



Status and distribution of Icelandic-breeding geese: results of the 2019 international census

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Goose & Swan Monitoring

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Summary

The 60th consecutive annual census of Greenland/Iceland Pink-footed Geese and Iceland Greylag Geese took place during autumn and early winter 2019. Sites holding Pink-footed Geese were surveyed in October and November, whilst those holding Greylag Geese were surveyed in November only. Coverage in Britain was excellent, with all of the key sites covered. During the time of the census, weather conditions were generally considered good, and little disturbance was reported from sites during the October and November periods with very few sites reporting underestimated counts. Count data were also received from Ireland, the Faroe Islands and Southwest Norway, and from Iceland where an aerial census was conducted in favourable flying conditions.

Maxima of 500,928 Pink-footed Geese and 101,235 Greylag Geese were counted in October and November, respectively. The Greylag Goose figure was adjusted to account for the estimated number of British/Irish Greylag Geese likely to have been counted during this census, resulting in population estimates of 500,928 Pink-footed and 73,355 Greylag Geese. Compared to the previous year, the 2019 figures represent an increase of 13.6% in the Pink-footed Goose population and an increase of 25.6% in the Iceland Greylag Goose population. The possible explanations for these changes in population size are discussed in this report.

Fifteen sites in Britain held 10,000 or more Pink-footed Geese in October, with Montrose Basin, Angus, holding the largest number during the census (66,575 birds). Combined counts from 32 sites that supported numbers exceeding 1% of the 2019 Pink-footed Goose population estimate accounted for 81.5% of the total October count. During the November census, 72.5% of the Iceland Greylag Goose population was present in North Scotland, principally in Orkney.

The breeding success of Pink-footed Geese was assessed for flocks wintering at locations in Scotland and England during October and November, with 15.6% young found amongst those flocks sampled: this being lower than the previous year and lower than the previous ten-year mean of 17.6%. The mean brood size of successful pairs was 1.98 goslings. The breeding success of Iceland Greylag Geese was sampled in northern Scotland with 20.1% young recorded amongst flocks, although this was based on a very small sample size, which is lower than the previous year and lower than the previous ten-year mean of 21.7%. The mean brood size was 2.17 goslings per successful pair.

1. Introduction

The Pink-footed Goose *Anser brachyrhynchus* population which breeds in Iceland and along the east coast of Greenland, winters almost exclusively in Britain (Mitchell 2002), whilst Greylag Geese *Anser anser* breeding in Iceland principally winter in northern Britain, with small numbers in Iceland, Ireland, the Faroes and Southwest Norway (Swann & Brockway 2002). Large concentrations of both species occur during the autumn, Pink-footed Geese particularly in East Central Scotland, Southwest Lancashire and Norfolk and Greylag Geese in North Scotland, notably Orkney. As winter progresses, redistribution to other parts of the wintering range occurs and estimation of the size of these populations is therefore most effective in the autumn (Mitchell & Hearn 2004, Hearn & Mitchell 2004).

The Icelandic-breeding Goose Census (IGC) has been undertaken annually since 1960 and aims to assess the size, distribution and breeding success of Greenland/Iceland Pink-footed Geese and Iceland Greylag Geese. Since 1990, two coordinated counts have been undertaken, the first in October and the second in November. These are timed to coincide with periods when these geese are most concentrated after their arrival in Britain. Pink-footed Geese arrive earlier than Greylag Geese and are, therefore, usually best counted in October. The November count allows for the later migration of Greylag Geese to be completed. Every three years, a coordinated spring count is also undertaken in order to map the distribution of birds during this important part of the annual cycle; the most recent was in spring 2018 (reported in Brides *et al.* 2018).

This report provides an overview of the 60th consecutive annual census and an update on the population size and breeding success of Greenland/Iceland Pink-footed Geese and Iceland Greylag Geese following the 2019 breeding season.

2. Methods

Dates of the coordinated counts were chosen to avoid periods of full moon as far as possible, in an attempt to minimise the likelihood of geese remaining in feeding areas overnight. Counts were conducted by a network of experienced volunteer observers and professional conservation staff over the weekends of 19/20 October (Pink-footed Geese) and 23/24 November (Pink-footed and Greylag Geese).

In order to ensure coverage was as comprehensive as possible, Local Organisers were asked to check that all possible roosting locations in their areas were covered. Data from Global Positioning Satellite (GPS) tags carried by several Pink-footed Geese were used to identify any roosting locations not previously covered by the census, to ensure coverage of any potential gaps; counters were deployed to these locations. In Iceland, concerted effort was made to count Pink-footed Geese in October by birders and members of the public, this being a new approach used for the 2019 census.

On 22nd November, the annual aerial survey of Greylag Geese was carried out in southern Iceland. Data from this survey were combined with ground counts undertaken elsewhere in Iceland along with counts and sightings submitted by birders and members of the public. In previous years, non-systematic information from hunters was also taken into account; however, this information was not collected in 2019.

Counts of Greylag Geese in Southwest Norway are undertaken in January. Guidance from local counters in the region suggests that the winter influx of Iceland migrants (determined by the presence of marked individuals from Iceland) occurs in late October or early November and they remain there throughout the winter (A. Follestad pers. comm.). The count from January is, therefore, used as an estimate for the November census period; this approach has been adopted for several years.

In some cases, counts made close to the coordinated count dates were included in the analysis if there was no reason to suspect they duplicated other counts. Most counts were of roosting geese, made either at dusk, when the birds were flying in, or at dawn, as they departed for feeding areas. In a small number of areas where roost sites were poorly known, inaccessible or infrequently used, daytime counts of feeding birds were made. Consequently, in this report the term 'site' is applied to a range of geographical areas. Most are individual waterbodies where a goose roost occurs, whilst some are feeding areas around known roosts, and others are a mixture of the two. All sites are, however, areas to which an individual count can be attributed. For the purpose of analysis, counts from Orkney, Southwest Norway, Faroe Islands and Iceland are treated as consolidated sites. Up to 2012, geese in Caithness were counted during the daytime when they were feeding on agricultural land and the county was treated as a consolidated site. However, since 2012, roost counts have been undertaken and these are now reported separately.

If necessary, adjustments are applied to count totals in order to generate the population estimate for the Pink-footed Goose and Greylag Goose populations. These adjustments take into consideration estimated counts for sites that were not visited at the time of the census (for both populations) and estimated numbers of British/Irish Greylag Geese (for the Iceland Greylag Goose).

Where a count was not undertaken, an estimate of the number of geese present may be provided by local counters. For regularly monitored sites (those counted in at least three of the previous five years) that were not counted during the current census, and no estimate was provided by a local counter, numbers are estimated using the mean of the counts made during the relevant month during the previous five years (e.g. the mean from 2014–2018 would be used for 2019). Estimated numbers (from either source) that exceed 0.5% of the current IGC peak count total for the relevant population are added to the peak count to give the adjusted population estimate.

Increasing numbers of British/Irish Greylag Geese in core wintering areas for the Icelandic migrants, such as Orkney, Caithness and the Moray Firth means that assessing the abundance of the Iceland population at wintering sites is difficult. Where there are reasonable estimates of the abundance of British/Irish Greylag Geese, these are subtracted from winter counts. However, up to date information on the status of Iceland Greylag Geese south and east of an arbitrary line from

Bute to Aberdeenshire is largely lacking and, simply as a precaution, any counts obtained through the IGC from this area are discounted, as it is likely the majority of birds in this area during November are from the British population. This is carried out as a precautionary measure but is unsatisfactory as it will likely lead to the Iceland Greylag Goose population being underestimated.

An attempt was made to account for the presence of British/Irish Greylag Geese in areas where Iceland Greylag Geese were known to winter. For the 2019 census, this involved sites in Ireland (1,165), Orkney (18,000, see Discussion), Caithness (1,000) and Highland (750). British Greylag Geese also occur throughout southern Scotland and northern England and where counts were thought to involve British birds, these have been deducted (see Table 2). In the Faroes, Greylag Geese are thought to be mainly sedentary and so counts of <1,000 birds, based on summer counts undertaken previously, have also been deducted (689 geese counted in 2019).

To assess breeding success, experienced observers made assessments of the proportion of young in non-breeding goose flocks (first-winter birds are separable from older birds by differences in plumage characteristics) and of brood size (number of young per successful breeding pair) during the autumn. Data collected from late September to mid-November 2019 were used to determine the percentage of young in flocks and the mean brood size of successful pairs.

3. Results

3.1. Coverage and conditions

The number of sites covered in each month is shown in Table 1. Coverage throughout the range of both species during 2019 was considered excellent. All of the important sites for Pink-footed Geese and Greylag Geese (based on counts made in previous years) were checked in 2019.

In 2019, an additional 38 sites were covered for Pink-footed Geese in October and 17 in November, compared with 2018. In part, the increase coverage was due to potential new roost sites for Pink-footed Geese being covered for the first time in 2019. Sixteen additional sites were checked for Greylag Geese in November compared with the previous year.

Table 1. The number of sites surveyed, and the number of sites holding Pink-footed and Greylag Geese in October and November 2019.

	October	November
Number of Pink-footed Goose sites surveyed	153	154
Number of sites holding Pink-footed Geese	101	90
Number of Greylag Goose sites surveyed	-	166
Number of sites holding Greylag Geese	-	82

In Iceland, Greylag Geese were counted by aerial and ground surveys: all counts were carried out in favourable conditions. Additional effort was put in to counting Pink-footed Geese in Iceland during the October census; this is something that we aim to build on in future years.

Elsewhere, good counting conditions during the census were reported for most sites. However, poor visibility was recorded at nine sites in October and ten in November, although it is uncertain whether these counts majorly affected the overall total: numbers of geese recorded at these sites have fluctuated in recent years making it difficult to determine the contribution counts from these sites typically make to census totals. Disturbance during counting was reported from one site in October and one in November, but comments from Local Organisers and counters suggest this did not adversely affect the counts at these location.

3.2. Total numbers

3.2.1. Pink-footed Goose

Totals of 500,928 and 357,507 Pink-footed Geese were counted in October and November 2019, respectively (Figure 1, Table 2). These represent an increase of 13.6% and a decrease of 8.0%, respectively, compared to the unadjusted total counts in the same months in the preceding year. No estimated counts (for sites not covered during the census; see Methods) needed to be added to the 2019 totals. The total count for October (500,928) has been selected as the population estimate (Figure 2).

3.2.2. Greylag Goose

In November 2019, 101,235 Greylag Geese were counted (Figure 1, Table 2). The unadjusted November count was 9.4% higher than that recorded the previous year. No estimated counts (for sites not covered during the census; see Methods) needed to be added to the 2019 totals. Following adjustments for British/Irish Greylag Geese likely to be included in this count, a population estimate of 73,355 Iceland Greylag Geese was derived (Figure 2). This represents an increase of 25.6% compared to the previous estimate of 58,426 geese in 2018.

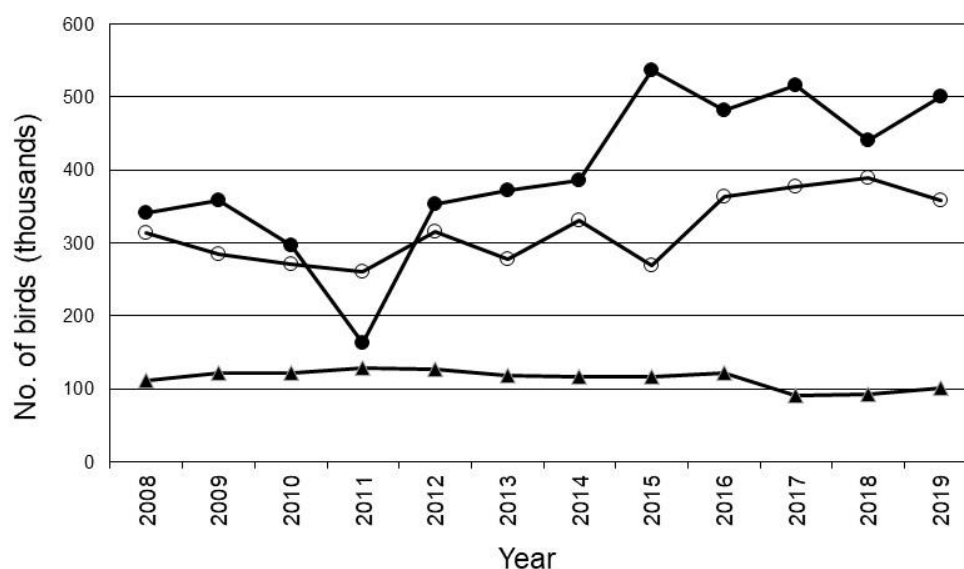


Figure 1. Peak (unadjusted) counts of Pink-footed Geese (circles) in October (filled) and November (open) and peak (unadjusted) counts of Greylag Geese (triangles) in November counted during the Icelandic-breeding Goose Census, 2008 to 2019.

Table 2. Totals of Pink-footed Geese and Iceland Greylag Geese by country and region in October and November 2019. Raw counts are shown with adjustments for non-Icelandic birds [-x]. Figures in parentheses indicate the number of sites counted.

Region/area	October 2019	November 2019	
	Pinkfoot	Pinkfoot	Greylag
Iceland*	7,500 (1)	20 (1)	16,500 (1)
Norway*†	-	-	267 (1)
Faroe Islands*	-	0 (8)	689 (8)
			[-689]
Ireland	12 (6)	73 (4)	3,341 (9)
			[-1,165]
Shetland*	nc	nc	nc
Orkney*	-	34 (1)	65,121 (1)
			[-18,000]
Caithness	3,980 (10)	3,857 (16)	5,478 (16)
			[-1,000]
Highland	67,003 (10)	11,340 (7)	2,314 (7)
			[-750]
Moray	26,320 (4)	47,450 (3)	1,189 (3)
Aberdeenshire	51,506 (9)	48,405 (7)	62 (7)
			[-62]

Region/area	October 2019	November 2019	
	Pinkfoot	Pinkfoot	Greylag
Angus/Dundee	83,700 (3)	33,479 (2)	50 (2) [-50]
Perth & Kinross	43,970 (8)	21,269 (11)	1,303 (11) [-1,303]
Stirling/Falkirk/Clackmannan	5,167 (4)	6,768 (4)	270 (4) [-270]
Fife	20,511 (16)	7,381 (12)	251 (12) [-251]
Argyll & Bute	-	-	560 (1) [-500]
Dumfries & Galloway **	15,225 (8)	11,523 (7)	0 (7)
Cumbria **	5,227 (5)	5,992 (4)	33 (4) [-33]
Lothians	9,592 (10)	6,531 (15)	1,509 (14) [-1,509]
Borders	33,219 (10)	10,311 (13)	486 (13) [-486]
Northumberland	6,573 (15)	3,401 (13)	1,579 (13) [-1,579]
Lancashire & Merseyside	46,260 (8)	40,231 (8)	0 (8)
N Wales/Dee Estuary	4,145 (3)	12,320 (4)	2 (4) [-2]
Humberside	32,814 (8)	14,483 (7)	0 (7)
Norfolk	38,204 (15)	72,631 (14)	231 (13) [-231]
Gloucestershire	-	8 (1)	-
<i>Raw total counts</i>	500,928	357,507	101,235
<i>Adjustment for non-Icelandic birds</i>			-27,880
Population Estimate	500,928		73,355

* Several feeding sites consolidated.

** Counts from the Solway Firth have been split between birds counted in Dumfries & Galloway and Cumbria.

† The count in Norway was undertaken in January 2020.

nc No count received.

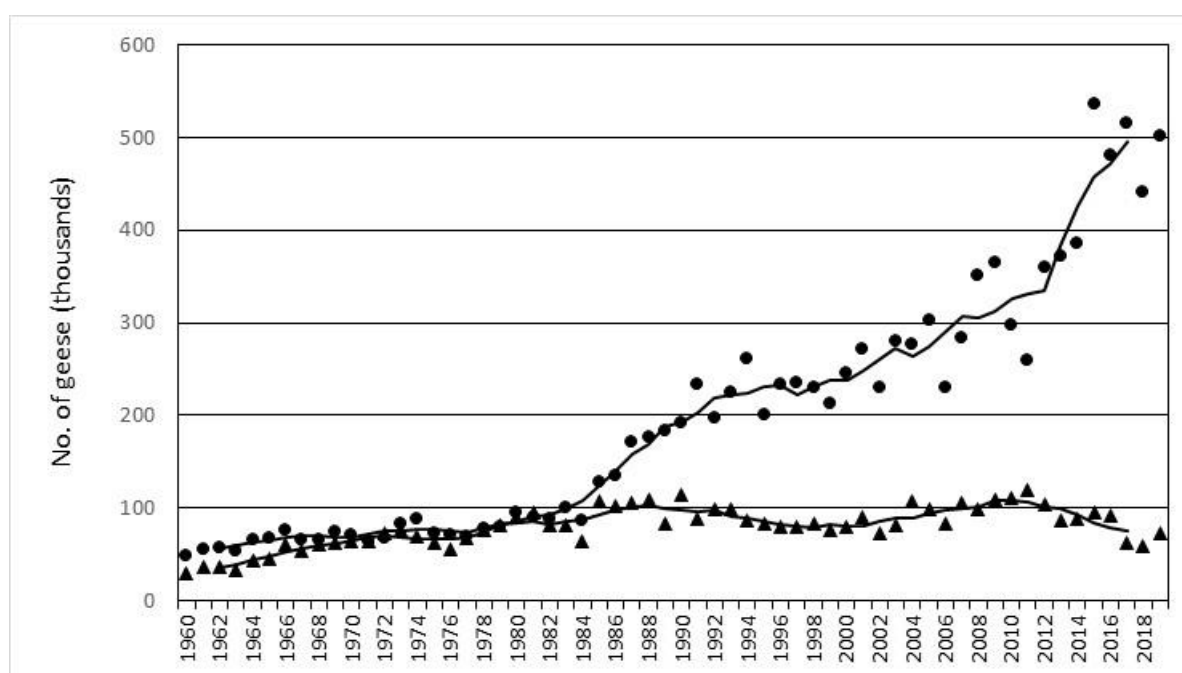


Figure 2. Population estimates for Pink-footed Geese (circles) and Iceland Greylag Geese (triangles), 1960 to 2019. The five-year running means (e.g. mean for 2017 is from the population estimate for 2015 to 2019) are shown as lines.

3.3. Regional distribution

3.3.1. Pink-footed Goose

By the time of the October census, the majority of the population had arrived in Britain, with just under a third (30.6%) recorded in East Central Scotland, c. 14–15% in each of North and Northeast Scotland and East England, and c. 10% or less in other regions, whilst 1.5% of the population remained in Iceland (Table 3, Figure 3). By November, all regions held lower proportions of birds, apart from Northeast Scotland where numbers had increased to 19.1%, East England, seeing an increase from 14.2% to 17.4% and West England where numbers had increased slightly from 10.1% to 10.5% (Table 3, Figure 3).

3.3.2. Greylag Goose

By November, just under three-quarters of the population (72.5%) were found in North Scotland, primarily in Orkney, with 22.5% present in Iceland, 3.0% in Ireland, 1.6% in Northeast Scotland and 0.1% in Southwest Scotland/Northwest England (Table 3, Figure 4 & 5). A small percentage (0.4%) of the population was also located in Norway (Table 3). In Britain, the overlap between the British and Iceland populations makes it difficult to determine the origin of individuals; however, it is doubtful that many Greylag Geese encountered south and east of a line drawn from Bute to Aberdeen (see Figure 4) in November are of Icelandic origin (but see Discussion).

Table 3. National and regional distribution (within Britain) of Pink-footed Geese and Iceland Greylag Geese counted during October and November 2019, expressed as a percentage of the maximum count for Pink-footed Geese and the maximum adjusted count for Iceland Greylag Geese.

	Pink-footed Goose		Greylag Goose
	October	November	November
Iceland	1.5	<0.5	22.5
Faroes	-	0	0
Norway	-	-	0.4
Ireland	0	<0.5	3.0
North Scotland ¹	14.2	3.0	72.4
Northeast Scotland ²	15.5	19.1	1.6
East Central Scotland ³	30.6	13.8	0
Southwest Scotland/ Northwest England ⁴	4.1	3.5	0.1
Southeast Scotland/ Northeast England ⁵	9.9	4.0	0
West England ⁶	10.1	10.5	0
East England ⁷	14.1	17.4	0
Total	100	72.3	100

¹ Orkney, Caithness and Highland

² Moray and Aberdeenshire

³ Angus & Dundee, Perth & Kinross, Stirling/Falkirk/Clackmannan

⁴ Argyll & Bute, Dumfries & Galloway and Cumbria

⁵ Lothians, Borders and Northumberland

⁶ Lancashire, Merseyside and North Wales/Dee Estuary and Gloucestershire

⁷ Humberside and Norfolk



Figure 3. Distribution of Pink-footed Geese in Britain and Ireland in October (left) and November (right) 2019.

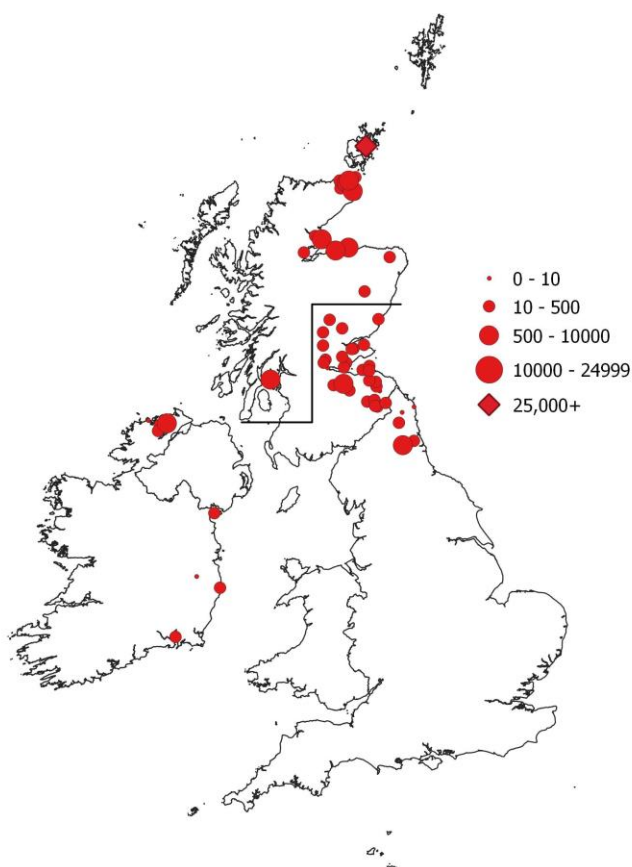


Figure 4. Distribution of Greylag Geese in Britain and Ireland in November 2019. The mapped counts do not differentiate between Icelandic and British/Irish birds. It is unlikely that many Iceland birds are present in Britain south and east of the line in November (see also Table 2).



Figure 5. Distribution of Iceland Greylag Geese in Iceland in November 2019.

3.4. Principal concentrations

3.4.1. Pink-footed Goose

Pink-footed Geese were recorded at 101 sites in October and 90 in November (Table 1, Figure 3). Fifteen sites held more than 10,000 birds in October (Table 4) and nine sites held this many in November. The number of sites holding more than 1% of the 2019 population estimate (5,009 birds) was 32 in October (Table 4) and 18 in November. The number of Pink-footed Geese at individual sites is likely to be lower in November compared with October as the geese re-distribute across the wintering range and become less concentrated at roost sites.

In October, combined counts from the top 32 sites accounted for 81.4% of the total population and numbers at the top five sites held 31.3% of the population (Table 4): high numbers were recorded at Montrose Basin, Angus, which held 66,575 birds (13.3% of the population estimate), Beaully Firth, Highland (26,000, 5.2%), Carsebreck and Rhynd Lochs, Perth & Kinross (24,000, 4.8%), Findhorn Bay (20,800, 4.2%) and Middlemuir, New Pitsligo Moss (18,200, 3.6%) (Table 4).

3.4.2. Greylag Goose

Greylag Geese were recorded at 82 sites in November (Table 1, Figure 4 & 5), five of which held more than 1% of the 2019 population estimate (733 birds) (this considers Orkney and Iceland as single consolidated sites) (Table 4). The two sites supporting the highest counts were Orkney, which held 47,121 birds (64.2% of the population estimate) and Iceland, which held 16,500 birds (22.5%).

As Orkney holds wintering geese from both the British and Iceland Greylag Goose populations, a good understanding is also required of the number of British birds present at the time of census. To estimate this for 2019, we used the total count from the August 2019 post-breeding census of Greylags in Orkney (22,956 birds; (Plowman J. In prep.) from which we deducted an estimate of the number of British birds shot in Orkney between August and November 2019 (5,000 birds, J. Plowman pers. comm.). This resulted in an estimate of 18,000 British birds, which was then deducted from the overall Orkney IGC total to estimate the number of Iceland Greylag Geese present in November 2019.

For the purpose of this report, Orkney is treated as a consolidated site. Appendix 1 shows the individual totals for the islands; 21 of the islands held 1% or more of the population estimate in November, although these individual counts are not adjusted for the presence of British Greylag Geese in Orkney (thought to number c. 18,000 birds in total, see above and Discussion).

Table 4. Sites that supported >1% of the (a) Pink-footed Goose (>5,009) and (b) Iceland Greylag Goose (>733) population estimates in October and November 2019, respectively. Note that these values are not the same as the internationally accepted threshold values for these populations that are used to identify sites of international importance: currently 5,400 for Pink-footed Goose and 980 for Iceland Greylag Goose (Wetlands International 2018). Greylag Goose counts are adjusted where possible (*i.e.* British/Irish birds have been deducted).

a) Pink-footed Goose

Site	October count	Percentage of population estimate
Montrose Basin, Angus	66,575	13.3
Beaully Firth, Highland	26,000	5.2
Carsebreck and Rhynd Lochs, Perth & Kinross	24,000	4.8
Findhorn Bay, Moray	20,800	4.2
Middlemuir, Aberdeenshire	18,200	3.6
Loch of Lintrathen, Angus	17,125	3.4
Alt Estuary, Lancashire	16,305	3.3

Site	October count	Percentage of population estimate
Loch of Skene, Aberdeenshire	15,425	3.1
Loch Leven, Perth & Kinross	14,886	3.0
Whitton Sands, Humberside	12,400	2.5
Holkham Bay, Norfolk	11,400	2.3
Bogbank, Borders	11,282	2.3
Ribble Estuary, Lancashire	10,770	2.2
Read's Island Flats, Humberside	10,500	2.1
Hule Moss, Borders	10,000	2.0
The Wilderness, Fife	9,867	2.0
Snettisham, Norfolk	9,790	2.0
Munlochy Bay, Highland	9,500	1.9
Aberlady Bay, Lothians	9,426	1.9
Loch of Strathbeg, Aberdeenshire	7,681	1.5
Iceland	7,500	1.5
Pilling to Cockerham, Lancashire	7,135	1.4
Wells, Norfolk	6,849	1.4
West Water Reservoir, Borders	6,800	1.4
Letham, Fife	6,700	1.3
Cromarty Firth: Udale Bay, Highland	6,630	1.3
Cromarty Firth: Alness Bay, Highland	6,000	1.2
Holy Island Sands, Northumberland	6,000	1.2
Loch Fleet, Highland	5,980	1.2
Inner Cromarty Firth: Dingwall Bay, Highland	5,870	1.2
Nairn Bar, Moray	5,350	1.1
Meikle Loch Slains, Aberdeenshire	5,200	1.0

b) Greylag Goose

Site	November count ¹	Percentage of population estimate
Orkney Islands (all sites)	47,121	64.2
Iceland	16,500	22.5
Loch Swilly, Ireland ²	2,480	3.4
Loch Eye, Highland ³	2,093	2.9
Greenland, Caithness ⁴	1,140	1.6

¹ Adjusted counts where possible (see text and Table 2).

² Ireland held an estimated 1,165 Irish birds (Table 2) that cannot be allocated to individual sites.

³ Highland held an estimated 750 British birds (Table 2) that cannot be allocated to individual sites.

⁴Caithness held an estimated 1,000 British birds (Table 2) that cannot be allocated to individual sites.

3.5. Breeding success

3.5.1. Pink-footed Goose

Between late September and late October 2019, a total of 15,992 Pink-footed Geese in 21 flocks was aged at various locations throughout Scotland and England (Table 5). This represented 3.2% of the 2019 population estimate. The brood size of 494 families was also determined during this period.

Breeding success was lower than the mean for the previous decade, with flocks containing 15.6% young birds (mean 2009–2018: $17.6\% \pm 1.09$ SE) (Table 5, Figure 6). The mean brood size of successful pairs was 1.98 juveniles, which is similar to the previous ten-year mean (mean 2009–2018: 1.99 ± 0.66 SE).

3.5.2. Iceland Greylag Goose

In 2019, it was only possible to assess the breeding success for a very small sample of Greylag Geese (see Discussion). During mid-November, 1,200 Greylag Geese from six flocks were aged at various locations in Caithness, Scotland: this represented 1.6% of the 2019 population estimate. The brood size of 12 families was also determined during this period.

The percentage of young found amongst flocks (20.1%) was lower than the previous year (22.6% in 2018), and lower than the recent ten-year mean (mean 2009–2018: $21.7\% \pm 0.40$ SE) (Table 5, Figure 6). The mean brood size of 2.17 goslings per successful pair was slightly lower than that of the previous ten-year mean (mean 2009–2018: 2.23 ± 0.08 SE).

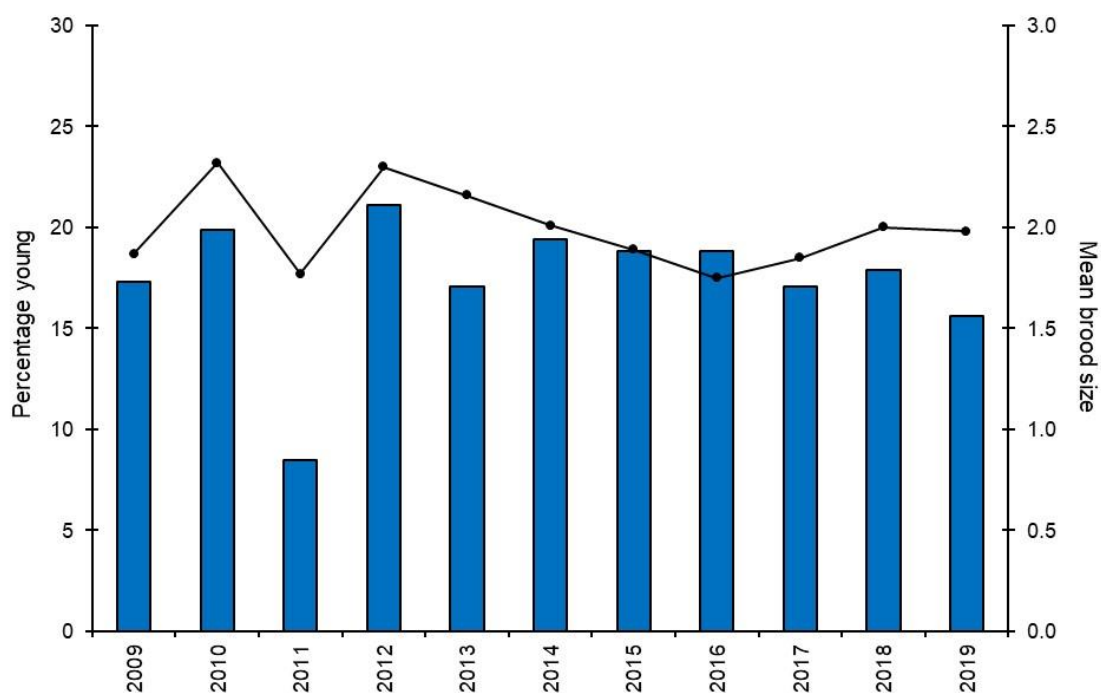
Table 3. The percentage of young in flocks and mean brood size of Pink-footed and Iceland Greylag Geese in 2019.

	Region	Time period	Total aged	% young	No. of broods counted	Mean brood size
Pink-footed Goose ¹	NE Scotland	Late Sept	1,200	22.8	28	2.25
		Early Oct	500	21.6	1	2
		Late Oct	1,000	15.7	-	-
	EC Scotland	Late Oct	6,700	14.8	18	
	W England	Late Sept	1,640	7.9	63	2.05
		Early Oct	3,392	14.4	247	1.93
		Late Oct	1,216	19.7	127	1.88
	E England	Late Sept	153	38.6	3	3
		Early Oct	191	29.8	7	3
	Total		15,992	15.6	494	1.98
Greylag Goose ²	N Scotland	Mid-Nov	1,200	20.1	12	2.17
	Total		1,200	20.1	12	2.17

¹ Pink-footed Geese were aged between 18 September and 31 October 2019.

² Greylag Geese were aged on 14–15 November 2019.

a) Pink-footed Goose



b) Greylag Goose

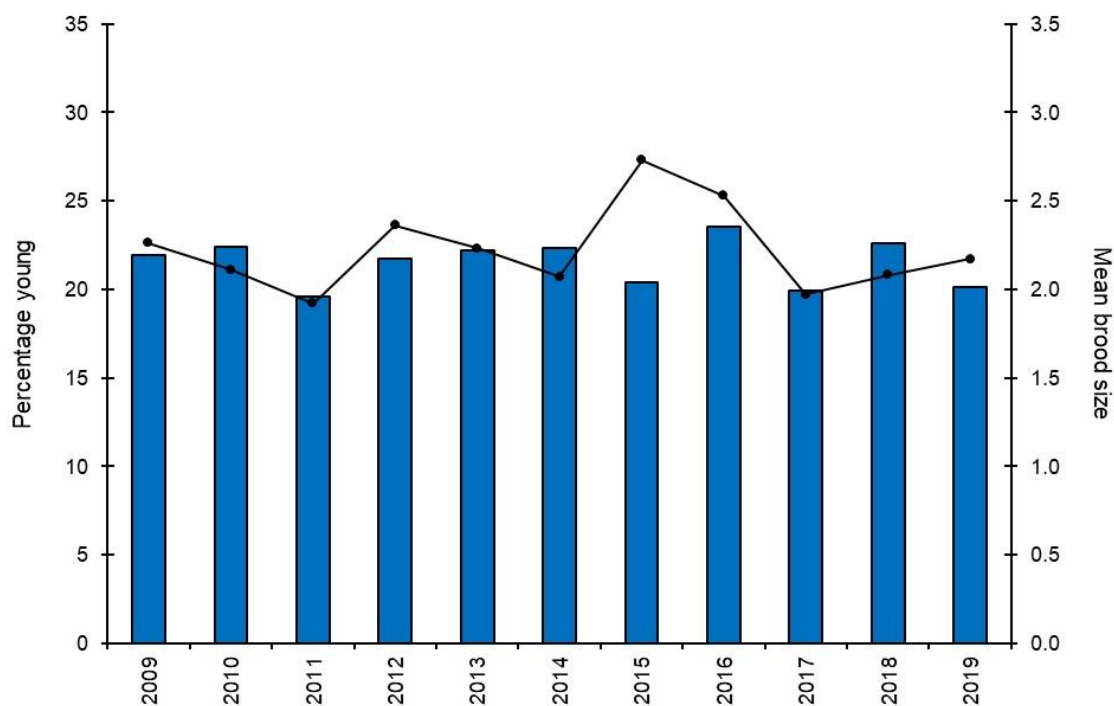


Figure 6. The percentage young (column) and mean brood size (line) found in flocks of (a) Pink-footed Geese and (b) Iceland Greylag Geese, 2009 to 2019.

4. Harvest in Iceland

Since 1995, the Environment Agency of Iceland has annually collected hunting bag information from all holders of a hunting licence. The reporting of this is carried out on a species by species basis and the country has been divided into six hunting areas. Data on hunting are available from the website of Statistics Iceland (<http://statice.is>). The reporting of hunting bag information is compulsory in Iceland and the yearly hunting licence cannot be renewed unless information on the previous year has been submitted by the hunter; therefore, the reporting rate is usually high. Hunting bag information for 1995 to 2019 are reported below: only preliminary data for 2019 were available at the time of writing.

No comparable data are available for Britain and Ireland, as hunting bag statistics are not collected; however, it would be advantageous to initiate the annual collection of hunting bag data in these countries to contribute to a better understanding of the demography of the Iceland Greylag and Pink-footed Goose populations.

4.1. Greylag Goose

The harvesting of Greylag Geese in Iceland has fluctuated between c.38,000–60,000 birds annually between 2008–2019 (Figure 7) (Statistics Iceland 2020). During 2018, 45,703 Greylag Geese were reported shot in Iceland, this being slightly above the previous ten-year mean (2008–2017: 45,454 birds \pm 1.816 SE). Since the start of hunting bag reporting in Iceland, the average total bag for Greylag Goose has been 40,295 birds (\pm 1.391 SE); but it is unknown to what degree the effect on harvesting in Iceland is having on the overall population total. To gain a better understanding of its effects on the population, collaboration with hunting officials and the integration of including hunting bag data in to analyses of population estimates is required (see Discussion).

4.2. Pink-footed Goose

The harvesting of Pink-footed Geese in Iceland has fluctuated between c.15,000–24,500 birds annually between 2008–2019 (Figure 7) (Statistics Iceland 2020). During 2018, 24,352 Pink-footed Geese were reported shot in Iceland, this being higher than the previous ten-year mean (2008–2017: 17,129 birds \pm 8.41 SE). Since the start of hunting bag reporting in Iceland, the average total bag for Pink-footed Goose has been 15,316 birds (\pm 7.23 SE).

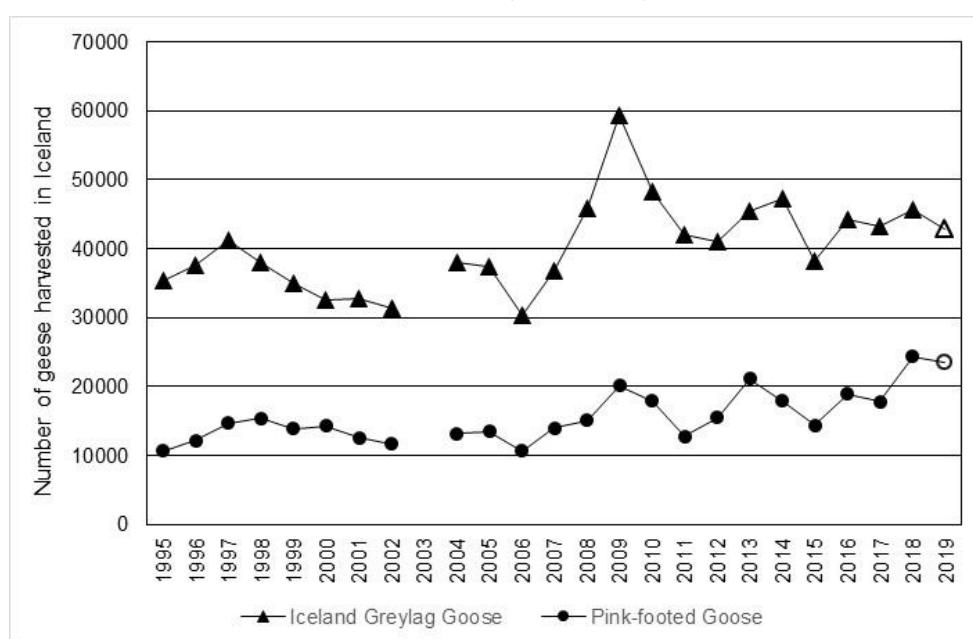


Figure 7. The annual number of harvested Greylag (triangles) and Pink-footed Geese (circles) in Iceland, 1995–2019. Data for 2019 (open triangle and circle) are preliminary. No data are available for 2003. (Statistics Iceland).

5. Discussion

5.1. Pink-footed Goose

The 2019 Pink-footed Goose population estimate of 500,928 was 13.6% higher than the 2018 estimate (440,891) and is the third highest population estimate during 60 years of annual monitoring of this population (Figure 2). Given that recent population estimates have fluctuated considerably between years whilst annual breeding success has remained stable, and with no apparent demographic explanation for a decrease in numbers, it is likely that the 2018 population estimate suffered from some degree of undercounting. Possible reasons for this could include the lack of information regarding how many Pink-footed Geese were present in Iceland during October 2018 and the likelihood that birds may have been roosting at locations in Britain not covered as part of the census.

Furthermore, we continue to lack adequate information on annual survival rates and, in particular, estimates of annual harvest, the main cause of mortality. Long-term monitoring of annual harvest in Iceland during 2009–2018 indicate that the bag has been largely stable and so it seems unlikely to be an explanation of the large annual variations in the numbers counted. Estimates of the number of Pink-footed Geese harvested during 2019 in Iceland are currently preliminary and will be reported on in full in the next report. In Britain and Ireland, hunting bag data are not collected at all.

To help improve the monitoring of Pink-footed Geese, in October 2019, a concerted effort was made by colleagues in Iceland to collect data using an approach not previously exploited, whereby birders and members of the public were asked to report sightings of geese at the time of the census: this approach will be built upon for future censuses. The use of GPS tracking data has also recently helped to identify potential roost sites in Britain either not previously covered by the census or not covered for some time. During October and November 2019, counters were deployed to an additional seven locations thought to hold roosting Pink-footed Geese. Five of these seven locations held Pink-footed Geese at the time of the census. Combined counts from these locations in October and November equated to 2.8% (14,005 birds) and 2.6% (13,200), respectively, of the overall population estimate. GPS tracking data continue to provide useful information on roosting locations used by birds throughout the wintering range and will continue to be used to identify new roost sites that are not yet covered as part of the IGC.

Interestingly, during winter 2019, two colour-marked Pink-footed Geese from the Svalbard/Northwest European population were sighted in Lancashire (S. Darbyshire pers. comm.). Whilst any interchange between the two populations is not thought to massively affect the overall population estimates, connectivity is known to occur from time to time (Madsen *et al.* 2014).

In recent years, annual breeding success of Greenland/Iceland Pink-footed Geese has been stable. During 2019, Pink-footed Geese wintering in Britain had a lower than average breeding season, with 15.6% young recorded in flocks. This was lower than the previous year (22.6%) and lower than the mean for the previous decade (mean 2009–2018: 17.6% \pm 1.09 SE). It is possible that temperature and weather conditions in Iceland may have affected the 2019 breeding success to some degree: the mean temperature (9.3°C) in Iceland in June 2019 was lower than the June temperature recorded in the previous five years (2014–2018; 10.2°C; Tutiempo 2020).

5.2. Iceland Greylag Goose

The population estimate of 73,355 Iceland Greylag Geese was 25.6% higher than the 2018 estimate (58,426), suggesting possible undercounts during 2017 (60,962 birds) and 2018 (58,426). However, it is worth noting that the population estimate in 2019 remains below the ten-year average of 92,851 birds (2009–2018). While it remains uncertain the degree to which undercounting and under-estimation in Orkney and Iceland (the two sites holding the majority of birds) may have affected the 2017 and 2018 population estimates, given that the 2019 population estimate remains below the ten-year average, the trajectory of the Iceland Greylag Goose population needs carefully monitoring to identify any real time declines to this population.

As Orkney continues to hold the largest proportion of the Iceland Greylag Goose population, a good understanding of the number of British Greylag Geese present in Orkney is needed to help determine the population size of the Iceland population. Thus, the autumn surveys of the British

birds carried out on Orkney play a vital part in providing a baseline for the monitoring and management of the Iceland population.

As previously reported, large numbers of British Greylag Geese in core wintering areas for the Iceland population, such as Orkney, Caithness and the Moray Firth, means that assessing the abundance of the Iceland population during the non-breeding season remains very difficult. Up to date information on the status of Greylag Geese in Britain, especially south and east of an arbitrary line from Bute east to Aberdeen (see Figure 4) (although increasingly north of this line too) is largely lacking. Therefore, simply as a precaution, any counts obtained through the IGC from the area south and east of the arbitrary line, are assumed to be British birds and subtracted from the total count. However, as recently as winter 2019/20, Iceland Greylag Geese have been sighted/GPS tracked as far south as the Central Belt of Scotland (A. Sigfusson pers. comm.) showing some overlap in the wintering population south of the arbitrary line, as described above, which means there is a possibility that some Iceland Greylag Geese have been deducted from the overall Iceland population total. To gain a better understanding on possible numbers of Icelandic birds wintering in these areas, updated information on the distribution of British Greylags is needed across the wintering range of the Iceland population in Britain. A similar approach to the method used on Orkney, whereby undertaking autumn surveys at key sites or within key areas, would be advantageous and possibly allow a more accurate population estimate to be determined.

The monitoring of annual breeding success of the Iceland Greylag Goose population in Britain also remains difficult because of the overlap in the main wintering area (Orkney and around the Moray Firth) of both populations, and a lack of any recent information regarding sites that may solely hold Icelandic birds. However, the results from summer counts carried out in 2016 suggest that the majority of birds found in Caithness in winter are from the Iceland population (C. Mitchell pers. obs.); hence, the annual breeding success of Iceland Greylag Geese in autumn 2019 was determined there. The percentage of young found amongst flocks was 20.1%, which was lower than the recent ten-year mean (mean 2009–2018: 21.7% \pm 0.40 SE). However, it was only possible to assess a very small sample of geese: indications were that fewer geese were present in the area in November 2019 compared with previous years, and many of the birds were in remote stubble fields and would fly when approached, which made assessments difficult (Carl Mitchell pers. obs.).

Given the increased difficulty in ageing Iceland Greylag Geese on the wintering grounds, it would be advantageous to explore options to sample the geese in Iceland prior to migration in order to assess the breeding success of this population. However, this does pose problems since changes in surveillance from November (wintering area) to August/September (in Iceland) will make the comparison of annual results difficult and so a period of overlap whereby both methods are used should be implemented.

Recommendations on the future monitoring of Iceland Greylag Geese were provided in earlier reports (see Brides *et al.* 2019); however, the annual surveillance of Iceland Greylag Geese still remains challenging. It would be advantageous to review the current monitoring programme and work with JNCC, NatureScot and colleagues in Iceland to explore new ways to continue monitoring this population. Given the increased difficulty in ageing Iceland Greylag Geese in Britain and with the discontinuation of the annual wing survey of harvested birds in Iceland, which provided additional information about breeding success, it would be beneficial to explore ways in which annual breeding success assessments could be carried out in Iceland, prior to migration commencing, including re-instating the annual wing survey. Likewise, given it is unknown the degree to which harvesting in Iceland, Britain and Ireland affects this population, any review of the monitoring programme should include collaboration with hunting officials: including annual harvest rates in the analysis of population estimates would be beneficial in refining and ensuring estimates are as accurate as possible. This would need close collaboration with the Environment Agency of Iceland, but also the initiation of collecting hunting bag data in Britain and Ireland, where it currently is not collected at all.

Furthermore, better understanding of the movements and distribution of wintering Iceland Greylag Geese in Britain and Ireland would be beneficial. Gaining information on winter movements and the use of roost sites would allow more focussed monitoring to take place at these locations. The reinstating of regular colour-marking or the use of telemetry would potentially provide new

information on roosting locations, along with up to date information on autumn distributions in Iceland, timings of migration and the distribution and movements in the wintering areas.

6. Acknowledgments

The IGG is part of the long-term Goose & Swan Monitoring Programme (GSMP), which monitors the abundance and breeding success of the UK's native goose and migratory swans during the non-breeding season. GSMP is organised by the Wildfowl & Wetlands Trust in partnership with the Joint Nature Conservation Committee (JNCC) and NatureScot.

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Appendix 1. Greylag Goose counts at individual sites in Orkney in November 2019.

Site	November count	% of the adjusted 2019 population estimate
West Mainland	26,330	35.9
East Mainland	10,544	14.4
South Ronaldsay	5,582	7.6
Shapinsay	5,182	7.1
Stronsay	4,470	6.1
Sanday	2,228	3
Westray	1,982	2.7
Eday	1,891	2.6
Rousay	1,561	2.1
Papa Westray	1,027	1.4
Egilsay	968	1.3
North Ronaldsay	644	0.9
Burray	548	0.7
Graemsay	536	0.7
South Walls, Switha, Melsetter	410	0.6
Flotta	403	0.5
Gairsay	400	0.5
Hoy and North Walls	311	0.4
Wyre	57	0.1
Fara	46	0.1
Auskerry	1	0
Total	65,121	88.8