



Status and distribution of Icelandic-breeding geese: results of the 2020 international census

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Goose & Swan Monitoring

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Summary

The 61st consecutive annual census of Greenland/Iceland Pink-footed Geese and Iceland Greylag Geese took place during autumn and early winter 2020. Sites holding Pink-footed Geese were surveyed in October and November, whilst those holding Greylag Geese were primarily surveyed in November. Coverage in Britain was good, 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 and Southwest Norway, and from Iceland where an aerial census was conducted in favourable flying conditions. The additional spring census that was due to take place in 2021 was cancelled due to the various restrictions in place across Britain and Ireland as a result of the Covid-19 pandemic.

Maxima of 485,509 Pink-footed Geese and 92,582 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 485,509 Pink-footed and 60,061 Greylag Geese. Compared to the previous year, the 2020 figures represent a decrease of 3.1% in the Pink-footed Goose population and a decrease of 18.1% 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 (55,980 birds). Combined counts from 27 sites that supported numbers exceeding 1% of the 2020 Pink-footed Goose population estimate accounted for 82.1% of the total October count. During the November census, 71.0% 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 from October to early December, with 15.4% young found amongst those flocks sampled: this being slightly lower than the previous year and lower than the previous ten-year mean of 17.4%. The mean brood size of successful pairs was 2.37 goslings. Due to the increasing difficulty in monitoring the breeding success of Iceland Greylag Geese on the wintering grounds, no age assessment data were collected during 2020.

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 the Greenland/Iceland Pink-footed Goose and Iceland Greylag Goose populations. 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 the 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 61st consecutive annual census and an update, following the 2020 breeding season, on the population size and breeding success of Greenland/Iceland Pink-footed Geese and the population size of Iceland Greylag Geese

2. Methods

2.1. Census methods

Dates of the coordinated counts in Britain and Ireland 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. In 2020, counts were conducted by a network of experienced volunteer observers and professional conservation staff over the weekends of 17/18 October (to cover sites supporting Pink-footed Geese) and 21/22 November (to cover sites supporting Pink-footed and/or Greylag Geese). The three-yearly spring census was scheduled to take place during the weekend of 13/14 March 2021; however, due to travel and other restrictions in place as a result of the Covid-19 pandemic, it was decided to cancel the spring census with a view of rescheduling this for spring 2022.

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 System (GPS) tags carried by several Pink-footed Geese were used to identify any roosting locations not previously covered by the census and, therefore, to ensure coverage of any potential gaps, counters were deployed to these locations.

In Iceland, no coordinated survey of Pink-footed Geese is undertaken as part of the census; however, hunters, birdwatchers and other members of the public were encouraged to make a concerted effort to count Pink-footed Geese in October 2020. On 21 November 2020, an aerial survey of Greylag Geese was carried out in southern Iceland. Data from this survey were combined with ground counts undertaken elsewhere, along with counts and sightings submitted by birdwatchers and members of the public. Non-systematic information from hunters was also taken into account.

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, in Britain and Ireland, counts made close to the coordinated count dates were included in the assessment 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 then, roost counts have been undertaken and these are now reported separately.

2.2. Data treatment

If necessary, adjustments were 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 2015–2019 would be used for 2020). 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, based on advice from counters and local organisers, was made to account for the presence of British/Irish Greylag Geese in areas where Iceland Greylag Geese were known to winter. For the 2020 census, this involved sites in Ireland (1,165 birds), Orkney (21,000, see Discussion), Caithness (552) 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).

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 early December 2020 were used to determine the percentage of young in flocks and the mean brood size of successful pairs.

All statistical analyses were carried out using R version 4.1.0 (R Core Team 2021). To quantify the uncertainty associated with the estimates of population size, 95% Poisson confidence intervals (CIs) were calculated. The 95% CI values were calculated for the population estimates of both species of geese including (i) annual Pink-footed Goose estimates (ii) the unadjusted Greylag Goose values, and (iii) the adjusted Iceland Greylag Goose values. CIs were calculated not only for the 2020 data, but also for estimates reported in previous reports between 2008 and 2019, to facilitate historical comparisons (Appendix 2). Further information on the methodology used to calculate the Poisson CIs can be found in Wood *et al.* (2021) and Brides *et al.* (In Press).

3. Results

3.1. Coverage and conditions

The number of sites covered in each month is shown in Table 1. In 2020, 17 fewer sites were checked for Pink-footed Geese in October and seven fewer were checked in November, compared to 2019. During the November census, 35 fewer sites were checked for Greylag Geese compared to 2019. In part, the decrease in coverage is likely due to restrictions that were in place due to the Covid-19 pandemic. However, all of the important sites for both species (based on counts made in previous years) were checked in 2020 and, overall, coverage was considered good. Annual variation in the total number of sites checked can fluctuate from year to year, based on counter availability, reacting to changing in feeding distributions and geese roosting at temporary and seasonal flooded sites.

Table 1. The number of sites surveyed, and the number of sites holding Pink-footed and Greylag Geese in October and November 2020.

	October	November
Number of Pink-footed Goose sites surveyed	136	145
Number of sites holding Pink-footed Geese	96	98
Number of Greylag Goose sites surveyed	-	131
Number of sites holding Greylag Geese	-	73

In Iceland, Greylag Geese were counted by aerial and ground surveys: all counts were carried out in favourable conditions. As no coordinated Pink-footed Goose surveys take place in Iceland, additional effort was put in to enlisting the help of hunters, bird watchers and members of the public to count Pink-feet in Iceland during the October census.

Elsewhere, good counting conditions during the census were reported for most sites. However, in Britain, disturbance was recorded at one site in October and poor visibility was recorded at four sites in November. Numbers of geese recorded at these five sites have fluctuated in recent years making it difficult to determine the contribution counts from these sites typically make to census totals; however, comments from Local Organisers and counters suggest the counts were not adversely affected at these locations.

3.2. Total numbers

3.2.1. Pink-footed Goose

Totals of 485,509 and 373,515 Pink-footed geese were counted in October and November 2020, respectively (Figure 1, Table 2). These represent a decrease of 3.1% and an increase of 4.5%, respectively, compared to the 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 2020 totals. The total count for October (485,509; 95% CI = 480,185–490,884) has been selected as the population estimate (Figure 2).

3.2.2. Greylag Goose

In November 2020, 92,582 (95% CI = 91,137–93,533) Greylag Geese were counted (Figure 1, Table 2) this unadjusted count was 8.5% lower than that recorded the previous year. No estimated counts (for sites not covered during the census; see Methods) needed to be added to the 2020 totals. Following adjustments for British/Irish Greylag Geese likely to be included in this count, a population estimate of 60,061 (95% CI = 59,148–60,987) Iceland Greylag Geese was derived (Figure 2). This represents a decrease of 18.1% compared to the previous estimate of 73,355 geese in 2019.

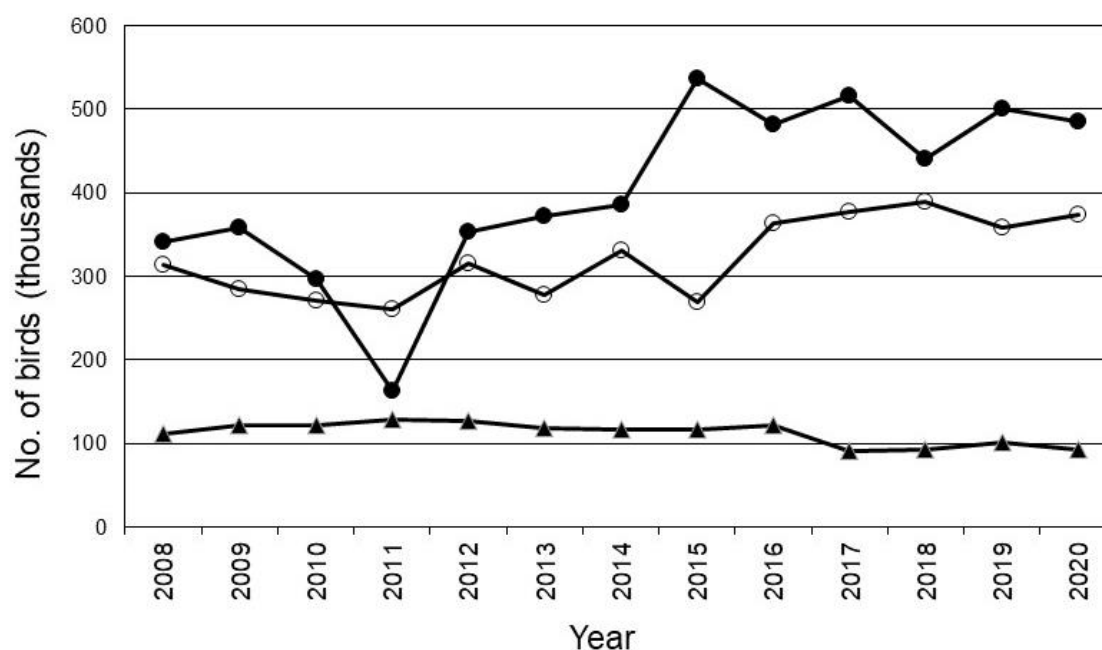


Figure 1. Peak counts of Pink-footed Geese (circles) in October (filled) and November (open) and peak (unadjusted) counts of Greylag Geese (triangles) in November counted during the Icelandic-breeding Goose Census, 2008 to 2020.

Table 2. Totals of Pink-footed Geese and Greylag Geese by country and region in October and November 2020. Raw (unadjusted) counts are shown. Adjustments for British/Irish Greylag Geese are presented in brackets [- denotes the deduction made]. Figures in parentheses indicate the number of sites surveyed. The population estimates for the Greenland/Iceland Pink-footed Goose and Iceland Greylag Goose in 2020 are also presented.

Region/area	October 2020	November 2020	
	Pinkfoot	Pinkfoot	Greylag
Iceland*	25,370 (1)	-	12,734 (1)
Norway**†	-	-	1,500 (1)
Faroe Islands*	-	-	nc
Ireland	-	161 (7)	2,196 (7) [-1,165]
Shetland*	nc	nc	nc
Orkney*	-	111 (1)	59,936 (1) [-21,000]
Caithness	1550 (2)	0 (4)	552 (4) [-552]
Highland	45,134 (8)	28,597 (8)	4,470 (8) [-750]
Moray	14,826 (3)	19,750 (5)	2,040 (5)

Region/area	October 2020	November 2020	
	Pinkfoot	Pinkfoot	Greylag
Aberdeenshire	32,992 (8)	40,231 (8)	210 (8) [-210]
Angus/Dundee	60,110 (2)	6,500 (2)	52 (2) [-52]
Perth & Kinross	30,028 (8)	13,142 (11)	2,487 (10) [-2,487]
Stirling/Falkirk/Clackmannan	3,828 (4)	1,322 (3)	294 (3) [-294]
Fife	11,499 (10)	43,952 (8)	359 (6) [-359]
Argyll & Bute	nc	nc	600 (3) [-500]
Dumfries & Galloway **	10,681 (4)	4,965 (7)	0 (7)
Cumbria **	2,653 (7)	3,668 (5)	57 (5) [-57]
Lothians	33,605 (18)	16,090 (14)	1,463 (15) [-1,463]
Borders	41,628 (14)	20,394 (15)	843 (14) [-843]
Northumberland	11,259 (16)	3,263 (15)	1,387 (15) [-1,387]
Lancashire & Merseyside	77,387 (8)	42,852 (9)	nc
N Wales/Dee Estuary	7,500 (1)	6,100 (2)	0 (2)
Cheshire	3,950 (1)	3,575 (1)	nc
Humberside	44,200 (8)	46,335 (9)	nc
Norfolk	27,309 (13)	70,777 (12)	302 (13) [-302]
North Yorkshire	nc	1,730 (1)	1,110 (1) [-1,110]
<i>Raw total counts</i>	485,509	373,515	92,592
<i>Total adjustment for British/Irish Greylag Geese</i>			-32,521
Population Estimate	485,509		60,061

* 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 2021.

nc No count received or no count undertaken.

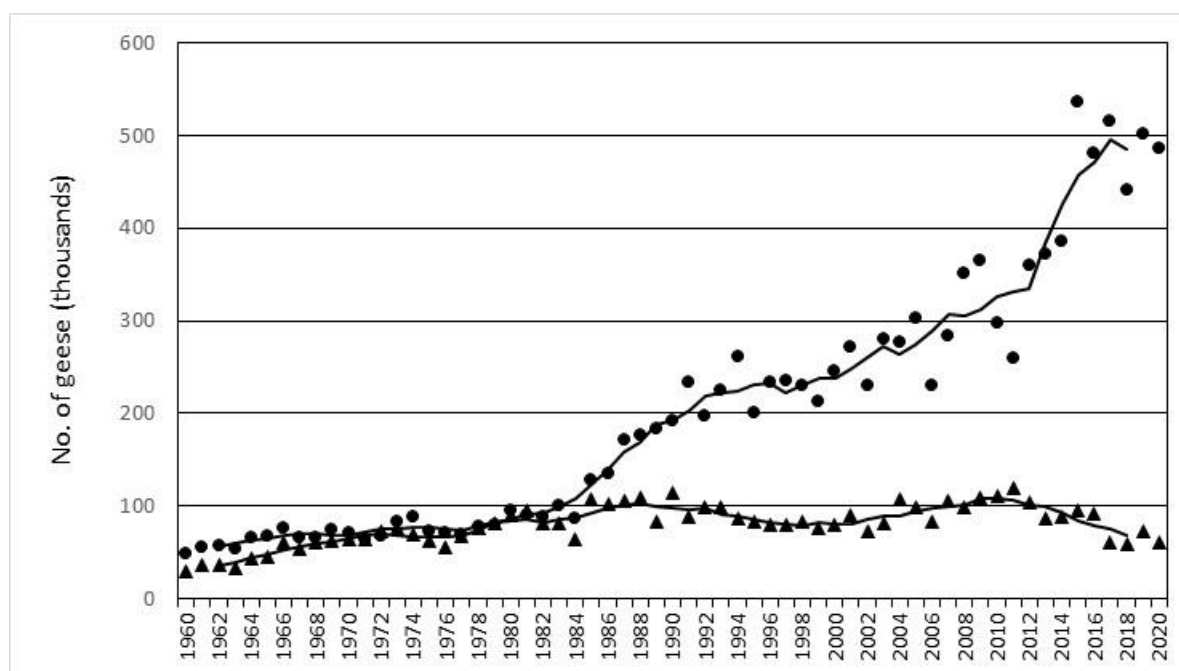


Figure 2. Population estimates for the Greenland/Iceland Pink-footed Goose (circles) and Iceland Greylag Goose (triangles) populations, 1960 to 2020. The five-year running means (e.g. mean for 2018 is from the population estimate for 2016 to 2020) are shown as lines.

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 21.7% recorded in East Central Scotland, 18.3% in West England, 17.8% in Southeast Scotland/Northeast England and less than 15% in all other regions, whilst 5.2% of the population remained in Iceland (Table 3, Figure 3). By November, all regions held lower proportions of birds, apart from East England and Northeast Scotland where numbers had increased (Table 3, Figure 3).

3.3.2. Greylag Goose

By November, just under three-quarters of the Iceland population (71.0%) were found in North Scotland, primarily in Orkney, with 21.2% present in Iceland and less than 4% in Norway, Ireland and all other regions in Britain (Table 3, Figure 4 & 5). In Britain, the overlap between the British and Icelandic 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 2020, 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	5.2	-	21.2
Faroes	-	-	-
Norway	-	-	2.5

Ireland	-	<0.5	1.7
North Scotland ¹	9.6	5.9	71.0
Northeast Scotland ²	9.8	12.4	3.4
East Central Scotland ³	21.7	13.4	0
Southwest Scotland/ Northwest England ⁴	2.7	1.8	0.2
Southeast Scotland/ Northeast England ⁵	17.8	8.2	0
West England ⁶	18.3	10.1	0
East England ⁷	14.7	24.5	0
Total	100	76.2	100

¹ Orkney, Caithness and Highland

² Moray and Aberdeenshire

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

⁴ Argyll & Bute, Dumfries & Galloway and Cumbria

⁵ Lothians, Borders and Northumberland

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

⁷ North Yorkshire, Humberside and Norfolk

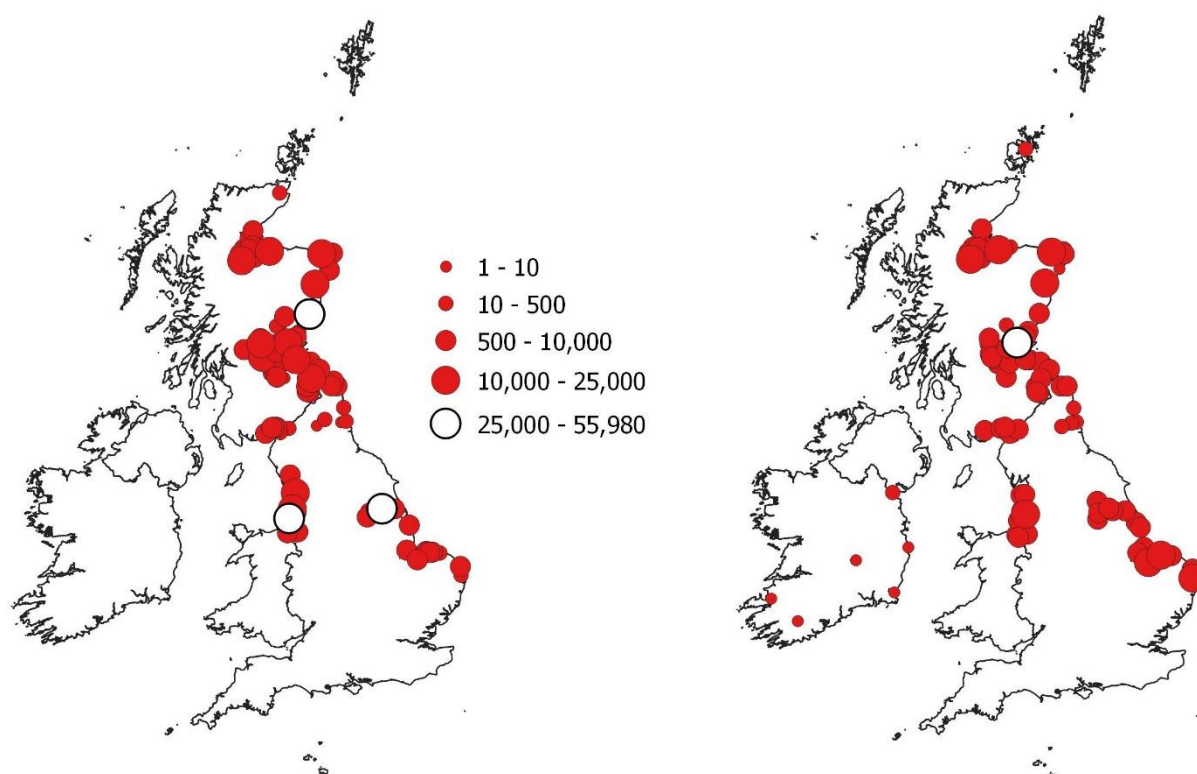


Figure 3. Distribution of Pink-footed Geese in Britain and Ireland in October (left) and November (right) 2020. Note that 25,370 Pink-footed Geese were also counted in Iceland in October 2020 (not shown).

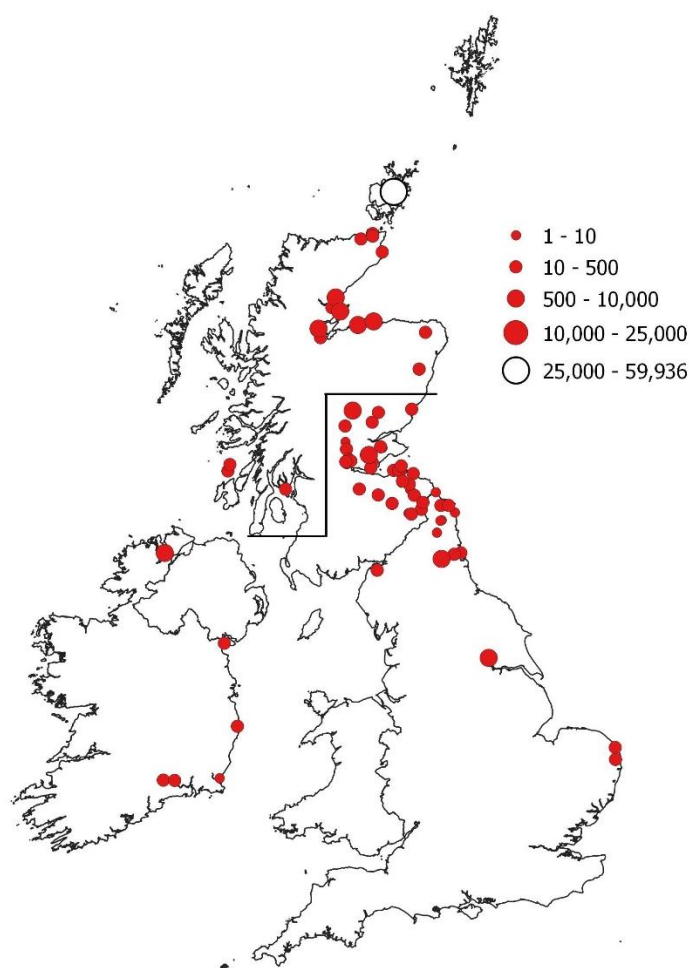


Figure 4. Distribution of Greylag Geese in Britain and Ireland in November 2020. The mapped counts do not differentiate between Icelandic and British/Irish birds. It is unlikely that many Icelandic birds are present in Britain south and east of the line in November (see also Table 2).



Figure 5. Distribution of Greylag Geese in Iceland in November 2020.

3.4. Principal concentrations

3.4.1. Pink-footed Goose

Pink-footed Geese were recorded at 96 sites (noting Iceland is considered a single consolidated sites) in October and 98 in November (Figure 3). Fifteen sites held more than 10,000 birds in October (Table 4) and ten sites held this many in November. The number of sites holding more than 1% of the 2020 population estimate (4,855 birds) was 27 in October (Table 4) and 25 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 27 sites accounted for 82.1% of the total population and numbers at the top five sites held 33.3% of the population (Table 4): high numbers were recorded at Montrose Basin, Angus, which held 55,980 birds (11.5% of the population estimate), Alt Estuary, Merseyside (31,262, 6.4%), Read's Islands Flats, Humberside (30,000, 6.2%), Iceland (25,370, 5.2%) and Beaulieu Firth, Highland (19,300, 4.0%) (Table 4).

3.4.2. Greylag Goose

Greylag Geese were recorded at 73 sites (noting Orkney, Iceland and Norway are considered single consolidated sites) in November (Figure 4 & 5). Seven sites held more than 1% of the 2020 Iceland Greylag Goose population estimate (600 birds) (Table 4), with the two sites supporting the highest counts being Orkney, which held 38,936 (64.8% of the population estimate), and Iceland, which held 12,734 birds (21.2%).

As Orkney holds wintering geese from the British and Iceland Greylag Goose populations, a good understanding is also required of the number of British birds present at the time of the census. To estimate this for 2020, 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 2020 (c. 2,200 birds, J. Plowman pers. comm.). This resulted in an estimate of c.21,000 birds, which was then deducted from the overall Orkney IGC total to estimate the number of Iceland Greylag Geese present in November 2020.

For the purpose of this report, Orkney is treated as a consolidated site. Appendix 1 shows the individual totals for the islands: 13 of the islands held 1% or more of the Iceland Greylag Goose population estimate in November, although these individual counts are not adjusted for the presence of British Greylag Geese (see above and Discussion).

Table 4. Sites that supported >1% of the (a) Pink-footed Goose (>4,855) and (b) Iceland Greylag Goose (>600) population estimates in October and November 2020, 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 2021). 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	55,980	11.5
Alt Estuary, Lancashire	31,262	6.4
Read's Island Flats, Humberside	30,000	6.2
Iceland	25,370	5.2
Beaulieu Firth, Highlands	19,300	4.0

Site	October count	Percentage of population estimate
RSPB Marshside, Lancashire	18,820	3.9
Aberlady Bay, Lothian	17,628	3.6
Carsebreck and Rhynd Lochs, Perth & Kinross	17,500	3.6
Hule Moss, Borders	17,000	3.5
Pilling to Cockerham, Lancashire	16,455	3.4
Loch of Skene, Aberdeenshire	11,530	2.4
Findhorn Bay, Moray	11,500	2.4
Loch Leven, Perth & Kinross	11,407	2.3
Middlemuir (New Pitsligo Moss) Aberdeenshire	10,750	2.2
Letham area, Lothian	10,470	2.2
Meikle Loch Slains, Aberdeenshire	9,400	1.9
Bogbank, Borders	9,240	1.9
The Wilderness, Fife	9,059	1.9
Snettisham, Norfolk	8,790	1.8
Cromarty Firth: Udale Bay, Highland	8,250	1.7
Overy Marshes Holkham, Norfolk	7,702	1.6
Parkgate, Dee Estuary, North Wales	7,500	1.5
West Water Reservoir, Borders	7,450	1.5
Cromarty Firth: Nigg Bay, Highland	6,900	1.4
Caerlaverock NNR, Dumfries & Galloway	6,676	1.4
WWT Martin Mere, Lancashire	6,350	1.3
Inner Cromarty Firth: Dingwall Bay, Highland	6,194	1.3

b) Greylag Goose

Site	November count ¹	Percentage of population estimate
Orkney Islands (all sites)	38,936	64.9
Iceland	12,734	21.2
Loch Eye, Highland ²	2,953	4.9
Loch Swilly & Donegal, Ireland ³	1,805	3.0
Loch Spynie, Moray	1,500	2.5
Norway	1,500	2.5
Loch Fleet, Highland ²	700	1.2

¹Adjusted counts where possible (see text and Table 2).²Highland held an estimated 750 British birds (Table 2) that cannot be allocated to individual sites.³Ireland held an estimated 1,165 Irish birds (Table 2) that cannot be allocated to individual sites.

3.5. Breeding success

3.5.1. Pink-footed Goose

Between mid-September and mid-December 2020, a total of 17,345 Pink-footed Geese in 28 flocks was aged at various locations throughout Scotland and England (Table 5). This represented 3.6% of the 2020 population estimate. The brood size of 453 families was also determined during this period. These results suggest that breeding success in 2020 was lower than the mean for the previous decade, with flocks containing 15.4% young birds (mean 2010–2019: 17.4% \pm 1.10 SE) (Table 5, Figure 6). The mean brood size of successful pairs was 2.37 juveniles, which is slightly higher than the previous ten-year mean (mean 2010–2019: 2.00 \pm 0.06 SE).

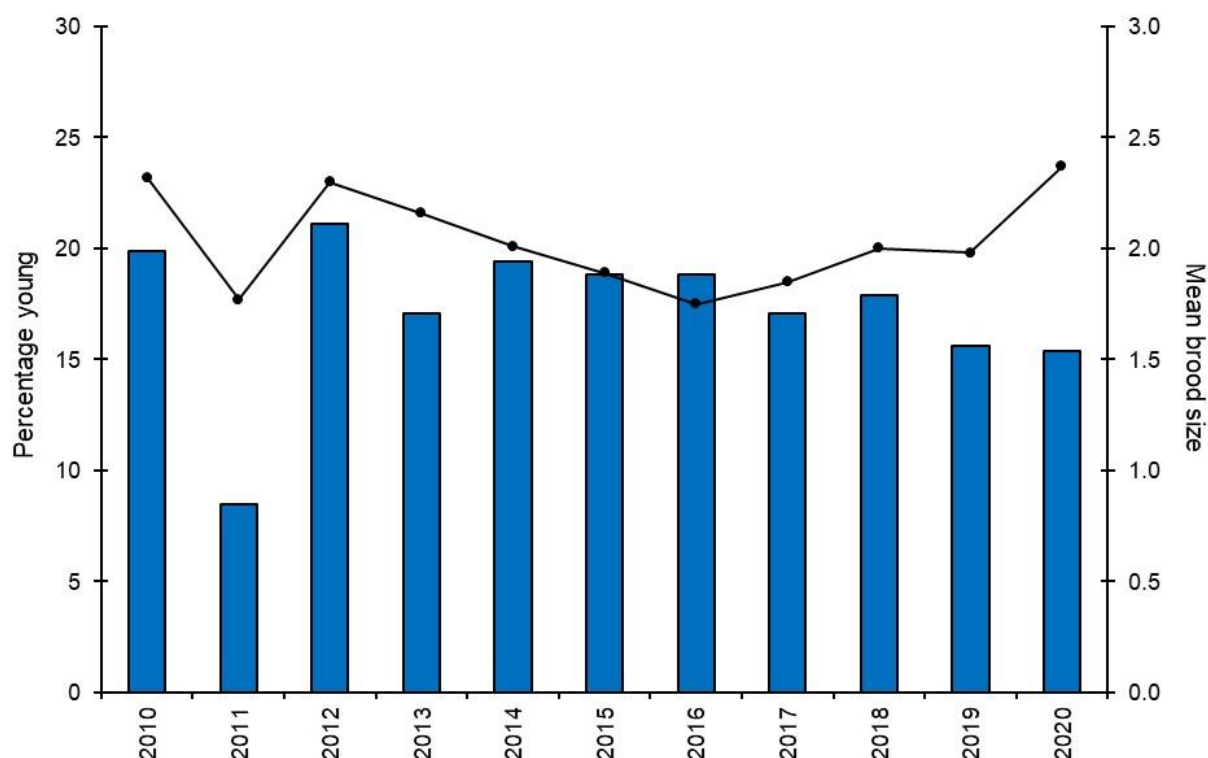


Figure 6. The percentage young (column) and mean brood size (line) found in flocks of Pink-footed Geese in Britain, 2010 to 2020.

Table 3. The percentage of young in flocks and mean brood size of Pink-footed Geese in 2020.

Region	Time period ¹	Total aged	% young	No. of broods counted	Mean brood size
EC Scotland	Mid-October	4,100	15	19	2.05
	Late October	2,000	12.8	7	2.14
	Mid December	2,050	16.3	9	2.00
NE Scotland	Mid-September	50	34	7	1.71
	Late September	500	33.4	30	2.10
	Early October	50	26	-	-

Region	Time period ¹	Total aged	% young	No. of broods counted	Mean brood size
West England	Late September	570	16.5	8	2.38
	Early October	558	43.9	79	3.10
	Mid-October	2,303	18.5	64	2.53
	Early November	3,043	2.3	27	2.56
	Mid-November	783	12.6	47	2.11
	Early December	1,338	24.9	156	2.13
Total		17,345	15.4	453	2.37

¹ Pink-footed Geese were aged between 17 September and 15 December 2020.

3.5.2. Greylag Goose

Due to the increasing difficulty in assessing the breeding success of Iceland Greylag Geese on the wintering grounds, no age assessment data were collected during autumn 2020: see discussion.

4. Discussion

4.1. Pink-footed Goose

The 2020 population estimate of 485,509 (95% CI = 480,185–490,884) Pink-footed Geese represents a decrease on the previous estimate of 500,928 birds (95% CI = 495,605–506,304) (Appendix 2). Although a slight decrease, the number is not too dissimilar to the population estimates recorded since the peak in 2015, which have ranged between 440,891 (2018) (95% CI = 436,228–836,504) and 536,871 (95% CI = 531,741–542,039) (2015). The 2020 population estimate, however, is likely to be within +/- 5% of the true population value and it therefore seems that the Greenland/Iceland Pink-footed Goose population has been relatively stable since 2015. As breeding success and hunting pressure have remained stable over the years (Brides *et al.* 2020) and with no apparent demographic explanation for a decrease in numbers, it is possible that some birds were missed from the overall total in 2020. One explanation for the slight decrease in numbers is the possibility that a number of Pink-footed Geese were outside the usual range of the population and therefore not included within the 2020 census.

During October 2020, two colour-marked Pink-footed Geese both ringed in England were sighted in The Netherlands during the week of the October IGC census (Figure 7); both birds were reported in separate flocks of several hundred birds. One individual, ringed in Norfolk in 2018 had previously been sighted in the UK in Dumfries & Galloway during winter 2019/20, suggesting that this individual is a regular wintering bird in the UK: it was sighted in The Netherlands on 10/10/2020. The other individual, which has not been sighted in the UK since being ringed in Lancashire in 2018, was sighted in The Netherlands on 12/10/2020, in Belgium on 13/11/2020 and 09/02/2021 and in Denmark on 03/03/2021. The latter sighting is interesting, as it suggests that this individual might potentially have joined the population breeding in Svalbard.

Whilst it's not known how many individuals from the Greenland/Iceland population were on mainland Europe during the time of the October IGC census, it is possible that birds migrating from Iceland were caught up in an area of low pressure over the southern North Sea named Storm *Odette* which produced an extended period of disruptive winds, exceptional rainfall and notably cold temperatures in parts of the UK between 24–26 September 2020, with parts of Norfolk experiencing one of the longest durations of gales to affect the area during the past 30 years (Holley 2021).

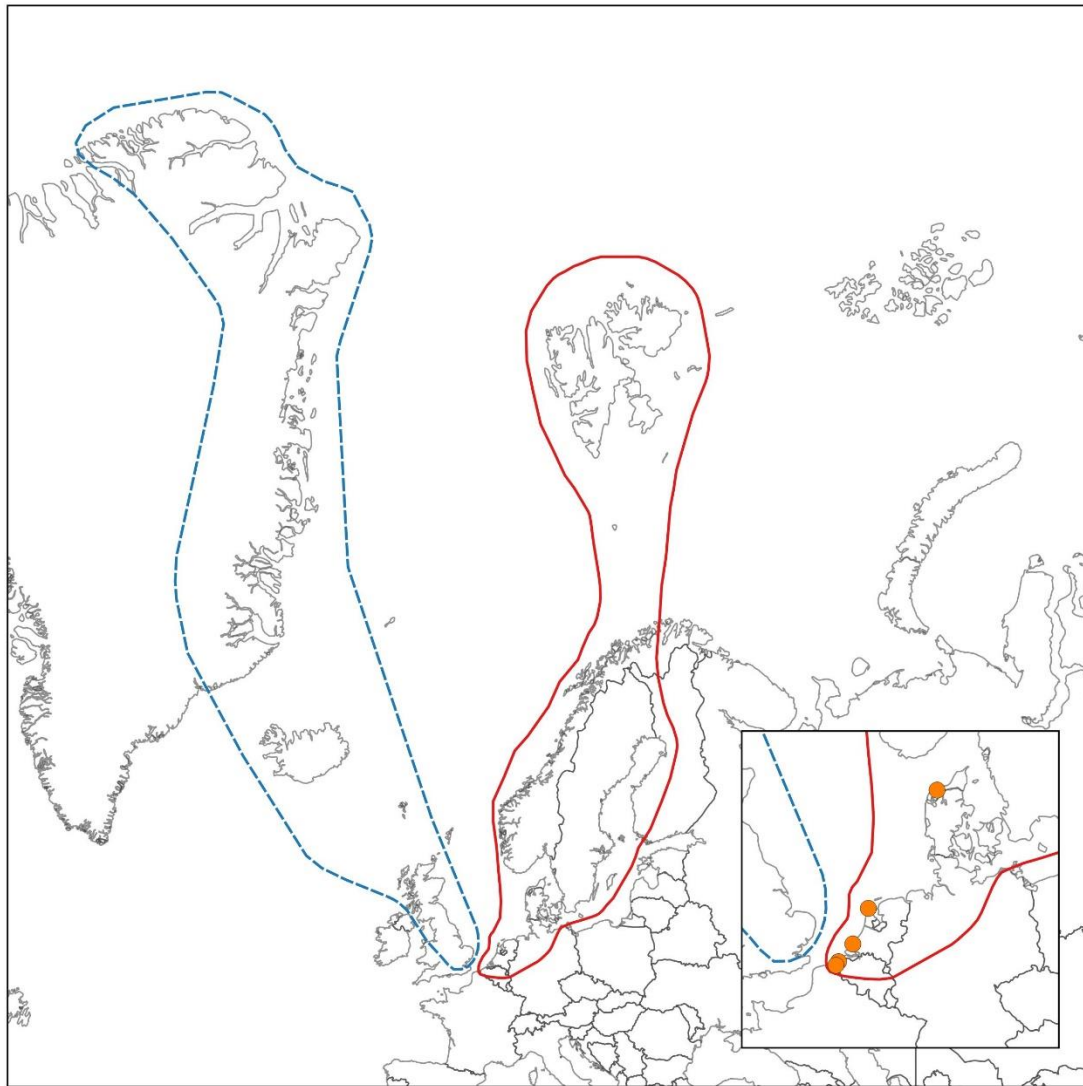


Figure 7. The population ranges of the Greenland/Iceland Pink-footed Goose (blue dashed line) and the Svalbard Pink-footed Goose (red solid line) with the re-sightings (orange dots) of the Pink-footed Geese colour-marked in England and sighted in Belgium, the Netherlands and Denmark during winter 2020/21 in the inner box (WWT unpublished data).

These interesting sightings come after marked Pink-footed Geese from the Svalbard population were seen in the UK during the time of the 2019 ICG census (see Brides *et al.* 2020). Whilst interchange between the two populations is known to occur from time to time (Madsen *et al.* 2014), it is not thought to massively affect the overall population estimates (Brides *et al.* 2020). Such sightings also reaffirm the importance and usefulness of colour-marking and the use of telemetry in population monitoring, giving valuable knowledge and insights into connectivity that may occur between different populations.

Breeding success data suggest Pink-footed Geese wintering in Britain had a lower than average breeding season in 2020, with 15.4% young found in those flocks assessed compared to the previous ten-year mean of 17.4% (± 1.10 SE: 2010–2019) (Table 5, Figure 6). However, the mean brood size of successful pairs was 2.37 juveniles, which is higher than the previous ten-year mean (2010–2019: 2.00 ± 0.06 SE). It is possible that temperature and weather conditions in Iceland may have affected the 2020 breeding success to some degree: although the mean temperature (10.7°C) in northern Iceland in June 2020 was slightly higher than the June temperature recorded in the previous five years (2015–2019; 9.7°C ; Tutiempo 2021), periods of prolonged wet weather could have contributed to a poorer breeding season.

4.2. Iceland Greylag Goose

The population estimate of 60,061 (95% CI = 59,148–60,987) Iceland Greylag Geese was 18.1% lower than the 2019 estimate (73,355, 95% CI = 72,308–74,418) (Appendix 2) and remains below the ten-year average of 87,804 birds (2010–2019). The recent decline in population size of Iceland Greylag Geese is a cause for concern. It remains unclear to what degree undercounting and possible under-estimation in Orkney and Iceland may have affected recent population estimates. Whilst Orkney and Iceland are the two sites which hold the majority of Icelandic birds, more up to date information from elsewhere in the wintering areas, especially in regard to the numbers and distribution of British Greylag Geese, is much needed in order to produce more accurate population estimates going forwards.

Large numbers of British Greylag Geese in core wintering areas of the Iceland population, such as Orkney, Caithness and the Moray Firth, makes assessing the abundance of the Iceland population very difficult. In order to provide an estimate of the number of Icelandic birds in areas where British birds also frequent, we deduct an estimate of the number of British birds thought to be in the area during the time of the November census. 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 British birds and subtracted from the total count. Given that information on British birds in these areas is now largely out of date, the undertaking of late summer surveys in key areas, similar to those undertaken periodically on Orkney, is necessary and may allow a more accurate population estimate to be derived.

Consideration of hunting pressure of the Iceland population, both in Iceland and Britain, also needs to be taken in to account. Possible changes in the timing of autumn migration from Iceland to Britain potentially has the consequence to allow for more birds to be shot in Iceland prior to departure. During 2019, 42,780 Greylag Geese were reported shot in Iceland, this being similar to the previous ten-year mean (2009–2018: 45,444 birds \pm 1,816 SE) (Statistics Iceland 2021). Since the start of hunting bag reporting in Iceland in 1995, 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 of 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 in Iceland and the integration of hunting bag data in to analyses of population estimates is required. Furthermore, hunting bag statistics are not routinely collected in Britain and Ireland; however, it would be advantageous to initiate the annual collection of these data to contribute to a better understanding of hunting pressure on wintering Iceland Greylag Geese, and similarly, of course, on Pink-footed Geese.

British Greylag Geese on Orkney are actively being managed to try to reduce impacts on agriculture in the islands. Although this scheme does not overlap with the period when Icelandic birds are present, Greylag Goose has recently been placed on the general licence (GL02/21) in Scotland that allows birds to be controlled throughout the year to protect crops and livestock. There is, therefore, a short period of the close season from the end of January through to the point when Icelandic birds leave Scotland, when there could be increased shooting mortality for the Icelandic population. Increased shooting pressure and the extension to the shooting season has resulted in seeing some birds starting to winter off Mainland Orkney and moving to the surrounding islets. To gain a better insight in to this, it would be advantageous to analyse already collected re-sightings data, and perhaps capture and colour-mark more British Greylag Geese on Orkney during the summer, to study their winter movements and distribution in relation to the Icelandic birds.

The colour-marking of both Iceland and British Greylag Geese plays an important role in the future monitoring of the Iceland population: it will enable a better understanding of the wintering distribution of Iceland Greylags, provide information on the timing of movements from Iceland and allow updated survival analyses to be undertaken. The last such assessment was undertaken in 2004 (Frederiksen *et al.* 2004).

Recommendations for the future monitoring of this population were given in Brides *et al.* 2020. However, as mentioned in previous reports, the monitoring of Iceland Greylag Goose breeding success on the wintering grounds in Britain is becoming increasingly difficult due to overlap in the

wintering range of the Icelandic and British populations. Due to this, no assessment of breeding success was undertaken during 2020. As part of future discussions surrounding the monitoring of this population, preferably with contacts in Iceland, consideration should be given to exploring ways in which breeding surveys of the species can be undertaken in Iceland before the autumn migration commences. It would also be advantageous to explore whether age ratio information collected from hunting bag data gathered in Iceland could be used going forwards as a way of estimating productivity, as has been the case in previous years in Iceland.

5. Acknowledgments

The IGC is part of the long-term Goose & Swan Monitoring Programme (GSMP), which monitors the abundance and breeding success of the UK's native geese and migratory swans during the non-breeding season. GSMP is organised by the Wildfowl & Wetlands Trust (WWT) in partnership with the Joint Nature Conservation Committee (JNCC) and NatureScot. This census would not be possible without the support of a large number of dedicated goose counters. Enormous thanks go to them and the local organisers for all their efforts, advice and comments on their local goose situations. Thanks also to Colette Hall (WWT) and Kirsi Peck (JNCC) for providing comments on an earlier draft.

6. References

- Brides, K, C. Mitchell, A. Sigfússon & S. N.V. Auhage. 2018. *Status and distribution of Icelandic-breeding geese: results of the 2017 international census*. Wildfowl & Wetlands Trust Report, Slimbridge. 19pp.
- Brides, K, C. Mitchell, A. Sigfússon & S. N.V. Auhage. 2020. *Status and distribution of Icelandic-breeding geese: results of the 2019 international census*. Wildfowl & Wetlands Trust Report, Slimbridge. 19pp.
- Brides, K., Wood, K.A., Hall, C., Burke, B., McElwaine, G., Einarsson, O., Calbrade, N., Hill, O. & Rees, E.C. (In Press). Population size, distribution, habitat use and breeding success of the Icelandic Whooper Swan *Cygnus cygnus*: results of the 2020 international census. *Wildfowl* 71: 000–000.
- Frederiksen, M., Hearn, R.D., Mitchell, C., Sigfússon, A., Swann, R.L. & Fox, A.D. (2004) The dynamics of hunted Icelandic goose populations: a reassessment of the evidence. *Journal of Applied Ecology* 41, 315–334
- Hearn, R.D. & Mitchell, C. 2004. *Greytag Goose Anser anser (Iceland population) in Britain and Ireland 1960/61–1999/2000*. Waterbird Review Series, Wildfowl & Wetlands Trust/Joint Nature Conservation Committee, Slimbridge.
- Holley, D.M. 2021. The impacts of Storm Odette in eastern England, 24–26 September 2020. *Weather*, 76: 86–88. <https://doi.org/10.1002/wea.3920>
- Madsen, J., R. Tjornlov, M. Frederiksen, C. Mitchell & A. Sigfusson. 2014. *Connectivity between flyway populations of waterbirds: assessment of rate of exchange, their causes and consequences*. *Journal of Applied Ecology* 51: 183–193.
- Mitchell, C. & Hearn R.D. 2004. *Pink-footed Goose Anser brachyrhynchus (Greenland/Iceland population) in Britain and Ireland 1960/61–1999/2000*. Waterbird Review Series, Wildfowl & Wetlands Trust/Joint Nature Conservation Committee, Slimbridge.
- Mitchell, C. 2002. Pink-footed Goose. In: Wernham, C.V., Toms M.P., Marchant J.H., Clark J.A., Siriwardena G.M. & Baillie S.R.. (Eds). *The Migration Atlas: movements of the Birds of Britain and Ireland*. T. & A.D. Poyser, London.
- R Core Team. 2021. *R: A language and environment for statistical computing*. Version 4.1.0. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.
- Statistics Iceland. 2021. Online database: <https://statice.is/>. Accessed July 2021.
- Swann, R.L. & I. Brockway. 2002. Greytag Goose. In: Wernham, C.V., Toms M.P., Marchant J.H., Clark J.A., Siriwardena G.M. & Baillie S.R.. (Eds). *The Migration Atlas: movements of the Birds of Britain and Ireland*. T. & A.D. Poyser, London.
- Tutiempo. 2021. <https://en.tutiempo.net/climate/06-2020/ws-40630.html>. Accessed May 2021.
- Wetlands International. 2021. *Waterbird Population Estimates*. Online Database: <http://wpe.wetlands.org/view/1751>. Accessed May 2021.
- Wood, K.A., Hall, C., Brides, K., Griffin, L., Hearn, R.D., Mitchell, C., Rees, E.C. & Hilton, G.M. 2021. Counting with confidence: estimating the uncertainty associated with measures of avian abundance and productivity from the Goose & Swan Monitoring Programme (GSMP). Wildfowl & Wetlands Trust Report, Slimbridge. 68pp.

Appendix 1. Unadjusted Greylag Goose counts at individual sites in Orkney in November 2020.

Site	November count	% of the adjusted 2020 population estimate
West Mainland	23,110	38.6
East Mainland	8,522	14.2
South Ronaldsay	6,090	10.2
Sanday	4,474	7.4
Stronsay	3,814	6.4
Shapinsay	2,603	4.3
Westray	2,318	3.9
Rousay	2,134	3.6
Eday	1,860	3.1
Papa Westray	906	1.5
Egilsay	826	1.4
Burray	671	1.1
Graemsay	624	1.0
Gairsay and Sweyn Holm	570	0.9
Hoy and North Walls	464	0.8
North Ronaldsay	278	0.5
Flotta	264	0.4
South Walls, Switha, Melsetter	229	0.4
Wyre	164	0.3
Fara	15	<0.05
Total	59,936	100

Appendix 2. Estimates ($\pm 95\%$ Poisson CI) of the Pink-footed Goose and Iceland Greylag Goose populations, including the unadjusted and adjusted totals for Iceland Greylag Goose, 2008-2020.

	Pink-footed Goose			Iceland Greylag Goose (unadjusted)			Iceland Greylag Goose (adjusted)		
Year	Grand total	l95% CI limit	u95% CI limit	Grand total	l95% CI limit	u95% CI limit	Grand total	l95% CI limit	u95% CI limit
2020	485,509	480,185	490,884	92,592	91,137	93,533	60,061	59,148	60,987
2019	500,928	495,605	506,304	101,235	103,663	106,760	73,355	72,308	74,418
2018	440,891	436,228	836,504	92,509	91,085	93,968	58,426	57,536	59,333
2017	515,852	510,660	521,092	89,874	78,496	91,284	60,691	59,735	61,664
2016	481,341	476,327	486,306	121,046	119,413	122,710	90,471	89,278	91,684
2015	536,871	531,741	542,039	116,330	111,099	114,360	101,281	99,848	102,734
2014	393,170	388,668	407,721	119,853	118,260	121,477	95,998	94,736	97,180
2013	372,074	367,959	376,237	117,432	115,798	119,094	88,577	87,311	89,864
2012	359,175	354,920	363,478	128,250	126,567	129,963	104,632	104,525	107,506
2011	260,325	256,869	263,827	128,915	87,320	130,544	239,830	118,326	121,537
2010	304,472	301,519	308,478	121,280	105,456	108,337	110,962	109,393	112,560
2009	364,212	359,977	368,554	121,904	120,173	123,672	109,496	107,846	111,180
2008	351,129	347,639	354,780	110,441	98,461	110,155	98,291	96,692	99,920