

# Feeding behaviour of wintering Pink-footed and Greylag Geese in north-east Scotland

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## Introduction

The recent status of wintering Pink-footed Geese *Anser brachyrhynchus* and Greylag Geese *Anser anser* in north-east Scotland has been described by Bell *et al.* (1988). The Loch of Strathbeg and the Slains Lochs (Meikle, Cotehill and Sand) are the traditional goose roosts in Aberdeenshire and have been occupied by both species for many years. Pink-footed Geese have increased at these two traditional sites, especially at Loch of Strathbeg, while Greylag Geese in contrast have, since 1965, occupied five new roosts at Loch of Skene, the Dinnet Lochs (Davan and Kinord), Haddo House Lake, Fedderate Reservoir and Corby Loch. By the mid-1980s north-east Scotland held up to 40,000 Pink-footed and 30,000 Greylag Geese and had become one of the most important wintering areas in Britain for both species. Since the roosts in north-east Scotland are well separated (Bell *et al.* 1988), there is little overlap between feeding areas round the respective roosts and thus Greylag Geese have been able to utilise a much larger feeding area. Earlier studies in east-central Scotland found the Pink-footed Geese ranged further from the roost than Greylag Geese (Newton and Campbell 1973; Newton *et al.* 1973). This study found the opposite to be the case in north-east Scotland. The feeding areas used by geese from the various roosts and the feeding preferences of both species between the 1983–84 and 1985–86 winters are described here.

The parts of north-east Scotland utilised by geese are mainly low-lying, fertile and intensively farmed, though the Dee valley is rather well wooded and has fewer suitable feeding areas for geese. Barley is grown up to 350 m (1,100 ft) above sea level in mid-Donside. The open undulating nature of much of the Aberdeenshire farmland, combined with a good network of minor roads, greatly facilitated the locating of feeding flocks of geese.

## Methods

Feeding areas were located by observing flight lines of geese arriving at and departing

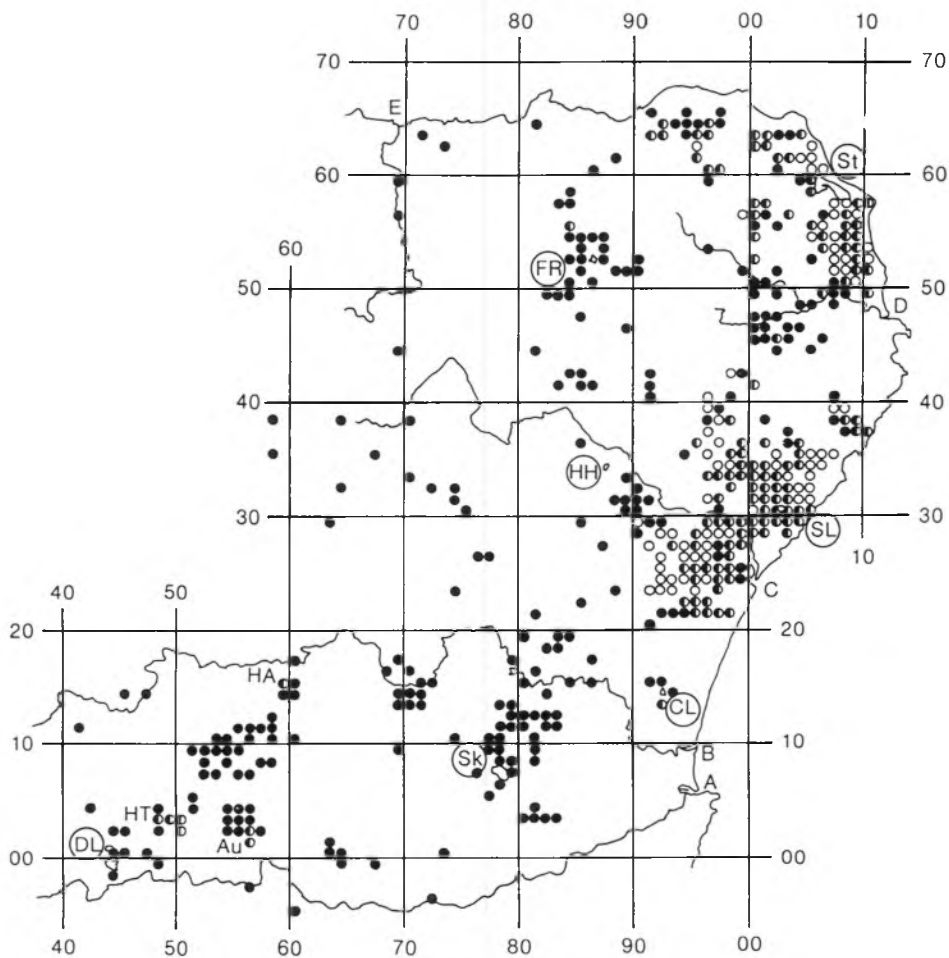
from the roosts. Farmland was also searched systematically for feeding flocks of geese. All the ground out to 2 to 3 km beyond the maximum recorded range of geese from each roost was checked at some stage and it is thought that all suitable areas (i.e. arable farmland) were visited at least once. Seven 10 km squares lying between gridlines 20 and 60 north and between 60 and 80 east in the west-centre of the study area (see Figure 1) were the least well covered with only 2–7 visits each. The feeding areas used by geese from the various roosts were visited for at least 3 hours on the following number of occasions between the 1977–78 and 1985–86 winters: Slains Lochs 123, Loch of Strathbeg 72, Dinnet Lochs 57, Loch of Skene 31, Fedderate Reservoir 12 and Haddo House Lake 11. Corby Loch was visited on 31 occasions, but feeding areas more than 2 km from the Loch were never checked systematically because of the small numbers of geese using the site and the problems of overlap with birds from other roosts.

Emphasis was placed on different areas in different winters, thus most of the work undertaken in the Haddo House area was between 1981–82 and 1983–84 winters when especially large numbers of Greylag Geese were present there. The Slains and Dinnet areas were searched most thoroughly since the geese at Slains fed relatively close to the roost, while those from the Dinnet Lochs fed in a rather confined area. The geese from the Skene, Haddo House and Strathbeg roosts ranged over larger areas and so information on feeding areas and the distances of feeding flocks from the roosts could be biased towards those birds closest to the roost at these sites. All statements regarding geese feeding at a site from a roost which was not the closest were based on observations of flight lines and of geese arriving at or leaving these sites. Otherwise all flocks were assumed to use the closest roost. The large distances (15–34 km) between roosts in north-east Scotland greatly facilitated such assumptions. At most sites it was impractical to attempt complete counts of geese on the feeding areas though this could be done satisfactorily on Deeside in spring up to and including

1985 as the Greylag Geese there were then concentrated in just a few areas. Complete counts of geese in the fields were also attempted at Slains/Ythan in the spring between 1978 and 1983. Statistical analyses of foraging distance were carried out using chi-squared on the number of flocks feeding at 2 km intervals from the roosts.

In the 1983–84 to 1985–86 winters a record was kept of the position of all flocks as well as the field type to assess feeding preferences. Feeding flocks were marked on 1:50,000 scale maps and the distance to

the roost measured to the nearest 500 m. No attempt was made to distinguish wheat, barley or oats stubble (grouped as stubble), or between winter wheat and winter barley (grouped as winter cereals), or between spring sown wheat, barley or oats (grouped as spring cereals). Spring cereals were rarely undersown with grass in Aberdeenshire during this period. Where such fields became apparent from late autumn onwards they were classed as grass, but these accounted for only about 2% of all observations on stubble.



**Figure 1.** A map of north-east Scotland showing the feeding areas of geese from all the roosts. One-km squares in which feeding flocks of geese were recorded between the 1977–78 and 1985–86 winters are shown: ○ Pinkfeet, ● Greylag, ◐ both species. The lines represent the 10 km grid system. Key to sites mentioned in text. Roosts (encircled) – CL = Corby Loch, DL = Dinnet Lochs, FR = Fedderate Reservoir, HH = Haddo House Lake, Sk = Loch of Skene, SL = Slains Lochs, St = Loch of Strathbeg. Rivers – A = Dee, B = Don, C = Ythan, D = Ugie, E = Deveron. Other localities – Au = Auchlossan, HA = Howe of Alford, HT = Howe of Tarland.

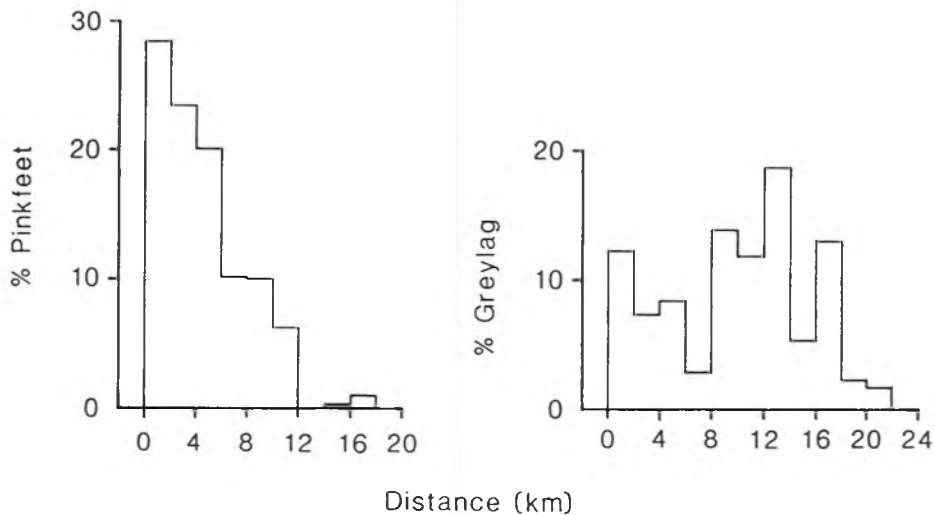
## Results

### 1. Feeding Areas

Figure 1 shows the one-km squares in which feeding flocks of Pink-footed and Greylag Geese were recorded in north-east Scotland between 1977 and 1986. The feeding areas were clustered round roosts for both species at Loch of Strathbeg (St) and at the Slains Lochs (SL); and round roosts for Greylag Geese at the Dinnet Lochs (DL), Loch of Skene (Sk), Corby Loch (CL), Haddo House Lake (HH) and Fedderate Reservoir (FR). At Strathbeg, Slains and Fedderate the geese spread out fairly evenly from the roosts, while at Haddo House the main feeding area was to the north-west, at Skene between the north and north-west and at

Dinnet between north and east, the last flock being confined by moorland to the south and west.

The foraging distances of the two species from all the roosts in north-east Scotland in the 1983–84 to 1985–86 winters are shown in Figure 2. For Pink-footed Geese, 82.1% were found within 8 km of the roost (median 4.0 km), whereas for Greylag Geese 68.0% were found between 8 and 22 km of the roost (median 10.7 km) ( $X^2$  for 10df = 83.64). Foraging distances in autumn (Sep–Nov) were slightly greater than in mid-winter (Dec–Feb) or spring (Mar–Apr) but the difference was only significant for Greylag Geese (Table 1). There were differences in foraging behaviour between roosts which are highlighted in the following account.



**Figure 2.** The proportions of Pink-footed and Greylag Geese foraging with distance from all roosts in north-east Scotland. Sample sizes were 353 flocks totalling 335,850 Pink-footed Geese and 253 flocks totalling 106,900 Greylag Geese, using pooled data from the Strathbeg, Slains, Skene and Dinnet roosts.

#### a) Northern (Buchan)

The feeding areas used by the two species in Buchan are shown in Figure 1. The distribution follows that of arable farmland and is patchy because of the presence of areas of heathland and moorland. The two species were usually fairly well segregated, and in the 41 one-km squares where both species were recorded they were not necessarily present at the same time. When the two species fed in the same field they usually

formed discrete flocks. The two species were recorded in 70 one-km squares within 10 km of the roost. It was estimated that within this radius there were another 26 one-km squares having more than half their area suitable for geese, from which these were absent. There were many more potentially suitable areas, particularly to the south and south-west of the river south Ugie, and westward along the coast of the Moray Firth. At Loch of Strathbeg 87.5% of the Pink-footed Geese fed within 8 km of

**Table 1.** Variation of foraging distance of Pink-footed and Greylag Geese with month for the sample shown in Figure 2. Differences for Pink-footed Geese are not significant, but for Greylag Geese Sep–Nov versus Dec–Feb and Sep–Nov versus Mar–Apr,  $X^2$  for 10df = 23.14 and 38.83 respectively.

	Median distance (km)	
	Pink-footed Geese	Greylag Geese
Sep–Nov	4.0	12.3
Dec–Feb	3.7	10.0
Mar–Apr	3.6	5.7

the roost and 84.4% of the Greylag Geese between 8 and 18 km of the roost, the median distances of the feeding birds being 3.9 km and 10.4 km respectively ( $X^2$  for 8df = 61.02). Up to the 1985–86 winter Pink-footed Geese from Strathbeg were not recorded further than 14 km from the roost. However, the huge numbers present in autumn 1985 (up to 27,900) were certainly feeding beyond the usual areas as searches there on several occasions found relatively few birds.

Greylag Geese were recorded as far out as 35 km to the west in the late 1970s and there were undoubtedly more feeding sites along the north coast than indicated in Figure 1. This area was possibly more important in the late 1970s when rather larger numbers of Greylag Geese were present at Strathbeg in autumn than in the last few seasons (Bell *et al.* 1988). None were recorded further out than 17 km in the 1983–84 to 1985–86 winters. It was unclear whether the flock of one to two thousand Greylag Geese regularly feeding by the River Deveron in the 1984–85 winter were roosting locally or came from Strathbeg. However, Greylag Geese were found to be roosting on the lower Deveron in the 1986–87 winter so the former seems more likely. Those from Fedderate Reservoir appeared to feed within 4 km of the roost, while at some sites just beyond, the birds were definitely from Strathbeg or Haddo House.

#### *b) Central (Ythan Valley)*

Most of the land around the Ythan was suitable for feeding geese. Up to 10 km from the Slains Lochs geese were recorded in 106 one-km squares and were absent from 47 apparently suitable squares, while between 10 and 15 km out they were present

in a further 38 one-km squares and absent in 75. This area was very thoroughly covered and it is not clear why so many sites which appeared suitable to the human observer were apparently not utilised. The total area available within 15 km of the roost was estimated to be about 260 km<sup>2</sup>.

At Slains there was not a significant difference in foraging distance between the two species. Complete field counts in the spring between 1978 and 1983 gave median distances of 4.2 km for Pink-footed and 2.4 km for Greylag Geese ( $X^2$  for 7df = 8.73, ns). This value of 4.2 km for Pink-footed Geese agrees very well with that of 4.1 km determined from the less systematic data obtained in the 1983–84 to 1985–86 winters. However, the Greylag Geese in these three seasons showed a significant increase in feeding range to 5.8 km ( $X^2$  for 7df = 23.87). This was because many Greylag Geese in the latter period were feeding out at a considerable distance between north-east and north-west in mid-winter, when the largest numbers were present. In the 1983–84 winter some Greylag Geese were feeding 16 km out to the north-west in an area only 6 to 7 km from the roost at Haddo House. The distribution of Greylag Geese at Slains therefore showed two peaks at 0–2 km and 8–12 km from the roost in the 1983–84 to 1985–86 winters. In the spring Greylag Geese roosting on the Ythan estuary often fed out to the south-west where there appeared to be some overlap with those from Corby Loch to the south. Because of this uncertainty these birds were not included in the calculations of distances of feeding flocks.

Preferences for certain areas sometimes changed between winters, but certain fields, or groups of fields, appeared to be favoured year after year. The change to a winter cereal regime (Bell *et al.* 1988) may have caused the birds to range further from the roost. Up until the mid-1970s many geese remained to feed on the Slains estate throughout the winter, but subsequently many favoured fields carried winter cereals or, more recently, oilseed rape, and were abandoned. In the late 1970s the maximum distance that Pink-footed Geese were recorded from the roost was 10 km, but this was unusual. The maximum distance by the mid-1980s was 14 km and the geese regularly fed at least 10 km out. The smaller numbers of Greylag Geese also generally fed much further out in the 1980s than 10

years earlier. In the mid-1970s the entire flock often fed on potato fields on the Slains estate, within 2 or 3 km of the roost, for weeks at a time. Fields containing waste potatoes were usually ploughed by December in the 1980s. The two species formed separate flocks when present in the same field, as did those from Strathbeg.

Most of the Greylag Geese from Haddo House fed out to the west and especially the north-west, while much smaller numbers regularly fed to the east and south-east and only very occasionally small numbers arrived at dusk from the north, north-east and south-west (Figure 1). There was much suitable ground in all directions. The map showing feeding areas is very far from complete for the birds from Haddo House. The geese from here were found as far out as 31 km which gave a potential overlap of feeding areas with birds from all the other roosts, except those from Dinnet Lochs. All searches of feeding areas here were carried out from mid-November onwards and so sites closer to the roost which could have been used earlier in the autumn were probably not recorded. In view of this, no data from the Haddo House roost were included in the analysis of foraging distances. The Greylag Geese from this roost were found in only 30 of the one-km squares within 20 km of the roost. Within the same radius there were another 254 suitable one-km squares in the general direction of the main feeding flight, with many more again to the north-east and south-west. This roost had the largest potential feeding area of any in north-east Scotland, but was largely deserted by the 1985-86 winter (Bell *et al.* 1988).

#### *c) Southern (Donside and Deeside)*

Most of the geese roosting at Loch of Skene flew out towards the Don valley to the north to feed (Figure 1) though up to 1,500 birds used fields to the south-east especially in the spring. The farmland round Skene contained more woodland and shelter belts than on the coast or in Buchan, consequently the distribution of feeding areas was rather more broken. At times the geese flew out considerable distances. The Howe of Alford 19 km to the west-north-west was used regularly by most of the geese from Loch of Skene for a few weeks in autumn 1981 but not much since, though Greylag Geese from the roost at the Dinnet Lochs

used this area in the mid-1980s. Atkinson-Willes (1963) stated that Pink-footed Geese were believed to use the Howe of Alford. No mention of the time of year was made but observations during this study suggested that both species use the area in the spring.

In the autumn of 1982 there was a regular flight for several weeks from Loch of Skene to the Wells of Ythan area (37 km to the north-north-west) where about 5,000 geese were feeding. Many of these came from the roost at Haddo House which was nearer (27 km to the east), but about 1,500 were flying to and from Loch of Skene. The Greylag Geese from Skene also fed out to the north of the lower Don valley where there was potential overlap with geese from Haddo House and from Corby Loch. It was not clear how much day-to-day interchange there was of geese using feeding areas with such alternative roost sites.

The median distance for feeding Greylag Geese from Loch of Skene was 5.8 km. The geese from Skene were found feeding in 42 one-km squares within 10 km of the roost but were not recorded in another 27 apparently suitable squares. Between 10 and 20 km from the roost the corresponding figures were 23 and 80 one-km squares, though 30 of the latter were closer to other roosts. Undoubtedly many more sites north of the Don valley were used as large numbers of geese flighted into this area at times.

In recent winters when large numbers were present, Greylag Geese from Corby Loch flighted out to the north, and to the lower Don valley. There was potential overlap with those from other roosts in both these areas. There were several apparently suitable areas to the north and east which were much closer but which never attracted geese.

At the Dinnet Lochs all the main feeding areas were a considerable distance away, and most birds in autumn were feeding between 10 and 22 km out (82.8% between 10 and 18 km, median distance 14.2 km). In the mid-1970s, when the Dinnet roost was first occupied, the Howe of Tarland some 5 km to the north-east was used in autumn. This area was unable to support the large numbers of more recent winters and was mainly used in the spring by the early 1980s. The Greylag Geese extended their feeding range over the arable farmland to the north-east and by the mid-1980s several hundred birds regularly fed on the Howe of Alford

some 20 km away. There was a regular feeding flight of several thousands north into Donside for a few weeks in autumn 1983 but only small numbers were recorded there since. In November 1985 large numbers flighted east down the valley to feed on south Deeside but the precise feeding sites were not identified before snow moved them on. The Greylag Geese from Dinnet were recorded feeding in 60 one-km squares. Within 20 km of the roost there were only another 43 apparently suitable squares, 5 on Deeside, 15 to the north-east and 23 to the north. The very large flock of Greylag Geese at Dinnet (up to 19,900 birds) were thus concentrated in rather a small area and the change to winter cereals which was occurring there in the mid-1980s will lead to increasing conflict with the local farmers.

Much smaller numbers of Greylag Geese occurred on Deeside in the spring than in autumn. They favoured two main areas, Auchlossan and the Howe of Tarland, and for three or four weeks from mid-March the grazing pressure in these rather small areas was considerable. In spring 1986 several flocks were found well out to the north-east for the first time, indicating an expansion of the spring feeding range in response to the larger spring numbers which occurred that year. Small numbers of Pink-footed Geese also occurred at Auchlossan and the Howe of Tarland in spring (Bell *et al.* 1988).

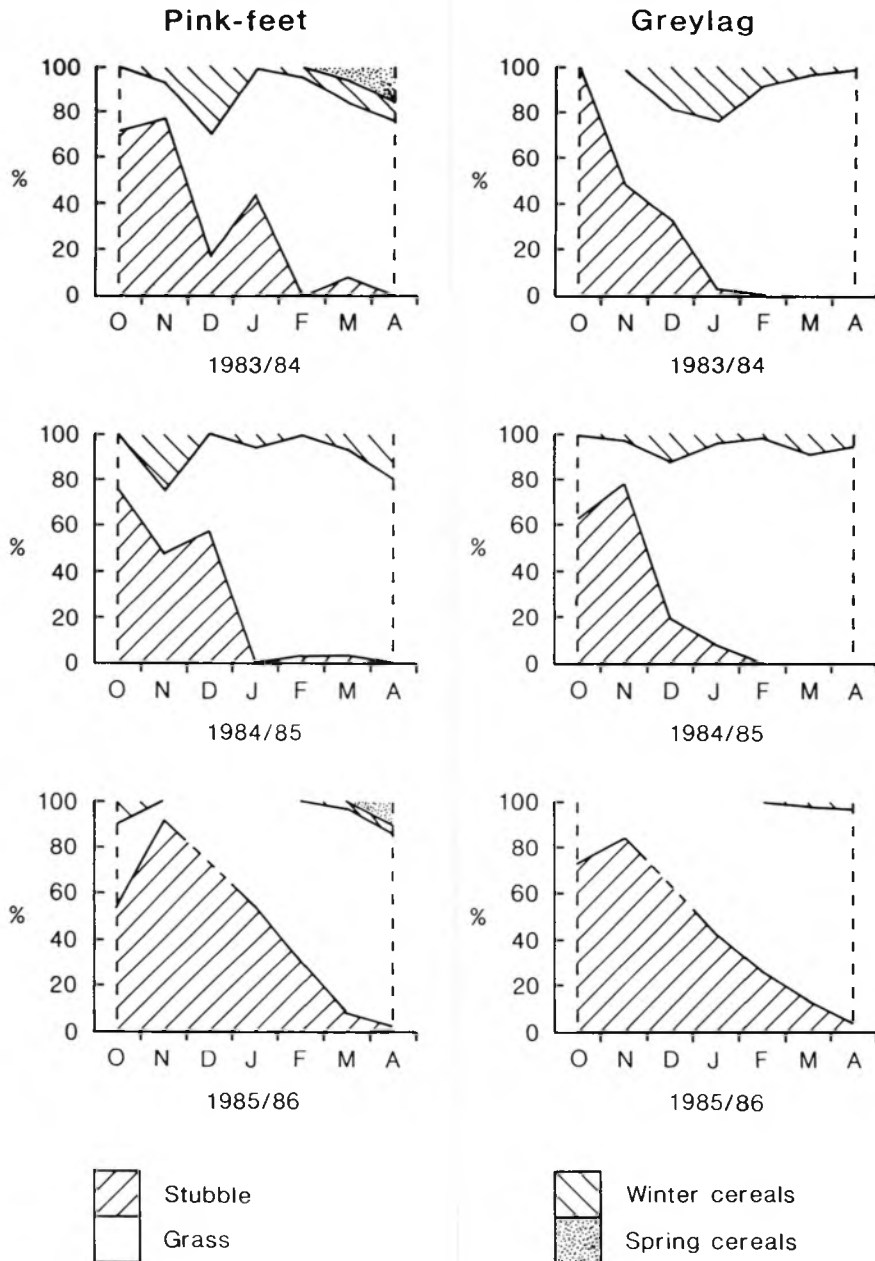
### *Feeding Preferences*

Table 2 shows pooled data on the feeding preferences of the two species from all the roosts in Aberdeenshire for the 1983–84 to 1985–86 winters. There were insufficient data, particularly in mid-winter, from the different sites to show any differences in field usage between sites. At the Slains Lochs and Loch of Strathbeg both species showed very similar usage of field type.

However, some differences were apparent between the three winters using pooled data from all the sites (Figure 3). The proportion of Pink-footed Geese on stubble in the 1985–86 winter after the late and dirty harvest was higher than in the previous winters, 91% in November 1985 compared with 77% and 48% in November 1983 and 1984 respectively, but these differences were not significant because of the small number of flocks involved. They remained on stubble much later into the winter than usual with 34% of Pinkfeet on stubble in January/February compared with 14% in 1984 and 1.8% in 1985. (Using pooled data for January and February, testing number of flocks on stubble versus other field types,  $X^2 = 6.81$  and 15.44 respectively for 1984 versus 1986 and 1985 versus 1986.) Greylag Geese showed a similar effect with very low numbers on stubble in January, February and March 1985, but in 1986 the figures were 42%, 25% and 14% respectively.

**Table 2.** The feeding preferences of geese in Aberdeenshire over the 1983–84, 1984–85 and 1985–86 winters are shown as a percentage of the number of geese on each field type in each month. The total number of flocks and total number of geese observed are also shown.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
<b>a) Pink-footed Geese</b>							
No. of flocks	44	33	30	30	78	120	104
No. of geese ( $\times 10^{-3}$ )	68.2	39.3	21.5	22.2	60.3	90.3	78.8
% stubble	62.4	69.3	33.7	23.4	12.5	6.2	0.5
% grass	31.4	17.9	48.6	68.0	82.7	86.4	79.7
% winter cereals	4.6	12.8	17.7	2.5	1.0	5.5	11.1
% spring cereals	0	0	0	0	0	1.4	8.7
% potatoes	1.6	0	0	6.1	0.7	0	0
% turnips	0	0	0	0	3.1	0.5	0
<b>b) Greylag Geese</b>							
No. of flocks	19	77	33	32	41	119	51
No. of geese ( $\times 10^{-3}$ )	14.2	51.1	9.8	8.1	12.7	36.3	10.0
% stubble	77.4	75.2	32.0	20.4	5.7	7.1	2.1
% grass	22.5	24.5	49.0	73.3	90.2	88.3	94.9
% winter cereals	0.1	0.3	18.5	4.4	3.4	4.1	3.0
% spring cereals	0	0	0	0	0	0	0
% potatoes	0	0	0.5	0.9	0.7	0	0
% turnips	0	0	0	0	0	0.5	0



**Figure 3.** The feeding preferences of Pink-footed and Greylag Geese in north-east Scotland during the 1983-84, 1984-85 and 1985-86 winters. Data for December 1985 were extrapolated from the November and January values because snow moved most geese out of the area.

(Using pooled data January to March, numbers of flocks on stubble versus other field types  $X^2 = 5.21$  for 1985 versus 1986.) The amount of feeding on winter cereals varied inversely with the amount of stubble, thus in both the 1983-84 and 1984-85

winters there was appreciable feeding by both Pinkfeet and Greylag on winter cereals, while in the 1985-86 winter very few flocks were seen on such fields. Feeding on newly sown spring cereals was only recorded for Pink-footed Geese since most

of the Greylag Geese had departed before spring cereals were planted, from mid-April onwards. In some years appreciable numbers of Pink-footed Geese went on to the newly sown fields, e.g. 16% in April 1984 and 10% in April 1986. However, it was not clear how much seed or young shoots were actually consumed as the geese frequently used such fields for loafing, day-roosting or dust-bathing. Small numbers of geese fed on potato fields after the crop was lifted and also on turnip fields after sheep had been in or the crop had been lifted. On one occasion Greylag Geese were recorded grazing turnip leaves during heavy snow. The remainder of the feeding was on grass. This was of major importance, with over 90% of both Pinkfeet and Greylag found on grass from January onwards in 1984 and 1985.

The proportions of the different crop types around the main goose roosts in north-east Scotland are shown in Table 3. The changes which have occurred since 1960 have been detailed in Bell *et al.* (1988). Unfortunately the proportions of autumn and spring sown cereals were not recorded in the agricultural statistics prior to 1985. Subjective impressions are that very few winter cereals were grown in the north-east before 1980 but since then the proportion

has risen sharply and by the mid-1980s accounted for 30–50% of cereals around Strathbeg and for 50–75% in the Ythan valley, but with much lower proportions on Donside and Deeside. Winter cereals first appeared around Dinnet in the autumn of 1985. Winter wheat has also begun to replace barley in Buchan.

In most parishes only 1–2% of the crop area was under potatoes. Most of these were seed potatoes or early potatoes and again subjective impressions were that the potato harvest was perhaps a month or more earlier in the mid-1980s than ten years earlier. Many potato fields were ploughed back and resown with cereals before the winter in the mid-1980s. Use of potato fields by geese was therefore very low compared to 5 or 10 years earlier. The amount of oilseed rape grown has greatly increased since 1984. Most of the remainder of the crop area was turnips used for stock feeding. Three flocks of Pinkfeet and two of Greylag were recorded on turnips in the three winters under study while no geese were recorded on rape fields, though the flock of Mute Swans at the Ythan estuary regularly fed on a rape field adjacent to the estuary in the 1985–86 winter.

**Table 3.** Percentages of different crop types in 1984 around the roosts at Loch of Strathbeg, the Slains Lochs, Haddo House Lake, Loch of Skene and the Dinnet Lochs. Grass is ley pasture and excludes rough grass, remainder mainly turnips for stock feeding. Crop statistics were obtained from the Scottish Records Office for selected parishes close to each roost.

Roost	Wheat	Barley	Oats	% cultivated area		Grass	Remainder
				Potatoes	Rape		
Strathbeg	5.6	33.6	1.4	2.1	0	53.3	4.0
Slains	8.1	37.9	0.3	1.1	0	48.4	4.2
Haddo	8.2	37.7	2.2	2.6	1.2	44.8	3.3
Skene	2.3	33.1	0.8	1.9	0.2	57.2	4.5
Dinnet	0.8	26.8	1.0	0.7	0.1	64.4	6.3

## Discussion

The division of feeding areas between Pink-footed and Greylag Geese in north-east Scotland from 1977–86 was completely different to that found in east-central Scotland in the late 1960s. There Pink-footed Geese foraged further from the roost than did Greylag Geese (Newton and Campbell 1973; Newton *et al.* 1973), and on the basis of that study it is generally stated (e.g. Owen 1980; Thom 1986) that this is the norm in Britain. In north-east Scotland the opposite was found.

At the Slains Lochs, where Pink-footed Geese usually outnumbered Greylag Geese by five-to ten-fold, the situation was rather confused. Between 1978 and 1983 a series of complete field counts found median distances of 4.2 km for Pink-footed Geese and 2.4 km for Greylag Geese. However, over the 1983–84 to 1985–86 winters the latter showed a significant increase to a median distance of 5.8 km. They appeared to feed at greater distances than Pink-footed Geese only when relatively large numbers were present in mid-winter.

At the only other roost in the area which



held both species, the Loch of Strathbeg, the situation was clearcut. In the 1983–84 to 1985–86 winters 87.5% of the observed Pink-footed Geese were feeding within 8 km of the roost, whereas 84.4% of the Greylag Geese were feeding between 8 and 18 km of the roost. The pattern of one-km squares occupied by the two species also showed areas favoured by one or other species and emphasised this difference. There was some evidence in the autumn of 1985 that the Pinkfeet at Strathbeg were expanding their feeding range in response to the four-fold increase in numbers (Bell *et al.* 1988).

The Greylag Geese at the other roosts also ranged further than the Pink-footed Geese at Slains and Strathbeg. Greylag Geese from Haddo House Lake foraged over a vast area apparently ignoring many suitable areas near the roost. Those from Loch of Skene flighted out great distances at times, but the farmland here was rather more broken by woodland than on the coast. The Dinnet roost was very unusual in that there were no suitable feeding areas close by and in the 1983–85 autumns when over 10,000 Greylag Geese were present 82.8% were feeding between 10 and 18 km from the roost. Feeding flights of over 20 km were recorded fairly regularly for Greylag Geese from the Dinnet Lochs, Loch of Skene, Haddo House Lake and Loch of Strathbeg.

The reasons for such differences in foraging behaviour between the two species in different parts of their wintering ranges are unclear. In Aberdeenshire several thousand Pink-footed Geese were present at both the main roosts in autumn in the 1930s when there were only small numbers of Greylag Geese (Berry 1939). Pink-footed Geese were therefore able to establish themselves on the best feeding areas. However, since both Strathbeg and Slains have held much larger numbers of geese since then it seems unlikely that competition between the species could have limited feeding areas close to the roost for Greylag Geese.

In east-central Scotland there are many more waters available as roost sites than in Aberdeenshire (Newton *et al.* 1973), particularly for Greylag Geese which will use smaller, more enclosed roosts than the more wary Pink-footed Geese. Here it is possible that Greylag Geese, spread over many roosts, are able to use farmland close

to the roost, while Pink-footed Geese, concentrated on the larger, less disturbed roosts, have to spread further afield. Preliminary observations in Perthshire in the 1986–87 winter showed that Pink-footed Geese still ranged further than Greylag Geese in this area. However, foraging behaviour at Loch Leven has changed totally from the pattern described by Newton and Campbell (1973) and both species now commute much further than in the early 1970s (personal observations). The distances travelled depend on many factors including inter-roost distances, numbers of geese using the roost, location of feeding areas relative to the roost, and the quality of feeding available. The large increase in both populations, changes in the farming regime and disturbance of certain feeding areas may have contributed to rapid changes in foraging behaviour by both species over the last two decades. Foraging patterns seem likely to be the result of local conditions at individual roosts rather than any inherent behavioural differences between the two species in their ability to commute long distances, although the different sensitivities of the two species to disturbance at the roost may be a predisposing factor. The Greylag Goose roosts at Strathbeg, Haddo House, Skene and Dinnet were some of the largest in Britain in recent years, and this may have been a factor in determining foraging distance.

The feeding patterns observed in north-east Scotland in the mid-1980s were somewhat different to those found for Pink-footed and Greylag Geese at Loch Leven in the 1968–69 and 1969–70 winters (Newton and Campbell 1973) and for Pink-footed Geese in Lancashire from 1977–78 to 1980–81 (Forshaw 1983). In the Loch Leven study autumn stubbles and grass in the New Year were also the most important food sources but grass made up a slightly smaller proportion (30–45%) of field type than in north-east Scotland. Potatoes were much more important (7–11% of field type in autumn) and accounted for up to 50% of feeding sites for both species in some months (Newton and Campbell 1973). In Lancashire potato fields were also important, comprising up to 16.9% of feeding sites. Waste carrots were also an important food source there (Forshaw 1983). In both these studies the proportion of feeding occurring on stubbles and grass at the appropriate seasons was lower than that found in the 1983–84 to

1985–86 winters in north-east Scotland. The area of grass available in the spring in north-east Scotland was probably the main reason for the large numbers of geese using the area at this season (Bell *et al.* 1988).

The potential conflicts between wintering geese and agriculture are well known and have been discussed many times elsewhere (see Owen 1980). Here only those aspects relevant to the situation in north-east Scotland are discussed. Over the last 30 years there were several changes in the farming regime of major importance to the geese wintering in the area. The change from oats to barley in the 1960s was previously suggested by Kear (1965) as a major factor in the establishment of a larger wintering population of Pinkfeet in east and central Scotland and the change in status of both Pink-footed and Greylag Geese in north-east Scotland supports that conclusion (Bell *et al.* 1988). However, all the more recent changes tended to reduce the availability of food sources and lead to increasing conflict with the farming community. The major change to winter cereals has led to a reduction in autumn stubbles, previously the most important food source early in the winter, and then to problems when the geese later moved on to the newly sown fields. The earlier harvesting of potatoes and the increasing use of oilseed rape have also reduced the available food supply. In Aberdeenshire winter cereals sown late in the autumn (late October and November) only grow a few centimetres before being checked by cold weather and are then at an ideal length for goose grazing. In fields planted from mid-August to late September

the shoots are usually over 10 cm long and safe from goose grazing by late autumn. The geese present in March and April compete with farm livestock for the first bite of spring grass and on some farms favoured by geese this competition is severe. However, fields containing any type of scaring device were extremely unusual in north-east Scotland and up to 1986 very few licences were issued by the Department of Agriculture and Fisheries for Scotland to enable geese to be shot outside the season in support of scaring measures.

Much apparently suitable ground was unused by geese while certain fields or groups of fields were favoured year after year. A summary of the numbers of one-km squares in which feeding flocks of geese were recorded and an estimate of suitable one-km squares where geese were not observed is shown in Table 4. For most of the roosts about a third of the available ground was not apparently utilised. At Dinnet a further 13 suitable squares to the north of Donside were rarely used, possibly because a flight over hills 400–600 m high was involved. The only feeding areas actually on a nature reserve were a few fields owned by the RSPB at Strathbeg. Those farmers who tolerated geese on their fields and provided secure areas when the birds were disturbed elsewhere ensured the presence of large numbers of geese in a generally hostile environment. It is hoped that such an enlightened outlook continues and that the wintering populations of geese are adaptable enough to withstand future changes on the feeding areas and at the roosts.

**Table 4.** A summary of the foraging ranges used by geese from the four main roosts in north-east Scotland. The number of one-km squares within a 10 km radius only of the roosts are shown because there were overlaps at greater distances. For the Dinnet Lochs squares within a radius of 20 km are shown since these birds regularly foraged to that distance.

Roost	Species	Median foraging distance (km)	One-km squares used	One-km squares not used
Strathbeg	Pinkfeet	3.9	54	42
	Greylag	10.4	47	49
	both species	—	70	26
Slains	Pinkfeet	4.1	97	56
	Greylag	5.8	75	78
	both species	—	106	47
Skene	Greylag	5.8	42	27
Dinnet	Greylag	14.2	60	30

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### Summary

The feeding areas used by Pink-footed and Greylag Geese in north-east Scotland between the 1977–78 and 1985–86 winters are described together with their feeding preferences over the

latter three winters. At all sites the former fed closer to the roosts than the latter, median distances being 4.0 km and 10.7 km respectively. This difference was most marked at Loch of Strathbeg where large numbers of each species occurred and where 87.5% of Pink-footed Geese fed within 8 km of the roost, whereas 84.4% of Greylag Geese fed between 8 and 18 km of the roost. Greylag tended to forage further in autumn than during the remainder of the winter.

In autumn cereal stubbles were the preferred field type, with the geese progressively moving on to grass later in the winter. The proportion of geese feeding on stubbles and winter cereals was inversely related depending on the timing of the harvest, subsequent ploughing and resowing. The monthly pattern of field usages were similar in the 1983–84 and 1984–85 winters but stubble was utilised for much longer after the late and dirty harvest of autumn 1985. Waste potatoes, turnips and spring cereals were minor food sources.

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