

Greenland barnacle geese *Brant leucopsis* in Britain and Ireland: results of the International census, spring 2018



RESEARCH REPORT

Research Report No. 1154

Greenland barnacle geese *Branta leucopsis* in Britain and Ireland: results of the International census, spring 2018

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RESEARCH REPORT

Summary

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Background

Between 1959 and 2018, fourteen full international surveys of the Greenland population of barnacle goose *Branta leucopsis* have been conducted at wintering sites in Scotland and Ireland using a combination of aerial survey and ground counts. This report presents the results of the 2018 census in Scotland, conducted primarily between 19-20 March, and also includes the total count in Ireland in order to estimate the total population size.

Main findings

- In Scotland, 39 sites, out of 228 checked, were found to hold 55,424 Greenland barnacle geese. A further 501 birds were estimated from one site, bringing the Scotland total to 55,925. In Ireland, 16,237 geese were counted. The total wintering population was estimated at 72,162 birds. This represents a 10.5% decrease on the 2013 census total.
- The number counted on Islay in spring 2018 (34,750), the most important site in the winter range, was 22.6% lower than that recorded in spring 2013, whereas the number of geese throughout the remainder of Scotland has increased by 16.0% since 2013.
- Up to 2013, the increase in the number of birds wintering in Scotland was largely driven by increases at a small number of core areas. Currently, five areas (Islay, North Uist (consolidated), Tiree and Coll, Oronsay/Colonsay and South Walls (Orkney)) hold the majority of geese, accounting for 92.4% of the Scotland total and 71.6% of the international total in March 2018. Islay alone held 62.1% of the Scottish total and 48.2% of the international total. Overall, numbers at these five core areas have increased more than six-fold since 1959, whereas numbers outside these areas have remained relatively stable.
- During the 2018 census, twelve sites held numbers that exceeded 1% of the latest census in Scotland; eight of these also exceeded 1% of the latest international census total. Of these, Oronsay/Colonsay and South Walls are not classified as SPAs for Greenland barnacle geese (although Switha, the principal roost site of the South Walls flock, is an SPA). The suite of SPAs which have Greenland barnacle goose as a qualifying species held 84.2% of the national and 65.1% of the international population in Scotland (i.e. UK).

- The Islay Sustainable Goose Management Strategy (ISGMS) was developed in 2014 and will run until 2024. The Strategy aims to reduce damage to crops on Islay by reducing the number of Greenland barnacle geese wintering on the island. As part of the Strategy, an average of 2,760 Greenland barnacle geese have been shot on Islay each winter from 2015/16 to 2017/18. In Iceland, the species is legal quarry and a mean of 1,636 geese were reported shot there during the period 1995 to 2016. Thus, in 2016, a minimum of 5,034 Greenland barnacle geese were reported shot in the two countries. This level of mortality may have contributed to the reduction in the international population size.
- Islay is now a major arrival point after the autumn migration, and in recent years, a proportion of the geese move on to other wintering areas. The recent increase in disturbance as part of the ISGMS may have resulted in a greater proportion of the geese wintering elsewhere in the range. This possible redistribution of geese within the winter range is the subject of current research.
- The current monitoring strategy of one complete international census every five years and annual counts at a subset of important sites appears inadequate in terms of fully understanding the conservation status (abundance and population trend) of Greenland barnacle geese and the effects of ongoing management practices, including the ISGMS. An increased level of surveillance is therefore required. However, such surveillance needs to be balanced against cost and as a pragmatic solution an international census, including aerial survey, is recommended once every three years.
- In addition, information on demography and movements of the geese is needed, in order to ensure that adequate information is available to underpin population management and to investigate the possible redistribution of Greenland barnacle geese from Islay as a result of the management currently being undertaken as part of the ISGMS.

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Table of Contents	Page
1. METHODS	1
2. RESULTS	2
2.1 Population size and distribution	2
2.2 Long-term trends	4
3. DISCUSSION	6
3.1 Census total and accuracy	6
3.2 Long term changes in abundance	7
3.3 Site use	9
3.4 Nationally and internationally important sites	10
3.5 Seasonal counts on Islay	13
3.6 Counts on North Uist	14
3.7 Barnacle geese breeding in Iceland	17
4. RECOMMENDATIONS	18
4.1 Timing and frequency of population counts	18
4.2 Monitoring of nationally and internationally important sites	18
5. REFERENCES	19
ANNEX 1: SITES WITH NIL GREENLAND BARNACLE GEESE IN SCOTLAND DURING THE MARCH 2018 CENSUS	21
ANNEX 2: LONG-TERM TRENDS ON SPAS IN SCOTLAND	23

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1. METHODS

The method 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 twin-propeller 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 Greenland barnacle geese have previously been recorded are surveyed, as are, where practicable, adjacent mainland coast where suitable vegetation is present.

- 19 March: Liverpool to Islands off Islay, west coast Argyll, Mull, Gunna, Small Isles, islands from Barra Head to Barra, Sound of Barra, North Uist/Sound of Harris, west Harris, west Lewis to Stornoway.
- 20 March: Stornoway, Shiant, Skye, Wester Ross, west Sutherland to Liverpool.

Aerial survey in Ireland was undertaken using an Air Corp Reims Rocket Cessna 172 and was carried out on two days, 20-21 March 2018.

Ground counts were coordinated with the aerial survey in each country and most were conducted within a few days of the flights (see Table 1 for dates). However, counts outwith, but close to, this period were accepted if counters could not undertake counts on the scheduled dates.

Photo verification of the flocks encountered during the aerial survey provided greater accuracy than visual estimates made at the time. The accuracy of visual counts has, however, 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).

2. RESULTS

2.1 Population size and distribution

During the 2018 census, coverage was comprehensive with a total of 228 islands and mainland sites in Scotland visited, and 39 were found to hold Greenland barnacle geese (range 1 - 34,750 birds). Counts at all sites in Scotland holding Greenland barnacle geese during the 2018 census and their locations are given below (Table 1, Figure 1). Sites visited in Scotland, but where no geese were found are listed in Appendix 1. Due to flight restrictions imposed by the Ministry of Defence, no count could be undertaken on the Monach Isles (NF6562); the mean of the two previous counts from 2008 and 2013 for each island has been used as an estimate for spring 2018.

The total in Scotland, including the estimate for the Monach Isles, was 55,925 geese, while that of Ireland was 16,237 geese. Thus, the total population estimate was 72,162 birds.

Overall, 94.9% of the census total comprised estimates from ground counts, 4.2% were counted from photographs taken during the aerial survey and 0.9% from estimates. Fourteen flocks were counted from photographs during the aerial survey. No visual estimations of flocks, where no photograph was obtained, were needed.

Table 1. Sites holding Greenland barnacle geese in March 2018

Area		Date	Site	Grid reference	Number of geese	Survey method ¹
Islay						
	1	20/21 Mar	Islay	NR3362	34,750	G
Kintyre						
	2	7-Mar	Machrihanish, Kintyre	NR6821	5	G
Inner Hebrides						
	3	19-Mar	Colonsay/Oronsay	NM3588	2,250	G
	4	19-Mar	Danna	NR6978	650	G
	5	19-Mar	Luing	NM7408	530	G
	6	19-Mar	Inchkenneth, Mull	NM4335	226	P
	7	19-Mar	Muck, Eilean nan Each	NM4279	38	P
	8	19-Mar	Tiree	NL9844	5,126	G
	9	19-Mar	Gunna	NM1051	85	P
	10	19-Mar	Coll	NM1554	1,266	G
Outer Hebrides						
	11	19-Mar	Borve Point, Barra	NF6501	223	P
	12	19-Mar	Fiaray, Sound of Barra	NF7010	244	P
	a	-	Monach Isles	NF6163	501 ²	E
	13	19-Mar	Baleshare, North Uist	NF7861	440	G
	14	19-Mar	Paible/Balemore, North Uist	NF7466	1,442	G
	15	19-Mar	Balranald/Goula, North Uist	NF7070	677	G
	16	19-Mar	Griminish, North Uist	NF7576	610	G
	17	19-Mar	Vallay, North Uist	NF7776	610	G
	18	19-Mar	Sollas/Grenitote, North Uist	NF8175	325	G
	19	19-Mar	Newton, North Uist	NF8877	180	G
	20	19-Mar	Ahmore, North Uist	NF8474	921	G
	21	19-Mar	Berneray, North Uist	NF9182	745	G
	22	19-Mar	Opsay, Sound of Harris	NF9876	81	P
	23	19-Mar	Boreray, Sound of Harris	NF8581	537	P
	24	19-Mar	Copay, Sound of Harris	NF9394	183	P
Minch						
	25	20-Mar	Eilean an Taighe, Shiantas	NG4297	268	P

Skye						
	26	20-Mar	Isay	NG2157	193	P
	27	20-Mar	South Ascrib	NG3063	46	P
	28	20-Mar	Eilean More	NG3657	42	P
Wester Ross						
	29	9-Mar ³	Gruinard	NG9494	120	G
	30	20-Mar	Achiltibuie	NC0208	157	P
	31	20-Mar	Eilean Chrona	NC0633	35	P
Sutherland						
	32	5-Feb ⁴	Eilean an Ròn Mor	NC1758	69	G
	33	26-Mar	Durness area	NC3968	262	G
	34	20-Mar	Tongue area	NC5860	242	G
Orkney						
	35	16-Mar	South Walls	ND3289	1,460	G
	36	20-Mar	Loch of Skail	HY2318	137	G
	37	20-Mar	Marwick	HY2324	1	G
	38	20-Mar	South Ronaldsay	ND4684	231	G
	39	20-Mar	Deerness	HY5607	20	G
Scotland total					55,925	
Ireland total					16,237 ⁵	
Total population					72,162	

Notes:

¹ G denotes ground count, P denotes photographic verification and E denotes estimate.

² Flight restrictions meant no count was undertaken. The mean of the counts made in 2008 (520) and in 2013 (482) has been used as an estimate for March 2018.

³ Counted on 9 March 2018. A regular wintering flock, but not located during aerial survey.

⁴ Counted on 5 February 2018. A regular wintering flock, but not located during aerial survey.

⁵ No estimates were required in Ireland. Count total provided by National Parks & Wildlife Service.

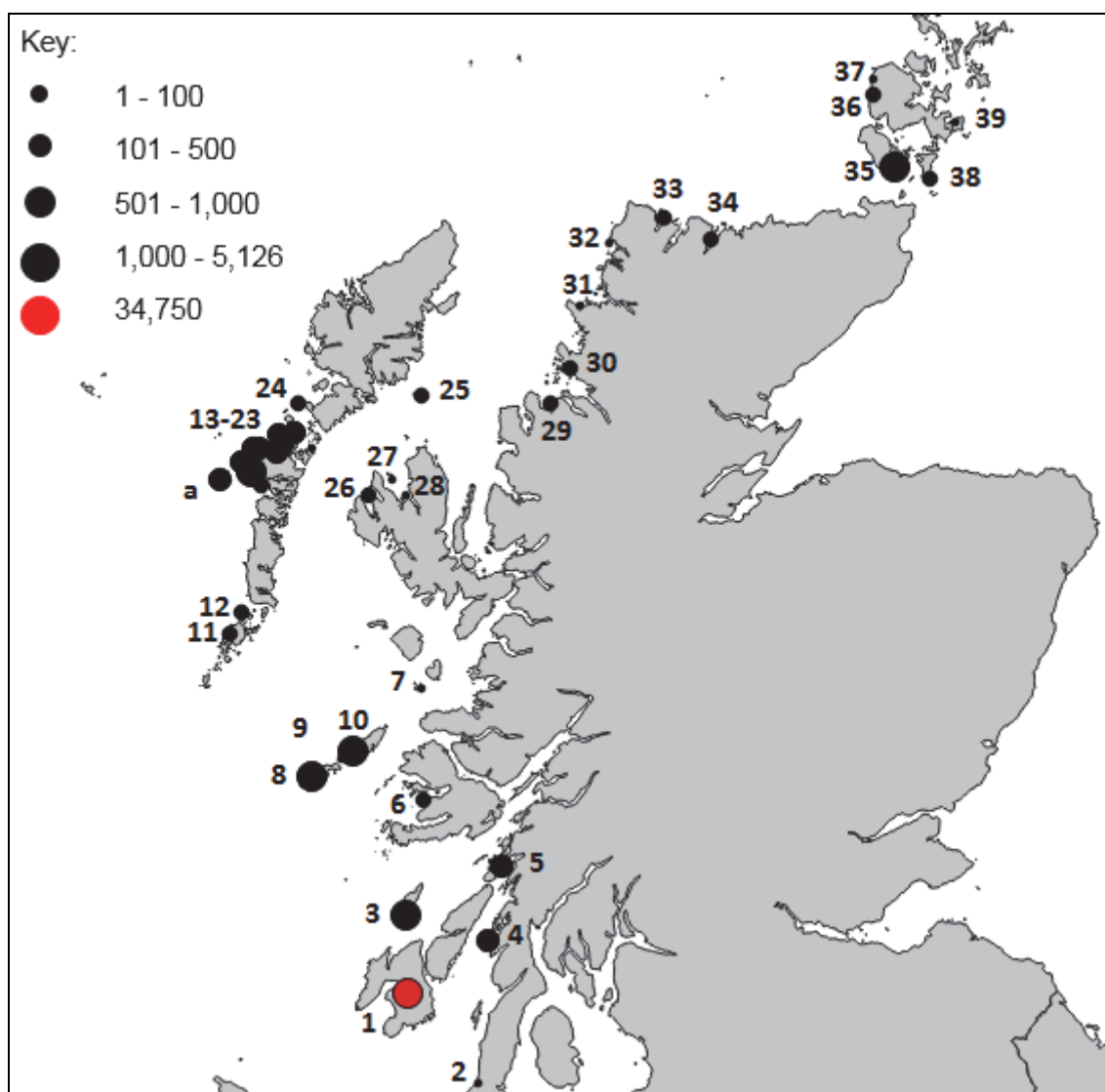


Figure 1. Sites in Scotland holding Greenland barnacle geese in March 2018 (see Table 1 for key to site numbers).

2.2 Long-term trends

The total number of Greenland barnacle geese has decreased by 10.5% from 80,670 in 2013 to 72,162 in 2018 (Table 2, Figure 2). The long-term increase on Islay, ongoing since the 1960s, except for a drop in numbers in the 1980s, now appears to have stopped during the past five years. In contrast, overall numbers elsewhere in Scotland remained relatively constant throughout the 1970s and 1980s, but have increased since 1994.

Table 2. Percentage change in Greenland barnacle goose numbers in Scotland and Ireland between March 2013 and March 2018.

	March 2013	March 2018	Change (%)
<i>Islay</i>	44,914	34,750	-22.6
<i>Scotland excluding Islay</i>	18,256	21,175	16.0
Scotland total	63,170	55,925	-11.5
Ireland total	17,500	16,237	-7.2
Population total	80,670	72,162	-10.5

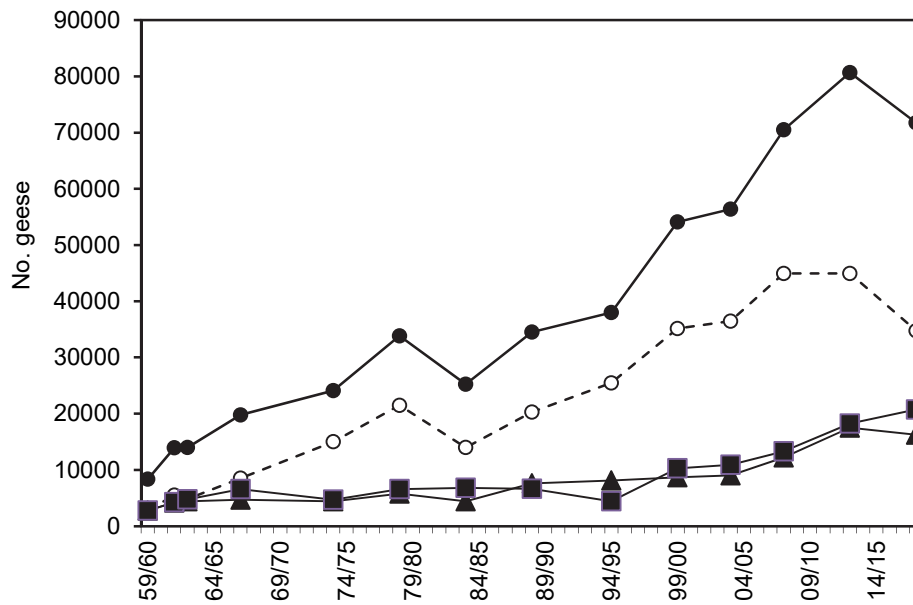


Figure 2. Census totals for the Greenland population of barnacle goose, 1959/60–2017/18. (● Total population, ○ Islay, ■ Scotland excluding Islay, ▲ Ireland).

3. DISCUSSION

3.1 Census total and accuracy

The population estimate of Greenland barnacle geese, based on the census of known and potential wintering sites carried out in Britain and Ireland in March 2018, was 72,162, 10.5% lower than that recorded in March 2013 but still the second highest total to date. All the counts made during the aerial survey were taken from photographs (Figure 3) and no visual estimates (where no photograph was available) were necessary. This increases the accuracy of the individual site counts and indicates that the accuracy of the overall census total is likely to be high.



Figure 3. Photograph taken during the March 2018 aerial survey showing a flock of 81 Greenland barnacle geese at Opsay, Sound of Harris (C Mitchell).

Count conditions were very good, with a high pressure system over Scotland and Ireland providing light winds and no rain, and the counts were largely synchronised. The majority of the counts in Scotland and Ireland were made over a three-day period (19-21 March). No Greenland barnacle geese were reported in Iceland at the time of the census (A. Sigfusson *pers. comm.*) and, in an analysis of spring arrival dates in Iceland, Gunnarsson & Tómasson (2011) noted first arrivals around 15 April. Thus, it seems likely that the census took place before any geese had left Scotland and migrated to Iceland.

Coverage was thought to be good with all known haunts, except the Monach Isles (see below), of Greenland barnacle geese checked during the census. Prior to the census, Royal Society for the Protection of Birds (RSPB) reserve wardens, Highland Rangers and SNH staff reported only one new site that was thought to hold barnacle geese; Borge Point, Barra (NF6501) was checked during the aerial survey and was found to hold 223 geese.

Flight restrictions, due to artillery activity over the west coast of South Uist, meant that the Monach Isles, Outer Hebrides could not be counted. The mean of the count in March 2008 (520 birds) and March 2013 (482) was used as an estimate for March 2018 (501 birds). No geese were recorded in Lewis, and the three small flocks counted there in March 2008 (Floday, Tolsta and Port of Ness) may no longer be present.

Three counts obtained outwith the core census period were used for the international population estimate. A count of 120 barnacle geese at Gruinart, Wester Ross, was made on 9 March 2018; 69 birds were counted at Eileann an Ròn Mor, west Sutherland on 5 February

2018 and five birds were counted at Machrihanish, Kintyre on 7 March 2018. All three sites normally hold geese throughout the winter period and thus merited inclusion in the final population estimate.

In Scotland, the aerial survey follows an established route covering over 200 offshore islands and areas accessible to counters on the ground are also covered (e.g. Islay, Tiree etc.). Despite the apparent recent change in behaviour involving a proportion of geese arriving on Islay and then moving onto other areas (see 4.5 below), contact with a comprehensive network of local birdwatchers only identified one new area thought to hold barnacle geese (Borve Point, Barra). Thus, we are confident that the census adequately covered the winter range of Greenland barnacle geese in Scotland and that no newly occupied areas are being missed.

Considering the caveats outlined above, none are considered to substantially affect the census total and it is therefore recommended that the population estimate for Greenland barnacle goose is revised to 72,162 birds.

3.2 Long term changes in abundance

Long term changes in abundance are ultimately driven by changes in survival and/or breeding success within the population. Pettifor *et al.* (1999) suggested that the population is more affected by changes in mortality than productivity. The annual percentage of first-winter birds recorded on Islay has decreased since the mid- to late 1980s, although the number of geese on Islay, up to 2008, continued to increase throughout this period (Figure 4). A decrease in mortality, partly due to the introduction of goose management schemes that used payments to farmers to benefit geese, may have supported the population growth up to 2013.

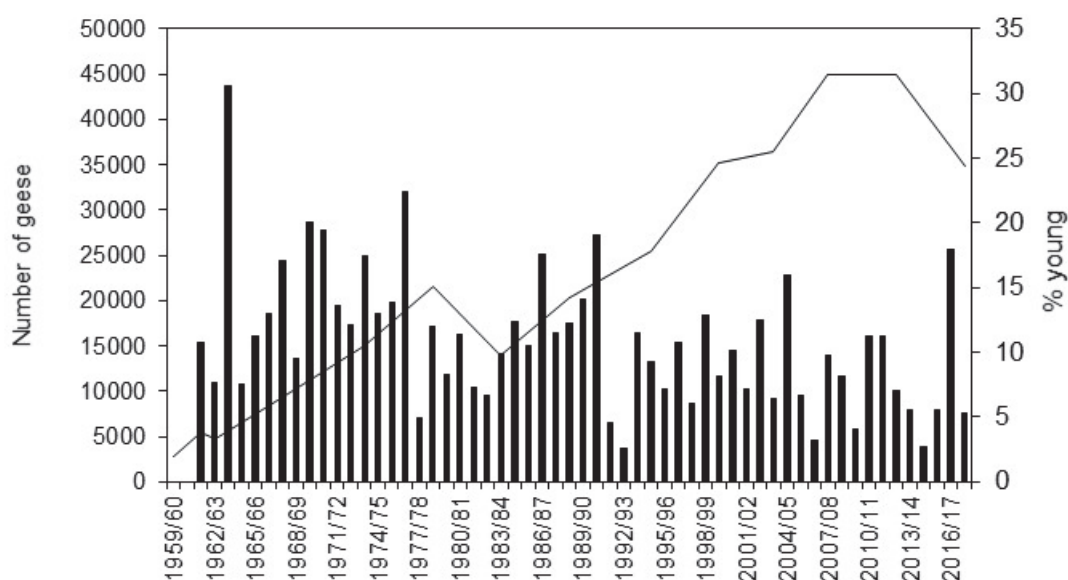


Figure 4. Population size (—) and percentage of first-winter birds (columns) of Greenland barnacle geese on Islay, 1959/60 – 2017/18.

Since 2001/02, as part of a management programme aimed to reduce economic losses to agricultural interests organised by SNH, Greenland barnacle geese have been shot on Islay. The number shot each winter has varied, with an average of 540 geese shot annually in the ten-year period 2001 to 2010. However, the bag limit was increased from winter 2012/13

and, in 2015/16, 2,160 Greenland barnacle geese were shot; this increased to 2,794 in 2016/17 (Figure 5a), and increased further to 3,321 in 2017/18. In Iceland, the species is legal quarry and a mean of 1,636 geese were reported shot there during the period 1995 to 2016 (range 925 – 2,629, Figure 5b). Thus, in 2016/17, 2,794 Greenland barnacle geese were reported shot on Islay and in 2016, 2,240 were shot in Iceland. In addition to those cleanly shot, killed and retrieved, a further proportion will have been shot but not retrieved or not killed outright. The latter carry embedded lead shot pellets and this can lead to a reduction in survival (Madsen & Noer, 1996). This increase in the number shot since 2012/13, may have contributed to the decrease in numbers in the international population between 2013 and 2018.

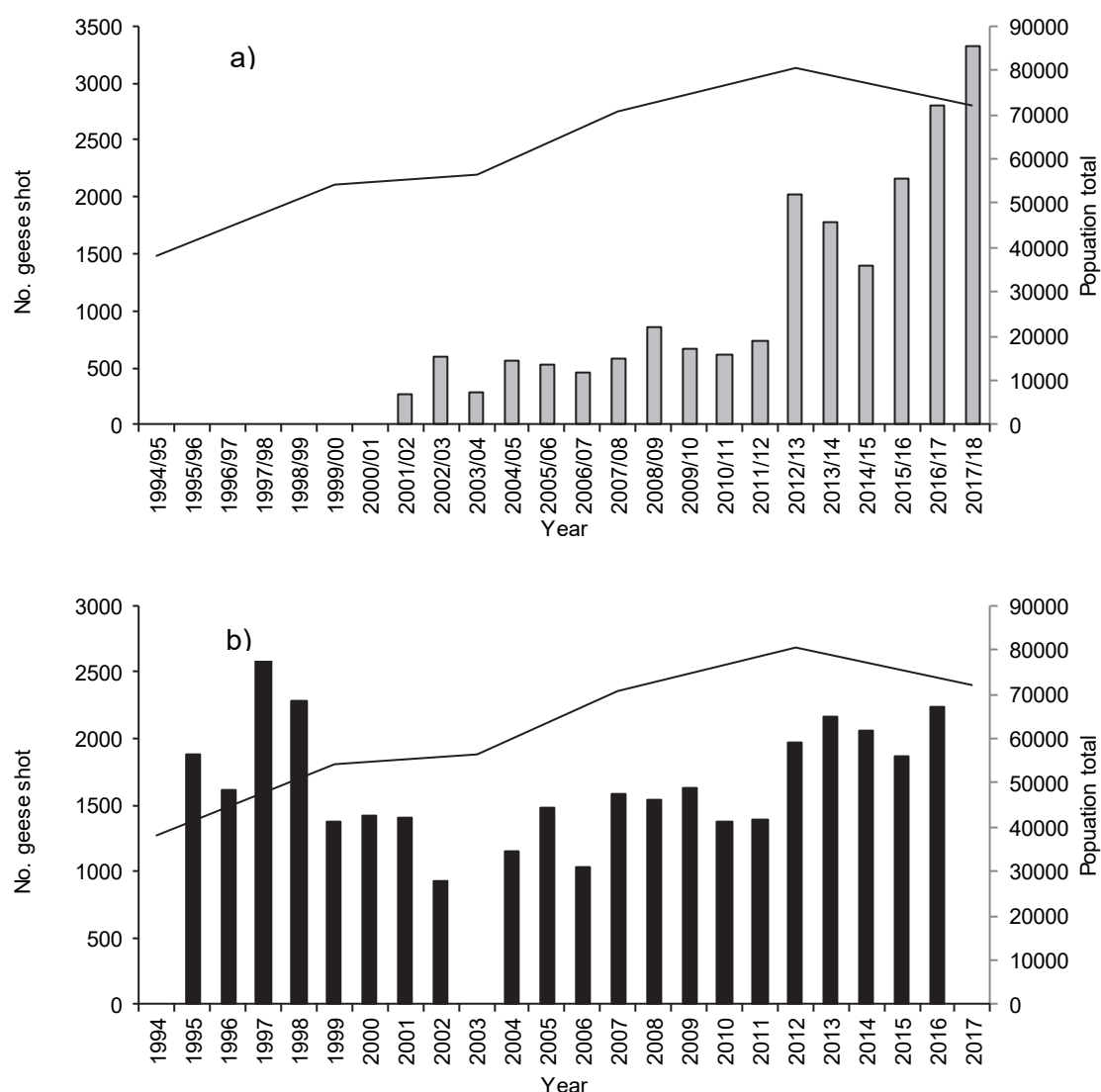


Figure 5. Greenland barnacle goose population size (line; 1994/1995 to 2017/18) and a) the number shot on Islay (grey bars; data from SNH) 1995 to 2016, and b) the number shot in Iceland (black bars; data from <http://px.hagstofa.is>; accessed on 23/7/2018). Note that no bag data from Iceland were available in 2003.

In addition, on the Uists (Outer Hebrides), 47 geese were shot under licences issued by SNH, in 2015/16 and 54 were shot in 2016/17. On Tiree (Argyll), 35 geese were shot in 2016/17.

3.3 Site use

The number of occupied sites in Scotland supporting >10 birds, whilst variable between censuses, has increased since 1959/60 and has remained fairly stable since 1983/84 (Figure 6). The number of occupied sites in Scotland in 2018 (37 sites holding more than 10 birds) was the third highest on record.

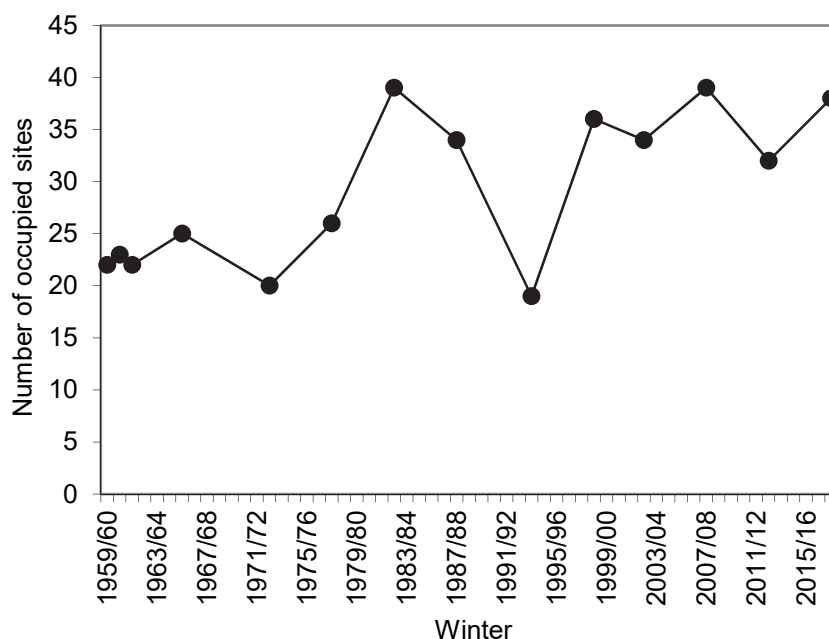


Figure 6. Number of sites in Scotland occupied by Greenland barnacle geese (> 10 birds) in spring censuses 1959/60 to 2017/18.

The increase in abundance of the population in Scotland appears to have largely affected numbers at a small number of core areas. Currently, five core areas: Islay, North Uist (consolidated), Tiree and Coll, Oronsay/Colonsay, South Walls held the majority of geese; 71.6% of the international total and 92.4% of the Scotland total in March 2018. Islay alone held 48.2% of the international total and 62.1% of the Scotland total. Overall, numbers at these five core areas have increased more than six-fold since 1959 (Figure 7). Islay accounts for the largest number of birds in the Scotland total and the decline in numbers on Islay in March 2018 is reflected in the trend of the five core areas (Figure 7). The number of geese outside these core areas has remained at around 4,000 birds (range 1,695 – 6,166) since the late 1950s, with no overall trend (Figure 7).

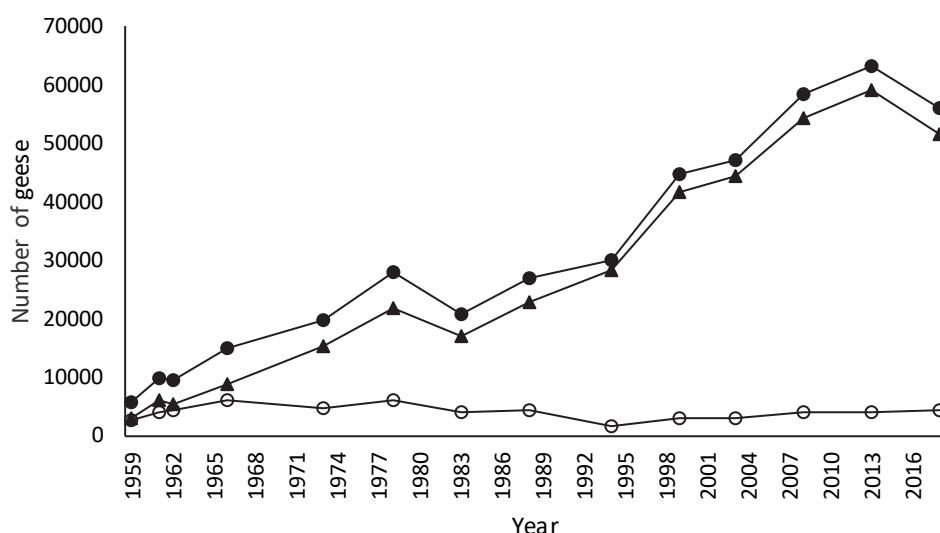


Figure 7. Trend in the number of Greenland barnacle geese found within and outside five core areas in Scotland; ● All sites, ▲ Five core areas (Islay, North Uist (consolidated), Tiree and Coll, Oronsay/Colonsay and South Walls), ○ all other sites.

Census data indicate that use of some of the smaller sites, such as the Treshnish Isles and the Shiantis, has decreased since the late 1970s/early 1980s. 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 the use of more intensive farming methods, and the establishment of goose management schemes, have attracted geese to alternative sites. The increase in number and range of White-tailed Eagles *Haliaeetus albicilla* along the west coast of Scotland in the last twenty years may also be having an impact on the number and distribution of over wintering geese at some sites, especially on smaller offshore islands. Some of these smaller sites (e.g. Bach, NM7726) may now have been abandoned due to the presence of eagles, with the geese moving to larger flocks elsewhere.

3.4 Nationally and internationally important sites

A site is considered internationally important if it regularly supports 1% or more of the individuals in a population (following criterion 5 of the Ramsar Convention) (Wetlands International 2012). In Britain, a site is considered nationally important if it regularly holds 1% or more of the British population estimate. Assessments of site importance are usually made on the basis of a minimum of three years' count data within a five year period, but, in the absence of regular counts at many of these sites, we have here presented the 2018 site counts against 1% of the international and British population estimates based on this census (1% threshold for international importance would be 722 geese, and for national importance in Britain it would be 559 geese¹).

During the 2018 census, 12 sites were found that exceeded the 2018 British threshold, and eight sites that also exceeded 1% of the 2018 international population estimate (Table 3). The number of sites exceeding nationally important numbers (based on the 1% threshold estimated at that time) fluctuated between 1959 and 1993, but since then has slowly

¹ Note that these are not the currently accepted international and national 1% thresholds, which remain 810 (Wetlands International 2018) and 580 (Musgrove *et al.* 2013), respectively, and that a comprehensive assessment of site importance would use annual peak site counts.

increased. The number of sites exceeding internationally important numbers declined to the mid-1990s and then increased thereafter until the latest census (Figure 8).

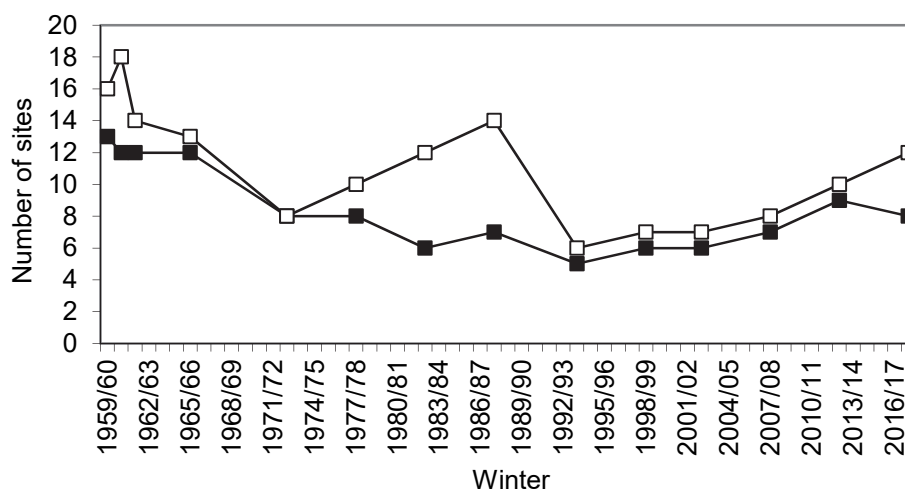


Figure 8. Number of sites in Scotland holding nationally or internationally important numbers of Greenland barnacle geese during censuses, 1959/60 to 2017/18 (□ nationally important sites, ■ internationally important sites).

Many of the sites exceeding 1% of the international or national census totals in 2018 are protected wholly, or in part, by classification as Special Protection Areas (SPAs) under the EC Birds Directive. Of those sites where numbers exceeded the international threshold, only Oronsay/Colonsay and South Walls² are not classified as SPAs for Greenland barnacle geese.

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, 34,750 barnacle geese were counted on Islay in March 2018, and some, but not all, of these use the three SPAs where the geese are a qualifying species. Similarly on Tiree, geese counted there roost and feed both within and outwith the SPA boundary. On some offshore island groups, geese can be quite mobile, moving from within the SPA boundary to just outside it. This is particularly the case for North Uist Machair and Islands SPA where the geese range between several offshore islands and mainland areas, either within a day or between days. Wherever possible, allowances have been made to allocate counts of Greenland barnacle geese to functional feeding/roosting units that include SPAs. The number of Greenland barnacle geese wintering within and outwith SPAs merits further research and analysis.

The suite of SPAs in Scotland that have Greenland barnacle goose as a qualifying species, the proportion of the population that they held during the 2018 census and the current frequency of monitoring are shown in Tables 3 and 4. Overall, in March 2018, the suite of SPAs in Scotland held 84.2% of the national population and 65.1% of the international population.

Three of the nine SPAs in Scotland (North Sutherland Coastal Islands, Shiant Isles and Treshnish Isles) did not hold internationally or nationally important numbers of Greenland barnacle geese. No count was possible on the Monach Isles.

² Switha, the roost site for the geese feeding on South Walls is classified as a SPA for Greenland Barnacle Geese

Table 3. Sites holding Greenland barnacle geese that exceeded 1% of the international (722 geese) and national (559) estimates from the 2018 census. The number recorded at each site during the 2018 census is given in parentheses.

Site name	SPA classification (<i>italics denote those sites where Greenland barnacle geese are a qualifying feature of the SPA</i>)
Sites holding >722 birds (internationally important) in March 2018:	
Islay (34,750)	<i>Gruinart Flats, Laggan, Bridgend Flats, Rhinns of Islay, Eilean na Muice Duibhe</i>
Tiree (5,126)	<i>Sleibhtean agus Cladach Thiriodh</i>
Oronsay/Colonsay (2,250)	
South Walls, Orkney (1,460)	<i>Switha (the main roost of the South Walls flock is an SPA)</i>
Balemore/Paible, North Uist (1,442)	<i>North Uist Machair and Islands</i>
Coll (1,266)	<i>Coll</i>
Ahmore, North Uist (921)	<i>North Uist Machair and Islands</i>
Berneray, North Uist (745)	<i>North Uist Machair and Islands</i>
Additional sites holding >559 birds (nationally important):	
Balranald, North Uist (677)	<i>North Uist Machair and Islands</i>
Isle of Danna, Argyll (620)	
Vallay, North Uist (610)	<i>North Uist Machair and Islands</i>
Griminish, North Uist (610)	<i>North Uist Machair and Islands</i>

Table 4. Percentage of the international and national population size of Greenland barnacle geese (72,162 and 55,925 geese, respectively) present in the SPA suite in Scotland in March 2018, and their current frequency of monitoring.

SPA code	SPA name	SPA total in March 2018	% of international population	% of national population	Frequency of monitoring
9003051, 9003052 and 9003053	Islay ¹	34,750	48.2	62.2	Annual
9003031	Coll	1,266	1.8	2.3	Annual
9001071	Monach Isles	501 ²	0.7	0.9	c. 5 years
9001211	North Sutherland Coastal Islands ³	504	0.7	0.9	Annual
9001051	North Uist Machair and Islands ⁴	3,189	4.4	5.7	Annual
9001041	Shiant Isles	268	0.4	0.5	c. 5 years
9002891	Switha ⁵	1,460	2.0	2.6	Annual
9002032	Sleibhtean agus Cladach Thiriodh (Tiree Wetlands and Coast)	5,126	7.1	9.2	Annual
9003041	Treshnish Isles	0 ⁶	0	0	c. 5 years
TOTAL		47,064	65.1	84.2	

Notes:

¹ Counts on Islay include geese using the Gruinart Flats (9003051), Bridgend Flats (9003052) and Laggan (9003053) SPAs. 34,750 geese were recorded at the time of the March 2018 census although a peak winter count of 46,903 had been recorded in November 2017.

² No count was possible on the Monach Isles due to flight restrictions. An estimate of 501 geese was based on the mean of the previous two surveys (2008 and 2013).

³ Includes counts from Eilean Hoan/Durness and Eilean nan Ròn/Kyle of Tongue where monitoring is annual.

⁴ Barnacle geese can be quite mobile in North Uist using feeding and roosting grounds both within and outwith the SPA. However, the total of 3,189 geese was based on counts from Baleshare (440),

Balranald/Goula (677), Vallay (610), Newton (180), Berneray (745), Boreray (537). See also Discussion and Table 5.

⁵ Barnacle geese feed at South Walls, Orkney (not an SPA) and roost on Switha (SPA).

⁶ No geese were found on the Treshnish Isles, but 226 geese were counted on Inchkenneth (NM4335), 11km to the east of Staffa (part of the Treshnish Isles SPA). The geese are quite mobile in this area, and this flock may have fed/roosted on the Treshnish Isles at other times during the winter.

3.5 Seasonal counts on Islay

During periods of no shooting of barnacle geese on Islay in the late 1990s and low shooting (fewer than 1,000 birds shot) in the mid-2000s, the number counted there in November was similar to that recorded later in the winter (+/- 10%, Figure 9). In the most recent three winters (2015/16 to 2017/18), the number of barnacle geese shot has increased to over 2,000 birds each winter, and the number of barnacle geese counted on Islay peaked in November, but declined thereafter (Figure 9, see also Hilton 2014).

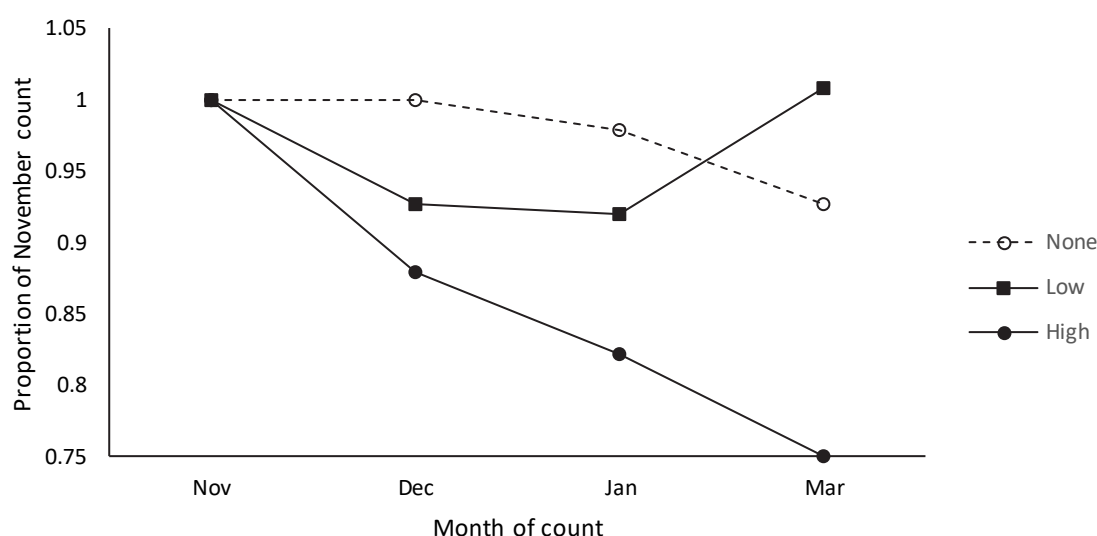


Figure 9. The mean number of Greenland barnacle geese counted on Islay expressed as a proportion of the November counts in three time periods; ○ = no shooting (1997/98 to 1999/2000), ■ = low shooting (2006/2007 to 2008/2019) and ● = high shooting (2015/16 to 2017/18) (SNH data).

In the most recent three winters, after the autumn arrival, a proportion of the birds were shot and, presumably, a proportion moved on to other wintering areas with the number counted in November declining by 23.4% by February in 2015/16, by 23.3% in 2016/17 and by 28.2% in 2017/18 (Figure 10).

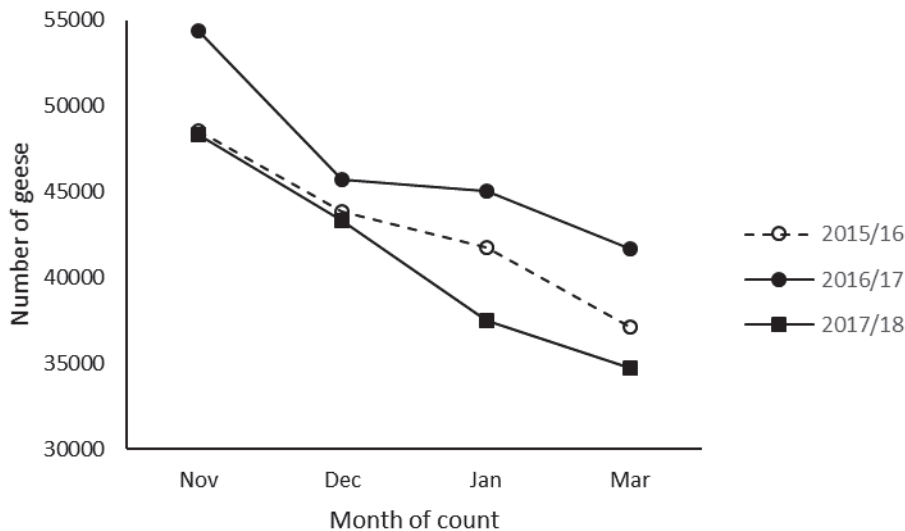


Figure 10. The number of Greenland barnacle geese counted on Islay 2015/16 to 2017/18 (SNH data).

It is therefore possible that the increase in disturbance caused by the recent increase in shooting activity may have led to a redistribution of geese to other wintering areas. For example, the number of Greenland barnacle geese on Tiree (c. 80 km northwest of Loch Gruinart, Islay), numbers increased by 18%, from 4,518 to 5,126 and on North Uist (consolidated), numbers increased by 49% from 4,533 to 6,751 over the same period. However, there has been no apparent increase in numbers in Ireland between 2013 and 2018. The causes and consequences of the apparent redistribution of Greenland barnacle geese merits further research. As mentioned above, only one new site holding barnacle geese has been identified in Scotland, thus it seems likely that the decline in numbers on Islay through the winter simply moves some birds to existing wintering areas.

3.6 Counts on North Uist

The number of Greenland barnacle geese wintering on the mainland of North Uist and nearby islands has increased since the late 1980s. The proximity of sheep-grazed islands to managed grassland fields on the mainland can lead to movements of birds between them, notably when they are disturbed. Regular (at least annual) counts on the mainland are organised and undertaken by SNH, but surveillance is somewhat complicated by the geographical range of the mainland counts areas, only some of which are within the North Uist Machair and Islands SPA. The aerial survey allows offshore islands to be checked simultaneously, allowing a total count for the whole of North Uist to be achieved. In order to set a standard form of reporting on counts of Greenland barnacle geese in this area for this report, the following is proposed:

- Regular counts from the SNH count areas are shown stippled (Figure 11).
- The count for the North Uist Machair and Islands SPA in March 2018 includes birds recorded at sites 14, 16, 18, 21 and 22) plus counts from Boreray and Pabbay.
- The total count for 'North Uist consolidated' is bounded by the green line shown in Figure 11.

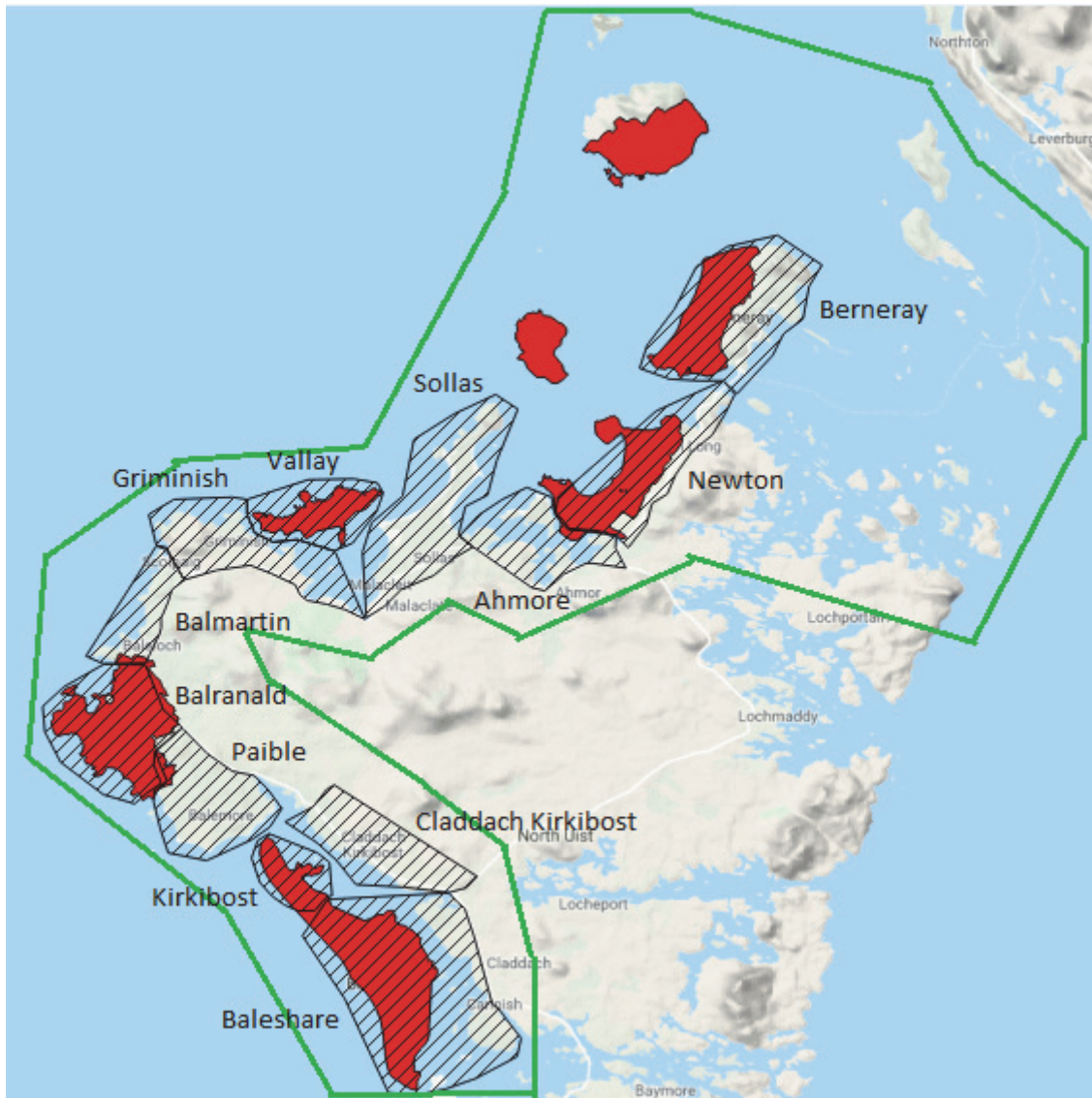


Figure 11. SNH Greenland barnacle geese count areas (black/stippled and named), North Uist Machair and Islands SPA (red) and North Uist consolidated (green line) used for this report – see text for further information.

The number of Greenland barnacle geese recorded in North Uist in March 2018 is summarised in Table 5.

Table 5. The number of Greenland barnacle geese recorded in North Uist in March 2018.

Site ¹	Count unit/site	Central grid reference	SNH count areas ²	North Uist Machair and Islands SPA total ³	North Uist consolidated ⁴
13	Baleshare	NF7762	440	440	440
14	Paible	NF7466	1,442		1,442
15	Balranald	NF7070	677	677	677
16	Griminish	NF7475	610		610
17	Vallay	NF7776	610	610	610
18	Sollas	NF8175	325		325
29	Ahmore	NF8474	921		921
20	Newton	NF8877	180	180	180
21	Berneray	NF9182	745	745	745
22	Opsay	NF9876			81
23	Boreray	NF8581		537	537
24	Coppay	NF9394		183	183
	Total		5,950	3,189	6,751

Notes:

¹ See Table 1 and Figure 1 for site numbering.

² SNH count areas are shown as shaded black/stippled in Figure 11.

³ North Uist Machair and Islands SPA are shaded red in Figure 11.

⁴ All counts from area bounded by green line in Figure 11.

The switch in habitat use from offshore islands, where the geese take advantage of semi-natural grasslands which were often summer grazed, to managed grasslands on mainland areas is particularly noticeable on North Uist. The proportion of birds counted in the North Uist (consolidated) area (see Figure 11) using the mainland area has increased from none, up to 1994, to 0.88 in 2018 with a corresponding decrease in the use of offshore islands (Figure 12).

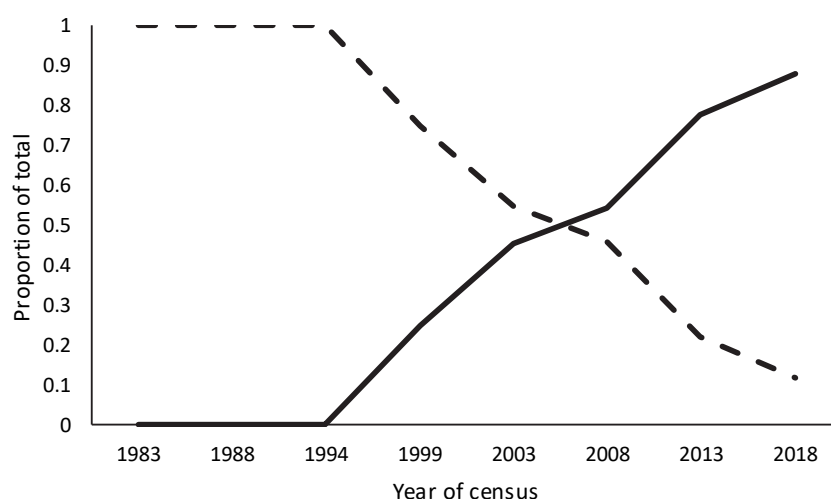


Figure 12. The proportion of Greenland barnacle geese counted on mainland sites on North Uist (solid line) and offshore islands (dashed line) from 1983 to 2018.

3.7 Barnacle geese breeding in Iceland

Barnacle geese now breed in Austur-Skaftafellssýsla county, south-east Iceland, in an area where birds from the Greenland flyway are known to stage on autumn passage. In 2009, about 40 barnacle geese were known to nest in the area. Fieldwork in the summer of 2014 revealed at least 509 nests, an increase of over 1,200 % in five years (Stefánsson *et al.*, 2015). By 2017, the number of nests had increased to nearly 2,000, each comprising two adults. In addition, the summering population will include many hundreds of non-breeding geese and failed breeders, in addition to the goslings produced from each successful nest. Eighty birds have been caught there during their annual wing moult in July and sightings of the marked geese indicate that the Iceland-breeding birds winter within the range of the Greenland population (most of the sightings have been on Islay). Thus, it is highly likely that the increasing number of barnacle geese nesting in Iceland are part of a Greenland/Iceland/UK/Ireland population. This appears to be a case of 'short-stopping', where geese start to breed along the flyway route, short of the normal breeding areas. This has also occurred in the Russia/Netherlands population, where barnacle geese started to breed on Gotland, Sweden (57°30'N 18°33'E), along the flyway route, but short of the normal breeding areas in arctic Russia (Larsson *et al.* 1988). The contribution of the Iceland breeding birds to the winter population merits further investigation since the annual breeding success and other demographic rates of the birds from the two geographical areas may diverge.

4. RECOMMENDATIONS

The primary objectives of the census are to provide a contemporary assessment of population size and to provide information on site importance. Meeting these two requirements may, however, need different methods.

4.1 Timing and frequency of population counts

To monitor changes in population size at a time when active culling of geese is ongoing and to track the possible effects of the rapid increase in the number of birds breeding in Iceland, the current monitoring programme of one international census every five years appears inadequate in terms of providing sufficient sensitivity in documenting changes in numbers. The risk created by a census interval that is too long is that annual management decisions are based upon data that have become out-of-date. An annual coordinated international census is probably not possible given the resources this would require, so it is therefore recommended that the frequency of the international census should be increased to one census every three years in order to provide better alignment with management decision-making. However, to be effective an increase in the frequency of coordinated censuses would require the participation of both countries (Scotland and Ireland) holding wintering Greenland barnacle geese.

An analysis of arrival dates of spring migrants recorded in Iceland suggested that, in recent years, Greenland barnacle geese had begun to arrive earlier in the year by approximately 0.67 days per year between 1988 and 2009, or by up to 14 days over the 21-year study period, although the first arrivals in the mid-2000s were on or about 15 April (Gunnarsson & Tómasson, 2011). Thus, it seems prudent to continue to carry out future aerial surveys in either early or mid-March to avoid missing birds which may start their migration in early April.

4.2 Monitoring of nationally and internationally important sites

Numbers of Greenland 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.

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 Table 4) although offshore islands, necessitating aerial survey, are often counted less frequently (currently once every five years as part of the international census).

However, the need for regular counting needs to be balanced against the cost of aerial survey. It is therefore suggested that an aerial survey carried out every three years offers a pragmatic solution to the needs of a population census and coverage across the complete SPA network.

It is important to note that this is not an exhaustive list of monitoring needs for the population management currently being undertaken and only covers monitoring the total population size and site use.

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ANNEX 1: SITES WITH NIL GREENLAND BARNACLE GEESE IN SCOTLAND DURING THE MARCH 2018 CENSUS

Islay and islands	Texa	NR3943
	Eilean Bhrìde	NR4547
	Eilean a'Chuirn	NR4748
	Nave Island	NR2875
Jura	Glas Eilean	NR4464
	Am Froach	NR4662
	Brosdale Island	NR4962
	Eilean nan Gabhar	NR5367
	Eilean nam Coinean	NR5468
	Eilean Bridhe	NR5569
	Eilean Mor (Jura)	NM6701
Sound of Jura	Eilean Mor (Kintyre)	NR6675
	Corr Eilean	NR6775
	Eilean Nan Coinean	NR7186
	Eilean Dubh	NR7187
	Carsaig	NR7389
	Eilean nan Cille	NR7597
	Reisa an t-Sruith	NR7399
	Reisa Mhic Phaidean	NM7501
	Eileach an Naoimh	NM6409
	A'Chuli	NM6511
	Garbh Eileach	NM6611
	Dun Chonnuill	NM6812
	Eilean Dubh Mor	NM6910
	Eilean Dubh Beg	NM6911
	Lunga	NM7008
	Fiolan Meadhonach	NM7109
	Rubha Fiola	NM7110
	Ormsa	NM7111
	Eilean Mhic Chiarain	NM7211
	Belnahua	NM7112
	Insh Island	NM7319
	Bach	NM7726
	Eilean nan Gamhna	NM8338
	Eilean na Cloiche	NM8338
	Eilean Dubh	NM8339
	Eilean Dubh	NM8742
	Bernera	NM7939
	Eilean Muisdale	NM7835
Mull	Eilean Mor	NM3416
	Eilean a Chalmain	NM3017
	Eilean Dubh	NM3018
	Eilean nam Muc	NM2819
	Eilean Dubh	NM2820
	Eilean Ghomain	NM2820
	Soa	NM2419
	Iona	NM2723
	Inchkenneth	NM4335
	Little Colonsay	NM3736

Treshnish Islands	Staffa	NM3235
	Bac Beag	NM2437
	Bac Mor	NM2438
	Lunga	NM2441
	Fladda	NM2943
	Burgh More	NM3044
	Burgh Beg	NM3044
Small Isles	Eigg	NM3971
	Canna/Sanday	NG2505
Wester	Longa	NG7377
Ross	Eilean Furadh	NG7993
Skye	Wiay	NG2936
	Tarner	NG2939
	Harlosh	NG2739
	Mingay	NG2257
	Ascribs (South Ascrib)	NG3063
	Ascribs (Eilean Garave)	NG2964
	Ascribs (Eilean losal)	NG2865
	Eilean Flodigarry	NG4871
	Sgeirna Eireann	NG4872
	Fladda-chuain	NG3861
Islands south of Barra	Berneray	NL5680
	Mingulay	NL5683
	Geirum More	NL5581
	Solon Mor	NL5784
	Solon Beg	NL5784
	Outer Heisker	NL5786
	Pabbay	NL6087
	Lingay	NL6089
	Greanamul	NL6289
	Flodday	NL6192
	Sandray	NL6491
	Muldoanich	NL6096
	Biruaslaim	NL6096
	Vatersay	NL6395
Sound of Barra	Fuday	NF7308
	Orosay	NF7106
	Lingay-fhada	NF7303
	Garbh Lingay	NF7403
	Gighay	NF7604
	Hellisay	NF7503
	Lamalum	NF7503
	Flodday	NF7502
	Fuiay	NF7402
	Stack Islands	NF7807
	Lingay	NF7511
Monach Isles	Shillay	NF5962
Noth Uist	Beinn Bhaile	NF7168
	re-seeds	NF7371
	Balmartin	NF7273
	Ben Scolpaig	NF7376

North Uist	Aird Mhic Caoilt	NF7875
	Oronsay	NF8475
	Newton	NF8877
Sound of	Gumersam Mhor	NG0282
Harris	Gumersam Bheag	NG0381
	Langay	NG0182
	Gilsay	NG0280
	Lingay	NG0179
	Groay	NG0079
	Scaravay	NG0178
	Narstay	NF9777
	Opsay	NF9876
	Sarstay	NF9776
	Hermetray	NF9874
	Huletray	NF9875
	Vaccasay	NF9775
	Groatay	NF9873
	Tahay	NF9775
	Sursay	NF9676
	Votersay	NF9575
	Stromay	NF9475
	Torogay	NF9278
	Lingay	NF8778
	Pabbay	NF8988
	Shillay	NF8891
West Coast,	Gasker	NA8711
Harris	Soay Mor	NB0605
	Soay Beg	NB0505
	Fladday	NA9915
	Kearstay	NA9617
	Greine Sgeir	NB0116
	Liongarn	NA9919
	Eilean Mealastadh	NA9821
	Greineim	NA9825
	Eilean Molach	NA9932
Loch Roag,	Old Hill	NB1143
Lewis	Bereasaidh	NB1242
	Floday	NB1241
	Campay	NB1442
	Cealasaidh	NB1441
	Little Bernera	NB1440
	Pabay Mor	NB1038
	Vacsay	NB1137
	Vuia Mor	NB1335
	Floday	NB1033
	Vuia Beg	NB1233
Loch	Tabhaidh Mhor	NB4222
Erisort,	Tabhaidh Bheag	NB4122
Lewis	Tarnt Braigh	NB4023
Shiantas	Eilean an Tighe	NG4297
	Garbh Ebn	NG4198
Wester	Longa	NG7377
Ross	Priest Island	NB9202
	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
	Eilean Mullagrach	NB9511
	Eilean Mor	NC0517
	Froachlan	NC0518
West	A'Chleit	NC0220
Sutherland	Soyea	NC0421
Coast	Eilean Chrona	NC0633
	Mor	NC1238
	Meall Beg	NC1337
	Badcall Bay	NC1540
	Handa	NC1348
	Loch Laxford	NC2050
	Eilean a' Chunnaidh	NC2057
	Am Balg/En Buigach	NC1866
	Eilean an Roin Mor	NG4198
North	An Garbh-eilean	NC3373
Sutherland	Eilean Cluimhrig	NC4665
Coast	Rabbit Island	NC6063
	Sgeir an Oir	NC6164
	Eilean Iosa	NC6365
	Coomb Island	NC6664

ANNEX 2: LONG-TERM TRENDS ON SPAS IN SCOTLAND

Maximum winter numbers of Greenland barnacle geese at nine SPAs in Scotland (Figures 13–21), 1956/57–2017/18. Bars indicate maximum winter count. Dots indicate years when no data were collected. Lines indicate national total based on international censuses. Note that some long term count 'sites' do not match SPA boundaries exactly.

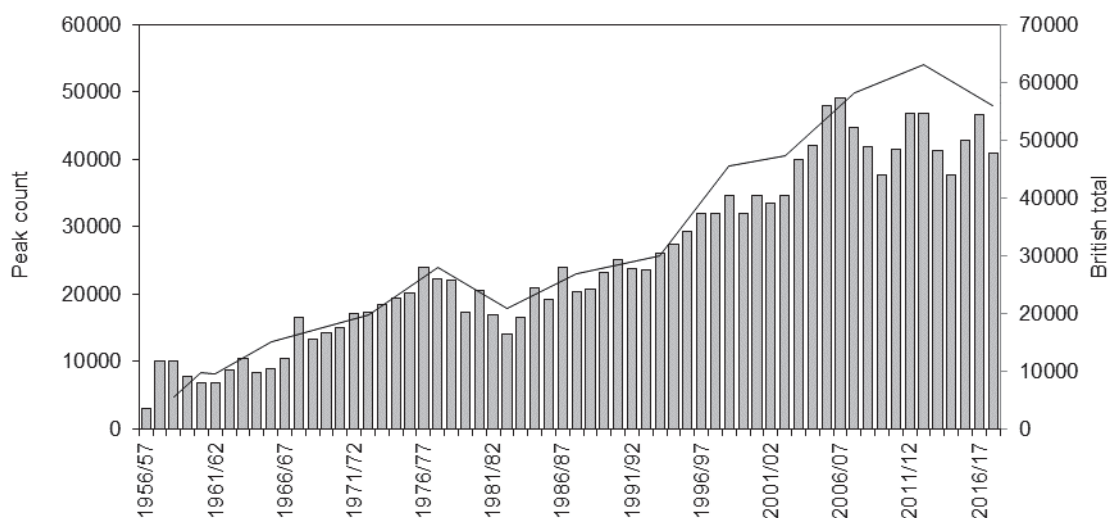


Figure 13. Islay

Counts on Islay include geese using the Gruinart Flats, Bridgend Flats and Laggan SPAs as well as geese feeding outwith the SPA areas. Up to 1986/87, bars show maximum winter count. From 1987/88, bars show the mean of up to four island-wide counts undertaken each winter.

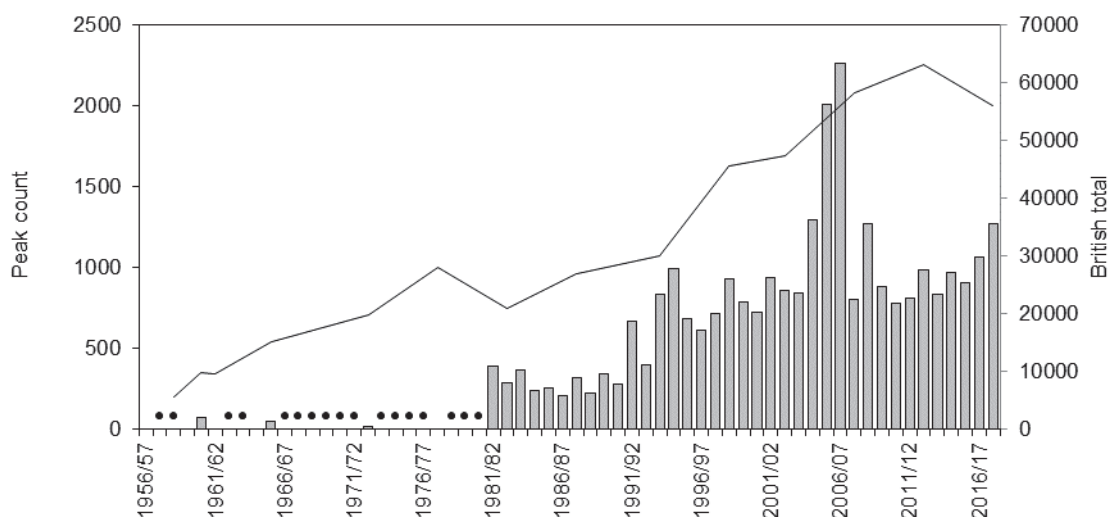


Figure 14. Coll

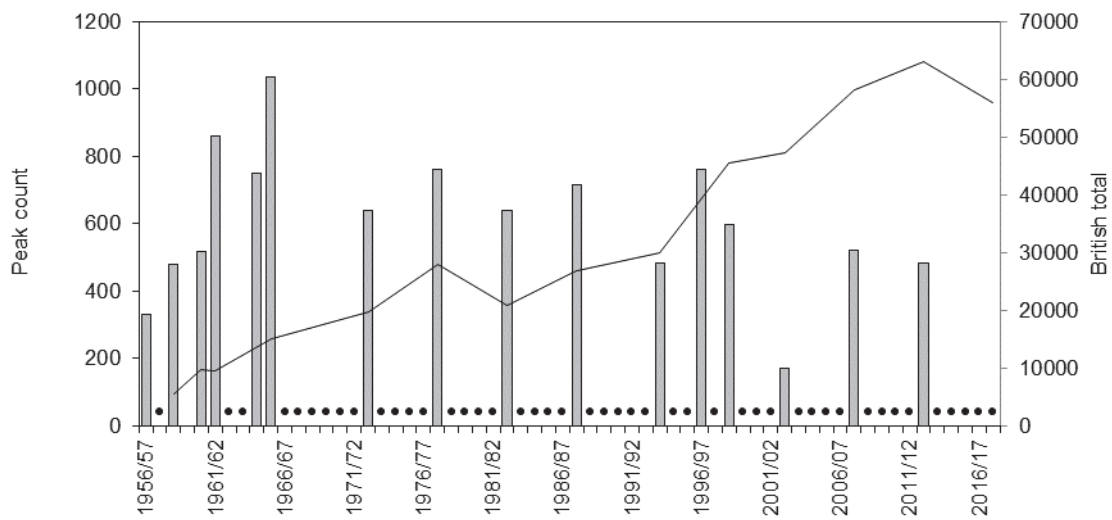


Figure 15. Monach Isles

Flight restrictions meant no count was undertaken in March 2018. The mean of the counts in 2008 (520) and in 2013 (482) has been used as an estimate in Table 1 and for deriving the population totals.

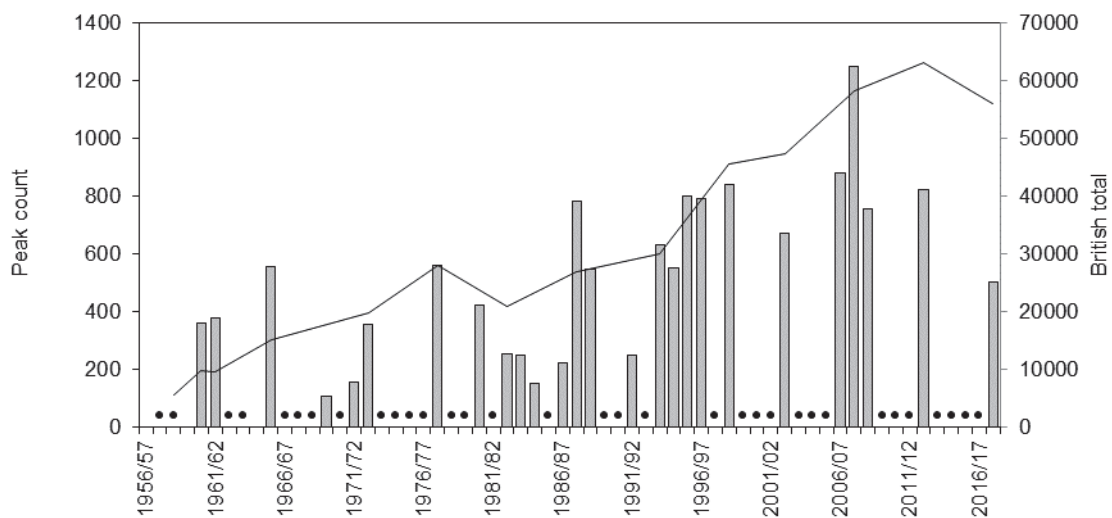


Figure 16. North Sutherland Coast

Graph includes counts from Balnakeil (NC3968), Eilean Hoan (NC4467), Eilean nan Ron (NC6365), Neave Island (NC6664), Rabbit islands (NC6063) and mainland around the Kyle of Tongue.

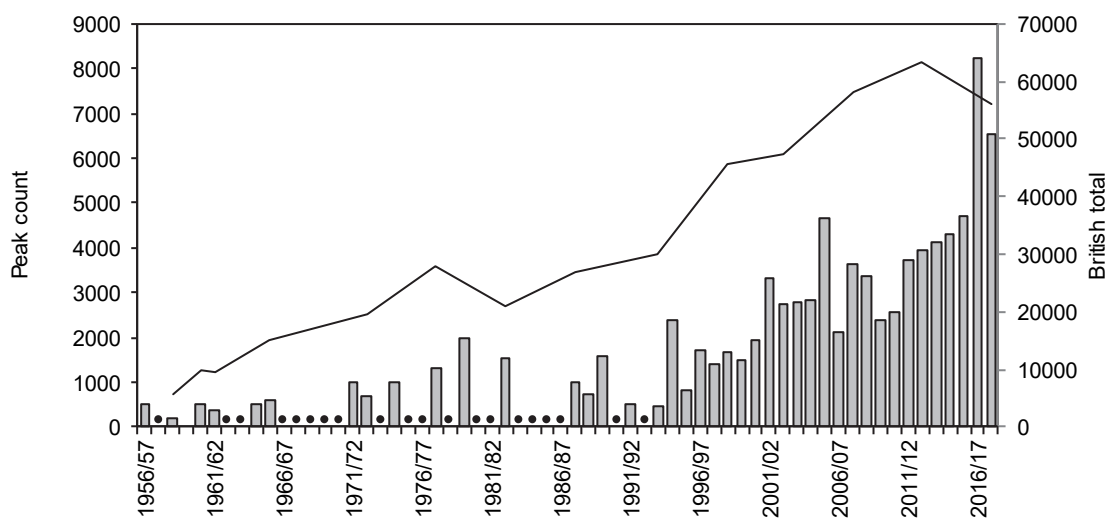


Figure 17. North Uist Coast and Islands

Counts on North Uist include geese using the North Uist Coast and Islands SPA as well as geese feeding outwith the SPA.

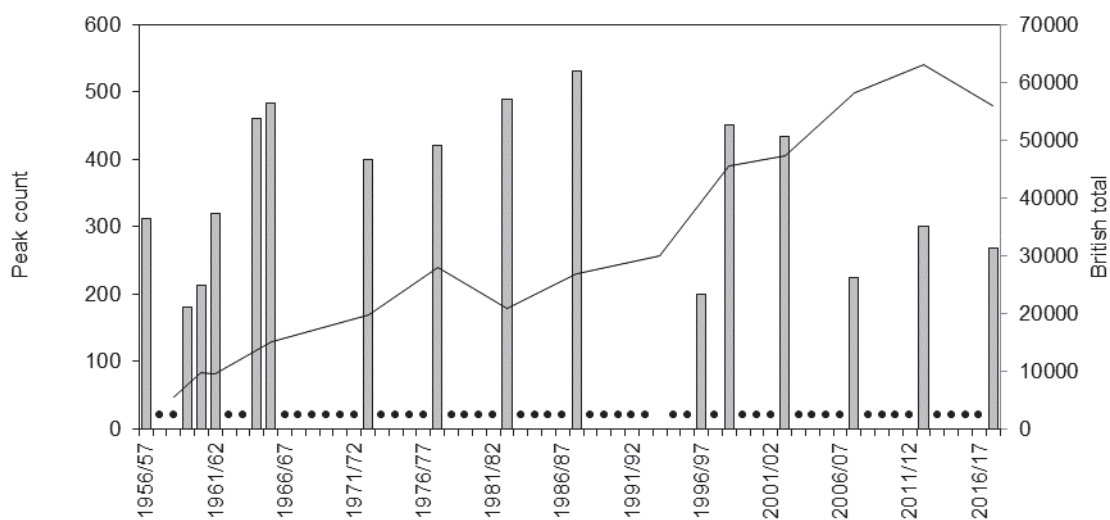


Figure 18. Shiant Isles

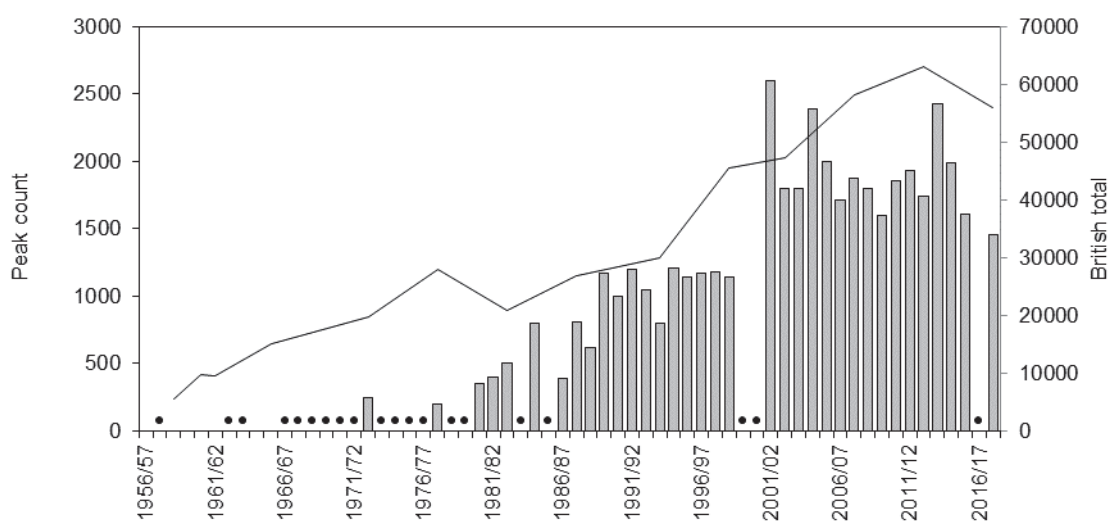


Figure 19. Switha (South Walls, Orkney)

The island of Switha (ND3690) is an SPA, and where the geese roost. However, the daytime feeding grounds are on a nearby island (South Walls, ND3189) which is not protected.

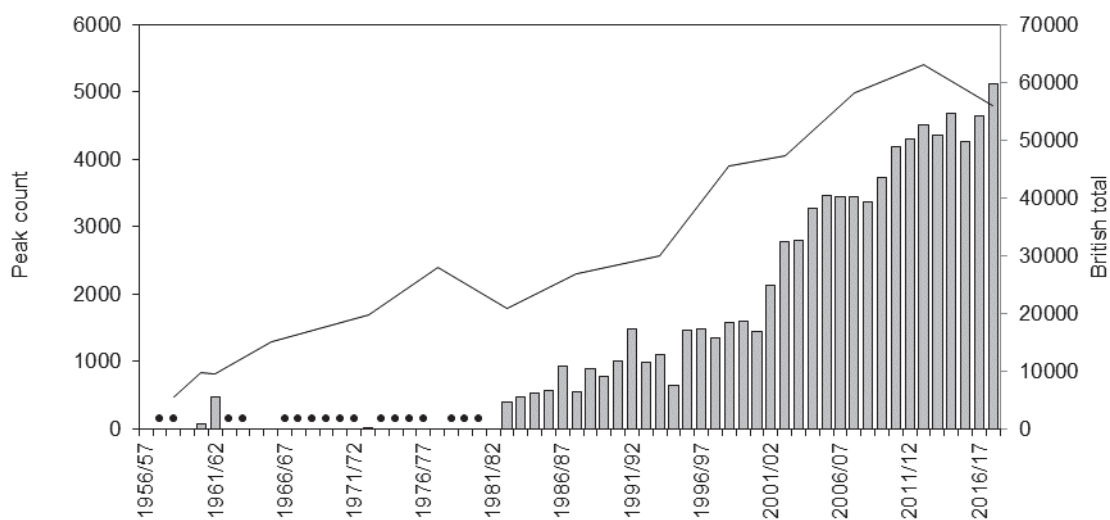


Figure 20. Sleibhtean agus Cladach Thiriodh (Tiree Wetlands and Coast)

Counts on Tiree include geese using the Sleibhtean agus Cladach Thiriodh SPA as well as geese feeding outwith the SPA.

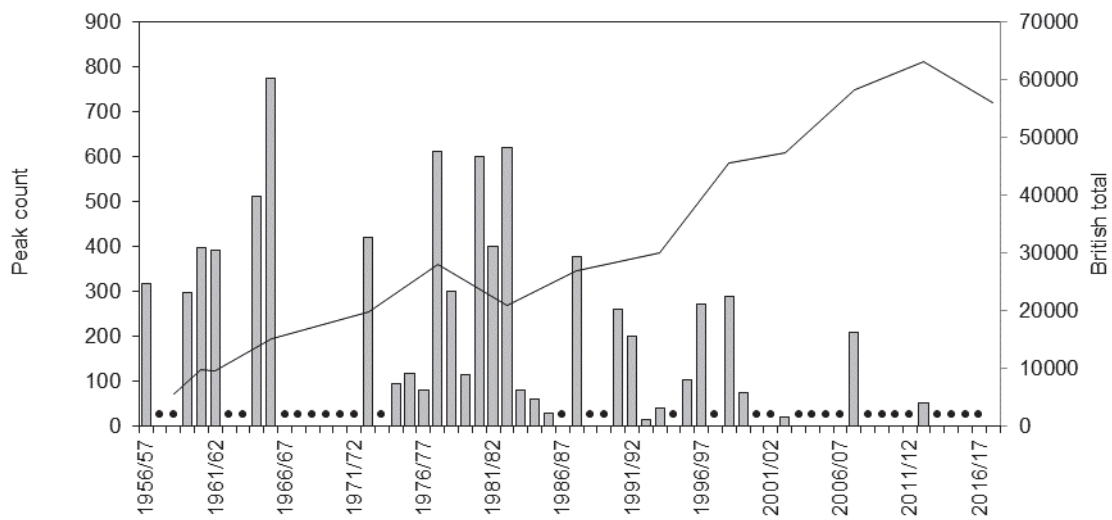


Figure 21. Treshnish Isles

No barnacle geese were found on the Treshnish Isles, but 226 geese were counted on Inchkenneth (NM4335), 11km to the east of Staffa. The geese are quite mobile in this area, and this flock may have fed/roosted on the Treshnish Isles at other times during the winter. Maximum winter numbers of Greenland barnacle geese at nine SPAs in Scotland (Figures 13–21), 1956/57–2017/18. Bars indicate maximum winter count. Dots indicate years when no data were collected. Lines indicate national total based on international censuses. Note that some long term count ‘sites’ do not match SPA boundaries exactly.

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