 egg	2			
2 eggs	5	0	18	21
3 eggs	27	1	0	2
4 eggs	2	2	0	5
5 eggs	1	3	0	0
Mean clutch size = 2.86				

There were already signs of predated nests at the Nunnery and Garrisdale colonies in late May and by early July this was more marked. At the Nunnery all the study nests in boulder and open cliff sites had failed (Table 3b). Only nests on narrow cliff ledges were succeeding. We estimated that only 18 chicks would fledge from this colony, where the number of active nests had dropped to a low of 49 (0.36 chicks per nest). At Garrisdale, of the 28 occupied study nests 21 had failed and only 12 young fledged from the surviving seven nests (0.42 per study nest laid in). In the colony as a whole, we estimated only 89 young had been reared from 141 nests (0.63 chicks per nest). Once again, successful nests were those located on cliff sites, although one boulder area in the centre of the colony also displayed 'normal' survival. At the Lamasgor colony we have no study nests but we estimated that only 23 young were reared from 58 nests (0.4 chicks per nest). The successful nests were all located in the highest parts of the colony, well up the tallus slopes and away from the shore. Many traditional nest sites in boulders close to the shore were completely abandoned this year and the

overall number of nests in this colony was well down. The large colony at Geugasgor on the north side of the island was much as normal. Here, we estimated that 479 young were reared from 328 nests (1.5 per nest), slightly down on the 1.7 estimated in 2001.

Once again, the reasons for the high failure rate at Garrisdale, Lamasgor and the Nunnery appeared to be linked with high levels of predation. Most nests failed at the egg or small chick stage. It was noticeable in all colonies that nests in more inaccessible locations were surviving and producing broods of two or three young, suggesting that food shortage was not the cause of the many failures. There is also evidence of birds re-distributing within colonies, from under boulders to sites on narrow ledges on cliffs. New colonies were also becoming established; for instance, on Sanday the number of nests increased from two in 1994 to 27 in 2002, with the birds utilising inaccessible ledges in caves and on cliffs and stacks.

### Great skua

A pair nested on Sanday laying a single egg. The chick died shortly after hatching.

### Herring gull

The frequency distribution of clutch sizes recorded in six sub-colonies in late May is shown in Table 4 and information on hatching success in a further six sub-colonies observed in early July is shown in Table 5.

**Table 4.** Herring gull clutch size in late May at six study colonies on Canna in 2002.

	<i>Sub-colony</i>					
	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>
1 egg	13	7	3	8	0	3
2 eggs	16	9	0	13	3	1
3 eggs	69	22	6	52	11	9

Mean clutch size was normal, at 2.55.

**Table 5.** Number of herring gull nests that showed signs of success or failure on Canna in 2002.

	<i>Sub-colony</i>					
	<i>D</i>	<i>E</i>	<i>G</i>	<i>H</i>	<i>I</i>	<i>J</i>
Chicks	7	9	0	0	2	2
Failed	77	13	3	8	249	73

Of the 443 nests checked only 4.5% had produced chicks, indicating the least productive breeding season we have ever recorded. There was an almost total failure in all colonies on the island. At sub-colony A, the number of fledged chicks is usually estimated by capture-recapture (see methods). No chicks were found there, nor any signs of successful nests seen, indicating a total failure in this colony. We estimate that the 862 pairs on the island produced about 60 chicks (0.07 chicks per pair). Most nests appear to have failed at the egg or small chick stage.

### Great black-backed gull

Thirty-three pairs of great black-backed gull were monitored, 30 of which failed and three produced single young, giving an overall productivity of 0.09 young per pair. This was by far the lowest figure we have recorded since monitoring started in 1997, the next lowest being 0.3 in 2001 (Table 7).

### Black-legged kittiwake

The results obtained from the Sanday colony are detailed in Table 6.

**Table 6.** Number of occupied black-legged kittiwake nests and sites in four study colonies on Sanday and number of large young per nest in 2002.

	<i>Sub-colony</i>			
	<i>K1</i>	<i>K2</i>	<i>K3</i>	<i>K4 (Dun Mor)</i>
<i>No. sites*</i>	2	4	3	1
<i>No. nests</i>	57	50	43	30
1 large young	13	16	8	5
2 large young	6	7	9	2
av. young per nest	0.44	0.60	0.60	0.30

\* site = bird present on more than one occasion but no nest built.

Overall in the Sanday study colony, 90 young were produced from 180 nests (0.5 chicks per nest). At the cave colony, on the north side of the island, success was higher with 129 young from 178 nests (0.72 chicks per nest). This gives an overall success rate across all sites combined of 0.61 chicks per AON. The mean across the five plots was 0.53 (s.e.  $\pm 0.07$ ), much lower than the 2001 figure of 0.75 (s.e.  $\pm 0.09$ ).

**Table 7.** Breeding success of selected seabirds on Canna 1993-2002.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Fulmar	0.50	0.50	0.33	0.32	0.33	0.33	0.27	0.44	0.48	0.45
Manx shearwater	0.47	0.75	0.25	0.13	0.08	-	-	-	-	-
Shag	1.14	1.45	1.37	1.35	1.75	1.32	0.91	0.80	0.10	0.26
Herring gull <sup>a</sup>	58%	67%	70%	32%	78%	53%	11%	63%	10%	4.5%
Herring gull <sup>b</sup>	1.6	1.6	1.8	0.3	1.3	0.7	0.4	0.4	0.1	0
Great b-b gull	-	-	-	-	1.5	1.3	1.1	1.3	0.3	0.1
Kittiwake	0.50	0.86	0.86	0.97	0.95	0.95	0.64	0.51	0.83	0.61

Notes:

1. For fulmar and kittiwake, figures are overall breeding success across all plots, rather than 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 kittiwakes.
3. For herring gull <sup>a</sup> refers to percentage of nests which produced chicks and <sup>b</sup> refers to young fledged per nest based on capture-recapture at sub-colony A. An all-island estimate of chicks per nest was 0.07 in 2002.

## Auks

The mean weight of 54 guillemot chicks with a wing length greater than 60mm was 258g (see Appendix 2). This was significantly lower than in previous years (1983-2001) in which the mean was 271g (n=438, Z=3.53, p<0.01) and suggests that, as in 2001, the chicks were not in prime condition.



## 7. Ringing studies

### Ringing totals

Table 8 shows the number of adults and chicks ringed during 2002 and the number of fully-grown birds that was re-trapped.

**Table 8.** Number of birds ringed and adults re-trapped on Canna in 2002

	<i>Adults ringed</i>	<i>Chicks ringed</i>	<i>Full-grown re-trapped</i>
Fulmar	10	21	18
Shag	20	440	29
LBB gull	0	7	0
Herring gull	0	45	0
GBB gull	0	2	0
Kittiwake	56	67	22
Guillemot	204	1,201	568
Razorbill	156	44	99
Puffin	54	0	1
<b>Totals</b>	<b>500</b>	<b>1,827</b>	<b>737</b>

Due to high rates of breeding failure, fewer than normal gull and shag chicks were ringed. The use of a fleyg net once again increased the number of adult Atlantic puffins and razorbills that could be ringed and re-trapped. Guillemot totals were much lower than normal due to the early breeding season coinciding with our slightly later visit.

## 8. Return rates and age of first breeding

### Common guillemot

Of the 568 adult guillemots that were retrapped in 2002, 214 were birds that had been ringed as chicks on Canna and were being retrapped on the island for the first time. These included: two 3-year olds, 15 4-year olds (1 of which was breeding), seven 5-year olds, 38 6-year olds, 39 7-year olds, 34 8-year olds, 14 9-year olds and 23 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 2002 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 6<sup>th</sup> year</i>	<i>% back by 7th year</i>
1984	1,769	2.6	1.6	2.8	4.9
1985	2,236	3.6	0.7	1.3	2.2
1986	1,912	0.3	2.4	5.0	6.8
1987	1,067	2.4	0.8	1.3	2.7
1988	2,422	1.9	0.6	1.6	2.6
1989	2,357	2.8	0.7	1.1	1.5
1990	2,345	1.6	1.4	2.4	3.4
1991	2,241	0.3	2.1	3.3	6.3
1992	2,463	0.9	1.8	3.7	5.8
1993	1,908	0.7	1.8	3.6	6.9
1994	2,674	0.6	1.9	4.5	6.6
1995	2,913	1.3	1.3	2.6	3.9
1996	2,425	0.6	2.2	3.8	
1997	831	0.9	0.9		

The 1996 cohort, with its very low first year recovery rate, as expected showed very high return rates. It is not surprising that with these high return rates in recent years that numbers on Canna have continued to steadily increase.

### Razorbill

For the second 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. Sixty-six razorbills that had been ringed as chicks were re-trapped on the island for the first time in 2002. These included seven 2-year olds, seven 3-year olds, 14 4-year olds, one 5-year old, 10 6-year olds, three 7-year olds, eight 8-year olds, three 9-year olds and two 10-year olds.

### European shag

Only five shags that were ringed as chicks were retrapped on the island for the first time in 2002. All were breeders, being caught on nests, and comprised one 3-year old, two 5-year olds, one 6-year old and one 15-year old.

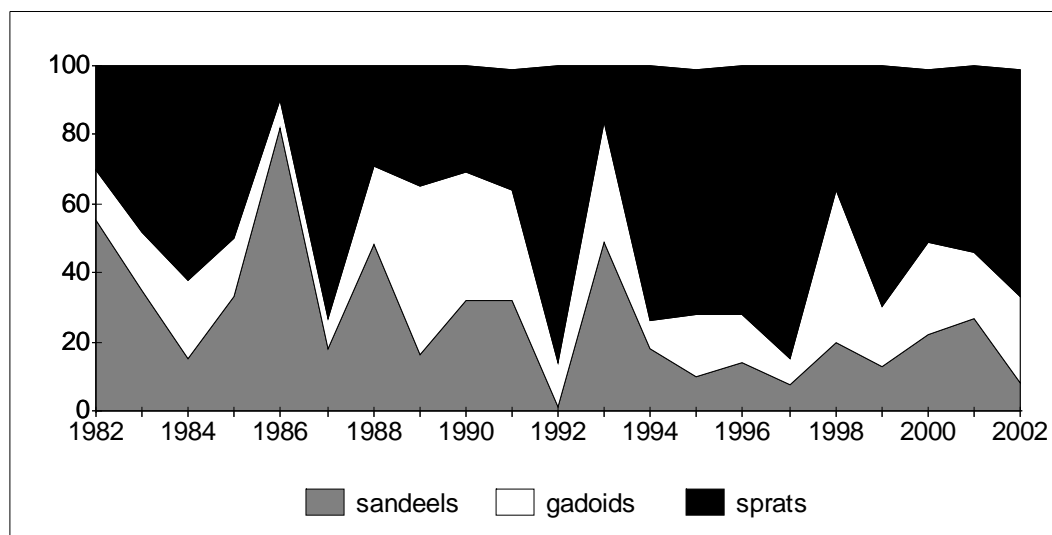
## 9. Feeding studies

### Common guillemot

Only 24 fish were collected from adult guillemots on their return to the colony from fishing trips, of which 16 (66%) was sprats *Sprattus sprattus*, two (8%) sandeels *Ammodytes* spp. and six (25%) Gadidae. Details of the fish sampled are given in Appendix 1. The mean length of the sprats was 108.7mm (s.e. 1.56), significantly lower than the long-term average (111.5 mm, s.e. 0.39, 1991-00 data,  $z = 1.7$ ,  $p < 0.05$ ). Of the Gadidae all six were whiting *Merlangius merlangus*. The mean size of the whiting was 100.2mm (s.e. 4.98).

Figure 5 shows that since 1982 the percentage of sandeels taken by guillemots has fluctuated but overall declined. Sprats, conversely, have increased in the diet, particularly since 1992 (with the exception of 1993 and 1998). In years when numbers of sprat taken are low gadoids became more important (e.g. 1988-91, 1993 and 1998). Since 1997 there has been a slight decline in sprats and increase in sandeels in the diet of common guillemots.

**Figure 5.** Fish species taken by common guillemots on Canna 1982-2002



### Other seabirds

Twenty-two food samples were collected from regurgitations of both adult and chick kittiwakes, of which 17 mostly contained 0-group sandeels. One of these also contained some small clupeids. Four contained small sprats (6-8cm in size) and one contained even smaller clupeids (probably sprats).

Each of the five shag regurgitates gathered in early July contained sandeels; two were 0-group and three were older. Shag pellets mainly contained gadoids (mostly *Trisopterus* sp.), some sandeels and a single flatfish (see Appendix 2).

Only three regurgitations from herring gull chicks were examined, all of which contained whitefish (considered to be discards from fishing boats).

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# Appendices

## Appendix 1 Common guillemot chick weights

Weights in grammes

236	266	275	233	246	265	215	206	220	254
260	243	272	258	241	269	272	278	234	300
268	225	250	281	265	224	283	259	242	256
256	268	256	252	241	272	310	266	284	259
289	215	292	280	302	260	255	294	213	224
277	294	254	222						

Note: Weights taken only from chicks with a wing length of >60mm. Mean weight was 258.0g.

## Appendix 2 Diet samples

### Common guillemot

Details are given of the size (mm) of fish caught by adult guillemots on Canna in 2002.

Sprats: 16 measured

<i>Length</i>	98	101	102	104	105	109	110	111	112
No. of fish	1	1	1	2	1	2	2	2	1
<i>Length</i>	115	123							
No. of fish	2	1							

Sandeels: two measured

<i>Length</i>	93	117
No. of fish	1	1

Whiting: six measured

<i>Length</i>	90	94	95	98	100	124
No. of fish	1	1	1	1	1	1

### Shag pellets

Seven shag pellets were collected: one in late May and six in early July. Their contents were as follows.

<i>Month</i>	<i>Total no of pellets</i>	<i>Sandeels</i>	<i>No of pellets containing:</i>		<i>Flatfish</i>
			<i>Gadidae</i>	<i>Trisopterus</i>	
May	1	1	1	1	
July	4	3	3	1	1
Total no. otoliths		29	121	500	1

Note: The *Trisopterus* otoliths are not included in the Gadidae total.