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Editor: Anne-Marie Smout
Assisted by: Professor D. Jenkins, Dr J.B. Nelson and Professor P.J.B. Slater
Business Editor: The Secretary, S.O.C., 21 Regent Terrace, Edinburgh EH7 5BT
(tel. 0131-556 6042).

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The status of the Eider on the Isle of May and other Forth Islands.

J. CALLADINE, M.P. HARRIS, S. TAYLOR & S. WANLESS

Eiders have bred on the islands in the Firth of Forth for centuries, for instance in the early 17th century they were said to be among the commonest birds found on the Isle of May (Rintoul & Baxter 1935). In recent years, counts of nests on those Forth Islands managed as nature reserves (Isle of May, Inchmickery and Fidra) have suggested a marked increase. This paper documents the past and current breeding status of the species on the Forth islands, including a systematic survey in 1994. Many Eiders used to breed on the Fife mainland; up to 1800 were thought to nest in the Tentsmuir and St Andrews areas in the early 1970s (Smout 1986). Very few breed there now (Fife Bird Reports), suggesting a possible shift in the breeding population.

Introduction.

Amongst the Forth islands, the largest concentration of Eider *Somateria mollissima* nests has always been on the Isle of May, yet very few young other than those recently hatched are ever seen on or around the island. The number of well grown, approaching fledging, young seen per year varies from 0-15 despite there being up to 1000 nests (Isle of May wardens' reports). Over many years a small number of females with young have been seen leaving the north end of the Isle of May. In addition, fishermen and other boat users reported occasional groups of ducklings crossing the eight kilometres of open water between the island and adjacent Fife coast. In 1994, we attempted to establish whether Isle of May ducklings reached the Fife coast and determine roughly the extent of that dispersal.

Methods

Past nest counts come from published and unpublished sources. In 1994 all the Forth islands (except the Bass Rock) were systematically searched for Eider nests during the last week of May. The timing and methodology were consistent with annual counts on the nature reserves. Where appropriate, the islands were divided into sections, each section being covered by a team of four or five counters walking transects 3-4m apart and eventually covering the entire section. A few areas were missed because of inaccessibility or to prevent disturbance to other breeding birds.

On the Isle of May, prior to the counts in 1983-1994, a random sample of nests (usually 100) were marked with short, unobtrusive canes. During the count each nest found was

recorded as either marked or unmarked. The proportion of marked nests found was used as a measure of nest finding efficiency. For example, if 85 of the 100 marked nests were found it was assumed that 85% of all nests on the island were found. The actual nest court was accordingly corrected to give a more accurate estimate of the actual number of nests. A similar accuracy check and correction was not possible on the other islands, so these counts are probably serious underestimates of the true breeding population.

Between 20 May and 15 June 1994, 120 incubating female Eider on the Isle of May were marked (under licence) with 4cm-long pieces of electricians' tape on the back of the head. The tags were attached using a three metre cane to avoid a close approach to the birds and adhered to feathers with superglue. Only birds which were not excessively agitated at the approach of the marking cane were tagged. No birds deserted as a result of marking.

From early June to mid-July (after the main hatching period), the adjacent Fife mainland coast from St Andrews to Lower Largo was systematically searched by S T. In addition, the coast from St Andrews to Tayport, and from Lower Largo to Kirkcaldy was less intensively search (Table 1). For ease of observation, and hence efficiency, most searches were made within two hours either side of high tide. All Eiders, including ducklings, were recorded and the females checked for tags.

Table 1. ***Dates of searches of the Fife coast for Eiders, 1994.***

Date		Area searched
June	1	St. Andrews - Eden Estuary
	4	Kinkeil Braes
	8	Crail - Cellardyke
	9	St. Monance - Elie
	10	Earlshall
	12	St. Monance
	16	Crail
	17	Kingsbarns - Fife Ness
	22	Methill - Ruddons Point
	25	Ruddons Point - Earslferry
	25	Elie - Crail
	27	Crail - St. Andrews
	28	St. Andrews - Eden Estuary
	29	Guardbridge - Tayport
July	1	St. Monance - Elie
	2	St. Andrews - Kinkeil Braes
	4	Eden Estuary
	7	Crail - Anstruther
	9	Kirkcaldy - Lower Largo
	12	Ruddons Point
	12	Earlsferry - Elie
	15	St. Monance - Fifeness
	16	Eden Estuary

Results

A total of 2331 Eider nests were found on eight islands in 1994. Comparable counts are available for seven of those islands from 1987 (Table 2).

Table 2 ***Counts of Eider nests on Forth Islands 1987 and 1994.***

	1987	1994
Inchgarvie	no count	60
Inchcolm	128	258
Inchmickery	118	313
Inchkeith	187	323
The Lamb	3	6
Fidra	163	220
Craigleith	182	153
Isle of May	635	998
Total	1416+	2331

Note: Isle of May nest counts are corrected for nest finding efficiency (see methods)

1. Isle of May

As already mentioned, in the early 17th century Eiders were said to be common and were recorded through the 18th and 19th centuries (Rintoul & Baxter 1935). Persecution was apparently responsible for a decline in the late 19th century. For the first 60 years of the 20th century, the number of nests varied between 20-100, with perhaps an increase in the late 1950s (Eggeling 1960). In the 1960s and early 1970s, between 100-200 Eiders nested each year, followed by a marked increase from the mid-1970s, to the present. Since 1978, when systematic counts began, the number of nests has increased by an average of 8.5% per year (Fig. 1). The annual fluctuations of nest counts are not unexpected because most recruitment of Eiders into the breeding population is probably by birds hatched in a relatively few, particularly 'good' years (Mendenhall & Milne 1985). Also the proportion of adults with breeding experience nesting in any one year can be highly variable: 45%-100% has been recorded (Coulson 1984).

2. Inchkeith

Eiders nested in the 17th century (Rintoul & Baxter 1935), but then declined, disappeared, or perhaps simply went unrecorded for many years. A count of 18 nests in 1960 was then considered the highest ever (Smith 1974). Concurrent counts of ducklings (69 in 1962 and 75 in 1963) suggested many more actually nested. In 1969, 120 adult females, 60 young and an additional 20 nests with eggs were found (Smith 1974). A count of 187 nests was made in 1987 (Nature Conservancy Council). In 1994, 323 nests were counted, suggesting an increase at a similar rate to that which occurred on the Isle of May.

3. Inchmickery

Eider eggs were taken in the mid-1800s; a single nest was found in 1934, suggesting a decline in the late 19th and early 20th centuries (Rintoul & Baxter 1935). Up to 100 females nested in the 1970s and early 1980s, but there has been a marked and sustained increase (11.3% per year) since 1987 (Fig. 1).

4. Inchcolm

In common with some other Forth islands, Eiders bred in the 18th century and had either declined or disappeared by the late 19th century (Rintoul & Baxter 1935). Systematic counts found 128 nests in 1987 and 120 in 1988 (NCC counts). The population appears to have doubled since that time to 258 nests in 1994 (Table 2), equivalent to a similar rate of increase to that which occurred on Inchmickery.

Figure 1. ***Counts of Eider nests on the Isle of May, Inchmichery and Fidra, 1978-1994.***

Notes:
1) *Nest counts are plotted on a log. scale*
2) *Rate of increase on the Isle of May = 8.5% per annum (r^2 = 0.68)*
3) *Rate of increase on Inchmickery = 11.3% per anum (r^2 = 0.83)*
4) *Regression not significant for Fidra*

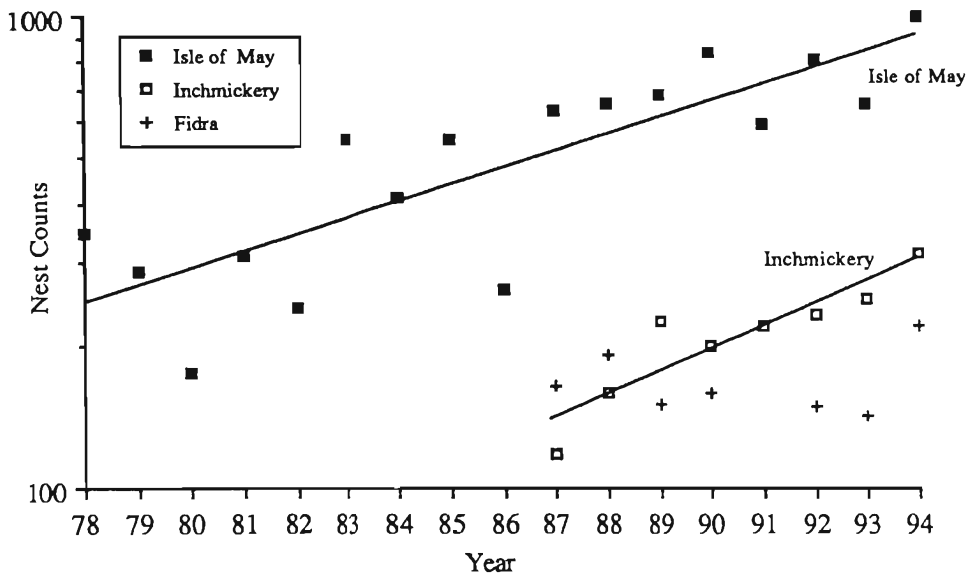

Table 3. ***Counts of Eider ducklings on mainland Fife coast.***

Area	Date	No. of ducklings
Eden Estuary	4 July	**7**
St. Andrews	1 June	7
	28 June	46
	2 July	**62**
	23 July	16
St. Andrews-Boarhills	8 June	9
	27 June	**55**
Boarhills-Kingsbarns	27 June	**29**
Kingsbarns-Cambo	17 June	**31**
	27 June	16
Cambo-Fife Ness	17 June	**31**
	27 June	16
	15 July	4
Fife Ness-Crail	15 July	**14**
Crail	8 June	**22**
	16 June	6
	7 July	2
	15 July	1
Crail-Cellardyke	8 June	**8**
	25 June	6
Cellardyke	8 June	14
	25 June	**16**
	7 July	13
	15 July	5
Cellardyke-Anstruther	12 June	**8**
	25 June	7
	15 July	2
Anstruther-Pittenweem	25 June	**5**
	15 July	3

Area	Date	No. of ducklings
Pittenweem-St. Monance	12 June	**4**
	15 July	3
St. Monance-Elie	25 June	**16**
	15 July	1
Elie-Earlsferry	8 June	4
	25 June	**7**
Earlsferry-Ruddons Point	13 June	11
	22 June	3
	25 June	**20**
Ruddons Point-Lundin Links	22 June	6
	25 June	16
	9 July	**36**
West Wemyss-East Wemyss	9 July	**5**
Isle of May	9 June	**69**
	17 June	15
	5 July	1
	20 July	5

Note: Maximum number of ducklings seen in each area is shown in bold.

5. Craigleith and Fidra

Eiders nested on these and neighbouring islands in the late 19th and early 20th centuries (Rintoul & Baxter 1935). In contrast to some other Forth islands, annual counts on Fidra between 1987-1994 suggested a stable population of between 142-220 nests (Fig. 1). Craigleith was the only island where the 1994 count was actually less than that in 1987, although the difference was relatively small (Table 2).

6. Post-hatching dispersal from the Isle of May

Eider ducklings were seen on the Isle of May and on the Fife coast from the Eden Estuary in the north to West Wemyss in the south (Table 3). A maximum of 445 ducklings were found within the area searched. Twenty-four tagged females were seen attending newly hatched young on and around the Isle of May between 24 May-20 June (casual observations only). Thirteen tagged females

Table 4. ***Sightings of tagged female Eiders on mainland Fife coast.***

Location	Distance from Isle of May (km)	Date	Number of tagged females	Number of untagged females in attendance	Number of ducklings being attended
St. Andrews	26	1-26/6	2	0	3
Cambo	16	17/6	1	5	25
Cellardyke	9	8/6	1	5	6
Cellardyke	9	25/6	1	2	3
Anstruther	9	12-25/6	2	0	5
St. Monance	13	12/6	1	3	4
Ardross	15	25/6	1	9	2
Elie	17	25/6	1	4	3
near Elie	17	25/6	1	0	1
Kincraig Point	20	13/6	1	1	11
Lower Largo	25	22/6	1	44	6

Note: Distances from the Isle of May are minimum distrances travelled assuming no overland crossings are made.

were seen off the Fife mainland coast, all attending young (Table 4). Female Eiders commence moulting their head and neck feathers in July (Cramp & Simmons 1977) so some marked females will have lost their tags before being seen away from the nest, through moult and also, no doubt, through inadequate adhesion of tags to feathers. The 13 birds seen therefore represented the absolute minimum number of the original 120 marked birds which potentially took ducklings to the mainland.

Discussion

Counts from the Isle of May and other islands in the Firth of Forth show an increase in the number of breeding Eiders in recent years. Between 1987-1994, the combined populations of the Isle of May, Fidra, Craigleith, Inchmickery, Inchcolm and The Lamb increased by about 62% (Table 1). The 1994 survey coincided with record counts from the regularly monitored islands. The combined total of 2331 nests for the Forth Islands represents 7% of a recent estimate of the British breeding population (Gibbons *et al.* 1993). The Isle of May alone held 3% of the British population, while Inchmickery's 313 nests (1% of the estimate) on just 1.1 hectares was no less impressive.

On the Isle of May, nest finding efficiency has averaged 78% over the past seven years. In addition, a small proportion of birds would not have commenced laying at the time of the count; on Coquet Island (Northumberland) 5% of females had not laid by 28 May (Coulson 1984) and some failed nests could have been overlooked. No doubt, therefore, the counts

of nests on the Forth islands were underestimates; probably near 3000 female Eiders nested in 1994.

On the Isle of May, the increase in nesting Eiders probably began shortly after the departure of the last dog in 1973 (following the evacuation of the lighthouse keepers' families in 1972) and coincided with a period of reduced breeding gull numbers, from 17,000 - 20,000 pairs in 1972 to about 3000 by 1986 (Isle of May wardens' reports). It has been implied that gulls are important predators of Eider ducklings (Munro & Bedard 1977, Mendenhall & Milne 1985). The effect however of such predation on the overall survival of ducklings and eventual recruitment into the breeding population is questionable (Swennen 1989). Swennen found that female Eiders were effective at defending ducklings from gull attacks and those ducklings that were taken did not react fast enough to alarm calls uttered by the females; it was suggested they could be unfit and unlikely to have survived to maturity anyway. This could be the case on the Isle of May and other Forth islands. The recent increases in the Eider populations of Inchkeith, Inchmickery and Inchcolm have coincided with substantial increases in their breeding gull numbers, suggesting the relative unimportance of gull predation. On Inchcolm, from 1987-1994 the combined population of Herring Gulls *Larus argentatus* and Lesser Black-backed Gulls *L. fuscus* increased by 86% to about 3300 nests (NCC/Scottish Natural Heritage counts), while on Inchmickery over the same period the increase was by 77% to 216 nests (Royal Society for the Protection of Birds counts). An 'animal sanctuary' including cats, dogs and a pig was kept on Inchkeith between 1987-1991. The effect of the animals on ground nesting birds, including Eiders, can only be presumed but it is perhaps not coincidental that Inchkeith's Eider population increased at a lesser rate than on neighbouring Inchcolm and Inchmickery during that period; the dogs and pig were seen to eat Eider eggs. Inchkeith holds large numbers of breeding gulls; a combined total of 7600 nests of Herring and Lesser Black-backed gulls were counted in 1994 (SNH). It would be interesting to monitor any changes in its Eider population, following the abandonment of the animal sanctuary, in the face of a large and increasing gull population (30% since 1987). A repeat census in a further five years should be made and might help to clarify the relative importance of the effects of ground predators and gull predation on Eider populations.

On the Isle of May monitoring of hatching success suggested that the island is a safe place for Eiders to nest; 70-95% of nests successfully hatched eggs in each of the years 1984-1994 (Isle of May wardens' reports). The paucity of records of well-grown ducklings around the island implies that there is insufficient accessible food (for ducklings, attendant females, or both) within its immediate vicinity to maintain the population which use the island as a safe nesting area. Observations of Isle of May tagged birds on the mainland Fife coast in 1994 (Table 3) suggested that a proportion of the breeding Eiders have to leave the island in order to rear young.

Exchange of ducklings and attendant females within Eider crèches is common (Swennen 1989) but many females manage to keep their own ducklings with their crèches (Bustnes & Erikstad 1991). Those female Eiders which attend and defend young tend also to be those which successfully hatched eggs, even if they initially abandoned their own broods and later attended a crèche (Bustnes & Erikstad 1991). It is reasonable to assume

that at least a proportion of those ducklings seen with Isle of May marked adults originated from the Isle of May. Considering the potential output of ducklings from the Isle of May (998 nests, each with 3-5 eggs of which over 70% hatch) and the mere handful of Eiders now suspected of nesting on the Fife mainland (*Fife Bird Reports*), most of the ducklings found between St Andrews and Lower Largo (the most distant sightings of marked adults) must come from the Isle of May. As some of the ducklings travelled at least 26 kilometres within 7-10 days of hatching (Table 4) including a minimum of eight kilometres of open sea, it could be possible for ducklings from the Isle of May to cross the 15 kilometres to the Lothian coast. Further work would be required to determine how many ducklings are successfully reared and where they are reared. In any case, it appears that duckling survival must be greater than was suspected from observations on the Isle of May itself.

Considering the national importance of the Firth of Forth's breeding Eiders, and those of the Isle of May in particular, any conservation management should consider their requirements. It is essential that the island is protected from ground predators, including even casual dogs or other animals. The impact of the increasing pressure from human visitors should also be assessed. Human disturbance, albeit usually inadvertent, leads to predation of both eggs and young by gulls (pers. obs.) and this is likely to occur irrespective of duckling fitness and hence individual fledging potential. The potential impact of spillages from the concentrated shipping in the Firth of Forth must also be considered. Certainly monitoring the Forth's breeding Eiders is desirable, but the wide dispersal of ducklings from sites such as the Isle of May increases the difficulty of measuring productivity.

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J. Calladine, Scottish Natural Heritage, 46 Crossgate, Cupar, Fife KY15 5HS
M.P. Harris, Institute of Terrestrial Ecology, Hill of Brathens, Banchory, Kincardineshire AB31 4BY
S. Taylor, 7 Moir Crescent, St Andrews, Fife KY16 8XN
S. Wanless, Institute of Terrestrial Ecology, Hill of Brathens, Kincardineshire AB31 4BY

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Lek habitats of Capercaillie at Abernethy Forest, Strathspey

R. W. SUMMERS, R. PROCTOR & S. I. H. SHAH

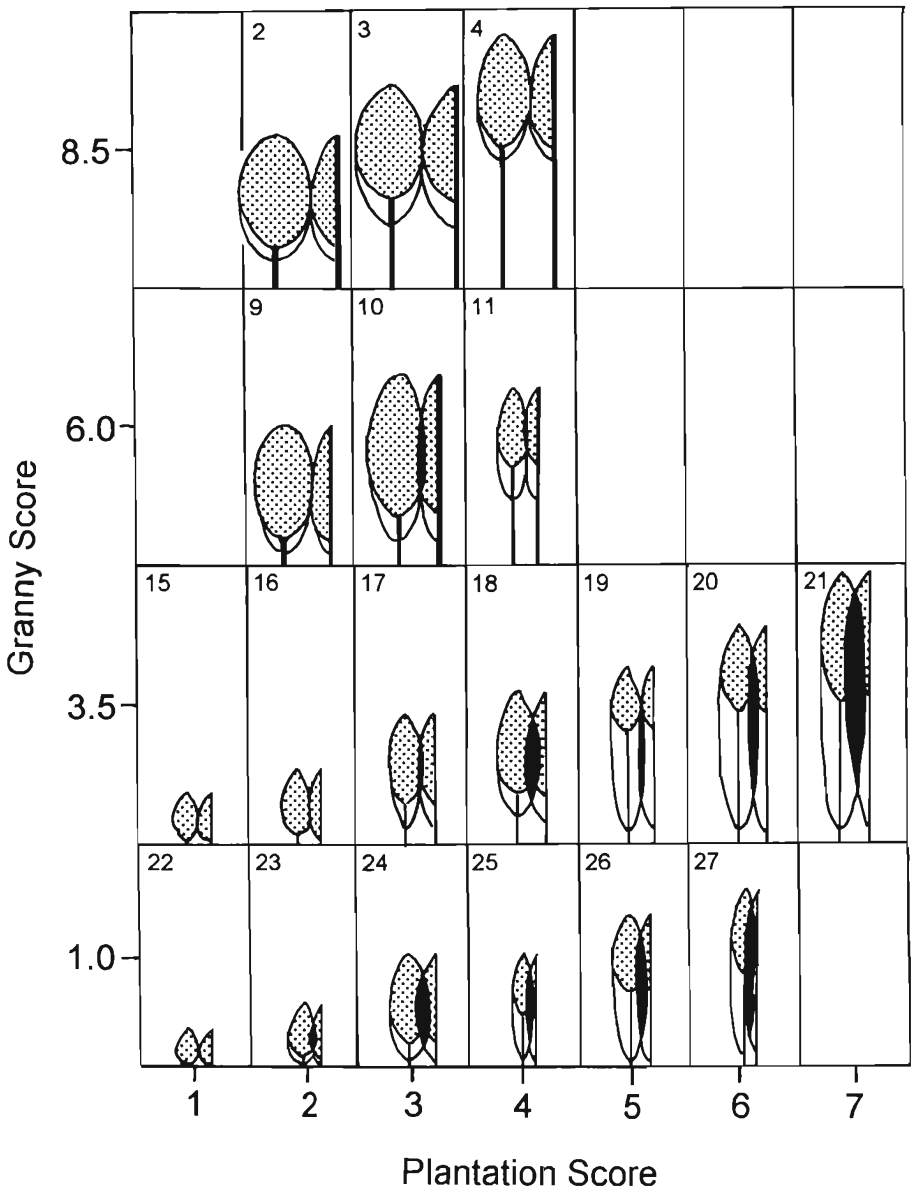
The habitat around 26 stances at five Capercaillie leks at Abernethy Forest in 1993 was described. Leks occurred in old open semi-natural pinewood and an old plantation (60 years old). Stances were on slopes, ridges and flat ground, and for those on slopes, aspects were generally northerly. The tree density at Abernethy Forest was lower than at leks in Scandinavia and Estonia. The field layer around the stances was dominated by tall heather and Vaccinium, though the stances themselves had short vegetation. Two of the leks were close to tracks so, in the future, human disturbance may pose a problem.

Introduction

The Capercaillie *Tetrao urogallus* is a Red Data bird in Britain because of its localised distribution and recent decline in population size (Batten *et al.* 1990, Gibbons *et al.* 1993). Male Capercaillie display collectively at traditional sites called leks. A lek is normally used by several males, each of which displays primarily on a few square metres of ground (its stance). Hjorth (1982) has likened the lek stance of each male to the innermost small portion of a wedge-like home range extending outwards. This is known as the 'piece of cake' model.

Lek sites in Scandinavia are often in old woodland on elevated areas in forests where the under story is open and visibility is more than 30m (Hjorth 1985, Rolstad & Wegge 1987a). In Estonia, leks are mainly found in old pine forest on bogs with no undergrowth (Viht 1991). In a study in the Austrian Alps, Capercaillie preferred a south-south-east aspect for lekking, suggesting a preference for warmer hillsides in the early morning (Spitzer 1985). Given the preference for old forest and certain topographical features, it seems likely that leks will occur in only certain places, so that modern forestry is potentially deleterious if it changes the characteristics of these places. In Scandinavia it was found that moderate logging at lek sites was acceptable as long as tree density was not reduced below 500 trees per ha and clear cuts were not greater than 50m in diameter (Rolstad 1989). Large clearfells (greater than 20ha) and heavy thinning (leaving less that 400 trees per ha) reduced the numbers of birds using lek sites (Rolstad & Wegge 1989a), as did general fragmentation of the forest because the number of leks in an area depended on the size of patches of old forest (Rolstad & Wegge 1989b). The smallest occupied forest was c.50ha, and the number of leks increased with one lek added for each 2.5 - 3km^2 increase in forest size (Rolstad & Wegge 1987b). In Scotland, Picozzi *et al.* (1992) found that Capercaillie leks were also associated with old forests, which were often semi-natural. Despite this and other studies, habitat descriptions of leks have tended to be general. This study sets out to describe the habitat around stances at Capercaillie leks in Abernethy Forest, one of the largest pieces of semi-natural forest left in Scotland (Steven & Carlisle 1959, Bain & Bainbridge 1988).

Figure 1. ***Diagrammatic representations of trees within difference forest structure types, based on their "granny" and "plantation" scores. Stipple - canopy, black - canopy overlap with neighbours, white - dead branches. Semi-natural pinewood typically falls within types 2-10. Adapted from Picozzi*** **et. al. (1992).**



Study area and methods

Abernethy Forest (57°15'N, 3°40'W) covers about 30km^2 of the northern slopes of the Cairngorm Mountains and extends into Strathspey. Old semi-natural woodland comprises about two-thirds of the forest, the rest being plantations of different ages. Scots pine *Pinus sylvestris* is the dominant tree. The semi-natural forest has had selective felling, leaving clearings with some trees which act as seed sources for natural regeneration. However, because the red deer *Cervus elaphus* population has been high for about 100 years and deer browse young trees, there has been little regeneration in the woodland, leading to an old (greater than 100 years) open forest with a park-like appearance in some areas (Steven & Carlisle 1959, O'Sullivan 1973, Heard 1988).

In order to describe the woodland at the leks, we made the following measurements from the ten closest trees around each lek stance: the tree height, diameter at breast height (DBH) and canopy depth (percentage of the trunk that had foliage). The density of at least ten trees greater than 1m tall within a 4-25m radius of the stance was measured. The woodland structure in terms of two principal component scores (a 'granny' score and 'plantation' score) was described (Picozzi *et al.* 1992, Fig. 1). Increasing 'granny' scores indicate a tendency towards open semi-natural pinewood whilst increasing 'plantation' scores indicate a trend towards evenly-spaced dense woodland with no ground vegetation. Lek habitats were related to available habitats based on the areas of each woodland type, described in terms of their 'granny' and 'plantation' scores (Raistrick 1995). The field and ground layers of vegetation were assessed by pacing a grid, 5 x 10 paces, and recording the plant species at each step. Also, the heights of heather *Calluna vulgaris, Vaccinium myrtillus and V. vitis-idaea* were recorded using a sliding polystyrene disk (diameter 24cm and mass 30g) on a graduated stick whose end rested on the ground. The slopes and aspects of stances, and distances from stances to the nearest track or path were also measured. To determine whether Capercaillie select slopes with a particular aspect, systematic sampling of the whole forest was carried out to assess the availability of different aspects. Using 1:25,000 Ordnance Survey maps, the presence of a slope and its aspect was recorded at the intersections of a 0.5km grid. A similar procedure was adopted to determine whether birds tended to lek away from tracks which are a potential source of disturbance. The distances from the systematically chosen points to the nearest track were measured and related to distances between leks and tracks.

Results

Six leks were known at Abernethy Forest and habitat data were obtained from 26 stances at five of these. The average distance between the nearest leks was 1.9km (standard deviation 0.9km) and the lek density was one per 5km^2 of forest. The average distance between adjacent stances within a lek was 108m (S.D. 62m). Six of the stances were on ridges, 15 on slopes and five on flat ground. For 14 (93%) of those stances on slopes, the aspect was northerly (between NW and NE). Ninety-five of 196 systematic sample points throughout the forest were on slopes and 60% of them faced between NW and NE. Only 18% were between SE and SW. Thus, the preponderance of north-facing slopes in the forest can explain why most stances face north. The habitat at lek stances varied markedly between the five leks. The median tree density ranged from 140 - 790 trees per

TABLE 1. Habitat characteristics at lek stances of Capercaillie at Abernethy Forest. The number of stances at each lek is shown in brackets.

	Lek 1 Median	(n=10) Quartiles	Lek 2 Median	(n=6) Quartiles	Lek 3 Median	(n=2) Quartiles	Lek 4 Median	(n=4) Quartiles	Lek 5 Median	(n=4) Quartiles
Tree density (no. per ha)	790	490-1260	140	140-240	145	130-160	290	160-440	495	450-540
Tree height (m)	14	13-16	16	14-17	10	5-15	16	9-17	18	17-20
Tree diameter, DBH (cm)	26	25-36	39	33-58	34	12-57	37	17-47	47	41-51
Tree canopy (%)	66	55-75	70	50-75	77	73-80	64	54-75	39	31-56
Field layer										
Heather height (cm)	32	21-43	43	46-51	32	30-34	44	38-48	27	19-35
Vaccinium height (cm)	18	13-18	19	19-24	-	-	15	13-22	11	9-13
Heather cover (%)	15	0-34	29	16-34	63	50-76	52	32-75	27	0-61
Vaccinium cover (%)	35	22-40	34	12-44	7	2-12	15	4-28	30	24-60
Grass cover (%)	6	0-18	10	5-30	11	10-12	8	0-27	-	-
Ground layer										
Moss cover (%)	40	26-62	72	64-78	62	28-96	62	47-71	95	84-99
Needle cover (%)	55	38-70	24	22-36	36	0-72	28	14-37	1	0-13
Distance to track (m)	115	75-250	900	850-900	250	-	550	525-550	51	20-89

ha (Table 1). Median tree heights were 10 - 18m, and diameters at breast height 26 - 47cm. The canopy depth was related to tree density, with values up to 77% where tree density was low. The forest structure at stances, in terms of 'granny' and 'plantation' scores is shown in Table 2. Four leks (numbers 2-5) had stances with high 'granny' scores (forest types 2-10, Plate 1), whilst lek 1 was mainly in a 60 year-old plantation (Plate 2). One stance at lek 4 was amongst very young trees (low 'plantation' and 'granny' scores). The forest types at the leks generally reflected the main forest types found at Abernethy Forest, in that 46% of the stances were in 46% of the forest that was old and open (types 2-10), and 27% in 12% of the forest that was old plantation (type 11). However, stances tended not to occur in the young forest (types 15, 16 and 22). The field layer around the stances was dominated by either heather (15 - 63%) or *Vaccinium* (7 - 35%) (Table 1). The heather was taller (27 - 44cm) that the *Vaccinium* (11 - 19cm). The ground layer was composed primarily of moss (40 - 95%) or dead needles (1 - 55%). The vegetation at the stances themselves was composed of either needles, moss or very short *Vaccinium*, heather or *Empetrum nigrum*. The median vegetation height at the stances was 4.5cm (quartiles 2.6 - 6.4cm). Stances varied greatly in their distance from tracks, ranging from 51 - 900m (Table 1). The distances from the centre of each lek to tracks were 50, 170,

TABLE 2. The frequency with which lek stances occurred in different types of forest structure and the percentage area of these types in Abernethy Forest. See Fig. 1 for diagrams of the forest types.

Forest type	Lek number						Percentage
	1	2	3	4	5	All	area
2		1	1			2	7.4
3		4		1	1	6	18.6
4					1	1	11.8
9				1		1	2.6
10				1	1	2	5.1
11	5	1			1	7	12.0
15						0	5.6
16			1			1	8.1
17	1					1	11.3
18	3					3	0.9
19	1					1	0.4
22				1		1	8.4
Others						0	7.8

200, 300 and 700m. In comparison, the median distance that systematic points were from tracks was 200m (quartiles 50-300m) (Fig. 2). While the sample size for leks was too small for statistical comparison with the systematic distances, it does show that there was no tendency for leks to be situated well away from tracks.

Discussion

The average distance between leks at Abernethy Forest was similar to that in other parts of Scotland (2.1km) (Picozzi *et al.* 1992), in Scandinavia (2.0-2.1km) (Wegge & Rolstad 1986) and in Estonia (1.9-2.4km) (Viht 1991). In a review of the habitat requirements of Capercaillie in Scandinavia, Rolstad & Wegge (1989c) indicated how the habitat provided the birds' primary needs. The simplest explanation for their liking of old forests was through their requirements for food (primarily pine needles and blaeberry *Vaccinium myrtillus* leaves and berries) and ability to move through the forest (to stand on branches large enough to support their mass, and fly between trees). Thus, as male Capercaillie are sedentary and rarely move more that 400m from their lek (Gjerde & Wegge 1989), it is possible that the lek habitat is determined partly by the birds' basic requirements as well as the intrinsic qualities of the lek (Rolstad & Wegge 1987a). Capercaillie display in the trees around the stance as well as the stance itself so require strong horizontal branches to stand on. The old 'granny' trees at Abernethy Forest provide this. Old open forest also gives all-round visibility, which can be enhanced by displaying on a ridge (Rolstand & Wegge 1987a). At Abernethy Forest, we found features of leks

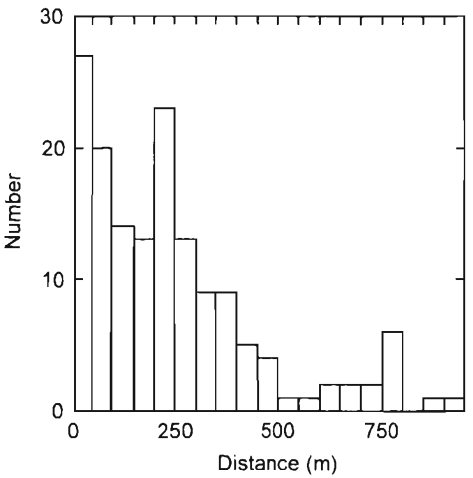
Plate 1. ***A lek stance (beside the large tree on the left) in old open forest with a high "granny" score.***

Plate 2. A lek stance (in the foreground) in old plantation.

which were dissimilar to leks elsewhere. Two of the leks occurred in park-like landscape where the tree densities were only 140 and 145 per ha. These tree densities were well below the acceptable densities (over 500 trees per ha) found in Norway (Rolstad 1989). Also, leks in Estonia usually occurred amongst trees at 600-700 per ha (Viht 1991). Spitzer (1985) noted that leks tended to have a SSE aspect in the Alps, suggesting that the birds benefited from the warmth of the morning sun. In contrast, the leks at Abernethy Forest tended to have a northerly aspect. Abernethy Forest is on the northern side of the Cairngorm Mountains so the majority of the slopes faced north. However, there are small hills in the forest which would allow Capercaillie to choose south-facing slopes. Perhaps it is more important to select warmer hillsides in the Alps where it is colder than Abernethy Forest at the times when Capercaillie display.

One lek in Abernethy is believed to have been recently abandoned (in 1979) due to human disturbance (S. Taylor pers. comm.). Thus, given the apparently shy nature of Capercaillie, it was surprising to find that there was no particular avoidance of tracks and one of the leks was close to a track well-used by vehicles, cyclists and pedestrians. However, the stances closest to the track are no longer used, suggesting that the lek has moved back from the track. As the Capercaillie population in Scotland is small (Batten *et al.* 1990), it is important that lek sites are protected, both from disturbance and from destruction through forestry. Unfortunately, the rarity of the bird and the attractiveness of its spectacular display leads bird-watchers to seek out Capercaillie in spring. This increasing pressure may lead to disruption of leks.

Figure 2. ***The frequency distribution of distances between systematic points and nearest tracks in Abernethy Forest.***



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R. W. Summers & R. Proctor, RSPB, Etive House, Beechwood Park, Inverness
S.I.H. Shah, D.F.O. Wildlife, Kakul Road, Abbottabad, Pakistan

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Nest reliefs and feeding rates of Merlins

R. C. DICKSON

This paper summarises observations on nest reliefs and feeding rate of Merlins in Galloway at three and six nests respectively between 1971-92. It shows that males did about a third of the daytime incubation. Food items brought were found to be less frequent in the pre-laying and incubation periods and greater when the young hatched and fledged; there was no difference in feeding rates between different periods of the day. Males provided most of the food throughout the greater part of the breeding cycle.

Introduction

During long-term studies of Merlins *Falco columbarius* in Galloway, the number of times males relieved incubating females were recorded at three ground nests in 1972-77. Between 1971-92, their feeding rates at six nests were also recorded from the pre-laying stage through to post-fledging and the results pooled from all nests (Table 1). One nest site was situated on a cliff face with newly planted conifer plantations below and open hill above; two were tree nests, 38kms apart, both at the edge of conifer plantations surrounded by open moorland; and three were at ground nests, 3-5kms apart, on heather slopes above the edge of conifer plantations. The breeding cycle was categorised into four stages: pre-laying; brooding; nestling and post-fledging.

Nest relief and behaviour

Both sexes incubated. In 46 hours observations from hidden positions at some distance, males (only blue-backed males were present at all nests) relieved females on 14 occasions (0.30 reliefs/hour). Trimble (1975) and Green (1977) recorded males spending up to two hours incubating but the longest relief in Galloway was 1.8 hours and the shortest 8+ min. (mean 40 min.). Five (36%) of the reliefs were after males brought prey to the sitting females and she fed while he incubated. In the other nine instances when reliefs were watched, females either preened, or once chased an unidentified passerine in the breeding area, once recovered cached prey, and once attacked two Carrion Crows *Corvus corone* until the male left incubation duties and took over the attack; the female immediately returned to the nest in a spectacular stoop.

On relieving incubating males, females soared, tail and wings spread, above nests on three occasions before dropping vertically in spectacular stoops to the nests. Conversely, males were only once seen to soar on being relieved; otherwise they either preened or flew away directly. On all occasions, however, nest relief was preceded by both sexes calling beforehand, usually from a perch.

In two all-night watches at the same nest site between 2030-0800hrs and 1915-0900hrs on 31 May/1 June 1972 and 1973 respectively, females incubated throughout, commencing at 2052 and 2155; the first and only relief by

Table 1. ***Feeding rates of Merlins in relation to the breeding cycle in Galloway, 1971-92.***

Period	No.food items brought	No.hrs observ.	No.prey Del./hr.	Periods of day (deliveries) Morning No.	(hrs)	Afternoon No.	(hrs)	Evening No.	(hrs)	
Pre-laying	12	47	0.26	7	(22)	4	(20.5)	1	(4.5)	(a)
Brooding	11	71	0.15	2	(23)	4	(21)	5	(27)	(b)
Nestling	37	69	0.54	7	(23)	18	(25)	12	(21)	(c)
Post fledge	39	79	0.49	7	(19)	11	(29)	21	(31)	(d)

Notes : (a) $x^2 = 0.56$, 1 d.f., N.S. (b) $x^2 = 0.94$, 2 d.f., N.S. (c) $x^2 - 3.88$, 2 d.f., N.S. (d) $x^2 = 3.50$, 2 d.f., N.S.

a male was at 0702 on 1 June 1973. However, Rowan (1921-22) found that a male incubated throughout one all-night observation which he stated could merely have been an individual idiosyncrasy.

Feeding rates

The total number of prey brought overall was 99 items during 266 hrs observations (0.37 deliveries/hour). However, the number of food items brought was nearly three times less in the pre-laying and brooding stages (0.19 deliveries/hour) than in the nestling and post-fledging stages (0.51 deliveries/hour). The total number of deliveries recorded overall in the pre-laying stage was 12 deliveries in 47 hours observations (0.26 deliveries/hour). Females largely stopped hunting in the pre-laying stage and became less active towards the egg-laying stage, possibly to avoid the risks involved in hunting then ('egg-laying lethargy' Newton 1979), and relied more on males to provide for them. Interestingly, though, prey deliveries were greater in the pre-laying (0.37 deliveries/hour) than in the egg-laying stage (0.20 deliveries/hour). This could be related to the requirements of females to put on body fat prior to the commencement of laying and/or that it may be essential to successful pair-bonding in that females could choose good male providers. In the brooding stage, when females were inactive, prey deliveries were reduced by nearly a half (0.15 deliveries/hour). The number of prey deliveries subsequently increased threefold in the nestling (0.54 deliveries/hour) and post-fledging (0.49 deliveries/hour) periods when the young probably needed large amounts of energy for growth and development (Table1). Thus there is a significant difference in feeding rates between stages with the highest occurring in the nestling and post-fledging periods (Chi-squared = 18.82, 3 d.f., $P<0.01$).

Males alone did most of the hunting and provisioning of food until late in the nestling period when they were eventually helped by females. Then the number of prey deliveries increased three times as much as males alone provided during the brooding period. This higher rate continued until the young left the breeding area, but males still contributed more deliveries than females in the ratio of 1.5.

Some of the older publications state that Merlins are fed at certain times of the day (Selous 1913, Taylor 1914). In this study, however, there were no significant differences in feeding rates in any of the separate stages of breeding cycle between periods of the day (Table 1).

Discussion

By noting which sex was flushed from nests in the wild during routine inspections in Northumbria and Newfoundland, Newton *et al.* (1978, 1986) and Temple (1972) concluded that male Merlins took a share of incubation. The findings in this paper agree with previous conclusions that males did about a third of the daytime incubation. Rowan heard no signals between sexes at changeover in Yorkshire and he considered that males left when so inclined and his mate then took over. No regular rituals preceded nest relief in Galloway either but both birds called before relief, probably indicating that they were ready to relieve and be relieved. Males brought prey

Table 2. ***Comparison of food deliveries at Merlin's nests in Galloway, Norway, Europe and Iceland.***

Period	Nos of prey deliveries/hour			
	Galloway	Norway (a)	Europe (b)	Iceland (c)
Pre-laying	0.26	-	-	-
Brooding	0.15	0.28	-	0.14
Nestling	0.54	0.38	0.64	-
Post fledging	0.49	0.46	-	-

Notes:
a) Data from Sperber & Sperber1963
b) Data from Chislett 1933; Macintyre 1947; Hård & Enemar 1980.
c) Data from Selous 1913.

on only 36% of reliefs suggesting that commencement of incubation duties by males was not triggered by the presentation of food.

There are few studies of feeding rates of Merlins throughout the breeding season apart from the studies by Sperber & Sperber (1963) in Norway and several for the nestling period (Chislett 1933; Macintyre 1947; Hård & Enemar 1980). Sperber & Sperber provides the only direct comparison and then feeding rates are fairly similar (Table 2). Other references to prey deliveries range from 0.36 - 0.82 deliveries/hour with a higher average of 0.64 in the nestling period than recorded either by Sperber & Sperber or by this study (Table 2). Pertinently, Selous's (1913) recordings during the brooding stage of 0.14 deliveries/hour is identical to the findings in the study (Table 2).

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R.C. Dickson, Lismore, New Luce, Newton Stewart DG8 0AJ.

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The Status and distribution of wintering Pink-footed and Greylag Geese in east central Scotland

M.V. BELL & S.F. NEWTON

The numbers of Pink-footed and Greylag geese wintering in Perth & Kinross District of Tayside Region and in Central Region were monitored through the winters of 1986/87 to 1993/94 by counts at roosts and of birds on the feeding areas. Pinkfeet were present from late September to early May with peak numbers in autumn when c.65,000 were usually present in early to mid-October with 86,868 in mid-October 1991 the largest number recorded. Numbers fell sharply thereafter with 20,000-25,000 usually present from December to February with a small increase in March and April as birds returned north. Migrant Greylag were present from mid-October to mid-April and numbers were relatively stable with 9000-14,000 present throughout the winter. This represented a large decrease from 10-30 years earlier when this was the major wintering area in Britain. Pinkfeet regularly roosted at 21 sites and were found feeding in 466km² while the more dispersed population of Greylag roosted on at least 55 waters and fed in 491km². In total at least 60 sites were used as roosts and 751km² for feeding. The change in status of both species is discussed in relation to recent changes in agricultural cropping regime and shooting practice.

Introduction

In the first decade of the Wildfowl Trust's November census of wintering Pink-footed *Anser brachyrhynchus* and Greylag Geese *A. anser* in Britain, initiated in 1960, Perth and Kinross was the most important area for both species, with major roosts of Pinkfeet at Loch Leven, Dupplin Loch and the Carsebreck Lochs and of Greylag at the Blairgowrie Lochs, Drummond Loch and the Carsebreck Lochs (Boyd & Ogilvie 1969; 1972). The area totals in early November varied from 12,237 - 27,375 Pinkfeet and from 14,202 - 33,109 Greylag, accounting for up to 35.9% and 57.0% of the respective UK populations (Boyd & Ogilvie 1969; 1972). The general winter ecology and feeding distribution of geese in this area was described by Newton *et al.* (1973), while a detailed study of feeding ecology was undertaken at Loch Leven (Newton & Campbell 1973). The importance of the area was maintained through the 1970s with up to 54.3% of the Pinkfeet and 47.4% of the Greylag populations found in November, but since the early 1980s the area has become relatively less important for geese (Thom 1986; Wildfowl & Wetlands Trust annual reports on the grey goose counts).

Most of the major goose roosts in Britain have been protected by Site of Special Scientific Interest (SSSI) designation for a number of years and more recently many have also been given Special Protection Area (SPA)

and Ramsar Site status. Many of these designations were based on the annual November counts which give a rather crude measure of site importance but are often the only data available. In many areas little is known about the number of geese using particular roosts throughout the winter, or about the use geese make of the farmland round each roost for feeding, with the exception of the early study by Newton & Campbell (1973) at Loch Leven and more recent studies in Lancashire (Forshaw 1983) and north-east Scotland (Bell *et al.* 1988; Bell 1988). Changes in agricultural support have resulted in large changes in cropping patterns in many areas used by wintering geese over the last ten to twenty years. In addition there is now much more disturbance of geese on the feeding areas by farmers wishing to protect autumn sown crops and also by organised shooting parties, especially in the Kinross Basin, Strathmore and Strathearn. During the course of this study several areas which regularly held large numbers of geese in the late 1980s were virtually unoccupied a few winters later. These changes make it vital to understand the feeding behaviour of geese at each roost.

The Central Scotland Goose Group was formed in the autumn of 1988 to bring together all the local goose enthusiasts and co-ordinate their efforts to this end. This paper is the result of their labours and describes the present status and feeding areas used by both species throughout the winter in the old counties of Perthshire, Kinross-shire, Stirlingshire and Clackmannanshire, which now form Perth and Kinross District of Tayside Region and Central Region (Fig. 1). A more detailed account of the feeding ecology of geese in parts of this area will be presented elsewhere.

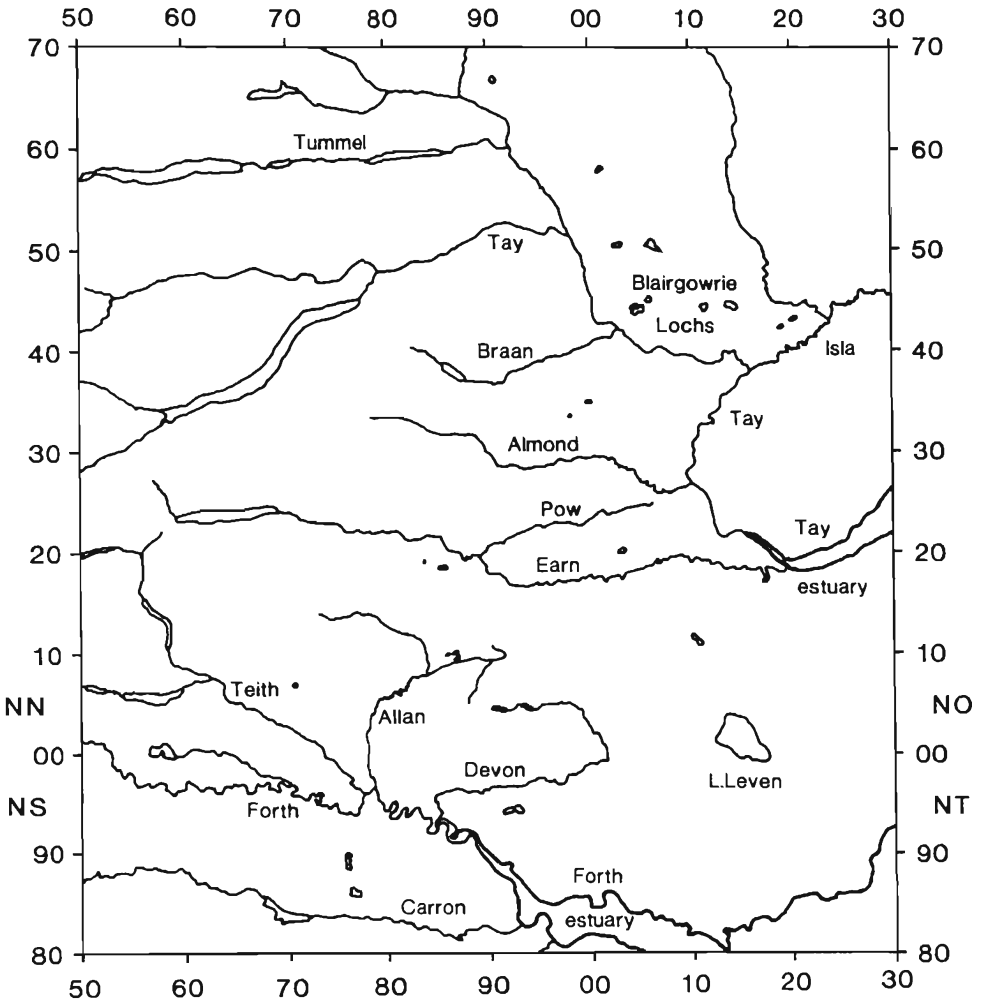
Methods

Geese were usually counted leaving the roosts at dawn by experienced observers familiar with the behaviour of the birds at their particular sites. At some roosts it was necessary to deploy several counters because of the size and topography of the site. It was possible to obtain satisfactory counts of Pinkfeet at some sites on the dusk flight shortly after they arrived in autumn and again in late April just before they departed. In some areas it was possible only to count geese on the feeding areas by systematic searches from roads. The date, time, farm name, 6 figure grid reference and food crop of all feeding flocks were recorded.

All the main roosts were counted in November, and more recently also in October, for the National Goose Count organised by the Wildfowl & Wetlands Trust. In addition to these national co-ordinated counts, counts were undertaken at most sites throughout the winter from the autumn of 1988 onwards. At one of the main roosts almost weekly counts were obtained as part of a detailed study on the feeding ecology of the two species.

Data are presented in several ways depending on the coverage achieved at the various sites. For most roosts only one count was obtained in each month but at those where more than one count was available, the largest has been used. This includes all the data for the Carsebreck Lochs/Strathallan, early autumn counts at Dupplin Loch, and some months at Kercock and in Strathearn for Greylag. The three largest monthly counts were averaged to give the 'regular' count as defined for ducks (Atkinson-Willes 1963). The average count for each month gives a monthly index of site usage.

Figure 1. ***Map of the study area. Major rivers and 10km square grid lines are shown.***



Results & Discussion

Pink-footed Geese regularly roosted at 21 sites and were recorded feeding in 466km^2. They were mainly confined to the lower-lying straths with large flocks in the Forth valley, Strathallan, Strathearn and the Kinross basin (Fig. 2). In contrast, Greylag Geese were much more dispersed, roosting on a minimum of 55 sites and feeding in 491km^2 of which 284 were not occupied by Pinkfeet. As well as occurring in the main valleys they were found also far into the hills, most notably in the upper Tay/Tummel catchment (Fig. 3). In total 751km^2 were used by feeding geese. However, many of these squares contained only a few suitable fields so the true foraging area was very much less than 751km^2.

Both species flighted in much better light at dawn than at dusk throughout the winter. At the Carsebreck Lochs where both species were regularly observed, Pinkfeet tended to flight a few minutes before Greylag at dawn. As the autumn progressed departures became earlier with the main flight usually 25-30 min. before sunrise in November and 45 min. before sunrise in December and January. With increasing day length they departed slightly later, 25-40 min. before sunrise, for the remainder of the winter. Cloud cover made little difference to departure times, consequently the departures on gloomy dawns in mid-winter could not always be seen. Most very early departures (up to 76 min. before sunrise) occurred on fine frosty mornings. In early autumn Pinkfeet returned 30-60 min. after sunset and by late autumn 45-75 min. after sunset was typical. People living near roosts often reported geese flying at night but the extent to which night feeding occurred was difficult to determine. One of us lived under the flightline of Pinkfeet commuting between roosts in Strathallan and the Forth valley and geese often returned well after dark (up to 7hrs 20min. after sunset) on completely overcast nights. We have no reason to believe this behaviour was unique to this roost. Geese were disoriented during fog and were often unable to locate the roosts if visibility was less than c.400m, circling the street lights of local towns and villages all night, behaviour previously noted in north-east Scotland (Bell *et al.* 1988).

The following account details the present and past status of each species by area.

1.FORTH VALLEY

a) Skinflats to Alloa

There was a well established roost of Pinkfeet on the estuarine mud flats at Skinflats in the 1930s but this was deserted during the 1939-45 war because of disturbance from aircraft. The roost was re-occupied in the 1950s with regular autumn numbers of 1100 and a peak of 1700, somewhat smaller numbers than before (Atkinson-Willes 1963). Several hundred Greylag also used the site at this time. It was suggested that the roost was deserted at some stage during the 1970s or early 1980s (Owen *et al.* 1986) but it is unclear whether this assertion was based on systematic counts at the roost or on casual observations. The mudflats east of Grangemouth have not been used by roosting geese for many years.

At present Skinflats holds c.2000 Pinkfeet in autumn (Table 1) with generally lower numbers later in the winter, though 4930 in January 1992 was the highest total recorded during this study (Table 1). Apart from the October and November counts most of the figures in Table 1 were based on field surveys. After the shooting season most geese moved up river and roosted in the Alloa/Tullibody

Figure 2. ***The distribution of feeding areas for Pink-footed Geese by one km square. The Forth and Tay estuaries and rivers Forth, Allan, Earn, Tay and Tummel are shown also.***

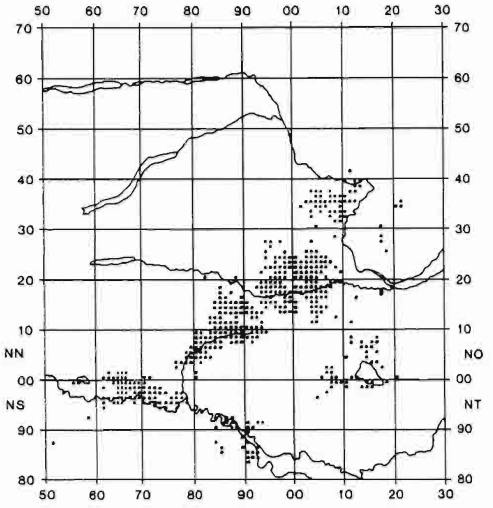
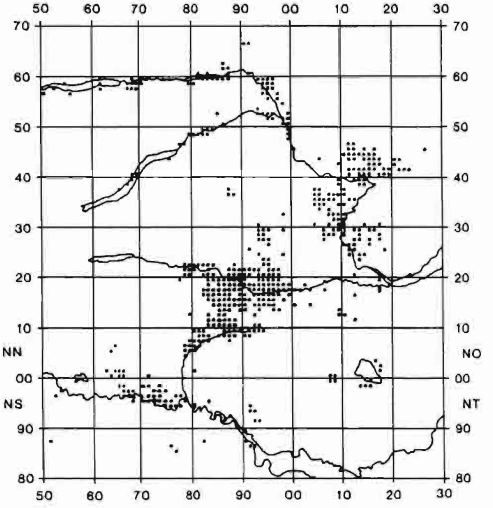


Figure 3. ***The distribution of feeding areas for Greylag Geese by one km square. The Forth and Tay estuaries and rivers Forth, Allan, Earn, Tay and Tummel are shown also.***



Inch area where substantial flocks remained to late April in recent years with 3500 in late April 1991. The geese fed over the alluvial plain from Skinflats village west towards Stirling on the south side of the estuary and also favoured the Kennetpans/Clackmannan area on the north shore and were recorded in 27km^2 (Fig. 2). Much of the farmland was intensively arable and geese were unwelcome, there being much disturbance to protect crops in addition to wildfowling along the estuary.

In late October and early November 1990 large numbers of geese appeared at Gartmorn Dam near Alloa with 1600 Greylag and 450 Pinkfeet present on 8 November. The Pinkfeet quickly moved on but hundreds of Greylag remained in the area into the New Year, also roosting on the Forth at Cambus on some nights. Large numbers often flighted east out of Gartmorn towards Powmill but the exact feeding areas were not located. Since the 1990/91 winter Pinkfeet have been very occasional in small numbers and most flocks of Greylag have been under 200 birds which fed close to the roost. The neighbouring Peppermill Dam (in Fife) held 110 Pinkfeet on the mid-November count in 1993.

Small numbers of Greylag, usually under 200 birds, sometimes roosted on the estuary at Skinflats or further upstream around Alloa Inch. Six hundred were at the latter site on 31 January 1993. Greylag were recorded feeding in 11km^2 along the estuary and in the Clackmannan area (Fig. 3).

b) Lake of Menteith and the Carse of Stirling

Historically the Flanders Moss/Lake of Menteith area was one of the few inland haunts of Pinkfeet in Scotland with several thousand present in the earlier decades of this century (Berry 1939). Greylag first appeared in the early 1900s and by the 1920s numbered up to 2000 birds (Berry 1939). Through the 1960s and 1970s the November counts usually found 500-2500 Pinkfeet, though none were located in several autumns, and 500-1000 Greylag, with a peak of 2235 in 1975 (Boyd & Ogilvie 1969, 1972). Lake of Menteith and Flanders Moss were the main Pinkfoot roosts at that time; the Greylag preferred Lake of Menteith, though up to 500 regularly used Loch Rusky in the early 1960s. This site was then deserted following disturbance from fishing and boating (Boyd & Ogilvie 1972) but was occupied again in the late 1970s.

The Carse of Stirling was a difficult area to cover since geese from a number of roosts fed there and too few observers were available to cover all these roosts simultaneously. Consequently many of the data were obtained by field searches of the area west of the M9 to the periphery of Flanders Moss in addition to counts of geese roosting at Lake of Menteith. Field searches were problematical in the areas south-west of Lake of Menteith but the geese rarely flighted in that direction. Visibility was restricted by the topography and trees on the undulating ground between the Carse and the Teith Valley, but this area was more important in autumn when the geese fed on cereal stubbles and at this time most counts were of birds at the roosts. Pinkfeet known to have commuted into the Forth valley from roosts in Strathallan were subtracted from the field counts shown in Table 1, so that these figures represent the numbers of geese roosting in the Forth valley.

Pinkfeet arrived at Lake of Menteith in late September and in recent autumns the peak was between 1000 - 3300 birds in either October or November (Table 1). The

TABLE 1. ***Average monthly counts of geese using resorts in the Forth Valley 1988/89 - 1993/94 winters.***

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	regular	max
Pinkfeet, Forth Estuary	1383	1873	667	1831	874	1100	1579	1761	4930
Pinkfeet, Loch Mahaick	2431	2529	-	-	-	-	-	-	6531
Pinkfeet, Carse of Stirling	2231	933	1725	1889	3103	2450	4854	3469	7280
Greylag, Carse of Stirling	-	565	1060	848	694	964	-	906	2000

- = insufficient data available to calculate a meaningful average.

TABLE 2. ***Maximum monthly counts of Pink-footed Geese in Strathallan 1986/87 - 1993/94 winters.***

	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	regular
1986/87	3700	5000	6400	-	1870	5200	6650	5900	2850	6317
1987/88	5300	11400	11460	4600	3850	4430	6250	5500	5200	9703
1988/89	3300	17000	16400	13300	6250	8490	5840	8800	6260	15567
1989/90	9200	14200	8300	8340	4700	1680	4200	9550	970	10697
1990/91	15950	9920	6330	7280	7400	3310	5830	9190	5650	8836
1991/92	13100	9240	9650	9020	7040	2080	8945	10400	10000	9763
1992/93	5900	7340	7880	8890	6580	3780	8000	11280	1850	9390
1993/94	3000	7120	4750	4250	4925	3900	6220	7300	1190	6880
average	-	10153	8896	7954	5327	4109	6492	8490	-	9644

September and May counts were not used to calculate the regular population as geese were present for only part of these months.

November totals for 1991, 1992 and 1993 are known to be low as geese roosting at Flanders Moss and Loch Rusky were missed, depressing the average for that month. In the 1993/94 winter an SNH/RSPB survey team confirmed that Loch Rusky and the lochan on Flanders Moss were more important roosts for both Pinkfeet and Greylag than Lake of Menteith (Thompson & Harding in prep.). There were no records of either species roosting at Loch Watston near Doune during this study though over 1000 Pinkfeet were found there on the November count in 1979 and 1980. Numbers of Pinkfeet feeding on the Carse were usually low from late November through December and January, largely due to disturbance on the feeding areas, but geese returned to the area in February once the shooting season was over (Table 1). The Forth Valley frequently remained free of snow when sites further north in Strathallan were snow covered and geese displaced from there or from further afield then boosted numbers as happened in January and February 1990 when almost 5000 were present.

When the Pinkfeet first arrived in autumn they fed close to Lake of Menteith, with the farms on the periphery of Flanders Moss being particularly favoured. Later in the winter they moved further east to the Blairdrummond and Gargunnock areas. There were only two records of Pinkfeet feeding in the Buchlyvie to Balfron areas during this study. In March 1991 Pinkfoot feathers were found at Mill Dam above Kippen. Most Pinkfeet feeding at the eastern end of the Carse came from roosts in Strathallan but birds also commuted to the Thornhill areas at times, mixing with the geese from the roosts further west. Up to 5900 Pinkfeet from roosts in Strathallan were recorded feeding in the Forth Valley. Why geese feeding near Thornhill should choose to fly 21km to roost in Strathallan rather than 3-8km to the roosts west of Thornhill is unclear but was presumeably related to disturbance and roost security. On 2 April 1994, 8050 were found feeding on the Carse and 7250 of them roosted locally, the largest number recorded during this study. Pinkfeet were recorded feeding in 80km^2 in the Carse of Stirling.

The number of Greylag using the Carse of Stirling fluctuated considerably over recent winters. On occasion only a few hundred were located, but in the 1991/92, 1992/93 and 1993/94 winters over 1000 were present for long periods, particularly in the Gargunnock and Drip areas. The areas west towards Kippen and Thornhill used to be the main Greylag feeding sites, with smaller numbers north and west of Thornhill. The river Forth meanders through the Carse several meters below the level of the surrounding farmland and Greylag often fed along the sloping grassy banks where they were difficult to see. Some low counts may be due to birds being missed along the river. Up to 400 were noted in fields by the Teith south of Callendar on occasions. The feeding distribution of Greylag was slightly more restricted than that of Pinkfeet, being recorded in 43km^2.

The roosting behaviour of Greylag was even more complicated than that of Pinkfeet. In autumn geese feeding at the east end of the Carse came from Loch Coulter, some 8km to the south in the Gargunnock hills, on several occasions but this roost was not counted regularly. None were recorded at North Third reservoir which is closer to the Carse. Later in the winter these birds probably roosted along the river Forth. The Greylag further west may also have used the river or flighted west to roost at Loch Rusky or Lake of Menteith. Greylag from Strathallan very rarely flighted

into the Forth valley during the first four winters of this study but more recently small flocks of up to 50 birds have commuted to feed here. It seems probable that Greylag roosting at Loch Coulter may also flight east to feed on farmland north of Stenhousemuir which is equi-distant to the Carse of Stirling. A flock of up to 300 Greylag has recently appeared on the Slammannan plateau south of Falkirk, sharing the area with Scotland's only flock of Bean Geese *A. fabilis* (J. Simpson pers. comm.).

c) Loch Mahaick

Loch Mahaick on the Braes of Doune is somewhat of an enigma. Pinkfeet were first recorded there in autumn during the 1950s (Atkinson-Willes 1963), but the site was not checked regularly. C.1700 birds were present in November 1963 - 1964 and from 1974-1983 between 0 -2500 were found on the November count. In November 1988, 6530 were recorded and in the following two autumns large numbers were also present with rapid build ups over a few weeks during October leading to transient peaks and rapid falls through November (Table 1). Few birds were found later in the winter and the site did not appear to be used in spring. Since then autumn numbers have fallen back to a few hundred. The geese flighted out between SSW and SSE with small flocks very occasionally going east into Strathallan. The main feeding areas appeared to be on barley stubbles on the undulating farmland south of the Teith, an area where viewing is difficult. Greylag were only noted at Loch Mahaick on three occasions with 178 the most.

2. STRATHALLAN

a) Pink-footed Geese

Pink-footed Geese first appeared at the Carsebreck Lochs in the 1930s, initially only in autumn, but by the 1960s were present all winter (Berry 1939; Atkinson-Willes 1963). The number of Pinkfeet found on the November count remained fairly steady at between 1000-4000 through the 1960s, 1970s and early 1980s with a peak count of 6270 in 1974 but showed a marked increase in the late 1980s.

The first large arrival of Pinkfeet usually occurred in the last week of September with marked autumn peaks in 1987-1991 before numbers fell away in mid-winter. In 1992 and 1993 autumn numbers were much lower than in the previous five seasons (Table 2). There was a spring peak in March or April with major departures in the last week of April or first week of May. Late spring departures were a feature of this site; 10,000 were still present on 3 May 1992. Autumn numbers reflected the amount of grain shed before or at harvest (Bell *et al.* in prep.). In autumns with clean harvests the peak occurred in the last week of September (1990, 1991) or the first week of October (1989), whereas following dirty harvests (1987, 1988) the autumn peak occurred later in October or in November and large numbers remained for longer than in years with clean harvests (Table 2). Changes in cropping regime from spring barley to oilseeds and long-term set-aside led to a large drop in autumn numbers from 1991 onwards (Table 2).

Most Pinkfeet roosted at the Carsebreck Lochs but at times up to 3000 roosted at two other sites in the valley, while upper Glendevon reservoir 6km SE held large numbers (up to

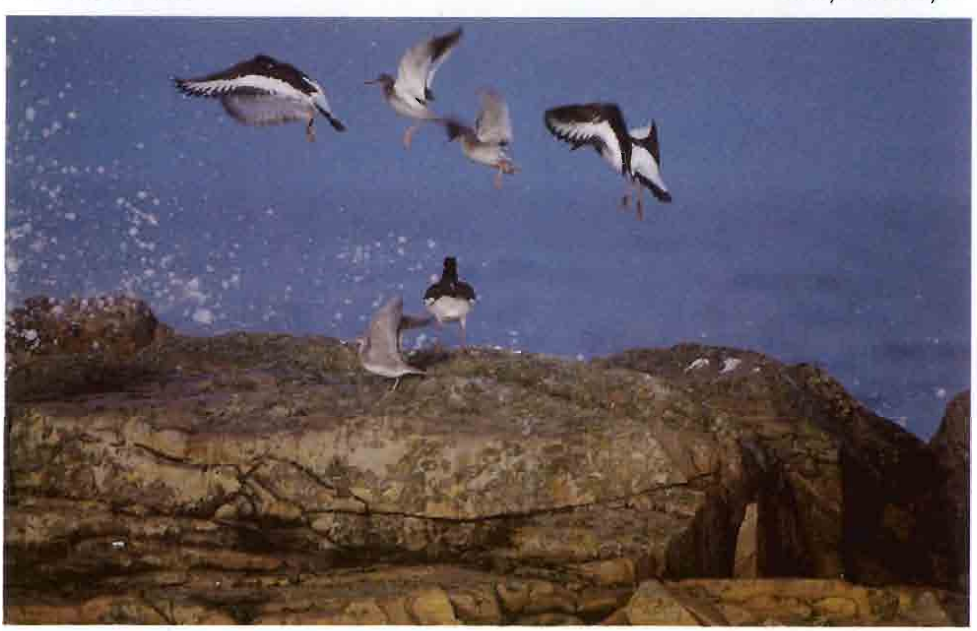
Male Capercaillie *Tetrao urogallus.*

Keith Brockle

This Turtle Dove Streptopelia turtur wintered at Lundin Links 1994/95.
Anne-Marie Smou

Hawfinch Coccothraustes coccothraustes at St Andrews, October 1994.
Mary Macintyre

The long-staying Grey-tailed Tattler Heteroscelus brevipes at Burghead, said to have caused 90 arrests for speeding on the A9 when it was first reported in November 1994. *Mary Macintyre*



Magpie's nest – with a difference

The nest of a Magpie *Pica pica* was recently donated to Glasgow Museums. It had been removed from about 15-20 feet up in a *Cupressus* tree, which was being partially cut down in a garden in Rutherglen, Glasgow. The cup of the nest was like a normal magpie's nest, made from twigs, bound together with mud and lined with fine roots. Underneath the nest, however, the magpies had constructed a platform mainly using S-shaped wire wall ties from a nearby building site. Approximately 100 ties were used, together with the miscellaneous pieces of wire and even an old aerial from a car! I always thought that magpies collected shiny objects and put them in their nest. This is the first time I have heard of them actually *making their nest* out of the objects which they have stolen.

Richard Sutcliffe, Curator, Science Department, Glasgow Museums.

Platform of wire wall ties for magpie's nest from Rutherglen. Glasgow Museums

7360) in autumn 1989, 1990 & 1991. Several temporary floodwater pools were used by Pinkfeet also.

Pinkfeet from the roosts in Strathallan were recorded feeding in 143 km^2. The main feeding areas were in Strathallan between Blackford and Kinbuck up to the limit of cultivation, but Pinkfeet often flighted NE into Strathearn and SW into the Forth valley to feed between the Carse of Lecropt and Blairdrummond Moss (Fig. 2). At times they flighted as far as Thornhill. Pinkfeet used several sites for loafing. These offered a refuge close to feeding areas from disturbance and were situated in the direction of all the main flightlines at 300m to 6.0km from the main roosts. Four were fields in the valley while the other four were fields just below the muir line. All were sites with minimal disturbance and good visibility.

b) Greylag Geese

Greylag were first recorded at Carsebreck around the turn of the century when the lochs were first dammed and were numerous by the 1920s when 2000 were often present (Berry 1939; Atkinson-Willes 1963). When the November counts of grey geese were initiated Greylag were the slightly more numerous here with 2500-6000 usually present and a peak count of 8280 in November 1968. Numbers declined sharply in the mid-1970s to c.1500, with a brief recovery to 2000-4000 in the early 1980s, but these numbers have not been maintained and 500-1000 is now normal in November. The numbers of Greylag showed a different pattern to those of Pinkfeet and were generally less predictable. They arrived in mid-October and numbers increased steadily to peak in mid-November in two autumns (1988 and 1989) or plateaued from late November through December (1990 and 1991) (Table 3). In autumn 1992 there was an early peak in late October within a week of the birds arriving, while in the 1986/87 and 1990/91 winters the peak numbers were present in February (Table 3). Greylag departed in early to mid-April showing no spring passage. In autumn they were much less dependent on cereal stubbles than Pinkfeet, feeding on grass most of the winter (Bell *et al.* in prep.).

Greylag roosted at the main lochs and on an adjacent pool. After the shooting season these roosts were largely abandoned in favour of the river downstream from Greenloaning and several floodwater pools. Where the two species shared roosts they tended to roost apart and flighted separately at dawn unless disturbed by people.

Greylag had a much more restricted feeding range than Pinkfeet and were recorded in 66 km^2 (Fig. 3). They favoured fields in the valley floor and on the northern slopes of the valley, rarely feeding on the Ochils side of the valley or flighting into Strathearn or the Forth Valley. By the end of this study, following changes in the farming regime and increased disturbance from shooting they were confined to just a few farms. Greylag did not use specific loafing areas, resting in the fields where they fed. When Greylag and Pinkfeet fed in the same field they tended to feed in discrete flocks. However, in the early years of this study when Greylag were more numerous, the two species sometimes fed in large randomly mixed flocks and flighted together at dusk. This very unusual behaviour was often noted here in the 1960s and 1970s (M.A. Ogilvie pers comm.) and was very occasionally noted in the Kinkell Bridge area of Strathearn and in the Forth Valley during this study.

TABLE 3. ***Maximum monthly counts of Greylag Geese in Strathallan, 1986/87 - 1993/94 winters.***

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	regular
1986/87	940	1450	2000	2720	4360	600	-	3027
1987/88	880	2480	2100	1550	1490	955	217	2043
1988/89	2065	2470	1480	940	940	1285	1080	2005
1989/90	1410	2150	1530	1020	1060	1120	1145	1697
1990/91	580	915	1240	910	2520	1295	380	1685
1991/92	385	1325	1300	1295	1395	1087	550	1340
1992/93	1625	1165	1220	835	580	710	380	1337
1993/94	322	726	970	700	620	495	611	799
average	1026	1585	1480	1246	1621	943	623	1742

TABLE 4. ***Maximum monthly counts of Pink-footed Geese in Strathearn, 1986/87 - 1993/94 winters.***

	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	regular
1986/87	nc	c.25000	11000	7300	4400	2150	4400	nc	14433
1987/88	29000	c.30000	11100	2080	6380	5690	6880	nc	15593
1988/89	39000	40000	14800	14500	8700	6800	6700	4380	23100
1989/90	(1700)	31000	7150	7850	5750	6160	8220	7900	15707
1990/91	c.27000	42000	5470	6400	1365	2240	5300	5300	17957
1991/92	57500	48900	10700	nc	9200	5300	nc	7075	22933
1992/93	c.20000	25500	15700	4800	nc	6000	6350	3815	15850
1993/94	nc	39000	12840	nc	5680	4200	7815	nc	19885
average	-	35175	11095	7155	5925	4818	6524	5694	17808

nc not counted September counts were not used to calculate the regular population since birds were only present for part of the month.

3. STRATHEARN

a) Pink-footed Geese

Pink-footed Geese first appeared at Dupplin Loch in the 1930s as a result of disturbance from shooting on the Tay estuary to the east (Berry 1939). Dupplin was the most important roost in Britain in the two decades following the initiation of the Wildfowl Trust's autumn census of grey geese in 1960 (Boyd & Ogilvie 1969) with a peak of 27,500 in November 1973 comprising 33% of the population. Newton *et al.* (1973) commented on the unusual nature of Dupplin Loch as a Pinkfoot roost: relatively small (c.30ha) with mature mixed woodland to the water's edge. The site is only tenable because of the absolute protection from disturbance given by the owners since the roost was established over 60 years ago.

The November counts averaged over long periods have remained relatively constant at Dupplin over the last 34 years with means of 10,258 in 1961-69, 12,011 in 1970-79 and 8781 in 1980-89, with the average since recovering to over 10,000 again. These figures hide some considerable fluctuations with only just over 3000 present in some years, but more typically well over 10,000. More recently mid-November numbers have fluctuated between 5000 - 15,700. The largest numbers occurred here some 4-6 weeks earlier as the geese arrived in Britain for the winter. For a few weeks Dupplin held huge flocks (Table 4) with peaks of over 30,000 in late September or early October of six of the last eight autumns and 57,500 on 28 September 1991. During the arrival period in most years there is a constant coming and going of geese over the Perth area in all directions. It would be interesting to know just how many birds pass through Dupplin each autumn; in some years the initial arrival of Pinkfeet in Aberdeenshire was from the south (Bell pers. obs.). It was the realisation that huge numbers of Pinkfeet were concentrated at just a few sites in Scotland in early to mid-October which prompted the suggestion that this would be a better time for censusing this population (Newton *et al.* 1990).

There was insufficient food available to sustain such huge flocks for long and in autumns with clean harvests all the stubbles within c.10km of the roost were cleared within 1-2 weeks and numbers fell very rapidly, e.g. from 42,000 to 8200 in 14 days from 7 October in 1990 and from 39,000 to 10,700 in eight days from 9 October in 1993. It is not known if Dupplin was always such an important arrival site for Pinkfeet since regular counts were not made in the early autumn period. The change from spring sown barley to winter wheat and barley and oilseed rape means that the area is now unable to support large flocks later into November. It seems probable that in those autumns when the site held over 10,000 birds on the November count that more would have been present a month or so earlier as is still the case. In only one recent winter, 1988/89, was a five figure count maintained into December following the very dirty harvest that autumn. Typically 4000-8000 remained from December onwards (Table 4) unless snow moved the birds on. Numbers increased slightly in March and early April but the area was not important for staging and most birds departed by the end of April.

Large flocks of Pinkfeet sometimes roosted on floodwater, particularly after the shooting season. The regular flood on the Pow at Gorthy was particularly favoured and held up to 4000 birds while floodwater by the Earn between Dalreoch and Aberdalgie was also used with up to 4300 birds noted. Numbers

using Dupplin fell to 1500 at such times. The totals in Table 4 includes geese roosting on floodwater.

Most Pinkfeet roosting at Dupplin fed within 5km of the roost but some flighted out at least 11km at times. They were found feeding in 142km^2 (Fig. 2). The area to the north and north-east round Tibbermore was particularly favoured. Rather few birds flighted ESE down the Earn; geese feeding at the mouth of the Earn were believed to have roosted on the Tay estuary but may have come from Loch Leven. Small numbers regularly flighted SSE out of Strathearn towards Glenfarg. Feeding flocks were difficult to locate in this area because of the topography. It is possible that such flocks could have been leaving the area for Loch Leven or further afield. The fields in Strathearn between Forteviot-Dunning and Aberuthven were frequently disturbed by shooting parties and were little used during the shooting season, especially in the last few years of this study. To the SW Pinkfeet foraged as far as the Kinkell Bridge area. There was considerable overlap with Greylag from Drummond Loch and occasionally with Pinkfeet from Carsebreck here; on one day in December 1988 geese from all three roosts fed in the same potato field here. To the NW Pinkfeet foraged as far as Abercairney and also moved out of the valley to feed in the Buchanty area in late winter and spring. Visibility was restricted north of Methven by undulating ground and trees and it was probable that this area was used more frequently than records indicated. It was also thought that birds sometimes flighted out NE over Perth to feed on the north slope of the Sidlaws but overlaps with geese from the Tay estuary made interpretation of the few feeding flocks noted in this area difficult. Most of the longer feeding flights occurred in late autumn and early winter.

Pinkfeet used several areas for loafing and as refuges from disturbance on the feeding areas. Cleavage Muir to the south, the Pow flood and the Fornaught-Buchanty area were particularly favoured but a number of farms closer to the roost where the geese were generally tolerated were also used. All these sites offered good visibility of approaching danger and some were remote from roads and normal human access. Methven Moss, which was used many years ago (Newton *et al.* 1973), was too overgrown to hold geese.

Pinkfeet were first recorded in numbers at Drummond Loch in December 1988 when 2900 were present on the 18th, with over 1000 remaining into the first week of January. The flock was feeding with Greylag in an unharvested field of barley south of Muthill and were almost certainly from Carsebreck where the total fell coincidentally by a similar number. None were recorded at Drummond the following winter but large numbers were again present in October 1990 with 3550 on 21st; none remained by mid-November. This pattern has been repeated each autumn since, with birds appearing in early October and staying for just a few weeks. The peak counts were 3400 in October 1991, c.3000 in 1992 and c.2500 in 1993. Their appearance has coincided with lower numbers in Strathallan and it seems probable that Pinkfeet displaced by changing agricultural practice are now feeding on cereal stubbles in the Crieff area and roosting at Drummond. By clearing the local stubbles of spilt grain before the Greylag arrive the Pinkfeet may have contributed to the drop in numbers of Greylag at Drummond in recent autumns. However, Greylag were less dependent on cereal stubbles than Pinkfeet (Bell *et al.* in prep.).

b) Greylag

During the first decade of the November counts, Drummond Loch was the single most important roost for Greylag in Britain (Boyd & Ogilvie 1972) with an average count of 5897 and a maximum of 10,242 in 1961-69. This position was maintained through the 1970s but there was a sharp fall from 1981 onwards with 3500-5000 becoming the norm with a peak of 7500 and a low of 1180 since 1981. Some doubt has been cast on the accuracy of the large counts recorded in the late 1970s (Thom 1986) but even with this proviso there has undoubtedly been a substantial fall in numbers over the last 10-15 years. In the 1960s Greylag also roosted regularly at the neighbouring Loch Balloch and on three sites by the Earn between Kinkell Bridge and Innerdunning (Newton *et al.* 1973). Pitcairnie Loch at Dupplin was also used by 500-1500 Greylag in November up to a few years ago with a peak of 3990 in 1972. They are now scarce there.

Greylag arrived in the second half of October and in recent winters numbers peaked in late October or early November (Table 5). Numbers then dropped slightly through December and January before increasing in late February and March as birds moved through on passage. Overall numbers tended to be very constant through the winter (Table 5). There was an influx in December 1988, thought to be associated with snow further north, which gave the highest total recorded during this study of 7200.

When the Greylag first arrived, they roosted at Drummond but as the winter progressed the flock dispersed onto many smaller waters in Strathearn. In some winters this dispersal occurred just before the mid-November count and this caused considerable logistical difficulties in obtaining a coordinated count in November. Up to 3000 geese may have been missed in November 1987, 1989 and 1991 before the full extent of this problem was appreciated. Apart from Drummond Loch, Greylag feeding in Strathearn roosted at Loch Balloch, Mains of Drummond pond, Loch Cowdens, the ponds at Abercairney House, Loch Meallbrodden, East Fordun Dam and on at least six semi-permanent floodwater pools in the Kinkell Bridge area. Although the smallest of these pools was only c.0.5ha, up to 800 geese were accommodated at such sites. Unless these pools were frozen, which occurred very infrequently during recent mild winters, a complete count of Greylag in Strathearn necessitated either a complete search of fields for feeding flocks or a combination of roost and field counts, either option taking about five hours. This was only possible in reasonable weather.

Greylag were recorded feeding in 134km^2 in Strathearn over the 1986/87 - 1993/94 winters. The most important feeding sites during the first part of this study were in the Kinkell Bridge area and the majority of birds fed here from December onwards. However, in the last three winters regular disturbance from organised shooting parties has made this area much less attractive and at times it has been deserted. Shooting probably accounted for the low numbers found in Strathearn in November 1992 and 1993. Feeding areas further downstream have largely been abandoned. In the 1986/87 - 1987/88 winters over 1000 Greylag fed regularly in the Innerdunning to Dalreoch area but it is now very unusual to find Greylag feeding south of the A9 there. The local keepers believe regular shooting to be the cause. Greylag feeding in this area probably roosted at Pitcairnie Loch or on the semi-permanent pools by the river, some of which have now been drained.

TABLE 5. ***Maximum monthly counts of Greylag Geese in Strathearn, 1986/87 - 1993/94 winters.***

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	regular
1986/87	1000	7270	5140	3050	2300	2075	2250	5153
1987/88	4250	5900	2940	3590	2750	2970	585	4580
1988/89	2980	4380	7200	4000	4130	3290	2800	5237
1989/90	c.2500	3825	3400	3280	2580	5040	1970	4088
1990/91	3510	4120	2840	2570	2335	3420	2275	3683
1991/92	5325	5465	4600	nc	4300	3665	4520	5130
1992/93	5050	2040	nc	2754	2985	3500	3714	4088
1993/94	4000	1300	nc	3435	2400	3720	nc	3718
average	3577	4288	4353	3240	2973	3460	2588	4460

The totals include all roosts in Strathearn.

TABLE 6. ***Average monthly counts of Pink-footed and Greylag Geese at roosts in the Tay Valley, 198/89 - 1993/94 winters.***

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	regular	max
Greylag, Scone	72	871	710	1015	1005	513	580	898	1730
Pinkfeet, L.Tullybelton & Mullion	4518	3903	2645	658	1974	1222	784	3271	8350
Pinkfeet, Kercock	755	626	1393	734	8	664	1868	1375	3820
Greylag, Kercock	698	1141	2207	1369	1394	556	618	1637	3196
Greylag, Stormont L.	-	850	-	-	-	-	-	-	2000
Greylag, Marlee L.	481	665	622	757	313	126	452	699	1750
Greylag, L. Clunie	107	827	926	456	582	256	539	778	4000
Greylag, L of Lowes	1331	1333	295	54	91	178	-	987	3040
Greylag total Blairgowrie Lochs	3853	4093	2718	2655	2542	891	nc	4109	7415
Greylag, Upper Tay/Tummel	791	1745	2184	1831	1333	1347	1623	1722	2603

Total for Blairgowrie Lochs is for coordinated counts only. - - insufficient date to calculate an average.

Smaller numbers of Greylag fed to the south-east, south and south-west of Drummond. Fields to the north-west between Crieff and Comrie were little used during the early years of this study but were more favoured in the last three winters when several hundred birds regularly fed here. In late October 1992, c.3500 fed on the Carse of Lennoch, the largest number for some years. Loch Balloch was frequently used by geese feeding west of Crieff and Loch Cowdens was used by those birds feeding at the Comrie end of the Carse. At times there was considerable mixing with Pinkfeet and Greylag from Carsebreck in the area south-west of Muthill.

In the late 1980s, 100-200 Greylag fed in the Buchanty area in late winter and spring. The roost for these birds was not discovered but Loch Meallbrodden or Loch Buchanty were the most likely sites. In the 1990/91 winter Greylag were particularly numerous in the Buchanty area with up to 900 roosting at Loch Buchanty from mid-November to mid-December and smaller numbers to mid-January when shooting dispersed the flock. Some also roosted at Loch Meallbrodden on occasion and two small hill lochs in Logiealmond were also believed to have been used. Large numbers were also present the following winter with 1250 at Loch Meallbrodden on 25 October (when there were also 5050 at Drummond) and 2000 were feeding in the Buchanty area by early November. Very few Greylag were noted in Glen Almond in the 1992/93 and 1993/94 winters. Since the appearance of Greylag in autumn in Glen Almond small flocks up to 210 birds have been noted regularly at Loch Freuchie near Amulree. These birds often flighted to Glen Almond.

4. TAY VALLEY

a) River Tay, Scone.

The Greylag roost on the Tay at Scone held its largest numbers from November to February with a regular winter count of c.1000 (Table 6). The peak recorded during this study was 1730 in February 1991. Some of the monthly totals from which the average counts were derived were of birds feeding in the Scone and/or Luncarty areas and may therefore be low. This was another awkward roost to count because the geese could be spread over at least 1km of bank and some flightlines were obscured by trees. There was always the worry that some birds roosted further upstream by the mouth of the Almond and along the racecourse. This roost became untenable during spates and it was not clear where the birds then moved to but on occasions large numbers of droppings and feathers were found on the North Inch in Perth. The ponds at Dunsinnan House and South Friarton near St Martins have been reported to hold geese in late winter though we have no direct evidence that these sites were used as night roosts during this study.

The main feeding areas were within 4-5km of the river to the east and north-east in the Scone area but some birds also fed in the Balbeggie-St Martins area some 6km distant. Greylag also flew upstream to feed in the Luncarty-Stanley area and occasional flocks were found in the Moneydie-Pitcairngreen area which may also come from the Tay.

b) Lochs Tullybelton & Mullion and the Bankfoot area.

Loch Tullybelton and Loch Mullion are small hill lochs which lie 14-16 km WSW of Kercock. Pinkfeet first roosted at Loch Tullybelton in the late 1960s when barley replaced oats as

the main cereal crop on the farmland to the east. The local estate believed that up to 5000 geese used the loch in autumn with few present in mid-winter and small numbers in spring. Counts since the 1989/90 winter showed this to be an accurate assessment. Pinkfeet were first noted at Loch Mullion in October 1991; there were none here in November 1989. Pinkfeet at both lochs flighted out up to 12km between ENE and SSE to feed in the fields towards Luncarty and Airntully, the area round Bankfoot being particularly favoured, with a few birds sometimes flighting south into Glen Almond.

In the 1987/88-1988/89 winters, geese were systematically counted on the fields in the Luncarty-Airntully-Bankfoot area. At first it was thought that many if not all the Pinkfeet here were commuting from Dupplin Loch, 15 km SSW, but subsequently large flocks were found on several days when it was known that none had left Dupplin on this flightline. Pinkfeet were not observed at Kercock in the 1988/89 winter. In spring of 1989 Pinkfeet were observed loafing at Loch Tullybelton during the day and permission was obtained to visit the loch to count the geese at dawn the following winter. The field counts may have overestimated the use of Loch Tullybelton in mid-winter since roost counts subsequently showed few birds to use it at that time. Loch Tullybelton has held 3000-5800 Pinkfeet in autumn, peaking in either October or November. Numbers usually fall sharply thereafter and remain low until March or April (Table 6); 2050 in April 1990 was the largest spring count noted during this study. The loch was often frozen for long periods from December to February and then held no birds. King's Myre near Airntully was used by 200 Pinkfeet in October 1990 and was probably used on other occasions. The river Tay seems the only other possibile roost. Loch Mullion held Pinkfeet in October and November of the last three winters with 2550 in mid-October 1992 the most, giving a combined total of 8350 for the two lochs. Loch Mullion was not checked systematically in the spring but 2000 roosted there in February 1994.

Greylag were not recorded at Loch Tullybelton but small flocks of up to 100 birds were found at Loch Mullion on three out of five autumn counts. They probably fed to the south in Glen Almond. Greylag were always found in the fields in the Luncarty, Stanley and Bankfoot areas with 500-1000 regular and a peak of 1530. These birds could have come from a number of roosts, the Tay at Scone or Kercock being the most likely. Several hundred regularly fed north of Bankfoot in late winter and these might have roosted on the nearby Stare Dam or flighted north to Loch of Lowes some 7km away. A small pool near Airntully was used by Greylag 20 years ago (Newton *et al.* 1973) but was not checked during this study, though birds sometimes fed close by. Kings Myre was another possible roost for Greylag feeding in this area. Cairnleith Moss at Bankfoot was a loafing area for both species, especially Pinkfeet, and it is possible that small numbers of Greylag might have roosted in the marsh there.

c) Blairgowrie Lochs and river Tay, Kercock

This is a complex series of roosts comprising six lochs separated by up to 16km situated between Blairgowrie and Dunkeld, and the river Tay at Kercock-Meikleour four km to the south (Fig. 1). These roosts were formerly one of the most important sites in Britain for Greylag but numbers have fallen substantially over the last 10-15 years from regular

November totals of 7000-15,000 to 3000-5000 (Table 6). Unfortunately two of the November counts during this study (1989 & 1990) were badly affected by fog and many birds were missed; these two seasons were omitted in calculating the November average. Numbers usually peaked in November and December falling back later in the winter with 1700-3000 present from January onwards (Table 6). Numbers dropped sharply in March, but this was probably due to birds dispersing onto smaller pools since Greylag at other sites did not leave the area this early. The lochs were not used for staging by Greylag in spring. The largest count recorded during this study was 7415 on 17 October 1992 and the only other counts over 6000 birds were in October 1990 and November 1988. This suggests that the area can no longer sustain such numbers through the winter and that many move on shortly after arrival. In recent winters c.200 birds using Marlee Loch were believed to be feral.

The numbers of Greylag using the different roosts varied considerably between and within winters depending on disturbance, availability of food and weather conditions. Loch of Lowes held the largest numbers shortly after the birds arrived in October through into November with birds moving on quickly thereafter, 200-300 was a good total for the New Year (Table 6). This site was often frozen for long periods in mid-winter. There used to be frequent interchange between geese roosting at Loch of Lowes and Loch of Butterstone but the latter site has been deserted since a fish farm was built there. Loch Clunie also tended to hold its largest numbers in the autumn but rather more birds used this site later in the winter (Table 6). Numbers at Marlee Loch were rather variable between winters and the largest counts occurred from November to January. This roost seems to have become more important in the last few winters, its larger size perhaps offering a better refuge from shooting. Stormont Loch was only counted regularly in November and appears to have become much less important than a decade ago, birds apparently switching to Marlee. The adjacent Fingask/White Loch only held substantial numbers (646) once during this study in February 1989. Monk Myre, the eastern-most of the lochs and one of the most important roosts a decade ago was not used.

At Kercock and Meikleour on the Tay the geese roosted on the shingle banks along c.4km of river. This site recorded over 1800 Greylag in every month from October to February with a regular count of c.1500 (Table 6) and was particularly important in mid-winter when the lochs were frozen. However, it was untenable when the river was in spate. Numbers here were also much lower in March and April (Table 6), possibly due to disturbance from fishermen.

In autumn 1992 it was discovered that several hundred Greylag were flighting from the Blairgowrie area to roost on lochs in the hills to the north-west. A small lochan on Cochrage Muir was used by up to 300 birds and up to 150 geese appeared to be flighting to Loch Charles some 10km north of Loch Clunie. Loch Benachally may also be used as a roost at times. A further complication in assessing numbers in this area can be floodwater and it is possible that many of the lower counts obtained later in the winter during mild weather, and especially after the shooting season, missed birds roosting on floodwater or on the hill lochans.

The geese generally fed on the mixed farmland within c.4km of the roosts but those birds which flighted east and north-east from

Kercock might have foraged further afield. The decrease in numbers and change in distribution of roosting birds reflected changing agricultural practice to an autumn sown cereal and oilseed regime, particularly east of Blairgowrie into Strathmore. This has led to increased disturbance associated with crop protection and there is also much more commercial shooting. This accounted for the drop in numbers roosting at Monk Myre and Stormont Loch. Few birds flighted east into Strathmore, an area where syndicate goose shooting has been particularly prevalent, and the associated disturbance severe.

Pinkfeet first started to roost at Kercock during the spring in the late 1980s with 2100 recorded on 1 April 1988. Since then they have become regular with records throughout the winter (Table 6) though the largest flocks still tend to occur in autumn and late spring. The Pinkfeet tended to roost separately from the Greylag further upstream. They usually flighted out to the south and west and there was probably considerable overlap on the feeding areas with birds from Loch Tullybelton. Indeed the Tay at Kercock was probably used as an alternative roost when Loch Tullybelton was frozen.

Flocks of Pinkfeet have become increasingly frequent at the Blairgowrie Lochs though they rarely stay for long. There were 900 at Stormont Loch on 13 November 1988 and 150 there on 21 October 1990 when there were also 350 at Loch Clunie, while 1233 were at Loch of Lowes on 30 September 1990. Small numbers have been recorded there and at Marlee on several occasions.

d) Upper Tay and Tummel Valleys

Small numbers of Greylag were found on the November counts in Strathtay in the 1960s with 1200 in 1967 the most. However numbers appeared to decline sharply after 1972 with none located between 1973 and 1975. Numbers have since more than recovered and by the end of the 1980s the flocks were the largest recorded with a regular wintering population of c.1900 birds (Table 6). The geese arrived in the second half of October and peaked in November and December, 2603 in November 1992 being the highest total recorded. Numbers then fell back slightly later in the winter but 1000-1500 usually remained throughout unless snow moved the birds on. There was a slight increase in March and April as passage birds moved through the area. Sizeable flocks often remained to mid-April, later than at most other Greylag sites in the area; 1885 were present on 14 April 1991.

This was a difficult area to count. The roosts of most flocks were unknown and therefore all counts were of geese feeding in the fields. A drive of c.150 miles was required to cover all the sites which took one observer about six hours. The short day-length in mid-winter made this impossible on anything other than a fine day. During this study the main flocks were located on the riverside haughs south and west of Ballinluig and between Aberfeldy and Dull, in the Moulin area of Pitlochry and at Tulliemet near Ballinluig. Smaller flocks were regularly found at Loch Tummel, Dunalastair reservoir and Loch Tay with occasional flocks at Glen Fincastle, Loch Rannoch and Loch Moraig, in a total of 86km^2 (Fig. 3). A complicating factor was the presence of c.200 feral birds which were usually found at Loch Tummel. However, these birds were not always discrete and mixed with the migrant Icelandic birds at times.

Greylag feeding in the Ballinluig area may have roosted on river shingle but also probably

used Lochs Ordie, Benachally and Broom; geese feeding in the Pitlochry area may have also used the latter site as well as flying upriver to roost at Loch Tummel or Loch Moraig. The birds feeding in the Appin of Dull used Loch Glassie and perhaps also Loch Tay at times. Those geese feeding at Lochs Tay, Rannoch and Tummel and at Dunalastair reservoir roosted on these waters. There were also a number of other hill lochs which may have been used as roosts.

5. TAY ESTUARY

Only the western end of the inner Tay estuary is in Perthshire, the remainder divided between Angus and Fife. This is a very difficult site to count, almost 20km in length from the mouth of the Earn to Invergowrie Bay at Dundee, with geese roosting anywhere along this length depending on disturbance. A minimum of at least six counters is required to cover the site properly. Unfortunately several attempts at coordinated counts during this study were severely hampered by bad weather and the status of both species isstill very unclear, especially in late winter and spring. A count of c.10,000 geese, almost certainly Pinkfeet, near Mugdrum in mid-March 1992 suggested the area could be very important in spring. Geese found feeding at Rhynds by the mouth of the Earn almost certainly roosted on the estuary. Pinkfeet also flighted NW over the Sidlaws and south into Fife but these feeding areas were not located.

6. LOCH LEVEN AND THE KINROSS BASIN

a) Loch Leven

The populations of waterfowl at Loch Leven are the best documented in Scotland, see Allison *et al.* (1974). Pinkfeet were using Loch Leven by the turn of the century with autumn peaks of 2000-3000 birds while Greylag were scarce. Numbers of Pinkfeet increased after 1920 and Greylag only colonised in numbers after 1940. By the 1950s the site was a major arrival point for Pinkfeet and wintering site for both species.

Loch Leven was the first site in Britain where a detailed study of the winter ecology of these species was undertaken (Newton & Campbell 1973). In the late 1960s and early 1970s there was an early autumn peak of 10,000-15,000 Pinkfeet at the end of September or early October, then numbers fell away through the autumn with 3000-5000 usually present from December to April. There was no peak during the period of spring passage. The build up of Greylag was much slower peaking at around 3000-5000 in late autumn or mid-winter and again no noticeable spring peak (Newton & Campbell 1973). This general picture pertained until the mid-1980s with a trend of slightly larger numbers of Pinkfeet remaining through the winter. Since then the numbers of Pinkfeet have increased markedly with over 20,000 recorded in several recent Octobers and 18,000 in November 1989 (Table 7). Typically 5000-8000 now remained through the winter decreasing in April as birds moved north. Regular counts showed that the autumn peak was usually around the second or third weeks of October a week or two after the peak at Dupplin Loch. In contrast numbers of Greylag fell sharply in the 1990/91 winter (Table 8) and all but disappeared. Small numbers of feral birds confuse the picture, but a Greylag ringed in a catch of 20 on 15th March 1993 was shot in Iceland on 25 April 1993 (A. Lauder pers. comm.) so migrant Greylag were still using the site in that winter.

TABLE 7. ***Maximum monthly counts of Pink-footed Geese at Loch Leven 1986/87 - 1993/94 winters.***

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	regular
1986/87	4920	10500	4500	4800	5100	3900	nc	7200
1987/88	7900	9700	7700	6900	5500	3200	nc	8433
1988/89	12200	9000	5200	6800	6000	5100	4700	9333
1989/90	15000	18000	nc	nc	nc	6800	nc	13267
1990/91	16000	11000	6800	7500	4580	nc	nc	11500
1991/92	21880	9770	2860	7110	6815	8082	5500	13244
1992/93	23070	6730	8610	7600	7750	6700	nc	13143
1993/94	10090	11860	5250	6997	7000	3885	nc	9650
average	17208	11472	5880	6997	6536	6367	-	12161

nc = not counted. Average is for 1989/90 onwards.

TABLE 8. ***Maximum monthly counts of Greylag Geese at Loch Leven, 1986/87 - 1993/94 winters.***

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	regular
1986/87	164	800	1500	2100	1700	1200	nc	1767
1987/88	720	1800	2250	2150	1500	400	nc	2067
1988/89	1200	1900	1700	2200	2400	1100	400	2167
1989/90	nc	1200	nc	nc	nc	550	nc	875
1990/91	157	272	1800	2300	60	nc	nc	1457
1991/92	175	250	145	42	40	0	0	190
1992/93	39	50	173	200	370	300	nc	290
1993/94	30	70	36	0	0	40	nc	49
average	81	123	118	81	137	113	-	176

nc = not counted. Average is for 1991/92 to 1993/94.

In the early 1970s most Pinkfeet and Greylag fed within a few km of the loch within the area bordered by the perimeter roads (Newton & Campbell 1973). Twenty years later it was difficult to see a goose in this area away from the RSPB reserve at Vane Farm. The Pinkfeet flighted many km west towards Powmill, north-east towards Strathearn, the Tay estuary and Cupar and east towards Glenrothes. Many feeding sites in these latter areas were not found during this study and figures 2 and 3 are a poor representation of the extent of the feeding area used by geese from Loch Leven. To the north there was overlap with Pinkfeet roosting at Glenfarg Reservoir, Dupplin Loch and the Tay estuary.

In common with all the arable areas of eastern Scotland used by wintering geese large changes have occurred in the cropping regime over the last 10-20 years which have had a dramatic effect on the distribution of feeding geese. Also, almost all the ground within the perimeter roads which was formerly the main feeding area is now shot over regularly. From the top of Benarty Hill on a clear day it was possible to observe the flocks of Pinkfeet being constantly moved around the Kinross basin by shooting parties (J. Burrow pers. obs.). Disturbance from shooting was a major determinant of the number of birds and their distribution within the area. The RSPB is now returning about 120ha of arable farmland at Vane Farm to wet grassland for breeding waders. This will also benefit wintering geese by offering some of the birds a secure feeding area and should help to ease the conflict with local farmers.

b) Glenfarg Reservoir

Glenfarg Reservoir is situated at the eastern end of the Ochil Hills some 8km NNW of Loch Leven. Up to 1500 Pinkfeet were recorded here on three November counts in the 1960s but were rarely found in the 1970s. During this study large numbers were found on the mid-October counts with 3990 in 1990 and 4800 in 1993. Numbers dropped rapidly in November because of disturbance from shooting at the reservoir and in the surrounding area. The site did not appear to be used by roosting geese in mid-winter or spring though birds from Loch Leven and Dupplin sometimes fed in the area. In the 1970s up to 1500 Greylag were regularly found at Glenfarg on the November counts but numbers have been much lower since and 226 was the largest flock found during this study.

Conclusions

Large changes in the status and distribution of both species were found compared to 20-25 years ago (Newton *et al.*1973; Newton & Campbell 1973). Major concentrations of Pinkfeet (regularly over 10,000 birds) were present at three sites, Loch Leven, Strathearn and Strathallan, though Pinkfeet roosted regularly at 21 sites and were recorded feeding in 466 km^2. A number of new roosts were occupied in the last decade and the expansion in range is continuing. The November counts are the only long-term index of goosenumbers available. During the 1960s and 1970s the numbers of Pinkfeet in the area in November reflected the national trend and showed a steady increase but the large expansion of the population since then has not been reflected here and it appears that the area has reached its carrying capacity (Fig.4). The feeding area is much more extensive than that described by Newton *et al.* (1973).

The largest numbers of Pinkfeet were present in early to mid-October with a total of 86,868 on 12/13 October 1991. More typicaly c.65,000

Figure 4. ***The November total of Pink-footed Geese and their proportion of the total population 1961-1993.***

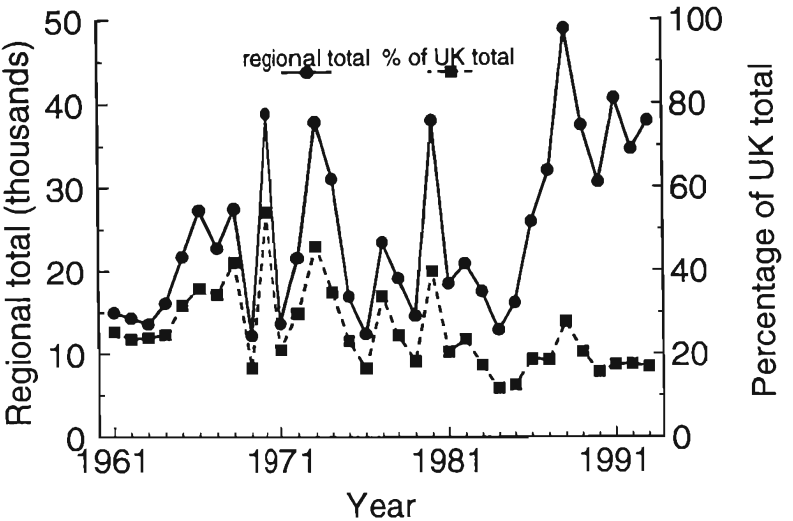
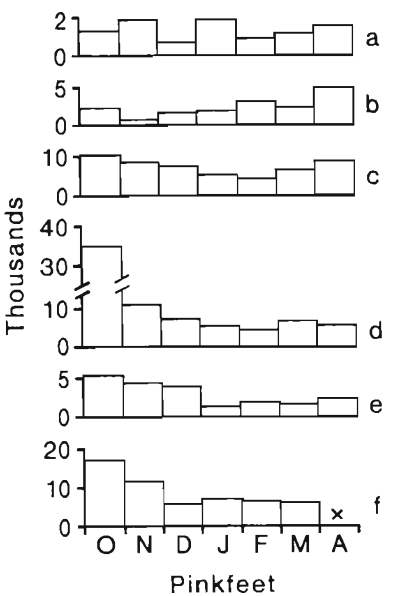


Figure 5. ***Average monthly counts of Pink-footed Geese at the main roosts: a = Skingflats, b= Carse of Stirling, c = Strathallan, d = Strathearn, e = Lochs Tullybelton & Mullion and Kercock, f = Loch Leven. Note different scales. x = insufficient data.***



were present at this time falling to about half this number by mid-November with 20,000-25,000 remaining throughout the winter. Most sites held their peak numbers in October or November (Fig. 5). Dupplin Loch was identified as a key site when the geese first arrive in Britain, regularly achieving peaks of over 30,000 in late September and early October with 57,500 on 28 September 1991 accounting for a quarter of the population in that year. Strathallan was the only site to show a marked spring peak with large numbers remaining here to late April or early May (Fig. 5).

The wintering population of Greylag was much smaller and more dispersed than that of Pinkfeet, roosting on at least 55 sites and feeding in 491km^2. Numbers were relatively steady throughout the winter with little discernible autumn or spring passage (Fig. 6), reflecting the fact that the area is on the southern edge of the wintering range. The population has undergone a large decline and the November totals for the region are now the lowest since counts began in 1960 (Fig. 7) though the birds are spread over more sites. All the major roosts have lost birds and some have almost been deserted, e.g. Loch Leven. This has made it very difficult to obtain a coordinated count of Greylag in November and the only way to census flocks in several places is to systematically search the feeding areas which is very time-consuming and dependent on reasonable visibility.

Many areas are now less suitable for wintering geese. Changes to autumn sown cereals and oilseeds in the 1980s left less stubble available in autumn and early winter and brought conflict with farmers. Rotational set-aside may reverse this change by leaving stubbles in areas where autumn sowing is the norm. However, long-term set-aside, particularly in areas where spring ploughing and sowing was usual as in Strathallan, has eliminated many suitable fields and probably caused the recent decrease in numbers here (Bell *et al.* in prep.).

Observers who have been counting geese since the 1970s can testify to the great increase in disturbance to feeding geese from shooting which has occurred over the last 20 or so years. There is also much anecdotal evidence from people living in the countryside to this effect. In theStrathallan area the incidence of goose shooting on the fields has increased at least three fold since 1988 (Bell *et al.* in prep.). Many farms which were formerly important feeding sites for both species have become untenable because of disturbance from shooting, particularly in Strathmore and Strathearn. Greylag appeared much more vulnerable than Pinkfeet to shooting on the feeding areas and seemed unwilling to move to new feeding areas in response to shooting. This was partly a reflection of the fact that most Greylag fed in relatively small areas close to their roosts, in marked contrast to the situation found in north-east Scotland where Greylag flighted further than Pinkfeet (Bell 1988). Pinkfeet were more wary than Greylag but, because they fed in larger flocks, were better able to take advantage of a good food supply before being disturbed. They were much more mobile and less field-faithful on a day to day basis than Greylag and disturbance had less effect on them. However, being more wary, they were likely to desert a site if disturbed at the roost.

Disturbance of geese by shooting at the roosts was minimal at most sites during this study. All the major roosts are SSSIs and in many cases SPAs and Ramsar sites and one is a NNR. The roosts are thus protected by the highest British and European conservation designations. In spite of this the numbers of Greylag have fallen substantially to the point

Figure 6. ***Average monthly counts of Greylag Geese at the main roosts: a = Carse of Stirling, b = Strathallan, c = Strathearn, d = Scone, e = Blairgowrie Lochs & Kercock, f = upper Tay/Tummel. x = insufficient data.***

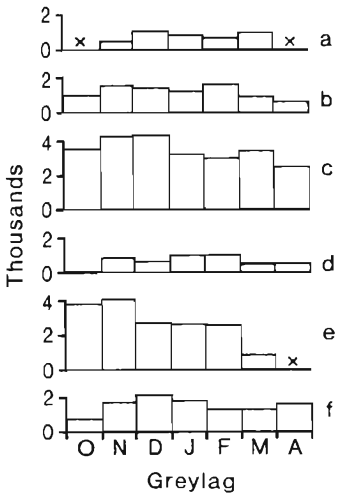
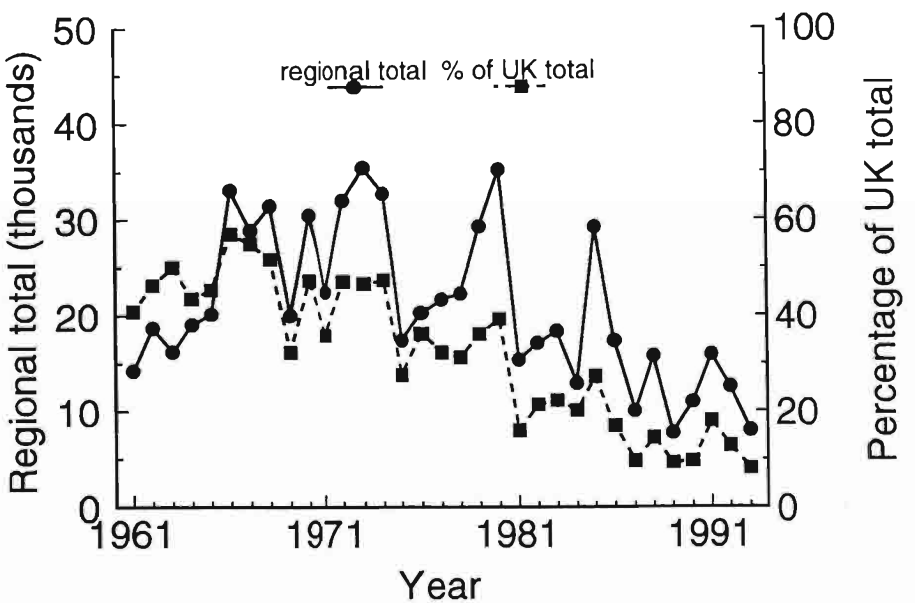


Figure 7. ***The November total of Greylag Geese and their proportion of the total population 1961-1993.***



of disappearance at some formerly major roosts. The average November total for Loch Leven, Dupplin Loch, Drummond Loch and the Carsebreck Lochs was 3132 for the three autumns 1991-93 compared with 11,542 for the corresponding three autumns a decade earlier and 19,847 in 1971-73. The need for secure feeding areas is now a priority if the present wintering range of Greylag is to be maintained. Protecting the roosts has failed to safeguard this population. Set-aside has been a huge wasted opportunity to solve the conflict between geese and farmers and indeed in some areas has exacerbated the problem. We believe many farmers and the major estates would welcome an option to manage set-aside land for geese if an appropriate scheme was put in place by SOAFD or an equivalent body.

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M.V. Bell & S.F. Newton Central

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

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Short Notes

Diurnal and tidal activity patterns of Purple Sandpipers on the Isle of May, Fife.

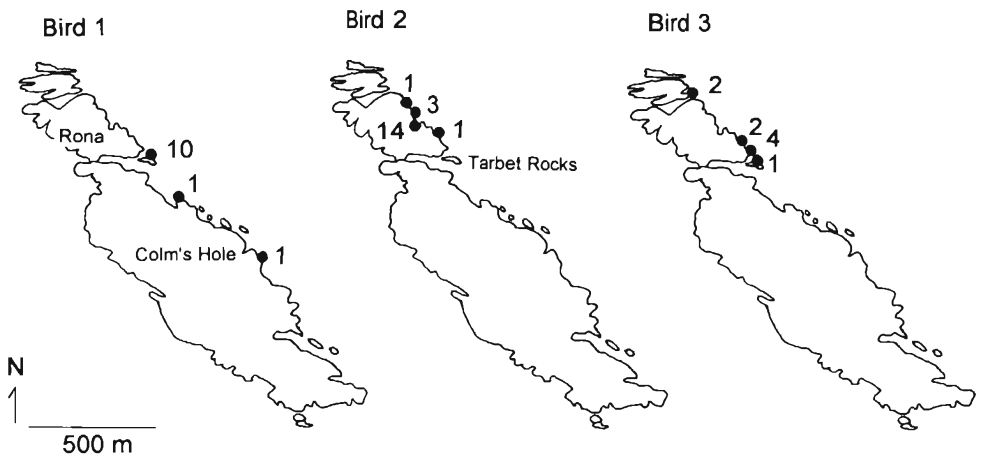
In many studies of the winter feeding ecology of waders, nocturnal activities of the birds are neglected. Waders equipped with touch-sensitive bills can locate prey in soft substrates and potentially can feed at night. Whilst this has been shown for some sandpipers feeding on mudflats (McNeil 1991. *Proc. Int. Orn. Congr.* 20: 1098-1104), there seems less scope for tactile-foraging on rocky shores. The Purple Sandpiper *Calidris maritima* is unusual in that it winters on rocky shores and occurs further north than any other wader, experiencing long nights in winter. The aim of this study was to obtain a better understanding of the night-time activities of Purple Sandpipers.

The study was done from 14 - 17 April 1993 and 9 - 16 April 1994 on the Isle of May, Fife (Plate 1). Four Purple Sandpipers were dazzled-netted at night, one on 14 April 1993, and three on 9 April 1994 on the east side of Rona (Fig. 1). Transmitters, weighing 1g, were glued to the back feathers and the birds were released at the site of capture.

During two 24-hour periods, the radio signals from the transmitters were listened to for a minute, each half hour. The signal was classed as 'varying' or 'steady'. Varying signal strength indicated that the bird was active, due to the changing alignments of the transmitting antennae relative to the receiving antenna,

Plate 1. The Low Light and the north end of the Isle of May where the study was carried out.

Figure 1. ***The Isle of May showing sites where the radio-tagged Purpe Sandpipers were subsequently relocated. The numbers give the frequency of records. They were all captured on the south-east part of Rona.***

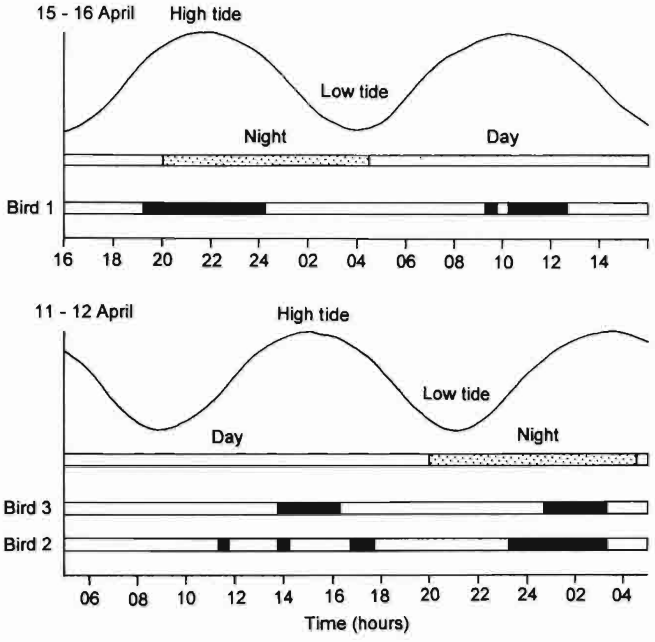


which has held still. Steady signals indicated that the bird was standing still. The birds were inactive only around high tide and were active at low tide regardless of whether it was day or night (Fig. 2). The fact that they were active at night suggests that they were feeding. It is not known how they detect prey on rocky shores at night, though Purple Sandpipers do have a touch and taste-sensitive bill (Gerritsen & Sevenster 1985. *Fortschritte der Zoologie* 30: 237-239) and do not need to rely on visual cues to detect prey.

Information on the areas occupied by the birds was obtained by triangulation. The locations of birds were monitored at irregular intervals but only those at intervals greater than 3h were plotted. All the birds were located within small areas on the island (Fig.1), usually close to where they were captured. Bird 1 remained between east Rona and Colm's hole, spending most of the time on the Tarbet rocks (Fig. 1). Bird 2, which was located every time it was searched for, had a restricted range over six days.

Birds 1, 3 and 4 went missing on occasions. At dawn on 17 April 1993, bird 1 disappeared from the area where it spent the previous day and could not be found anywhere on the

Figure 2. ***The activity patterns (□ active, ■ inactive) of three radio tagged Puple Sandpipers in relation to tide and day/night (▒ night).***



island. Later that day, the bird was located on the mainland at Fife Ness, 8km from the island. The bird had flown there in a force 4-5 wind. Bird 3 had no set pattern to its arrivals and departures. It remained on the island during 11 April and departed early on 12 April. It then returned for the night of 12-13 April but was not located again until 2030hrs (GMT) on 15 April. It was still on the island at 0630hrs on 16 April when observations stopped. Bird 4 spent no daylight hours on the island, arriving between 1930hrs and 2055hrs when it was almost dark and departing between 0300hrs and 0330hrs when daylight was just breaking (sunrise was about 0515hrs). This bird was also located at Fife Ness on 16 April 1994. The weather was very windy (force 7, northerly) during some of the times when the bird commuted to and from the island.

Colour-ringed Purple Sandpipers marked on the Isle of May have been sighted at many localities in the outer Firth of Forth and north along the Fife coast to St Andrews, as well as on the island itself (Atkinson *et al.* 1981. *Ornis Scand.* 12: 18-27). This information together with the data on the departures and arrivals of radio-tagged birds indicate that the island is used in different ways by Purple Sandpipers. There are those that appear to be resident on the island where they occupy small areas. Also, there is evidence that some birds use the island irregularly and there is turnover in the Isle of May population. Then, there are birds which use the island at night and commute to the mainland for the day. In earlier studies on the Isle of May, Summers *et al.* (1975. *Scott. Birds* 8: 299-308) suspected

that Purple Sandpipers commuted from and to the island, using the island as a safe roosting place, perhaps because there are no rats on the island.

R.W. Summers, Lismore, Mill Crescent, North Kessock, Inverness IV1 1XY.

Plate 2. ***A Purple Sandpiper at a roost.*** ***Photographs by the author.***

Little Ringed Plovers attempt breeding in Dumfriesshire

As BTO representative for Dumfriesshire, I was contacted by a bird-watcher who had found a pair of Little Ringed Plovers *Charadrius dubius* on 27 May 1992. On condition that the site remained confidential we visited the locality together on 31 May and watched an incubating bird with its mate. When we returned on 7 June both birds were feeding at the water's edge; the scrape was empty and the birds had failed. When we returned on 12 June a bird was incubating a clutch 60m away from the original scrape. The birds were twice observed chasing off Ringed Plovers *Charadrius hiaticula* which approached their nest. On 24 June and 4 July the birds were still incubating this clutch and the original observer returned on 7 July hoping to see the pair with small young, but the adults had disappeared. The site was searched again on 13 July but no Little Ringed Plovers were seen and we concluded that the pair had failed at around the time of hatch.

In 1993 Little Ringed Plovers were first seen on 9 May. There were two birds, one of which performed a 'butterfly' type song flight over the territory of the previous year, then performed a scrape-display. On 11 May two male Little Ringed Plovers were in song-flight and a third bird was also seen. Hopes of successful breeding were dashed by the weather. Snow followed by heavy rain on 13-15 May caused flooding and all suitable nesting habitat disappeared under water for at least two days. Although the site was regularly visited throughout the season the birds were not seen again. They were not seen at all in 1994 despite frequent searches at the appropriate times.

There are two former records of Little Ringed Plovers breeding in Scotland; in Lanark in 1968 (Stalker, D. *Scott. Birds* 5: 282-3) and at a disused gravel pit in Fife in 1989 (Oliver, D.W. *Scott. Birds* 16: 42-3) but the site was afterwards destroyed. A displaying male was seen at another gravel pit in Fife in 1990, but no female appeared and this site also was subsequently filled in. *The New Atlas of Breeding Birds in Britain and Ireland: 1988-1991* (1993, Gibbons, Reid & Chapman) shows the Fife breeding record and two other 'sight records' for Scotland. The *Atlas* also indicates a gradual spread of Little Ringed Plovers into northern England, with the nearest breeding birds being near the Solway, in Cumbria. With so much recent gravel extraction in Dumfriesshire for the upgrading of the A74 to motorway standard it is possible that other pairs may have attempted to breed or may do so in future years.

Richard Mearns, Connansknowe, Kirkton, Dumfries DG1 1SX.

Numbers and breeding success of Manx Shearwaters on the Isle of Canna, 1973-94.

In April 1973 and 1974, all suitable Manx Shearwater *Puffinus puffinus* sites on the island were visited and the number of burrows with shearwater droppings at their entrance counted. Observation burrows were then used to calculate the number of burrows subsequently laid in. This gave a figure of 1000-1500 breeding pairs on Canna (Swann & Ramsay 1976 *Seabird Report* 5:38-41).

In April 1993 the process was repeated. 253 burrows with droppings were located along the crags by the Tarbert Road, on the south side of the island, and none elsewhere. Of 35 study burrows subsequently checked, which had had droppings at their entrance, only 17 (49%) were laid in. Two others were occupied by single birds and a third contained a dead adult. These figures suggest that there were only 124-144 pairs of shearwaters nesting on Canna in 1993. In April 1994 only 117 burrows with droppings were located though exceptionally heavy rain may have led to this being an under estimate. These figures indicate a massive decline in the number of shearwaters nesting on Canna over a 20 year period. The cause of this decline could be a reduction in breeding success or increased mortality rates or a combination of these two factors.

TABLE 1. ***Number and percentage of occupied Manx Shearwater burrows on Canna and breeding success as a percentage of eggs laid that fledged young.***

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
no.occupied burrows	35	45	49	46	41	38	42	38	46	44	37
% observation burrows occupied	73%	72%	75%	78%	77%	66%	73%	82%	81%	67%	66%
% young fledged per egg laid	51%	82%	73%	61%	76%	25%	2%	68%	59%	66%	65%

	1987	1988	1989	1990	1991	1992	1993	1994
no. occupied burrows	41	31	13	21	25	28	17	16
% observation burrows occupied	66%	65%	24%	42%	43%	45%	33%	32%
% young fledged per egg laid	68%	42%	31%	52%	52%	46%	47%	75%

Breeding success has been monitored on Canna since 1976 (Table 1) using up to 60 observation burrows. The percentage of occupied burrows was fairly high from 1976-1984 (Table 1) but began to fall after 1984 and dropped even further from 1989-1994. Breeding success has tended to be variable. Low success in 1976 and 1982 was attributed to high levels of rat predation in the colony but applications of rat poison in subsequent years appeared to cure the problem (Swann & Ramsay 1984. *Scott. Birds* 13:40-47). To ascertain whether rat predation was still a problem, chew sticks (spatulas dipped in molten margarine) were placed throughout the colony in April 1994 to detect the presence of rats. The sticks were collected three days later. None had been chewed.

Excluding these 'poor' years, breedings success tended to be about 0.59-0.82 young per egg laid (1976-87). This compares with a mean of 0.7 on Skokholm (1973-76) (Brooke 1990. *The Manx Shearwater,* Poyser, London.). Between 1988-1993 breeding success was markedly lower with only 0.31-0.52 young per egg laid. The cause of this decline in breeding success is not known. Since 1982, however, other seabird species on Canna have shown declines in numbers and breeding success. Kittiwakes *Rissa tridactyla* have steadily declined since 1982, Shags *Phalacrocorax aristotelis* have undergone a major decline in numbers and breeding success since 1984, whilst Guillemot *Uria aalge* and Razorbill *Alca torda* numbers peaked in 1983 and 1985 respectively and have since shown slight declines (Swann 1993, *JNCC Report* No. 181). The causes of these declines are unknown but a reduction in the availability of sandeels has been suggested as a contributory factor in the decline of the breeding success of Shags (Swann *et al.* 1994 *Seabird* 16: 50-56) and may also have had an effect on shearwater breeding success.

Acknowledgements

Many thanks to everyone who helped gather this data over a 19 year period. I am indebted to Dr and Mrs J L Campbell and the National Trust for Scotland for giving permission to conduct our seabird studies on the island. The work done on Canna is currently supported by the JNCC Seabird Monitoring Programme.

R. L. Swann, 14 St. Vincent Road, Tain, Ross-shire IV19 1JR

Buzzard's interaction with stoat

On 14 February 1994 at a floodwater pool in a field at Cullerlie, near Echt, Grampian we watched a Buzzard *Buteo buteo* feeding on a dead young Herring Gull *Larus argentatus.* As the Buzzard fed, a stoat *Mustela erminea* appeared a few metres away. The Buzzard flew 5m to a fence post. Within a few seconds the stoat appeared under the fence, directly below the Buzzard. The stoat ran around the foot of the post, jumping up at the Buzzard from time to time, at one point almost landing on the fence. For about 10 mins the Buzzard flew from post to post while the stoat ran after it and continued to leap up at it now and again.

The Buzzard flew to the edge of the floodwater about 15m from the fence. Again, within 30 secs the stoat reappeared 7-8m from the

Buzzard. The stoat walked, then began to run straight for the Buzzard until it was within 0.5m of it before retreating. This behaviour continued for about 1 min. On its final run, the stoat went right up to the Buzzard's legs and actually nudged the bird. The Buzzard flapped its wings and seemed almost to lose its balance. The stoat then retreated about 1m and began rolling onto its back. This behaviour was followed by it running in very small circles, somersaulting, twisting and pulling itself along on its back. The Buzzard appeared to be watching it and moved a little closer.

King (1989. *The Natural History of Weasels and Stoats*. Helm) refers to an observer, J. H. Lawton, who watched almost identical behaviour of a stoat 'dancing' in front of Moorhens *Gallinula chloropus* where it occasionally attempted to catch them. 'Dancing' stoats are well documented (Corbet & Southern 1964. *Handbook of British Mammals*). It is still debated whether it is a deliberate hunting technique or an involuntary response to parasitic worms inside the skull (King 1989).

It seems possible in this case that the stoat was 'mobbing' the larger predator, or may even have been hunting it. R. C. Dickson (1980 *Scott. Birds* 11: 119) observed an otter *Lutra lutra* apparently attacking a Hen Harrier *Circus cyaneus* on a fence post. It seems unlikely that a stoat would attack prey as large as a Buzzard but 'in relation to their size, stoats and weasels kill larger prey than do any other British carnivores' (Hewson & Healing 1971. The Stoat and its prey. *J. Zool. Lond.* 164: 239-244). Also Anderson (1966. *The Countryman* 122) saw a Buzzard swoop, pick up a weasel and fly off with it, but the Buzzard fell to the ground, dead, covered with blood and with the weasel gripping its breast. Svendsen (1982. *The Wild Mammals of North America*) reports a dead eagle, which was found to have a bleached weasel skull fixed to its neck.

In our case, the Buzzard flew back to the fence. The stoat also returned to the fence, once again below the Buzzard. After a few minutes the stoat disappeared and was not seen again, although the Buzzard was still present when we left 15 min. later.

Judy M. Duncan, 86 Broadfold Drive, Bridge of Don, Aberdeen AB23 8PP
Gillian F. A. Cooper, 14 Abbotshall Gardens, Cults, Aberdeen AB1 9LA

Spread-wing posture by a juvenile Peregrine Falcon in winter

On 2 February 1992 from 1136 to 1208hrs, a dry day of weak sun and a moderate to fresh wind, I saw a juvenile Peregrine Falcon *Falco peregrinus* on an exposed fence post facing into the wind in farmland on low ground in west Galloway. On and off for over 15 min, it sat with its wings extended at right angles (like the spread-wing posture of a Cormorant *Phalacrocorax carbo*), occasionally preened and twice shook its feathers. During this time it twice jumped down into rough grass and lay down with its wings spread-eagled, facing into the weak sun, for short periods. It eventually flew away.

On 9 February 1992 at 1344hrs, after heavy rain in the morning and sunny spells in the afternoon, I again saw a juvenile Peregrine Falcon (probably the same bird) sitting on the same fence posts for over an hour and carrying out similar activities to those seen a week earlier. It again jumped down into rough grass and twice lay down with its wings spread-eagled, facing the sun, and then sat with its wings fully extended on a fence post. At 1450hrs it chased a flock of Sky Larks *Alauda arvensis*.

Feather care used by Peregrines in winter includes water bathing (Baker 1967. *The Peregrine Falcon*. Collins, London), preening, shaking and wing stretching but the above behaviour is probably seldom seen or recorded in the wild. Some falcons will spread their wings fully while sunning in the prone position on the ground but apparently only in captivity (Simmons K.E.L. 1986. *The Sunning Behaviour of Birds*. Bristol). Simmons (in litt.) points out that interpretation of such incidents is always difficult but that the birds could have been 'sun-drying' and 'sun-basking' probably after a bath on one or both occasions. The Sparrowhawk *Accipiter nisus* uses a standing loose-spread wing posture for drying and sunning after a bath and this posture has also been seen in sunning Peregrines (see Simmons for details) but the full-spread open wing standing posture (see above) has not been recorded in the Peregrine although it has been seen in wild Eleonora's Falcon *Falco eleonorae* (Simmons 1986.)

R.C. Dickson, Lismore, New Luce, Newton Stewart DG8 0AJ

Magpie's nest - with a difference

The nest of a Magpie *Pica pica*, pictured in the colour plate was recently donated to Glasgow Museums. It had been removed from about 15-20 feet up in a *Cupressus* tree, which was being partially cut down in a garden in Rutherglen, Glasgow. The cup of the nest was like a normal Magpie's nest, made from twigs, bound together with mud and lined with fine roots. Underneath the nest, however, the Magpies had constructed a platform mainly using S-shaped wire wall ties from a nearby building site. Approximately 100 ties were used, together with other miscellaneous pieces of wire and even an old aerial from a car! I always thought that Magpies collected shiny objects and put them in their nest. This is the first time I have heard of them actually making their nest out of the objects which they have stolen.

Richard Sutcliffe, Curator, Science Department, Glasgow Museums

Wheatears' mountain top roost

The wide plateau on top of Ben Avon, Britain's 16th highest mountain, in the eastern Ciarngorms, is scattered with huge tors of rock, the largest protruding some 20m upwards out of the summit plateau. The tors are formed of huge masses of granite with linear cracks weathering into them, some forming deep fissures.

It is pleasing to note these tors are of use to birds. On 17 July 1994 I passed Clach Choutsaich, a prominent tor at 1110m asl, just prior to dusk. A group of seven or eight Wheatears *Oenanthe oenanthe* were perching about the tor and sitting in the mouths of certain deep horizontal crevices, calling perhaps to each other or perhaps in mild alarm to me. I passed back again at 2215h, now in very dim light. The Wheatears were out of sight, but a soft call or two revealed that they were deeper within the tor's fissures, settling inside to roost. Whether this was a family group that may also have nested in the tor is now known. During the day, Wheatears were common on the stony parts of the summit plateau.

Roosting is an aspect of bird behaviour often given scant treatment in species accounts. There is no mention of birds using these tors by Seton Gordon (1939, *The Cairngorm Hills of Scotland,* Cassell, London) nor by Nethersole-Thompson & Watson (1981, *The Cairngorms*, Melven Press, Perth). *BWP* Vol 5 (1988) does not detail roosting but records that outside Britain, Wheatears inhabit mountain-top plateaux up to 3000m in Europe, above 3000m in Iran, and to 3500m in the former USSR.

Harry E. M. Dott, 70 Findhorn Place, Edinburgh EH9 2NW

Items of Scottish interest

Most of the following papers and reports on birds in Scotland are available in the Waterston Library at 21 Regent Terrace for reference, and include all that have come to notice in the period October 1994 to February 1995. The librarian would be glad to learn of anything that has been missed, and to receive reprints or copies of papers on any aspect of ornithology or natural history. Bird reports marked with an asterisk are available from the SOC at the prices quoted, but please add 50p per order for postage and packing.

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William G. Harper

Advice to Contributors

Authors should bear in mind that only a small proportion of the Scottish Birds readership is science-trained, and should aim to present their material concisely, interestingly and clearly. Unfamiliar technical terms and symbols should be avoided wherever possible and if deemed essential should be explained. Supporting statistics should be kept to a minimum. All papers and Short Notes are accepted on the understanding that they have not been offered for publication elsewhere and that they will be subject to editing. Papers will be acknowledged on receipt and will be reviewed by at least two members of the editorial panel and in some cases also by an independent referee before being accepted. They will normally be published in order of acceptance of fully revised manuscripts. The editors will be happy to advise authors on the preparation of papers.

Reference should be made to recent issues of Scottish Birds for guidance on style of presentation, use of capitals, form of references, etc. **Papers should be typed on one side of the paper only, double-spaced and with wide margins; two copies are required and the author should also retain one.** Headings should NOT be underlined, nor typed entirely in capitals. Scientific names in italics should follow the first text reference to each species and should follow Voous 'List of Recent Holarctic Bird Species' as given in the The British Birds' List of Birds of the Western Palearctic (1984). Only single quotation marks should be used throughout and numbers one to ten should be written out whereas 11 and above should be written as numerals. Dates should be written:.....on 5 August 1991.....but on the 5th (if the name of the month does not follow). Please note that papers shorter than 700 words will be treated as Short Notes where all references should be incorporated into the text, and not listed at the end, as in full articles.

Tables, maps and diagrams should be designed to fit either a single column or the full page width. Tables should be self-explanatory and headings should be kept as simple as possible, with footnotes used to provide extra details where necessary. Each table should be on a separate sheet. Maps and diagrams should be in Indian ink and be camera ready, but drawn so as to permit reduction to half their original size.

For details of writing Research Progress Reports, please contact the editor in advance.

Errata:- Snow Buntings: Vol 17.4
p 223-234

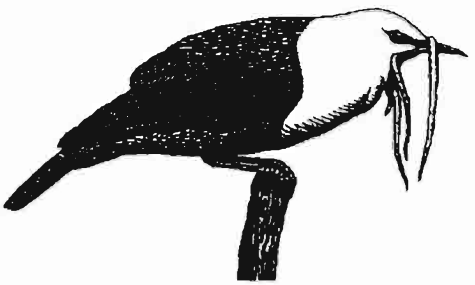
Figure 1. Estimated first egg dates (days from 1st May) of all Snow Bunting nests and broods found during 1987-1993, arranged by 5-day periods (10=days 8-12, 15=13-17, etc.). Hatched bars represent Area A, solid bars Area B.

Figure 2. Estimated first egg dates (days from 1st May, to nearest 5-day interval) of first brood Snow Bunting nests found on Area A in each of the six summers 1988-1993. Hatched bars show nests which were ultimately thought to be successful, filled bars those those which failed. The arrows indicate the occurrence of heavy snowfalls (more than 5cm or giving 95+% snow cover) and the figure below is the number of days for which 50% cover persisted.

Figure 3. The annual percentage of female Snow Buntings which, having reared one brood successfuly, went on to rear a second brood successfully, against the mean first egg date (days from 1st May) of successful first broods.

Figure 4. The frequency of total contents (estimated clutch size: eggs plus young) of 115 Snow Bunting nests found with eggs or small young (filled) and 76 nests with 5 to 9-day-old young (hatched).

Figure 5. The frequency distribution of brood sizes in Snow Bunting nests when the young were ringed (mostly 6-8 days old) in first (hatched bars; n=127) and second broods (filled bars; n=77).

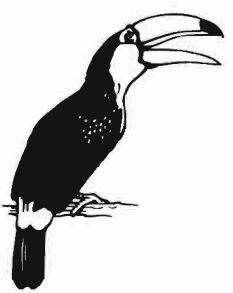


NEOTROPICAL BIRD CLUB

Neotropical bird club launched

A club has been launched to promote the study and conservation of the birds of the Neotropics (South America, Central America and the Caribbean). It is currently seeking founder members to help reach the launch budget of £2000, which is required to get the club running and to publish the two first issues of its intended journal 'Continga'. Founder members will be asked to pay a minimum of £25, and will be formally acknowledged in the first issue of 'Continga'. 'Continga' will provide a colourful and much needed forum for exchange of information on the avifauna of this extremely rich and diverse area, and will contain papers and features on the birds and their conservation as well as news of recent observations and discoveries (at present, new species are still being discovered at the rate of more than two a year). It is hoped that in due course the club will be able to provide direct funding and support for practical conservation programmes.

For further details and membership forms, please contact:
Rob Williams,
Publicity Officer,
Neotropical Bird Club,
c/o The Lodge,
Sandy,
Bedfordshire SG19 2DL



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