

The numbers of Greenland Barnacle Geese in Britain and Ireland

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Introduction

The population of Barnacle Geese *Branta leucopsis* which breeds in East Greenland winters exclusively on the west and north coasts of Scotland, and round the coasts of Ireland. It is completely separate from the Svalbard-breeding population which winters on the Solway Firth between Scotland and England, and from the Russian-breeding population which winters in the Netherlands. Almost all the wintering haunts of the Greenland population are small, uninhabited islands, and the only practicable method of censusing the population is by aerial survey. Because of expense and other difficulties this has only been achieved at irregular intervals, some years apart.

Although the complete counts of the population are not regularly available, annual monitoring of numbers and breeding success is carried out on the geese wintering on the island of Islay in the Inner Hebrides, where a majority of the population occurs (personal observations), and on the Inishkeas, Co. Mayo, the second most important haunt (Cabot and West 1973; D.B. Cabot, pers. com.)

Ogilvie and Boyd (1975) gave the results of the eight aerial surveys, some of them only partial, carried out between 1957 and 1973. A complete survey was made in spring 1978 but the results were only circulated (Ogilvie 1978). A further complete survey was carried out in spring 1983 and it is the results of this survey, together with those of previous ones, which are dealt with in this paper.

The actual technique used has been described before (Boyd 1968) but briefly involves using a single-engined high-wing light aircraft, with one or two observers, flying at about 140 km/hr and at about 200 m above the ground or sea. Flocks of geese are invariably flushed by the approaching aircraft and counted as they wheel over the land or, in the case of the many small islands, out over the

sea. If necessary the aircraft turns with the flock enabling first estimates to be checked. In addition photographs may be taken for subsequent confirmation but visual counts are always made at the time and indeed are often possible in conditions when adequate photography is not.

After some early trials at different times of the winter, the period of the census has been reasonably constant in recent years, being held in the last few days of March and running into the first week of April. While light aircraft flying at any time of the year in western Ireland and western Scotland will be subject to interference from the weather, this period does offer maximum daylight length. At the other end of the winter the geese do not arrive until late in October. There is some evidence from counts on Islay (see later) that geese may move from one haunt to another, particularly in February and early March, but certainly none depart for the breeding grounds before about the third week of April at the earliest. Thus in late March and early April the weather is not obviously worse and sometimes much better than in the preceding months, the geese are reasonably sedentary, and the daylength is long enough to make two flights of three to four hours each in the course of a day.

The precise route of the survey is dictated by several considerations as well as the known or suspected distribution of the geese. The location of airfields with fuel is a major factor while the need to obtain Customs clearance on entering and leaving the Republic of Ireland also dictates entry and exit points.

The 1983 survey

This took place from 26 March to 5 April and was about average in involving six days of useful flying and five spent grounded by bad weather. The route

taken started in south-west Ireland, after a positioning flight via Cardiff from the aircraft's base in Gloucestershire. From there the survey moved north up the west coast using airfields at Cork, Galway and Sligo. Scotland was reached at Prestwick, whence a survey flight was made up the Inner Hebrides to Benbecula in the Outer Hebrides. This was used as a base for two out and return flights covering the Outer Hebrides chain and the coasts of north-west Scotland. The final survey flight took in more of the Inner Hebrides on the way to Islay, where the author remained to carry out a ground count, while the pilot flew back to Gloucestershire.

The geese on Islay have nearly always been counted from the ground as a contribution to the overall survey, as experience has shown that attempting to count the many large flocks spread over the island from the air poses problems of overlap and omission. The very much smaller numbers present on other haunts, most frequently in a single flock, are very much easier to cope with. In addition welcome ground counts were received for the Inishkeas, Co. Mayo, made by Dr D.B. Cabot, and from Tiree and Coll, made by D. Stroud, both counting within the period of the aerial survey. Oscar Merne, of the Irish Forest and Wildlife Service, kindly made a brief aerial survey of Lambay Island and the Skerries, Co. Dublin. One major mainland haunt in Ireland, that at Lissadell, Co. Sligo, was counted on the ground by the author, saving the need for flying over this wildlife reserve, and usefully occupying some time when weather conditions had grounded the aircraft.

Results

The results of the ten aerial surveys of Greenland Barnacle Geese are presented in Table 1. Following Ogilvie and Boyd (1975) the haunts are combined firstly into 55 sites or grouped sites, and secondly into 11 regions. Barnacle Geese have been recorded on over 200 individual islands and headlands in Ireland and western Scotland in the last 30 years, and actually found on 176 during the course of the aerial surveys. The groupings follow more or less natural bound-

aries, taking in island clusters, or restricted to geographically separated single haunts. The regions, too, follow fairly natural lines, though keeping Islay as a separate region because of its dominating position in the counts. The names of the sites or grouped sites are taken from the most important haunt in the group if there is no existing geographical name for that group. The regions are named on the map in Figure 1, while the numbers allocated in Table 1 to each site or group of sites are also shown on it.

In Table 1, it has been necessary to interpolate some counts for surveys which were incomplete because of bad weather or shortage of time. This has not been done for the first surveys in Scotland and Ireland, those of February 1957 and March 1959, nor for the Irish haunts in March 1965 when only the Inishkeas was visited. In other cases, though, the mean of the counts on either side of the missing one has been used.

Table 1 gives separate sub-totals for Ireland and Scotland, for Scotland excluding the island of Islay, and for Ireland and Scotland combined, but also excluding Islay. This is because the numbers on Islay are so much larger than in the rest of the range that changes in the latter could easily be obscured. The total on Islay rose spectacularly to 1978, but fell quite sharply to 1983. The situation on the island will be discussed in more detail below. In Ireland, numbers rose steadily from March 1959 to March 1966, doubling in the process. Since then there has been a slight decline to 1973, a considerable leap to a record total in 1978, and then as large a decline by 1983 back to very nearly the 1973 level. The picture for Scotland shows some similarities, with a steady growth from December 1957 to March 1966, though with an earlier decline from February 1957 to December 1959. There was then a sharp drop in 1973, a nearly complete recovery in 1978 back to 1966 levels, and then a further slight increase by 1983. These changes have not been uniformly distributed across the two countries as will be seen later.

Use of the individual and grouped sites

One of the logistical problems of the

Table 1. The numbers of Barnacle Geese counted during aerial surveys, 1957-83. Figures in brackets are interpolated means of counts on either side. No interpolations have been made for February 1957, March 1959 or March 1965 (Irish) surveys. Blank = not surveyed.

Region (see Table)	No. on map (Fig 1)	Site or grouped sites	No. of sites in group	Feb 1957	Mar 1959	Dec 1959	Mar 1961	Apr 1962	Mar 1965	Mar 1966	Mar 1973	Mar 1978	Mar 1983
IRELAND													
E. Coast	1	Lambay Island	2								45	66	121
	2	Wexford Slobs	1		0						2	2	
Kerry	3	Blaskets	2			12	85	0		20	0	0	0
	4	Magharee Is	2			0	34	0		0	0	260	0
Clare	5	Illaunearon	1			0	0	90		60	0	0	0
	6	Mutton Is	1			6	280	265		320	480	455	375
Galway	7	St. MacDara's Is	1		0	0	0	0		0	43	225	0
	8	High Is	8		106	190	140	213		411	53	25	0
S. Mayo	9	Inishbroon	1		40	40	0	0		0	20	159	2
	10	Inishdalla	6		40	160	51	86		90	4	238	0
	11	Clew Bay	5		160	53	150	85		0	0	0	54
	12	Inishgallon	1		0	50	0	0		40	0	0	0
W & N Mayo	13	Duvillaun	4		90	30	157	23		156	145	430	0
	14	Inishkeas	2		1600	1200	2300 ¹	2500 ¹	2800 ¹	2600 ¹	1980 ¹	1332	1900 ¹
	15	Inishkeeragh	4		190	10	153	188		40	240	360	50
	16	Kid Is	6			240	152	76		42	164	132	98
Sligo	17	Lissadell	5			363	230	304		370	210	819	900
	18	Inishduff	2			0	0	35		18	45	35	0
Donegal	19	Rathlin	1			10	0	0		0	70	153	20
	20	Toraylaydon	5			90	130	182		262	395	468	560
	21	Inishdooyey	8		30	210	247	309		195	282	545	352
	22	Clonmass	1		0	0	50	45		80	0	55	0
	23	Glasedy Is	4		71	107	5	3		14	220	0	0
TOTAL IRELAND			73		2322	2771	4164	4404		4718	4398	5759	4432
SCOTLAND													
Islay	24	Islay	1	3000		2800	5500	4800	(8300) ²	8500	15000 ³	21500 ²	14000 ³
Inner Hebrides	25	Trodday	1	0		0	18	0	(0)	0	0	70	0
	26	Brosdale Is	2	38		140	107	124	(85)	45	0	0	0
	27	E. Mor (Kintyre)	1	35		0	14	44	(120)	196	110	436	210
	28	En. Mor (Jura)	1	0		10	4	0	(8)	16	(8)	0	0
	29	Olronsay	1	16		0	0	230	(124)	18	40	45	180
	30	Soa	1	5		0	0	0	(31)	61	35	0	2
	31	Treshnish	5	317		299	470	390	510	795	419	610	620
	32	Tiree/Coll	3	420		25	380	484	(419)	534	143	390	619
	33	Small Is	2	19		0	0	2	(29)	(29)	(29)	55	15
	34	Barra-Barra Head	11	225		49	142	171	289	443	80	154	371
Outer Hebrides	35	Sound of Barra	6	238		86	452	415	392	360	336	455	375
	36	South Uist	1	200		110	250	0	23	0	0	0	0
	37	Monachs	3	330		480	519	860	750	1035	640	760	638
	38	Sound of Harris	20	490		174	599	498	493	575	980	1330	1555
	39	Taransay	2	201		15	120	7	0	120	125	0	0
	40	Gaskair	1	41		110	10	70	140	122	0	130	0
	41	Shiant	3	303		290	214	317	450	483	450	420	580
	42	L. Roag	2	37		0	0	0	52	19	0	20	33
	43	L. Erisort	2	0		0	0	32	0	6	0	55	0
	44	Islay	4	151		130	140	395	420	380	297	290	250
Skye	45	Ascribs	3	193		0	122	204	308	272	132	140	172
	46	Trodday	4	182		60	108	47	264	236	143	94	255
N & W coasts	47	Longa	1	38		56	15	20	5	0	(5)	10	0
	48	F'oura	1	21		0	0	11	0	0	(0)	0	0
	49	Summer Is	6	95		73	0	57	(102)	146	(122)	98	54
	50	A. Chleit	2	52		37	33	0	(17)	33	0	49	0
	51	Chrona	4	121		172	100	9	(32)	55	96	121	75
	52	Roin Mor	2	0		21	64	0	(37)	74	190	65	61
	53	Hoan Is	2			(212)	180	244	(335)	425	6	220	0
	54	Rabbit Is	3			(157)	179	135	(133)	130	350	339	255
Orkney	55	Orkney	2									200	500
TOTAL SCOTLAND (excluding Islay)			102	3766		2706	4240	4766	5566	6603	4703	6556	6820
TOTAL SCOTLAND			103	6766		5506	9740	9566	13868	15103	19736	28056	20820
TOTAL IRELAND & SCOTLAND (excluding Islay)			175			5400	8404	9170		11321	9134	12315	11252
GRAND TOTAL			176			8277	13904	13970		19821	24134	33815	25252

Notes.

1. Ground counts provided by Dr D.B. Cabot

2. Mean of two ground counts made during the winter

3. Ground counts on Islay made at the time of the aerial survey

aerial surveys has been that far more islands and headlands have to be checked than actually hold geese at any one time. On only one survey, April 1962, have more than half the known sites held geese (Table 2, upper half), and even when the sites are grouped, the overall percentage has only been above 80% on a few occasions (Table 2, lower half). Over the period of the surveys, the use of individual sites has fluctuated quite considerable, from a little over one-third to just

over one-half. There is little difference between the two countries in this respect, with the exception of the March 1983 survey, when the percentage of sites in use in Ireland fell to an all-time low of 25%, which was not reflected in Scotland. This drop was the more surprising, perhaps, following the record high percentage in use in the previous survey, 58% in March 1978. This pattern was not reflected in Scotland where the March 1983 use was slightly higher than in 1978,

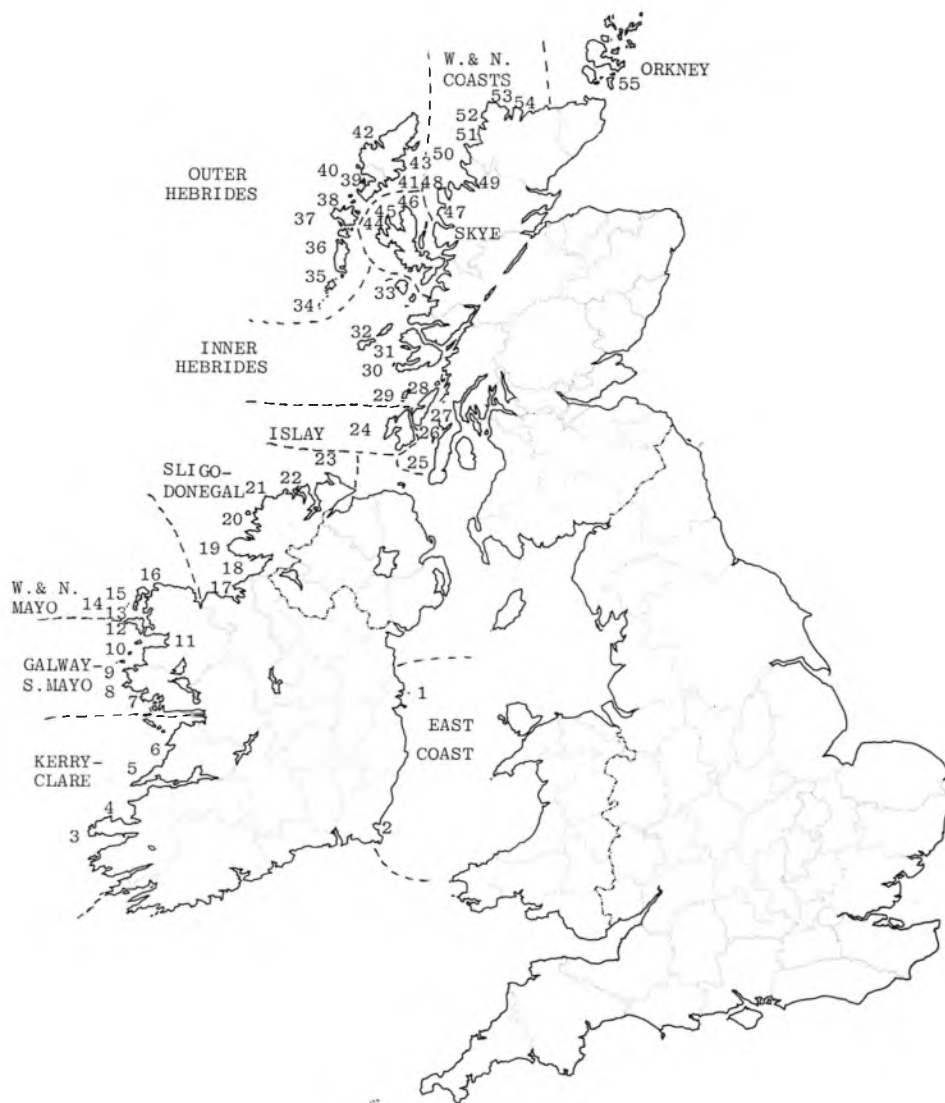


Figure 1. Map showing groupings of Barnacle Goose haunts and divisions between regions. Numbers as in Table 1.

Table 2. Percentage use of individual and grouped sites by Barnacle Geese, 1957-1983

USE OF INDIVIDUAL SITES				Number of sites used at each census								X 100	
Country	Total no. sites used 1957-83	Sep 1957	Mar 1959	Total number of sites used, 1957-83								Mar 1978	Mar 1983
				Dec 1959	Mar 1961	Apr 1962	Mar 1965	Mar 1966	Mar 1973				
Ireland	73		31	40	35	50		45	41	58	22		
Scotland	103	51		37	56	55	54	49	37	42	46		
Total	176	51	31	38	47	53	54	47	39	47	36		
Total of each sites counted in each census		97	44	164	169	164	69	167	160	173	176		

USE OF GROUPED SITES				Number of grouped sites used at each census								X 100	
Country	Total no. of grouped sites used, 1957-83	Sep 1957	Mar 1959	Total number of grouped sites used, 1957-83								Mar 1978	Mar 1983
				Dec 1959	Mar 1961	Apr 1962	Mar 1965	Mar 1966	Mar 1973				
Ireland	23		85	76	71	71		76	74	78	48		
Scotland	31	86		69	77	74	81	87	73	81	65		
Total	54	86	85	72	75	73	81	82	73	80	57		
Total of grouped sites counted in each census		29	13	50	52	52	16	51	49	54	54		

though both were below the overall average.

Changes in the use of individual sites may reflect very short-term behaviour patterns by the geese, hence the grouping of sites adopted here. Within these more or less geographically isolated groups, changes may more nearly indicate the adoption or abandonment of whole areas by the geese. Here the pattern in March 1983 in both Ireland and Scotland is quite striking, with both showing the lowest percentage use for any survey, that in Ireland very markedly down. Quite why this should have occurred is unclear. During the period of greatest increase on Islay it might have been supposed that geese could have been deserting other sites in favour of that island, but there is no evidence of this, at any rate between 1973 and 1978, though, as Ogilvie and Boyd (1975) suggested, it could have been occurring between 1966 and 1973. Between 1978 and 1983, as will be discussed later, the numbers on Islay fell sharply, partly at least as a result of increased shooting and disturbance. The 1983 survey has therefore not produced any indication that the reduction in numbers has led to an increase of use of haunts elsewhere.

Regional distribution

The regional totals are shown in Table 3, together with an overall mean for each. For the seven complete surveys, the totals are expressed in Table 4a as percentages of the total count, with the addition of separate percentages for Ireland and for Scotland. Finally, Table 4b shows the percentage distribution for each region based on totals which exclude the numbers on Islay. Each region will now be examined in turn, leaving Islay to last.

East coast of Ireland

There are just two small haunts here, Lambay Island and the Skerries. Numbers are small but have grown markedly in the last ten years. Until the mid-1960s there was a wintering flock of up to 500 on the Wexford Slob (Rutledge 1966) but this disappeared completely and has shown no signs of returning. However if the present trend on the islands continues, an overflow down to the Slob might well be expected. Up to 20 Barnacle Geese have also been reported on the island of Skomer, off the Pembrokeshire coast, in one or two recent winters though there were apparently none at

Table 3. Regional distribution of Barnacle Geese, 1957-1983

Region	Feb 1957	Mar 1959	Dec 1959	Mar 1961	Apr 1962	Mar 1965	Mar 1966	Mar 1973	Mar 1978	Mar 1983	Mean
E. coast								47	68	121	79
Kerry - Claire			18	399	355		400	480	715	375	392
Galway - S. Mayo		346	493	341	384		541	120	647	56	366
W & N Mayo		1880 ¹	1480	2762	2787		2838	2529	2254	2048	2385
Sligo - Donegal		101 ¹	870	662	878		939	1222	2075	1832	1201
Islay	3000		2800	5500	4800	8300	8500	15000	21500	14000	9266
Inner Hebrides	850		474	993	1274	1326	1670	784	1606	1646	1180
Outer Hebrides	2063		1314	2306	2370	2589	3163	2611	3324	3552	2586
Skye	526		190	370	646	992	888	572	524	677	599
W & N coasts	327 ¹		728	571	476	661	863	769	902	445	677
Orkney									200	500	350
TOTAL	6766 ¹	2327 ¹	8277	13904	13970	13868 ¹	19821	24134	33815	25252	19609

1. Incomplete and not used in calculation of means.

Table 4a. Percentage distribution of Barnacle Geese by regions, 1959-1983

Region	Dec 1959	Mar 1961	Apr 1962	Mar 1966	Mar 1973	Mar 1978	Mar 1983	Mean
E. coast	0	0	0	0	<1	<1	<1	<1
Kerry - Claire	<1	3	3	2	2	2	2	2
Galway - S. Mayo	6	2	3	3	1	2	<1	2
W & N Mayo	18	20	20	14	10	7	8	12
Sligo - Donegal	9	5	6	5	5	6	7	6
Islay	34	40	34	43	62	63	55	47
Inner Hebrides	6	7	9	8	4	5	7	6
Outer Hebrides	16	16	17	16	11	10	14	13
Skye	2	3	5	5	2	2	3	3
W & N coasts	9	4	3	4	3	3	2	3
Orkney	0	0	0	0	0	<1	2	1
Ireland	33	30	32	24	18	17	18	23
Scotland, excl. Islay	33	30	34	33	20	19	27	27

Table 4b. Percentage distribution of Barnacle Geese by regions, 1959-1983, omitting Islay.

Region	Dec 1959	Mar 1961	Apr 1962	Mar 1966	Mar 1973	Mar 1978	Mar 1983	Mean
E. coast	0	0	0	0	<1	<1	<1	<1
Kerry - Clare	<1	5	4	3	5	6	3	4
Galway - S. Mayo	9	4	4	5	1	5	<1	4
W & N Mayo	27	23	30	25	29	18	18	25
Sligo - Donegal	14	8	10	8	13	17	16	12
Inner Hebrides	9	12	14	15	9	13	15	12
Outer Hebrides	24	27	26	28	29	27	32	28
Skye	3	4	7	8	6	4	6	5
W & N coasts	14	7	5	8	8	7	4	8
Orkney	0	0	0	0	0	2	4	1

the time of the 1983 survey (C.M. Perrins, pers. com.). Skomer lies across the Irish Sea from the Wexford Slobs.

Kerry-Claire

Numbers in this region rose quite steadily

from the first survey in December 1979 to that in March 1978. However the process was sharply reversed by March 1983. In percentage terms, the region has, in fact, shown little change overall. It relies heavily on one site, Mutton Island, which is still being grazed. Sites to the south of that, the Magharee and Blasket

Islands, have never been occupied as regularly.

Galway – South Mayo

Numbers in this region have always fluctuated but it is difficult to see why they should drop so dramatically as they did between 1978 and 1983. Several different haunts are involved and at least some of them are as suitable now as they were in the past. It may be that in 1983 the geese had moved north earlier than usual, or that there is some other, underlying, reason why they were not present then. Only future surveys will be able to show whether this was a fluke result or the start of a more marked change.

West and North Mayo

This has always been the most important region in Ireland, thanks to the inclusion of the Inishkeas, two islands off the west coast. The number of geese on them has fallen, though, from a consistent level of around 2500 in the early 1960s, to the present 1900. Dr D.B. Cabot has paid nearly annual visits to the islands for many years and confirms that this drop has taken place though he has not been able to establish a definite reason for it. The islands have been sheep-grazed for very many years and continue to be so.

There is no evidence that the geese are leaving the Inishkeas for the immediately adjacent islands, though they undoubtedly use them, as was shown by the 1978 survey. They are all quite small, and can only support limited numbers for any period.

Sligo – Donegal

This region of Ireland has shown some increase. Overall numbers more than doubled to 1978, though they dropped slightly by 1983. For the percentage of the population which it holds, it is now rivalling West and North Mayo. Much of the increase can be attributed to the mainland reserve at Lissadell, established in 1971, while the acquisition in 1982 of Sheshkinmore should bring more

benefits in the future. Several of the islands in the region no longer look as suitable as they once did, but presumably the mainland reserves have compensated for this at least in part.

Inner Hebrides

The numbers in this region rose throughout the 1960s but fell away badly at the time of the 1973 census, only to rise again to about the same level in 1978, with this number being maintained to 1983. The percentage of the whole has shown no definite trend. The region includes the haunts closest to Islay, but despite the great increase there, has not apparently reflected it. Certainly there is no evidence of substantial numbers being driven off Islay to these nearest islands.

Outer Hebrides

This region has shown a fairly steady growth in numbers right through to 1983, the only region to do so. There was a slight decline in 1973, but this was quickly made good by the time of the next survey.

The National Nature Reserve on the Monarch Islands, established in 1966, did not bring about any increase there. Rather the increase has been concentrated in the many islands scattered over the Sound of Harris, between the main islands of North Uist and Harris. The larger islands at the west end of the sound are much more important than those in the east, not least because some of them have stretches of sheep-grazed machair, fertile grass and herb swards on lime-rich sand. There have, indeed, been complaints from crofters and farmers on the inhabited island of Berneray that the geese are becoming a nuisance, though none have been seen on that island on any of the recent surveys.

Another important haunt within this region is the group of three islands making up the Shiant. After little change through several surveys, they held record numbers in March 1983.

Skye

The islands round Skye, particularly

in the bays on the north-west side, and off the north coast, have held a fairly steady number of geese, though are now below the peak reached in 1966 and 1967. They are not very important in percentage terms but are an important link in the range, connecting the west coast of the mainland with the Outer Hebrides.

West and North coasts of Scotland

The numbers here have varied quite a lot between surveys, and fell to their lowest ever in March 1983. This was rather puzzling, particularly because of the establishment in 1980 of a reserve on Eilean Hoan off the north coast. Active management includes sheep grazing: 534 Barnacle Geese were counted there in February 1982, and 740 on 30 October 1982 (R. H. Dennis, pers. com.). On the west coast most of the island haunts are very small and some, certainly, seem to be suffering from a lack of grazing in recent years. The percentage of birds in this region seemed to be declining slowly but steadily even before the sharp drop in 1983.

Orkney

At the time of the March 1973 survey there were apparently no regularly wintering Barnacle Geese in Orkney, but by 1978 there was a flock of 200, which had increased to 500 by March 1983. The birds frequent small islands in Scapa Flow.

It is not absolutely certain that these Barnacle Geese do belong to the Greenland population. There have been a number of ringing recoveries and colour-ringing sightings in Orkney of Barnacle Geese belonging to the Svalbard population which winters in the Solway Firth and it would not be inconceivable that this flock might be made up of birds stopping short of their destination. However, a local observer has failed to see any colour-ringed birds among the flock at a time when as many as 20% of the Svalbard population are carrying them (P.J. Reynolds, in litt.) and so the likelihood is that they do belong to the Greenland population.

Their inclusion in the 1983 survey results accounts for the whole of the increase in the Scottish total since 1978. Subsequent changes in the size of this wintering flock will be of considerable interest.

Islay

Ogilvie (1983) reviewed the numbers, changes in status, and problems with agriculture, of the Barnacle Geese on Islay, in the period to 1980-81. This section will briefly cover some of the same ground, as well as bringing the situation up to date.

Table 5 sets out all available counts of the geese on Islay taken from Boyd (1968), Ogilvie (1983), and the files of the Wildfowl Trust. Some of the earlier counts were probably little more than estimates, while others may well have been incomplete. Since the mid-1960s, all the November counts, and the great majority of those at other times of the winter, have been made by the author, usually in the company of another experienced goose counter.

Changes in the numbers of the Barnacle Geese found on Islay have to be viewed in conjunction with the annual breeding success of the birds. This is measured each autumn by means of age-ratio counts, typically sampling in most recent years at least 4000 birds to produce a percentage of young birds which can be regarded as typical for the whole population on the island. These percentages are also set out in Table 5.

The most obvious points to be drawn from Table 5 include the very considerable and rapid increase in numbers which took place from the early 1960s to the peak of 24000 in November 1976. Counts before 1960 are both less complete and almost certainly less accurate, but it does seem as if there were fluctuations in numbers through the 1950s but no distinct trend. Numbers have fallen since 1976, and especially since 1980. Also apparent from the table is the increase which takes place in most winters, such that the February or March count is either actually larger than the count the previous November, or shows only a small fall, despite winter mortality. The obvious conclusion to be drawn is that

Table 5. Counts of Barnacle Geese on Islay, 1952-3 to 1982-3, and annual breeding success.

Winter	November	December	January	February	March/April	% young
1952-3		3000				
1953-4	2750					
1954-5			9000			
1955-6					3000	
1956-7				3000		
1957-8	10000	6250 ¹			5500	
1958-9	10000	4200 ¹	5600		4500	
1959-60		2800 ²		7700 ¹		14.1
1960-1	4600			6850	5500 ²	9.7
1961-2	5800			6300	6900 ¹ 4800 ²	10.7
1962-3	6100				8700	7.6
1963-4				10400		30.6
1964-5	8300		8250			7.5
1965-6					9000 8500 ²	11.2
1966-7	8400	6500		10500		13.0
1967-8	16500			10600		17.1
1968-9	13300		12300	13100		9.5
1969-70	14300				13700	20.0
1970-1	14500				15100	19.4
1971-2	16600				17100	13.6
1972-3	17300				15000	12.1
1973-4	18100				18400	17.4
1974-5	19400				19300	13.0
1975-6	20200		19800		20100	13.9
1976-7	24000			21000	19800	22.4
1977-8	19600			22200	21500	4.9
1978-9	22000				17000	12.0
1979-80	17300				17300	8.3
1980-1	20500				18000	11.4
1981-2	14800				17000	7.3
1982-3	12800			14000	14000 ¹	6.7

1. Average of 2 or 3 counts made in same month

2. Counted from the air

geese move to Islay from other haunts during the winter, probably in February and early March. This obviously has a bearing not only on the situation on Islay, but also on the true picture pertaining elsewhere in the range, as at the time of the aerial surveys in late March and early April, this movement will already have taken place.

The varying breeding success shown in Table 5 explains some, though probably not all, the variation in total numbers. Certainly the decline in recent years has been in parallel with a series of poor breeding years, though there have also been increasing losses over the same period, largely from an increase in the shooting on the island. Ogilvie (1983) described how increased shooting had increased the kill from around 500-700 per winter during the 1960s and early

Table 6. Recruitment and losses of Barnacle Geese on Islay, 1959-1982.

Period	Mean recruitment %	Mean losses %
1959-66	12.7	6.8
1967-74	15.2	7.4
1975-82	11.6	15.3

1980s.

Table 6 summarises the recruitment and losses of the Islay population since 1959, showing the rapid rise in losses in recent years, coupled with declining productivity.

The situation has now changed once more, with the 1981 Wildlife and Countryside Act granting full protection to the Barnacle Goose, but also permit-

ting licensed shooting on Islay to prevent serious agricultural damage. The first winter of licensed shooting, 1982-83, saw a reduction in the number of geese shot, probably to well under 1000, and this number may fall further in subsequent winters. However disturbance of the geese, already increased by the extra shooting, may continue at a high level as more attention is paid to scaring the birds from vulnerable crops.

Discussion

The aerial surveys have fulfilled the requirement of discovering the size of the Greenland population of Barnacle Geese, though at infrequent intervals. The situation on Islay continues to be monitored very regularly and information gathered is of use both in discussions of the undoubted problem of the geese versus the Islay farming community and in studying the population as a whole. Unfortunately our understanding of the population away from the island is at best incomplete, and at worst, dangerously wrong. There are two areas where the Islay counts can be used to interpret what has happened elsewhere in the range. These are the annual breeding success, and the movement of birds to and from Islay.

The only other haunt, apart from Islay, where regular age-counts have been made, is the Inishkeas, Co. Mayo. Here Dr. D.B. Cabot has amassed a long run of observations which show that on average, the breeding success of the birds wintering on the Inishkeas is only about 50% that of the birds on Islay (Cabot and West 1973; Dr D.B. Cabot, pers. com.). Dr Cabot attributes this, at least in part, to the much less good feeding for the geese on the Inishkeas as compared with on Islay, all the grass being old, unfertilised, and merely grazed by sheep. On Islay the geese feed extensively on resown pastures many of which are fertilised to produce early spring growth. Evidence is accumulating that the spring condition of geese returning to the arctic to breed may be the most important factor controlling breeding success, whilst being heavily modified by such factors as weather on the actual breeding grounds (see Owen 1980).

If the breeding success figures for the Inishkeas are typical of the rest of the range then this would help to explain why the numbers have not grown on these other islands to the same extent as on Islay. However the second feature of the Islay situation also has a bearing on this, namely the influx of birds during the late winter. These are presumably geese moving to Islay to take advantage of the better spring feeding there, or because there simply is no worthwhile spring food at wherever they spend the first part of the winter.

It is difficult to put a precise figure on the number of Barnacle Geese moving to Islay during the winter, but the totals in Table 5 suggest that it varies between a few hundred and perhaps 3000. If these geese return the following autumn to their previous winter's haunt then it could be argued that their breeding success, at least, ought to be closer to that of the birds which spent the winter on Islay rather than those which wintered elsewhere. On Inishkeas Dr Cabot has marked between 17 and 70 birds in several recent years. Some of these birds, which are colour-ringed, have been seen on Islay, and a few have turned up year after year, spending the whole winter there. This would tend to suggest that these birds had been converted from Inishkeas-winterers to Islay-winterers. However the sample is very small. It is possible to speculate that some of the steady increase in numbers on Islay through the 1960s and 1970s may have been because birds moved to Islay one winter and then returned there in the following autumn instead of going back to their original haunt.

Ringling of geese on Islay or more frequent aerial surveys are the only ways in which more can be discovered about movements to or from Islay during the winter, though ringling would only yield results if several other haunts could be visited on the ground. In some years, notably 1967-8, 1972-3, 1976-7, and 1978-9, there was a substantial drop in numbers from the November count to the March or April one. If at the same time birds had been arriving on Islay from other haunts then the real decline must have been greater. It is possible to find particular reasons why numbers might have dropped in certainly three of the winters

listed. The numbers present in November 1967 were altogether exceptional and perhaps caused by the temporary arrival on the island of geese which then moved off to their more traditional haunts. Winter 1976-7 was a difficult one for the geese on Islay, with the largest numbers ever recorded present in the autumn, but very little food for them following the prolonged drought of 1976. Finally winter 1978-9 was a very cold one and again it is felt that there may have been a worsening food shortage through winter.

What it is not possible to discern, particularly with the infrequency of the aerial surveys, is what happened to the birds which left Islay in those winters. Certainly there has been no massive increase in the rest of the range over a period of years to compensate for the equally massive decline experienced on Islay. The implication is that when birds did leave Islay through food shortage, coupled with the increased shooting and disturbance, it led to an overall population decline not a redistribution.

It may be felt that the status of the geese away from Islay gives no major cause for concern. Numbers have increased over the full period of the surveys, and at least maintained themselves in recent years despite probable poor breeding. However there is the problem of the possible deterioration in habitat on some of the traditional wintering islands, a subject which badly needs more study. A further problem is the continuing shooting and scaring of the geese on Islay. Under the new licensing system, the geese may be shot throughout the winter and spring, the closing date now being 30th April. Although the actual numbers of birds being shot may well be many fewer than in recent years, the continuing disturbance and harrying of the birds is bound to have an adverse effect on their ability to build up fat reserves, and thus adversely affect their subsequent breeding success. Furthermore this effect will not just be on the birds wintering on Islay, as was the former shooting, finishing as it did in February, but also on those birds coming to Islay from other haunts for the spring. They, too, will suffer and so, in due course, will the numbers of geese on those other haunts.

There are proposals for a large sanc-

tuary for the geese on Islay, coupled with management of the land to improve the feeding for geese within the reserve area and so relieve the pressure on other parts of the island. Whether or not these ideas are implemented, and this seems fairly likely in the near future, it is of great importance for the well-being of the population as a whole to see that the right conditions are maintained or even improved elsewhere in the range. The number of reserves for the geese is very few, and while statutory protection takes time and may not always be practical, it would be well worth exploring the possibility of ensuring adequate sheep-grazing of as many of the island haunts as can be achieved, whether by the provision of small subsidies to the traditional graziers, or by the actual provision of the sheep by some conservation body. At the same time the oft-heard plea must be made again for more monitoring and research. Censuses at five-yearly intervals are wholly inadequate for a proper understanding of what the population is doing, particularly in view of the rapidly changing situation on Islay, while our knowledge of the food requirements of the geese is woefully meagre. The establishment of a large reserve on Islay, while vital to the geese on that island, must not be considered as the sole conservation requirement of the population, but only as part of an integrated plan covering the whole range and based on a much better comprehension of the needs of the geese than we have at present.

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Summary

The population of Barnacle Geese *Branta*

leucopsis which breeds in East Greenland and winters in western Ireland and Scotland has been censused by aerial surveys at irregular intervals since 1957. The population grew from about 8000 in 1959 to 33800 in 1978 but dropped to 25000 by 1983. The situation on Islay, where between 34% and 63% of the population has been found on different surveys,

dominates the overall picture, but the changes in status in other areas are identified and discussed. A reduction in sheep grazing on some small islands may be adversely affecting numbers of geese using them. Conservation and management suggestions are put forward but only in conjunction with more research and monitoring.

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