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Summary

Further to the 'traditional' autumn grey goose censuses, the third in the current phase of mid-winter and spring co-ordinated counts of Pink-footed and Greylag Geese took place over the weekends of 20/21 January and 30/31 March 1996. The total numbers of both Pink-footed Geese (c.138,200) and Greylag Geese (c.54,500) counted in January, represented 69% and 66%, respectively, of the numbers that had been counted in the previous autumn. In mid-winter, Pink-footed Geese appeared to be concentrated in east-central Scotland (28%) and in more southerly haunts such as west England (20%) and east England (24%). The total numbers of Pink-footed Geese (c.103,000) and Greylag Geese (c.44,000) counted in March were lower than had been expected (51% and 53%, respectively, of the count in the previous autumn). There was a large concentration of Pink-footed Geese recorded in north-east and east-central Scotland: 61% of the count total, although this is smaller than the proportion recorded there in spring 1994 (88%). Greylag Geese were more difficult to find in spring, however the majority of those geese recorded, some 61%, were found in north and east-central Scotland. A summary of the results of the co-ordinated counts undertaken during the three winters 1993/94 to 1995/96 is presented.

Methods

Mid-winter and spring counts

Co-ordinated counts were carried out on the weekends of 20/21 January and 30/31 March 1996, using the same methods as the long-running autumn counts. The counts did not attempt to cover every known goose roost in the country, but rather, ensured coverage of the most important roosts, as determined by *a priori* analysis of previous winter and spring counts in each area. In addition, analysis of the WeBS data revealed a few additional sites where *ad hoc* counts have been made in the past and which have held reasonable numbers of geese.

In some areas it was not possible to cover all roosts on the official count dates, and observations made up to five days either side of the count weekend were included in the mid-winter and spring count totals. It has been possible to incorporate additional WeBS counts into this report. These are primarily of small numbers of geese recorded at sites not normally covered by the grey goose counts. Invariably they were undertaken during the day (not at dawn or dusk) and thus probably represent underestimates of the true number of geese using the site as a roost. However, they are important as a means of identifying new (or long abandoned) roosts which may become important in years to come, and efforts will be made to count these roosts during future censuses.

Comparisons are made between the mid-winter or spring counts and average winter counts from the 36 sites holding internationally important numbers of Pink-footed Geese and 30 sites holding important numbers of Greylag Geese cited in Cranswick *et al.* (1997).

Results

Mid-winter counts

Coverage was good, and totals of **138,180** Pink-footed and **54,576** Greylag Geese were recorded (Table 1). In all, 163 sites were checked on 28/29 January 1996. Most of the major roosts and many of the minor roosts identified were covered. Around this period, conditions were reasonable for counting, being generally cold and overcast, although mist in some places (*e.g.* Fife) may have affected count accuracy.

Of the 36 sites regularly holding internationally important numbers of Pink-footed Geese (see Cranswick *et al.* 1997), the six principal omissions from the January counts were (shown with the 1991/92 to 1995/96 average winter maxima): Glenfarg Reservoir (3600), Crombie Loch (3583), Ardoch Loch (2620), Skinflats (2394), Drummond Pond (2272) and Gargunnock (2060). The distribution of Pink-footed Goose counts in January 1996 are shown in Figure 1. Large concentrations were recorded in Lancashire (31,000), in Norfolk (24,132) and on the Solway Estuary (19,108). Together, these three areas held 54% of the total counted in January, and 37% of the total October population estimate. By comparison, in October, the three areas held only 11% of the autumn total. Pink-footed Geese were concentrated in east-central Scotland, east England and west England, together representing 73% of the count total (Table 2, Figure 1). The 15 sites which held more than 1900 Pink-footed Geese (the internationally important threshold) in January 1996 are shown in Table 3, and all but four (Alloa Inch, Holbeach St Matthew, Loch Flemington and Monikie Reservoirs) regularly support at least that number.

For Greylag Geese, the 17 sites which held more than 1000 Greylag Geese (internationally important levels) in January 1996 are shown in Table 3, and all but five (Bridge of Earn, Strathearn west sites, Alloa Inch, River Teviot Nisbet area and Hirsell Lake) regularly support that number or more. Approximately 66% of the total population estimate as established by the November census was recorded in January. Large concentrations of Greylag Geese were recorded on the Isle of Bute (3870), Findhorn Bay (3150), Bridge of Earn (3000) and Loch of Skene (3000). Of the 30 sites regularly holding internationally important numbers, the five principal omissions from the January counts were: Drummond Pond (3200), Stranrear Lochs (2532), Loch Garten (1471), Corby Loch (1193) and Fincastle Loch (1136). The distribution of Greylag Goose counts in January is shown in Figure 2. Notable concentrations were found in east-central Scotland, north-east Scotland and south-west Scotland/north-west England which together accounted for 72% of the total (Table 2, Figure 2).

Spring counts

Coverage was reasonably good and a total of **102,986** Pink-footed Geese and **43,976** Greylag Geese were recorded from 117 sites on 30/31 March 1996. Most of the major roosts and many of the minor roosts identified were covered.

The 16 sites which held internationally important numbers of Pink-footed Geese (more than 1900) are shown in Table 3, and of these, all but three (Caithness, Loch Spynie and Alloa Inch) regularly support that number. Of the 36 sites regularly holding internationally important numbers of Pink-footed Geese (Cranswick *et al.* 1997), the nine principal omissions from the March counts were (shown with the 1991/92 to 1995/96 average winter maxima): Loch of Kinnordy (4760), Tay Estuary (4016), Glenfarg Reservoir (3600), Crombie Loch (3583), Ardoch Loch (2620), Skinflats (2394), Hightae Loch (2277), Gargunnock (2060) and sites in the Upper Forth Estuary (2001). Notable concentrations were found in north-east Scotland (34% of the count total, Table 2), in particular at the Ythan Estuary (21,300) and Loch of Strathbeg (10,439) - the two sites which held largest numbers in spring 1994 and spring 1995. Large concentrations also occurred on the

Figure 1a. The distribution of Pink-footed Geese in January 1996

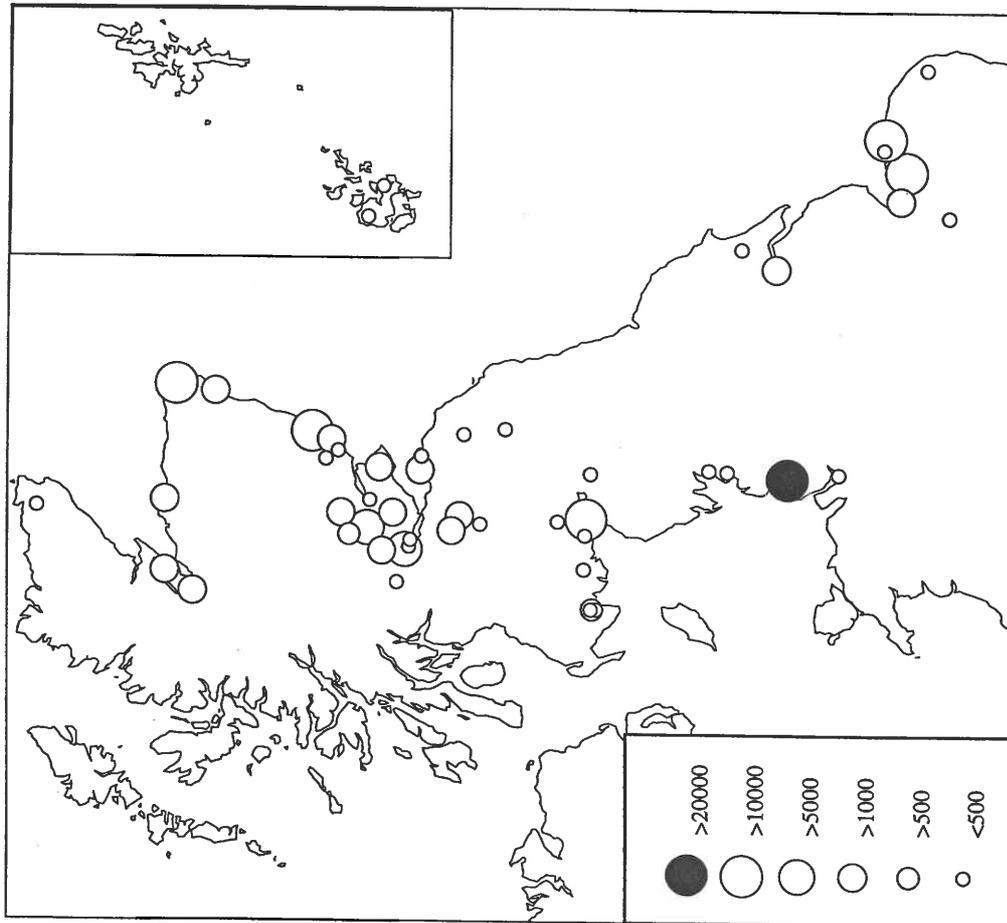


Figure 1b. The distribution of Pink-footed Geese in March 1996

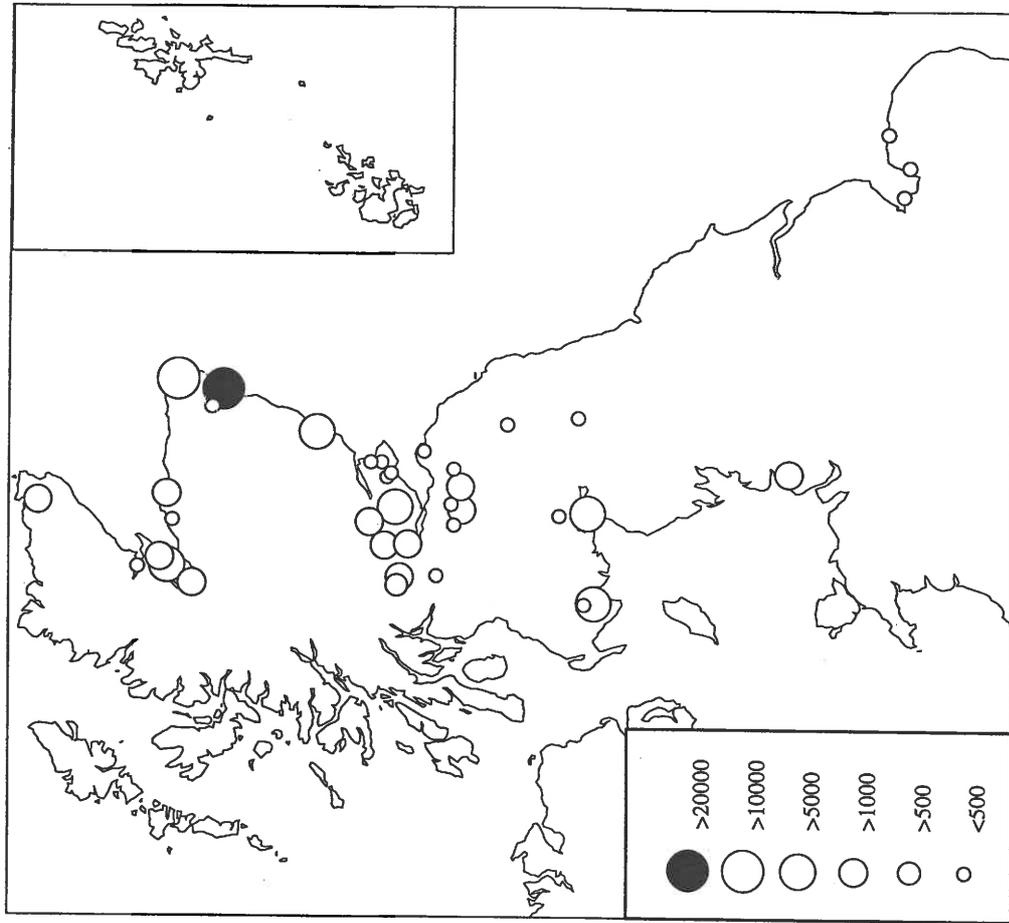


Figure 2b. The distribution of Greylag Geese in March 1996

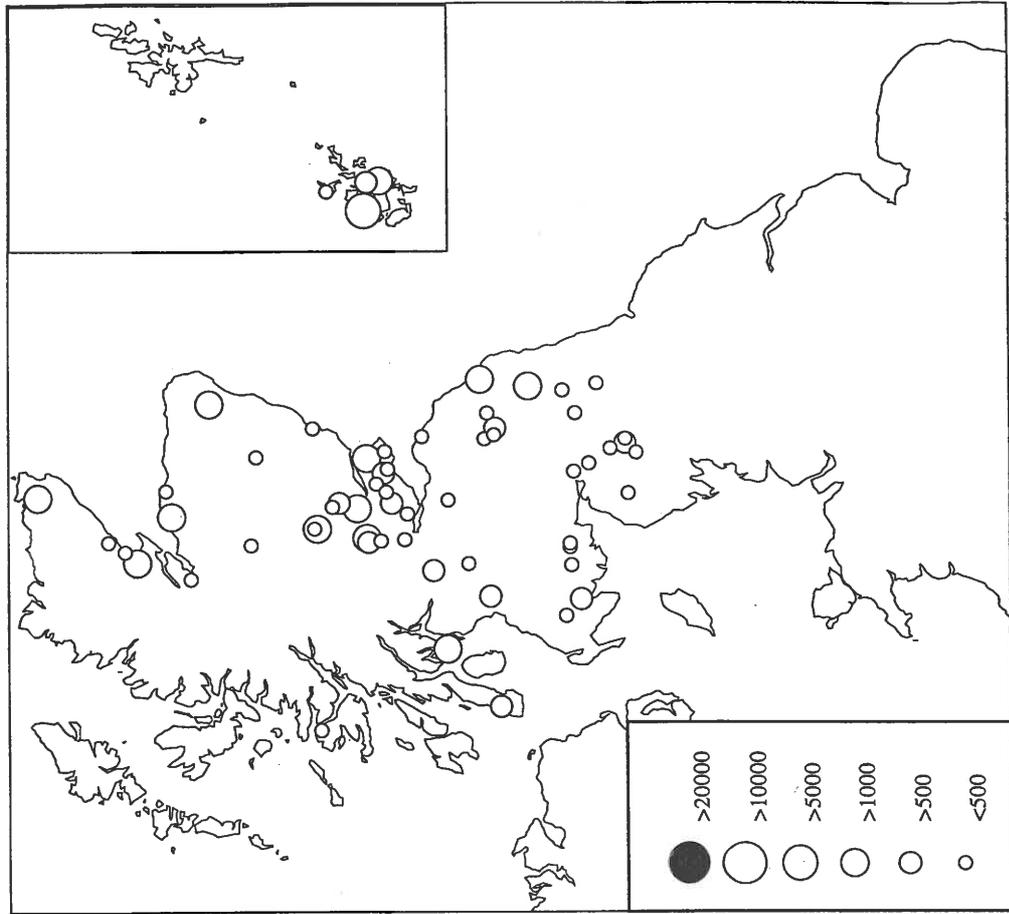
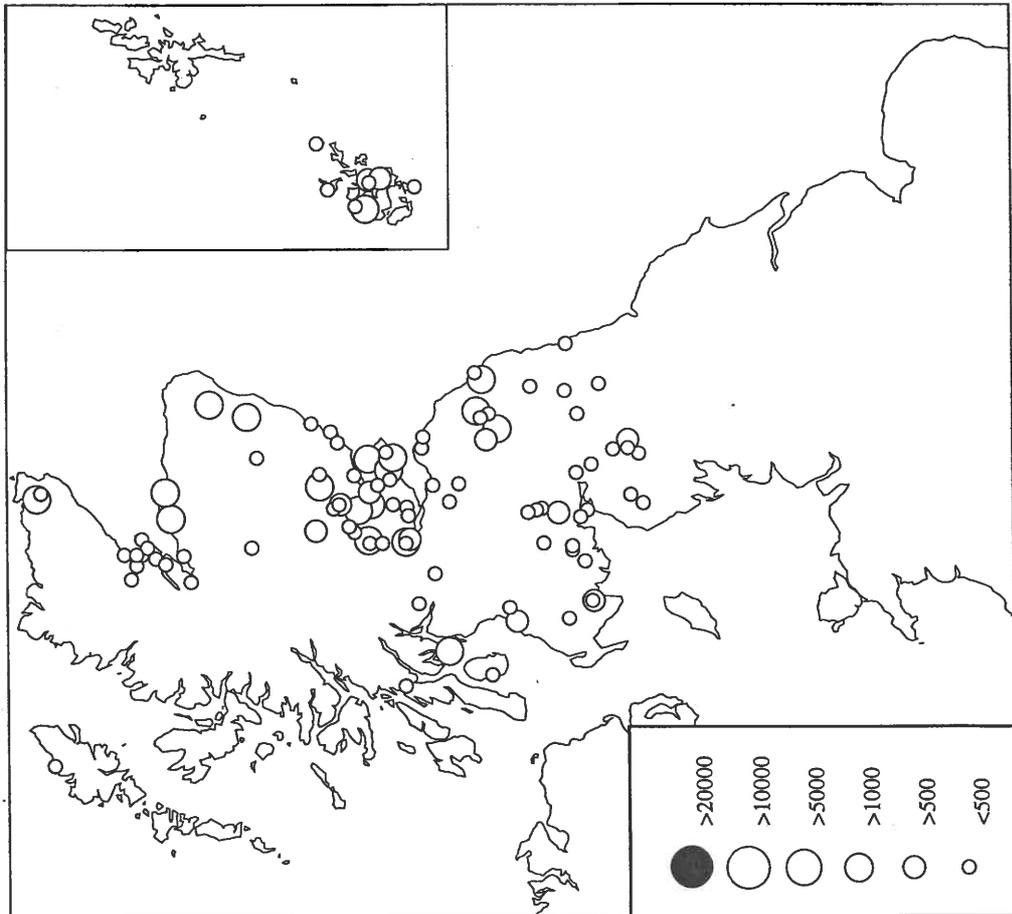


Figure 2a. The distribution of Greylag Geese in January 1996



Solway Estuary (9730), Udale Bay (Cromarty Firth, 7150) and on the west side of Wigtown Bay (7000).

Of the 30 sites regularly holding internationally important numbers of Greylag Geese, the six principal omissions from the March counts were: Loch of Skene (10,840), Loch of Lintrathen (3098), Stranrear Lochs (2532), Loch Garten (1471), Corby Loch (1193) and Findcastle Loch (1136). The total number of Greylag Geese recorded was low (42,961) and accounted for only 53% of the total population as established by the November count. Notable concentrations in March 1996 were found in north and east-central Scotland, together accounting for 61% of the count total (Table 2, Figure 2). South-east Scotland/north-east England showed the lowest number of Greylag Geese, with only 8% of the count total. High counts were recorded in Orkney (West Mainland, 7230; East Mainland 1823), in Caithness (2987), on Bute (2460), at Findhorn Bay (2300) and sites in west Strathearn (2100). The 12 sites which held internationally important numbers of Greylag Geese (more than 1000) are shown in Table 3, and of these, all but two (Strathearn west sites and Caistron Quarry) regularly support that number.

The principal changes in the distribution of both Pink-footed and Greylag Geese at a regional level between the January and March counts are shown in Table 1. The numbers of Pink-footed Geese recorded in Ross & Cromarty increased from 2150 to 10,429; those in Gordon/Aberdeen increased from 1890 to nearly 22,000. Other regions showed a decrease in the number of Pink-footed Geese counted: from over 11,600 to 5600 in Angus/Dundee; from 27,739 to 2300 in Lancashire and from over 30,000 to virtually none in Norfolk.

Changes in the distribution of Greylag Geese were not so dramatic as in the case of Pink-footed Geese. The numbers recorded in Orkney increased from 5056 to nearly 10,000 and those in Caithness increased from just over 1000 to nearly 4000 - but overall, increases were relatively small in magnitude. More noticeably, some regions showed a decrease in the number of Greylag Geese counted: from 5350 to 2400 in Moray; from over 4000 to 1000 in Gordon/Aberdeen and from over 10,000 to 7221 in Perth & Kinross.

Table 1. The numbers of Pink-footed and Greylag Geese recorded in Great Britain in January and March 1996. The number of sites counted is also given.

DISTRICT/REGION	JANUARY 1996			MARCH 1996		
	Sites	Pink-footed Geese	Greylag	Sites	Pink-footed Geese	Greylag
Shetland	0	nc	nc	nc	nc	nc
Orkney	9	83	5056	5	6	9931
Western Isles	1	0	28	0	nc	nc
Caithness	3	332	1069	1	3916	3987
Sutherland	3	0	823	3	331	1472
Ross & Cromarty	12	2150	1164	4	10429	193
Inverness/Nairn	0	nc	nc	0	nc	nc
Badenoch & Strathspey	1	0	17	1	0	286
Moray	3	1302	5350	3	3100	2400
Banff & Buchan	1	10,553	0	1	10,439	0
Gordon/Aberdeen	3	1890	4200	2	21,750	1015
Kincardine & Deeside	1	0	8	1	0	41
Angus/Dundee	9	11,620	2988	5	5600	250
Perth & Kinross	18	17,048	10,069	15	16,301	7221
Central	7	7310	2352	4	4850	390
Fife	17	2723	5087	15	674	3035
Argyll & Bute	2	0	4070	5	6	3407
Glasgow area*	6	0	1114	4	60	1325
Clydesdale	2	289	0	1	0	0
Stewartry/Wigtown	9	1076	1358	6	7062	1759
Annan. & Eskdale/Nithsdale**	9	12,635	1238	2	9980	5
East/Midlothian	8	1211	464	7	2252	380
Edinburgh/West Lothian	4	1250	282	3	63	152
Borders west***	9	102	3376	8	450	1583
Tweeddale	1	4800	0	1	2800	0
North-east England	8	0	2891	6	81	3478
Cumbria**	8	351	1572	8	10	1666
Lancashire and Merseyside	3	27,739	0	1	2300	0
Lincs/Notts/Humberside	4	3312	0	1	214	0
Norfolk	4	30,374	0	3	312	0
TOTAL	169	138,180	54,576	117	102,986	43,976

* **Glasgow area** includes Bearsden & Milngavie, Clydebank, Cumbernauld & Kilsyth, Cumnock & Doon Valley, Dumbarton, East Kilbride, Eastwood, Glasgow City, Hamilton, Inverclyde, Kilmarnock & Loudoun, Kyle & Carrick, Monklands, Motherwell, Renfrew and Strathkelvin.

** for convenience, counts from the **Solway Firth** are included in the Annandale & Eskdale/Nithsdale total even though some birds roost and feed on the Cumbrian side of the estuary.

*** includes Ettrick & Lauderdale, Roxburgh and Berwickshire.

nc not counted

Table 2. Gross regional distribution of Pink-footed and Greylag Geese in Britain in January and March 1996, expressed as a proportion of the count for each species.

Area *	Pink-footed Goose		Greylag Goose	
	January	March	January	March
North Scotland	1.9	14.3	14.9	36.1
North-east Scotland	9.9	34.3	17.5	7.9
East-central Scotland	28.0	26.6	37.6	25.0
South-east Scotland/North-east England	5.3	5.5	12.8	12.7
South-west Scotland/North-west England	10.4	16.6	17.1	18.6
West England	20.1	2.2	0	0
East England	24.4	0.5	0	0

* areas are defined as follows (see also Figure 3):

North Scotland:	Shetland, Orkney, Western Isles, Highland
North-east Scotland:	Grampian
East-central Scotland:	Tayside, Central, Fife
South-east Scotland/North-east England:	Lothian, Borders, Northumberland
South-west Scotland/North-west England:	Strathclyde, Dumfries & Galloway, Cumbria
West England:	Lancashire, Merseyside
East England:	Humberside, Lincolnshire, Norfolk

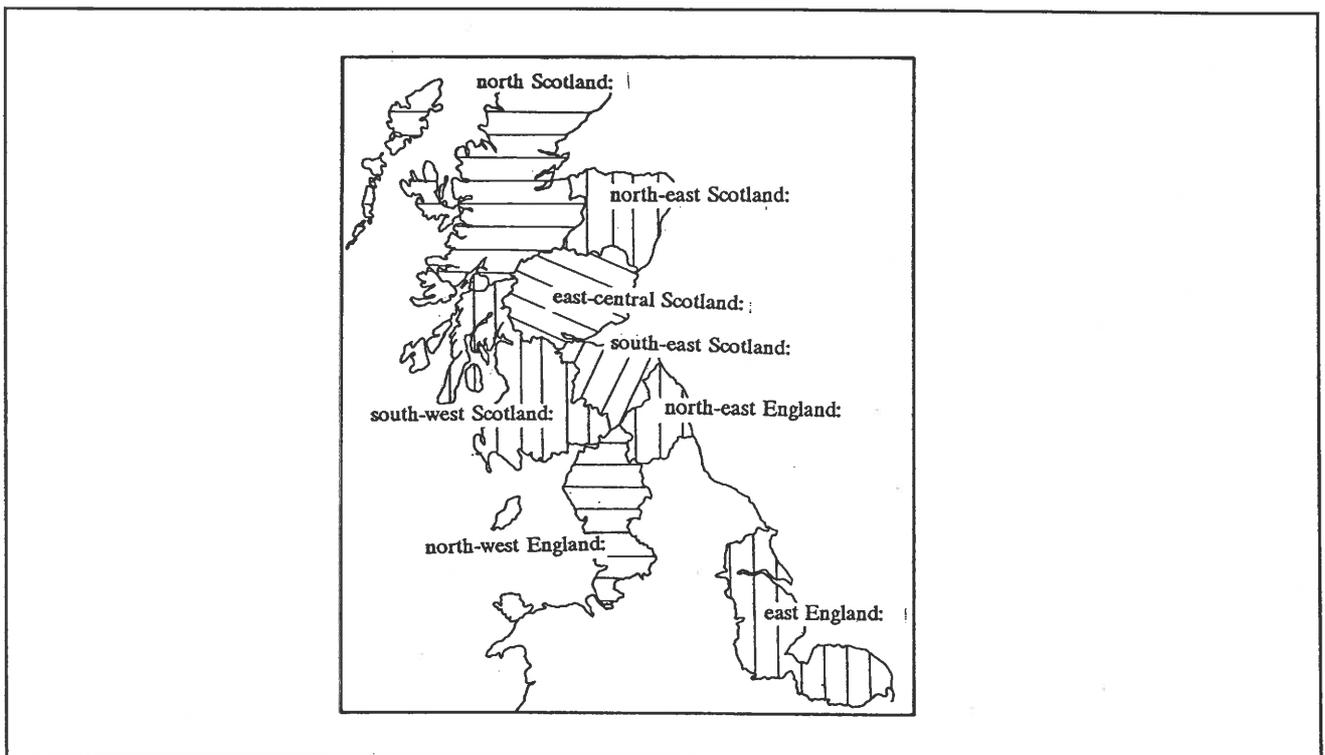


Figure 3. Area names used in this report

Table 3. Principal Pink-footed and Greylag Goose resorts counted in winter and spring 1996. Those sites with more than 1900 Pink-footed Geese or more than 1000 Greylag Geese counted are shown.

Pink-footed Geese	January count	% of total January count		March count	% of total March count
○ South Lancashire Mosses	27,650	(20.0)	○ Ythan Est. (Meikle Loch/Slains)	21,300	(20.7)
○ Snettisham	15,000	(10.9)	○ Loch of Strathbeg	10,439	(10.2)
○ Holkham	15,000	(10.9)	○ Solway Estuary (consolidated)	9730	(9.5)
○ Solway Estuary (consolidated)	12,419	(9.0)	○ Loch Leven	8800	(8.6)
○ Loch of Strathbeg	10,553	(7.6)	○ Cromarty Firth: Udale Bay	7150	(7.0)
○ Montrose Basin	10,500	(7.6)	○ Wigtown Bay (west side)	7000	(6.8)
○ Dupplin Lochs	6930	(5.0)	○ Montrose Basin	5600	(5.5)
● Alloa Inch	6700	(4.8)	● Caithness	3916	(3.8)
○ West Water Reservoir	4800	(3.5)	○ Dupplin Lochs	3860	(3.8)
○ Carsebreck & Rhynd Lochs	3800	(2.8)	○ Carsebreck & Rhynd Lochs	3640	(3.5)
○ Loch Leven	3709	(2.7)	● Loch Spynie	3000	(2.9)
● Holbeach St Matthew	2300	(1.7)	● Alloa Inch	2800	(2.7)
○ Cameron Reservoir	2110	(1.5)	○ West Water Reservoir	2800	(2.7)
● Loch Flemington	2500	(1.5)	○ South Lancashire Mosses	2300	(2.2)
● Monikie Reservoirs	2000	(1.2)	○ Cromarty Firth: Nigg Bay	2200	(2.1)
			○ Gladhouse Reservoir	1900	(1.9)
Greylag Geese	January count	% of total January count		March count	% of total March count
○ Isle of Bute	3870	(7.2)	○ Orkney: west mainland	7320	(17.0)
● Findhorn Bay	3150	(5.9)	○ Caithness	2987	(7.0)
● Bridge of Earn	3000	(5.6)	○ Isle of Bute	2460	(5.7)
○ Loch of Skene	3000	(5.6)	○ Findhorn Bay	2300	(5.4)
● Strathearn (west sites)	2655	(4.9)	● Strathearn (west sites)	2100	(4.9)
○ Orkney: west mainland	2644	(4.9)	○ Orkney: east mainland	1823	(4.2)
○ Loch of Lintrathen	2300	(4.3)	● Castron Quarry	1530	(3.6)
○ Loch Spynie	2200	(4.1)	○ Holburn Moss	1500	(3.5)
○ Holburn Moss	2000	(3.7)	○ Eden Estuary	1265	(2.9)
○ River Tay (Scone)	1600	(3.0)	○ Dornoch Firth: Ardmore Bay	1260	(2.9)
● Alloa Inch	1535	(2.9)	○ River Tay (Scone)	1235	(2.9)
○ Eden Estuary	1520	(2.8)	○ Pitlochry Area	1114	(2.6)
○ Carlhurlie Reservoir	1276	(2.4)			
● River Teviot (Nisbet area)	1200	(2.2)			
○ Kilconquhar Loch	1135	(2.1)			
● Hirsell Lake	1050	(2.0)			
○ Caithness	1044	(1.9)			

Key:

- - sites which regularly support more than 1900 Pink-footed Geese or more than 1000 Greylag Geese (from Cranswick *et al.* 1997)
- - sites which regularly support less than 1900 Pink-footed Geese or less than 1000 Greylag Geese (from Cranswick *et al.* 1997)

DISCUSSION

Mid-winter counts

The 1996 winter counts recorded approximately 69% of the autumn Pink-footed Goose population, and 66% of the autumn Greylag Goose population. The 1996 spring count recorded relatively low numbers (compared with the autumn counts) of both species; approximately 51% of the autumn Pink-footed Goose population, and only 53% of the autumn Greylag Goose population.

In mid-winter, Pink-footed Geese appeared to be concentrated in east-central Scotland (28%) and in more southerly haunts such as west England (Lancashire, 24%) and east England (Norfolk, 20%) (Table 2). This is in contrast to the winter 1993/94 when over 42% of the January count was recorded in Norfolk (east England) alone (*e.g.* 68,000 in January 1994). The highest counts in Norfolk during the 1995/96 winter was of 50,615 on 22 December and of 54,760 on 12 January but by late January the count had fallen to 27,000 and, presumably, Pink-footed Geese had started their northward migration. Thus it seems likely that although over 40% of wintering Pink-footed Geese counted were to be found in England, either fewer Pink-footed Geese had moved to more southerly wintering haunts than in 1993/94, or the return migration had started earlier than in that winter. This may be explained by comparing the weather during the two mid-winter periods. Cold spells in December and January 1993/94 had clearly influenced a major movement south in that winter, whilst on the whole, both mid-winter 1994/95 and 1995/96 were milder.

The low number of Greylag Geese observed in the mid-winter and spring counts confirms the difficulties in locating this species at these times expressed by many counters. This is consistent with the general understanding that the large flocks of Greylag Geese observed in autumn become more fragmented and dispersed throughout the winter, using small remote, lochs and temporary flooding as roosts.

In January 1996, Greylag Geese were fairly evenly distributed although east-central Scotland held the largest proportion (38%) whilst the other four areas which held Greylag Geese each supported 13-18% of the count (Table 2). By March 1996 the proportion recorded in north Scotland had increased from 15% to 36% as Greylag Geese started their spring migration through Britain (Figure 2). A corresponding decrease was recorded in east-central Scotland (from 38% to 25%).

Spring counts

The spring counts of the 1980s and early 1990s clearly identified north-east and east-central Scotland as the main focus for Pink-footed Geese in spring. A striking feature of the 1996 spring count was the large concentration of Pink-footed Geese recorded in north-east and east-central Scotland: 61% of the count total (Figure 1, Table 2) although this is smaller than the proportion recorded there in spring 1994 (88%) and spring 1995 (69%). North Scotland held 14% of the count total whilst the four areas further south held relatively few Pink-footed Geese, amounting to 25% overall.

Like the Pink-footed Geese, the bulk of the Greylag Goose population, some 61%, was found in north-east and east-central Scotland (Table 2, Figure 2), with high counts being recorded from Caithness (3987) and Orkney (9931) particularly.

The arrival pattern of Greylag Geese in Iceland is poorly described or understood, and monitoring of their arrival in the southern lowlands of Iceland would be extremely valuable in placing the results of future spring counts in context.

Monitoring in mid-winter and spring 1996

The voluntary goose counter network is in reasonably good shape. A few gaps have been identified, however, particularly in the Strathclyde area and around the Firth of Tay, which are high priorities for coverage for the autumn 1997 counts. Although most of the voluntary network took part in the additional counts this year, it has been made clear by several area organisers that it will be difficult to maintain this increased input every year. Many counters expressed doubts as to the value of mid-winter and spring roost counts, on the grounds that use of roost sites is unpredictable, and birds can be widely dispersed, such that the final count may be an underestimate and thus inaccurate. In order to achieve an accurate count for their area, many counters feel the need to carry out daytime feeding counts, often over extensive areas, which can involve much more time and expense than they can afford to contribute regularly. It would be worthwhile considering some form of remuneration based on mileage in some or all areas.

Many roost sites included in the counts are extremely difficult to reach, particularly in wintry conditions, and some organisers feel that counters are being put in potentially dangerous situations. Spring dawn counts particularly were the focus of some criticism. Counters need to be in a position to count before dawn and in late March or early April, this can mean getting up at 4am. There is also a strong view that the voluntary counter network is experiencing a serious overload, in terms of the number of surveys being carried out and requests for data from a range of conservation bodies.

Any future spring counts would be best planned around the last two weeks of March, should this coincide with the new moon. Counters should clearly be kept informed as to the reasoning behind the need for increased monitoring of grey geese, as well as having the results of their efforts returned to them quickly in a concise and straight-forward report.

SUMMARY OF STUDY (WINTERS 1993/94 - 1995/96)

Abundance

The population estimates for Pink-footed and Greylag Geese during the three year study period (winters 1993/94 - 1995/96) are shown in Table 4, together with the mid-winter and spring counts. Overall, the mid-winter counts recorded 68%, and the spring counts recorded 43% of the autumn Pink-footed Goose population estimate; the mid-winter counts recorded 54%, and the spring counts recorded 43% of the autumn Greylag Goose population estimate.

Table 4. *The population estimates, mid-winter and spring counts of Pink-footed and Greylag Geese made in Britain, 1993/94 to 1995/96.*

Winter	Pink-footed Goose			Greylag Goose		
	Autumn population estimate	Mid-winter count (% of autumn count)	Spring count (% of autumn count)	Autumn population estimate	Mid-winter count (% of autumn count)	Spring count (% of autumn count)
1993/94	224,354 ¹	160,812 ² (72)	86,320 ² (38)	99,253 ¹	41,654 ² (42)	34,031 ² (34)
1994/95	260,486 ³	168,276 ⁴ (65)	106,292 ⁴ (41)	86,132 ³	48,227 ⁴ (56)	36,373 ⁴ (42)
1995/96	200,343 ⁵	138,180 ⁶ (69)	102,986 ⁶ (51)	82,722 ⁵	54,576 ⁶ (66)	43,976 ⁶ (53)
Average	228,400	155,756 (68)	98,500 (43)	89,400	48,200 (54)	38,100 (43)

¹ from Mitchell (1994)

² Stenhouse (1994) ³ Mitchell & Hearn (1995)

⁴ Mitchell (1995)

⁵ Mitchell (1996) ⁶ This report

The relatively low numbers of both Pink-footed and Greylag Geese recorded during the mid-winter and especially the spring counts confirms the difficulties in locating birds expressed by many counters. Large autumn flocks soon break up and the geese become widely dispersed - complete coverage of the country using a volunteer counter network was impossible. Results from spring counts in the 1960s and 1980s, though consistent with each other, also failed to record sufficient geese to be compatible with the November figures made at that time. In late March, some geese do not consistently return to roost on permanent water and after the breakup of autumn flocks the geese may be more widely dispersed in areas that are topographically complex and with few local goose counters.

It must be stressed therefore, that the mid-winter and spring counts did not set out to replicate the complete census. Rather, the aim of the survey was to obtain accurate roost counts from the most important sites in Britain in order to understand better the distribution and abundance of grey geese at these times. However, it may be possible to estimate the number of geese that the counts missed.

Numbers will inevitably decrease to some extent as a proportion of the population is shot during the autumn and winter months. The inland shooting season ends on 31 January (shooting in February occurs on the foreshore where the season ends on the 20th) and there appears to be an increase in wildfowling activity during that month as the end of the season approaches. Thus, a proportion of the population will also be shot between the mid-winter counts (January) and the spring counts (late March or early April).

However, the numbers of both species shot each winter are unknown. There is no legal requirement for any wildfowler in Britain to record what species or how many individual birds he/she shoots. The British Association for Shooting and Conservation (BASC) are contracted by WWT to undertake an anonymous survey to try to ascertain the extent and distribution of goose shooting. In 1995/96, 64% of 5,000 circulated survey forms (*'goose shooting survey'*) were returned to BASC, and based on these returns, BASC estimated *c.* 25,000 Pink-footed Geese and *c.* 17,500 Greylag Geese are shot between September and February each year (Reynolds & Harradine 1996). These figures must be treated as estimated minima since very few shooting bag data were provided from commercial goose guides (4 guides returned survey forms) or from BASC affiliated Wildfowling clubs (17% returned survey forms), yet 28-33% of wildfowlers acquired goose shooting through guides, and 13-16% acquired goose shooting through a wildfowling club.

Despite the paucity of data on how many geese are shot during the shooting season it can be argued that based on an average autumn population of *c.* 228,400 Pink-footed Geese during the study period (Table 4) at least an estimated *c.* 25,000 (11%) were shot by the time of the mid-winter and spring counts. For Greylag Geese, an estimated *c.* 17,500 (20%) of the autumn population of *c.* 89,400 are shot.

Adding the estimated number shot each winter to the mid-winter and spring counts should provide an estimate of the number of geese not accounted for by the counts. For Pink-footed Geese, the mid-winter counts could not account for *c.* 48,000 birds, and the spring counts missed *c.* 130,000 birds. For Greylag Geese, the mid-winter counts could not account for *c.* 23,000 birds, and the spring counts missed *c.* 33,000 birds. Note however, as identified above, a proportion of both populations will be shot between the mid-winter and spring counts.

Distribution

The distribution of both Pink-footed Geese and Greylag Geese is clearly affected by weather conditions, especially in feeding areas in Scotland. Tables 5 and 6 show the relative distribution of both species during the 3 years. In January 1994, roosts in Norfolk supported 38% of the

count total at that time - 12% higher than the three year average (26%). Many birds left traditional mid-winter haunts to feed at sites further south due to severe winter weather conditions in east-central Scotland. The return spring passage through east-central Scotland accounted for 40% of the count total at that time - this presumably included birds returning from Norfolk having been displaced south three months earlier.

Greylag Geese also respond to changes in local weather conditions. In January 1996, east-central Scotland accounted for 38% of the count total at that time - 10% higher than the three year average - with both north and north east Scotland supporting proportionally fewer birds than on average.

Table 5. *The mid-winter (January) and spring (late March/early April) distribution of Pink-footed Geese in Britain 1993/94 - 1995/96. Values expressed as a proportion of the count total*

Area	mid-winter (January)				spring (late March/early April)			
	1993/94	1994/95	1995/96	Mean	1993/94	1994/95	1995/96	Mean
North Scotland	0.1	1.8	1.9	1.3	5.6	15.7	14.3	11.9
North-east Scotland	15.0	10.8	9.9	11.2	45.2	43.4	34.3	41.0
East-central Scotland	17.2	31.5	28.0	24.8	39.8	26.6	26.6	31.0
SE Scotland/NE England	3.3	8.6	5.3	5.6	1.8	5.2	5.5	4.2
SW Scotland/NW England	6.0	13.2	10.4	14.1	4.1	5.4	16.6	8.7
West England	15.1	18.4	20.1	17.3	3.5	4.7	2.2	3.5
East England	42.6	15.7	24.4	26.0	0	0	0.5	0.2

Table 6. *The mid-winter (January) and spring (late March/early April) distribution of Greylag Geese in Britain 1993/94 - 1995/96. Values expressed as a proportion of the count total.*

Area	mid-winter (January)				spring (late March/early April)			
	1993/94	1994/95	1995/96	Mean	1993/94	1994/95	1995/96	Mean
North Scotland	16.7	26.7	14.9	19.4	26.6	34.6	36.1	32.4
North-east Scotland	31.1	21.8	17.5	23.4	20.0	27.6	7.9	18.5
East-central Scotland	28.1	18.0	37.6	27.9	29.3	20.3	25.0	24.9
SE Scotland/NE England	8.9	17.4	12.8	13.0	14.0	6.1	12.7	10.9
SW Scotland/NW England	15.2	16.2	17.1	16.1	10.1	11.5	18.6	13.4
West England	0	0	0	0	0	0	0	0
East England	0	0	0	0	0	0	0	0

The mean relative distribution of both species for the three periods autumn (October or November counts), mid-winter (January) and spring (March or April) is shown in Figure 8. Count data show that the distribution of Pink-footed Geese in different parts of their winter range in Britain changes within seasons. Large numbers arrive during October and November in north-east, east-central, south-east Scotland and west England (Lancashire). Numbers peak in England in mid-winter (primarily Norfolk and Lancashire), with few persisting into March, by which time the more

sedentary winter populations of south-west Scotland and eastern Scotland have begun to be augmented, presumably through arrivals from further south. Maximum numbers occur in north-east Scotland (Loch of Strathbeg and Ythan Estuary) and north Scotland (sites around the Moray Firth) from March onwards and peak during April. In January there is a conspicuous migration northwards in Britain, with birds travelling through west and north-west England, south-west Scotland and east-central Scotland, reaching north-east Scotland by mid-March (see Fox *et al.* 1994). Recovery and recapture data from the 1950s suggest that this pattern is long established. Fox *et al.* (1994) suggest that Pink-footed Geese which feed primarily on grass in spring, are responding to a gradient of plant growth (particularly the high protein content associated with the onset of growth), using the differential occurrence of the 'spring bite' in northward staging towards their ultimate destination - the breeding grounds in Iceland and Greenland.

Count data show that the distribution of Greylag Geese in different parts of their winter range in Britain also changes within seasons. Large numbers arrive during October and November in north Scotland (especially at Loch Eye and associated sea firths) and north-east Scotland (especially at Dinnet Lochs). The passage of geese through key arrival sites is pronounced (see Figure 4 in Mitchell *et al.* 1995) with numbers at Loch Eye and Dinnet Lochs recorded in late November often only 20-30% of those recorded at peak in late October or early November. Greylag Geese disperse to many traditional wintering sites in east-central, south east and south-west Scotland, with some wintering as far south as Cumbria and Northumberland in northern England. From February, some Greylag Geese undertake a migration northwards in Britain, with birds reaching north Scotland (especially around Moray Firth, Caithness and Orkney) by the end of the month. Others almost certainly migrate directly from their winter quarters to Iceland from late March onwards.

Individual sites

In order to assess the relative importance of individual sites during mid-winter and spring, counts obtained on any date during each month (December to April only) have been analysed (Tables 7 & 8). Thus, these include co-ordinated mid-winter and spring counts and counts made on WeBS weekends, and any *ad hoc* counts made by counters. The three roost sites in Norfolk (Snettisham, Holkham and Scolt Head) together with the South Lancashire mosses regularly support peak numbers of Pink-footed Geese during the mid-winter period. Loch of Strathbeg and the Ythan Estuary especially support peak numbers in late spring.

Table 7. Mean monthly counts of Pink-footed Geese, December to April 1993/94 to 1995/96. Final column is the mean of the peak count in any month (December to April).

Site	December	January	February	March	April	Mean Peak
Snettisham	27,323	38,242	12,385	2916	326	45,925
South Lancs mosses	24,550	27,612	27,260	2300	5000	27,260
Holkham Bay	20,048	15,427	6180	112	0	26,760
Ythan Estuary	136	46	362	15,282	11,340	23,880
Loch of Strathbeg	23,933	15,051	15,875	12,794	19,961	22,450
Montrose Basin	14,115	7550	6300	5400	2385	21,230
Solway Estuary	1974	8736	17,470	3080	2450	17,470
Scolt Head	13,297	10,912	1500	0	0	16,860
Warham	12,565	10,995	-	-	-	12,565
Cameron Reservoir	98	6652	3417	5353	280	10,350
Dupplin Lochs	-	6305	2910	5838	6650	7815
Loch Leven	4401	6466	3245	7618	6975	6100
Kinnordy Loch	2765	667	2	8	330	5530
West Water Reservoir	6320	5420	3079	1453	3500	5080

Table 7. *Cont.*

Site	December	January	February	March	April	Mean Peak
Carsebreck/Rhynd Lochs	5500	3940	2120	4527	4857	4750
Aberlady Bay	3950	990	-	40	-	4400
Meikle Loch Slains	-	3080	-	870	1150	4220
Hightae Loch	-	0	-	4000	-	4000
R Tay: Bloody Inches	3820	964	-	40	162	3820
Crombie Reservoir	2000	3000	2100	-	-	3000
Anthorn to Newton	-	-	4543	2556	2800	2800
Dinnet Lochs	810	27	43	740	2678	2435
R Forth: Gargunnock	-	-	-	2060	-	2060
R Gorth: Kincardine	-	-	-	2001	-	2001
Biggar Water	-	-	-	2000	-	2000

- site not counted

Table 8. *Mean monthly counts of Greylag Geese, December to April 1993/94 to 1995/96. Final column is the mean of the peak count in any month (December to April).*

Site	December	January	February	March	April	Mean Peak
Dinnet Lochs	11503	2082	1626	368	177	25408
Haddo House Lakes	4200	1520	-	4300	4900	4300
Drummond Pond	17	3435	13	2339	2200	3720
R Tay: Bloody Inches	3196	1220	-	677	147	3196
Loch of Skene	3533	2400	1850	1300	-	3000
Orkney:west mainland	-	2600	2815	5078	4012	2926
Carlhurle Reservoir	400	1096	2014	1123	402	2470
White Loch:Lochinch	-	1243	45	700	-	2451
R Eamont:Watersmeet	-	88	2150	753	-	2150
Lindisfarne NNR	-	1017	0	524	-	2000
Findhorn Bay	25	2679	92	44	1393	1821
Loch of Strathbeg	811	193	140	7	170	1600
Carse Bay	256	22	-	1500	147	1500
Holburn Moss	1375	1655	1750	1175	-	1500
R Tay above Dunkeld	-	1400	-	890	-	1400
Loch of Mey	1300	100	100	-	15	1300
Loch Spynie	2330	2467	-	200	2300	1300
Cromarty Firth:Udale	1959	390	500	56	0	1208
Orkney:east mainland	-	401	-	1512	848	1200
R Teviot (Nisbet)	185	755	629	600	-	1090

- site not counted

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