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Canna seabird studies 2001

R L Swann

Highland Ringing Group
14 St. Vincent Road
Tain
Ross-shire
IV19 1JR

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For further information please contact:
Seabirds and Cetaceans
Joint Nature Conservation Committee
Dunnet House
7 Thistle Place
Aberdeen
AB10 1UZ

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1. Summary

1.1 Three visits were made to Canna during 2001 to count and ring seabirds, monitor breeding success and collect food samples.

1.2 The timing of the 2001 breeding season was slightly earlier than average for European shags and later than average for auks.

1.3 Counts showed small declines, compared with 2000, for black-legged kittiwakes and slight increases for European shags. Major declines affecting Northern fulmars, herring gulls and razorbills continued in 2001, whereas common guillemots continued to increase, reaching a new peak count.

1.4 Breeding success was exceptionally low for European shags, herring gulls and great black-backed gulls, in which mass failures occurred. Breeding success of black-legged kittiwakes was average and Northern fulmars above average.

1.5 A total of 551 fully grown and 3,154 pullus seabirds were ringed with BTO metal rings and 1,604 fully grown birds were retrapped in breeding colonies.

1.6 Another high total of 362 common guillemots ringed as chicks in previous years was located back in colonies for the first time. One 3- and three 5-year olds were found breeding. A further three 3-year olds, one 4-year old and 35 5-year olds were also caught, but their breeding status was not known. The 1991 to 1994 and 1996 cohorts, of which very few were reported as dead in their first year of life, are showed high return rates. Sixty-two razorbills and 16 European shags that had been ringed as chicks were also retrapped in colonies for the first time.

1.7 In all, 110 fish were collected from adult common guillemots. Sprats dominated (54%), followed by sandeels (27%) and Gadidae (19%; mostly whiting). Sprats were smaller in size compared with the long term average as were the sandeels, due to the large number of 0-group sandeels being taken. European shag regurgitates and pellets collected in May and early July contained sandeels, but gadoids dominated in those collected in August. Black-legged kittiwake samples were dominated by 0-group sandeels. Herring gulls apparently mainly fed on whitefish discards from prawn boats.

1.8 Predation was still a major problem in some of the seabird colonies on Canna in 2001. A survey conducted by National Trust for Scotland during the 2000/01 winter showed brown rats *Rattus norvegicus* to be present throughout the island, including all major seabird colonies. Brown rats were implicated in recent seabird declines on the island. Large raptors took high numbers of Northern fulmars; on Sanday, peregrine falcons and great skuas took Atlantic puffins. In addition in 2001 following their mass failure, due to food shortages, gulls appeared to increase predation on the European shag colonies.

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 2001, the 33rd 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 second 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 2001 to cover the seabird breeding season: 25-28 May, 29 June-7 July and 27 July-5 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 *Alca torda* 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 year, however, an earlier visit combined with a slightly late breeding season meant our common guillemot and razorbill counts were more comparable with previous (pre 1997) seasons. 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 2001, two observers checked the known traditional Manx shearwater areas between the Nunnery and Garrisdale with tapes being played at 100 burrow entrances.

Common guillemot and razorbill

Counts were made of the number of occupied sites in accessible colonies at Geugasgor (Figure 1) and other smaller colonies. Occupied common guillemot sites are recognised by the presence of an egg or chick. Occupied razorbill sites are 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 Northern fulmars at Tialasgor and Geugasgor and black-legged kittiwakes at Geugasgor, which were made by boat. The units used differ from species to species and are indicated in the results section.

Monitoring breeding success

Northern fulmar

At the Sanday study plots the position of Apparently Occupied Sites (AOS) was marked on a photograph taken in late May and the number of large chicks at these sites noted in early August. At the Nunnery/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 are 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 twelve sub-colonies scattered throughout the island. Three were counted in late May to provide details of clutch size; the remainder was counted in early July. Nests in eight of these were checked for signs of hatching (e.g. copious droppings, food remains, chicks); those with no such signs were classed as having failed. 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 coloured plastic tag; on the second sweep each nest found with a tag was given a second tag and those without are given a different coloured tag. Using the information from the second sweep we could 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 revisited a few days later and the number of ringed chicks caught 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) were marked on photographs at the Sanday study plots. These were checked again on 2 July and 28 July to see how many had eggs or chicks. The size and number of chicks was also recorded.

Figure 1 Outline map of Canna and Sanday showing study sites

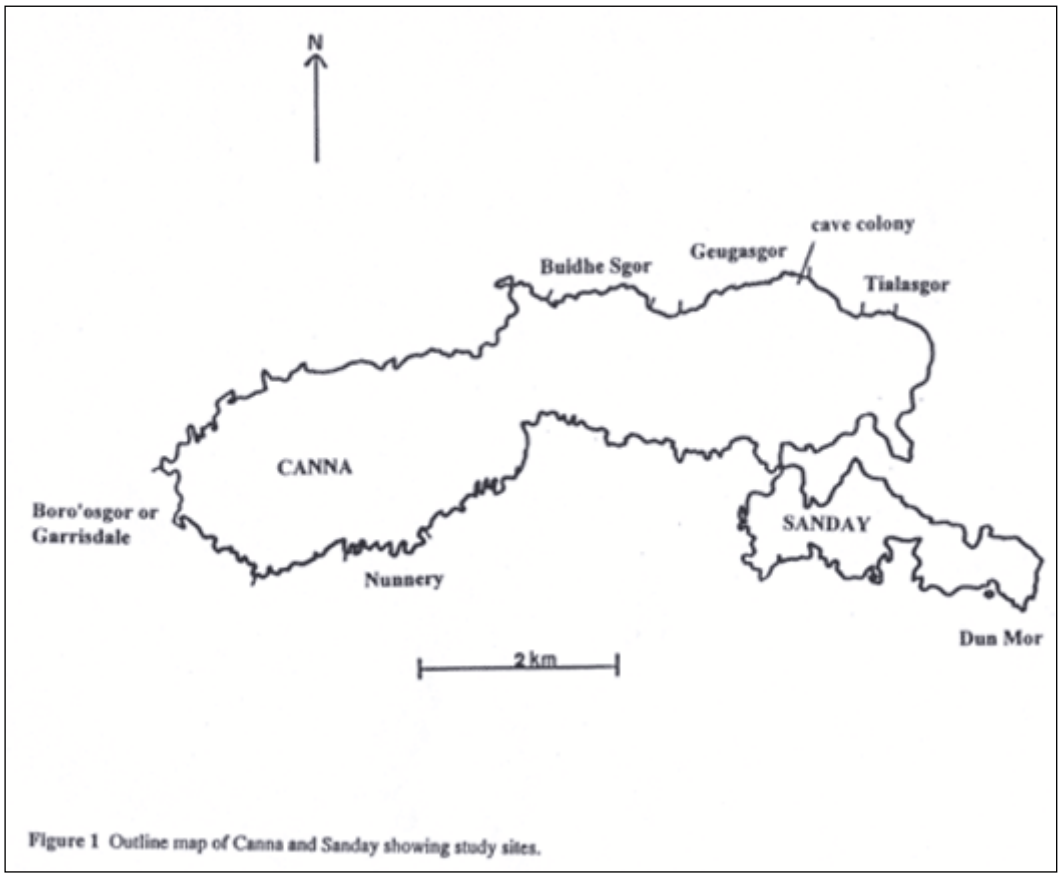

Figure 1 Outline map of Canna and Sanday showing study sites.

4. Count results

Details are given of the 2001 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 402 AOS was counted. This continued the overall decline in numbers noted since the mid 1990s.

Manx shearwater

Only one bird responded to taped calls from the 100 burrows checked between the Nunnery and Garrisdale. This was in a burrow in a gully at Am Beannan (NG224043), where a bird had responded in 2000. No other signs of Manx shearwaters (e.g. depredated adults) were noted on the island.

European shag

Numbers increased slightly in 2001 compared with 2000, to 844 AON. This was probably an underestimate, due to the very high failure rate in many colonies as we know that many nests that contained eggs in late May had 'disappeared' by early July.

Great skua

From May to July a pair of great skuas *Stercorarius skua* was present on an area of moorland towards the eastern end of Sanday. In late July they were joined by a second pair.

Mew gull

Numbers of mew gulls *Larus canus* were low in 2001, with only ten Apparently Occupied Territories (AOT) counted.

Lesser black-backed gull

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

Herring gull

A total of 1,006 AOT was counted, and in the study colonies 525 nests were counted. This represents a continuation of a long term decline that started in 1989 (Figure 2).

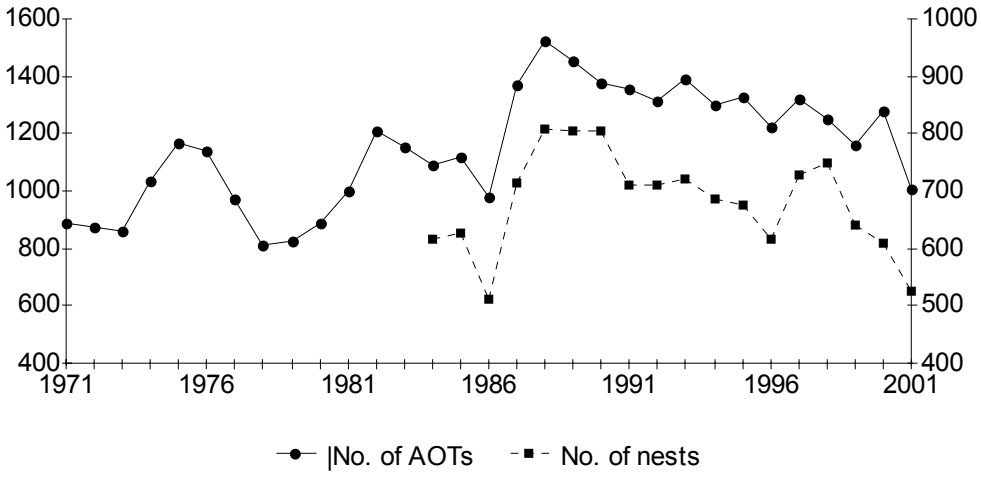

Figure 2. Number of apparently occupied Herring gull territories on Canna (left axis) and nest counts in study colonies (right axis).

Great black-backed gull

There was a marked decrease in numbers in 2001 compared with 2000, to 72 AOT (Table 1). This was equal to the lowest count since 1992.

Black-legged kittiwake

Following the recent rapid increase in numbers, there was a slight decline in 2001 to 1179 occupied nests from last year's record peak (Figure 3).

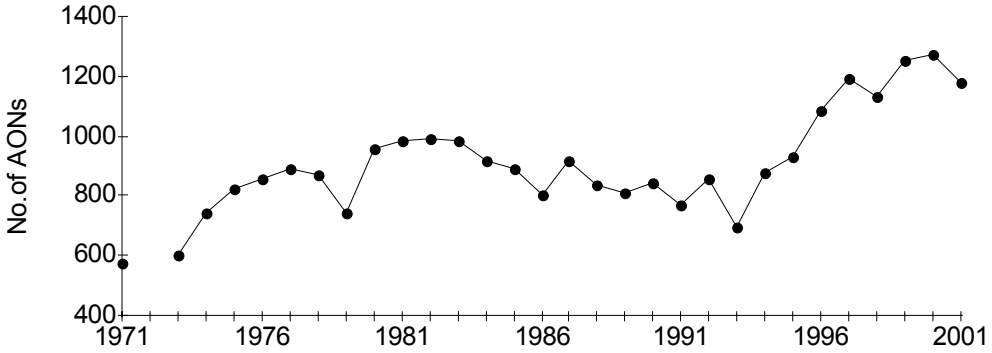

Figure 3. Number of apparently occupied black-legged kittiwake nests on Canna 1971-2001.

Common tern

Although 2-3 pairs of common terns *Sterna hirundo* were present in early July no nesting attempts took place.

Common guillemot

Numbers remained very high, with a new record total of 1,249 occupied 'nests' counted in the study sites. Figure 4 shows how numbers have increased since 1974. Counts were most accurate at the Geugasgor sites. At other sites birds sometimes left in varying numbers prior to our visits.

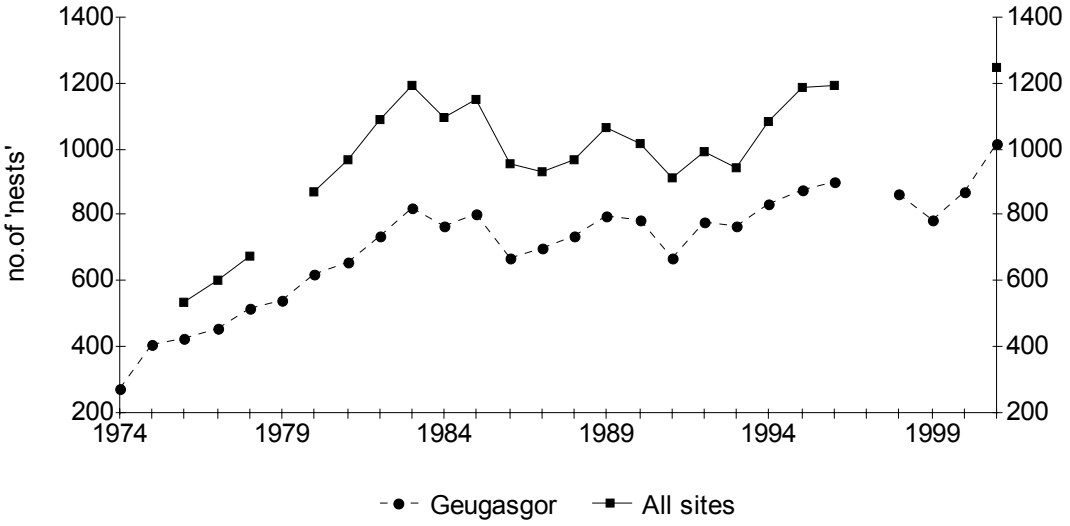

Figure 4. Number of common guillemot 'nests' in study sites on Canna. Gaps indicate years when too many chicks left prior to our arrival to obtain an accurate count.

Razorbill

At the main Geugasgor study colony 250 occupied sites were counted in July, whilst at the peripheral sites to the west end of the island no occupied sites were located in the Nunnery and only two at Garrisdale, giving an overall total of 252. As few birds had left prior to our arrival this represented a severe decline (Figure 5). At Geugasgor a decline appears to have been in progress since the mid 1980s, whilst at the other sites a rapid decline occurred since 1990 (Figure 5). At these latter colonies the decline may be associated with increased predation of eggs by rats, which has been observed at these locations. Indeed, at Garrisdale the only surviving birds are now located on inaccessible cliff ledges.

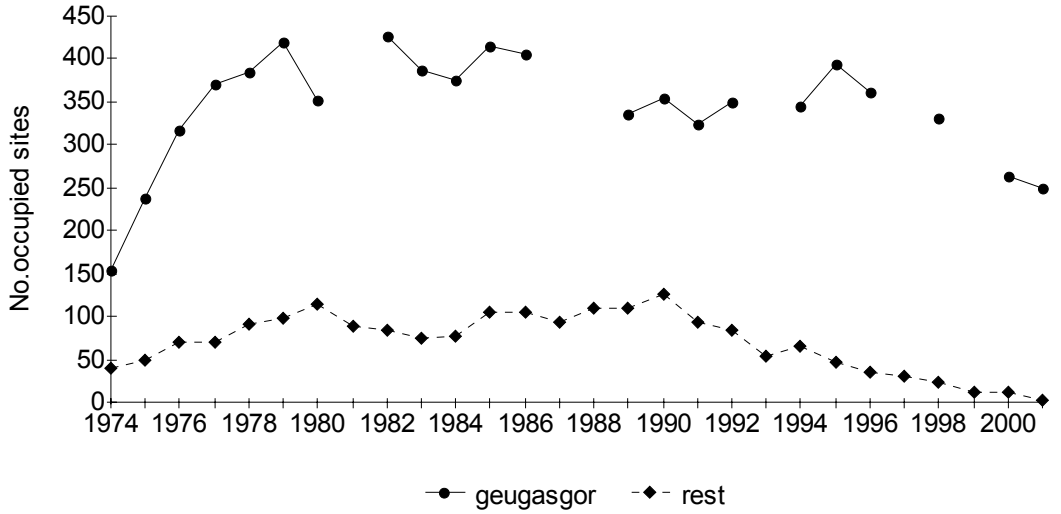

Figure 5. Number of occupied razorbill sites in study areas at Geugasgor and at other colonies on Canna 1974-2001.

Black guillemot

Sixty-seven individual adult birds were counted (Table 1). As the method section suggests this under-estimates the true number present.

Table 1. Counts of breeding seabirds Isle of Canna 1992-2001

	1992	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*Peak (year)*
Northern fulmar [1]	671	654	517	653	585	435	471	386	443	402	669 (1977)
European shag [2]	925	697	837	984	890	1,148	1,140	742	838	844	1,753 (1984)
Mew gull [4]	12	15	8	17	14	13	18	14	15	10	18 (1983)
LBB gull [4]	31	31	39	39	40	43	(33)	42	41	43	69 (1975)
Herring gull: pairs [4]	1,316	1,391	1,301	1,326	1,226	1,320	(1,251)	1,159	1,282	1,006	1,525 (1988)
Herring gull: nests [3]	712	721	686	675	615	729	748	640	610	525	809 (1988)
GBB gull [4]	75	83	91	85	72	93	86	80	89	72	93 (1997)
Black-legged kittiwake [2]	855	693	875	932	1,087	1,193	1,133	1,252	1,274	1,179	1,274 (2000)
Common tern [3]	18	3	6	3	0	1	1	7	3	0	18 (1992)
Common guillemot [5]	989	941	1,084	1,184	1,190	-	(991)	(996)	(950)	1,249	1,191 (1983)
Razorbill [5]	434	(314)	410	441	396	-	(355)	-	(274)	252	520 (1985)
Black guillemot [6]	55	48	86	85	88	75	58	73	(54)	67	137 (1986)

Notes: Units used are as follows
1. AOS for Northern fulmar
2. AON for European shag and black-legged kittiwake
3. Nest with egg or chick for common tern or herring gull (nest)
4. AOT for gulls
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.

5. Timing of breeding

The winter in north-west Scotland was colder than average in 2001, with snow falls and even frosts recorded on Canna. Spring was very dry but northerly and easterly winds kept temperatures below average, probably resulting in below average sea temperatures at the start of the seabird breeding season. European shags laid slightly earlier than usual, with 11% of 748 nests containing eggs in early July (compared to 14% in 2000, 12% in 1999, 19% in 1998, 24% in 1997, 68% in 1996 and 50% in 1995). Auks appear to have laid slightly later than normal as there were very few large chicks and little evidence that any had fledged prior to our visit.

6. Breeding success

Details are given of the 2001 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 three study plots. This gives an overall success rate across all sites combined of 0.48 chicks per site/egg and a mean rate from the sites of 0.45 (s.e. ± 0.11), slightly higher than the 2000 figure (0.44) and the highest productivity recorded since 1994 (Table 7).

Table 2. Northern fulmar breeding success on Canna in 2001

Study site	*No. AOS*	*No. young*	*Young per site*
Sanday A	21	12	0.57
Sanday B	22	12	0.54
Nunnery/Garrisdale	17	2	0.12
Buidhe Sgor	24	14	0.58
Total	84	40	0.48
			Mean (SE) 0.45 (0.11)

Manx shearwater

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

European shag

Details from the study nests are shown in Table 3.

Table 3. European shag breeding success on Canna in 2001.

a) Clutch size

Clutch size	*No. nests*
1 egg	1
2 eggs	3
3 eggs	30
4 eggs	2
5 eggs	1

b) Fledging success

Young fledged per nest laid in	*Number of nests*	
	Nunnery	*Garrisdale*
0	11	46
1	0	2
2	1	0
3	0	1

Full clutch size was recorded for 37 of the 64 nests in which eggs were laid. Average clutch size in these nests was 2.97, slightly higher than that recorded in 1999 and 2000. In late May, occupancy looked very high with most nests containing eggs or newly hatched young. On our return in July things had altered markedly; at Garrisdale, of the 49 occupied nests, all bar 3 had failed, and only 5 young had been reared (0.10 per nest). In the colony as a whole we estimated only 88 young had been reared from 214 nests (0.41 chicks per nest). At the Nunnery productivity was similarly low; only 12 study nests were occupied in late May and by early July only one contained young (0.17 chicks per nest). Again for the colony as a whole we estimated only 19 young were raised from 63 nests (0.3 per nest). At Lamasgor, although there were no study nests we estimated that only 11 young were reared from 139 nests (0.08 chicks per nest). The large colony at Geugasgor on the north side of the island was much as normal; an estimated 582 young being reared from 334 nests (approximately 1.7 per nest).

The reasons for the high failure rate at Garrisdale, Lamasgor and the Nunnery once again appear linked with high levels of predation. At Lamasgor most nests had failed at the egg stage. Numerous predated eggs were found with a groove all along the long axis of the egg. Predation by gulls appears to have been the likely cause. Gulls also probably were involved in predation at the other colonies (including small patches at Geugasgor), but the remains of eaten chicks suggests that some mammalian predation also occurred.

Herring gull

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

Table 4. Herring gull clutch size in late May at six study colonies on Canna in 2001.

	Sub-colony		
	A	*B*	*C*
1 egg	11	2	4
2 eggs	17	11	8
3 eggs	34	19	7
Empty	17	0	1

Overall clutch size was low at 2.38 (excluding the empty nests). In early July eight other colonies were checked to see how many nests had produced chicks.

Table 5. Number of herring gull nests that showed signs of success or failure on Canna in 2001.

	Sub-colony					
	D	E	G	H	I	J
Chicks	34	2	0	1	1	9
Failed	100	31	12	160	25	34

	Sub-colony	
	K	L
Chicks	1	23
Failed	43	226

Of the 702 nests checked only 10% had produced chicks, indicating one of the least productive breeding seasons we have ever recorded on Canna. There was an almost total failure at all colonies on the west of the island. The large colony on Sanday (sub-colony D) and at Rhu Langanis (sub-colony L) were more successful, but even there most of the birds failed. At sub-colony A, the number of fledged chicks was estimated by capture-recapture (see methods), giving a total of only 9 chicks fledging from the estimated 90 nests, an average of only 0.1 chicks fledged per nest, the lowest figure ever recorded on Canna. The very low breeding success may have been due to a large reduction in commercial fishing activity around Canna in the early part of the summer which resulted in far fewer discards from boats and therefore a major food shortage for gulls.

Great black-backed gull

Thirty-two pairs of great black-backed gull were monitored. Of these 25 failed, four produced one young, two produced two young and one produced three young, an overall productivity of 0.34 young per pair. This is by far the lowest figure recorded since monitoring started in 1997 (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 2001.

	Sub-colony			
	K1	*K2*	*K3*	*K4 (Dun Mor)*
*No. sites**	*6*	*4*	*1*	*0*
No. nests	*56*	*53*	*44*	*36*
1 large young	14	15	10	10
2 large young	13	18	7	5
Mean, young per nest	0.71	0.96	0.54	0.56

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

Overall in the Sanday study colony, 135 young were produced from 189 nests (0.71 chicks per nest). At the cave colony on the North side of the island success was even higher with 163 young from 169 nests (0.96 chicks per nest). The mean for the five plots was 0.75 (s.e. $\pm$ 0.09), much higher than the 2000 figure of 0.49 (s.e. $\pm$ 0.08).

Table 7. Breeding success of selected seabirds on Canna 1992-2001.

	1992	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*
Northern fulmar	0.31	0.50	0.50	0.33	0.32	0.33	0.33	0.27	0.44	0.48
Manx shearwater	0.46	0.47	0.75	0.25	0.13	0.08	-	-	-	-
European shag	0.93	1.14	1.45	1.37	1.35	1.75	1.32	0.91	0.80	0.10
Herring gull [a]	60%	58%	67%	70%	32%	78%	53%	11%	63%	10%
Herring gull [b]	0.9	1.6	1.6	1.8	0.3	1.3	0.7	0.4	0.4	0.1
Great b-b gull	-	-	-	-	-	1.5	1.3	1.1	1.3	0.3
Black-legged kittiwake	0.45	0.50	0.86	0.86	0.97	0.95	0.95	0 64	0 51	0.83

Notes:

1. For Northern fulmar and black-legged kittiwake, figures are overall breeding success across all plots, rather than means of individual plot figures.
2. Figures are large young per AOS or egg for Northern fulmars, chicks fledged per egg laid for Manx shearwaters, chicks fledged per nest in which eggs were laid for European shags, large chicks per occupied territory for great black-backed gulls and chicks fledged per AON for black-legged kittiwakes.
3. For herring gull [a] refers to percentage of nests which produced chicks and [b] refers to young fledged per nest based on capture-recapture.

Auks

Auk breeding success appeared to be good but the weights of 56 common guillemot chicks with a wing length greater than 60 mm averaged only 250.4 g (see Appendix 1). This was the lowest mean weight ever recorded on Canna (the previous range being from 257-283 g) and suggests that the chicks were not in prime condition.

7. Ringing studies

Ringing totals

Table 8 shows the number of adults and chicks ringed during 2001 and the number of fully-grown birds retrapped.

Table 8. Number of birds ringed and adults retrapped on Canna in 2001

	Adults ringed	*Chicks ringed*	*Full-grown retrapped*
Northern fulmar	9	19	9
European shag	47	478	43
LBB gull	0	5	0
Herring gull	0	152	0
GBB gull	0	14	0
Black-legged kittiwake	18	113	7
Common guillemot	301	2,225	1,431
Razorbill	151	148	113
Atlantic puffin	25	0	1
Totals	**551**	**3154**	**1,604**

Due to high rates of breeding failure fewer than normal gull and European shag chicks were ringed. The use of a fleyg net increased the number of adult Atlantic puffins and razorbills ringed and retrapped. A record number of adult common guillemots were caught, partly a reflection of increasing numbers.

8. Return rates and age of first breeding

Common guillemot

Of the 1,431 adult common guillemots that were retrapped in summer 2001 an exceptionally high number (362) were birds that had been ringed as chicks on Canna and were retrapped on the island for the first time. These included: four three-year olds (one of which was breeding), only one four-year old, 38 five-year olds (3 of which were definitely breeding), 36 six-year olds, 57 seven-year olds, 36 eight-year olds, 52 nine-year olds and 56 ten-year olds. Swann (2000) showed a negative correlation between the recovery rate of pullus common 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 2001 illustrate this further (Table 9).

Table 9. Recovery rates and return rates of common guillemot chicks ringed on Canna.

Year	*No. ringed*	*% recovered in 1st year*	*% back by 5th year*	*% back by 6th year*	*% back by 7th year*
1984	1,769	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	
1996	2,425	0.6	2.2		

The 1996 cohort, with its very low first year recovery rate, as expected started to reveal high return rates. It is revealing that, with the high return rates in recent years that numbers on Canna have continued to steadily increase. First year recovery rates were also very low from 1997 to 1999 suggesting that this growth will continue.

Razorbill

Sixty-two razorbills that had been ringed as chicks in previous years were retrapped on the island for the first time in 2001. This is an exceptionally high figure and was achieved by using a fleyg net. Six were three-year olds, two were four-year olds, 13 were five-year olds, nine were six-year olds, eight were seven-year olds, two were eight-year olds, seven were nine-year-olds, five were ten-year olds and ten older than this.

European shag

Sixteen European shag chicks were retrapped on the island for the first time. All were breeders, being caught on nests, and comprised two two-year olds, five four-year olds, two six-year olds, four seven-year olds, two eight-year olds and one ten-year old.

9. Feeding studies

Common guillemot

A total of 110 fish were collected from adult common guillemots on their return to the colony, of which 59 (54%) were sprats *Sprattus sprattus*, 30 (27%) were sandeels *Ammodytes* spp., 21 (19%) were Gadidae. Details of the fish sampled are given in Appendix 2. The mean length of the sprats was 106.5 mm (se 1.36), significantly lower than the 1991-2000 mean (111.5 mm, se 0.39, $z=3.60$, $p<0.01$). The mean size of sandeel was only 103.3 mm (se 6.49) significantly below the 1991-2000 mean (135.2 mm, se 3.53, $z=4.32$, $p<0.01$), with 15 of the 23 being 0-group sandeels. Of the Gadidae 13 were whiting *Merlangius merlangus*, three *Trisopterus* sp. (probably Norway pout) and two possibly haddock *Melanogrammus aeglefinus*. The mean size of whiting was 93.4 mm (se 2.86) not significantly larger than the 1991-2000 mean (90.5 mm, se 1.12, 1991-00 data, $z=0.9$, ns).

Other seabirds

Twelve food samples were collected from regurgitations from both adult and pullus black-legged kittiwakes, eight of which mostly contained 0-group sandeels. One of these also contained older sandeels and another a gadoid. The other samples contained gadoids. Two of these were medium-sized gadoids and two small gadoids.

The eight European shag regurgitates gathered in early July all contained a mixture of sandeels, gadoids (mainly *Trisopterus*) and butterfish *Pholis gunnellis*, a pattern echoed by the otoliths from seven pellets collected in May and July (Appendix 2).

Fifteen regurgitations from herring gull chicks were examined, of which only six contained whitefish (considered to be discards from fishing boats), whilst nine contained sandeels. This suggests that due to the reduction in fishing activity around Canna, birds fed on fishing discards to a lesser extent than usual. Indeed there was much evidence of shellfish being eaten in the colonies (particularly mussels and limpets). This may explain the mass breeding failure of gulls on Canna in 2001.

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11. References

Swann, R L (1997) Canna seabird studies 1997. *JNCC Report No.268*

Swann, R L (1998) Canna seabird studies 1998. *JNCC Report No.286*

Swann, R L (2000) Integrated seabird monitoring studies on the Isle of Canna, Scotland 1969-1999. *Atlantic Seabirds,* **2**, 151-164

Walsh, P M, Halley, D J, Harris, M P, del Nevo, A, Sim, I M W, & Tasker, M L (1995) *Seabird monitoring handbook for Britain and Ireland*. Peterborough, JNCC, RSPB, ITE, Seabird Group

Appendices

Appendix 1 Common guillemot chick weights

Weights in grammes

262	288	207	256	260	232	250	256	232	238
254	234	281	260	280	200	262	262	232	224
310	264	242	264	243	225	252	240	260	232
222	230	274	272	246	244	208	274	256	242
266	254	268	250	260	246	231	251	220	252
268	258	258	286	232	250				

Note: Weights taken only from chicks with a wing length of >60 mm. Mean weight was 250.4g.

Appendix 2 Diet samples

Common guillemot

Details are given of the size (mm) of fish caught by adult common guillemots on Canna in 2001.

Sprats: 47 measured

Length	90	92	94	96	97	99	100	101	102
No. of fish	1	1	1	2	2	1	3	1	4

Length	103	104	105	106	107	108	109	110	111
No. of fish	3	1	4	3	1	1	2	4	3

Length	112	115	117	121	127	144
No. of fish	2	2	2	1	1	1

Sandeels: 23 measured

Length	68	73	76	77	79	80	82	89	90
No. of fish	1	2	1	1	2	2	2	1	1

Length	107	116	122	126	136	145	155	163	170
No. of fish	2	1	1	1	1	1	1	1	1

Whiting: 13 measured

Length	*77*	*79*	*87*	*92*	*93*	*95*	*96*	*97*	*102*
No. of fish	1	2	1	1	1	1	1	1	1

Length	105	106
No. of fish	1	2

European shag regurgitates

	Minimum number of:			
Sample no	*Sandeels*	*Gadidae*	*Trisopterus*	*Butterrfish*
1	0	1	0	0
2	0	60 (small)	9	0
3	0	0	1	0
4	20 0-group + 1 older	0	0	0
5	Many 0-group	0	0	0
6	4 1+ or older	15 (very small)	8	0
7	0	0	1	Several
8	0	4*	1	0

*Six otoliths from sample 8 were identified as whiting.

Notes: Minimum counts are presented, based on whole fish counted or number of otliths divided by two. Sample 6 also contained two seamouse *Aphrodita* sp. mandibles.

European shag pellets

Seven European shag pellets were collected, three in late May and four in early July. Their contents were as follows.

Month	*Total no of pellets*	*No of pellets containing:*			
		Sandeels	*Gadidae*	*Trisopterus*	*Butterrfish*
May	3	2	1	2	
July	4	1	4	4	1
Total no. otoliths		251	344	33	1

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