



**GREENLAND BARNACLE GEESE
BRANTA LEUCOPSIS IN BRITAIN
AND IRELAND: RESULTS OF
THE INTERNATIONAL CENSUS,
SPRING 2008**

WWT Report

Authors

Carl Mitchell¹, Alyn Walsh², Colette Hall¹ & Olivia Crowe³

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1 WWT, Slimbridge, Gloucester, GL2 7BT, UK

2 National Parks and Wildlife Service, Wexford Wildfowl Reserve, Co. Wexford, Ireland

3 Birdwatch Ireland, P.O. Box 12, Greystones, Co. Wicklow, Ireland

Published by:

Wildfowl & Wetlands Trust

Slimbridge
Gloucestershire
GL2 7BT

T 01453 891900

F 01453 891901

E monitoring@wwt.org.uk

Reg. charity no. 1030884

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SUMMARY

Between 1959 and 2008, twelve full international surveys of the Greenland population of Barnacle Goose have been conducted at wintering sites in Ireland and Scotland using a combination of aerial survey and ground counts. This report presents the results of the 2008 census, conducted primarily between 16-18 March 2008, surveying a total of 328 islands and mainland sites along the west and north coasts of Scotland and Ireland. In Ireland, 33 sites were found to hold 12,232 Greenland Barnacle Geese and in Scotland, 40 sites were found to hold 58,269. The total wintering population was estimated at 70,501 birds. This represents a 25.0% increase on the 2003 census total.

Growth of numbers on Islay has increased in recent years. An increase of 23.3% has occurred since the survey of spring 2003 compared to a previous increase of 3.7% from 1999 to 2003. Likewise, numbers of geese throughout the remainder of Scotland have increased by 23.5% compared with 7.9% between the surveys of 1999 and 2003. In Ireland, an increase of 35.3% has occurred since the survey of spring 2003 compared to a previous increase of 4.3% from 1999 to 2003. The highest rate of increase (39.0%) was found at sites away from the Inishkea Islands.

Several key sites hold the majority of geese. A comparison of the number of occupied sites in each of the census years indicates that the number of occupied sites in 2008 was higher than in any previous year. In Scotland, combined numbers at the key sites have undergone a continued high rate of increase, whereas numbers at outlying sites have stabilised following an initial increase up to the early 1970s. In Ireland, combined numbers at the key sites have similar rates of increase as areas elsewhere, although much of this growth is attributable to increasing numbers at Ballintemple/Lissadell. Numbers on the Inishkea Islands have remained comparatively constant since the 1960s. Numbers at sites outside these two key areas have continued to increase steadily from the mid 1970s.

Counts of Greenland Barnacle Geese on Islay in March 2007 suggested that 52,709 birds were present, approximately 6,500 more than the total count there in spring 2008. Only two other sites showed significantly higher counts in spring 2007 compared with spring 2008. Tiree and Coll were counted later than Islay and probably held birds that had moved north from Islay. It is possible, therefore, that the March 2007 count on Islay was an over-estimate.

The 2008 census found 26 sites that exceeded the threshold for national importance; nine of these also exceeded the threshold for international importance. Of these, Oronsay, Isle of Danna and South Walls all held more than 1% of the international total in 2008, but are not classified as SPAs (although the principal roost site of the South Walls flock, on Switha, is an SPA). However, as the population has increased, the number of sites exceeding nationally (and internationally) important thresholds has decreased since 1959.

The suite of SPA/SSSIs which have Greenland Barnacle Goose as a qualifying species held 94.9% of the national population in Scotland and 73.5% of the national population in Ireland. The number of Barnacle Geese has increased on six of the nine SPAs in Scotland. The six sites are close to relatively large areas of managed grassland, particularly on Islay. Three remote offshore island SPAs in Scotland have shown a decline in usage, despite a dramatic increase in the overall population.

The current monitoring strategy of one international census every five years is inadequate in terms of fully understanding distribution and use of sites throughout the wintering range. Although counts at key sites such as Islay, Coll, Tiree and South Walls are carried out throughout the winter, aerial surveys are restricted to late March/early April, and therefore provide only a single 'snapshot' of the distribution across the range. There is a need to increase the frequency of counts across the wintering range above and beyond that which is currently being achieved, to meet the international timetable for the revision of waterfowl population estimates and 1% thresholds.

Consequently, it is recommended that a full international census is held every three years to enable revision of estimates in line with the established international timetable. The feasibility of additional mid-winter counts, to better ascertain the mid-winter distribution and identify those sites which are important at that time of year, should be explored to help improve knowledge of site use and potential impacts of changing site management.

1 INTRODUCTION

The world range of the Barnacle Goose *Branta leucopsis* comprises three distinct populations: the North Russian/Eastern Baltic breeding population which winters in the Netherlands and north Germany; the Svalbard breeding population which winters on the Solway Firth, Scotland/England; and a third population which breeds in northeast Greenland (Ogilvie *et al.* 1999). The Greenland population winters almost exclusively in north and west Scotland and west Ireland. In Scotland, the wintering range extends throughout the Inner and Outer Hebrides and north to Orkney. On the west coast of Ireland, the main concentrations occur between the Dingle Peninsula, Co. Kerry, and Inishowen in north Co. Donegal.

The first full survey of wintering sites was undertaken in 1959/60 (Boyd 1968), since when there have been 12 full international censuses, conducted at approximately five-yearly intervals (see Worden *et al.* 2004). Some of the wintering sites can be surveyed by ground counts, but because of the inaccessible nature of most sites (many are uninhabited, comparatively remote islands), aerial survey is required to achieve complete coverage of the population. This report presents the results of the 2008 census which was coordinated in Scotland by the Wildfowl & Wetlands Trust (WWT) and, in Ireland, by the National Parks and Wildlife Service (NPWS).

2 METHODS

The methodology employed for the international census has been previously described in full (Walsh & Merne 1988). Weather conditions, length of daylight hours and type of aircraft (in the past) have meant that aerial surveys were more easily carried out in late March or early April (Boyd 1968). Aerial surveys are conducted using a high-winged aircraft flying at approximately 150-200 m above ground or sea. Counts are undertaken as the geese are flushed by the approaching aircraft. One observer makes a visual estimate of flock size while the second attempts to photograph the geese. The photographs are examined later and, if of good quality, are used to derive the count for the census total. The visual count is used where the quality of the photograph is poor or where there were difficulties photographing the entire flock. All islands where Barnacle Geese have previously been recorded are surveyed, as are all other islands and adjacent mainland coast where suitable vegetation is present.

Ground counts are made on several key sites in Scotland and Ireland where large flocks occur and where access is possible. Ground counts are used to derive the census totals for these sites, since this method provides the most accurate estimates for large flocks. The first ground-based counts on Islay were made in 1952/53 and these have continued annually since. In recent years, two or three counts have been undertaken on Islay each winter (in late autumn, mid-winter, and early spring) by Scottish Natural Heritage (SNH) as part of the Islay Goose Management Scheme, to assess numbers of Greenland White-fronted Geese *Anser albifrons flavirostris* and Greenland Barnacle Geese. The international census of Barnacle Geese is timed to coincide with the spring count. Counts are usually repeated on two consecutive days and the mean of these (the 'adopted' count), unless one is deemed inaccurate, is used as the island total. SNH and the Royal Society for the Protection of Birds (RSPB) undertake at least two counts each winter on both Tiree and Coll and sites in southwest Argyll, coordinated with those on Islay. SNH also carries out monthly ground counts on South Walls, Orkney as part of the Barnacle Goose Refuge Scheme and have done so since winter 1994/95. As part of the international census, ground-based counts are also undertaken at other known sites (where accessible), e.g. the Sutherland coast and North Uist. In Ireland, ground counts on the Inishkea Islands began in 1962 and have continued annually to the present, while regular counts have been made at mainland sites at Lissadell/Ballintemple.

The 2008 aerial survey of Scottish sites was conducted between 16-17 March 2008, using a twin-engined Partenavia aircraft. A total of 15 hours flying was undertaken, surveying approximately 216 islands and remote areas along the west and north coast. Surveys were conducted only when weather conditions were suitable. The daily flight itinerary comprised:

16 March: Glasgow, Islay, west coast Argyll, Mull, Coll/Tiree, Small Isles, northwest Skye, Stornoway.
17 March: Shiant, Skye, Wester Ross, Sutherland, Lewis, Harris, North Uist/Sound of Harris, Benbecula, Monach Isles, Sound of Barra, islands to Barra Head.

Aerial survey in Ireland was undertaken using an Aer Corp Rheims Rocket Cessna 172 and was carried out on two days, 17-18 March 2008. Approximately 11 hours flying was undertaken, surveying sites in a south to north direction along the west coast of Ireland from the Blasket Islands, Co. Kerry to Inishtrahull, Co. Donegal. Weather conditions were good, with good light and visibility and generally light winds. The daily flight itinerary comprised:

17 March: Survey of all known sites from Blasket Islands to the North Mayo coast at Strandhill, Co. Sligo.
18 March: Ballintemple/Lissadell northwards to Inishtrahull Island.

Ground counts at the following sites were used to calculate the total population estimate: Oronsay (5 March), Eilean Trodday (7 March), Floday (10 March), Aird Mhic Caoilt, Grenitote, Goula/Balranald, Balemor and Kirkibost, North Uist and Tolsta and Port of Ness, Lewis (all 16 March), Coll & Tiree (17 March), Machrihanish and the Isle of Danna (18 March), Islay (18/19 March), South Walls (19 March), Eilean Hoan/Balnakeil (20 March), Summer Isles (24 March), Staffin Island (25 March), Inisheeny (12 March), Roonagh Lough (13 March), Ballybeg Island and Termoncarragh (both 17 March), Moynishmore Island, Rosmurrevagh, Lisadell/Ballintemple, Loughros Beg Bay and Malin Head (all 18 March).

Overall, 89% of the 73 counts were undertaken in the 3 day period 16-18 March, 2008.

3 RESULTS

During the 2008 census, a total of 328 islands and mainland sites was visited. Thirty-three of the 112 sites surveyed in Ireland were found to hold Greenland Barnacle Geese and 40 of the 216 sites in Scotland were found to have birds present. Counts at all sites holding Greenland Barnacle Geese during the 2008 census are given in Table 1 and their locations are shown in Figs. 2 & 3. Sites visited but where no geese were found are listed in Appendix 1.

The Scottish total was 58,269 geese, while that of Ireland was 12,232 geese. A flock of 232 Greenland Barnacle Geese was recorded at the Dyfi Estuary, Wales, in October to December 2007 (R. Jones pers. comm.), but the flock left the site in late December 2007 and in March 2008, at the time of the census, no geese were present. Thus, the total population estimate was 70,501 birds.

Overall, 94.5% of the census total comprised estimates from ground counts (85.5%) and from photographs obtained during aerial survey (9.0%). In Scotland, five small flocks, with an average flock size of c. 44 birds, were counted by visual estimation during aerial survey. In Ireland, 32% of counts there were derived from visual estimates. This included a single flock of 2,525 birds counted, from the air, on the Inishkea Islands. The estimate is considered accurate, since a ground count undertaken by David Cabot revealed 2,550 birds just prior to the survey period. Excluding that flock, 12 smaller flocks, with an average flock size of c. 78 birds, were counted by visual estimation during aerial survey. The relatively small flock sizes of geese estimated in this way minimised potential errors. The accuracy of visual counts has been shown to be acceptable when numbers have been compared to those derived from photographic verification of individual flocks (Delany & Ogilvie 1994, Cranswick *et al.* 2000). Likewise in 2008, although only 5.5% of the count total was derived using visual estimates, a comparison of counts where both estimates and photographs were available gave reasonable correlation (Fig. 1).

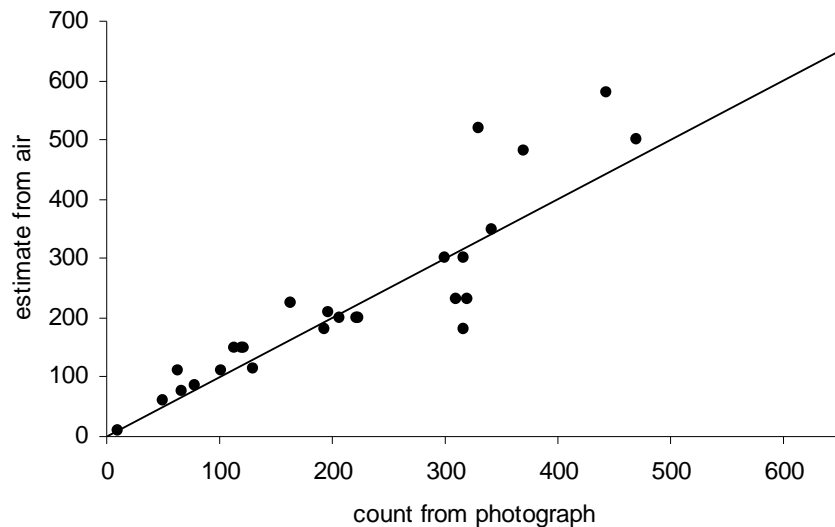


Figure 1. Accuracy of visual estimates compared to photographic counts of individual Barnacle Goose flocks in Scotland and Ireland during the 2008 aerial survey (line indicates 100% accuracy).

Table 1. Sites holding Greenland Barnacle Geese in March 2008 (unless indicated, counts were derived from estimates during aerial survey; G denotes ground count, P denotes photographic verification).

County	Site	Grid reference	Number of geese	Method	
Ireland					
Clare	1	Illauonearaun	Q828570	80	
	2	Mutton Is.	Q975745	120	P
Galway	3	Inishmuskerry	L785265	20	
	4	Birmore Is.	L810265	121	P
	5	Croaghnaकेला Is.	L688332	330	P
	6	Duvillaun	L585662	320	
	7	Inishshark	L490650	444	P
Mayo	8	Inishdalla	L633721	67	P
	9	Ballybeg I.	L650758	55	G
	10	Roonagh L.	L752760	52	G
	11	Inisheeny	L920844	145	G
	12	Moynishmore Is.	L865943	280	G
	13	Rosmurrevagh	L859954	47	G
	14	Inishgalloon	F621030	36	
	15	Duvillaun More	F574160	221	P
	16	Leamareha Is.	F605178	80	
	17	Inishkea Islands	F550220	2,525	
	18	Inishkeeragh	F605304	50	
Sligo	19	Inishglora	F614315	90	
	20	Termoncarragh	F665350	850	G
	21	Kid Is.	F790435	35	
Donegal	22	Lisadell/Ballintemple	G600440	3,930	G
Donegal	23	Rathlin O'Birne	G466798	370	P
	24	Loughros Beg Bay	G660920	203	G
	25	Inishbarnog	G640963	5	
	26	Roaninish	B659028	207	P
	27	Inishkeel	B710000	210	
	28	Inishkeeragh	B680122	164	P
	29	Inishmeane	B795285	32	
	30	Inishsirrerr	B785304	196	P
	31	Inishdoeey	B895385	190	
	32	Dunfanaghy	C020380	320	P
	33	Malin Head	C400598	437	P
Ireland Total			12,232		
Scotland					
Kintyre peninsula	34	Machrihanish	NR6719	33	G
Islay	35	Islay	NR3060	44,961	G
Inner Hebrides	36	Island of Danna	NR6978	711	G
	37	Oronsay	NR3588	1,200	G
	38	Garbh Rèisa, Luing	NR7597	113	P
	39	Staffa (Treshnish Isles)	NM3235	130	P
	40	Bac Mór (Treshnish Isles)	NM2438	10	P
	41	Fladda (Treshnish Isles)	NM2943	67	
	42	Tiree	NL9645	3,393	G
	43	Coll	NM1553	167	G
Skye	44	Muck/Eilean nan Each	NM4279	102	P
	45	Isay	NG2157	316	P
	46	South Ascrib	NG3063	79	P

County	Site	Grid reference	Number of geese	Method
Skye (cont.)	47 Eilean Trodday	NG4479	56	G
	48 Staffin Island	NG4969	70	G
Outer Hebrides	49 Fiaray	NF7010	342	P
	50 Ceann Ear (Monach Isles)	NF6562	470	P
	51 Ceann Iar (Monach Isles)	NF6063	50	P
	52 Balemore/Paible	NF7466	360	G
	53 Balranald/Goula	NF7070	620	G
	54 Grenitote/Sollas/Malacate	NF8175	236	G
	55 Vallay	NF7776	175	G
	56 Trumisgarry	NF8675	32	G
	57 Boreray	NF8581	750	P
	58 Berneray	NF9182	120	G
	59 Killegary	NF9783	64	P
	60 Ensay	NF9786	193	P
	61 Shillay	NF8891	300	P
	62 Garbh Eilean (Shiants)	NG4198	224	P
	63 Soay Beg	NB0505	9	
	64 Floday	NB1033	10	G
65 Tolsta	NB5447	36	G	
66 Port of Ness	NB5463	14	G	
West Sutherland	67 Gruinard	NG9494	40	
	68 Summer Isles/Achiltibuie	NC0308	60	G
	69 Soyea	NC0421	42	
	70 Meall Mor	NC1238	65	
North Sutherland	71 Eilean Hoan	NC4467	832	G
	72 Eilean nan Ròn	NC6365	205	P
Orkney	73 South Walls	ND3189	1,612	G
Scotland total			58,269	
Wales				
Dyfed	Dyfi Estuary	SN6090	0	G
Ireland total			12,232	
Scotland total			58,269	
Wales total			0	
Total population			70,501	

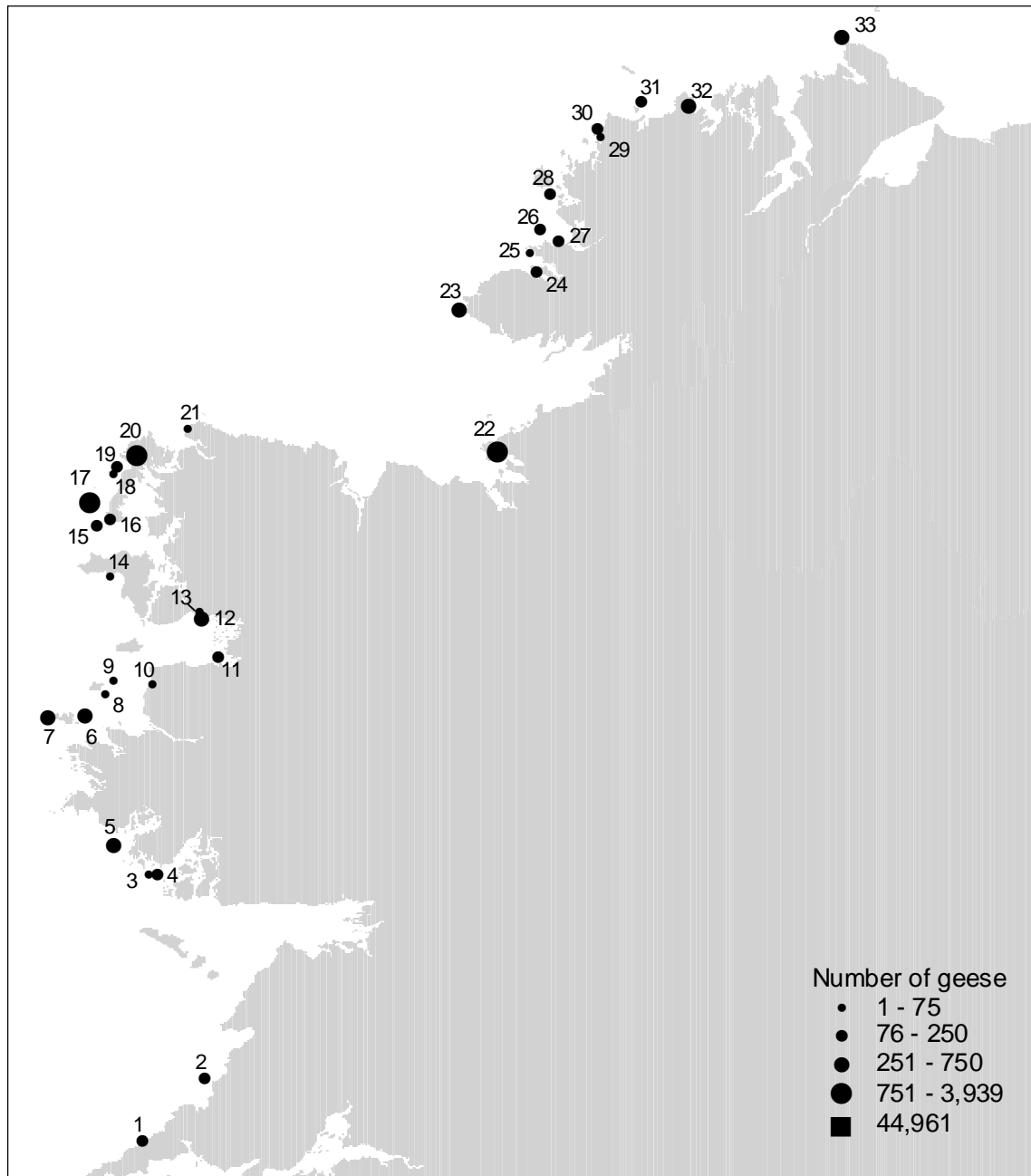


Figure 2. Sites in Ireland holding Barnacle Geese in March 2008 (see Table 1 for key to site numbers).

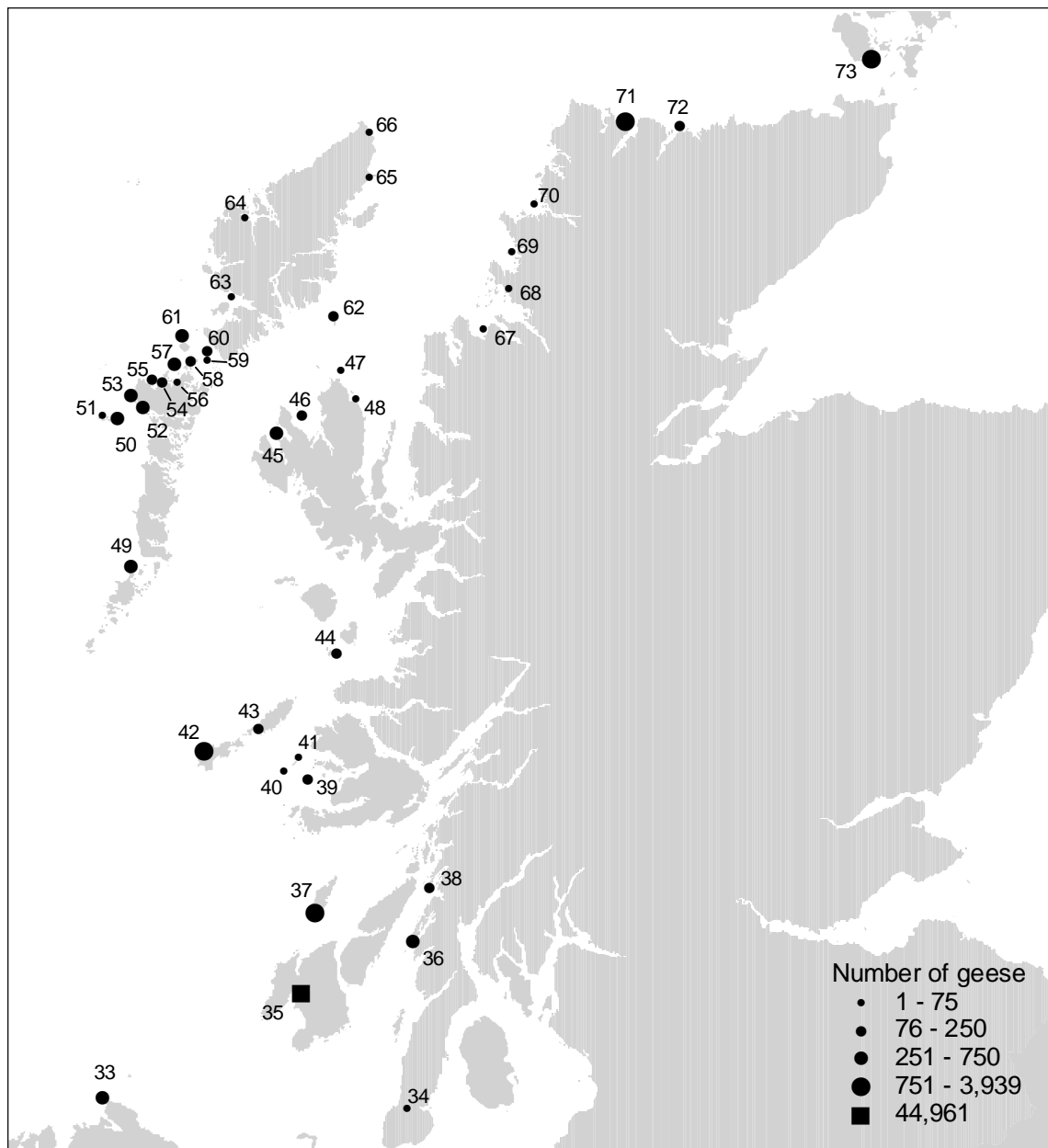


Figure 3. Sites in Scotland holding Barnacle Geese in March 2008 (see Table 1 for key to site numbers).

4 DISCUSSION

4.1 Census total and accuracy

The population of Greenland Barnacle Geese, as surveyed in Britain and Ireland in March 2008, was 70,501, the highest total to date, having surpassed the previous peak count of 56,386 in March 2003. Count conditions during the census were good, and 89% of ground and aerial counts were made over the course of three days, minimising the risk of geese having moved between sites and resulting in them being missed or double-counted. Estimates derived visually during aerial survey – a potential area of inaccuracy – comprised only 5.5% of the census total. Consequently, it is recommended that the population estimate for Greenland Barnacle Goose is revised, following standard rounding conventions (see Kershaw & Cranswick 2003), to 70,500 birds.

4.2 Long-term trend and distribution

Total numbers of Greenland Barnacle Geese have continued to follow an upward trend (Fig. 4). The increase on Islay since the 1960s (except for a drop in numbers in the 1980s) has been maintained. Although overall numbers elsewhere in Scotland remained relatively constant throughout the 1970s and 1980s, numbers have increased since 1994. Numbers on the Inishkea Islands have remained comparatively stable, while numbers at other Irish sites are still following a long-term upward trend.

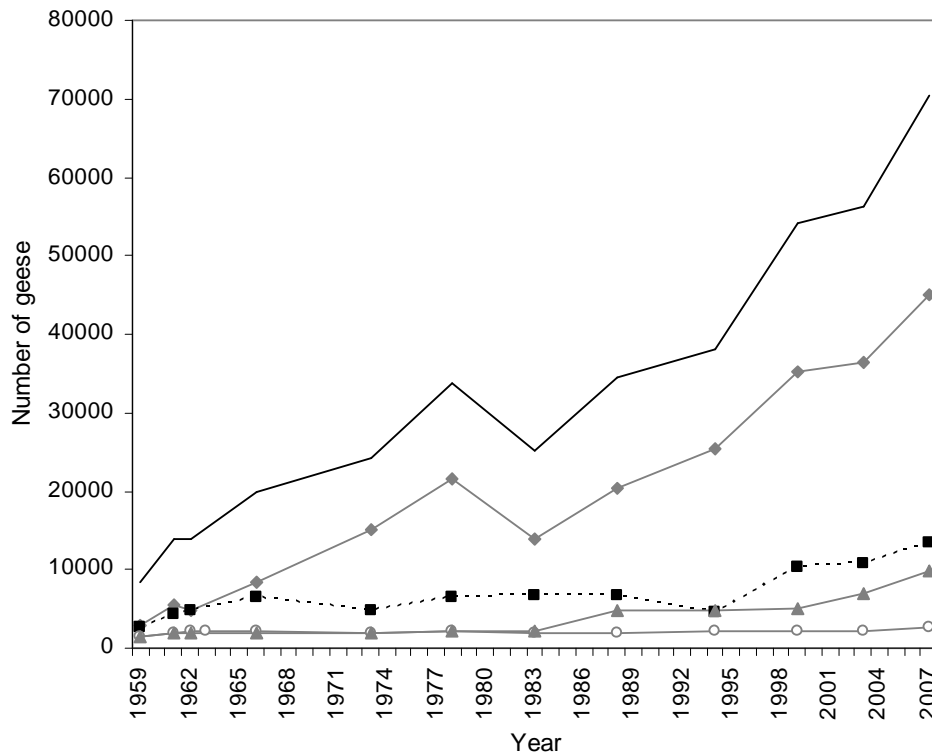


Figure 4. Census totals for the Greenland population of Barnacle Geese, 1959-2007 (— Total population, ◆ Islay, - -■ - - Scotland excluding Islay, ○ Inishkea Islands, ▲ Ireland excluding Inishkea Islands).

It has been previously suggested that the population is becoming concentrated at a small number of sites while outlying sites away from these key areas have seen a decline in numbers (Delany & Ogilvie 1994, Cranswick *et al.* 2000). Changes in distribution and use of individual islands have occurred since 1959, although a comparison of the number of occupied sites in each of the census years does not indicate any clear trend and, overall, the number of occupied sites in 2008 was higher than in any previous year (Fig. 5).

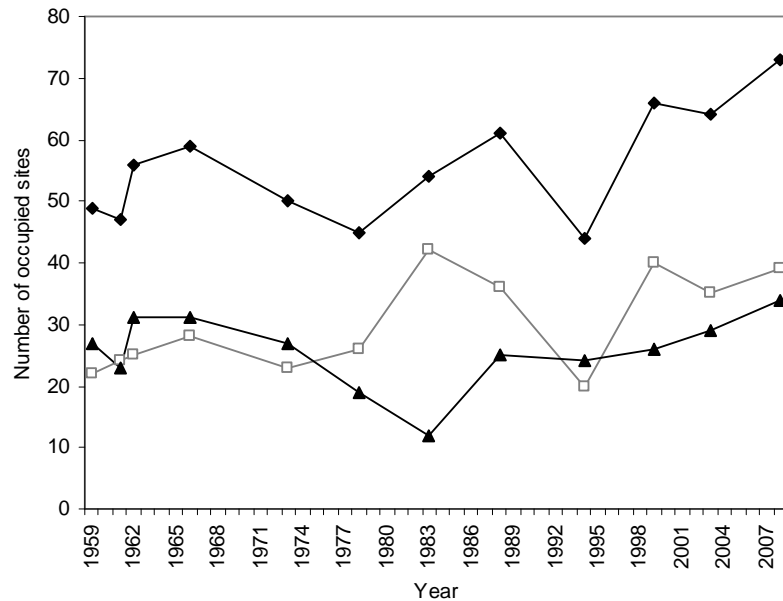


Figure 5. Number of sites occupied by Greenland Barnacle Geese in spring censuses 1959-2008 (● Scotland, □ Scotland, ▲ Ireland).

Results of recent censuses have indicated that the increase in the population as a whole is largely dictated by increases at a small number of key sites. Currently, Islay, Tiree, Coll, South Walls, Inishkea Islands and Ballintemple/Lissadell hold the majority of geese (80.3% of the total in 2008) with Islay alone holding 63.8% of the population total. Overall, numbers at these key sites have increased more than six-fold since 1959 (Fig. 6a). Total numbers outside these areas are still increasing, albeit at a lower rate (less than a three-fold increase).

In Scotland, combined numbers at the key sites have increased, whereas numbers at outlying sites have stabilised following an initial increase up to the early 1970s (Fig. 6b). Census data indicate that use of some sites, such as the Treshnish Isles and the Shiantas, has decreased since the late 1970s/early 1980s. This has been coincident with an increase in use of sites such as Boreray, Eilean Hoan and South Walls. Delany & Ogilvie (1994) suggested that many uninhabited islands have seen decreases in numbers of geese owing to habitat deterioration brought about by the cessation of grazing. In contrast, habitat changes caused by movement towards more intensive farming methods, and the establishment of goose management schemes, have attracted geese to alternative sites.

In Ireland, combined numbers at the key sites show similar rates of increase as areas elsewhere (Fig. 6c), although much of this growth is caused by an increase in numbers at Ballintemple/Lissadell. Numbers on the Inishkeas Islands have remained relatively constant since the 1960s. Numbers at sites outside these two key areas have continued to increase steadily from the mid 1970s.

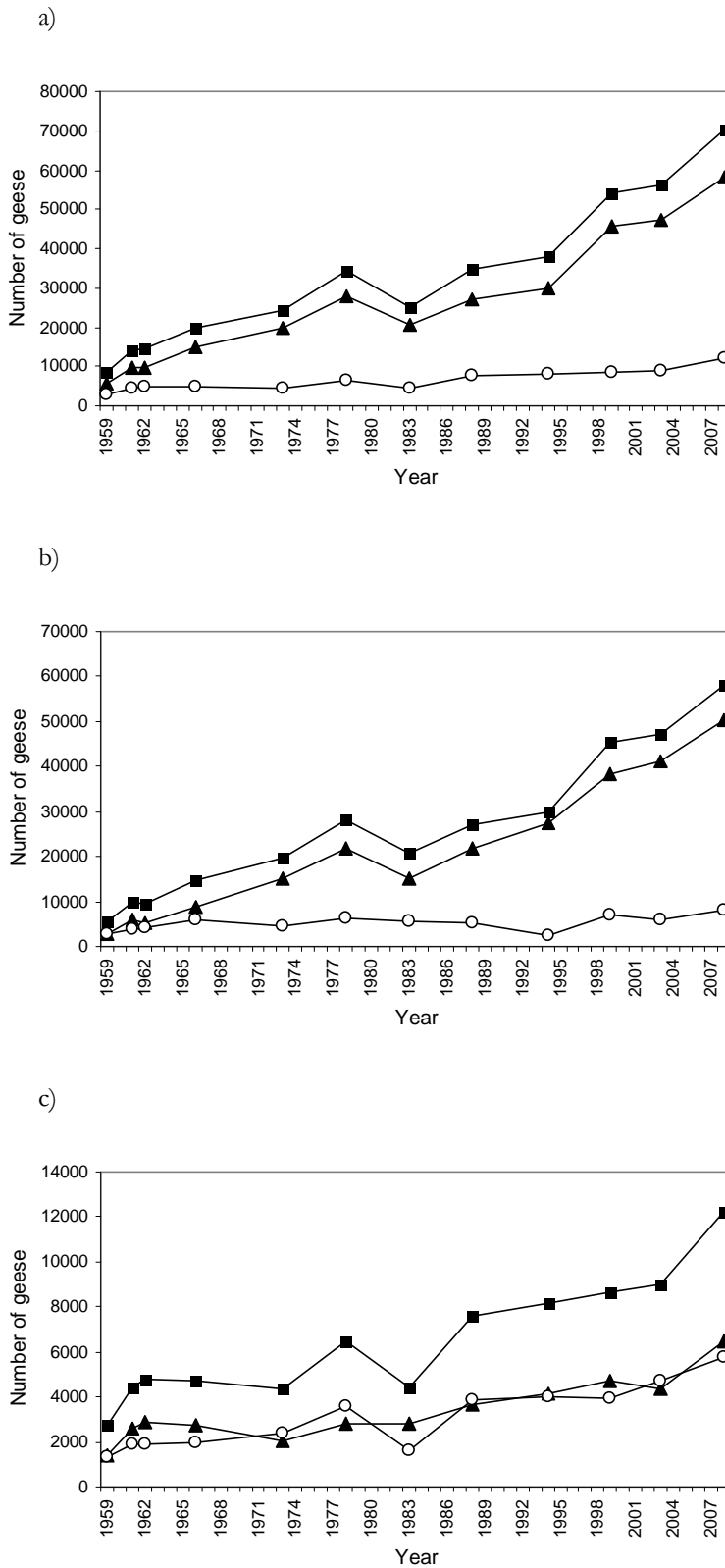


Figure 6. Trend in the number of Greenland Barnacle Geese found within and outside key sites: a) Scotland and Ireland combined, b) Scotland only and c) Ireland only; ■ All sites, ▲ Key sites, ○ other sites (key sites are Islay, Coll, Tiree and South Walls in Scotland; Inishkea Islands and Balintemple/Lissadell in Ireland).

There was a 25.0% increase in Greenland Barnacle Goose numbers between 2003 and 2008. The percentage change at the key sites of Islay and the Inishkea Islands, in Ireland and Scotland as a whole, and in Wales, are given in Table 2.

Table 2. Percentage change in Barnacle Goose numbers in Scotland, Ireland and Wales between March 2003 and March 2008.

	March 2003	March 2008	Change (%)
Scotland total	47,256	58,269	23.0%
Islay	36,478	44,961	23.3%
Scotland excluding Islay	10,778	13,308	23.5%
Ireland total	9,034	12,232	35.3%
Inishkea Islands	2,052	2,525	23.1%
Ireland excluding Inishkea Islands	6,982	9,707	39.0%
Wales	96	0	n/a
Population total	56,386	70,501	25.0%

This increase may be influenced by changes in survival and breeding success within the population. The annual percentage of first-winter birds recorded on Islay has decreased since the mid-late 1980s, although numbers of geese on Islay have continued to undergo substantial increases throughout this period (Fig. 7). Potential decreases in mortality and the introduction of goose management schemes, aimed in part to benefit geese, may have supported the continued population growth within this period. Pettifor *et al.* (1999) have shown that the population is more susceptible to changes in mortality than productivity.

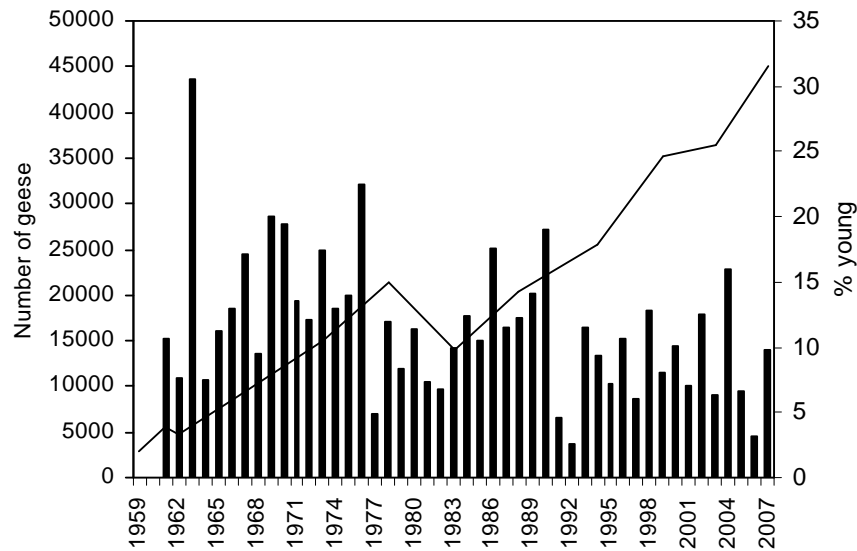


Figure 7. Population size (—) and percentage of first-winter birds (columns) of Greenland Barnacle Geese on Islay, 1959-2007.

4.2.1 Winter season 2006/07

Counts collated from three key sites in Scotland in winter 2006/07 suggest that higher numbers of Greenland Barnacle Geese were present in that season than in spring 2008 (Table 3). On the most important site, Islay, some 6,524 more birds were counted in spring 2007 compared with spring 2008. There was no indication from any other sites in Scotland, or Ireland, that counts at the major sites there in spring 2008 were any lower than the previous year, so the apparent decline was not universal. In addition, breeding success in 2006 was very low, at 3.2% young, so a large increase in the winter population was not expected.

Table 3. Counts of Greenland Barnacle Geese from three sites in Scotland in spring 2007 and 2008.

Site	Date of count in 2007	Count in 2007	Date of count in 2008	Count in 2008	Difference in numbers	% change between 2007 and 2008
Islay	17/21 Mar	51,485	17/18 Mar	44,961	- 6,524	-12.7%
Tiree	22/23 Mar	4,323	17/18 Mar	3,393	- 930	-21.5%
Coll	25/26 Mar	2,456	17/18 Mar	167	- 2,289	-93.2%

The mid-winter count on Islay, carried out in December 2006 found 47,053 Barnacle Geese, some 4,432 fewer than recorded in March 2007. It is possible that the late March 2007 count was an overestimate, or conversely the March 2008 count was an underestimate, although there was no indication from the counters on Islay that this was the case (M. McKay pers. comm.). Less likely was that the count contained birds that had started spring passage, although if this was the case it is hard to know where these birds may have come from. The only flocks further south than Islay are in west Ireland, and recent evidence from satellite tracking shows that tagged Barnacle Geese make a direct movement from west Ireland to Iceland during spring migration (not via sites in Scotland) (L. Griffin pers. comm.).

On Coll, the count in December 2006 was 1,415 birds, some 1,041 geese fewer than the count of 2,456 geese recorded on 25/26 March 2007, some 8-9 days later than the count on Islay. On Tiree, the spring 2007 count (4,323 birds) was carried out on 22/23 March some 2-3 days later than on Islay and was also higher than regular counts recorded throughout the winter (by c. 2,500 birds). The presence of newly arrived colour ringed birds seen on Tiree in late March, that had been recorded on Islay during the winter, suggests that by that time, Barnacle Geese had started spring passage within Scotland. It is therefore, likely that the large numbers recorded on Coll and Tiree contained birds on spring passage, probably from Islay.

However, regular counts through winter 2006/07 indicate that c. 1,415-2,456 birds were present on Coll that winter and the decline on that island in winter 2007/08 (maximum count 167 birds) was real.

4.3 Internationally and nationally important sites

A site is internationally important if it regularly supports 1% or more of the individuals in a population (following criterion 5 of the Ramsar Convention) (Wetlands International 2006). In Britain, a site is considered nationally important if it regularly holds 1% or more of the British total, and in Ireland if it holds 1% or more of the all-Ireland total. Assessments of site importance are usually made on the basis of a minimum of three years' data, but in the absence of regular counts at many of these sites, we have here assessed the 2008 count against 1% of the international, British and all-Ireland estimates obtained during this census. Based on these totals, the 1% threshold for international importance is 705 geese, for national importance in Britain it is 582 geese, and for all-Ireland importance it is 122 geese.

The 2008 census found 26 sites that exceeded the British or all-Ireland threshold, and nine sites that exceeded internationally important numbers. The number of sites exceeding nationally important numbers (based on the published 1% threshold at that time) decreased from 1959 to 1983, but has stabilised since then. The number of sites exceeding internationally important numbers shows a long-term decline (Fig.8).

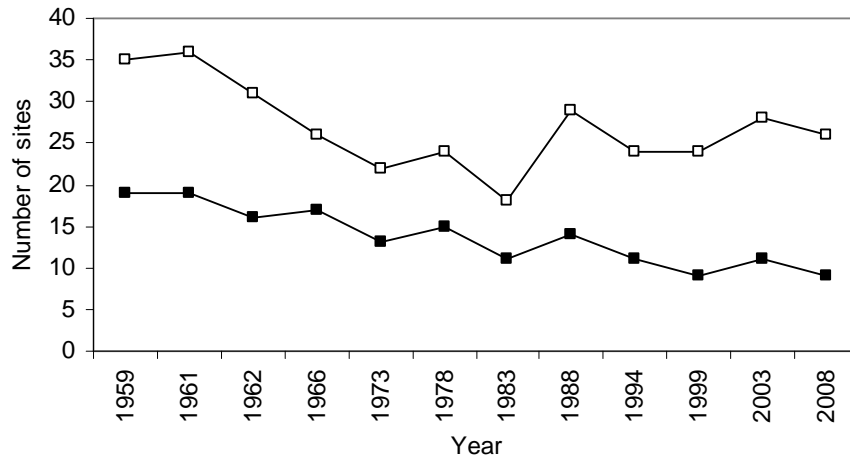


Figure 8. Number of sites in Britain and Ireland holding nationally or internationally important numbers of Greenland Barnacle Geese in census years, 1959-2008 (□ nationally important sites, ■ internationally important sites).

Those sites exceeding the threshold for national importance in the 2008 census are listed in Table 4. Many of these sites are protected wholly, or in part, by classification as Special Protection Areas (SPAs) under the EC Birds Directive. Oronsay, Isle of Danna and South Walls all held more than 1% of the international total in 2008, and are not classified as SPAs. The latter is omitted from the current SPA boundary (despite consistently exceeding internationally important numbers since the 1980s) on the basis that it is an area of largely agricultural rather than natural or semi-natural habitat. However, the principal roost site for this flock, on Switha, is an SPA. It is important to note that the site boundaries used in this census may not match site boundaries of SPAs, so the numbers quoted are indicative only. For example, over 44,000 Barnacle Geese were counted on Islay in March 2008, and some, but not all, of these use three SPAs where the geese are a qualifying species. Similarly on Coll and Tiree, geese counted there roost and feed both within and outwith the SPA boundary. The number of Greenland Barnacle Geese wintering within and outwith SPAs merits further analysis.

Table 4. Sites holding more than 1% of international, British or Irish totals of Greenland Barnacle Geese in March 2008 and their conservation status.

Site name	SPA classification (italics denote those sites where Barnacle Geese are a qualifying feature of the SPA)
Sites holding >705 birds in March 2008:	
Islay	<i>Gruinart Flats, Laggan, Bridgend Flats, Rhinns of Islay, Eilean na Muice Duibhe</i>
Tiree	<i>Sleibhtean agus Cladach Thiriodh</i>
South Walls, Orkney	<i>Switha (the main roost of the South Walls flock is an SPA)</i>
Oronsay	
Eilean Hoan	<i>North Sutherland Coastal Islands</i>
Boreray	<i>North Uist Machair and Islands</i>
Isle of Danna	
Inishkea Islands	Inishkea Islands
Ballintemple/Lissadell	Cummeen Strand & Drumcliff Bay
Termoncarragh	Termoncarragh Lake & Annagh Machair
Additional sites in Britain holding >582 birds:	
Balranald/Goula	<i>North Uist Machair and Islands</i>
Additional sites in Ireland holding >122 birds:	
Inishshark	Inishbofin & Inishark
Malin Head	
Rathlin O'Birne	Rathlin O'Birne Island
CroaghnaKeela	
Duvillaun, Galway	
Dunfanaghy	Dunfanaghy/Rinclevan
Moynish More Island	
Davillaun More, Co Mayo	
Inishkeel, Donegal	Inishkeel
Roaninish	Roaninish
Loughros Beg Bay	
Inishsirrerr	Inishsirrerr & Inishmeane
Inishdooney, Donegal	Inishbofin, Inishdooney & Inishbeg
Inishkeeragh (Donegal) group	Illancrone & Inishkeeragh
Inisheeny	

The suite of protected areas in Scotland and Ireland that have Greenland Barnacle Goose as a qualifying species, the proportion of the population that they support and the current level of monitoring are shown in Tables 5 & 6. In March 2008, four of the nine SPAs in Scotland (Coll, Monach Isles, Shiant Isles and Treshnish Isles) did not hold internationally or nationally important number of Greenland Barnacle Geese, although overall, the suite of SPAs in Scotland held 94.9% of the national population.

Peak counts during the non-breeding season from the late 1950s for the nine SPAs, and additional 3 SSSIs, in Scotland are shown in Fig. 9.

Table 5. Percentage of the national and international population of Greenland Barnacle Geese present in the protected area network in Scotland in March 2008, and their current level of monitoring. See text for discussion on site use by geese.

Site Name	Site total in March 2008	% of biogeographical population	% of national population	Level of monitoring
SPA				
Islay ¹	44,961	63.8%	77.1%	Annual
Coll ²	167	0.2%	0.3%	Annual
Monach Isles	520	0.7%	0.9%	c. 5 years
North Sutherland Coastal Islands ³	1,037	1.5%	1.8%	Annual (part)
North Uist Machair and Islands	1,870	4.0%	4.9%	Annual
Shiant Isles	224	0.3%	0.4%	c. 5 years
Switha ⁴	1,612	2.3%	2.8%	Annual
Sleibhtean agus Cladach Thiriodh (Tiree Wetlands and Coast)	3,393	4.8%	5.8%	Annual
Treshnish Isles	207	0.3%	0.4%	c. 5 years
SSSI				
Ulva, Danna and the McCormaig Isles	711	1.0%	1.2%	Annual
Pabbay ⁵	0	0%	0%	Annual
Balranald Bog & Loch nam Feithean ⁶	620	0.9%	1.1%	Annual
TOTAL	55,322	78.5%	94.9%	

¹ Counts on Islay include the Gruinart Flats, Laggan and Bridgend Flats SPAs.

² No Barnacle Geese were recorded on Gunna in March, 2008. The Coll figure (167 geese) will include all geese using southern Coll, Crossapol and Gunna.

³ Includes counts from Eilean Hoan/Durness (where monitoring is annual) and Eilean nan Ron/Kyle of Tongue (less than annual monitoring).

⁴ Barnacle Geese feed at South Walls, Orkney (non SPA) and roost on Switha.

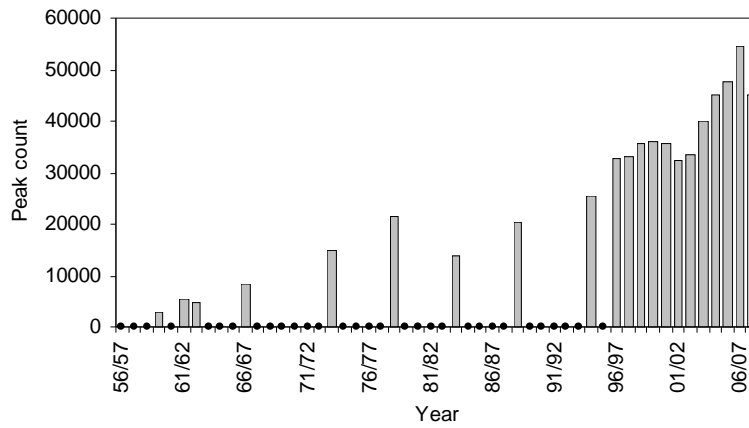
⁵ Barnacle Geese are quite mobile within the Sound of Harris. In March, 2008 no Barnacle Geese were recorded on Pabbay, however they were probably feeding on Shillay (NF8891) where 300 geese were recorded.

⁶ Barnacle Geese are quite mobile along west North Uist. In March, 2008, 620 Barnacle Geese were recorded at Balranald, however this represents a minimum figure, since, an additional 360 geese were recorded at Paible/Balmore (NF7466) less than 5km from Balranald.

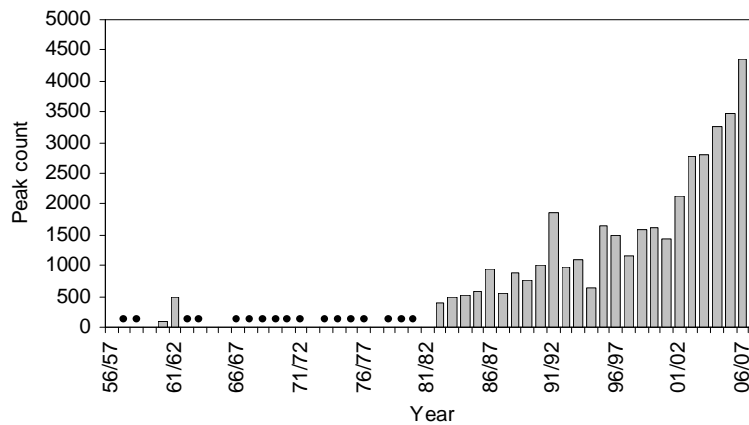
Table 6. Percentage of the national and international population of Greenland Barnacle Geese present in the SPA suite in Ireland in March 2008, and their current level of monitoring. See text for discussion on site use by geese.

Site Name	Site total in March 2008	% of biogeographical population	% of national population	Level of monitoring
Inishkea Islands	2,525	3.6%	20.6%	Annual
Drumcliff Bay	3,930	5.6%	32.1%	Annual
Termoncarragh Lake & Annagh Machair	850	1.2%	7.0%	Annual
Rathlin O'Birne Island	370	0.5%	3.0%	c. 5 years
Dunfanaghy/Rinclevan	320	0.5%	2.6%	Annual
Inishkeel	210	0.3%	1.7%	c. 5 years
Roaninish	207	0.3%	1.7%	c. 5 years
Inishsirr & Inishmeane	228	0.3%	1.9%	c. 5 years
Inishbofin, Inishdooy & Inishbeg	190	0.3%	1.6%	c. 5 years
Illancrone & Inishkeeragh	164	0.2%	1.3%	c. 5 years
TOTAL	8,994	12.8%	73.5%	

a) Islay



b) Tiree



c) Coll

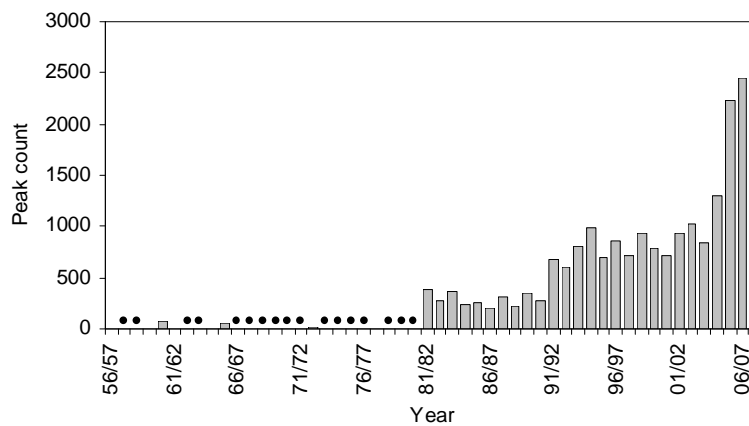
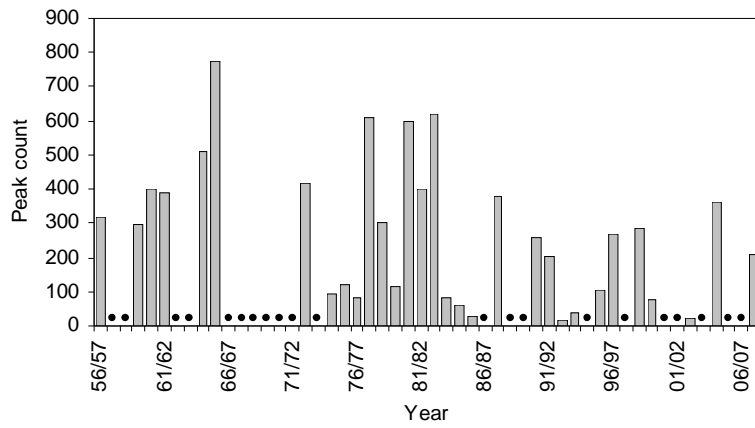
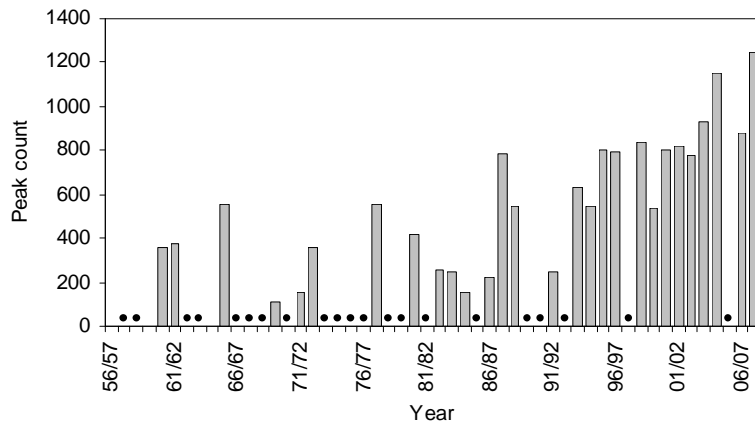


Figure 9a-c. Maximum winter numbers of Greenland Barnacle Geese, 1956-2008, at SPAs in Scotland. Dots indicate years when no data were collected.

d) Treshnish Isles



e) North Sutherland coast



f) North Uist coast and islands

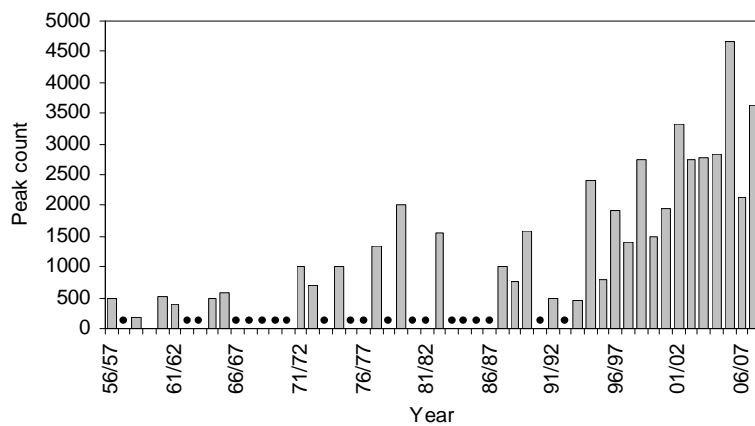
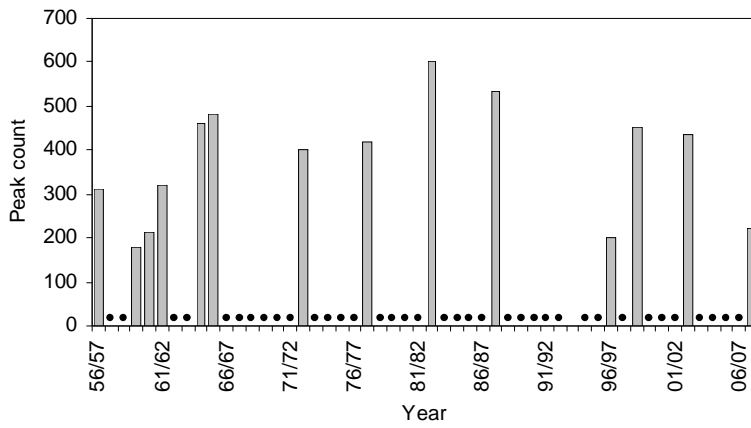
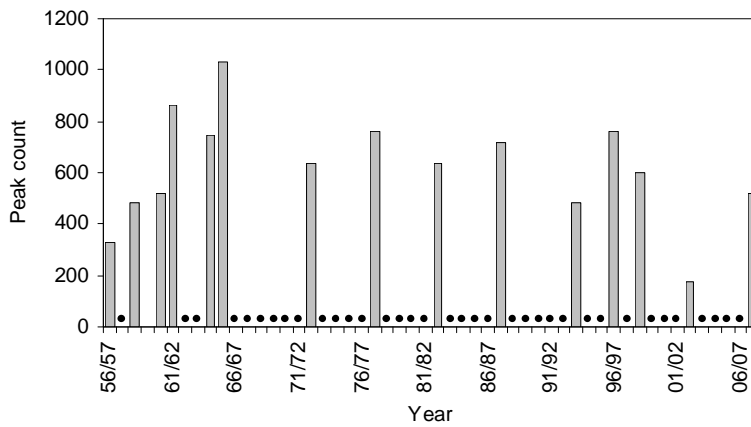


Figure 9d-f. Maximum winter numbers of Greenland Barnacle Geese, 1956-2008, at SPAs in Scotland. Dots indicate years when no data were collected.

g) Shiant



h) Monach Isles



i) South Walls

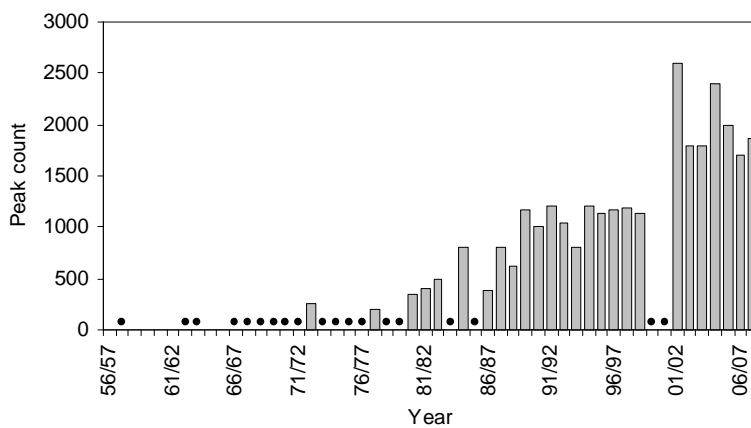


Figure 9g-i. Maximum winter numbers of Greenland Barnacle Geese, 1956-2008, at SPAs in Scotland. Dots indicate years when no data were collected.

The number of Greenland Barnacle Geese has increased at six of the nine SPAs in Scotland (Islay, Tíree Wetlands and Coast, Coll, North Sutherland Coastal Islands, North Uist Machair and Islands, and Switha (South Walls) (Fig. 9). All six sites either hold, or are close to, relatively large areas of managed grassland, particularly on Islay. Three SPAs have showed a decline in usage, despite a dramatic increase in the overall population (Fig. 9), namely the Treshnish Isles, Shiant Isles and Monach Isles, which are relatively small offshore islands with no areas of managed grassland, although to some degree, all have been summer grazed by sheep. Summer grazing has been identified as an important requirement for over-wintering Barnacle Geese (see Ogilvie *et al.* 1999). Any reductions in this management may be having an effect on numbers wintering at these sites. The overall proportion of the biogeographical population using the Scottish SPAs is shown in Fig. 10 and has shown a long-term increase, although this is heavily affected by the inclusion of counts from Islay. The island supports five SPAs of which three have Greenland Barnacle Goose as a qualifying species (see Table 4). However, the geese occur over much of the managed grassland on Islay, both within and outwith the SPA boundaries.

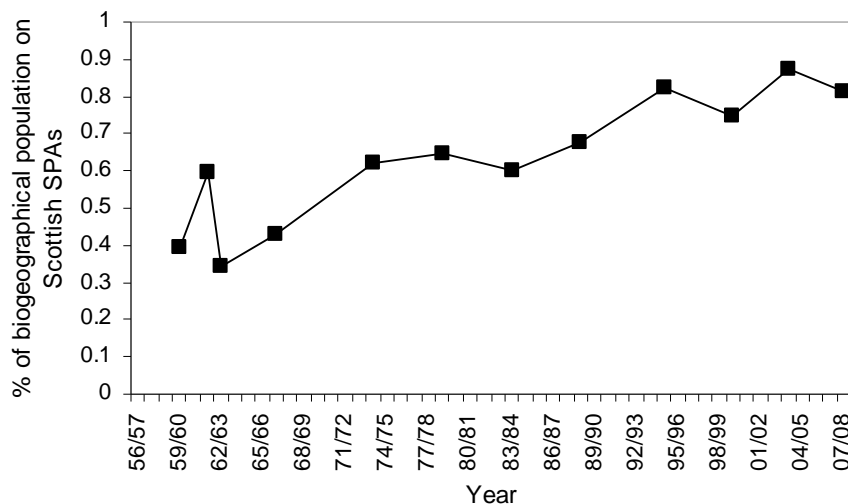


Figure 10. The proportion of the biogeographical population of Greenland Barnacle Geese using SPAs in Scotland, 1958-2008.

4.4 Recommendations

The generally accepted international timetable for waterbird population estimates to be revised is every three years, with the 1% thresholds revised once every nine years (Rose & Stroud 1994). The current monitoring programme of one international census every five years is, therefore, inadequate in terms of providing sufficient understanding of changes in numbers, and the distribution and use of sites throughout the wintering range. It is therefore recommended that the frequency of the international census should be increased to once every three years in order to better fulfil these objectives. However, to be effective an increase in the frequency of coordinated censuses would require the participation of all countries holding wintering Greenland Barnacle Geese.

Numbers of Barnacle Geese at several of the key sites are surveyed annually, and in some cases at different times of the winter. However, there are limited data available for most other sites. As the international census has traditionally been undertaken in late March/early April just once every five years, it provides only a single ‘snapshot’ of the distribution across the non-breeding range, and gives little information on within-winter use of individual haunts, or on between-year variation in site use. Indeed, given the departure of the geese on their northward spring migration, typically in mid-April (but see below), it is likely that, in some years, the distribution of geese at the time of the census may be related to pre-migration requirements and may not be representative of winter distribution. Consequently, the current dataset may not allow for the detection of all sites of national or international importance during the main wintering period. Past surveys have typically been made in single-engined aircraft, which are less powerful, generally slower, have shorter endurance, and are less able to fly through inclement weather to reach the more remote islands, and this, to some extent, dictated the timing of the

census. In more recent censuses, a twin-engined aircraft has been used in Scotland, and this gives greater scope for undertaking additional counts in, for example, mid-winter.

Evidence from the northward spring migration of Greenland White-fronted Geese suggest that the mean departure dates from Ireland/Scotland and the mean arrival dates in Iceland occur earlier in the spring than previously (AD Fox pers. comm.). The anomaly between counts of Greenland Barnacle Geese on Coll and Tiree in late-March 2007 and mid-March 2008 (see 4.2.1) also suggest that in some springs, movements north, probably from Islay, starts before April. Thus, it seems prudent to carry out future aerial surveys in either early or mid-March to avoid this phenomenon.

Under the Environmental Protection Act 1990 (section 133(d)), one of the functions to be undertaken through the Joint Nature Conservation Committee (JNCC) is the establishment of Common Standards Monitoring (CSM) of designated sites in Britain to allow reliable assessment of the conservation status of key interest features, to identify those factors considered to be adversely affecting the feature, and to identify priorities for action at a local and national scale (JNCC 2004, Williams 2006). For those protected sites where birds are a notified or qualifying interest feature, the minimum requirement for CSM is one survey per cycle of six years. If, however, the feature is based on the number of geese at a site, it is recommended that surveys are conducted in at least three different relevant seasons within the six-year cycle. An average of three or more counts could then be used to assess the feature condition against pre-set targets and allow confident judgement of the trend in condition of the interest feature. Some SPAs are counted annually (see Tables 5 and 6) although offshore islands, necessitating aerial survey, are often counted less frequently (generally every five years as part of the international census). It is therefore recommended that additional counts are undertaken across the complete protected site network where coverage is currently less than annual. This will require the use of aerial survey to count inaccessible offshore islands.

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Grateful thanks to all and apologies to anyone inadvertently omitted.

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APPENDIX 1. SITES WITH NIL BARNACLE GEESE DURING MARCH 2008 CENSUS.

County	Site	Grid reference	County	Site	Grid reference	
Ireland				Slyne Head Islands	L5241	
Donegal	Inishduff	G6472		Talbot Island	L5752	
	Muckcross Head	G6273		Eeshal Island	L5653	
	Toralaydan	G5489		Inishturk	L5753	
	Tormore Island	G5590		Errislannan Point Island	L6050	
	Loughros Point	G6493		Inishbofin	L5366	
	Sheshkinmore	G6895		Cruagh	L5355	
	Illancrone	B6910		Friar Islands	L5258	
	Inishfree Upper	B7112		High Island	L5057	
	Rutland Island	B7114		Inishgort	L5063	
	Owey Island	B7123		Black Rock	L4963	
	Inishillintry	B7322		Inishlyon	L5665	
	Inishfree Lower	B7524		Inishbrook	L6364	
	Gola Island	B7636		Freaghillaun North	L6665	
	Cruit Island	B7320		Crump Island	L6765	
	Umfin Island	B7638		Lecky Rocks	L5965	
	Inishbofin	B8836		Shanvalleybeg	L6865	
	Inishbeg	B8939		Clare	Bishop's Rock	Q8559
	Clonmass	C1036			Ballard Bay	Q9166
Glashedy Island	C3752			Carrowmore Point	Q9869	
Garvan Islands	C4360			Mattle Island	Q9772	
Inishtrahull	C4965			Castle Point, Kilkee	Q8358	
Drumnatinny			Kerry	Magharee Islands	Q6121	
Sligo	Ardboline	G5544		Beginish	V2898	
	Connor's Island	G6652		Young's Island	V2899	
	Horse Island	G5644		Great Blasket	V2596	
	Inishmurray	G5754		Magharee Peninsula	Q6219	
Mayo	Frehill Is.	L7070	Wexford	Wexford North & South Slobs	T0720	
	Inishdegil More	L7367				
	Inishturk	L6174	Scotland			
	Caher Island	L6676	Islay and Islands	Texa	NR3943	
	Clare Island	L6885		Eilean Bhride	NR4547	
	Achillbeg	L7192		Eilean a'Chuirn	NR4748	
	Duvillaun Beg	F5916	Jura	Glas Eilean	NR4464	
	Fallmore	F6118		Am Froach	NR4662	
	Glebe, The Mullet	F6020		Brosdale	NR4962	
	Gaghta Island	F6017		Eilean nan Gabhar	NR5367	
	Erris head	F7041		Eilean nam Coinean	NR5468	
	Stags of Broad Haven	F8448		Eilean Bridhe	NR5569	
	Doonvinalla	F8445		Eilean Mor (Jura)	NM6701	
	Pig Island	F8844	Sound of Jura	Eilean Mor (Kintyre)	NR6675	
	Illanmaster	F9343		Corr Eilean	NR6775	
	Horse Island, Mayo	F9842		Eilean Nan Coinean	NR7186	
Galway	Brannock Islands	L7612		Eilean Dubh	NR7187	
	Inisherik	L8323		Carsaig	NR7389	
	Duck Is.	L7627		Eilean nan Cille	NR7597	
	Mason Island	L7429		Reisa an t-Sruith	NR7399	
	St Macdara's Island	L7230		Reisa Mhic Phaidean	NM7501	
	Illauacroagh	L6934		Eileach an Naoimh	NM6409	
	Inishdawros	L6341		A'Chuli	NM6511	
	Illauunurra	L5840		Garbh Eileach	NM6611	
	Horse Island	L5741				

County	Site	Grid reference	County	Site	Grid reference
	Dun Chonnuill	NM6812		Lingay	NL6089
	Eilean Dubh Mor	NM6910		Greanamul	NL6289
	Eilean Dubh Beg	NM6911		Flodday	NL6192
	Lunga	NM7008		Sandray	NL6491
	Fiolan Meadhonach	NM7109		Muldoanich	NL6096
	Rubha Fiola	NM7110		Biruaslum	NL6096
	Ormsa	NM7111		Vatersay	NL6395
	Eilean Mhic Chiarain	NM7211	Sound of Barra	Fuday	NF7308
	Belnahua	NM7112		Orosay	NF7106
	Insh Island	NM7319		Lingay-fhada	NF7303
	Bach	NM7726		Garbh Lingay	NF7403
	Eilean nan Gamhna	NM8338		Gighay	NF7604
	Eilean na Cloiche	NM8338		Hellisay	NF7503
	Eilean Dubh	NM8339		Lamalum	NF7503
	Eilean Dubh	NM8742		Flodday	NF7502
	Bernera	NM7939		Fuiay	NF7402
	Eilean Muisdale	NM7835		Stack Islands	NF7807
Mull	Eilean Mor	NM3416		Lingay	NF7511
	Eilean a Chalmain	NM3017	Monach Isles	Shillay	NF5962
	Eilean Dubh	NM3018	North Uist	Baleshare	NF7861
	Eilean nam Muc	NM2819		Kirkibost	NF7565
	Eilean Dubh	NM2820		Beinn Bhaile	NF7168
	Eilean Ghomain	NM2820		re-seeds	NF7371
	Soa	NM2419		Balmartin	NF7273
	Iona	NM2723		Ben Scolpaig	NF7376
	Inchkenneth	NM4335	North Uist	Newton	NF8877
	Little Colonsay	NM3736		Aird Mhic Caoilt	NF7875
Treshnish Islands	Bac Beag	NM2437	Sound of Harris	Gumersam Mhor	NG0282
	Lunga	NM2441		Gumersam Bheag	NG0381
	Burgh More	NM3044		Langay	NG0182
	Burgh Beg	NM3044		Gilsay	NG0280
Small Isles	Eigg	NM3971		Lingay	NG0179
	Canna/Sanday	NG2505		Groay	NG0079
Wester Ross	Longa	NG7377		Scaravay	NG0178
	Eilean Furadh	NG7993		Narstay	NF9777
Skye	Wiay	NG2936		Sarstay	NF9776
	Tarner	NG2939		Hermetray	NF9874
	Harlosh	NG2739		Opsay	NF9876
	Mingay	NG2257		Hulmetray	NF9875
	Eilean Creagach	NG2965		Vaccasay	NF9775
	Eilean Garave	NG2964		Groatay	NF9873
	Eilean Iosal	NG2865		Tahay	NF9775
	Staffin	NG4969		Sursay	NF9676
	Eilean Trodday	NG4479		Votersay	NF9575
	Eilean Flodigarry	NG4871		Stromay	NF9475
	Sgeirna Eireann	NG4872		Coppay	NF9394
	Fladda-chuain	NG3861		Torogay	NF9278
Islands south of Barra	Berneray	NL5680		Lingay	NF8778
	Mingulay	NL5683		Pabbay	NF8988
	Geirum More	NL5581	West Coast Harris	Gasker	NA8711
	Solon Mor	NL5784		Soay Mor	NB0605
	Solon Beg	NL5784		Fladday	NA9915
	Outer Heisker	NL5786		Kearstay	NA9617
	Pabbay	NL6087		Greine Sgeir	NB0116

County	Site	Grid reference
	Liongam	NA9919
	Eilean Mealastadh	NA9821
	Greineim	NA9825
	Eilean Molach	NA9932
Loch Roag Lewis	Old Hill	NB1143
	Bereasay	NB1242
	Floday	NB1241
	Campay	NB1442
	Kealasay	NB1441
	Little Bernera	NB1440
	Pabay Mor	NB1038
	Vacsay	NB1137
	Vuia Mor	NB1335
	Vuia Beg	NB1233
Loch Eristort Lewis	Tabhaidh Mhor	NB4222
	Tabhaidh Bheag	NB4122
	Tarnt Braigh	NB4023
Shiants	Eilean an Tighe	NG4297
	Eilean Mhuire	NG4398
Wester Ross	Priest Island	NB9202
	Glas-leac Beag	NB9205
	Bottle Island	NB9501
	Carn Iar	NB9602
	Carn Deas	NB9602
	Eilean Dubh	NB9703
	Horse Island	NC0204
	Meall nan Gabhar	NC0205
	Tanera More	NB9807
	Tanera Beg	NB9607
	Eilean Fada Mor	NB9707
	Eilean a'Char	NB9608
	Glas-leac Mor	NB9509
	Eilean Mullagrach	NB9511
	Eilean Mor	NC0517
	Froachlan	NC0518
West Sutherland coast	A'Chleit	NC0220
	Eilean Chrona	NC0633
	Badcall Bay	NC1540
	Handa	NC1348
	Loch Laxford	NC2050
	Eilean a' Chunnaidh	NC2057
	Am Balg	NC1866
	Eilean an Roin Mor	NG4198
North Sutherland Coast	An Garbh-eilean	NC3373
	Eilean Cluimhrig	NC4665
	Rabbit Island	NC6063
	Sgeir an Oir	NC6164
	Eilean Iosa	NC6365
	Coomb Island	NC6664