

ROOST SELECTION BY PINK-FOOTED ANSER BRACHYRHYNCHUS AND GREYLAG A. ANSER GEESE IN EAST CENTRAL SCOTLAND

MV BELL, AV NEWTON and S F NEWTON

Central Scotland Goose Group, c/o 48 Newton Crescent, Dunblane, Perthshire FK15 0DZ, Scotland.

The choice of winter roosts made by Pink-footed and Greylag Geese in Strathallan and Strathearn was examined over seven and three winters respectively. In Strathallan both species roosted on a central complex of three lochs. Pink-footed Geese also used another four permanent waters and four floodwater pools, while Greylag used another three permanent pools, three floodwater pools and three stretches of river. Three of the Pink-footed sites were not used by Greylag and four of the Greylag sites were not used by Pink-footed Geese. Use of the main roost by Pink-footed Geese showed little variation with season, occupancy being 89% in autumn, 90% in winter and 93% in spring (post-shooting season). Greylag showed a much lower occupancy which fell through the winter with 74%, 55% and 8% at the main roost complex in autumn, winter and spring respectively. In Strathearn almost all Pink-footed Geese occupied the main roost in autumn and winter but 20% of birds used two floodwater sites in spring. Occupancy of the main Greylag roost was again much lower falling from 83% in autumn to 24% in spring with geese using another eight permanent or floodwater pools not used by Pink-footed Geese.

The main determinant of choice of roost was freedom from disturbance by people, and especially from shooting. All other factors such as exposure, shoreline vegetation, including trees and availability of shoreline grazing, seemed unimportant. The findings are discussed in relation to censusing these populations in a national context.

Keywords: Ecology, Behaviour, Communal Roosting, Shooting, Counts, Pink-footed Goose, Greylag Goose.

The roost sites used by Pink-footed *Anser brachyrhynchus* and Greylag *A. anser* Geese wintering in Britain are largely known from their behaviour in autumn when the annual census of these populations is made (Boyd & Ogilvie 1969, 1972, The Wildfowl & Wetlands Trust Annual Reports). Though there have been several studies on various aspects of the wintering ecology of these species in Britain (Newton & Campbell 1973, Forshaw 1983, Bell 1988, Patterson *et al.* 1989), only two previous studies have examined roost selection by these species through the winter (Newton *et al.* 1973, Bell *et al.* 1988). This question is of more

than academic interest since our ability to census these populations and determine which areas are of greatest importance for wintering geese depends on being able to locate them. In east central Scotland 25 years ago both species were found to use a number of smaller permanent and floodwater pools which were within the feeding range of the main roosts (Newton *et al.* 1973). The situation in north-east Scotland in the early 1980s was very different. Here there is a paucity of alternative roost sites and large numbers of geese occurred at a few roosts throughout the winter, though floodwater occasionally

provided alternative sites in mid- and late winter (Bell *et al.* 1988).

As part of a study on the winter ecology of Pink-footed and Greylag Geese in east central Scotland since 1987 (Bell & Newton 1995), we examined roost selection throughout the winter in two valleys, Strathallan and Strathearn (Figure 1). The main roosts in Strathallan are the Carsebreck Lochs, used by both species, and in Strathearn, Dupplin Loch at the east end of the valley, used principally by Pink-footed Geese, and Drummond Loch at the west end of the valley, used principally by Greylag. A large number of smaller waters occur within the foraging range of both species. Two of the main roosts (Dupplin and Carsebreck) hold large numbers of Pink-footed Geese, while much smaller numbers of Greylag are found at Drummond and Carsebreck, where numbers have greatly decreased at both sites over the last 10-15 years (Bell & Newton 1995). Dupplin Loch is one of the main arrival sites for Pink-footed Geese in Britain with up to 60,000 present for a few weeks in early autumn (Newton *et al.* 1990, Bell & Newton 1995). Numbers disperse very quickly leaving a typical wintering population of 4,000-8,000 birds from December onwards. Drummond Loch near Crieff was formerly the largest Greylag roost in Scotland (Thom 1986), but the whole of Strathearn now holds only 2,500-5,000 birds

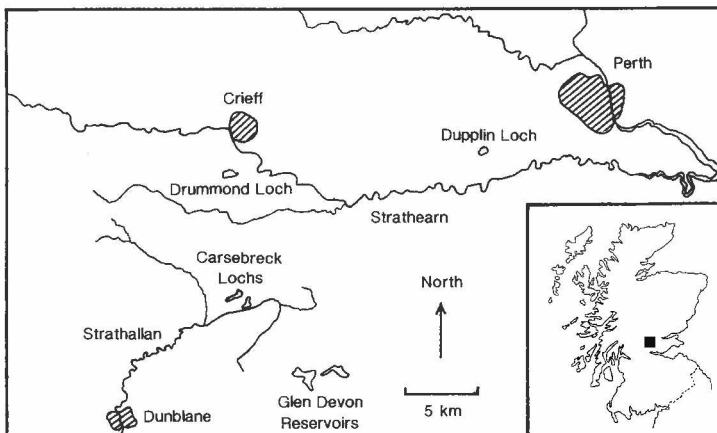
throughout the winter. Up to 3,000 Pink-footed Geese have recently started to use Drummond Loch in October (Bell & Newton 1995). In Strathallan there is an autumn peak of Pink-footed Geese usually numbering 10,000-15,000, with 4,000-8,000 remaining through the winter and a spring peak of up to 11,000 while Greylag now number under 1,000 birds (Bell & Newton 1995). This paper documents the use as roosts of all waterbodies in Strathallan and Strathearn by these two species.

Methods

The number of geese using the area was determined by conducting counts at the main roosts followed by searches of the feeding area. Roost counts were carried out at dawn, except in early autumn just after Pink-footed Geese had arrived or again in late spring just before their departure when it was possible to count at dusk. Complete counts were usually obtained weekly in Strathallan and monthly in Strathearn. More frequent counts were undertaken during the arrival period for Pink-footed Geese in late September and early October.

At roost counts detailed notes were made of the numbers of geese on each flight line. The feeding area was then searched systematically by car, usually in the morning following the roost count. Each feeding flock was assigned to a roost; in cases where geese from more than one roost fed together the roost was assigned

Figure 1. Map of the study area.



as the site from which the majority flighted. The use of minor roosts was deduced when flocks were found which had not flighted from the main roosts. In Strathallan the presence of geese at the minor roosts was often confirmed by hearing birds before they departed at dawn, and on clear mornings the flight lines from four of these roosts were visible from the observation point overlooking the main roost complex. On some occasions minor roosts were counted directly. The presence of goose feathers and fresh droppings was also taken as an indication of roost occupancy. In Strathearn one of the main floodwater sites used by Pink-footed Geese from February to April was often counted at the same time as Dupplin Loch. Pink-footed Geese roosting at the two alternative sites in Strathearn (roosts 41 and 42) fed close to these roosts. Movements of geese on the feeding areas were easily observed over most of the area used by geese roosting in Strathallan and by Pink-footed Geese in Strathearn. We do not believe movements of flocks between the dawn flight and their location on the ground was a serious source of error in assigning roosts. However, it was frequently not possible to assign a roost to flocks of Greylag in Strathearn because of the number of alternative sites available; 159 such feeding flocks were not used in the analysis.

The physical characteristics of the waterbodies used as roosts were noted, including size, open shoreline, 'walk-out' grazing, reeds, mature trees along the shore and shelter. Areas of permanent water were calculated from enlarged photocopies of 1:25,000 O.S. maps, while areas of floodwater were estimated in the field. Other characteristics were based on detailed knowledge of the roost sites. 'Walk-out' grazing was where there were no physical barriers, eg rushes, reeds, fences, hedges or walls, to prevent

Figure 2. The distribution of roosting Pink-footed and Greylag Geese in Strathallan by site for the 1987-88 to 1993-94 winters combined. Roosts are grouped as follows in order of increasing distance from the main roost complex (roosts 1-3): 4* = roosts 4 + 8; 9* = roosts 9 + 12 + 13; 11* = roosts 6 + 11; 10* = roosts 10 + 14 + 15.

geese walking directly onto grassland. The frequency of shooting was assessed by talking to game keepers at the main estates (roosts 1-6, 8, 11, 14, 20-22, 40, 42) and occasionally to people living near roosts, observations by ourselves and other local birdwatchers and by the presence of shooting butts currently in use.

In the analysis of the results, autumn was taken as September to November, winter as December and January, and spring as February to May (post-shooting season) since there was a major change in roosting behaviour in February.

Results

Strathallan

In Strathallan a few roosts were used very frequently and the remainder on a less regular basis (**Figure 2**). Use of the main roost by Pink-footed Geese varied from 88.7% of all the birds in the area in autumn to 93.1% in spring averaged over all winters, with 76.2% in autumn 1989 the minimum recorded (**Table 1**). Greylag were much less dependent on the main roost, usage falling from 73.7% in autumn to just 7.6% in spring (**Table 1**).

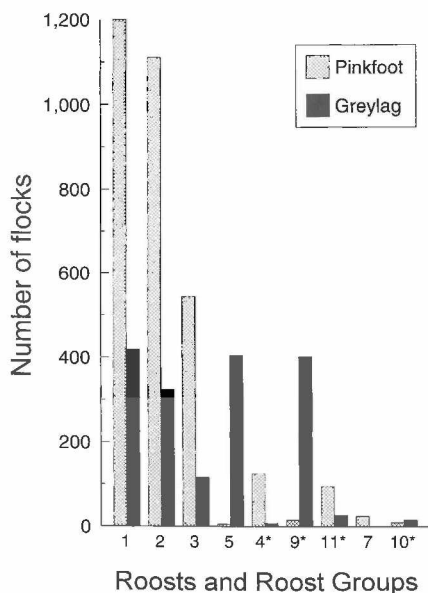


Table 1. The percentage of Pink-footed and Greylag Geese (individuals) using the main roost complex in Strathallan by season.

	Pinkfeet			Greylag		
	autumn	winter	spring	autumn	winter	spring
1987/88	100.0	97.7	99.3	96.1	43.9	29.8
1988/89	97.6	92.5	98.9	71.7	45.5	4.5
1989/90	76.2	95.6	96.8	76.9	67.5	5.9
1990/91	87.1	100.0	88.8	43.4	60.4	4.3
1991/92	77.4	74.0	94.1	65.7	53.6	10.0
1992/93	96.6	80.9	82.4	76.4	27.3	3.6
1993/94	96.7	89.1	88.6	100.0	82.3	5.6
overall (all years)	88.7	89.9	93.1	73.7	54.7	7.6
total geese	852,075	356,671	818,048	58,159	66,417	83,343
total flocks	947	705	1574	479	629	772

Autumn = Sep-Nov, winter = Dec-Jan, spring = Feb-May.

The main roost complex of three lochs (sites 1-3) was occupied by Pink-footed Geese throughout the winter, though the exact usage of the individual lochs varied both within and between winters. At different times each of the three lochs held all of the birds. The monthly frequency of usage of all the roosts by Pink-footed Geese for all winters combined is shown in **Table 2**. Greylag also roosted on all three lochs of the core complex, but the two species tended to keep apart at the roost with Greylag especially only using particular bays or stretches of shore. As the numbers of Greylag using the area decreased, they increasingly deserted the main roost complex in favour of a number of small pools (especially roost four) and by spring most (over 90%) roosted at other sites (**Tables 1 & 3**).

Pink-footed Geese roosting at roosts four and eight usually flighted south-west to feed along the river Allan or in the Forth valley, roost four being preferred in autumn and roost eight later in the winter when it became flooded (**Table 2**). Roosts six and seven also held large numbers of Pink-footed Geese at times (**Table**

2). Roost seven was situated at 340 m above sea level in hills to the south-east and was used by up to 7360 geese in three autumns (1989, 1990 and 1991) (**Table 2**). The nearest feeding areas were 3.5-4 km from this roost and involved a flight over hills of 450 m. Roost five was a regular roost for several hundred Greylag throughout the winter (**Table 3**). After cessation of shooting on 31 January, most Greylag in the valley roosted at four sites (roosts 9, 12, 13 & 15) along the river adjacent to the fields used for feeding at this time (**Table 3**). Temporary flood pools (roosts 11, 14 & 15) also provided roosts for both species, these becoming more important after the shooting season (**Table 3**). Roost ten, the most distant of the alternative roosts, was occupied occasionally by Pink-footed Geese (**Table 2**). When the two species roosted on the same water they usually flighted separately unless disturbed. Occasionally large mixed feeding flocks were found, especially in the earlier years of this study when Greylag were more numerous. The two species then flighted in mixed flocks at dusk.

Table 2. The number of flocks of Pink-footed Geese using different roosts in Strathallan, all winters combined. The direction and distance in km from a central location in the main roost complex (1-3) and the peak counts are also given.

Roost	Distance	Peak count	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Total
1	0	12,500	125	244	154	128	123	81	204	322	55	1,436
2	0	7,230	-	14	97	83	90	81	64	115	-	544
3	0	13,000	17	110	111	107	110	99	180	294	83	1,111
4	1.5 wsw	2,700	5	20	9	10	26	-	6	-	-	76
5	0.9 n	110	-	-	-	-	-	-	4	1	-	5
6	4.2 e	3,250	-	-	1	4	3	11	18	42	-	79
7	6.0 se	7,360	9	15	-	-	-	-	-	-	-	24
8	2.0 sw	1,100	-	3	6	-	9	21	10	-	-	49
9	4.0 sw	490	-	-	-	-	1	1	7	-	-	9
10	9.5 sw	2,500	-	-	-	-	-	-	1	-	-	1
11	4.0 ese	2,510	-	-	6	-	2	-	-	7	-	15
12	4.5 sw	20	-	-	-	-	4	-	-	-	-	4
13	6.7 sw	6	-	-	-	-	-	1	1	-	-	2
14	1.5 e	1,020	-	-	-	-	-	3	-	-	-	3
15	3.0 sw	750	-	-	-	-	5	-	-	-	-	5
All			156	406	384	332	373	298	496	781	138	3,363

Table 3. The number of flocks of Greylag Geese using different roosts in Strathallan, all winters combined. The direction and distance in km from a central location in the main roost complex (1-3) and the peak counts are also given.

Roost	Distance	Peak count	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Total
1	0	1,200	3	93	103	102	54	36	18	9	-	418
2	0	1,500	-	3	35	41	17	14	4	2	-	116
3	0	1,025	1	25	90	64	114	21	3	6	-	3
4	1.5 wsw	186	-	4	2	1	-	-	-	-	-	7
5	0.9 n	750	-	31	57	55	82	52	72	55	-	404
6	4.2 e	234	-	1	28	24	42	20	39	29	-	183
7	6.0 se	-	-	-	-	-	-	-	-	-	-	0
8	2.0 sw	-	-	-	-	-	-	-	-	-	-	0
9	4.0 sw	200	-	-	-	-	3	1	39	19	-	62
10	9.5 sw	-	-	-	-	-	-	-	-	-	-	0
11	4.0 ese	145	-	-	3	-	7	-	-	3	-	13
12	4.5 sw	2,195	-	-	-	-	13	52	109	54	2	230
13	6.7 sw	640	-	-	-	-	-	17	61	32	-	110
14	1.5 e	115	-	-	-	-	2	-	-	-	-	2
15	3.0 sw	390	-	-	-	-	8	5	-	-	-	13
All			4	157	318	287	342	218	345	209	2	1,882

Strathearn

Roost selection in Strathearn showed a similar pattern to that in Strathallan. Pink-footed Geese from Dupplin Loch (roost 40) sometimes used alternative floodwater sites, (roosts 41 and 42) when available in late winter and early spring, with up to 37% roosting away from the main site in spring (Tables 4 & 5). One of these sites (41) was disturbed by shooting regularly and therefore used only from February onwards, even though it was usually flooded before then. The pools equidistant between Dupplin and Drummond Lochs (roosts 25-28), were not used by Pink-footed Geese during this study.

Greylag used up to eight alternative sites in Strathearn from November onwards (Table 6) giving a progressively lower proportion of birds at roost 20 through the winter (Table 4). By spring (February to April) only 17.0-31.9% of the birds used the main roost over the three winters (Table 4). Since 1990 we have identified another two sites (7 km West-North-West and 6.5 km East-North-East of roost 20) which have been used fairly regularly.

Roost selection

During hard frosts the waterfowl using roosts one to three maintained some open water on which geese could roost. However, goose droppings on the ice indicated that many

roosted on the ice also, although they were then vulnerable to predation by foxes *Vulpes vulpes*, which were common. It is not known if a period of prolonged frost would have caused geese to desert the area since none of the winters during this study were severe. Pink-footed Geese at roost six were vulnerable to foxes and several corpses were noted there. In spite of this, the site was used regularly. In very stormy weather (force seven or greater) Pink-footed Geese preferred to roost on the shore or on adjacent fields rather than on the water. They may also have stayed out on the feeding areas on such nights, as was noted in north-east Scotland (M.V. Bell *pers. obs.*).

The waters used as roosts showed very varied characters, including the main sites (roosts 1, 2, 3, 20 & 40) (Table 7). Most sites had mainly open shorelines with some walk-out grazing and some shelter. However, one of the main roosts (40) was completely enclosed by mature trees and had no adjacent grazing. Shooting occurred on up to two dates in autumn each year at roosts one to three. Out of nine occasions after shooting, the numbers of Pink-footed Geese in the valley fell substantially on four and were unchanged on five. On four of the nine occasions the roosting pattern changed, with several thousand birds moving to alternative roosts, mainly roosts four and seven, leaving total numbers feeding in the valley unchanged on two of these occasions. The shoots occurred before the Greylag had arrived

Table 4. The percentage of Pink-footed and Greylag Geese (individuals) using the main roosts in Strathearn by season.

	Pinkfoot			Greylag		
	Autumn	Winter	Spring	Autumn	Winter	Spring
1987/88	100.0	100.0	75.9	90.1	53.7	17.0
1988/89	100.0	92.6	99.7	99.9	86.7	23.3
1989/90	100.0	91.8	63.2	62.3	36.4	31.9
all years	100.0	93.5	80.3	82.6	63.5	24.1
total birds	303,867	88,338	153,684	58,310	75,758	90,498
total flocks	269	189	316	167	294	398

Autumn = Sep-Nov, winter = Dec-Jan, spring =Feb-Apr.

Table 5. The number of flocks of Pink-footed Geese using different roosts in Strathearn for winters 1987-88 to 1989-90 combined.
The direction and distance (km) of sites from the main roost (40) and peak counts are given.

Roost	Distance	Peak count	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
40	0	40,000	32	134	102	79	93	61	104	99	704
41	6.9 wnw	3,520	-	-	-	-	-	27	15	-	42
42	4.6 ese	1,460	-	-	-	-	5	6	-	-	11
All			32	134	102	79	98	94	119	99	757

Table 6. The number of flocks of Greylag Geese using different roosts in Strathearn, 1987-88 to 1989-90 winters combined.
The direction and distance (km) of sites from the main roost (20) and the peak counts are given.

Roost	Distance	Peak count	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
20	0	6,400	38	89	71	87	30	37	30	382
21	2.0 wnw	800	-	6	-	7	9	11	2	35
22	1.9 wsw	355	-	-	-	-	7	3	1	11
25	10.8 ene	290	-	-	-	-	6	15	5	26
26	9.2 ese	2,230	-	-	-	17	21	41	27	106
27	8.0 e	850	-	-	-	3	12	10	-	25
28	10.8 ese	1,760	-	18	25	39	12	1	-	95
29	14.0 e	1,210	-	-	-	1	2	4	-	7
40	17.7 e	1,450	4	6	1	2	-	-	-	13
All			42	120	97	156	99	122	65	701

Table 7. The characteristics of water bodies used as roosts by Geese in Strathallan and Strathearn. A = open shoreline, B = 'walk-out' grazing, C = reeds, D = mature trees on shoreline, E = shelter, F = shooting, + symbols are defined below.

Roost	Water	Area (ha)	A	B	C	D	E	F
1	permanent	21.1	+	+	+		+	+
2	permanent	11.7	++	+++			+	+
3	permanent	8.7	++	+++			+	+
4	permanent	3.0			++	+++	+++	
5	permanent	0.5	+	+		+	++	
6	permanent	1.0				+	++	+
7	permanent	70	+++	+			+	
8	floodwater	0.03	+++	+++				
9	river		+	++			++	++
10	permanent	5.0	++				+	
11	floodwater	<2	+++	+++				
12	river		+	++			++	++
13	river		+	++			++	++
14	floodwater	<0.1	+++	+++				
15	floodwater	<1	+++	+++				
20	permanent	34.5		++	+	++	+++	+
21	permanent	7.4	+	++	++	+	+++	+
22	permanent	1.1	+				+	
25	floodwater	<0.5	+++	+++			+	+
26	semi-permanent	<0.1	+++	++			+	+
27	floodwater	<3	++	++		+	++	+
28	permanent	4.0			+	++	+	++
29	floodwater	<5	+++	+++			+	++
40	permanent	26.3			++	+++	+++	
41	floodwater	<25	+++	+++			+	+++
42	floodwater	<5	+++	+++			+	+

The areas of floodwater were estimates of the maximum extent of flooding in a normal winter. Other features were classified as follows, eg for open shoreline +++ indicates completely open with no shoreline cover apart from a few rushes and sedges, ++ approximately two-thirds open, + one-third open and no symbol indicates totally enclosed by tall vegetation. Shelter includes an assessment of the exposure of the site as well as shelter by the surrounding vegetation, no symbol indicating very exposed and +++ very sheltered. For shooting +++ indicates shooting at least weekly, ++ shooting monthly, + shooting once or twice a winter and no symbol indicates no shooting.

in any numbers and consequently their roosting behaviour was unaffected. Shooting on two farms East-South-East of and adjacent to the main roost may also have encouraged Pink-footed Geese to use roost seven and thus avoid overflying these farms to reach feeding areas. In Strathearn there was no shooting at roost 40 and only occasional shooting at roost 20. There was some shooting at all but one (roost 22) of the minor sites (Table 7).

Discussion

This study located more roosts than were previously recorded in the area by Newton *et al.* (1973), perhaps associated with population increase, and we gained some understanding of the factors governing their usage. In Strathallan we were able to examine roosting behaviour throughout the winter over seven winters and identified a minimum of 12 alternative roost sites. This is likely to be an underestimate of the true situation since the recording method of assigning the roost to the site from which the majority of birds in a feeding flock came, biases the data towards the roosts holding the most birds. We probably also missed a few birds which roosted on small floodwater pools. However, we believe these factors are unlikely to account for an error of more than a few percent in the figures for usage of the main roost by season. A smaller data set for Strathearn confirmed the findings in Strathallan even though the two valleys were rather different in nature with respect to agricultural cropping regime and the distribution of minor roosts within the feeding range.

Both species were prepared to use waters much smaller than the main roosts, probably in order to be closer to the feeding sites. The major roosts were the largest lowland waterbodies in the study area and therefore offered the greatest security. There was little or no shooting at these sites. In all other respects they were different with roosts one to three open and exposed, roost 20 sheltered and largely surrounded by mature mixed woodland, and roost 40 sheltered by mature mixed woodland and reedbeds along much of the shore. Most of the minor sites were reasonably

open with varying degrees of shelter and little or no non-shooting disturbance from people. Most sites offered grazing along the water's edge and/or an uninterrupted walk into grassland.

The only alternative sites noted by Newton *et al.* (1973) in Strathallan were roost seven, used by under 500 of both species, and another pond (not used during this study) used by fewer than 500 Greylag. Roost seven is now much more important for Pink-footed Geese in some autumns but we did not record Greylag there. In Strathearn, roost 21 and three floodwater sites along the lower Earn were used by Greylag and no alternatives were recorded for the Pink-footed Geese from Dupplin Loch (Newton *et al.* 1973). One of these river sites has since been abandoned associated with regular disturbance from shooting.

In Strathallan all but roosts four and seven seem much less secure to the human observer, while two of the others (five & six) and roost four are more sheltered from the prevailing South-West wind. As the numbers of Greylag decreased they increasingly abandoned the main lochs and roost five has become almost as important as the main roost complex. A similar dispersal has occurred in Strathearn, but there all the minor roosts seem considerably less secure than roost 20. There does not seem to have been any change at roosts one to three and 20 to cause such a change and indeed there is less goose shooting at roosts one to three now than 15 years earlier. Disturbance from shooting appeared to be the major determinant of occupancy of the minor roosts. In Strathallan the only minor roosts regularly disturbed by shooting were those down the river (9, 12 & 13) and the nearby floodwater (roost 15), the latter site only being flooded after exceptionally heavy rain. The three river sites were used extensively by Greylag after the end of January when wildfowling ceased, with occupancy by 16 flocks in December and January versus 279 flocks in February and March. At roost eight, which was disturbed by shooting on adjacent ground, occupancy by Pink-footed Geese was nine flocks in December and January versus 31 flocks in February and March. In Strathearn small pools and floodwater were used

extensively from February onwards though most were available before then. Occupancy of roosts 25-29 by Greylag increased from 85 flocks in December and January to 124 flocks in February and March. Roost 41 was made untenable for geese and other waterfowl by regular shooting before 31 January, with no flocks recorded in December and January versus 42 in February and March. Both species became much less wary once shooting ceased and may therefore accept less secure roost sites in the spring. In north-east Scotland large numbers of Pink-footed Geese switched from roosting on an inland loch to a nearby estuary at the end of the shooting season on the estuary each spring (Bell *et al.* 1988). The use of small waters was limited by frost and the recent run of mild winters may have encouraged desertion of the main roosts in their favour. In colder winters, such as 1990-91 and 1993-94, the smaller pools in Strathallan were frozen for several weeks and had lower occupancy.

The minor roosts tended to be used by only one of the two species. Thus in Strathallan roost four was predominantly Pink-footed Geese (76 vs 7 flocks), roost five predominantly Greylag (404 vs 5 flocks), roosts seven and eight only Pink-footed Geese, roost nine predominantly Greylag (62 vs 9 flocks), as were roosts 12 (230 vs 4 flocks) and roost 13 (110 vs 2 flocks), while roosts six, 11, 14 and 15 held both species but only roost six was used regularly. In Strathearn the feeding areas of the two species were better separated (Bell & Newton, 1995) and the minor roosts were not shared during the 1987-88 to 1989-90 winters, though roost 41 has been used by Greylag since. A lack of marked birds prevented us from documenting how individual birds used the available roosts. This is a topic worthy of more attention since Giroux (1991) showed that a small sample of radio-tagged Pink-footed Geese in north-east Scotland changed roost on average once every ten nights. Our observations also suggested a considerable turnover of Pink-footed Geese throughout the winter.

Attempts at comprehensive counts of Pink-footed and Greylag Geese in mid-winter or spring, based on the autumn roost sites, have

found far fewer birds than the counts of the previous autumn (Salmon, 1988, 1989, Kirby & Shimmings, 1990, Stenhouse, 1994). Typically c. 65% of the Pink-footed Geese found in autumn were located in counts conducted between mid-March and mid-April in 1988, 1989 and 1990 but only 37% were found in 1994. For Greylag the figures varied from 34% to 77%. A mid-winter count in 1994 was rather more successful for Pink-footed Geese, locating 72%, but less so for Greylag (42%) (Stenhouse, 1994). These additional counts later in the winter were intended to determine the distribution of both species at that time, and especially to identify large concentrations of birds, rather than to census the population. One interpretation of the low counts in winter and spring, is that large numbers of geese are using parts of Britain not covered by a count network based on autumn roosts. The shortfalls in the national totals of Greylag, especially, are similar to the proportion of Greylag we found roosting on minor sites in Strathallan and Strathearn. We therefore believe that most, if not all, of the missing birds were probably somewhere within the known feeding ranges from the main autumn roosts, but using satellite roosts not covered by the count network. The mid-winter and spring national counts may therefore have considerably underestimated the importance of some areas and missed major concentrations of geese. Given that we recorded up to 1,100 Pink-footed Geese roosting on 300 m² of floodwater (roost eight, Strathallan) and regularly recorded densities of 1,000 roosting geese/ha it is easy to miss large numbers of birds. The apparently recent tendency for geese to roost away from the main roosts makes monitoring the population a time consuming business, dependent upon reasonable weather, extensive local knowledge and a larger network of counters than is presently available in many areas.

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