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Numbers of wintering Pink-footed and Greylag Geese in north-east Scotland 1950-1986

M.V. BELL, J. DUNBAR
AND J. PARKIN

The status of Pink-footed and Greylag Geese in north-east Scotland this century is described with emphasis on the large changes which have occurred since 1960. During this period the numbers of Pinkfeet have increased greatly at the two traditional roosts, the Loch of Strathbeg and the Meikle Loch. Up to 30% (40,000 birds) of the British wintering population may roost there. Greylag have also increased and now occupy five new roosts. North-east Scotland regularly holds up to 30% (30,000 birds) of the British wintering population of Greylag. The reasons for these changes are discussed.

Introduction

Pink-footed Geese *Anser brachyrhynchos* and Greylag Geese *Anser anser* have been wintering in north-east Scotland for many years. The early Scottish naturalist Thomas Edward recorded Pinkfeet at the Loch of Strathbeg (Smiles 1877), but there was considerable confusion between this species and the Bean Goose *Anser fabalis* in the 19th century. Pinkfeet were certainly present at Strathbeg by the turn of the century and by the late 1930s up to several thousand occurred here, and in the Slains area to the south in autumn (Berry 1939). However, the use of the Loch of Strathbeg as a roost was probably interrupted during both world wars. In the Great War it was used as a seaplane base and in the second war there was disturbance from the adjacent Crimond airfield. At the time of Berry's review of wild duck and wild geese in Scotland, Greylag were stated to be present in only small numbers at several sites in the Dee faunal area, with their status unchanged for many years (Berry 1939). No quantitative information on the wintering geese existed before the Wildfowl Trust began its series of national November counts of Pinkfeet in 1950 and Greylag in 1960.

This paper describes the fluctuations in numbers of both species since then. During this period several new roosts have been occupied by Greylag, and the last 10 years in particular have seen some dramatic changes. North-east Scotland is now one of the most important areas in Britain for both Pinkfeet and Greylag with up to 40,000 and 30,000 respectively.

Survey area

The area of north-east Scotland discussed in this paper is shown in Fig. 1. It comprises the area north of the River Dee and east of the River Deveron, mainly the old county of Aberdeenshire including part of Kincardine to the south and Banff to the north-west, all now in Grampian region. This large area has very few stretches of water which are suitable as goose roosts and consequently large numbers of geese are concentrated in a few sites. This has the advantage that a few observers can obtain a fairly complete picture of the changes in numbers through the winter. There are two major Pinkfeet roosts, at Loch of Strathbeg and the Meikle Loch/Ythan estuary, and seven Greylag

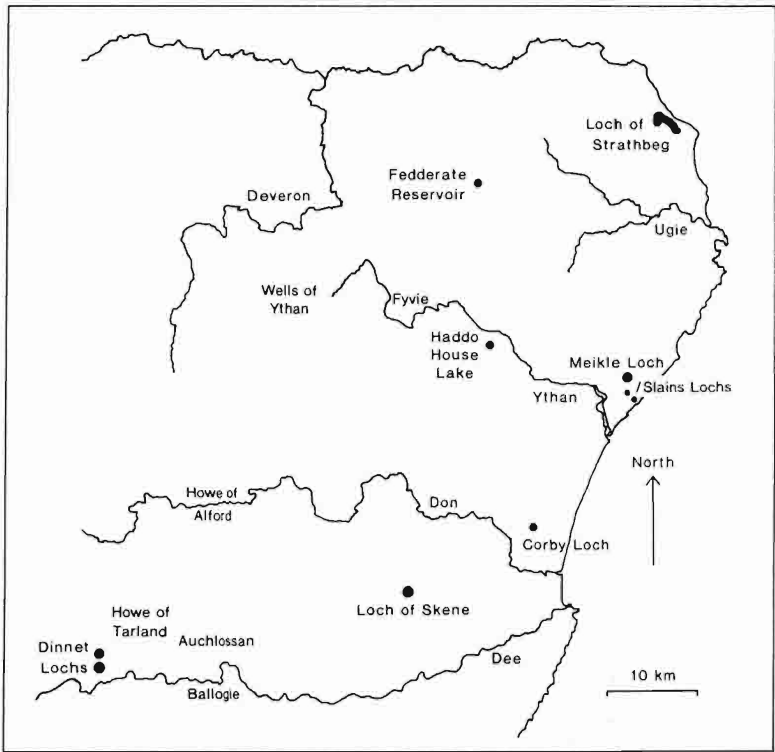


FIGURE 1. A map of north-east Scotland showing the position of the goose roosts and other places mentioned in the text, in relation to the main rivers and the coast. Pinkfeet roost at Loch of Strathbeg and the Meikle Loch, and Greylag roost at the Loch of Strathbeg, Federation Reservoir, Haddo House Lake, the Slains Lochs, Corby Loch, Loch of Skene and the Dinnet Lochs.

roosts, at Loch of Strathbeg, Loch of Skene, Lochs Davan and Kinord (collectively the Dinnet Lochs), Haddo House, Corby Loch, the Slains Lochs and Federation Reservoir.

The roosts in north-east Scotland are well separated from the other wintering areas for both species. There are no major Pinkfoot sites to the north and the nearest roost to the south is the Montrose Basin (77 km SSW of the Ythan estuary), which is regaining its former importance since the Scottish Wildlife Trust established a reserve there in 1981. There are major concentrations of Greylag in Caithness, Easter Ross and along the Moray Firth. The nearest

roosts are at Loch Spynie near Elgin (82 km west of Strathbeg) and in Strathmore (Perthshire and Angus), 50 km to the south of the Dinnet Lochs.

Methods

Experienced observers familiar with particular sites counted geese arriving at or leaving the roosts. Long runs of data were available from the same few observers for most roosts.

The national November count data were taken from Boyd & Ogilvie (1969, 1972), Ogilvie & Boyd (1976), from the annual reports of the Wildfowl Trust and from Dr M.A. Ogilvie (pers. comm.).

Agricultural statistics on cropping regimes were obtained from the Scottish Records Office for selected Aberdeenshire parishes and years since 1960. The parishes of Crimond, Lonmay and St Fergus were taken as representative of the feeding areas used by the geese from Strathbeg; those of Slains, Logie-Buchan and Foveran for the geese from Meikle; Methlick and Meldrum for the geese from Haddo; Kinellar and Skene for the geese from Skene and Lumphanan, and Leochel-Cushnie for the geese from Dinnat. The years 1960, 1965, 1970, 1975, 1978, 1980, 1982 and 1984 were taken to give a spread over the period since north-east Scotland became of major importance for wintering geese.

Results

Buchan

Loch of Strathbeg Of the two goose roosts in Buchan, the Loch of Strathbeg qualifies as a site of international importance for ducks, geese and swans. The loch is large (220 ha), shallow, rather exposed and within 500 m of the sea. It is a difficult roost to count because of its size. Since the RSPB reserve was established in 1973 most of the geese have roosted at the sheltered north-west end of the loch in the peninsula area which is relatively undisturbed by wildfowlers.

There is a run of monthly counts at Strathbeg since the mid-1950s. Fig. 2 shows the winter maximum and average mid-monthly count (October to March up to 1973, October to April since 1973) for both Pinkfeet and Greylag at Loch of Strathbeg since the 1954/55 winter. Table 1 shows the average mid-monthly counts for seven convenient periods from 1954/55 to 1986/87 and the maximum count within each period. Until the 1963/64 winter numbers of both species were low, with Pinkfeet slightly the more numerous. Greylag numbers were relatively stable through the winter while Pinkfeet numbers reached a peak in autumn and then declined. Numbers remained fairly constant for the next eight or nine winters with both species present in similar numbers and increasingly likely to stay through the winter.

Numbers increased after 1973. In the following 10 years the Greylag reached maxima of 9500 in November 1975, 9600 in November 1982 and 8350 in March 1985. Since the 1984/85 winter the Greylag numbers have decreased slightly but Pinkfeet numbers have increased markedly. The maximum count of Pinkfeet at Strathbeg up to 1983/84 was 7500 in November 1977 but in the 1984/85 winter, 20,200 were recorded in October,

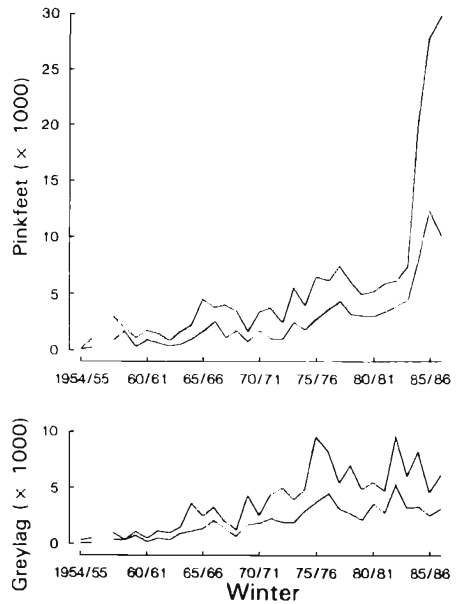


FIGURE 2. The average monthly count and maximum count of Pinkfeet and Greylag at Loch of Strathbeg each winter from the 1954/55 – 1986/87 winters.

with 27,900 in October 1985 and 29,800 in October 1986. Over 10,000 were also present in the springs of 1985, 1986 and 1987.

Fedderate Reservoir The small flock of Greylag at Fedderate Reservoir has been counted in November and March since 1977 but it is not clear when the site was first occupied (John Edelman pers. comm.). This small water (c. 10 ha) is easily disturbed and appeared to hold more birds in the spring after the end of the shooting season than in the autumn. The numbers in November ranged from 10–2500 (average 684) between 1977 and 1986, and in March ranged from 1400–2700 birds (average 1840) between 1982 and 1986. The surrounding land which rises to 200 m (650 ft) is very exposed, often taking the brunt of winter snow storms from the north, and is therefore frequently deserted by geese in mid-winter.

Ythan Valley

Slains Lochs and Ythan Estuary The Slains estate and adjacent Ythan Estuary have been used extensively by both Pinkfeet and Greylag for many

TABLE 1. The average monthly counts of geese at Loch of Strathbeg from 1954/55-1986/87, together with the maximum count within each period (no counts available for the 1956/57 winter; nc = not counted).

PINKFEET	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Maximum
1954/55 - 59/60	1050	670	80	100	0	200	nc	3000
1960/61 - 64/65	1120	1306	180	240	305	546	nc	2239
1965/66 - 69/70	2556	2310	440	1150	850	2240	nc	4600
1970/71 - 74/75	2868	2870	60	1410	1000	1970	nc	5500
1975/76 - 79/80	4240	5570	3860	2300	2050	2300	3610	7500
1980/81 - 83/84	5725	4288	2975	1913	3950	2575	4513	7400
1984/85 - 86/87	25933	12283	6050	2467	4767	8717	10767	29800

GREYLAG	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Maximum
1954/55 - 59/60	350	398	300	503	3	52	nc	1100
1960/61 - 64/65	876	1432	680	510	416	157	nc	3734
1965/66 - 69/70	1340	2544	770	1450	1332	1050	nc	4380
1970/71 - 74/75	2970	3600	874	1302	1450	2970	nc	5000
1975/76 - 79/80	2986	6950	4160	2620	2450	1180	1920	9500
1980/81 - 83/84	3738	5488	4063	1850	3338	3750	3475	9600
1984/85 - 86/87	1383	3483	3617	2083	5367	4433	683	8350

years. Unfortunately there is little information on numbers here apart from the national November counts. Since 1980/81 more frequent counts have been carried out.

During the last 10 years the main Pinkfoot roost has been the Meikle Loch (26 ha). This is a Site of Special Scientific Interest (SSSI) but is not part of the Sands of Forvie and Ythan Estuary National Nature Reserve (NNR). The much smaller Cotehill Loch (3.1 ha) and Sand Loch (4.4 ha) are included in the NNR. The Meikle, Cotehill and Sand Lochs are collectively referred to as the Slains Lochs since they are situated on the Slains estate. In the following account Meikle Loch is used when discussing Pinkfeet and the Slains Lochs when discussing Greylag as small numbers of the latter often roosted on Cotehill and Sand Lochs, and pools on the Sands of Forvie. There was controlled wildfowling for geese and ducks at the lochs, and they provided a better sanctuary than the Ythan Estuary NNR 3 km to the south which was regularly disturbed by wildfowling. However, at the end of the shooting season the Pinkfeet resorted increasingly to the estuary and by mid-April most roosted there. Sometimes Pinkfeet roosted on Sand Loch near Collieston, and also on a semi-permanent floodwater pool 1 km to the north of the Meikle Loch.

The much smaller flock of Greylag was also usually found on the Meikle Loch, but showed a greater tendency to disperse. Flocks of several hundred birds quite often occurred on Sand Loch, pools on the Sands of Forvie, and at the Ythan

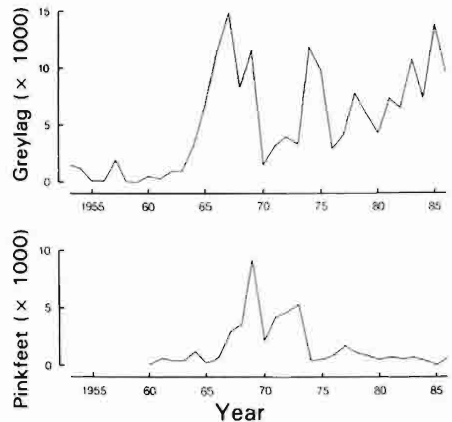


FIGURE 3. The November counts of Pinkfeet and Greylag at the Slains Lochs between 1953 and 1986.

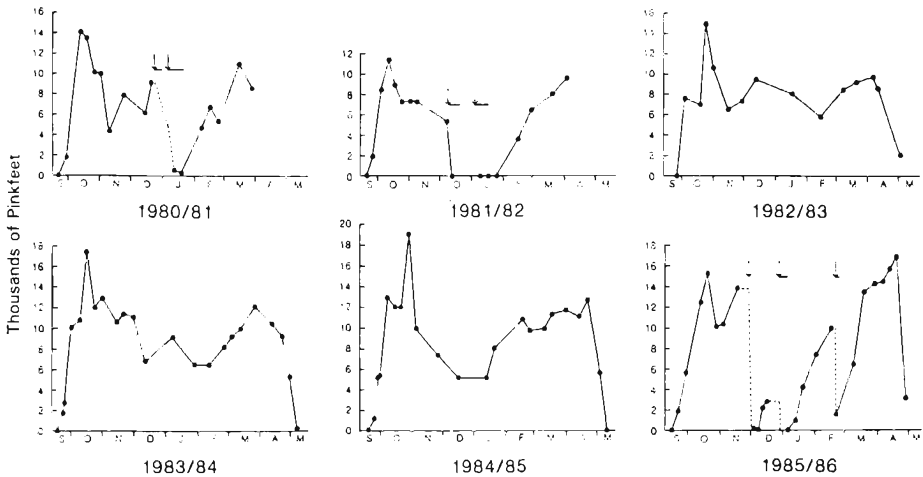


FIGURE 4. The numbers of Pinkfeet roosting at the Meikle Loch/Ythan Estuary between September and May from the 1980/81 – 1985/86 winters. The arrows indicate snowfalls and the bars periods with 10 cm or more snow cover. Broken lines are extrapolations based on counts before and after snowfalls.

Estuary in the spring; smaller numbers roosted at Cotehill less regularly. Site preferences changed between and within winters.

The November counts of Pinkfeet in the 1950s ranged from 0–2000 (Fig. 3), but since the mid-1960s very large numbers have occurred in some autumns. The November counts indicate little change in the status of the Pinkfoot here over the last 20 years; more than 10,000 birds were present in November 1966, 1967, 1969, 1974, 1975, 1983 and 1985. It seems probable that more now remain through the winter and occur in the spring than formerly.

Between the 1980/81 and 1985/86 winters detailed counts were obtained of the geese roosting at the Meikle Loch and Ythan Estuary. Whenever possible, attempts were made to count the roost weekly or fortnightly. Small numbers of Pinkfeet often arrived in the second week of September but the main arrival was in late September and early October, usually peaking at c. 15,000 birds in October (Fig. 4). In most years numbers had dropped by the November count, although high numbers were maintained through November in 1983 and 1985. The main factor influencing numbers in December, January and February was the presence of snow deeper than c. 10 cm. In winters when the Buchan coast was snowfree, numbers remained high throughout the winter, e.g. 1982/83, 1983/84 and 1984/85 (Fig. 4). In the three snowy winters, all the Pinkfeet

were left at least once, and this is probably more typical. However, the 1985/86 winter was unusual as three well-separated snowfalls caused major departures of the Pinkfeet, but on each occasion they soon returned.

In late February numbers began to build up and the spring peak was reached in late March or April (Fig. 4). In the first three winters of this series (1980/81–1982/83) the totals in late February and March were obtained from field counts, which at the time were thought to be adequate but which we now think may have been incomplete. No counts were carried out in April 1981 or 1982. In 1984/85 and 1985/86 there were very large peaks in late April and the departure in April 1985 especially was very late. In both years a prolonged period of cold north-westerly winds in late April may have delayed departure.

The numbers of Greylag at the Slains Lochs have been more variable than those of Pinkfeet over the last 25 years. The November counts between 1960 and 1966, and from 1974 onwards were rather low (326–1783 birds, Fig. 3), but in 1967–1973 numbers were much higher with 9370 in November 1969. The largest numbers of Greylag here since 1974 were 3600 on 9 April 1978 and 3200 on 20 November 1983. The autumn numbers have decreased and the main build-up of Greylag at Slains occurred after the November count in the 1983/84, 1984/85 and 1985/86 winters. Over the six winters studied the average

number of Greylag present from mid-October to mid-April ranged from 500-1600.

Haddo House Lake The lakes at Haddo House are small (c.4 ha each) and largely surrounded by trees. The Greylag roost on the upper lake which has been in the Grampian Region Country Park since 1981 and a sanctuary for many years. Some duck shooting occurs on the lower lake. The roost was first noticed in the autumn of 1981 when the ranger reported c.4000 Greylag in mid-November. By the end of November c.7000 were present which at the time was one of the largest counts recorded in north-east Scotland.

The early history of this roost is unclear. Apparently small numbers (less than 1000) had been present since about 1974. In the winter of 1980/81 they greatly increased. There had never been any shooting of the geese. After the "discovery" of this roost in 1981 it was monitored fairly regularly and numbers fluctuated greatly. In autumn 1982 the Greylag arrived in mid-October, c.4000 were present from late October to mid-November after which numbers increased rapidly to 11,900 on 11 December, falling thereafter. In the 1983/84 winter, numbers showed a similar pattern (peak 7700), but in the 1984/85 winter the autumn peak did not occur and numbers remained at c.4000-5000 from late October to late January then decreased. In the 1985/86 winter c.1000 birds were present throughout. Table 2 shows the numbers of Greylag at the Haddo House roost on the November and March counts between the 1981/82 and 1985/86 winters. Pinkfeet were only once recorded at this roost.

TABLE 2. The national November and March counts of Greylag Geese at the Haddo House roost from the 1981/83-1986/87 winter.

	1981/82	1982/83	1983/84	1984/85	1985/86
Nov	4000	4650	4600	4200	900
Mar	3500	4000	4500	650	500

The reason for these sudden changes in Greylag numbers is unclear. The lake is very small for so many geese and easily disturbed. Even so, geese did not start coming in after dark, as they now do at other sites in the north-east. There are no known alternative roost sites nearby, although 3000 Greylag were seen at Fyvie Lake in November 1979 (Owen *et al.* 1986), which appears to predate the large numbers at Haddo House. They have not been seen subsequently at Fyvie.

Donside and Deeside

Loch of Skene and Kemnay The Loch of Skene is large (118 ha), shallow and rather exposed on the low ground between lower Deeside and lower Donside. There was an autumn peak, low numbers in mid-winter depending on snow cover, and a spring peak. The Loch of Skene was subject to regular wildfowling. There were no sites close by which were suitable as permanent roosts but there were several semi-permanent marshes and pools in the Don valley to the north. These were probably used occasionally and may explain some of the fluctuations in numbers at Skene.

When the November counts of Greylag were started in 1960 there were several hundred roosting on the River Don near Kemnay and none used the Loch of Skene. The first record at Skene was of 150 in November 1964 and numbers increased to 2700 in 1974. During this period numbers at Kemnay were very stable at around 200 birds. There were no further records of geese roosting at Kemnay until late November 1987 when c.1500 used the site for about a week (G. Wright pers. comm.).

Fig. 5a shows the November counts for Loch of Skene since 1960. Both the November 1983 and November 1984 counts were thought to be incomplete; in 1983 4000 were present a week either side of the count date and in 1984 a flood in the Don valley probably attracted many birds. After the initial stabilization at c.2500 birds in the mid-1970s there was an increase to about 4000 birds between 1978 and 1984, then a further increase in 1985. The March counts between 1982 and 1986 varied from 3210-5060 birds which was one of the largest flocks of Greylag in Britain at this season.

In the early years of the counts small numbers of Pinkfeet also occurred in nine autumns with a maximum of 350 in November 1969. Very few have been recorded since. At Kemnay up to 300 Pinkfeet were feeding in riverside fields on the wildfowl count days between the 1967/68 and 1976/77 winters but none have been recorded since.

Up to the 1985/86 winter limited data suggested an autumn peak of 4000-6500 Greylag at Skene in late October/early November with a slight decrease by mid-November. The largest autumn number was 6540 on 20 October 1981, and 8850 seen on 19 January 1985 was exceptional at that time. There were usually less than 2500 in mid-winter, and a spring peak of up to 5000 birds in late March/early April. The numbers using the Loch of Skene in the 1985/86 winter are

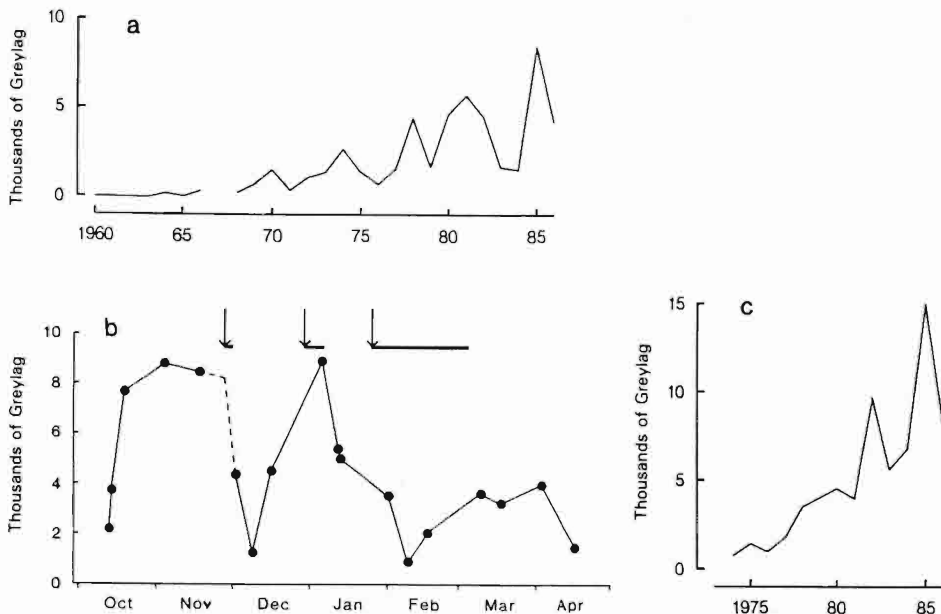


FIGURE 5. a) November counts of Greylag at Loch of Skene b) Counts of Greylag roosting at Loch of Skene during the 1985/86 winter c) November counts of Greylag at the Dinnet Lochs. The arrows indicate snowfalls and the bars periods with 10 cm or more snow cover.

shown in Fig. 5b. This winter was atypical as the numbers were the highest ever recorded here. The autumn peak of almost 9000 birds was the largest by several thousand and quite large numbers were present in mid-winter in spite of several snowfalls, with 8950 present on 5 January.

Corby Loch Corby Loch is a small loch (12 ha) near the coast just to the north of Aberdeen. It is unclear when Greylag first started to use this site and it was not counted systematically until the 1983/84 winter. It was known before then that several hundred geese often fed in the fields just to the north and south of the loch and occasionally when large numbers were present they flighted out to the lower Don valley. However, records in the mid-1980s suggested that substantial numbers of geese used the loch, particularly in spring. Early in the winter birds were shot and the autumn flocks tended to be smaller than those in spring.

The numbers of Greylag found at Corby Loch on the national counts since 1983 have ranged from 0-2000 (November) and from 800-2400 (March). Counts of 1600 on 9 November 1975 and

1150 on 11 November 1979 at the loch during the day were not included in the national counts for those years although the geese were almost certainly roosting there. Small numbers of Pinkfeet were occasionally found at Corby Loch, the largest being 140 on 22 November 1981.

The Dinnet Lochs and middle Deeside Small numbers of Greylag began using flooded fields at Auchlossan, the site of an old loch in middle Deeside, during the spring in the late 1960s. At this time they probably roosted on the flood itself, or on the River Dee at Ballogie, a site which is still occasionally used by up to 1500 geese. Small numbers also appeared at the Dinnet Lochs in the 1960s, particularly in the autumn, but they did not remain for long and it was not until the mid-1970s that the site was used regularly and numbers then increased rapidly. It is now one of the most important autumn concentrations of Greylag in Britain.

The Dinnet Lochs were first counted in November in 1974 and have been checked every year since. The lochs were included in the Muir

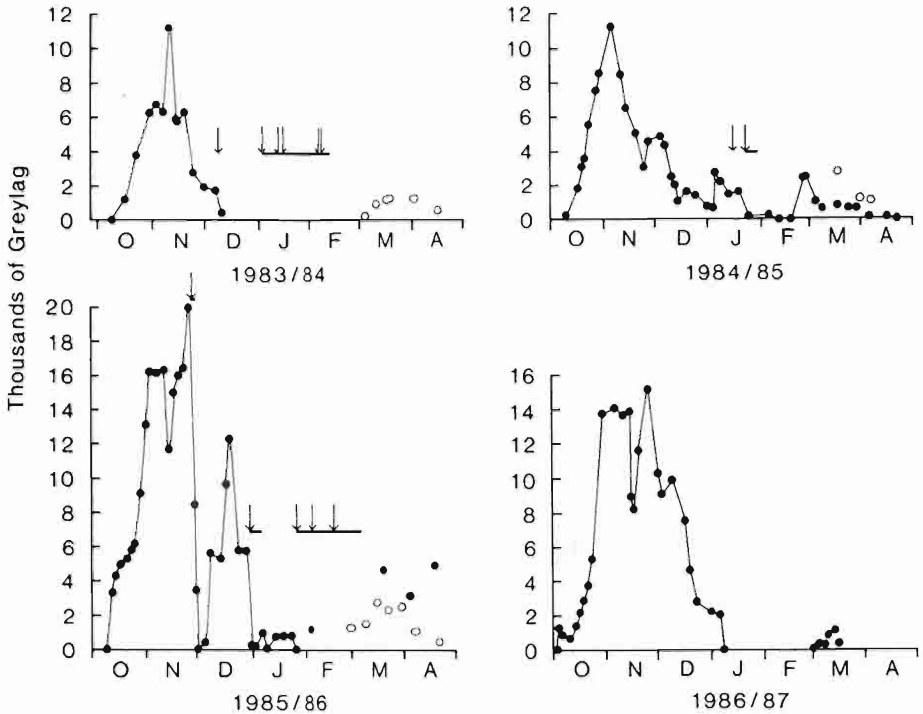


FIGURE 6. The numbers of Greylag roosting at the Dinnet Lochs in the 1983/84 – 1986/87 winters. ● = roost counts, o = field counts. The arrows represent snowfalls and the bars periods with 10 cm or more snow cover. Records of snowfall and snow cover were not available for the 1986/87 winter, and no field counts were undertaken in spring 1987.

of Dinnet NNR in 1977 and since the 1983/84 winter the warden has done regular counts. There was no shooting of ducks or geese at the Dinnet Lochs. The November counts at Dinnet show a series of sudden increases interspersed by a few years when numbers were stable (Fig. 5c). Between 1974 and 1977 800–1700 were recorded, between 1978 and 1981 there were 3500–4500 and there was a further large increase in 1982. The pattern of the autumn peak also changed slightly over the years. In the late 1970s numbers increased gradually through late October and November and were often still increasing when the first snowfall drove the geese south in the second half of November or in December. Very few were then seen until the spring. However, in the autumns of 1983 and 1984 they increased rapidly to peak in early November, then quickly decreased in the absence of adverse weather (Fig. 6). In 1985 the arrival was rather early with over

3000 on 12 October, 16,000 by 3 November and a peak of 19,900 on 26 November. Over the following three days snow caused all the geese to leave but unlike previous winters within a week large numbers were returning and a second peak of 12,300 occurred on 18 December. After further snow only small numbers remained through January and February, but there was a definite tendency for geese to remain here throughout the 1984/85 and 1985/86 winters. The spring count of 4600 in 1986 was the largest on record, but spring counts were difficult because the geese did not always roost on the lochs, and field counts were usually the most reliable at this time (Fig. 6). In late October 1986 over 13,000 were present and the peak count of 15,200 occurred on 24 November. In spring 1987 Greylag roosted at the lochs on only six nights from early to mid-March although they were present in the area until mid-April.

TABLE 3. Summaries of the November counts showing the north-east Scotland and national totals of Pinkfeet and Greylag in thousands, and the regional total as a percentage of the British total.

	PINKFEET			GREYLAG		
	Britain	NE Scotland	% of British total	Britain	NE Scotland	% of British total
1957-59	35.4	1.7	4.8			
1960-64	58.1	2.6	4.5	35.5	2.8	7.9
1965-69	69.9	13.1	18.7	55.5	6.4	11.5
1970-74	76.2	7.3	9.6	68.4	9.9	14.5
1975-79	74.2	11.7	15.8	67.8	12.6	18.6
1980-84	96.9	12.4	12.8	88.8	20.2	22.7
1985-86	129.3	25.5	19.7	112.2	25.1	22.4

Note. Greylag were first counted in 1961 at the Loch of Strathbeg, Slains Lochs, Loch of Skene and Kemnay. The Dinnet Lochs were first counted in 1974, Fedderate Reservoir in 1977, Haddo House Lake in 1981 and Corby Loch in 1983. Kemnay was not counted after 1976. Data summarized from Boyd & Ogilvie 1969, 1972; Ogilvie & Boyd 1976; Wildfowl Trust Annual Reports.

There were a few other places on south Deeside where feeding Greylag were recorded, and some may have been birds stopping for a short period before crossing the hills. On 18 March 1986 Dr A.G. Knox found a flock of 544 Greylag at a site on south Deeside where geese had not previously been recorded which illustrated the difficulty of attempting complete counts of Greylag in spring.

In autumn small flocks of Pinkfeet flew over Deeside and skeins sometimes stopped at the Dinnet Lochs for a few hours, but they rarely fed in the area. However, in spring small numbers, usually under 80 birds, regularly occurred for a few weeks in the Howe of Tarland and in some years many more were present. There were 780 there on 8 April 1979, 630 on 21 April 1985 and 890 on 20 April 1986. In spring 1987 up to 900 Pinkfeet were present in the Howe of Tarland from mid-February to April. Up to 600 roosted at the Dinnet Lochs on seven nights between 16 February and 21 April.

Discussion

North-east Scotland currently holds some very large concentrations of both Pinkfeet and Greylag, and the numbers of both species wintering in the area have increased greatly over the last 25 years. The November

counts between the early 1960s and mid-1980s showed a tenfold increase in Pinkfeet numbers in north-east Scotland against a four to fivefold increase nationally while Greylag also increased eight to tenfold in north-east Scotland but only two to threefold nationally (Table 3). The area regularly holds 15-30% of the British total of Pinkfeet and 20-35% of the Greylag. The regional distributions of the two species in autumn have previously been analysed (Boyd & Ogilvie 1969, 1972; Ogilvie & Boyd 1976) with the latter paper predicting increases in Aberdeenshire in both absolute and relative terms for Pinkfeet and smaller increases for Greylag. This has since occurred though Greylag have shown the largest gains (Table 3). The increase for Pinkfeet has been rather erratic, largely due to a temporary rise in the late 1960s when counts at Meikle Loch were especially high (see Fig. 3). Greylag have shown a steadier increase since 1960, the highest November total being 29,300 in 1982 which was 36.6% of the national total. They have increased by occupying five new roosts while the Pinkfeet are still concentrated at the two traditional sites. In recent autumns the largest numbers of Pinkfeet occurred in mid-October when

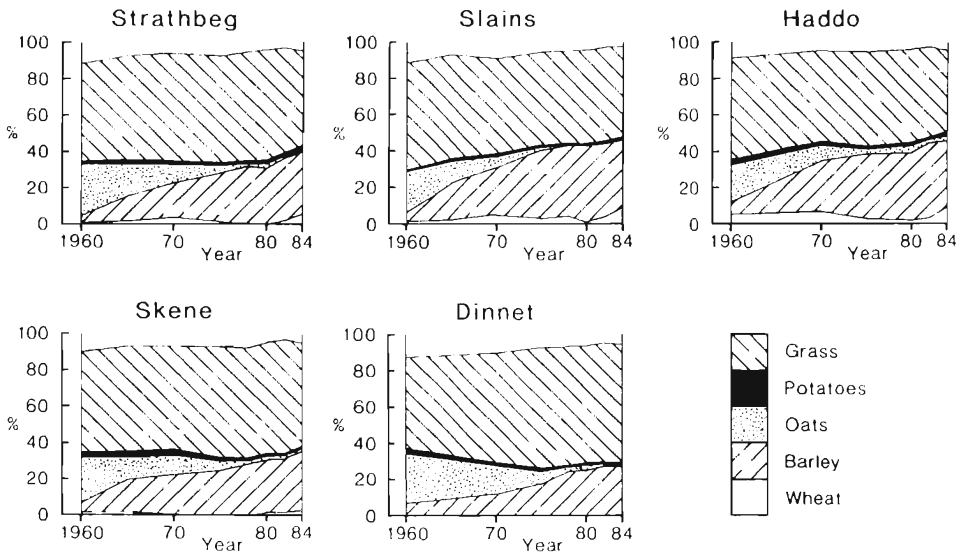


FIGURE 7. The proportion of different crop types as a percentage of the total cultivated area from selected parishes close to each of the main roosts. Agricultural statistics were obtained from the Scottish Records Office for the years 1960, 1965, 1970, 1975, 1978, 1980, 1982 and 1984 for the parishes of Lonmay, Crimond and St Fergus (Strathbeg), Slains, Logie-Buchan and Foveran (Slains), Methlick and Meldrum (Haddo), Kinellar and Skene (Skene), and Lumphanan and Leochel-Cushnie (Dinnet).

Loch of Strathbeg and Meikle Loch have together held up to 40,000 birds. North-east Scotland also holds large numbers of both species in the spring with up to 24,000 Greylag and 30,000 Pinkfeet present in March and April respectively.

There were no changes at the roost sites to make them more attractive to geese in this period but there were substantial changes in the farming regimes on the feeding areas. Fig. 7 shows how the cropping pattern has changed on the farmland adjacent to the main roosts between 1960 and 1984.

The data on crop areas are presented for each crop type as a percentage of the total cultivated area (which includes grass but not rough grazing) for the parishes relevant to each roost (Fig. 7). Between 80% and 90% of the grass was less than seven years old. During this period grass (45-65%) and cereals (25-50%) were the main crops but there were major changes in the cereal regime. Before 1960 most of the cereal

acreage was oats but over the following 10-15 years barley almost completely replaced the oats near the coast while the change was slower further inland (Fig. 7). The small area of wheat remained fairly steady between 1960 and 1980 but since then increased markedly to about 10% of total crop area in the Ythan valley by 1984. There has also been a major change to autumn sown winter cereals in recent years. Subjective impressions were that winter cereals were rarely sown before 1980, but since then the change has been rapid. By 1986 c.50-75% of the cereals round Slains and Haddo were autumn sown with lower proportions (c.30-50%) around Strathbeg and Skene, and only since 1985 were autumn sown cereals used on the higher ground at Dinnet. Their use in north-east Scotland was limited by the autumn weather and in 1985 the cereal harvest was very late so that the use of winter cereals was severely restricted for the following season.

The change from oats to barley in the 1960s was previously suggested as a major factor in the establishment of a large population of Pinkfeet in east and central Scotland (Kear 1965) since waste barley grain is their preferred food source. This theory is supported by the evidence from north-east Scotland where the cereal regime switched almost completely from oats to barley between the late 1950s and the mid-1970s. This change was slowest to occur inland (Fig. 7) and the Dinnet roost was the last major one to be occupied. Whether the change to winter cereals will reduce the numbers of geese using the area remains to be seen but it appears to have been a factor in decreasing the numbers in central Scotland, and moving geese further north. These arguments seem to be even more relevant to recent changes in the distribution of Greylag than Pinkfeet in the 1960s.

The proportion of cultivated ground under grass was greater in north-east Scotland than at Loch Leven in the late 1960s (Newton & Campbell 1973), and in parts of central Scotland currently used by geese. Grass was important in autumns with a clean cereal harvest, but was especially important in spring (Bell 1988) and was probably the reason why the recent series of March counts found proportionally more geese in north-east Scotland in spring than in most of the other British wintering areas.

The current high numbers of geese in north-east Scotland belie the fact that none of the roosts is fully safeguarded against future detrimental developments. Three of the main roosts are leased to conservation organisations as nature reserves, the Loch of Strathbeg to the RSPB, and the Ythan Estuary and Dinnet Lochs to the NCC as NNRS. The Loch of Skene and Meikle Loch are SSSIs. At all these sites the shooting rights are retained by the owners and geese are shot at all but the Dinnet Lochs. The Loch of Strathbeg is a site of international importance for wintering wildfowl, but this status was no safeguard when a proposal by one of the owners to commence shooting within the main refuge area and goose roost

had to go before a public inquiry in March 1987. Four of the roosts are very small in area and therefore extremely vulnerable to disturbance, including the Meikle Loch which is one of Britain's top five roosts for Pinkfeet. There are no alternative roost sites available, unlike the situation in east and central Scotland (see Newton *et al.* 1973). The recent changes at Haddo House showed that numbers can fall as rapidly as they increased, and indeed Greylag apparently underwent a similar increase and decrease at Slains between 1967 and 1973.

In conclusion, although the numbers of Pinkfeet and Greylag in north-east Scotland were in 1986 at their highest ever, changes in land use both on the feeding areas and at the roosts could rapidly change this situation.

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Loch of Strathbeg.

S.M.D. Alexander

The status of breeding Wigeon in Ettrick Forest

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T.W. DOUGALL

Wigeon were first proved to be breeding in the Ettrick Forest area of the Scottish Borders in 1893. The site is now of considerable importance for Wigeon and surveys in 1978 and 1987 found 30-39 pairs which represents c.10% of the British breeding population.

Introduction

For some time, the Ettrick Forest area in the Scottish Borders (Fig. 1) has been known to hold an appreciable number of Britain's breeding Wigeon *Anas penelope* (Baxter & Rintoul 1922, Sharrock 1976). This paper summarizes the present status of the species in this area and is based on two surveys in 1978 and 1987 which were done under contract to the Nature Conservancy Council (Dougall 1978, Thomson 1987).

Historical Background

The Wigeon was first recorded breeding in Scotland in 1834 when a nest was discovered in Sutherland (Baxter & Rintoul 1922). In 1884 or 1885, Wigeon were found summering in Ettrick Forest for the first time (Adair 1895). Evans (1893) found Wigeon at two Ettrick Forest lochs in 1893 and saw an agitated drake at one of these. On 16 June 1893, Adair (1895) saw a female and brood on a loch which he had visited annually for about 15 years. This was the first confirmed breeding record in Ettrick Forest. The first breeding record for Roxburghshire was in 1900 and by 1910 Wigeon were said to be breeding there regularly (Blackwood 1911, Evans 1911). Chapman (1912) confirmed breeding at five lochs in Selkirkshire and at four in Roxburghshire.

Numbers of breeding Wigeon in Ettrick Forest apparently increased from 1893 to

1912. Few records were published after this but it was still breeding there in 1922 and 1928 (Baxter & Rintoul 1922, 1928). Reviewing the 20-year period to 1939, Berry (1939) stated that nationally, a slow but steady increase had occurred. Expansion in range and numbers continued after this but at a slower rate (Baxter & Rintoul 1953). Sharrock (1976) believed that the expansion had ended by 1950 and that a contraction in range occurred in the 1960s. In 1968 six Ettrick Forest lochs were known to be occupied by Wigeon (Parslow 1973).

Study Area and Methods

The region is predominantly upland and most of the lochs are located at least 250 m a.s.l. The vegetation is mostly either commercial conifer forest or grassy sheepwalk with bracken *Pteridium aquilinum*, rushes *Juncus* spp. and heaths Ericaceae.

Twenty-one lochs were surveyed in both study years and nine were surveyed in one year only. Wigeon were known to have bred formerly at most of these lochs (Dougall 1978, Thomson 1987). The lochs were visited in the morning, mainly in June. Each was observed for one hour, on three occasions between 12 and 30 June in 1978 and on four occasions between 27 May and 12 July in 1987. All waterfowl species and numbers were recorded on each visit.

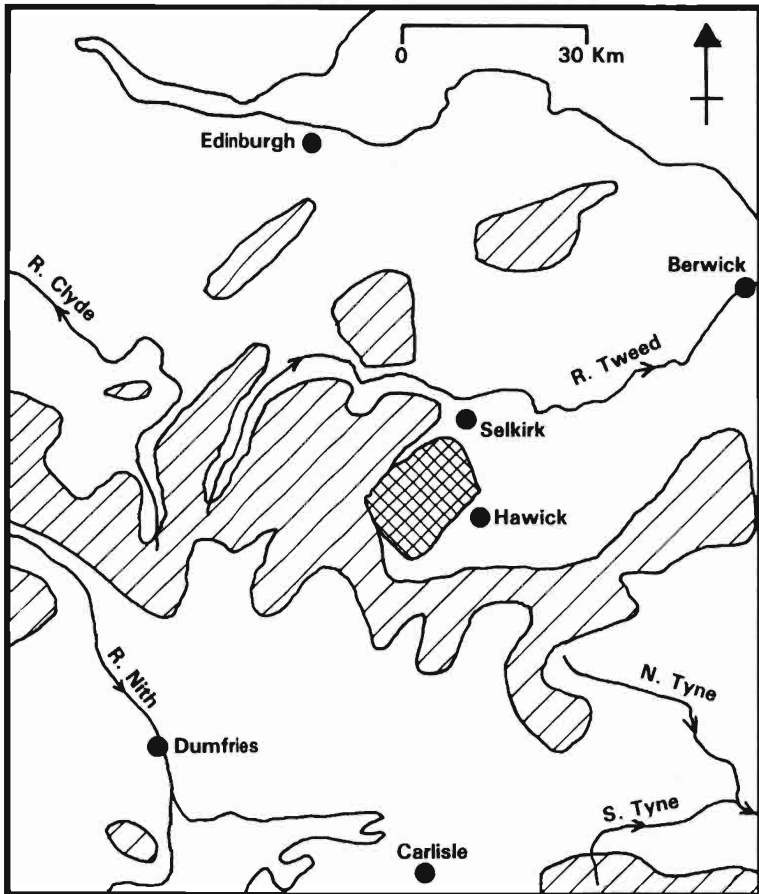


FIGURE 1. Location of the Ettrick Forest study area. The study area is indicated by cross hatching, and ground over 365 m by hatching.

Results and Discussion

To interpret the results of breeding surveys of Wigeon, the following points concerning their behaviour (Cramp & Simmons 1977) were considered:

- (i) only some individuals breed in their first year, but non-breeding birds may also be present on the breeding grounds;
- (ii) only one brood is raised each year, although replacement clutches may be laid;
- (iii) males leave the females and form moult flocks (not necessarily on their breeding loch) late in the incubation period, but successful females join moult flocks only at about the time that their young fledge;
- (iv) neither the members of a pair nor females and their young are always closely associated;
- (v) some adults may move between lochs, especially early in the season;
- (vi) Wigeon graze away from water, so numbers may be underestimated if only birds on lochs are counted.

TABLE 1. Numbers of Wigeon, brood size, and number of lochs with Wigeon present in Ettrick Forest in 1978 and 1987.

	1978	1987
No. pairs present	30	39
No. pairs confirmed breeding	12	12
Minimum no. of young hatched	68	55
Mean brood size when first seen	5.7	4.6
No. occupied lochs	10	17
No. lochs with confirmed breeding	5	6

To allow for these complications count data (Table 1) were considered as follows:

- (i) the number of pairs present (and believed attempting to breed) was estimated for each loch from the highest number seen there each year;
- (ii) the number of pairs confirmed breeding was based on the minimum number of broods (separable by age of ducklings) seen over all visits to that loch;
- (iii) the minimum number of young hatched was based on the total number of ducklings (separable by size) seen over all visits;
- (iv) the mean brood size was based on the number of ducklings in each brood when first seen;
- (v) the number of occupied lochs includes all lochs where one or more adults were seen;

- (vi) adults with young were assumed to have bred on the loch where they were first seen.

In 1978 and 1987 there were respectively 30 and 39 pairs of Wigeon in the Ettrick Forest in the breeding season. At least 12 pairs bred successfully each year (Table 1). Pairs were present on 18 lochs and bred at 10 of them over the two years; breeding was confirmed at up to six lochs in each year (Dougall 1978, Thomson 1987).

We compared our data with those of Parslow (1973) who made a single visit to six lochs on 5 and 6 June 1968 (Table 2). Results from 1978 and 1987 based on a single visit to the same lochs around the same dates as Parslow's suggest that he would have underestimated the number of Wigeon present in 1968 at these six lochs. Even so there appears to have been a drop in the number of pairs present in early June at these particular lochs between 1968 and 1987. However the total known breeding population of Ettrick Forest was the same in 1978 and 1987 (12 pairs), and the number of pairs attempting to breed may have increased. This implies a redistribution of breeding birds within the forest.

Wigeon often graze away from water. After the 1987 survey was completed, two new broods were found about 50 m and 300 m from a loch. They could not have been detected by the survey method used and are not included in the 1987 totals.

TABLE 2. Number of pairs of Wigeon and number of young hatched at six Ettrick Forest lochs in 1968 (Parslow 1973) and at the same lochs in 1978 and 1987.

	1968	1978		1987	
	5-6 June	Visit nearest	Whole survey period	Visit nearest	Whole survey period
		5-6 June	5-6 June	period	5-6 June
	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>
Pairs present	24	11	19	6	8
Pairs confirmed breeding	4	4	7	0	5
Minimum no. young hatched	c.8	22	40	0	25

These observations raise questions about how far away from lochs Wigeon breed, how large a grazing area they need and how important moorland/sheepwalk grazing is for Wigeon during the breeding season. Unless it can be established that such broods eventually make their way to a water body where they would be counted, the size of the breeding population and breeding success could be underestimated. Further, with continued afforestation in the uplands the loss of grazing areas may adversely affect breeding Wigeon; there is scope here for further research.

The British breeding population of Wigeon is approximately 400 pairs (Yarker & Atkinson-Willes 1971 estimated 350 pairs, and Sharrock 1976 estimated 300-500 pairs). Owen *et al.* (1986) did not include the Ettrick Forest among the main breeding areas of the species in Britain, and described Loch Leven, Kinross as having the largest concentration with 25-30 pairs (based on Newton & Campbell 1975). Wright (1986) has updated this estimate to 34-36 pairs for the years 1980-1984. However, with a breeding population of 30-39 pairs (7.5-10% of the estimated British breeding population), the Ettrick Forest should also be recognized as one of the main breeding areas of the species in Britain.

Acknowledgments

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Goosanders and Red-breasted Mergansers in the Moray Firth

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R.H. DENNIS

The Moray Firth holds internationally important concentrations of Goosander and Red-breasted Merganser in winter. In autumn, smaller numbers of both species use traditional sites there for the moult. The distribution and number of birds at these times of year are described and their possible origin discussed. A fisheries ban in the Moray Firth since 1979 is associated with a subsequent increase in numbers of both species.

Introduction

The Moray Firth is of international importance for wintering Goosander *Mergus mergus* and Red-breasted Merganser *M. serrator* (Prater 1981, Thom 1986). This paper presents the results of systematic and comprehensive surveys there between 1977 and 1987 and highlights seasonal and annual fluctuations in the number and distribution of both species. Earlier counts are also considered.

Methods

Both species were counted from the shore as all birds present were clearly visible. Until 1976 counts of part of the firth were made by local ornithologists on an irregular basis. Since 1977 counts have been more regular (monthly at present) and give complete cover. All sites frequented by Goosanders are counted on the same day to reduce the risk of double-counting. Red-breasted Mergansers are counted by the RSPB during routine counts of all coastal wildfowl (Allen 1979, Barrett 1983, Mudge & Aspinall 1985), although a complete count of all areas takes several days. This may result in under- or over-estimation of numbers as Mergansers are very mobile, but this problem has been largely overcome by recent co-ordinated counts. These have been made by a team of about 30 volunteers during BTO/Wildfowl Trust Birds of Estuaries

Enquiry counts since October 1984. Counts are made on the same day over a two-hour period. Data for earlier periods are from Scottish Bird Reports (Dennis 1970-82, Hogg 1983-85) and elsewhere.

Results

The moulting period

Flocks of flightless or nearly flightless moulting Goosanders are present on the sea between late June/early July and the end of August/mid-September at traditional sites in the Ness Mouth/Longman Bay area near Inverness and at Spey Mouth (Fig. 1). Although one or two males have been seen in some years, most birds appear to be adult females. At Ness Mouth the flock size, since 1977, has ranged from 112-233. At Spey Mouth, numbers have been lower, ranging from 33-96. These birds are presumably of mainly local origin but their status (breeders, failed or non-breeders) is unknown. For most of October, these birds leave the coast and enter rivers. Other females, which are known to have bred successfully (e.g. in Ross-shire and Inverness-shire), do not first visit the coast but remain and moult near their breeding sites on rivers and lochs.

Flocks of up to 200 moulting Red-breasted Mergansers also occur in traditional sites in the Moray Firth in July and

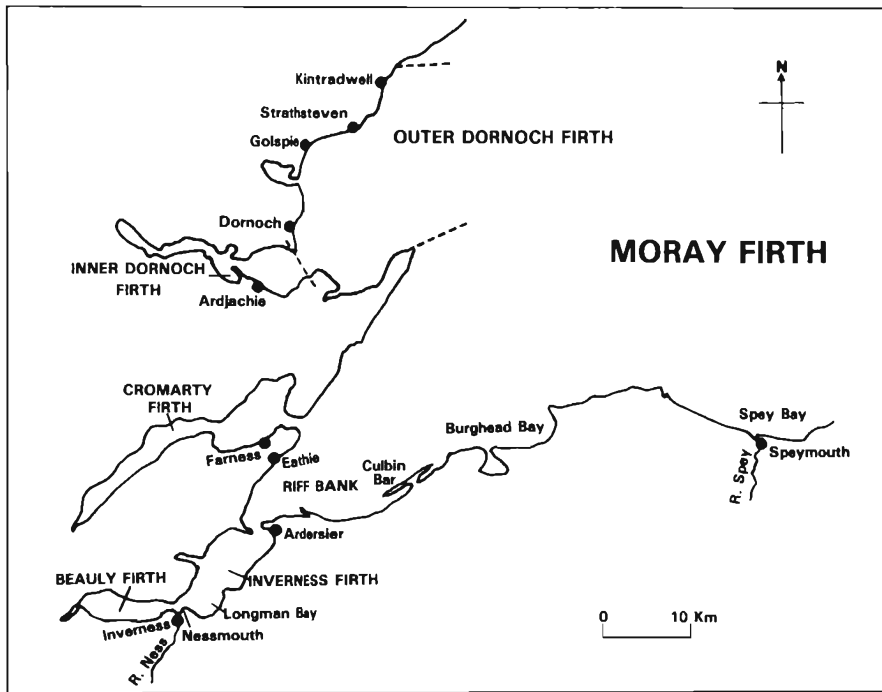


FIGURE 1. Map of the Moray Firth showing localities mentioned in the text.

August. The sites are at Kintradwell, Strathsteven and Golspie (Outer Dornoch Firth), Ardjachie (Inner Dornoch Firth), Farness (Cromarty Firth), Ardersier (Inverness Firth) and Eathie (Riff Bank) (Fig. 1). Small groups of birds occur elsewhere but total less than 100. In contrast to Goosander, most of the moulting birds at this time are males. Large flocks have been recorded in September in the Inner Dornoch Firth where 700, 600 and 500 were present in 1976, 1981 and 1982 respectively, although such large numbers are seldom present here in other months. Birds do not arrive at the main wintering sites until October or later.

Winter

Between late October and March, nearly all Goosanders are in the Beaulay Firth, but occasionally they may move into the interconnecting Inverness Firth to feed. Counts of

Goosander in the Beaulay Firth were started in winter 1962/3, when 410 birds were recorded. Peak winter numbers varied between 291 and 800 until 1973/4 when 1080 birds were present. This peak was exceeded the following winter (1290 birds) but returned to pre-1973/4 levels until 1980/1 when over 1000 birds were again recorded. The highest number seen in the Beaulay Firth was 2400 birds in February 1983, although the winter peak usually occurs earlier, in November or December (Table 1). Elsewhere in Britain, winter numbers reach a peak in January or February (Salmon 1980-83, Salmon & Moser 1984, 1985), probably through the arrival of continental immigrants (Owen *et al* 1986). Goosanders start to arrive in the Beaulay Firth earlier than those in more southerly localities. In recent winters when there was a notable influx to southern Britain (December 1978/January 1979, January 1985 and January 1987) the

TABLE 1. Counts of Goosanders in the Beaully and Cromarty Firths between November 1977 and March 1987. (Information from S.J. Aspinall, R.H. Dennis and M.I. Harvey, unpublished observations).

	Maximum numbers of Goosanders each month											
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Beaully Firth												
1977-78	-	-	-	-	-	355	-	-	-	350	-	-
1978-79	-	-	50	-	-	-	566	550	-	-	-	-
1979-80	-	-	-	-	-	-	600	900	-	-	-	-
1980-81	-	-	21	-	400+	750	1550	1510	-	-	-	-
1981-82	-	-	174	-	-	1258	1620	600	-	-	-	-
1982-83	-	-	-	233	200	1039	750	900+	2400	-	640	-
1983-84	-	112	-	-	626	1050	2150	910	242	-	-	-
1984-85	-	-	138	-	94	418	1280	250	-	-	-	-
1985-86	58	-	120	174	936	-	1700	1510	471	-	-	-
1986-87	-	121	-	80	760	1300	1124	1180	674	200	-	-
Cromarty Firth												
1981-82	-	-	-	-	-	-	-	-	300	-	-	-
1982-83	-	-	-	-	-	-	-	-	400	-	-	-
1983-84	-	-	-	-	-	-	358	-	-	-	-	-
1985-86 ^o	0	0	0	0	-	48	238	60	27	-	-	-
1986-87	0	0	0	0	30	0	2	131	78	0	-	-

Notes: - No count (from mid-April to early July less than 100 birds are present)

+ Incomplete count

^o No counts in the Cromarty Firth in 1984-85

size of the Beaully Firth flock did not change.

Flocks of Goosanders have been seen in the Cromarty Firth since winter 1981/2 (Table 1); they are probably birds from the Beaully Firth as groups have been seen flying between the two sites. The main winter arrival of Goosanders starts in mid-October with females and juveniles. The increase from late October is largely due to the arrival of adult males from their moulting grounds in northern Norway (Little & Furness 1985). Birds usually leave the firths in late January or early February.

Large flocks of Red-breasted Merganser are present in winter at several sites in the Moray Firth. Over 900 birds have been recorded in the Golspie-Dornoch section of the Outer Dornoch Firth but the largest flocks have been recorded in the

Cromarty, Inverness and Beaully Firths from December to February and on the Riff Bank from October to January (Table 2). The presence of the largest flocks of Merganser in the Inverness and Beaully Firths usually coincides with large numbers of Goosander there. In December 1970, 1520 Mergansers were present in the Cromarty Firth but there were very few birds present in the Inverness and Beaully Firths that year. In recent years, the largest flocks of wintering Merganser have been in the Inverness and Beaully Firths.

The large size of the Riff Bank flock (Table 2) was first recognised in October 1984, although surveys from the air and from boats between 1977 and 1983 had recorded up to 400 birds (G.P. Mudge pers. comm.). In the 1960s, Mergansers left the Inverness and Beaully Firths eastwards at

TABLE 2. Monthly co-ordinated counts of Red-breasted Mergansers at their main wintering sites in the Moray Firth from 1984/5 – 1986/7. (Information from Aspinall & Mudge 1986, Mudge & Aspinall 1985 and S.J. Aspinall unpublished observations).

Year	Month	Riff Bank	Cromarty Firth	Inverness and Beaully Firth
1984-85	Oct	1800	8	75
	Dec	552+	121	485
	Jan	–	401	–
	Feb	12+	223	155
	Apr	192	18	17
1985-86	Oct	1200	291	432
	Dec	1300	397	600
	Jan	1800	311	650
	Feb	57	588	822
	Apr	10	76	350
1986-87	Oct	1460	183	163
	Dec	1000+	615	932
	Jan	1300	425	1799
	Feb	265	343	705

Notes: – No count
+ Incomplete count

TABLE 3. Number of Red-breasted Mergansers counted in the Moray Firth between October 1977 and April 1987. (Information from Allen 1979, Aspinall & Mudge 1986, Barrett 1983, 1984, Mudge 1978, Mudge & Allen 1980, Mudge & Aspinall 1985, Scottish Bird Reports 1980-85).

Year	Maximum numbers of Mergansers each month									
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1977-78	–	–	–	505+	–	327+	379	922+	595+	–
1978-79	–	–	–	–	150+	138+	110+	171+	–	–
1980-81 ^o	–	–	–	–	350+	2541+	2250+	–	700+	–
1981-82	–	–	600+	–	1054+	43+	–	389+	196+	–
1982-83	–	–	500+	1067+	395+	296+	650+	942+	242+	–
1983-84	–	–	–	–	–	1370	–	885	–	115
1984-85*	–	344	–	2326	–	1284+	–	497+	–	377
1985-86*	291	534	–	2129	–	1948	2786	1316	–	519
1986-87*	546	653	–	2623	–	2588	3552	1351	–	647

Notes: – No count
+ Incomplete count
^o No counts in 1979-80
* Results for October-February from 1984-85 were from co-ordinated counts

dusk to roost on or near the Riff Bank (R.H. Dennis pers. obs.) but this roost flight no longer occurs. Co-ordinated counts of the Inverness and Beaulieu Firths and the Riff Bank in 1985/86 and 1986/87 indicate that the flocks which feed and roost in these areas remain discreet. The main winter arrival of Red-breasted Mergansers in the Moray Firth is from mid-October (Table 3). A rapid departure takes place in late January or February, although it seldom coincides with the departure of Goosanders.

Discussion

The Goosander flock in the Beaulieu Firth represents a quarter or more of the known British wintering population and about 2% of the estimated NW European wintering population (calculations based on estimates in Salmon & Moser 1985). It is the largest single flock west of the IJsselmeer in the Netherlands (Owen *et al* 1986). The Beaulieu Firth is, furthermore, the only regularly used estuarine site in Britain (Owen *et al* 1986). The Tay is the only other site in Britain known to have held a substantial number of birds: 1,000+ and 800 were recorded in the winters of 1972/73 and 1973/74 respectively but only 100-200 have been seen here in subsequent winters (Scottish Bird Reports 1970-85). Mills (1962) made no mention of the Beaulieu Firth as an important wintering area and, although birds may have been overlooked, it is likely that the firth has since progressively become a major wintering area in place of the Tay for the increasing British breeding population.

The breeding population of the Moray Firth catchment was estimated at c.300 pairs in 1975, out of a maximum of 952 pairs in Scotland and 1245 pairs in Britain (Meek & Little 1977a). Although it is likely that the local population winters in the Beaulieu Firth, birds from elsewhere have been seen. A colour-dyed female (of unknown breeding history) from Kielder, Northumberland, was present in the moulting flock in Longman Bay in August 1985 and a bird in

its second year, ringed as a fledgling in Northumberland was also present in the Moray Firth in winter (Meek & Little 1977b). A Swedish-ringed bird was recovered in Perth (Thom 1986) which indicates a continental origin for some over-wintering Goosanders. However, most recoveries of continental-ringed Goosanders have been in southern Britain; in years when there has been an influx of birds there, no corresponding increase in numbers has been noted in the Beaulieu Firth.

The Moray Firth is the most important wintering site for Red-breasted Merganser in Britain (Owen *et al* 1986) with up to 30% of the known wintering population and 7% of the estimated NW European wintering population (from Salmon & Moser 1985). The importance of the area in winter has only recently been fully recognized, although Mills (1962) reported flocks of up to 400 in the Beaulieu Firth and Baxter & Rintoul (1953) recorded Merganser 'sometimes' in very large numbers in the northern Firths'. There is no estimate of the local breeding population but it is certainly too low to account for all the birds present in the Moray Firth in winter. The total Scottish breeding population is estimated at 1200-1700 pairs (Thom 1986) and many of these are known to winter elsewhere (e.g. the Firths of Forth and Tay).

Birds ringed in Iceland and on the continent have been recovered elsewhere in Britain (Boyd 1959, Cramp & Simmons 1977) but as yet none have been found in the Moray Firth. Even so immigration undoubtedly accounts for many birds and an influx during January 1987 was associated with severe conditions in the Baltic. The departure of Mergansers in late January or February seldom coincides with that of Goosanders, which generally leave later, and this may be because many of the Mergansers are immigrants whereas Goosanders are largely native and have less far to travel to their breeding areas.

Fluctuations in wintering numbers of both Goosanders and Mergansers may be associated with the arrival of fish shoals and

with the size and length of stay of the shoals in the area. The start of the recent increase in numbers of sawbills in winter coincides with the fisheries ban in the Moray Firth which began in 1979. Both sprat *Sprattus sprattus* and herring *Clupea harengus* are known prey items of Merganser and formed most of the diet of birds examined on the Tay (Cramp & Simmons 1977).

In conclusion, although the increased numbers of Mergansers in all months and of Goosanders in winter may partly reflect greater observer awareness and coverage, we believe they also represent a genuine change in the status of both species in the Moray Firth.

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We should like to thank the many observers whose counts have been used in this paper and also Britoil plc who provided financial assistance for sea-duck surveys between 1982 and 1987. N.P. Ashmole, R.J. Aspinall, L.H. Campbell, M. Marquiss, G.P. Mudge, M.A. Ogilvie and N. Picozzi made many helpful comments on drafts of the paper.

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Waders on the coast of Shetland in winter: numbers and habitat preferences

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AND J.P. JOHNSTON

A total of 1467 km (92%) of the Shetland coastline was surveyed as part of the BTO/WSG Winter Shorebird Count and 11,602 waders were counted between December 1984 and February 1985. The most abundant was the Turnstone (5101). Several waders had strong habitat associations; Redshanks and Lapwings preferred mud, Ringed Plovers sand, Golden Plovers and Purple Sandpipers shallow-sloping bedrock. Oystercatchers, Turnstones and Curlews showed no clear preferences. Steep shores and cliffs were avoided by all species.

Introduction

The importance of estuaries for wintering waders (Charadrii) and other shore-birds is well established (Prater 1981). However, estuaries form only 24% of the British coastline, which is about 18,000 km long (Moser & Summers 1987). Rocky shores and sandy beaches make up the bulk of the coast and surveys in eastern and northern Scotland have shown that the densities of waders on rocky shores can equal those on estuaries (Summers *et al.* 1975, Summers & Buxton 1983). The absence of information on the size of shore-bird populations on the open coasts of Britain, together with an awareness that considerable numbers can occur in certain localities such as the Orkney Islands (Tay and Orkney Ringing Groups 1984), led to the inception of the British Trust for Ornithology/Wader Study Group (BTO/WSG) Winter Shorebird Count. The aims of this survey were (1) to identify stretches of open coast of special conservation value for wintering shore-birds, (2) to assess the total numbers of shore-birds which winter in Britain and Northern Ireland, and (3) to examine habitat preferences (Moser & Summers 1987).

The Shetland Islands, which represent about 8% of the British coastline (Flinn 1974), were surveyed by the Tay Ringing Group and Shetland Bird Club as part of the Winter Shorebird Count. This paper describes the numbers and distribution of the waders counted and their habitat preferences. Snipe *Gallinago gallinago* were excluded.

Study area

The Shetland Islands are formed by the peaks of a range of hills which rise from the flat continental shelf to a height of 450 m above sea level. The geology of the hundred or so islands that make up the archipelago is complex (Mykura 1974). There are two distinct geological parts, east and west of the Walls Boundary Fault (Fig.1). The eastern part is formed mainly of metamorphic rocks, and the western part mainly of igneous rocks and Old Red Sandstone.

There are two types of coastal topography; the older outer coast and younger inner coast (Flinn 1974). The outer coast, composed of cliffs, has been formed by millions of years of erosion by the sea.

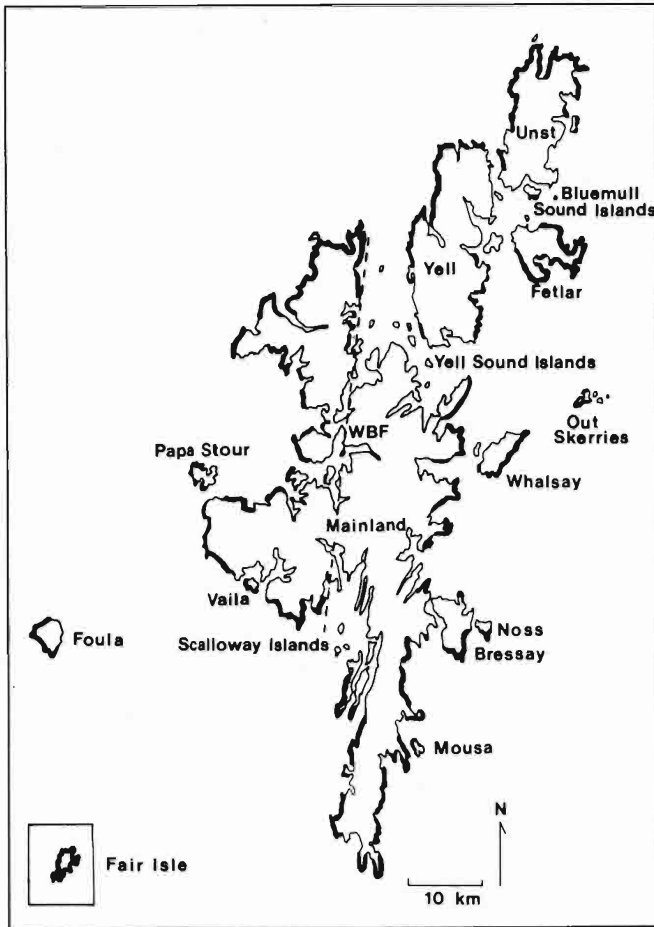


FIGURE 1. The Shetland Islands. Cliffs over 10 m in thick line (redrawn from Flinn 1974), WBF = Walls Boundary Fault (from Mykura 1974).

These hard cliffs have been cut back slowly, but because the sea level has been rising there has been no development of broad, wave-cut platforms. The young inner coast-line has formed since the last glaciation by the drowning of low hills. As a result the coast here is less steep, beaches of boulders, pebbles and sand have formed, and long-shore drift has helped to create features such as spits, bars and tombolos (Flinn 1974).

Methods

The fieldwork took place between 1 December 1984 and 12 February 1985, although 75% of the shore was surveyed during the first three weeks of January 1985. Each observer surveyed one section of shore each day, varying from a few kilometres to about 20 km. This length was subdivided into sections (1.0 km on average) whilst in the field to coincide with changes in habitat.

The following habitat categories were recognized:

Substrate type: Bedrock, boulders, cobbles, gravel, sand, mud.

Shore slope: Flat, moderate, steep, cliff.

The substrate type refers to the dominant substrate but this need not be the one on which the waders forage; for example, on "boulder shores" the waders may actually be foraging on the less abundant gravel. Only bedrock shores varied much in slope so, for the analysis, this substrate was divided into three slope categories: shallow-sloping bedrock (flat and moderate slopes); steep shore and cliff. The lengths of each of the sections were determined from 1:25000 O.S. maps.

Counts took place around low tide (half-ebb to half-flood), which considerably reduced the number of days available for counting because winter day-length is very short in Shetland. Birds in the intertidal zone of each section were counted if the observer walked past them or if the birds flew inland or out to sea. The numbers of waders in adjacent fields were noted whenever it was practicable. Long sections of contiguous coast were surveyed simultaneously by a team of observers, so that the effects of short-distance movements of birds during counts was minimized (Summers *et al.* 1984). Individuals working alone usually surveyed short sections.

Most of the coastline was surveyed by walking along in the intertidal zone or the high-water mark if the intertidal zone was less than 20 m wide. Sections at the base of cliffs were scanned with binoculars from the

cliff top, or from a boat. Small islands and skerries including Papa Stour, Vaila, Bluemull Sound Islands, Yell Sound Islands and Scalloway Islands (Fig. 1) were surveyed from a boat.

Habitat preference was determined from the equation

$$Q = \frac{r(1-p)}{p(1-r)}$$

where r is the proportion of waders of a given species in a given habitat and p is the proportion of that habitat in Shetland (Jacobs 1974). Values of the index (Q) greater than 1.0 indicate preference for, and values less than 1.0 indicate avoidance of, a particular habitat.

As the survey spanned 10 weeks, changes in weather conditions may have influenced the counts. Therefore, repeat surveys of sections were used to establish if any change in numbers of waders had occurred. The number of sections in which the number of waders had increased, decreased or stayed the same were used in a Sign Test to determine whether the changes in wader numbers had been statistically significant. Temperature data were obtained from Lerwick.

Results

The survey covered 1467 km of the Shetland coastline (Fig. 1). Of the 133 km which were not included, 66 km were cliff. The coast mainly consisted of bedrock (72%) with over 50% being steep rocky shore and cliff (Table 1, Fig. 1). Boulders and cobbles were present along 19% of the coast. Gravel, sand and mud made up less than 10% of the coastline.

TABLE 1. The percentages of different coastal types on 1533 km of the Shetland Islands. 67 km of non-cliff coast were not visited.

Slope	Bedrock	Boulders	Cobbles	Gravel	Sand	Mud	Totals
Flat	2.4	2.2	3.6	2.4	2.7	0.3	13.6
Moderate	16.7	7.3	4.4	3.3	0.6	0.0	32.3
Steep	23.6	1.0	0.1	0.0	0.0	0.0	24.7
Cliff	29.3	0.1	0.0	0.0	0.0	0.0	29.4
Total	72.0	10.6	8.1	5.7	3.3	0.3	100.0

TABLE 2. Counts of waders on the shores of the Shetland Islands in winter 1984-85.

	Bluemull Sound Islands		Yell Sound Islands			Whalsay	Papa Stour		Bressay	Scalloway Islands		Foula	Fair Isle	Total				
	Unst	Yell	Fetlar	Mainland	Out Skerries		Vaila	Noss		Mousa								
Oystercatcher	6	1	2	3	12	143	7	3	3	25	10	2	5	222				
Lapwing			130			249	3							382				
Ringed Plover.	32		102		8	319	31	3	24	35	10			564				
Grey Plover	1					1			1					3				
Golden Plover			20			316	55	2			29			422				
Turnstone	378	20	490	68	65	83	2852	280	128	157	28	252	79	159	22	21	19	5101
Curlew	61		281	1	4	5	941	11	7	9		1	1	9	74			1405
Bar-tailed Godwit							6					3						9
Redshank	105	2	262	21	8	7	1231	42	15	53	5	34	4	28	9		1	1827
Knot	5		5				2	13	1									26
Dunlin	15		7				65			9		4						100
Sanderling							1											1
Purple Sandpiper	100	69	94	14	25	101	618	102	6	27		143	59	136	12	26	8	1540
Total	703	92	1393	104	105	216	6744	544	165	283	33	497	163	363	122	47	28	11602

December was less cold than January when most of the survey was undertaken (Fig. 2). Although the January weather was not severe, the frost and snow which covered fields for several days may have caused waders to move onto the shore. Forty-two scattered sections totalling 53 km were surveyed twice, once during December (the mild period) and once in January (the cold period). These pairs of counts were used to measure the change that may have occurred in response to the colder January weather. For none of the species did the Sign Test show a significant difference between months so no adjustments were made to the numbers counted during the whole survey.

The total number of waders counted on all the shores was 11,602 (Table 2). Counts, expressed as the numbers per kilometre, showed that sandy and cobble shores had the highest densities, whilst cliffs and steep bedrock had low densities (Table 3).

Oystercatchers *Haematopus ostralegus* were relatively scarce and most were found on the east coast of Mainland (Table 2). They preferred boulder, cobble, gravel and sandy shores (Table 4). Twenty-seven were seen on grass fields by the coast.

TABLE 3. Numbers of waders per kilometre on different shore types in Shetland. The length (km) of each shore type surveyed is given in brackets.

	Cliff (383.7)	Steep bedrock (361.9)	Shallow bedrock (292.4)	Boulders (160.9)	Cobbles (124.6)	Gravel (87.7)	Sand (50.7)	Mud (4.7)
Oystercatcher	0.04	0.13	0.14	0.31	0.27	0.27	0.28	0.00
Lapwing	0.00	<0.01	0.27	0.77	0.79	0.23	1.01	1.70
Ringed Plover	0.00	0.04	0.21	0.22	1.06	1.03	4.48	0.85
Grey Plover	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.00
Golden Plover	0.00	0.06	0.99	0.08	0.44	0.51	0.00	0.00
Turnstone	1.18	2.52	4.75	4.31	6.69	4.99	7.44	1.28
Curlew	0.46	0.63	1.26	1.48	1.61	1.57	1.09	0.43
Bar-tailed Godwit	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00
Redshank	0.30	0.81	1.80	1.59	2.67	2.06	1.91	5.53
Knot	<0.01	<0.01	0.00	0.00	0.14	0.01	0.10	0.21
Dunlin	0.00	0.00	0.13	0.00	0.25	0.06	0.49	0.00
Sanderling	0.00	0.00	0.00	<0.01	0.00	0.00	0.00	0.00
Purple Sandpiper	0.48	0.95	2.04	0.72	1.42	0.27	1.95	0.00
Total	2.47	5.13	11.59	9.48	15.33	11.03	18.95	10.00

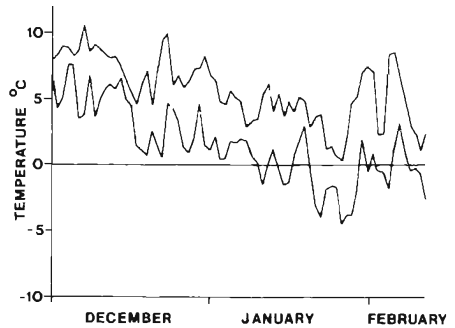


FIGURE 2. Minimum and maximum daily air temperatures ($^{\circ}\text{C}$) at Lerwick during the survey.

A total of 382 Lapwings *Vanellus vanellus* was counted on the shore, mostly on Mainland and Yell (Table 2). They preferred muddy, sandy and boulder shores (Table 4). An additional 633 was found on fields. Ringed Plovers *Charadrius hiaticula* favoured the sandy beaches (Tables 3, 4) throughout the islands (Fig. 3). There were 564 on the shore and 48 on adjacent grass fields.

Turnstones *Arenaria interpres* made up about half the total number of waders

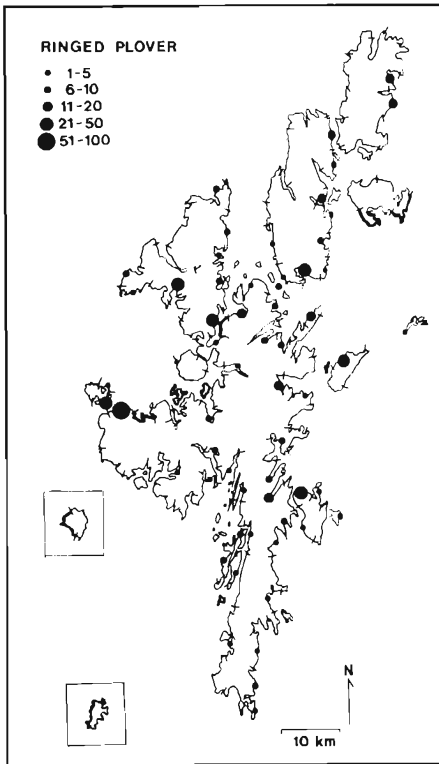


FIGURE 3. The distribution of Ringed Plovers in Shetland. The coastline not surveyed is shown in thick line.

counted (Table 2). They were found throughout the archipelago (Fig. 4) with the largest flocks at the Houb on Whalsay, Out Skerries, Unst and at Sullom Voe. A total of 268 was counted on grass fields. They used all shore types except mud, steep bedrock and cliffs (Tables 3, 4).

A total of 1405 Curlews *Numenius arquata* was counted on the shore, and like the Turnstones, they were catholic in their choice of shore type although they avoided mud, steep bedrock and cliff (Tables 3,4). A further 2574 were seen on fields mostly on Mainland and Yell. Redshanks *Tringa totanus* were the second most abundant wader on the shore. They were found on most habitats, but preferred the mud shores of the inner voes (Tables 3 and 4, Fig. 5).

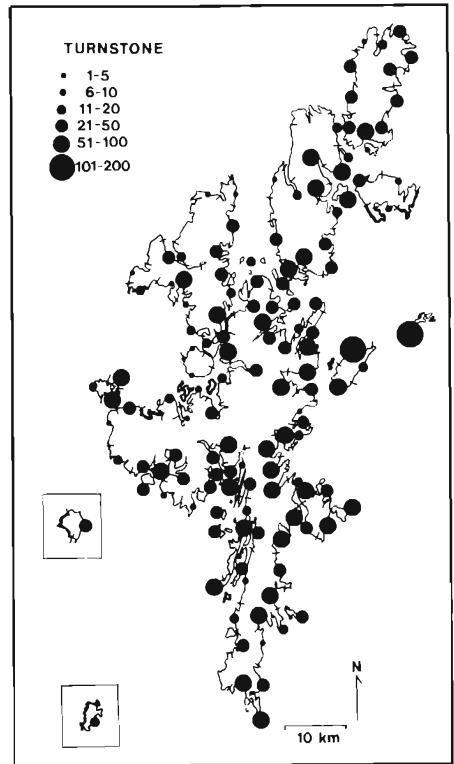


FIGURE 4. The distribution of Turnstones in Shetland. The coastline not surveyed is shown in thick line.

A total of 26 Knots *Calidris canutus* was counted. They were found in small groups at localities where the substrate was soft (Table 3). One hundred Dunlins *Calidris alpina* were present in sheltered voes, usually on sand and cobble shores (Table 3).

Purple Sandpipers *Calidris maritima* were the third most abundant wader on the coast (Tables 2, 3) and occurred mainly in the eastern part of Shetland (Fig. 6). Their preferred shore type was shallow-sloping bedrock (Table 4). Concentrations occurred on the Scalloway Islands (136), around Lerwick and on Bressay (c.250), at the Houb on Whalsay (87), on the islands in Yell Sound and adjacent Mainland (c.150) and on Linga in Bluemill Sound (57, Fig. 6). Only one was seen inland.

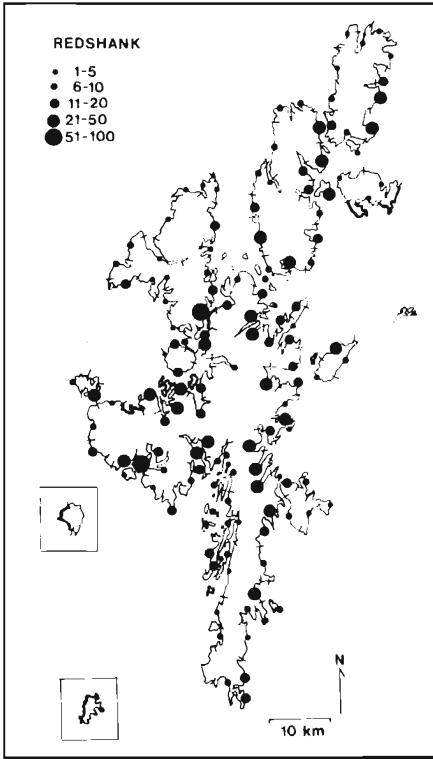


FIGURE 5. The distribution of Redshanks in Shetland. The coastline not surveyed is shown in thick line.

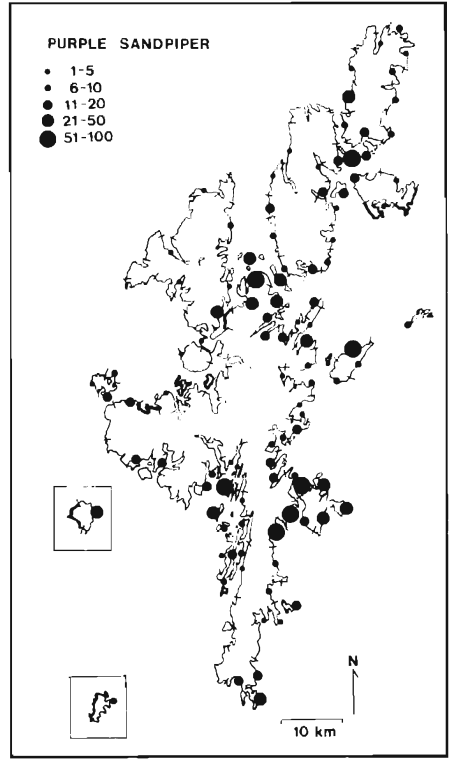


FIGURE 6. The distribution of Purple Sandpipers in Shetland. The coastline not surveyed is shown in thick line.

TABLE 4. Use of different shore types by waders in the Shetland Islands. Values greater than 1.0 indicate preference and less than 1.0 indicate avoidance (see text).

	Cliff	Steep bedrock	Shallow bedrock	Boulders	Cobbles	Gravel	Sand	Mud
Oystercatcher	0.2	0.8	0.9	2.3	1.9	1.9	1.9	0.0
Lapwing	0.0	<0.1	1.1	3.9	3.7	0.9	4.3	7.1
Ringed Plover	0.0	0.1	0.5	0.6	3.3	3.0	18.5	2.3
Golden Plover	0.0	0.2	8.8	0.3	1.6	1.9	0.0	0.0
Turnstone	0.3	0.7	1.5	1.3	2.1	1.5	2.2	0.3
Curlew	0.4	0.6	1.4	1.7	1.8	1.7	1.1	0.3
Redshank	0.2	0.6	1.6	1.3	2.4	1.7	1.5	4.7
Purple Sandpiper	0.4	0.9	2.5	0.7	1.4	0.3	1.9	0.0

Discussion

During the 10-week survey the weather changed from mild to cold (Fig. 2). Cold weather movements of waders, either locally from fields to the shore or long-distance to or from Shetland, could influence the counts on the shore (Baillie *et al.* 1986). Those waders which mainly forage inland are more likely to be affected since fields freeze before the sea-shore. However, we found no significant differences in counts between the mild and cold periods. This may have been due partly to the small sample sizes for comparison, or to the cold period not being sufficiently severe to affect the behaviour of the waders. Overall, the winter 1984-5 was milder than usual which resulted in the larger numbers of Lapwings than usual remaining in Shetland; they generally leave before mid-winter (Shetland Bird Reports).

The sections of cliff presented difficulties, for although the bases of smaller cliffs (<30 m) could readily be scanned with binoculars from the cliff top, the higher cliffs and those with convex profiles could not, so birds were missed. For example, during the survey of Noss by boat a group of 46 Purple Sandpipers was seen which would have been out of sight from the cliff top. Our totals may therefore underestimate some species.

As some waders along cliffs were overlooked, results which suggested that cliffs were generally avoided would be biased. Even so, we believe that our conclusions concerning the avoidance of cliffs are true, as steep bedrock also tended to be avoided and we are confident that this habitat was surveyed satisfactorily. Preferences were shown for one or more of all the other habitats by each species: Lapwings and Redshanks were most strongly associated with muddy shores, Ringed Plovers with sand, and Golden Plovers and Purple Sandpipers with shallow-sloping bedrock. Turnstones, Oystercatchers and Curlews favoured a range of shore types including shallow-

sloping bedrock, boulders, cobbles, gravel and sand. Clearly the waders preferred the sheltered, inner coastline to the steep, older, outer coastline. Steep shores are less suitable for waders because the intertidal zone is narrow, so there is less food available, and they are often washed by waves in bad weather making feeding difficult.

In general the distribution of the waders appears to be less influenced by geology than by topography, but the Purple Sandpiper tended to be less abundant on the west of the Walls Boundary Fault. Although no sites in Shetland can be regarded as of national importance for any wader, the following localities are important in the local context: the Houb on Whalsay; the Houb, Sullom; Orka Voe; Dales Voe and Swinster Houb; Breiwick, Lerwick; Maryfield to Scarfi Taing, Bressay; Vai Voe to Sponger Point, Whalsay; North and South Mouths, Out Skerries; Aith Voe, Cunningsburgh; Grutness to Virkie. All these sites had 100 or more waders.

The Shetland Islands have relatively few waders compared to the Orkney Islands to the south. The total number of waders estimated to be in Shetland was 12,000 and in Orkney was 51,000, even though the Shetland coastline is almost double the length of that of Orkney (Tay & Orkney Ringing Groups 1984). The density of waders on shallow-sloping, rocky shore was 12 per km in Shetland and 66 per km in Orkney. These differences stem from the fact that the Orkney Islands are almost entirely of Old Red Sandstone which has weathered into broad intertidal zones (Mather *et al.* 1975), but Shetland is mainly composed of hard metamorphic and igneous rocks which have resulted in steep rocky shores with a very narrow intertidal zone. Therefore, the area actually available to waders on the shores of Shetland is much smaller. Compared with other parts of Scotland, the Shetland coastline is one of the poorest for waders (Moser & Summers 1987); only the west coast of mainland Scotland had such low densities.

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The status and distribution of the Great Skua in the Western Isles

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The Western Isles contain many areas which few people visit and which are excellent habitat for Great Skuas. The known history of colonization is reviewed together with new survey information for 1986 and 1987 which located 78-87 breeding pairs.

Introduction

Great Skuas *Stercorarius skua* in the Western Isles (including the outlying islands) make up only c.1% of the Scottish population, but form the largest population outside Orkney and Shetland. Recent increases in numbers and range are described here, together with the results of surveys in 1986 and 1987. As with some other species (cf. Buxton 1985) there appear to be many more skuas breeding in the Western Isles than previously recorded. With few exceptions counts at colonies probably represent the minimum number of birds present, as many solitary breeding pairs or prospecting birds may have been overlooked.

Methods

A letter to local newspapers and community newsletters in 1983 asking for information on Great Skua breeding sites brought several replies. All known sites were visited and searched at random in 1986 and 1987 for 'apparently occupied territories'. This was the preferred census method as regular transects and counts of aggressive encounters were found to be generally inappropriate for this sort of terrain (Furness 1982). On small islands the location of territories was already known and occupied territories were relatively easy to find. Information for some remote sites was gleaned from other surveys, which are acknowledged where appropriate.

Status and Distribution

Lewis Great Skuas were reported to be breeding in 1892 by Harvie-Brown & Buckley (1892) but this was never verified. In 1945 a correspondent had informed J.W. Campbell that several pairs were nesting and in 1955 Campbell was able to visit the site and found four pairs plus a single bird, and two nests with eggs (Campbell 1959). Cunningham (1959) found three nests with eggs. All these sites were on the Druim Mor near Gress, which seems to have been the starting point for the colonization of Lewis. In 1973 there were 12 pairs at this site, in 1977 there were 26 pairs, and in 1979 a minimum of 15 pairs was found (N.E. Buxton pers. comm.) though by now the breeding area had spread to sites beyond the Druim Mor. In 1986 I found 12 pairs of territory-holding Great Skuas and in 1987, after a comprehensive sweep-search, found 17 pairs on the Druim Mor.

The Scottish Bird Report for 1974 noted that breeding had spread to the north of Tolsta, and by this time there were probably several pairs on the moor to the north and west of the original site at Gress. By 1983 there were five pairs nesting on Tolsta Head and two pairs of Arctic Skuas *Stercorarius parasiticus* were also present (M.M. Elliott pers. comm.)

A pair was found for the first time on the Galson moor in 1981, and was present again in 1982. In 1983 and 1984 there were

two pairs, in 1985 three pairs, and in 1986 and 1987 four pairs at this site. A colony had also been established on the moor between Sheshader and Bayble. The first known nesting of Great Skuas here was in 1968, and by 1986 there was a minimum of five pairs. In 1987 there were still at least four pairs.

By 1983 they were known to be breeding on the moor near Cuishader in north Lewis and were frequently seen over the moor near the village of Dell. They have been seen regularly for several years near Loch Orasay, and near the village of Laxay in the Lochs area of Lewis. Three pairs bred in the Druim Fada area in 1980 (Cunningham 1987). Solitary birds have occasionally been seen in the Uig area, and in Harris, though there have as yet been no confirmed attempts at breeding in these areas.

St Kilda A pair of Great Skuas was first recorded in summer 1956 (Williamson & Boyd 1960), and breeding was confirmed on Hirta in 1963 (Pollock 1963). By 1971 there were eight pairs on Hirta and a pair also bred on Soay that year (Harris & Murray 1978). In 1984 a pair bred on Boreray and there were eleven pairs on Soay and 25-30 pairs on Hirta. This gave a total of 37-42 pairs for the whole island group, although N.J. Aitken (pers. comm.) suggested that there were about 45 pairs, and a further 12 non-breeding adults. The NCC warden reported no change in 1985, although possibly two new territories were established (R.V. Collier pers. comm.). There were 35-42 pairs in 1986 and an additional seven nests suspected. A total of 54 apparently occupied territories was recorded in 1987 including 44 on Hirta, eight on Soay and two on Boreray. (Seabirds at Sea Team 1987).

North Rona The first recorded breeding was in 1959 (Cunningham 1987). Two nests were found in 1965 (Eggeling 1965) and there were three or four apparently occupied territories in 1972 (Evans 1978). In 1978 seven birds were seen but there was no proof of

breeding (Evans 1978). In 1980 seven or eight pairs nested and a minimum of four pairs nested in 1981 (N.E. Buxton pers. comm.). In 1986 there were 12 pairs holding territories and at least six pairs attempted to breed.

Shiant Isles Single birds were regularly seen prospecting in this area for several years before 1982. Two pairs, both with two eggs, a territory-holding pair, and two solitary birds were present in 1982 (Stevenson 1982). Between five and seven pairs were noted in 1986, including one on Eilean Each, one on Eilean Mhuire, and at least five pairs on Garbh Eilean, though there was no proof of breeding (Murray & Simpson 1987).

Flannan Isles A pair was seen on Eilean an Taighe in summer 1987 (M. Harman pers. comm.) but no nest was found.

Southern Isles One pair was recorded on Mingulay in 1979 and 1980. Five pairs were noted in 1985 though only three nests were found. The first breeding record for Berneray was also in 1985 when one pair incubated one egg (Earnshaw 1987).

Discussion

Without a skua ringing program for the Western Isles it is difficult to quantify how much the growth of colonies is due to locally reared birds returning to breed and how much is due to immigration. Some colonists were certainly from Foula (Shetland) as birds ringed there have been found at Gress (Lewis), Garbh Eilean (Shiant), and St Kilda. The rate of increase on St Kilda at least is far too high to be due to local chick production alone (Furness in litt.). A minimum of 78-87 pairs of Great Skuas nested in the Western Isles in 1986 and at least this number nested in 1987. Many more solitary birds were noted in 1987 over a wide area.

A considerable expansion of the distribution of the Great Skua has occurred since its first known nesting in the

islands. A close association between Great Skua nesting sites and established gull colonies may be due to the kleptoparasitic behaviour of skuas upon gulls. There is no apparent barrier to further expansion in range as both food and suitable nesting habitat are readily available. It seems certain that a more extensive coverage of the islands (especially Lewis and Harris) will reveal even more breeding birds.

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Great Skuas displaying at the nest.

J. Edlsten

The breeding birds of North Ronaldsay, Orkney

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A survey of the breeding birds of North Ronaldsay, Orkney during 1987 produced a total of 42 species, all but two of which were proved breeding. Past data bring the list of proven breeding species to 51, of which 34 currently breed regularly. Eleven species have become established since the last century and three have become extinct. Fourteen species breed only sporadically. A number of species find their northernmost British breeding sites in the island's wetlands.

Introduction

North Ronaldsay is the most northern and eastern island in the Orkney archipelago and lies at 59°22' N 2°26' W. It is also the most isolated being 5 km from Sanday, the nearest island to it, and 50 km from the capital Kirkwall on Mainland. It measures about 5 km in length and 1.5 km across at the widest point and has an area of c.8 km². The maximum height above sea-level is just 18 m. Most of the coastline is rocky, although there are also extensive sandy beaches along the south and east coasts. The land is fertile and has been inhabited since prehistoric times. A wall called the Sheep Dyke encloses the land and restricts the unique North Ronaldsay sheep to the shore, where they feed mainly on seaweed. In places the dyke extends back from the shore to allow the sheep access to some heavily grazed links.

Within the Sheep Dyke most of the land is used for agriculture, although a declining human population has resulted in some crofts being abandoned in recent years. Formerly the agriculture was varied but it has become increasingly centred on the rearing of beef cattle. Much of the land is therefore now under grass for grazing and for hay and silage production. The other important crop is oats which is grown for fodder. Some potatoes are also grown.

There are six main lochs, four of which have wetlands associated with them.

Bridesness and Hooking Lochs are both surrounded by extensive stands of flag irises *Iris pseudacorus* and have little open water. Ancum and Garso Lochs both have smaller areas of associated wetland. All but Ancum Loch are becoming choked with mare's tail *Hippuris vulgaris*. Gretchen and Bewan Lochs have very little marginal emergent vegetation, and are more favoured by migrants than by breeding birds. Numerous other places are waterlogged at least seasonally, while there are also many small damp sites with associated patches of irises.

As part of the activities of the newly formed North Ronaldsay Bird Observatory a complete census of breeding birds was carried out in 1987. This was the first complete survey and the results are presented here and compared where possible with records dating back to the last century.

Methods

The basic unit of the 1987 breeding bird survey was the 'apparently occupied territory' (AOT). The exact definition of this varied depending on the species. Territorial behaviour such as song or display was sometimes the only evidence of occupation. For non-territorial species the looser definition of a 'pair' was used. Other survey techniques are mentioned in the text where appropriate.

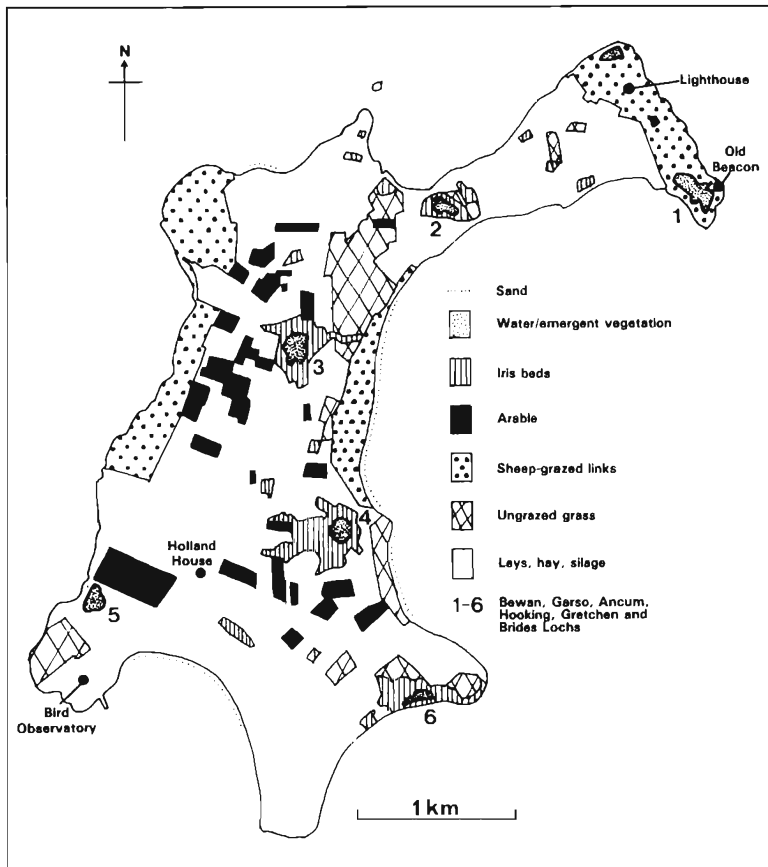


FIGURE 1. North Ronaldsay showing main localities and land use in 1987.

Pairs or AOTs were plotted on maps. Daily coverage from 20 April ensured that all the island was surveyed without the need for transects or sub-plots. Although only one definite registration was required, the presence of territories or pairs was often confirmed on subsequent occasions. Proof of breeding was not required, so the figures quoted usually represent the maximum number of probable breeding attempts.

Past data were extracted from published sources, with additional data from Dr. Kevin Woodbridge's notes since 1977. The only previous detailed accounts of the island's breeding birds are for 1892-93

(Briggs 1893, 1894), 1941 (Lack 1942, 1943) and 1964-66 (Walker 1967a).

Comments on status of breeding birds

Fulmar *Fulmarus glacialis* First bred in 1919 (Fisher 1952). By 1966 there were still only 34 pairs (Walker 1967a) and 35 pairs were recorded during 'Operation Seafarer' in 1968-70 (Lea & Bourne 1975). In 1981 120 pairs were estimated to be present. In 1987, 222 nests were found and at least 80 chicks fledged.

Cormorant *Phalacrocorax carbo* The colony on Seal Skerry is reputed to have been present since at least 1700 (Tulloch 1974). Fifty nests were

recorded in 1892 (Briggs 1893), in 1965 (Walker 1967a) and in 1968-70 (Cramp *et al* 1974). The highest recent count was of 86 nests in 1980; 66 nests were recorded in the 1987 survey.

Mute Swan *Cygnus olor* Although not breeding in 1941 (Lack 1943), by 1966 two pairs were nesting regularly (Walker 1967a). In 1980 three pairs were present in the breeding season. Since 1980 there has been a single pair on Ancum Loch.

Shelduck *Tadorna tadorna* There were 12 pairs in 1893 (Briggs 1894). The report of 'at least 40 pairs' in 1966 (Walker 1967a) seems too high. In 1987, there were 11 pairs and 8 broods were sighted.

Wigeon *Anas penelope* There is only one confirmed breeding record, of a female with a well-grown chick at Bridesness in July 1985 (M. Gray pers. comm.). Summering birds are frequently recorded, and were seen in 1987.

Gadwall *Anas strepera* Breeding was first confirmed in 1979. Pairs have summered each year since with breeding confirmed in 1981 (1 pair), 1986 (2 pairs) and 1987 (3 pairs with 13 fledged young).

Teal *Anas crecca* Although described as 'very common' in the 1960s (Walker 1967a) and 13-14 pairs were estimated for the wetlands in 1985 (E. Meek pers. comm.), only one pair was confirmed breeding in 1987, although at least three other pairs were present and probably bred.

Mallard *Anas platyrhynchos* A common breeding bird, as recorded by Briggs (1893) and Walker (1967a). In 1987 approximately 50 pairs were estimated from the number of 'loafing' males present in May, and 29 broods were seen.

Pintail *Anas acuta* The only confirmed breeding record is from 1978 when a female was found giving a distraction display at Bridesness. There are summer records most years and in 1987 a pair was present in May and a female with two fledged young was seen in July.

Shoveler *Anas clypeata* Two pairs on Hooking Loch in 1892 (Briggs 1893) constituted the second Orkney breeding record. Summer males were present in 1941 (Lack 1943), and in the 1960s it was noted as a 'common breeder' (Walker 1967a). In 1987 15 pairs were estimated from the number

of 'loafing' males present in May, although only four broods were seen.

Scaup *Aythya marila* A female with four ducklings was seen in 1954 (Walker 1967b), one of six Orkney breeding records (Booth *et al* 1984). None was seen in 1987.

Eider *Somateria mollissima* Only one nest was found in 1987, but 31 broods were sighted.

Water Rail *Rallus aquaticus* A bird on a clutch of nine eggs at Ancum Loch on 24 May 1987 was the first breeding record for the island. The nest hatched successfully. There were also summer records of birds at Hooking and Bridesness Lochs and two juveniles were seen at Bridesness Loch in September. Summer birds were noted in 1964-66 by Walker (1967a). There is only one other confirmed breeding record in Orkney this century, on Mainland in 1968 (Balfour 1972).

Corncrake *Crex crex* There was one calling male in 1987, but no evidence that it was paired. The species was abundant in the past; Briggs (1893, 1894) 'never knew them so common anywhere', and once recorded six nests in one field. By 1964-66 there was a maximum of 15 pairs (Walker 1967a). Recent totals of calling males have been 10,6,5,1,7,2,3,1 + ,2,2 from 1977-1986 inclusive. Breeding has not been confirmed since 1981.

Moorhen *Gallinula chloropus* 'Common' last century (Briggs 1893, 1894), and described as 'very common' in 1966 (Walker 1967a). In 1987 at least nine pairs bred.

Coot *Fulica atra* Last century 15-20 pairs bred (Briggs 1893), and 25 pairs were estimated to be present by Walker (1967a) in the mid-1960s. At least 11 pairs bred in 1987.

Oystercatcher *Haematopus ostralegus* Only 'two or three pairs' bred in 1892 (Briggs 1893). Inland breeding in Orkney began in the 1930s (Balfour 1972) and by 1966 Walker (1967a) recorded 86 pairs. In 1987 189 occupied territories were found giving a density of about 23 pairs/km². Territories were found in many habitats on the island, but ploughed fields, beaches and links (sheep-grazed grass) were particularly favoured as nest sites.

Ringed Plover *Charadrius hiaticula* Appears to have been a very common breeder in the past

(Briggs 1893, Walker 1967a), but this is no longer true. Twenty-five territories were found in 1987 and during the 1984 national survey (Meek 1985). Some nests are concealed in hollows beneath large stones or drystone dykes, presumably as an extra defence against predators, particularly sheep which have been recorded eating eggs (Walker 1967a).

Lapwing *Vanellus vanellus* Briggs (1893) described it as a 'common breeding species' but there was a maximum of just 15 pairs during 1964-66 (Walker 1967a). In 1987 there were 70 occupied territories (9 pairs per km²). Thirty-seven of the 70 territories were in damp pasture and most were associated with some damp grassland. Only 6 territories were found on ploughed ground in contrast to the preference for this habitat in more intensively agricultural areas (e.g. da Prato 1985).

Dunlin *Calidris alpina* 'Common' last century (Briggs 1893) but now extinct as a breeding bird. Lack (1943) saw just one bird 'doubtfully breeding', and none was seen in 1987.

Snipe *Gallinago gallinago* Buckley & Harvie-Brown (1891) recorded breeding 'in all the islands'. Twenty-nine drumming birds were heard in 1987. Green (1985) has shown that the peak number of drumming birds represents about half the eventual total number of nesting attempts so the breeding population may number about 60 pairs, as recorded also by Walker (1967a) in the 1960s.

Curlew *Numenius arquata* Curlew have increased throughout the Northern Isles this century (Heppleston 1981) and colonized North Ronaldsay in 1977. Six pairs were breeding by 1980, and in 1987 there were 25 occupied territories. Most were in dry, rough grassland or silage fields. (N.B. the reference to Lack mentioning 'several pairs on North Ronaldsay' in Booth *et al* 1984 is an error for South Ronaldsay).

Redshank *Tringa totanus* Only 'a few pairs' bred last century (Briggs 1893), although Lack (1943) described the species as 'common', and Walker (1967a) considered 'at least 50 pairs' to be present. In 1987 31 pairs were estimated mostly around the wetlands and particularly at Bridesness.

Red-necked Phalarope *Phalaropus lobatus* North Ronaldsay was one of the first known breeding sites for this species in Britain (Booth *et al* 1984).

Numbers were reduced by collecting but Briggs (1893, 1894), recorded at least 2 pairs breeding at the end of the 19th century. By 1941 there were 'several pairs' (Lack 1943), but nesting ceased during the 1950s, possibly due to the lowering of water-levels as the water mills fell into disuse (Balfour, in Booth *et al* 1984). They were still breeding in 1952 (Walker 1967a), but in 1959 they had not bred for 'about three years' (Slater 1960). The most recent sighting on the island was in 1981.

Arctic Skua *Stercorarius parasiticus* The first recorded breeding attempt was by a single pair in 1965 (Walker 1967a) but the first successful breeding was in 1975 (Orkney Bird Report 1975). Since 1977, one, sometimes two pairs have held territory, but breeding has been successful only in 1977 and 1986. In 1987 a single pair held territory and laid two eggs which disappeared during incubation.

Black-headed Gull *Larus ridibundus* Buckley & Harvie-Brown (1891) stated that the Hooking Loch colony was the largest they saw in Orkney. The estimate during 'Operation Seafarer' in 1968-70 was 3600 pairs (Lea & Bourne 1975). There has been a reduction in numbers recently and birds no longer breed away from the wetlands. Seven hundred pairs were estimated from transects and direct counts in the four colonies in 1987.

Common Gull *Larus canus* Past estimates include c.50 pairs in 1966 (Walker 1967a) and 40 pairs in 1968-70 (Lea & Bourne 1975). There were 69 pairs in 1987 mostly in small loose colonies on the coastal links or in patches of irises.

Lesser Black-backed Gull *Larus fuscus* Had been breeding for a few years in 1941 (Lack 1943), but there are no more recent breeding records.

Herring Gull *Larus argentatus* A pair beside Gretchen Loch in 1986 appears to be the only previous breeding record. In 1987 there were 2 pairs, both of which successfully reared young.

Sandwich Tern *Sterna sandvicensis* Sixteen nests at Bridesness in 1893 constitute the first breeding record for Orkney (Briggs 1894). Subsequently, numbers have fluctuated and in some years none have bred. A second colony at Hooking Loch was present by 1941 (Lack 1943). Highest breeding numbers were in the 1960s with 300 pairs in 1962

and 200 in 1967 (Balfour 1968), but with fewer in between (Walker 1967a), and just 37 pairs recorded by 'Operation Seafarer' (Cramp *et al* 1974). Breeding was regular during the 1970s with a maximum of 60 pairs in 1975 (Booth *et al* 1984). Since 1980 when none bred (Bullock & Gomersall 1981) breeding has been sporadic, but in 1987, 26 nests or broods were found at Hooking Loch, the largest number since 1977. At least 21 juveniles fledged.

Common Tern *Sterna hirundo* Briggs (1893) recorded 'a few' breeding last century, and c.20 pairs were said to be breeding in 1966 (Walker 1967a). Neither 'Operation Seafarer' nor the RSPB tern survey in 1980 recorded breeding (Cramp *et al* 1974, Bullock & Gomersall 1981). In 1987 a single pair laid one egg beside Bewan Loch, but it disappeared during incubation.

Arctic Tern *Sterna paradisaea* Large numbers have always bred, although accurate figures are difficult to obtain. 'Operation Seafarer' gave a figure of 950 pairs for 1968-70 (Lea & Bourne 1975), but the first accurate count was the 1980 RSPB survey which gave a figure of 1537 pairs (Bullock & Gomersall 1981). A series of five total-island counts between 27 May and 8 July 1987 recorded up to 1392 individuals (excluding non-breeders) in 26 colonies the largest of which contained a maximum of 280 birds. However the correction factor for the number of breeding pairs derived by Bullock & Gomersall (1981) was believed to be inapplicable as the breeding cycle was not synchronised. The total of 1137 nests found included an unknown number of repeat clutches. Fledging success was poor with c.100-200 chicks estimated to have fledged from c.1000 pairs. There was some evidence of predation by both Hedgehogs *Erinaceus europaeus* and domestic cats.

Black Guillemot *Cephus grylle* Lack (1943) was informed that the Black Guillemot was only a recent breeder, but this seems unlikely. 'Operation Seafarer' recorded 45 pairs in 1968-70 (Lea & Bourne 1975). A survey in 1984 recorded 374 individuals (Ewins & Tasker 1985) and a similar survey in 1987 recorded 458 individuals, but this figure cannot be used to assess the number of breeding pairs (Ewins 1985).

Rock Dove *Columba livia* Briggs (1893) recorded only one pair in 1888, and Walker (1967a) estimated 72 pairs present in 1966. In 1987 25 nest

sites were found, although no comprehensive search was made. About 50-75% of the population retains wild-type plumage but deviations from it are usually slight.

Skylark *Alauda arvensis* In 1987, 108 singing males were mapped. Walker (1967a) estimated 150 pairs in the 1960s.

Swallow *Hirundo rustica* Has bred in at least four of the last ten years, the most recent occasion being in 1984. Usually there is just one pair although there were two in 1984. None was present in 1987.

Meadow Pipit *Anthus pratensis* A recent colonist which was not breeding last century (Briggs 1893) or in 1941 (Lack 1943). By 1966 it was a 'common breeding bird' (Walker 1967a) and 41 territories were noted in 1987.

Rock Pipit *Anthus spinoletta* Only 18 territories were found in 1987, and large stretches of apparently suitable coastline were unoccupied. It was 'very common' last century (Briggs 1892).

Pied Wagtail *Motacilla alba* Although not found in 1941, Lack (1943) was informed that 'it normally breeds'. A pair in 1977 appear to have been the first in recent years, but they are now regular and nine pairs were present in 1987.

Wren *Troglodytes troglodytes* A pair seen carrying food in July 1987 constituted only the third confirmed breeding record for the island. Previous records were in 1975 (2 sites) and 1976 (Orkney Bird Reports 1975, 1976), although birds have summered in other recent years.

Wheatear *Oenanthe oenanthe* There are few past data on the breeding status although it was 'common' last century (Briggs 1893). In 1987, 42 territories were found.

Blackbird *Turdus merula* Two or three pairs had only been resident for a few years in 1892 (Briggs 1893). 'About fifty breeding pairs' were estimated in 1966 (Walker 1967a). There were 25 territories in 1987, most associated with occupied crofts.

Song Thrush *Turdus philomelos* One or two pairs had bred for a few years in 1892 but did not breed in 1893 (Briggs 1893, 1894). Lack (1943) described it as 'common' in 1941. Breeding was suspected during 1964-66 but never confirmed (Walker 1967a). A pair bred in 1977 and two, possibly

three bred in 1980; there are no more recent records.

Hooded Crow *Corvus corone* A pair raised four young in 1987, and were the first successful breeders since 1982. Walker (1967a) noted that this species 'formerly bred'.

Raven *Corvus corax* A pair has nested in the Old Beacon in recent years but the nest failed during incubation in 1987.

Starling *Sturnus vulgaris* In 1987, 216 nests with young were located.

House Sparrow *Passer domesticus* No survey was attempted, but Sparrows appear to be at least as common as Starlings.

Linnet *Carduelis cannabina* Bred formerly in the bushes at Holland House (Lack 1942, 1943), although breeding had ceased by the 1960s (Balfour 1968, Walker 1967a). None bred last century (Briggs 1893).

Twite *Carduelis flavirostris* Both Briggs (1893) and Walker (1967a) recorded this as a very common breeding bird, Walker estimating c.70 pairs. The species has become less common in recent years, particularly since 1981. Only 24 pairs were found in 1987.

Reed Bunting *Emberiza schoeniclus* One pair in 1941 were 'new there' according to Lack (1942, 1943), but by the 1960s it was 'common' with up to '40 pairs' (Walker 1967a). There were at least 20 pairs in 1987.

Corn Bunting *Miliaria calandra* A former breeder whose range is decreasing in Orkney; Briggs (1893) recorded 15-16 pairs in 1892. There were 14 pairs in 1964 and in 1965, and six pairs in 1966 (Walker 1967a), but none bred in 1967 (Booth *et al* 1984). There was a single singing male in 1975 (Orkney Bird Report 1975).

Discussion

Forty-two breeding species were found in the 1987 survey, with all but Pintail and Corncrake confirmed breeding. Both have been proved breeding in the past, as have another nine species. Quail *Coturnix coturnix* and House Martin *Delichon urbica* have probably bred but no written record

exists. Of the list of 51 known breeding species, 34 currently breed regularly, 14 breed sporadically, and three, Red-necked Phalarope, Dunlin and Corn Bunting, no longer breed. Dunlin and Corn Bunting have declined throughout Orkney while Red-necked Phalarope has not bred in Orkney since 1972 (Booth *et al* 1984).

Eleven species have become regular breeders this century. Fulmar, Shoveler, Sandwich Tern, Black Guillemot and Rock Dove are now well established, and their addition and that of Mute Swan, Curlew, Arctic Skua, Pied Wagtail and Reed Bunting have usually been associated with range expansions elsewhere in Orkney (Booth *et al* 1984). Meadow Pipit is also a recent colonist, but its range elsewhere in Orkney has remained stable.

Of the fourteen species which breed sporadically on the island, Hooded Crow and Raven may have been regular breeders in the past but for persecution; Ravens have bred annually in recent years. Gadwall, Water Rail and Herring Gull seem likely to become regular breeders, while Wigeon, Pintail and Common Tern all breed regularly elsewhere in Orkney and may yet become established on the island. Swallow, Wren and Song Thrush are occasional breeders, whose presence may be associated with high numbers passing through on migration. Neither Lesser Black-backed Gull nor Linnet have attempted to breed recently although both were breeding in 1941. The breeding of Scaup was exceptional.

Changes in habitat on North Ronaldsay in the last century have been slight. The island has maintained a mix of agriculture and wetland although the pattern of agriculture has changed. Pigs and chickens were formerly common, and corn and turnips which were major crops are now seldom grown. However, there has been little drainage although water-levels, especially at Hooking Loch, have dropped since the abandonment of the water mills, and this has resulted in an increase of emergent vegetation. The wetlands are im-

portant in maintaining the diversity of breeding birds on the island and also mark the northernmost limit of the British ranges of Mute Swan, Gadwall, Shoveler, Moorhen, Coot and Sandwich Tern as regular breeding species (Sharrock 1976).

An important event in recent years has been the accidental introduction of Hedgehogs in 1972. Declines in a number of ground nesting birds have been noted since, with Black-headed Gulls abandoning dry nest sites and wader chick production reduced over the last decade (Dr K.F. Woodbridge pers. comm.). Hedgehogs have been watched eating Arctic Tern eggs (K. Seel pers. comm.). Over 100 Hedgehogs were transported from the island in 1986, and this seemed to reduce levels of predation in 1987, although tern eggs and chicks were still found showing signs of Hedgehog predation.

Acknowledgments

This paper owes much to the local knowledge and encouragement of Dr Kevin Woodbridge. Eric Meek commented on later drafts and provided the more obscure references, Martin Gray helped with local knowledge and Alison Duncan assisted with production. I am grateful to Nick Picozzi and the editorial board for comments and help with the manuscript and to the islanders for their assistance during the fieldwork.

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Short Notes

Early records of Pochard breeding in Fife

In a recent treatment of the status and distribution of the birds of Fife, A.M. Smout (1986, *The Birds of Fife*, Donald, Edinburgh), quoting J.A. Harvie-Brown (1906, *A Fauna of the Tay Basin and Strathmore*, Douglas, Edinburgh), accredits Lindores Loch in 1897 as the first recorded nesting site of Pochard *Aythya ferina*. While examining an egg collection recently donated by the SOC to the National Museums of Scotland, I noticed two clutches (c/10 and c/4) inscribed 'Lindores 26.5.92' and 'Lindores 19.5.94'. These are identical in shape and colour to Pochard eggs in the museum's reference collection and Table 1 shows that their sizes and weights fall well within the ranges given for Pochard in W. Makatsch (1974, *Die Eier der Vögel Europas* Band 1. Neumann Verlag,

Radebeul). Of the two clutches, only the c/10 is recorded in the collector's notebooks; the initial entry appears as Scaup *Aythya marila*, which is most unlikely and was subsequently changed to Pochard by the collector, A.H. Meiklejohn.

R. Godfrey's (1898, *Ann. Scott. Nat. Hist.* 28: 238) observations suggest that Pochard might have been breeding in Fife prior to 1897; the clutches described here confirm that breeding took place at least as early as 1892.

I thank L. Cameron for assistance with translation and B. Zonfrillo for commenting on an earlier draft.

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TABLE 1. Range of length, breadth and weight of known Pochard eggs (Makatsch 1974) and of two clutches from Lindores Loch collected in 1892 (c/10) and 1894 (c/4).

Source	Length (mm)	Breadth (mm)	<i>n</i>	Weight of shell (g)	<i>n</i>
Makatsch (1974)	54.8-67.6	39.2-46.9	594	4.35-7.69	428
Lindores Loch	59.4-64.2	41.2-43.4	10	4.62-5.50	10
Lindores Loch	59.1-61.5	43.4-44.8	4	6.37-6.88	4

Red Grouse homing for 35 kilometres

Red Grouse *Lagopus lagopus scoticus* are generally considered sedentary. Jenkins *et al.* (*J. Anim. Ecol.* 32: 317-376) found that 97% of ringed cock grouse and 80% of hens were recovered (usually shot) within 1.5 km of where they had been ringed; no cock was found more than 8 km away, but one hen was found to have moved 42 km. In our current studies of radio-tagged grouse in Speyside none moved more than 10 km from the point of capture, even during snowy weather. However, there are casual obser-

vations of large scale grouse movements in the Badenoch District (MacPherson, *The Field*, 24 August 1914).

As part of an experiment, designed for another purpose, 43 grouse were caught at night on Flichity, Strathnairn, Inverness-shire in March and April 1987 and taken within 2 hours to Ralia Moss, Speyside, Inverness-shire. This was a minimum distance of 35 km from the north-west to the south-east corner of the Monadh Liath. All were tagged and some fitted with radio

transmitters. On a number of occasions during the following 4 months we visited Flichity but heard no radio signal and saw no tagged grouse; we assumed the grouse had been unable to navigate back to Flichity before August 1987. However, on 12 April 1988 a cock was recaptured within 1 km of where he had originally been caught on 3 April 1987. Most displacement-release experiments have been done with long distance migrants (reviewed by R.R. Baker 1982. *Migration paths through time and space.*

Hodder and Stoughton, London) but this example provides a substantiated case of a relatively sedentary bird returning to its spring territory after displacement beyond its normal area of familiarity.

Robin Baker and Adam Watson provided helpful comments.

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Decline of shore waders at Loch Morlich

Loch Morlich in Speyside has long been known as outstanding for waders nesting on or close to the shore, probably because of its unusual variety of shore habitats, but there has been concern about recreational developments leading to heavy human impact there since the 1950s (D. Nethersole-Thompson & A. Watson 1981. *The Cairngorms* Melven Press, Perth). Below, we note a decline of shore waders there.

The procedure was to walk slowly round the 5 km loch edge in May, stopping to scan the shore from vantage points, and noting locations and flights of singing birds; visits

were also made in June. Table 1 summarizes annual numbers in the 1930s-1950s. In early May then, the loch was alive all day with the songs and calls of Common Sandpipers. In addition, during the 1930s a Temminck's Stint *Calidris temminckii* brooded eggs in two years, and an unmated Green Sandpiper *Tringa ochropus* was sometimes seen in song flights over the loch edges. A Temminck's Stint was seen in 1947 and one brooded eggs in 1956, and in 1956 a Spotted Redshank *Tringa erythropus* appeared nearby. AW saw a Greenshank with chicks at the west end in 1948.

TABLE 1. Number of pairs of shore waders at Loch Morlich in May.

Species	Annually	Annually	1984-87
	1930s and early 1940s	late 1940s and early 1950s	
Oystercatcher <i>Haematopus ostralegus</i>	At least 4	A few	0
Ringed Plover <i>Charadrius hiaticula</i>	A few, up to 4	A few, up to 3	0
Lapwing <i>Vanellus vanellus</i>	6-8	A few	0
Dunlin <i>Calidris alpina</i>	1, with 2 some years	1-2 in some years	0
Curllew <i>Numenius arquata</i>	2-4 fed	1-2 fed	0
Redshank <i>Tringa totanus</i>	2-3	2-3	0
Greenshank <i>Tringa nebularia</i>	2-7 fed	3-6 fed	0
Common Sandpiper <i>Actitis hypoleucos</i>	Never fewer than 20	30 in 1947, 25-30 in 1952, over 30 in 1953 & 1956, never fewer than 20	2-5

Oystercatchers and Ringed Plovers declined in the late 1950s, and although a few still nested on the east beach in 1960, most pairs were failing to rear young by then; they all disappeared in the early 1960s. Lapwing, Curlew, Redshank, and Greenshank decreased in the 1960s and early 1970s. The last Greenshank disappeared in the mid-1970s. The Greenshank and Curlew extinction was a special case, largely attributed to their main breeding habitats in the forest bogs of Rothiemurchus west of Loch Morlich becoming dried out and overgrown with tall heather and trees (Nethersole-Thompson & Watson 1981). In the late 1970s no resident Lapwing, Dunlin, Curlew or Redshank occurred in any year, and in 1979 DNT found only one pair of Common Sandpipers on a part which annually had 5 pairs in the 1930s.

In 1984 the only resident waders around the whole of the loch were 3-4 Common Sandpipers. They seldom sang, and usually the loch was silent. One that sang on the north shore flew across the loch to sing on the east shore and on the east part of the south shore, and another that sang on the west shore flew across the loch to sing on the west part of the south shore and at the west end of the north shore; clearly, home ranges were big. In 1985 and 1986, there were two pairs of Common Sandpipers, and in May 1987 4-5 pairs; no other shore waders were present in these years.

Each year in 1933-42, DNT found 1-2 pairs of Common Sandpipers on the 4.5 km

shore of Loch an Eilein and two pairs on the 2 km shore at the nearby Loch Gamhna south of Aviemore; in May 1987 2-3 pairs and one pair were there. These lochs had less variety of shore habitat than Loch Morlich, and Common Sandpipers were the only breeding waders, but the important point is that their numbers have not declined greatly as at Loch Morlich. Many people have gone there in recent decades, but far fewer than at Loch Morlich. The lower impact is obvious on the verges, with far less damage from trampling, and with no roads, car parks and lay-bys along the lochsides.

We suggest that shore waders at Loch Morlich have declined through a combination of a) disturbance by many anglers, walkers, bathers and others, b) habitat impoverishment from trampling leading to poorer invertebrate food supply, c) habitat destruction by car parks, lay-bys, roads, and jetties on the north shore, and by a wide footpath round the rest of the loch, and d) probably robbing of eggs and chicks by more Crows *Corvus corone* and gulls foraging on the shore.

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ROBERT CARRICK 1911-88

Robert Carrick, one of Scotland's outstanding research ornithologists, died at Rogart in Sutherland on 17 July 1988. Though his earliest scientific studies of birds were carried out in Britain, his major contributions were made from 1952 to 1971 in Australia. He and his wife Chriss, who was an active partner in most of his work, retired to Dornoch in 1971. During their retirement the Carricks continued to travel worldwide, and spent the winter of 1987-88 in Capetown. Chriss died there suddenly and unexpectedly on 30 January 1988, and Robert returned home in March but never fully recovered from the loss of his wife.

Having graduated in Glasgow with First Class Honours in Zoology Robert studied slugs for his PhD at Edinburgh, and was appointed first as an Assistant in the Natural History Department at Aberdeen, and then to a lectureship in Agricultural Zoology at the University of Leeds. There he began his pioneering work on the ecology and behaviour of Starlings. During the war he was a Staff Major specializing in camouflage and deception and served in North Africa, Burma and India. He returned to Leeds after the war, but Professor V.C. Wynne-Edwards spotted him and appointed him to a senior lectureship in Aberdeen University. There he continued his work on Starlings, and being a fine photographer, used still and cine photography very effectively as a research tool. He and I began the study of Fulmars on Eynhallow, Orkney in 1950 – a study which continues, unbroken, to this day.

In 1952 he joined the Wildlife Survey Section of the Commonwealth Scientific and Industrial Research Organisation in Canberra, Australia, and eventually became the Deputy-Chief of its Division of Wildlife Research. His outstanding contribution to ecological ornithology was his classic long-term study of the social behaviour, ecology and population regulation of the Australian Magpie. Though many of the data are still not fully analysed, published summaries

brought him international acclaim. He also designed and commissioned the Australian Bird Banding Scheme.

Robert saw great opportunities for biological work in the Antarctic and soon became deeply immersed in ecological studies on Macquarie Island. His ten-year study of the Royal Penguin is another classic, and he also studied the southern Elephant Seal. His sub-Antarctic work, carried out in close association with the Australian National Antarctic Research Expeditions, led to his appointment as Deputy Director of the Mawson Institute for Antarctic Research in the University of Adelaide. While he was there he began yet another long-term study this time of the Silver Gull. Again his approach was innovative, concentrating on the ecology of the gulls in winter, away from their breeding colonies.

Robert was a highly enterprising biologist and an excellent organiser and leader of research teams. He was utterly committed to his team (which usually included Chriss) and inspired them to fierce loyalty and the highest standards of critical scientific work. He was a clear and original thinker, never a conformist, and was always prepared to challenge unwarranted authority.

Robert and Chriss travelled widely and he was an excellently informed and globally committed environmentalist. Politically Robert was a Liberal and he developed a strong interest in the well-being of black South Africans. He was a personal friend of Chief Buthelezi of Kwazulu, and he bequeathed his estate to the "Carrick Fund for Environmental Science" designed to provide financial support for training bright young Zulus in the environmental sciences in the University of Aberdeen. Always a man of action he will be fondly remembered, not least through the Carrick Fund, as one who was utterly committed to bettering the quality of life of his fellow men and of the environment in which we all live.

G.M. Dunnet

Items of Scottish Interest

The papers and reports on birds in Scotland listed here deal mainly with status and distribution. Papers in the widely available journals *British Birds*, *Bird Study* and *Ringing and Migration* are excluded. Most are available in the Waterston Library for reference. Items marked with an asterisk are available from the SOC Bird Bookshop postfree to SOC members at the prices quoted.

The librarian is glad to receive reprints or copies of papers on any aspect of ornithology or general natural history.

Scientific papers

- Long-term declines of Red Grouse in Scotland. R.W.F. Barnes 1987. *J. Appl. Ecol.* 24: 735-741. Based on game books from 160 Scottish moors.
- The numbers and distribution of Curlew in the Western Isles. N.E. Buxton 1987. *Hebridean Naturalist* 9: 51-55.
- Wading birds and wildfowl of the estuary and Firth of Forth, Scotland. D.M. Bryant 1987. *Proc. Roy. Soc. Edin.* 93B: 509-520.
- Energetics of the annual cycle of Dippers. D.M. Bryant & P. Tatner 1988. *Ibis* 130: 17-38. A study of Dippers on the River Devon in Central Scotland.
- Seaducks in the Moray Firth: a review of their current status and distribution. L.H. Campbell, J. Barrett & C.F. Barrett 1986. *Proc. Roy. Soc. Edin.* 91B: 105-112.
- Recent changes in numbers of waders on the Clyde Estuary, and their significance for conservation. R.W. Furness, H. Galbraith, I.P. Gibson & N.B. Metcalfe 1986. *Proc. Roy. Soc. Edin.* 90B: 171-184.
- The effects of territorial behaviour on Lapwing populations. H. Galbraith 1988. *Orn. Scand.* 19: 134-138. A study at three sites in the Carse of Stirling, Central Scotland.
- Recent changes in the status of some Clyde vertebrates. J.A. Gibson 1986. *Proc. Roy. Soc. Edin.* 90B: 451-467.
- Moorlands of the Campsie Fells and Touch Hills: their use by breeding birds. N. Harding, K.B. Shepherd & D.A. Stroud 1988. Nature Conservancy Council, Northminster House, Peterborough (Contract Report No. 800) 30 pp.
- The breeding biology of Guillemots on the Isle of May over a six year period. M.P. Harris & S. Wanless 1988. *Ibis* 130: 172-192.
- The breeding seabirds of the Firth of Forth, Scotland. M.P. Harris, S. Wanless & R.W.J. Smith 1987. *Proc. Roy. Soc. Edin.* 93B: 521-533.
- Utilization of discarded fish by scavenging seabirds behind whitefish trawlers in Shetland. A.V. Hudson & R.W. Furness 1988. *J. Zool., Lond.* 215: 151-166.
- Population dynamics of seabirds in the Firth of Clyde. P. Monaghan & B. Zonfrillo 1986. *Proc. Roy. Soc. Edin.* 90B: 363-375.
- Trends of population change at colonies of cliff-nesting seabirds in the Moray Firth. G.P. Mudge 1986. *Proc. Roy. Soc. Edin.* 91B: 73-80.
- Seasonal changes in the numbers and distributions of seabirds at sea in the Moray Firth, northeast Scotland. G.P. Mudge & C.H. Crooke 1986. *Proc. Roy. Soc. Edin.* 91B: 81-104.
- Regional, seasonal and annual variations in the structure of Purple Sandpiper populations in Britain. M. Nicoll, R.W. Summers, L.G. Underhill, K. Brockie & R. Rae 1988. *Ibis* 130: 221-233.
- Temporal and spatial patterns in the abundance of wintering Red-breasted Mergansers in an estuary. H. Richner 1988. *Ibis* 130: 73-78. A study on the Ythan estuary, northeast Scotland.
- Analysis of counts from monitoring Guillemots in Britain and Ireland. P. Rothery, S. Wanless & M.P. Harris 1988. *J. Anim. Ecol.* 57: 1-19. Nearly half the counts analysed were from north and east Scotland where numbers in general increased over the period 1975-82.
- Factors affecting the numbers of breeding birds and vascular plants on Lowland farmland. P. Shaw 1988. Commissioned Research Report No. 838 to the Chief Scientist, Nature Conservancy Council, Northminster House, Peterborough (188 pp).

- A study of 27 farmland sites in 1983 and 1984 in Lowland Scotland.
- The incidence of lead poisoning among Whooper and Mute Swans in Scotland. C.J. Spray & H. Milne 1988. *Biol. Conserv.* 44: 265-281. In a study in 1980-86 in northeast Scotland it was found that 47% of deaths of Whooper Swans were due to lead poisoning, compared to 13% for Mute Swans.
- A survey of moorland birds on the Isle of Lewis in 1987. D.A. Stroud, M. Condie, S.J. Holloway, A.J. Rothwell, K.B. Shepherd, J.R. Simons & J. Turner 1988. *CSD Report* No. 776, Nature Conservancy Council, Northminster House, Peterborough (76 pp).
- The distribution and local movements of shore-birds within the Moray Firth. F.L. Symonds & D.R. Langslow 1986. *Proc. Roy. Soc. Edin.* 91B: 143-167.
- Patterns of association between birds and invertebrates in the Clyde Estuary. D.B.A. Thompson, D.J. Curtis & J.C. Smyth 1986. *Proc. Roy. Soc. Edin.* 90B: 185-201.
- Dotterel numbers in relation to human impact in Scotland. A. Watson 1988. *Biol. Conserv.* 43: 245-256.
- Sparrowhawks affect the spacing behaviour of wintering Turnstone and Redshank. D.P. Whitfield 1988. *Ibis* 130: 284-287. The study site was a 5 km stretch of rocky shore in East Lothian.

Multi-paper reports of Symposia

- The environment of the Estuary and Firth of Clyde. J.A. Allen, P.R.O. Barnett, J.M. Boyd, R.C. Kirkwood, D.W. Mackay & J.C. Smyth (Eds) 1986. *Proc. Roy. Soc. Edin.* 90B: 539 pp. £25*. The Proceedings of a Symposium held in Glasgow in October 1985.
- The marine environment of the Moray Firth. R. Ralph (Ed) 1986. *Proc. Roy. Soc. Edin.* 91B: 358 pp. £25*. The Proceedings of a Symposium organised by the Royal Society of Edinburgh, the University of Aberdeen and Britoil plc held at the University of Aberdeen in March 1985.
- The natural environment of the Estuary and Firth of Forth. D.S. McLusky (Ed) 1988. *Proc. Roy. Soc. Edin.* 93B parts 3/4: 347 pp. £15*. The Proceedings of a Symposium held in Edinburgh in May 1987.

Bird Reports

- Angus and Dundee Bird Report for 1985 and 1986.* (41 pp) R.D. Goater (Ed) 1988. £3.50*. This nicely-produced report supercedes the ornithological section of the *Angus Wildlife Review*, the last edition of which covered 1981 and 1982.
- Ayrshire Bird Report for 1987.* (48 pp) Angus Hogg (Ed) 1988. £2*. Includes several short articles, one of which describes the remarkable movements of Leach's Petrels in September 1987.
- Caithness Bird Report for 1987.* (51 pp) 1988. £3*.
- Colonsay and Oronsay Bird Report for 1987.* (11 pp) John & Pamela Clarke (Eds) 1988. An unpublished report.
- Dumfries and Galloway Region Bird Report for 1987.* A. Donald Watson (Ed) 1988. £2.30*. Previous reports covered only Stewartry and Wigtown Districts.
- Fair Isle Bird Observatory Report for 1987.* (70 pp) Nick Riddiford (Ed) 1988. £2.50*. This is the 40th annual report from Fair Isle, produced to the high standard we expect, with many short articles.
- Forth Area Bird Report for 1985 and 1986.* (28 pp) C.J. Henty & M.V. Bell 1988. In *The Forth Naturalist and Historian* vol. 10 1988. £3*. The bird report covers Clackmannanshire, Stirlingshire and southwest Perthshire.
- Islay Bird and Natural History Report for 1987.* (20 pp) Malcolm Ogilvie 1988. £1*.
- Lanarkshire Bird Report for 1987.* (37 pp) I. English (Ed).
- Lothian Bird Report for 1987.* (92 pp) I.J. Andrews (Ed) 1988. £4*. An outstanding production, with a 54-page systematic list, a checklist of the birds of Aberlady Bay Local Nature Reserve by its warden Peter Gordon, and a number of short articles.
- Orkney Bird Report for 1987.* (78 pp) C. Booth, M. Cuthbert & E. Meek (Eds) 1988. £2*. Its 54 pp systematic list incorporates the records of the North Ronaldsay Bird Observatory, and there are a number of short articles.
- Outer Hebrides Bird Reports for 1984 and 1985.* (18 pp) Peter Cunningham 1987. In *Hebridean Naturalist no. 9* (80 pp) Stewart Angus (Ed), for the Western Isles Natural History Society, 1987. £3.50*. It is pleasing to see the *Hebridean Naturalist* revived after a gap of three years.

- Shetland Bird Report for 1987*. (63 pp) P.M. Ellis (Ed) 1988, for the Shetland Bird Club. £2.50*. Includes a study of the breeding habitat of the Whimbrel.
- Waders on Sanday (Orkney) 1987. C.J. Corse & R.W. Summers 1988. A 15 pp unpublished report by the Orkney and Tay Ringing Groups on studies in January and April.
- Greenland White-fronted Geese in Britain 1986/87. *Greenland White-fronted Goose Study Research Report* no. 6 1988 24 pp. At the autumn census 56% of these geese, more than 6000, were on Islay. Details are given of the year's events at Duich Moss.
- Caithness Seabird Project Report for 1987*. S. MacKay (Ed) 1988. This is the first report (36 pp) on the Highland Ringing Group's work on the seabirds of east Caithness. £1.50*.
- Birds on Tيرة 10-22 October 1987. M.W.A. Martin (1988). A 4 pp unpublished report.
- Seabirds between Bach Sheigra and Sgeir Ruadh, Sutherland 1987. A. Meakin 1988. *Seabird Group Newsletter* no. 51: 2-3.
- Seabirds by kayak - a report on counts off north Skye, June 1987. M. Mills 1988. *Seabird Group Newsletter* no. 51: 3-4.
- Raven survey in Stirlingshire, Dunbartonshire and the Loch Lomond drainage area of southwest Perthshire, Scotland in 1987. J. Mitchell 1987. A 4 pp unpublished report.
- Peregrine report for 1987 for Dunbartonshire and Stirlingshire*. J. Mitchell 1987. A 2-page unpublished report.
- Heronry report for Loch Lomondside 1987*. J. Mitchell 1987. A one-page unpublished report.
- 1987 census of territorial waders on the Ring Point Loch Lomond National Nature Reserve. J. Mitchell 1987. A one-page unpublished report.
- Islay Birds - a Checklist. M.A. Ogilvie 1988. A 20-page checklist published by the Islay Natural History Trust, Port Charlotte. £0.95*.
- St. Abb's Head National Nature Reserve seabird sample counts and seabird census 1987. K.J. Rideout and J.T. Martin 1988. A 20-page report to the Nature Conservancy Council, SE Scotland Region, Edinburgh.
- Forth Islands bird counts 1987. R.W.J. Smith 1988. *Edinburgh Nat. Hist. Soc. Journal* for 1987: 30-31.
- Central and southwest Perthshire Peregrines and Ravens in 1987. P. Stirling-Aird 1988. A 3-page unpublished report.

W.G. Harper

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nor typed entirely in capitals. Scientific names should follow the first text reference to each species and should follow Voous' 'List of Recent Holarctic Bird Species' as given in *The British Birds' List of Birds of the Western Palearctic* (1984).

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