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Orkney Cormorants - an aerial census of the breeding population

PETER REYNOLDS AND
CHRISTOPHER J. BOOTH

An aerial photographic survey of Orkney's Cormorant colonies was undertaken in June 1985, when 570 nests were counted, a similar total to earlier counts. Two new colonies have been established since the 1960s, though nesting on one of them is sporadic, and no colonies have been permanently abandoned. Numbers at Taing Skerry and Boray Holm appear to vary in a complementary way. Post-breeding nest counts proved unreliable as a means of assessing breeding numbers.

Introduction

The Cormorant, *Phalacrocorax carbo,* is a resident breeding species in Orkney (Balfour *et al,* 1967). These authors concluded that about 600 pairs bred in Orkney, at two main and five smaller colonies. Their counts, undertaken during the period 1956-66, involved a combination of ground counts of nests containing eggs or chicks and estimates of nests counted from a distance (boat or adjacent cliff-top).

Further counts of individual colonies were made in the intervening years up to 1984 (Booth *et al,* 1984; *Orkney Bird Reports,* 1983, 1984) but a simultaneous census of all colonies had not previously been undertaken. As the Cormorant was to be the subject of a BTO/SOC winter survey in 1985/86 it was considered timely to complete a simultaneous survey of all the Orkney breeding colonies in 1985.

Methods

The Orkney Cormorant colonies are distributed from Seal Skerry in the extreme north to Pentland Little Skerry in the extreme south, a distance of some 70km. All colonies are difficult of access, being situated on small offshore islands either on cliff-tops, rocky foreshores or shingle beach (Balfour *et al,* 1967). In view of this inaccessibility, the requirement for a simultaneous census, and a desire to avoid the excessive disturbance inherent in ground counts, it was decided to use aerial survey.

The survey was flown on 1 June 1985 between 1140 and 1247 hours BST, using a Pilatus-Britton-Norman Islander aircraft normally used for the domestic inter-island passenger service. During the survey the aircraft was flown at a height of 130m and over the colonies speed was reduced to 80 knots. One of us (CJB) sat

***Cormorant in breeding plumage.* W. Neill**

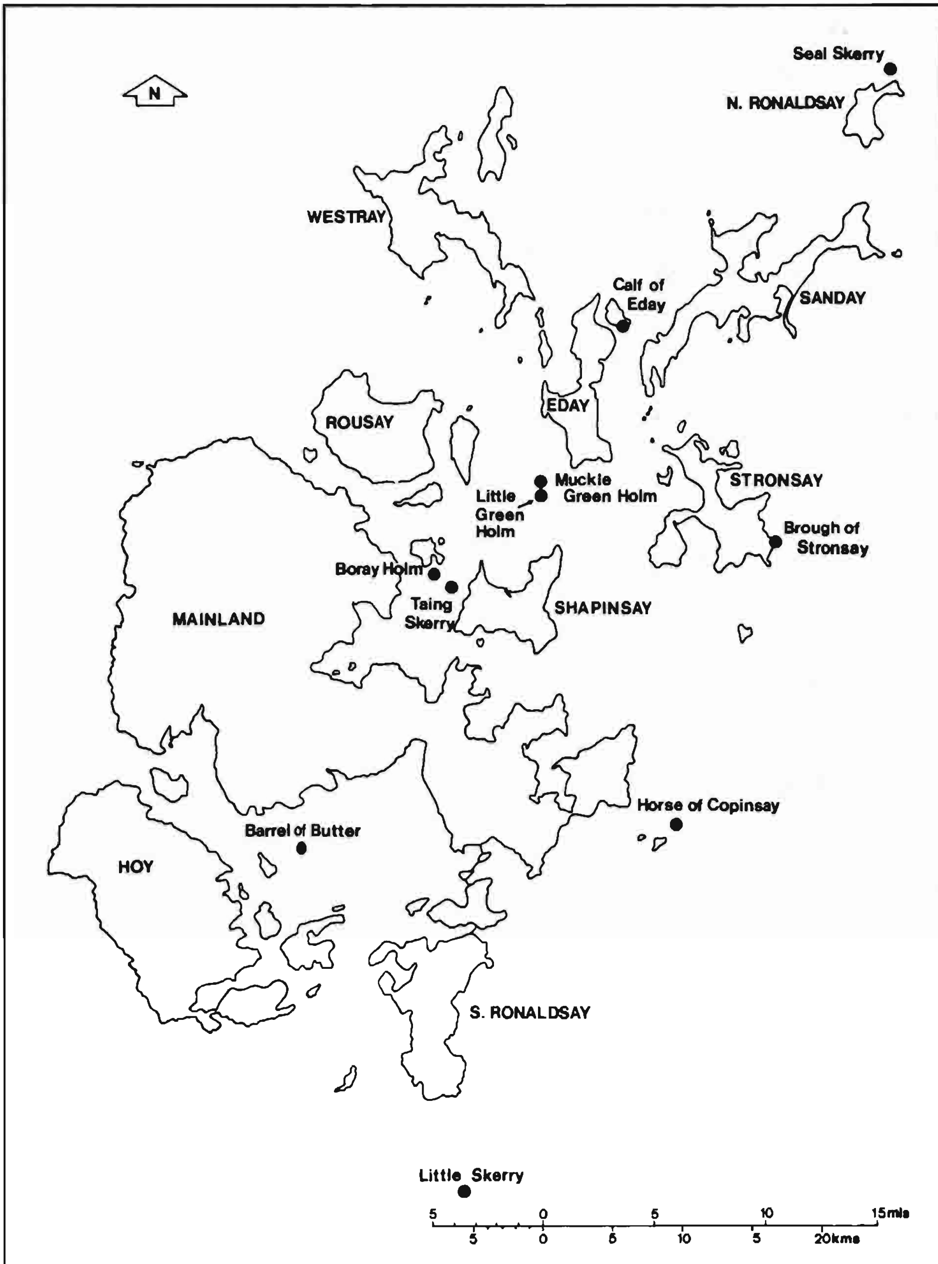


Fig. 1. Orkney, showing the principal islands and the location of the Cormorant colonies (filled circles) referred to in the text.

immediately behind the pilot and photographed the colonies using a Nikon FE camera with 50mm lens and Ilford 400SA black and white film. A second photographer (PR), complete with safety harness, was secured in the luggage hold and used a Nikon FM camera with 55mm lens and Ektachrome 400ASA colour transparency film. The rear photographer maintained contact with the pilot by means of an intercom. An observer (RGA) attempted to estimate colony nest totals but, given the constraints of both time and position in the aircraft, these were necessarily crude. Weather conditions during the survey were excellent, with no cloud or wind and good visibility. The colonies were flown in the following sequence: Seal Skerry; Calf of Eday; Muckle Green Holm; Little Green Holm; Boray Holm; Taing Skerry; Brough of Stronsay; Horse of Copinsay; Little Skerry; Barrel of Butter (Figure 1). Ground counts were undertaken on Taing Skerry and Muckle and Little Green Holms on 16 August.

Colour transparencies were projected onto white paper and nests marked. A nest was defined as an accumulation of nest material capable of holding either eggs or young. Counts of both colour and black and white photographs (using a hand lens in the latter case) were completed in the first instance independently by CJB and PR. Subsequently joint counts were made of colour transparencies followed by black and white prints and involving discussion of those "nests" which required a degree of interpretation. The original photographs have been deposited with the Nature Conservancy Council, Orkney.

Results and Discussion

Breeding Population

Using the joint counts derived from the colour transparencies a total of 570 nests were counted (Table 1). As Balfour *et al* (1967) concluded that the Orkney population fluctuated around 600 breeding pairs, it appears that there has been little overall change. However, in 1976 a count of three colonies, Calf of Eday, Boray Holm and Taing

TABLE 1 Cormorant nest counts obtained from colour transparencies and monochrome prints of Orkney colonies by two observers (PR and CJB). % difference between counts = difference between counts of two observers divided by the mean count and multiplied by 100. Estimate = estimated count by observer during flight.

Colony	Nest Counts							
	From Colour Transparencies					From Black and White Prints		
	PR	CJB	Joint	% Difference	Estimate	PR	CJB	% Difference
Seal Skerry	63	62	65	1.6	40	60	63	4.9
Calf of Eday	216	220	223	1.8	120	No Monochrome Coverage		
Muckle Green Holm	42	40	44	4.9	45	43	42	2.4
Little Green Holm	45	43	46	4.5	35	44	46	4.4
Boray Holm	0	0	0	0	0	0	0	0
Taing Skerry	148	131	146	12.2	80	134	142	5.8
Brough of Stronsay	24	22	22	8.7	22	21	24	13
Horse of Copinsay	4	4	4	0	4	4	4	0
Little Skerry	22	20	20	9.5	20	22	20	9.5
Barrel of Butter	0	0	0	0	0	0	0	0
Total	564	542	570	3.9	366	328	341	3.8

Skerry produced a total of 677 nests, suggesting that the population has declined from a peak in the mid 1970s. Fluctuations in the breeding populations at individual colonies are shown in Table 2.

Two new colonies have appeared since Balfour *et al* (1967) reviewed Orkney's Cormorant colonies. Breeding was first recorded on Little Green Holm in 1982. Attempts have also been made to colonise the Barrel of Butter during the last ten years (Booth *et al* 1984). This small skerry is the site of an illuminated navigation beacon and in some years nests have been destroyed because of possible interference with servicing requirements.

TABLE 2 Counts of nests at Orkney Cormorant colonies, 1956-1985. After Balfour, Anderson and Dunnet 1967; Booth, Cuthbert and Reynolds 1984; *Orkney Bird Reports 1983 and 1984.*

Colony	1959	1960	1961	1962	1963	1964	1965	1966	1968	1969	1970
Seal Skerry							50			50	
Calf of Eday			198	168	182	198	170			211	
Muckle Green Holm			82							58	
Little Green Holm											
Brough of Stronsay			c20							15	
Boray Holm	180	54	17	21	188	202	208	172		224	
Taing Skerry		166	190	185	43	15	0	c35			
Horse of Copinsay				20-30						16	
Little Skerry				c20						10	
Barrel of Butter											

Colony	1974	1975	1976	1977	1979	1980	1981	1982	1983	1984	1985
Seal Skerry					32	86	74				65
Calf of Eday	265		308				147	175+	217	c160	223
Muckle Green Holm							c50	45-50		c20	44
Little Green Holm								4-5	7-12	28	46
Brough of Stronsay		23			10+		c20	26	24	20	22
Boray Holm			119	112			40	56	19		0
Taing Skerry			250				80	114			146
Horse of Copinsay						c17		6		4	4
Little Skerry											20
Barrel of Butter				1				7+			0

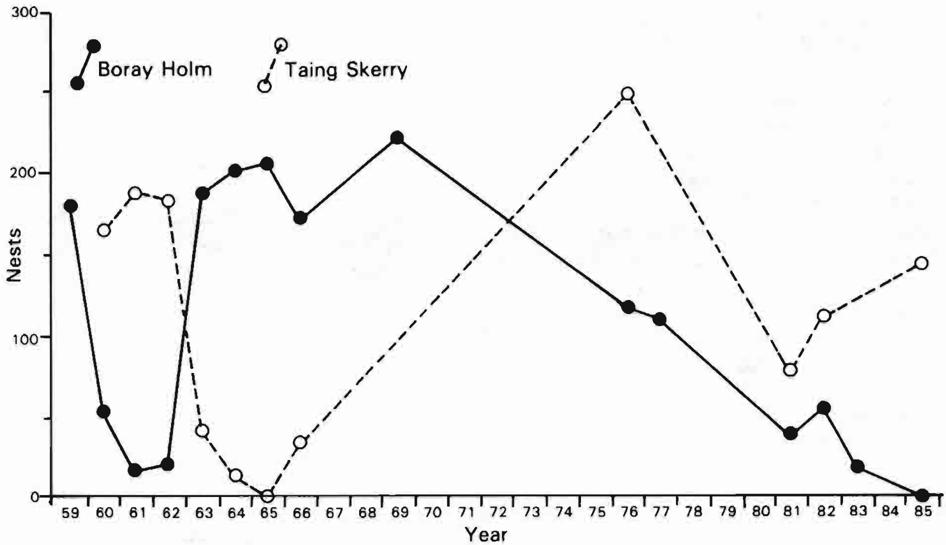


Fig. 2. Variations in nest numbers at two Orkney Cormorant colonies, Boray Holm and Taing Skerry, 1959 to 1985.

Annual colony fluctuations expressed in terms of coefficients of variation (standard deviation × 100/mean) show that the Brough of Stronsay, Calf of Eday and Seal Skerry are the least variable colonies (Table 3). Little Green Holm exhibits a high coefficient of variation, reflecting the establishment and subsequent growth of a new colony. Taing Skerry and Boray Holm appear to be the most unstable colonies. Numbers of nests fluctuate between these two colonies in a complementary manner, i.e., peak numbers on Taing Skerry coincide with low numbers on Boray Holm and vice versa. Balfour *et al* (1967) also commented on this relationship, which is shown in Figure 2.

Photographic counts: observer differences
Although the count unit was defined from the outset there was inevitably an element of interpretation involved when counting nests from photographs. This contributed to differences in counts between observers, as shown in Table 1.

TABLE 3 Mean nest counts, Standard deviation (SD) and Coefficients of variation (CV) for all Orkney Cormorant colonies, 1892-1985. Coefficient of variation = Standard deviation multiplied by 100 and divided by the mean.

Colony	Mean	No. of Counts	SD	CV
Seal Skerry	58	7	18	31%
Calf of Eday	205	13	44	22%
Muckle Green Holm	50	6	20	40%
Little Green Holm	22	4	19	86%
Brough of Stronsay	21	8	3	16%
Boray Holm	107	15	82	76%
Taing Skerry	111	11	83	74%
Horse of Copinsay	12	6	9	72%
Little Skerry	17	3	6	35%

For the colour transparencies the mean percentage difference between counts of two observers was 5.4 (5.9 if Calf of Eday is excluded). The equivalent figure for the black and white prints (excluding Calf of Eday for which no monochrome coverage was available) was 5.7. These differences were not significant ("t"-test, arcsine transformed data). For both colour transparencies and black and white prints differences between the counts of two observers varied by a mean value of about 5% and were not significant ("t"-test).

The mean difference between the joint counts and a total of thirty independent counts by two observers was 2.6 nests (SD 3.4). 57% of the joint counts were higher, 27% were the same and 16% were lower than the independent counts.

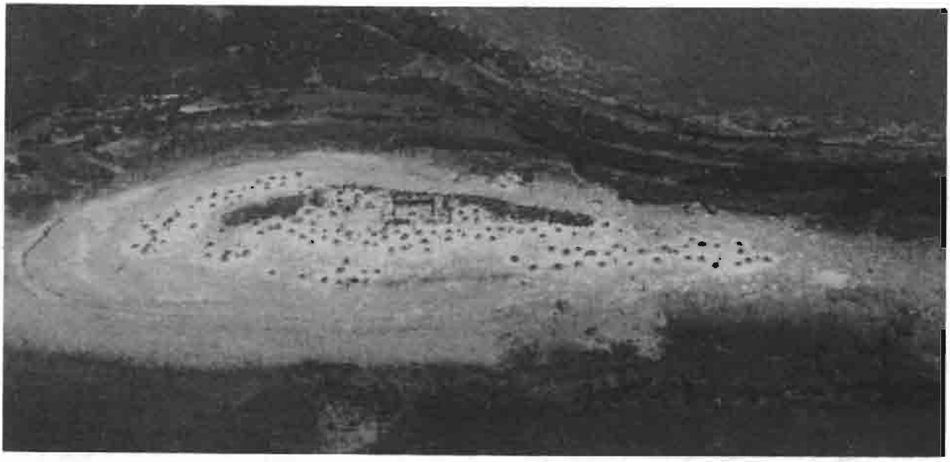
Ground counts

Clearly, were it not for problems of logistics and the wish to avoid excessive disturbance, it would have been desirable to undertake ground counts simultaneously with the aerial survey. In this way the accuracy of the aerial counts would have been determined. In the absence of simultaneous counts we subsequently undertook ground surveys of three colonies on 16 August 1985. The results are shown in Table 4.

TABLE 4 Nest numbers at three colonies, derived from colour aerial photographs (joint counts) obtained on 1 June and ground counts undertaken on 16 August.

Colony	Ground Survey	Aerial Photographs
Taing Skerry	127	146
Muckle Green Holm	30	44
Little Green Holm	28	46

Most nests were already in an advanced state of weathering and many had disappeared or were no longer recognisable as nests. Taing Skerry was occupied by moulting Common Seals *Phoca vitulina* and some were seen to be hauled out on the remnants of nests. At all three colonies nests were composed of seaweeds, especially *Laminaria sp.* and on Little Green Holm nests were frequently indistinguishable from



Nesting Cormorants on Taing Skerry. **C.J. Booth** naturally occurring accumulations of wave-deposited seaweed. With the exception of Taing Skerry, where four unfledged but well developed young were seen, the breeding season was clearly at an end.

It is obvious from the above that at most colonies there is little scope for undertaking post-breeding nest counts. Cliff-top colonies such as the Calf of Eday may be exceptions in this respect; here the nests are isolated to some extent from weathering and, being composed of Heather *Calluna vulgaris*, are more resilient.

A count was also made from the cliff-top opposite the Brough of Stronsay where the colony is located on the top of a rock stack. This count, undertaken on 25 June, found c. 15 nests (E. Meek pers. comm.). Clearly not all nests on this site are visible from the land, the aerial survey having identified 22 nests.

Acknowledgements

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(Revised ms. received 29 May 1986).

Variation in breeding output of Kestrel pairs in Ayrshire 1978-85

GORDON RIDDLE

Thirty Kestrel territories covering a range of habitat types were monitored from 1978 to 1985. Although overall production of young was very high, averaging three per occupied nest per year, considerable variation was recorded both in annual output and between upland and lowland territories. The three main causes of breeding failure were human interference, competition and predation from other avian species, and desertion due to adverse weather conditions. Failure was most common at the pre-laying and incubation stages of the cycle and brood survival was very high (90% of hatched young). The timing of the breeding cycle had a marked influence on productivity. Kestrel pairs which bred early laid larger clutches and produced more fledged young than later breeders.

Introduction

Work began in 1972 to study the status, density and breeding performance of the Kestrel *Falco tinnunculus* population in Ayrshire using sample plots which covered the main habitat types (Riddle 1979). From 1978 breeding performance at 30 sample territories was monitored annually. There was substantial variation in breeding output, with only two years, 1978 and 1979, being similar. The data were analysed both collectively and by the two main habitat groupings, upland and lowland, to determine which factors were associated with the considerable fluctuations in breeding output.

Methods

Six visits were made to each of the breeding territories annually to record territory occupation, the date of the first egg, clutch size and hatching dates, and to ring the young and check brood survival. Great efforts were made in March and early April to record whether or not a territory was occupied, as the accuracy of the monitoring depended upon tracing each breeding attempt from beginning to end. Pairs occupying a territory in early April may fail to breed and this is easily overlooked. The timing of breeding had been previously established, egg laying usually commencing between 15 April and 8 May (Riddle 1979).

The sample of 30 territories covered a mixture of habitat types and a range of nest sites (Table 1). Upland habitats included moorland, young conifer plantations and sheep walk; the birds nested on cliff ledges, old crow *Corvus corone* platforms and a hay shed. The lowland territories were in mixed farmland, both inland and coastal, and again covered a range of nest sites - cliff and quarry ledges, holes in trees and ledges on buildings. The territories were all locations traditionally used by Kestrels for many years.

Breeding failure was recorded if no young were produced from a nesting territory in which a pair had been present in early spring. The pair were assumed to have failed at the pre-laying stage if no eggs were laid in the nest scrape and the birds had disappeared. Competition or predation from other avian species was recorded when aerial combat was seen, the other predator nested in the territory and the Kestrel breeding attempt was discontinued. Predation by man was recorded when the clutch disappeared and signs of human presence at the nest site were obvious. If a clutch was deserted, or a brood depleted after a spell of more than a week of adverse weather conditions, then that was taken to be the cause of failure.

Rainfall and temperature figures for the period March to May 1981-85 came from two upland, Eskdalemuir and Leadhills, and two lowland, Prestwick and Hunterston, meteorological recording stations within the study area.

TABLE 1 Occupancy, production of young & habitat composition within 1 km of Kestrel nesting sites in Ayrshire 1978-85

Site	No. years occupied	Total no. young produced	Av. no. young per year	Habitat composition (%) Young conifer	Pasture	Arable	Mature wood	Moor	Coastal Heath	Urb Suburb	Water
Upland											
C/T	8	30	3.7		90			10			R
C	7	28	4		95		5				S
C	6	24	4	70	30						S
C	8	23	2.9		65			35			S
C	7	22	3.1	40	60						S
C	6	19	3.1		45		45	5			SL5
T	6	18	3	60	20		20				S
T/B	6	17	2.8		74			25			S1
C	5	17	3.4		60	35	5				S
T	6	16	2.6		75	25					S
T	7	15	2.1	35	55			10			S
C	6	12	2	40	60						S
C	6	12	2	50	50						R
C	4	8	2	25	60			15			S
C	4	8	2	60	40						S
Lowland											
B	7	31	4.4		70	12	8				RL10
C	7	30	4.3		45	45	5		5		S
C	7	29	4.1		60	25	5		5	5	S
B	7	27	3.9		70	10	10				RL10
C	8	25	3.1		95				5		S
C	6	20	3.3		50	30	10			10	R
C	7	19	2.7		60	10	15		10	5	S
C	5	19	3.8		95				5		S
B/T	8	18	2.2		45	30	25				S
C	6	18	3		75	25					S
B	6	17	2.9		30					70	S
C	3	10	3.3		95				5		S
B	4	7	1.7		50	40	10				S
T	5	5	1		70	5	15	10			R
C	4	5	1.2		20	35	40		5		S
%				15	59	10	7	4	1	3	1

KEY: C = Cliff T = Tree B = Building R = River S = Stream L = Loch

TABLE 2 Analysis of breeding data from 30 sites, 1978-85

	1978	1979	1980	1981	1982	1983	1984	1985	TOTAL
No. of territories visited	30	30	30	30	30	30	30	30	240
No. occupied	28	25	26	28	25	18	19	14	183
% occupied	93	83	81	93	83	60	63	48	76
Results known	28	25	25	27	25	18	18	13	177
No. of nests failed	4	4	7	8	8	4	2	5	42
% failed	11	16	28	26	32	22	11	38	23
Full clutches known	25	23	17	23	21	13	13	13	148
No. of eggs	119	108	79	113	97	55	69	68	698
Average clutch size	4.8	4.7	4.6	4.9	4.6	4.2	5.3	5.3	4.7
No. of eggs hatched *	100	87	60	87	61	37	65	45	542
% hatched	84	80	76	77	63	60	94	66	78
No. of young reared - all results	101	88	65	84	61	39	73	35	546
No. of young reared *	94	81	54	78	58	35	57	35	492
Average per successful nest - all results	4.2	4	3.6	4.4	3.6	2.8	4.7	3.9	4
Average all results	3.6	3.5	2.6	3.1	2.4	2.2	4	2.7	3
% eggs producing flying young*	80	75	68	69	60	64	82	51	70
% brood survival in nest	84	93	90	90	95	95	90	78	90

* estimated from breeding attempts where all the stages were recorded

Results

Overall breeding performance

The data for the years 1978-85 are presented in Table 2. The average clutch size recorded over the period was 4.7, 78% of eggs hatched, 92% of young survived and an average of 3 young were produced per breeding attempt. Fledged young were raised from 70% of eggs laid. Even in the poorest years an average of 2.2 young were reared per breeding attempt.

Variation in breeding output

Although many pairs produced flying young, there was considerable variation between years, between different nest sites and between upland and lowland sites in the same year. Between years brood size was correlated with clutch size ($r = 0.8071$, $p < 0.02$) and hatching success ($r = 0.8368$, $p < 0.01$). However territory occupation was not correlated with any aspect of breeding production.

Some nesting territories were consistently more productive than others (Table 1). However analysis of nest site characteristics and habitat in relation to the number of young produced per year occupied showed no significant differences between habitats or nest sites, though lowland areas with a low proportion of arable fields tended to produce more young per pair than other habitats.

Comparing upland with lowland sites there was good correlation for occupancy between years ($r = 0.9873$, $p < 0.001$), with high occupancy in both situations in the early years, falling dramatically in 1983 to 1985. There was no significant correlation in breeding production, which did not fluctuate in parallel for upland and lowland territories.

Major changes in the composition of nesting territories were recorded in four instances, all upland, where young conifer plantations were closing canopy and reducing the area available for hunting within the forest. In one, Kestrels had not been seen for the last two years but pairs were still breeding in the others, which had rough pasture nearby.

Causes of breeding failure and low output of young

In all, 42 breeding attempts failed, 12 pairs failed to lay, 24 pairs lost their clutches but only

TABLE 3 Analysis of failed breeding attempts 1978-85

	Habitat						
	Upland (n = 24)			Lowland (n = 18)			
Nest site	Cliff (10)	Tree (4)	Building (1)	Cliff (8)	Tree (2)	Building (5)	TOTAL
Eggs stolen - human	2	2		5	2	1	12
Young taken - human	1			1			2
Adults, young shot	2						2
Disturbance - human	1			1			2
*Natural accident		2					2
Competition - Peregrine	7	1					8
Competition - Tawny Owl				1			1
Crow predation		1	1				2
Deserted - weather	1			2	2	3	8
Deserted - unknown	2		1				3
TOTAL	16	6	2	10	4	4	42

* Nest collapse and young squashed on nest.

six lost broods of young (Table 3). Failure at the initial stage was more frequent in upland sites.

The three main causes of failure were human interference (43%, with cliff sites especially vulnerable), competition or predation from other avian species (26% particularly the Peregrine Falcon *Falco peregrinus* in upland sites) and desertion associated with adverse weather conditions (predominantly lowland).

The high failure rate of lowland nesting attempts in 1982 was almost entirely due to five clutches being taken by children. In 1981 it was a combination of the three main causes. In 1980, of the six upland failures, four were due to human interference and two to the return of the Peregrines to traditional sites formerly held before the decline in the 1960s.

a) **Competition for nest sites.** From 1980 onwards there was a steady increase in the number of upland Kestrel nesting territories occupied by Peregrines and six of the study sites were affected in this way. The Kestrels appeared in these territories in early spring but only on one occasion was a clutch actually laid and it was subsequently deserted when a male Peregrine began to use the Kestrel nest site as a roost. In one glen where two, and occasionally three Kestrel pairs normally nested, no Kestrel breeding was recorded from 1982, the year when the Peregrine re-established a breeding territory there. However three new Kestrel breeding territories were located three kilometres away in an area which had not supported Kestrels in the past. One upland site was taken over by a pair of Merlins *Falco columbarius* and on one lowland coastal cliff Tawny Owls *Strix aluco* successfully ousted the Kestrels.

b) **The timing of the breeding cycle in relation to breeding performance.** The date on which the first egg was laid was known in 142 breeding attempts (79 upland and 63 lowland). Laying dates ranged from 2 April to 25 May but 73% were within the three week period 14 April to 7 May. In some years the majority of laying dates were in April e.g. 1978 (78% n = 18), 1981 (75% n = 24) and 1984 (83% n = 12) while in others May dates predominated e.g. 1980 (72% n = 18) and 1983 (93% n = 15). In the remaining three years the spread was even between the two months. The timing of laying in upland and lowland was roughly synchronous in six of the eight years, the exceptions being 1979 and 1982 when the

TABLE 4 Breeding production in relation to the timing of laying

YEAR	Upland		Lowland	
	Median laying date	Brood size	Median laying date	Brood size
1978	28/4(n = 12)	3.6	29/4(n = 6)	3.6
1979	26/4(n = 11)	3.6	7/5(n = 10)	3.4
1980	1/5(n = 10)	1.8	1/5(n = 8)	3.6
1981	27/4(n = 14)	3.0	26/4(n = 10)	3.2
1982	19/4(n = 11)	2.8	6/5(n = 10)	2.0
1983	16/5(n = 8)	2.3	4/5(n = 7)	2.0
1984	17/4(n = 6)	3.3	27/4(n = 6)	4.6
1985	5/5(n = 6)	2.1	2/5(n = 6)	2.8

median laying date (the date by which half the pairs had laid) of upland pairs was in April compared to May in the lowland. (Table 4).

Kestrels which began breeding early in the season laid larger clutches and reared larger broods than those laying later in the season. (Figure 1). The pairs which started to breed before the three week peak (n = 16) laid larger clutches, average 5.3; hatched a larger percentage of eggs, 85%; reared more young, 4.4; and fledged more young per egg laid, 83%, than the birds which commenced laying after May 7 (n = 29). The equivalent figures for the later pairs were 4, 53%, 2 and 49% (for clutches 't' = 3.51; df = 42; $P < 0.002$ and for broods 't' = 4.30; df = 42; $P < 0.001$). The pattern which emerged from the upland data was that in all five years when the median laying date was in April the success rate was high, between 2.8 and 3.6 young reared per breeding attempt, compared to significantly lower figures when the median date was in May, 1.8, 2.1 and 2.3 ('t' = 4.99; df = 6; $P < 0.002$). The picture was less clear in lowland pairs though the two poorest years for production, 1982 and 1983, coincided with May dates (Table 4).

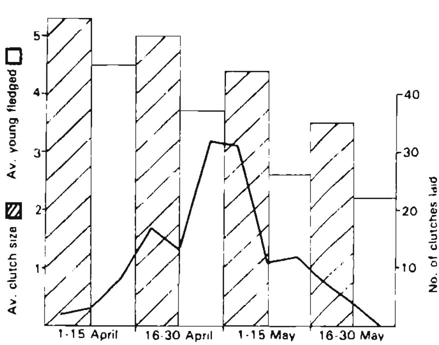

Fig. 1. ***Breeding productivity in relation to timing of laying.***

If the data are combined the pattern is similar, for example in 1983, when the breeding season was very late (median laying date 8 May), the average clutch size (4.2) and the average young produced per breeding attempt (2.2) was very low, while in 1984, an early season, the clutch size was large (5.3) and the output very high (4).

Pairs failed more frequently in May (20 out of 24) and 70% of the total failure were for clutches laid in May.

c) **The effect of weather conditions on breeding output.** Weather data (Table 5) show links between spells of good or bad weather (with the exception of 1980) and Kestrel productivity. Early breeding in 1981, 1984 and 1985 coincided with warm, dry springs and was accompanied by large clutches (averages 4.9, 5.2 and 5.2) but whereas the good weather lasted all through the breeding season of 1984 (4 young produced per breeding attempt), the weather changed dramatically in late spring 1985 and, during the wettest and coldest summer on record, hatching rates were low and brood survival poor (66% and 2.7). Similarly, in 1981, May was very wet and brood sizes were depleted. In 1983, which had a cold, wet Spring, the Kestrels bred late, laid the lowest average clutch size and produced the least young in any year of the study.

Discussion

Occupancy of the 30 sample Kestrel breeding territories was high in the early years of the study but fell dramatically in 1983 to 1985. Breeding numbers of raptors are limited by the availability of either food or suitable nest sites, whichever is in shortest supply (Newton 1979). All the study nesting territories had traditionally been used by Kestrels before 1978 and contained several potential nest sites, often as many as six.

TABLE 5 Weather data for April and May 1978-85 in relation to brood production.

YEAR	Median laying date	Mean brood size		April		May	
		All attempts	Successful	Mean temp.	No. days rain	Mean temp.	No. days rain
1978	28/4 (n=18)	3.6	4.2	5.3	12.5	10.3	9
1979	28/4 (n=22)	3.5	4.0	5.7	21	7.2	17
1980	1/5 (n=18)	2.6	3.6	7.6	8	9.2	8
1981	26/4 (n=24)	3.1	4.4	6.5	7	10	23
1982	30/4 (n=21)	2.4	3.6	7.6	13	9.5	15
1983	8/5 (n=15)	2.2	2.8	5.2	18	8.5	21
1984	18/4 (n=12)	4.0	4.7	7.2	8	9.9	8.5
1985	1/5 (n=12)	2.7	3.9	6.7	23	9.5	14.2

Data from meteorological stations at Eskdalemuir, Leadhills, Prestwick and Hunterston.

The high Carrion Crow population provided a great number of possible nest sites to supplement the cliff ledges and buildings (Riddle 1979).

However, interspecific competition did restrict the availability of sites, on a small scale with the Carrion Crow, Tawny Owl and Merlin, and to a greater extent with the Peregrine in upland sites. The re-establishment of the Peregrine population to the pre-1960s levels disrupted Kestrel breeding attempts and displaced pairs. This occurred from 1980, when two pairs were affected, to 1985 when no less than six of the 30 breeding territories held breeding Peregrines to the exclusion of Kestrels. In 1978 the breeding Peregrine population in the study area was eight pairs, and this had risen to 14 by 1985 (D. Roxburgh pers. comm.) The presence of non-breeding Peregrines was also noted in two other sites in 1985 but they did not affect the outcome of the breeding attempts.

No attempt was made to study food systematically, though 920 prey items were recorded at the nest sites and on plucking posts during the breeding season, of which 85% were Short-tailed Field Voles *Microtus agrestis*. This species was also the most important item in the Kestrel's diet in Eskdalemuir (Village 1981). Potential hunting areas (rough grassland, the niche of the Short-tailed Field Vole) made up a very large percentage of the area within easy flight distance of the majority of nest sites and Pettifer (1984) recorded Kestrels spending 81% of their foraging time over this habitat type.

The output of young from the sample territories was very high and the total number of young produced from upland and lowland situations was remarkably similar (269 to 280). However, variation in annual breeding output was recorded in several years and some variation was also found between upland and lowland territories in the same year. Information from Grampian, (Simm, pers. comm.), also showed annual variation, with few breeding pairs located and limited success in 1983 compared to very high productivity in 1984. Some territories were very productive over the eight years while others were consistently poor. For example adjacent, almost identical, territories held Kestrel pairs which laid large clutches, rarely failed and produced 58 young in 14 breeding attempts. This was not because of one experienced pair being in residence over a long period, as the hens were caught each year from 1980 onwards and, from ringing data, both territories had three different hens in the six years. On the other hand the males may have been the same each year.

From the analysis of the breeding data it was clear that the timing of the start of breeding attempts had a marked influence on subsequent productivity. Early breeders tended to produce large clutches and hatched larger broods, which had a high survival rate at least to fledging. As the breeding season progressed the clutch size, resultant brood size and success rate all decreased. Cavé (1968) recorded similar results in Holland using artificial nest sites and also showed that the young from early breeding attempts seemed to have a better chance of survival.

Small raptor species, like most birds, time their breeding season so that the young are in the nest and fledge when food is most plentiful (Newton 1979). In the case of the Kestrel in Ayrshire the brood period ranges from mid-May to mid-August, with fledging occurring as early as mid-June (Riddle 1979). The early-fledged young will also be learning to hunt when food is readily available and have a longer period to gain experience and build up reserves before the onset of winter, when many young Kestrels die. (Riddle in prep.)

In this study, early or late breeding seasons often coincided with consistent spells of good or bad weather conditions. Village (1981) also found that breeding numbers and performance were higher in years when warm dry springs affected the density and availability of voles. Heavy rain

Female Kestrel at nest box. **G. Riddle**

affects both hunting efficiency and prey availability and therefore the amount of food the cock bird is able to provide for the pair. Surface activity of voles diminishes when it rains (Franck 1954) and during heavy rain Kestrels are reluctant to fly and often seek shelter (Village 1981). Similarly, Cavé (1968) describes how, in Holland, birds were often observed seeking shelter when it started to rain, and how heavy rain and low temperatures inhibited breeding success. The cock Kestrel takes on the role of sole provider of food for the pair from just prior to egg laying to well into the nestling stage, so any factor which affects his ability to hunt is clearly important. Cavé and Village also recorded most failures occurring at the early stages of the Kestrel breeding cycle. Cavé investigated the relationship between food supply to the female and desertion, and proved statistically that it was the most important mortality factor at the clutch stage. He concluded that desertion was due to the inability of the male to supply the female with sufficient food.

A major factor influencing the production of young was the degree of human interference. The Kestrels in the study area usually nested in traditional sites, often using a series of well defined nest territories over many years (Riddle 1979). These sites (mostly cliffs) were visited regularly each spring by children; although the taking of young for falconry and pets has decreased since the early 1970s, egg collecting is still a problem and accounted for a third of all nest failures.

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(Revised ms. received 31 May 1986)

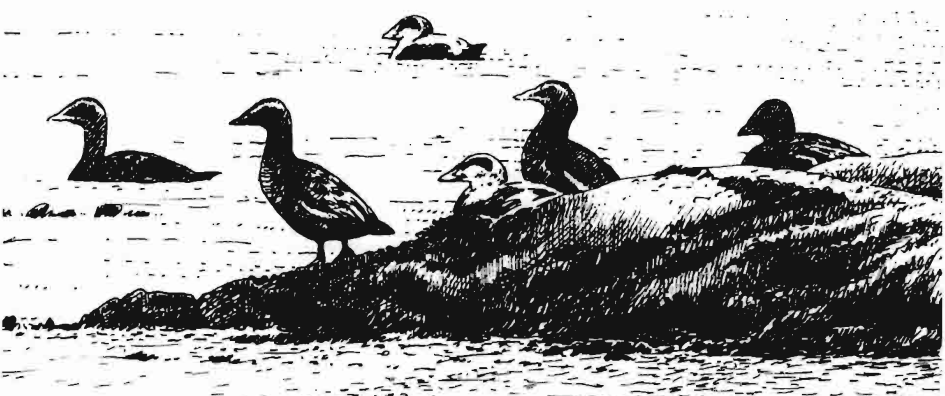
Changes in the status of the Common Eider in Shetland, 1977—1984

M. HEUBECK

Surveys of Eider moult flocks in Shetland during 1980-84 located 8,000-10,000 birds, compared to 13,800 on a less complete survey in 1977. The total Shetland population was estimated at not more than 16,500 in 1977 and 12,000 in 1984. Eiders are thought to be resident in Shetland with little immigration from surrounding areas. The results of the moult flock surveys therefore reflect a decline in the population of 25-30% between 1977 and 1984, with the main period of decline being 1977-1980. Possible explanations for this decline are discussed.

Introduction

The construction of a major oil terminal in the north Mainland of Shetland during the mid-1970s led to concern over the potential impact of oil pollution on the Shetland environment, and especially on the large populations of seabirds in the islands. One species considered to be at risk was the Common Eider *Somateria mollissima*, particularly during summer and early autumn when large flocks of flightless, moulting birds gather at traditional sites. Consequently, the Nature Conservancy Council conducted preliminary surveys of moulting Eiders throughout Shetland during 1975 and 1976, followed by a more complete survey in 1977. These identified the different moulting areas and provided the basis for an estimate of the total Shetland Eider population (Hope Jones & Kinnear 1979). Further surveys were carried out between 1980 and 1984 as part of the Shetland Oil Terminal Environmental Advisory Group's (SOTEAG) programme of environmental monitoring; this paper presents the counts made in these years and compares them with the results obtained during the 1970s.



Moulting Eiders. W. Neill

Methods

As many as possible of the traditional moulting areas were surveyed during the period mid-August to mid-September in each of the five years (for details of coverage see Table 1). In general, each moulting area was only surveyed once in each year and only single counts were made of most flocks. Many of the flocks gather at offshore skerries and cannot be seen from the land, while others are to be found below high headlands and can be easily counted from the clifftops. Methods of surveying and counting therefore varied according to location and weather conditions and were, in decreasing order of accuracy: 1. direct counts from the shore; 2. direct counts from a 10 metre boat; 3. counts made from aerial photographs of flocks, taken from a twin-engined 'Islander' aircraft; 4. direct counts from a 'Zodiac' inflatable boat. Although each method had advantages and disadvantages in terms of logistics and effort, the first two were used whenever possible.

Many of the flocks are remarkably faithful to particular sites. Others tend to move around within a fairly well defined area, probably in response to wind direction and disturbance. Many stretches of coastline which were not known to hold moult flocks were also checked, from both sea and air and no new major concentrations were found. In some flocks, adult males could be distinguished from females and immatures ('brown' birds) but this was generally only possible for counts made from the shore.

Results

The twenty moulting areas identified and the counts of Eiders made in 1977 and 1980-84 are shown in Table 1. Although surveys were also carried out in 1975 and 1976, coverage was not considered to be comprehensive enough to allow meaningful comparison with the 1980-1984 surveys and the data are therefore not included.

TABLE 1 Counts of Eiders in 20 moulting areas in Shetland, 1977 and 1980-1984. Where known, the percentage of adult males in flocks in 1984 is given in brackets.

		Moulting Area	1977	1980	1981	1982	1983	1984	
South-west	1	Sumburgh	2000	1551	1108	1771	2259	1484	(87%)
	2	St Ninian's Isle/Colsay				150	0	418	(74%)
	3	West Burra	250	594	172	195	293	235	(64%)
	4	Scalloway Islands		196	129		70	155	(60%)
	5	Westerwick/Skelda Ness	1800	1315	943	1120	990	1400	(80%)
North-west	6	Hillswick	794	946	566	540	927	650	(13%)
	7	Ronas	1400	128	125	537	447	1300	(80%)
	8	N. Yell Sound Islands	220	108	140	207	136	15	(40%)
	9	Sullom Voe				220	170	192	(36%)
	10	North Yell	82			230	92	130	(50%)
North-east	11	North Unst		208	126	175	125	75	
	12	North Fetlar	241		30	0	137	28	
	13	Burravoe	702	200	465	0	65	0	
	14	Out Skerries	320	823	476	742	695	965	
	15	Whalsay Skerries	3336	993	670	654	80	316	
South-east	16	South Nesting Skerries	310*	430	653	548	308	475	(29%)
	17	North Bressay/Noss	1630	398*	1350	1624	1021	1415	(60%)
	18	Gulberwick	475	500	694	495	747	428	(20%)
	19	Mail	251	170	323	201	97	59	(64%)
	20	Noness/Levenwick		234	111	186	221	373	(21%)
		TOTALS	13811	8794	8081	9595	8880	10113	

* = area not completely surveyed.

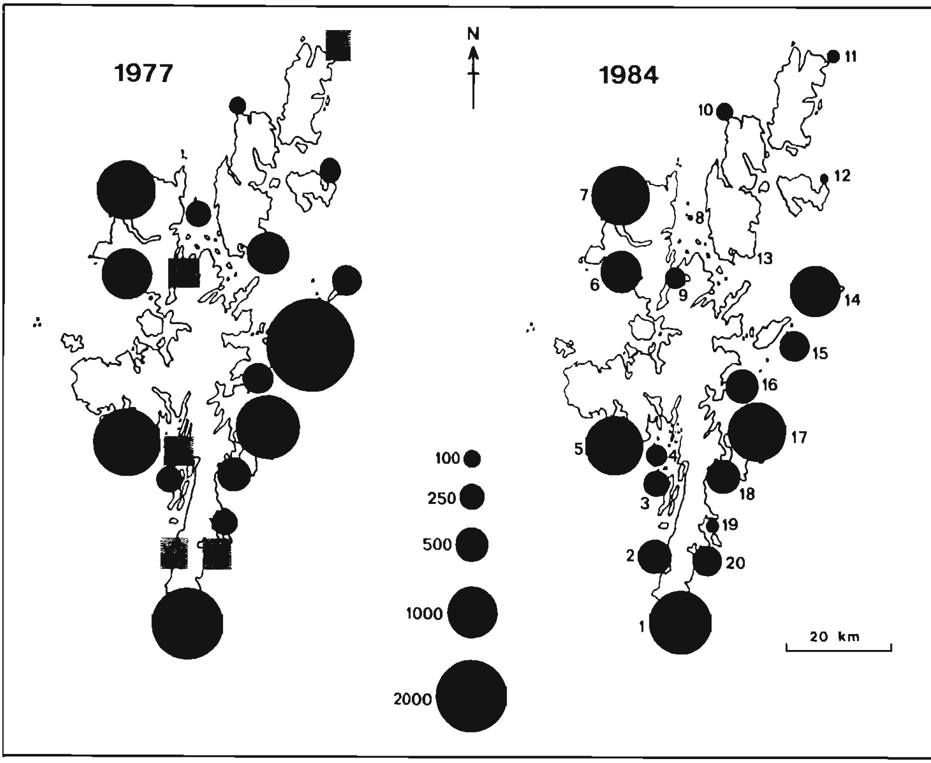


Fig. 1. ***Size and distribution of Eider moult flocks in Shetland, 1977 and 1984.*** *Circle area is directly proportional to the number of birds. Hatched squares represent regular moult areas not surveyed in 1977. Moulting areas are numbered as in Table 1.*

The distribution and size of moult flocks in 1977 and 1984 are compared in Figure 1. There is doubt as to whether the St Ninian's Isle/Colsay area (area 2) is used regularly as a moulting site; although an aerial survey in 1983 failed to locate any birds there, 418 were counted in the area in mid-September 1984. It is possible that moulting Eiders have used this area in the past and remained undetected. Alternatively, the birds seen in 1984 could have been part of an early northward dispersal from the major Sumburgh moulting area. Furthermore, in 1985 there was evidence that birds had moved from the Sumburgh area to the shelter of St Ninian's Isle in response to prolonged south-easterly winds.

Two main points emerge from the results. Firstly, the number of Eiders using a particular moulting area can vary considerably from one year to the next, as has been described in eastern Scotland (Campbell & Milne 1983), and one area (Burravoe, area 13) appears to have been abandoned. Secondly, although the annual totals between 1980 and 1984 are fairly consistent, they are all well below that recorded in 1977, despite less extensive coverage in that year.

The decrease in numbers was not uniform right round Shetland. If the 1977 survey results are compared with the mean of the 1980-84 counts in different areas of Shetland, it is clear that the largest decline occurred in the north-east (Table 2). Out Skerries was the only moulting area in this sector at which greater numbers were recorded between 1980 and 1984 than in 1977 (Table 1). The decline in numbers recorded among the Whalsay Skerries contributed more than any other area to the overall decrease in Shetland.

The proportion of adult males in the moulting areas varied greatly (Table 1), being as

TABLE 2 Number of moulting Eiders recorded in 4 areas of Shetland in 1977, compared to the average of counts between 1980 and 1984. Figures in brackets refer to the totals for only those areas that were counted in 1977.

Sector	1977 Total	1980-1984 Mean Totals	% Difference
South-west	4050	3310 (2788)	-18% (-31%)
North-west	2496	1570 (1446)	-37% (-42%)
North-east	4599	1610 (1509)	-65% (-67%)
South-east	2666	2612 (2387)	- 2% (-10%)
Total	13811	9102 (8130)	-34% (-41%)

high as 80% at Sumburgh, Silwick and Ronas and as low as 13-20% at Hillswick and Gulberwick. The proportion of adult males declined considerably in recent years at Gulberwick, the South Nesting Skerries and Hillswick (Table 3), and this has been due to increases in the number of 'brown' birds in the flocks as well as reductions in numbers of adult males.

An overall Shetland total of 15,500 Eiders was estimated from the results of the 1977 survey, based upon 13,800 birds actually counted, ca. 700 at Fair Isle and Foula and an estimated scatter of ca. 1,000 away from the known moulting areas (Hope Jones & Kinnear 1979). However, this latter figure is likely to be an underestimate. Despite the overall decline, 500-1500 Eiders were recorded between 1980 and 1984 in those areas not surveyed in 1977. Allowing for scattered females and juveniles not associated with moulting sites, a more realistic 1977 population estimate would be 16,000 - 16,500. The highest annual total recorded since was in 1984 (10,113), the year in which coverage was considered to be most complete. Even allowing for birds at Fair Isle and Foula and for scattered females and juveniles, the total population in Shetland in late summer 1984 was unlikely to have exceeded 11,500 - 12,000 birds, a decline of 25-30% since 1977. Although numbers declined between 1977 and 1980, counts do not suggest a continued decrease over the period 1980-1984.

TABLE 3 Counts of moulting Eider and the percentage of adult males in the flocks (in brackets) at Gulberwick, South Nesting Skerries and Hillswick, 1981-1984.

	1981	1982	1983	1984
Gulberwick	694 (88%)	495 (31%)	747 (10%)	428 (20%)
South Nesting Skerries		548 (69%)	308 (60%)	475 (29%)
Hillswick			927 (50%)	650 (13%)

Discussion

Although coverage undoubtedly improved between 1980 and 1984, as the understanding of movements of birds within moulting areas improved, there is clearly a considerable discrepancy between the number of Eiders counted in 1977 and in each of the years 1980-84. It is possible, but unlikely, that new and undiscovered moulting sites have been established in recent years. Other than the St Ninian's Isle/Colsay area (and there is doubt whether birds remain there throughout the moulting period), no new moulting areas have been found that were not known prior to 1975, despite the survey work and the considerable increase in the number of professional and amateur ornithologists in Shetland over the past decade.

It has been suggested, though not substantiated, that part of the Orkney Eider population migrates to Shetland during summer to moult (Hope Jones & Kinnear 1979). This would account for the greater numbers found in Shetland on surveys of moult flocks than on surveys of wintering birds. Winter surveys carried out during 1973/74 and 1974/75 located 6,991 and 8,799 birds respectively, revised upwards to estimated totals of 7,850 and 9,500 (Kinnear 1975). Eiders in Shetland are much more dispersed in winter than during the moulting period, when the location of the large flocks is also much more predictable and, although winter surveys involved considerable effort, coverage was patchy. In view of the rougher weather and shorter daylength during winter (both of which limit the time available for surveys) and the large sea area that has to be searched, it is perhaps not surprising that fewer Eiders were located in winter than in summer.

A more recent estimate for the Shetland wintering population of Eiders is 8,800 (Thom 1986), based upon the unpublished results of the BTO Winter Atlas and the 1984/85 Winter Shorebird Survey and this figure is reasonably close to the 10,113 recorded on the 1984 moult flock survey. It is therefore likely that the Shetland Eider population is largely resident within the island group and is not subject to any regular, substantial migration, and that the decreased numbers in moult flocks reflect a decrease in the Shetland breeding population. Elsewhere in Scotland, either little information is available on recent changes in status of Eiders or local increases have occurred (Thom 1986).

Between the summers of 1977 and 1980 there were two incidents of abnormal mortality of Eiders in Shetland, the first in early 1979 when at least 570 were killed in the "Esso Bernicia" oilspill (Heubeck & Richardson 1980). This incident occurred at the Sullom Voe Oil Terminal and, although tides and currents spread the 1,174 tonnes of heavy fuel oil widely, the main impact was in Sullom Voe and southern Yell Sound. It was estimated that the true mortality may have been double the number of corpses found, i.e. ca, 1,100 Eiders.

The second incident occurred in the winter of 1979-80 and affected the flock which forms during early winter in Bluemull and Colgrave Sounds, between Yell, Unst and Fetlar. This was the largest concentration of Eiders in Shetland, holding over 6,000 birds in 1976-77 (Richardson *et al* 1981). The first indication of unusual mortality was on 29 December 1979 when 24 unoiled Eider corpses were found on 1.5 km. of shore on the south coast of Unst. Thereafter, the crew of the Fetlar ferry reported occasionally seeing dead Eiders in the water during January, and three freshly dead birds were seen on 3 February. Although no thorough search was made of the coastline, spot checks of stretches of shore on Unst and Yell in early March found the dismembered remains of 50-60 Eiders (M.G. Richardson and R.J. Tulloch, pers. comm.). The strong tidal currents between Unst, Yell and Fetlar would be expected to distribute corpses widely, including out to sea. Although the scale of the mortality remains unknown, many more birds are likely to have died in the area than were found.

None of the Eider corpses appeared to have been oiled and no unusual numbers of oiled corpses of other species were found in the area, making oil pollution an unlikely cause. By the winter of 1979/80 the area was being overflown almost daily by Shetland Islands Council's pollution surveillance flights and no oil slicks were reported from Bluemull or Colgrave Sounds in December 1979 or January 1980 (J. Dickson, pers. comm.). Furthermore, mortality took place over a period of at least 6 weeks, suggesting a cause such as disease rather than a specific pollution incident.

Surveys by boat have shown that Eiders in the Bluemull/Colgrave Sounds flock disperse gradually after January and some are thought to move south into Yell Sound, where numbers normally increase as winter progresses. Evidence of this movement has since been substantiated by observations of marked drakes during the winter of 1984/85. The peak number recorded in Bluemull and Colgrave Sounds during the winter of 1979/80 was only 3,280, compared to 5,870 the previous winter and 6,240 in December 1976. Thereafter, numbers declined more rapidly and earlier than normal, with only 192 recorded in the area by 4 February 1980 (Figure 2), due presumably to both emigration and mortality. The maximum number recorded in this area in subsequent winters was 1,300 (30 October 1980) and although aerial searches have been made of adjacent coasts, no large concentration of Eiders has been located.

Other than oil pollution, the only other known cause of mass deaths of Eiders is heavy infestation of the acanthocephalan

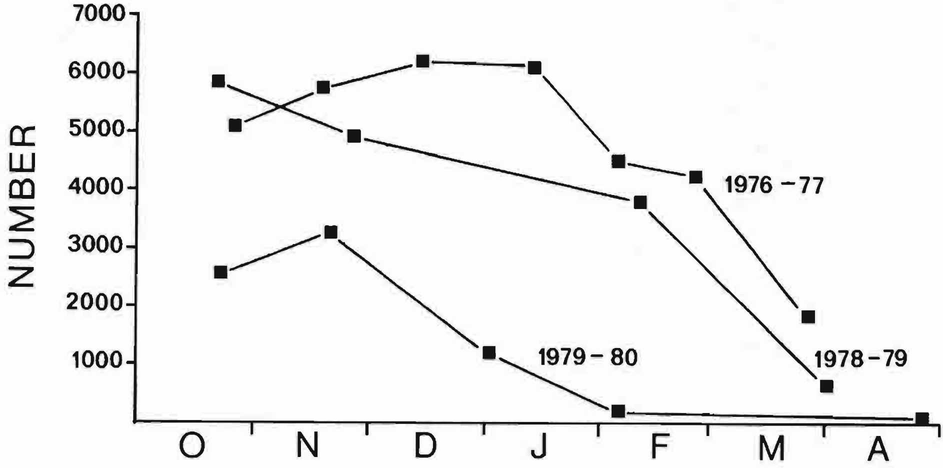


Fig. 2. Counts of Eider in Bluemull and Colgrave Sounds during the winters of 1976-77, 1978-79 and 1979-80.

worm *Profilicollis botulus.* Epidemics have been reported from the Baltic (Lampio 1946; Christiansen 1948; Persson *et al* 1974), the Waddensee (Swennen & van den Brock 1960), Maine and Massachusetts (Clark *et al* 1958) and North-east Scotland (Thom & Garden 1955; Garden *et al* 1964). The worm is a common parasite of the Eider, transmitted through ingestion of its intermediate host the Shore Crab *Carcinus maenas,* and occurs most frequently and at highest levels in juvenile birds, with older birds probably developing a resistance to infection (Liat & Pike 1980). Most epidemics of *P. botulus* have occurred during summer and early autumn and have mainly affected juvenile and female Eiders, although some cases have been reported from late winter and early spring (Thom & Garden 1955; Clark *et al* 1958). However, there is no evidence that such an epidemic occurred in Shetland and the cause of the Bluemull Sound mortality remains unknown.

The mortality incidents recorded in 1979 and early 1980 both occurred in the north-east of Shetland (where the decrease in the number of moulting birds was most marked) and are likely to have been the main factors behind the overall decline in the Shetland Eider population between 1977 and 1980.

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(Revised ms. received 30 July 1986)

William Eagle Clarke, ISO, LLD (1853-1938)

IAN DURANCE PENNIE

Over the years much important ornithological work has been carried out in Scotland, but as time passes it is all too easy to forget the contribution made by earlier workers. SB 12 carried an article by John Love on Harvie-Brown (1844-1916). Eagle Clarke comes next in the chronological sequence.

In 1959 David Lack named among the five most important bird books published in Britain in the first forty years of this century Eagle Clarke's *Studies in Bird Migration* (1912), and in the same year Sir Philip Manson-Bahr wrote that "Clarke did more than anyone for ornithology in Scotland".

William Eagle Clarke was born in Leeds in March 1853 and after education at Leeds Grammar School and University commenced life as a civil engineer and surveyor, but following an early interest in natural history was in 1884 offered the curatorship of Leeds Philosophical Society's museum. Four years later he was appointed assistant to Dr Ramsay Traquhair, curator of the natural history section of the Royal Scottish Museum, Edinburgh. According to William Berry (1948) Traquhair's main interest was geology and the show cases of birds were "a sorry lot of shabby moth-eaten mummies", but notwithstanding a meagre financial allocation Eagle Clarke at once started to replace these and brought the collection up to modern standards. On Dr Traquhair's retirement in 1906 Eagle Clarke succeeded him as curator and was then free to use his own ideas on the improving techniques of museum display.

In 1891 he became editor of *The Scottish Naturalist* in succession to Professor Trail of Aberdeen, and joint executive editor under Harvie-Brown during the period of *The Annals of Scottish Natural History;* on the restoration of *The Scottish Naturalist* in 1912 he again became editor, a post he retained until 1921. Eagle Clarke made many trips broad and was especially interested in polar ornithology, one of his most important systematic works dealing with the Scottish Antarctic expeditions of the early years of the century. But it was for his studies on bird migration tht he was best known to ornithologists.

In 1884 he was appointed a member of the British Association committee to investigate the migration of birds in the British Isles and was eventually given the responsibility of drawing up the final report. However, he realised that before attempting any major publication on migration he should gain first-hand experience by visiting certain lighthouses and islands around the British coast, in accordance with the theory of fixed migration routes. The first of these visits was disastrous! The Isle of Ushant, off the north-west tip of France, appeared to be ideally suited for his observations, but western Europe was not yet prepared for visiting ornithologists equipped with binoculars and collecting guns, and his visit coincided with a foolish French episode in Sudan which almost resulted in a Franco-British war. Consequently, Eagle Clarke and his companion T.G. Laidlaw were constantly harried by a sergeant of gendarmes and were forced to leave the island after only six days.

His next and more successful attempt was to stay at the Eddystone Lighthouse for a month, from mid September 1901. This he followed two years later by a month aboard the Kentish Knock lightship, a feat of endurance requiring considerable fortitude of mind and body since the "hideous and nerve-rending blast of the foghorn" rendered sleep impossible. Eagle Clarke spent his annual periods of leave from the museum on these excursions and returned from such "holidays" rather more jaded and worn than when he began them! (Berry 1948).

The next excursion, again accompanied by Laidlaw, was to the Flannan Isles in 1904 where they stayed at the lighthouse on Eilean Mor for sixteen days. On the return voyage they visited Suleskerry, where lighthousekeeper James Tomison was a well-known birdwatcher and contributor to *The Annals*.

"On consulting a map of Scotland with a view to selecting a bird-watching station in which to spend my autumn vacation in 1905 I was much impressed with the favourable situation of Fair Isle ....". Thus, Fair Isle - the "British Heligoland" - was discovered and the first full account of its birds published in *The Annals* for 1906. His companion on this occasion was a young zoologist, N.B. Kinnear (1882-1957, later Sir Norman Boyd Kinnear, Director of The British Museum, Nat. Hist.), who contributed a paper on the mammals of Fair Isle with a description of

William Eagle Clarke. (From the G. Waterston collection; reproduced with permission from Fair Isle Bird Observatory Trust)

a new sub-species of field mouse *Mus (Apodemus) sylvaticus fridariensis,* the Fair Isle Field Mouse. The name was suggested by Eagle Clark as Fridarey was the old norse name for the island. They also collected beetles, resulting in a paper on the Coleoptera of Fair Isle (Beare 1906).

It was on this first visit that Eagle Clarke met George Stout of Busta, then sixteen years old, who had a remarkable knowledge of the island's birds. Eagle Clark supplied him with books and field glasses and, after a few weeks training then and on a subsequent visit in 1906, regarded him as the official Fair Isle birdwatcher and recorder. George Stout left the island in 1909 and was introduced by Eagle Clarke to Charles Kirk, the Glasgow taxidermist, in whose employment he remained until his death on military service in 1916. Accompanied by George Stout, Eagle Clarke revisited Fair Isle in 1909 and 1910 and went to St Kilda in 1910, Auskerry in 1913 and finally the Butt of Lewis in 1914. After George Stout left the Isle Jerome Wilson of Springfield became the island's birdwatcher, although he too left on Naval service in 1915 but, happily, returned after the war.

It was only after his first St Kilda visit that Eagle Clarke felt sufficiently experienced and qualified to write a book on bird migration and his great two volume work was published in 1912. Although dealing solely with migration in the British Isles and drawn entirely from his own experiences, it was at once regarded as a milestone in the study of bird migration and was accorded an eight page review in *British Birds.* Eagle Clarke was a firm believer in the theory of fixed migration routes, invariably coastwise; while accepting that weather conditions influenced migration - his book is illustrated with excellent weather maps - he stated categorically that the *direction* of the wind had nothing to do with the results described.

In his important paper on migrational drift Williamson (1952) states that the concept of drift as an important influence on bird migration in the British area was first put forward by Misses Baxter and Rintoul in 1918. While Eagle Clarke's *Studies* was still in press T.A. Coward (1912) published a small, little known, book on bird migration in which he discusses clearly the effects of wind on migrating birds and it seems appropriate to quote one paragraph in full.

"The frequent occurrence of rare birds, so often almost or quite unknown in Britain on out-of-the-way islands, has led to strange theories. One is that there are regular flight-lines over Fair Island, The Flannans, St Kilda and elsewhere, similar to the one which is said to pass over Heligoland. Mr Eagle Clarke's long expected book will contain the ideas of the man who is best able to theorise on this point: I write now with the feeling that his knowledge may lead me to alter my ideas. The suggestion I can offer at present is that there are ornithologists directing their attention to these spots which, through geographical position and isolation are the likely refuges for wind-borne migrants." One wonders whether Clarke and Coward ever met and discussed this. Was Coward trailing his coat?

Eagle Clarke's final visit to Fair Isle was in 1921, accompanied by Surgeon Rear Admiral J.H. Stenhouse, who subsequently took over the Fair Isle bird studies. On that occasion they stayed at Pund, owned then by the Duchess of Bedford. (Previously Eagle Clarke had stayed at the South Light.) Here, to quote George Stout of Field ("Fieldy") they lived on bad food and good whisky for a fortnight. That was 66 years ago, and there is little personal recollection now of Eagle Clarke on the Isle. It is remembered that he was "a very nice man who was kind to the bairns." He visited the school and gave boxes to the boys for collecting beetles, and it is remembered that he trapped the field mice; but there is little else.

In that same year - 1921 - Eagle Clarke retired from the museum and from the editorship of *The Scottish Naturalist,* although he continued to contribute notes until 1928. He aimed to spend his retirement preparing a third edition of Howard

Saunders' *Manual of British Birds,* a work originally based on the fourth edition of Yarrell's *History of British Birds.* This was published in 1927 and, although a very fine book, illustrated in part with woodcuts by George Lodge, it never achieved popularity, possibly owing to competition from Witherby's new *Practical Handbook* with its coloured illustrations.

Latterly Eagle Clarke's mental health deteriorated and his final years were spent in an Edinburgh nursing home where he died on 10th May 1938. Manson-Bahr's assessment that "no man did more for ornithology in Scotland" was undoubtedly true.

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I.D. Pennie, 5 Badcall, Scourie, Sutherland

A comparative study of bird numbers in different habitats at Penicuik, Midlothian

BARBARA E.H. SUMNER

On a series of four walks, repeated each month for three years, all the birds using each different habitat in and around Penicuik, Midlothian, were noted. Densities of individual birds recorded each month in each habitat were found to fluctuate, and in some habitats a seasonal pattern emerged, repeated each year. Throughout the survey period, more species were found using scrub than any other habitat, and more habitats were used by Starlings than any other species. It is probable that the transect method employed underestimated the actual numbers of birds present, and the range of habitats they used.

Introduction

Penicuik, Midlothian, (pop. 17,430 in 1981), has grown from a small paper-milling village beside the River North Esk, into a prominent commuter town for Edinburgh. It is largely surrounded by agricultural land and woodland, and is close to moors, and to the Pentland Hills. The birds frequenting this district are mostly common species, for which there is little quantitative information outside the breeding season. The aim of the present study was to obtain an indication of how many birds were using each of the available habitats at different times of year.

Method

During the breeding season territorial species can be censused by mapping the territories held by singing males in a known area of habitat (Enemar, 1959; Williamson, 1964). This mapping technique, which developed in the U.K. as the Common Birds Census method (Williamson and Homes, 1964), is now regarded as the most reliable means of estimating bird densities in the field. Unfortunately, this method is not applicable outside the breeding season, and for non-territorial species, and non-breeding members of territorial species, it is not applicable at any time. Therefore a method had to be found which was applicable to all species, all the year round. The technique evolved was basically a belt transect method (see Järvinen and Väisänen, 1975, and Tiainen *et al.*, 1980, for discussion), and it must be stressed that the densities obtained are unlikely to be the true densities due to inherent variation in detectability between species, habitats, and seasons. Variation from other sources was reduced as much as possible by the experimental procedure, described below.

In September, 1981, on a series of four walks radiating from Penicuik (Fig. 1), all the habitats falling within comfortable range for bird identification, using 9 × 35 binoculars and the human ear, were classified. While scanning to right and left of the route, it was noticed that in open habitats, e.g. fields and moors, birds could be identified by sight at a distance from the route, and perpendicular to it, on either side. In woods and built-up areas this distance was much reduced. In the latter habitats birds could be identified from further away by sound, providing they sang or called. The furthest limits from the route at which birds could be detected by sight or sound in each habitat was established by means of obvious landmarks at each point along the walks. Such landmarks were usually field or woodland boundaries, or other features easily identifiable both on the ground and on large-scale maps. The area of each habitat, and the total study area,

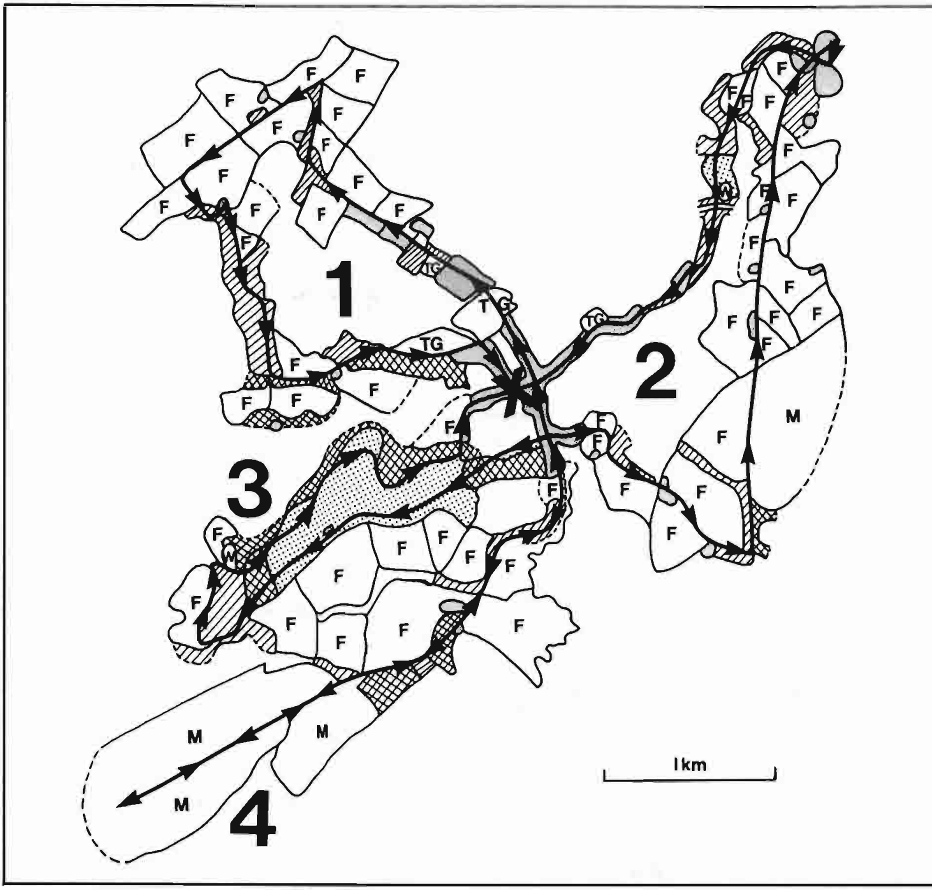


Fig. 1. The study area, showing the four walks (numbered in order of execution each month), and the habitats through which they passed. *The walks were taken in the direction of the arrows, starting and finishing at point X. Finely stippled areas = buildings; coarsely stippled areas = scrub; hatched areas = broad-leaved woods; cross-hatched areas = coniferous woods; open areas with F = fields; open areas with M = moors; open areas with TG = town greens; open areas with W = still water. Linear habitats have been omitted.*

were then obtained from 6 inches to 1 mile (9.5cm to 1km) or 1:10,000 Ordnance Survey maps, and converted to hectares (ha). Certain habitats encountered on the walks were regarded as linear phenomena, and were measured on the maps with a map measurer, and converted to kilometres (km).

The four walks took place at roughly weekly intervals, on weekday mornings between 8.30 and 12 noon, and as far as possible in fine, calm, weather. Consistency in time of day and weather conditions was important in view of the well-known influence of these factors on bird activity, and hence detectability. All the birds seen and/or heard in each different habitat were identified and counted, and care was taken to avoid overlap of areas surveyed on different walks, or on different parts of the same walk, so that each part of the total study area was only surveyed once in the month. As with the BTO Winter Atlas scheme (Lack, 1986), only birds which were using the habitats were counted; those flying high overhead from one place to another were disregarded. Swifts and other aerial species were listed for the habitats above which they were feeding or soaring. To reduce the risk of counting the same birds more than once on a survey walk, the observer kept moving as much as possible. In effect, the walks formed a belt transect through Penicuik and district, of total length 29.08km, and of width varying according to habitat.

From October, 1981, to September, 1984 (inclusive), the above four walks were repeated each month in the same order. Pilot work for the BTO Winter Atlas project had suggested that in terrestrial habitats more birds were seen if more time was spent on survey work. Therefore in the present study all the walks were timed, and at the end of the survey period a correlation coefficient was calculated for all the monthly times and bird counts, to see whether they were significantly correlated, and hence whether a correction factor would have to be applied to compensate for variations in survey time. No significant correlation was found. The mean ($\pm$S.D.) number of hours spent on survey work each month was 9.37 ($\pm$0.96).

Counts of individual birds seen and/or heard each month were expressed as densities, i.e. as numbers per hectare (or per kilometre for linear habitats), so that the results from different habitats could be compared.

Study Area

The total area surveyed was c750 hectares (ha) ranging from 137 to 305 metres (450 to 1,000′) above sea level. The greatest part of the study area was occupied by fields, which covered 354.0ha. It was found inconvenient to sub-classify these into arable or pasture, since an arable field in one season might become a pasture field in another, and *vice versa*. Most of the fields were on the higher ground of the study area, as were the moors, which occupied the next largest portion of the study area (148.2ha). The moors were covered with rough pasture, mosses and heathers, and were damp, as were many of the fields. Broad-leaved woods, which covered 93.4ha, were mostly at low and medium altitudes in the study area. They contained a mixture of tree species, usually dominated by Beech. Sycamore, Wych Elm, Birch and Rowan were also common, but Oak and Ash less so. The scrub, which covered 46.0ha of the study area at low and medium altitudes, consisted of rough grassland with scattered bushes, e.g. Willow, Birch, Broom, Gorse, Hawthorn, and Dog Rose. The scrub occupied ground formerly covered by broad-leaved woods, felled approximately thirty years ago; some of this ground is currently being planted with conifers. The coniferous woods in the study area, all plantations, covered 40.4ha of ground at low and medium altitudes. Sitka Spruce and Scots Pine were the dominant species, with some Norway Spruce and Larch. Town buildings and town greens under surveillance covered 38.5ha and 15.2ha respectively, within the town of Penicuik. Country buildings were scattered in the study area outside Penicuik, and consisted of small hamlets and isolated cottages and farms, covering 12.5ha altogether. Still water, represented by a large pond and some sewage treatment tanks, covered 1.7ha of low-lying ground.

The linear habitats were hedges, which altogether stretched for 4.5km; the River North Esk, of which 3.7km was studied; and several burns, measuring 3.0km altogether. The hedges, which were mostly roadside hedges, were of Hawthorn, or Hawthorn and Beech, with scattered other species such as Dog Rose, Gorse and Bramble. Although they formed field boundaries, the hedges were by no means stockproof, since gaps were frequent. Fences were also present. There was no sign of the management techniques listed by Pollard *et al.* (1974), except for infrequent mechanical hedge cutting.

Results

In all, 76 species were recorded in the study area during the survey period. Table 1 (which includes the scientific names of all species mentioned in the text) shows the habitats in which each species was recorded, and at which average density level. It is apparent that most species were recorded in scrub, followed by fields, broad-leaved woods, country buildings, town buildings, coniferous woods, moors, town greens, hedges, still water, river and burns, in decreasing order of species totals. Most resident species were recorded in more than one habitat whatever the time of year, and of these Starlings were found to be the most ubiquitous of all, using ten habitats. Summer and winter visitors were generally recorded in more than one habitat in their respective seasons. In this district several normally resident species, e.g. Collared Dove, Skylark and Song Thrush, are often absent in the winter, especially during severe weather. Certain species were only found in one

TABLE 1 **List of species recorded in the study area during the survey period, and the occurrence of each species in the different habitats (see footnotes).**

Species (and status in study area)	Habitat												No. of habitats used by each species
					Woodland		Buildings			Water			
	Moors	Fields	Scrub	Hedges	Broad-leaved	Coniferous	Country	Town	Town Greens	Still	River	Burns	
Dabchick, *Tachybaptus ruficollis (S)*										245.10			1
Heron, *Ardea cinerea (R)*		0.55	6.64					0.72		179.73	14.95		5
Mute Swan, *Cygnus olor (O)*										32.68			1
Greylag Goose, *Anser anser (W&S)*	0.75	6.67	0.75							375.82			4
Canada Goose, *Branta canadensis (O)*		0.16								16.34			2
Mallard, *Anas platyrhynchos (R)*	0.19	0.86								65.36	44.86		4
Tufted Duck, *Aythya fuligula (Sp)*										163.40			1
Goosander, *Mergus merganser (O)*											14.95		1
Sparrowhawk, *Accipiter nisus (O)*			0.60										1
Buzzard, *Buteo buteo (O)*			1.21										1
Kestrel, *Falco tinnunculus (R)*		0.71	1.21		0.89	0.69		1.44					5
Red Grouse, *Lagopus lagopus scoticus (R)*	4.87	0.08											2
Partridge, *Perdix perdix (R)*		1.41	33.21		5.95								3
Pheasant, *Phasianus colchicus (R)*	0.37	6.04	99.64		25.58	26.13	2.22						6
Moorhen, *Gallinula chloropus (R)*										588.24			1
Coot, *Fulica atra (R)*										114.38			1
Oystercatcher, *Haematopus ostralegus (S)*	8.81	7.38	3.02					0.72					4
Lapwing, *Vanellus vanellus (R)*	55.67	70.23	1.81		0.30		2.22	2.89	20.10				7
Redshank, *Tringa totanus (S)*	4.87	1.88											2
Curlew, *Numenius arquata (S)*	34.30	12.48	1.81		0.59			0.72					5
Snipe, *Gallinago gallinago (S)*	0.56	0.63	0.60										3
Black-headed Gull, *Larus ridibundus (R)*	7.87	41.27	25.97		2.68		44.44	753.25	804.09	1191.76			8
Herring Gull, *L. argentatus (R)*	8.25	4.71	1.81		0.89		2.22	12.27	1.83	16.34			8
Lesser Black-backed Gull, *L. fuscus (S)*	1.31	1.10	1.81				2.22	6.49		16.33			6
Great Black-backed Gull, *L. marinus (O)*	0.19	0.16	0.60										3
Common Gull, *L. canus (R)*	14.06	296.45	65.22		13.98	59.13	144.44	437.23	1233.55				8
Feral Pigeon, *Columba livia (R)*	8.81	41.82	35.63		21.71	6.19	1202.22	510.10	36.55				8

Woodpigeon, *C. palumbus (R)*	118.46	246.86	348.43	6.11	320.90	321.78	173.33	78.64	53.00			9
Collared Dove, *Streptopelia decaocto (R or S)*					0.56	0.69	17.78	0.72				4
Cuckoo, *Cuculus canorus (S)*		0.24	0.60									2
Swift, *Apus apus (S)*		2.43	6.04		0.59		0.69	175.32	12.79			6
Green Woodpecker, *Picus viridis (R or S)*		0.08	2.42			2.75						3
Gt. Spotted Woodpecker, *Dendrocopos major (R)*					1.19							1
Skylark, *Alauda arvensis (R or S)*	65.98	14.67	5.43				2.22					4
Swallow, *Hirundo rustica (S)*	1.12	18.91	9.66		4.16	4.81	431.11	40.40	3.65			8
House Martin, *Delichon urbica (S)*		10.99	3.02		5.06	2.75	68.89	92.35	18.27			7
Meadow Pipit, *Anthus pratensis (S)*	41.80	25.42	59.18		0.59	0.69	4.44	5.77	7.31			8
Pied Wagtail, *Motacilla alba (R)*	1.69	4.55	5.43		2.68	0.69	86.67	20.92	54.82			8
Grey Wagtail, *M. cinerea (R or S)*			1.21		0.30		2.22			14.95	9.26	5
Dunnock, *Prunella modularis (R)*	1.50	2.51	76.09	287.25	64.24	59.13	377.78	167.39	53.00			9
Whitethroat, *Sylvia communis (S)*			36.84	6.11	6.84	1.38	13.33	2.16				6
Blackcap, *S. atricapilla (S)*			1.21		0.30							2
Willow Warbler, *Phylloscopus trochilus (S)*		0.63	320.05	12.22	185.88	205.58	242.22	61.33	5.48			8
Chiffchaff, *P. collybita (S)*			2.42			0.69						2
Wood Warbler, *P. sibilatrix (S)*					3.27							1
Goldcrest, *Regulus regulus (R)*			40.46	24.45	64.24	275.03	55.56	0.72				6
Spotted Flycatcher, *Muscicapa striata (S)*			0.60		1.49							2
Robin, *Erithacus rubecula (R)*	0.19	2.98	157.00	281.14	208.18	167.77	633.33	251.08	34.72			9
Blackbird, *Turdus merula (R)*	1.87	10.28	199.28	660.07	200.15	188.39	706.67	365.80	201.02			9
Fieldfare, *T. pilaris (W)*	6.94	18.83	8.45	97.79	0.30		4.44					6
Redwing, *T. iliacus (W)*		0.47					2.22	0.72	16.45			4
Song Thrush, *T. philomelos (R or S)*	0.37	2.04	67.03	24.45	35.99	63.26	71.11	20.92	27.41			9
Mistle Thrush, *T. viscivorus (R)*		1.10	4.23		3.87	3.44	8.89	2.16				6
Long-tailed Tit, *Aegithelos caudatus (R)*			7.85		7.44	6.86	20.00					4
Coal Tit, *Parus ater (R)*		0.31	141.91	67.23	240.60	377.48	184.44	25.97	5.48			8
Great Tit, *P. major (R)*		2.21	94.81	73.34	170.41	134.08	180.00	67.10	5.48			8
Blue Tit, *P. caeruleus (R)*		7.22	241.55	763.97	503.21	224.15	884.44	387.45	84.06			8
Treecreeper, *Certhia familiaris (R)*					1.49	2.75						2
Wren, *Troglodytes troglodytes (R)*		2.04	166.67	36.67	146.92	90.07	226.67	47.62	3.65			8

Species (and status in study area)	Habitat												No. of habitats used by each species
					Woodland		Buildings			Water			
	Moors	Fields	Scrub	Hedges	Broad-leaved	Coniferous	Country	Town	Town Greens	Still	River	Burns	
Dipper, *Cinclus cinclus (R)*											628.08	74.07	2
Yellowhammer, *Emberiza citrinella (R)*	0.75	13.73	26.57	30.56	5.65	0.69	11.11	6.49	1.83				9
Brambling, *Fringilla montifringilla (W)*				6.11				1.44					2
Chaffinch, *F. coelebs (R)*	14.25	132.22	653.38	4736.58	902.93	903.47	2284.44	606.06	107.82				9
Goldfinch, *Carduelis carduelis (R)*	0.56	2.75	16.91	6.11	2.68	2.75	22.22	10.82	1.83				9
Siskin, *C. spinus (W)*			3.62										1
Greenfinch, *C. chloris (R)*	0.94	8.63	113.53	507.27	47.88	131.33	164.44	118.33	47.51				9
Bullfinch, *Pyrrhula pyrrhula (R)*		0.31	45.89	30.56	23.79	15.13	35.56	22.37	1.83				8
Linnet, *Carduelis cannabina (R or S)*	0.56	2.43	12.08				2.22	2.16					5
Tree Sparrow, *Passer montanus (R)*		1.02		201.69			13.33						3
House Sparrow, *P. domesticus (R)*	0.19	5.96	32.61	38.99	9.52	4.13	1348.89	1567.82	299.71				9
Starling, *Sturnus vulgaris (R)*	95.40	206.06	122.58	305.59	142.46	38.50	2126.67	2241.70	919.23	114.38			10
Magpie, *Pica pica (O)*		0.08											1
Rook, *Corvus frugilegus (R)*	118.46	313.09	93.60	73.34	331.61	124.45	395.56	222.94	381.94				9
Carrion Crow, *C. corone corone (R)*	58.67	118.57	201.69	55.01	126.40	126.51	271.11	352.09	190.06				9
Hooded Crow, *C. corone cornix (O)*		0.31											1
Jackdaw, *C monedula (R)*	90.16	194.29	625.60	24.45	158.22	244.77	1013.33	952.38	301.54				9
Total number of species using each habitat	35	54	56	25	46	36	43	42	31	13	5	2	

Footnotes:

(1) The numbers listed under each habitat, when multiplied by 10^{-3}, give the average monthly densities of each species recorded in the different habitats during the survey period.

(2) Densities are expressed in numbers of individuals per hectare or per kilometre according to the habitat (see text).

(3) Status symbols are as follows: O = only occasionally recorded; R = recorded at any time of year; S = summer visitor; Sp = spring visitor; W = winter visitor.

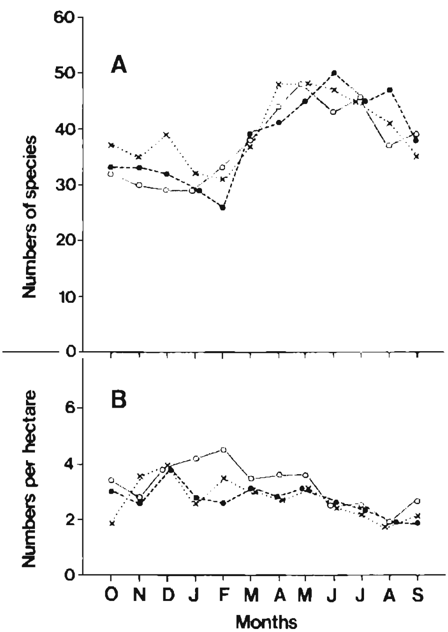


Fig. 2. Species numbers (A) and bird densities (B) recorded each month in the study area. *Months are indicated by their initials and years as follows: x..........x, 1981 to 1982; o——o, 1982-1983; ●----●, 1983 to 1984.*

habitat throughout the survey. Mute Swan, Tufted Duck, Moorhen and Coot were only recorded on still water. Goosander was only found in the river. Sparrowhawk, Buzzard and Siskin were only recorded in scrub. Great Spotted Woodpecker and Wood Warbler were only recorded in broad-leaved woods. Magpie and Hooded Crow were only seen in fields. Table 1 shows that, in general, commoner species were found in more habitats than rarer species.

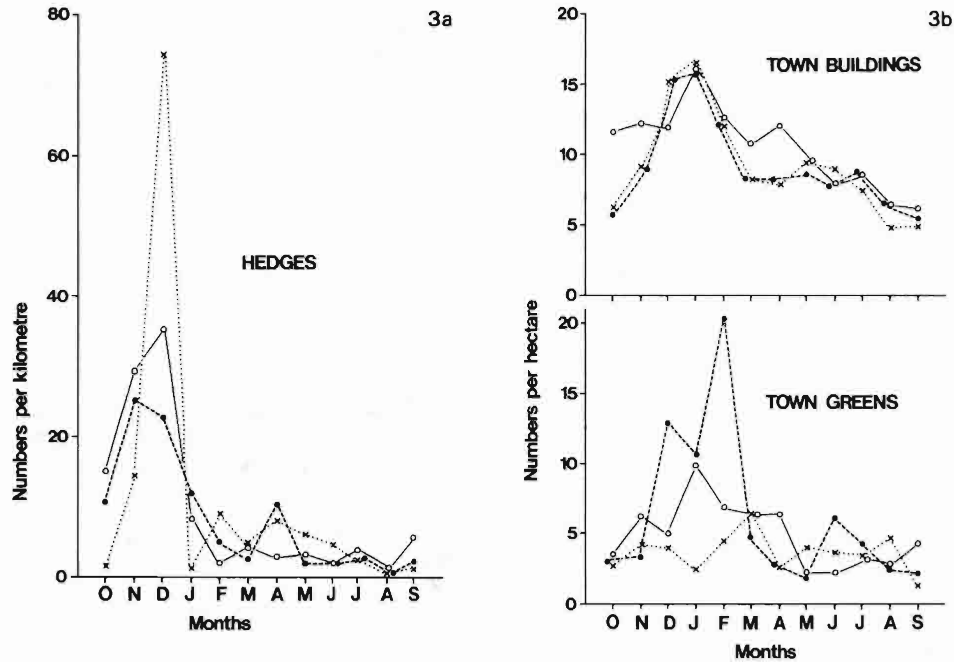
Monthly species totals in the entire study area are illustrated in Fig. 2A, and show that the number of species present increased each spring, remained high throughout the summer, and declined in autumn and winter. Monthly totals of individuals per hectare of the entire study area are illustrated in Fig. 2B, and show that there was less seasonal fluctuation in number of individual birds than in number of species. What fluctuation there was showed the opposite trend to species totals, namely, a slightly greater number of individuals was recorded in autumn and winter than in spring and summer.

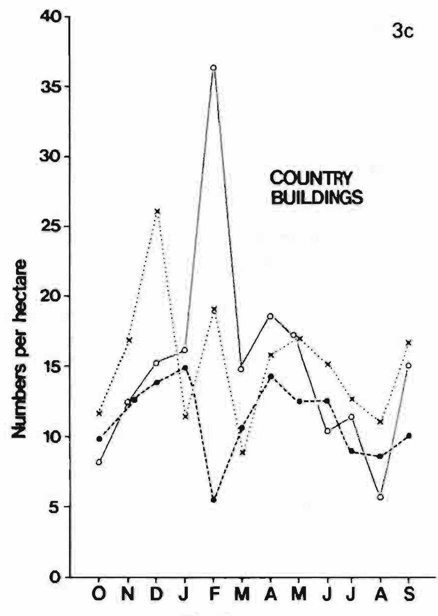
Monthly totals of individuals per hectare (or per kilometre) in each habitat are shown in Fig. 3a to f. Although the seasonal fluctuations in density were slight throughout the entire study area (see above), within a single habitat greater fluctuations were often apparent, and for some habitats these formed a characteristic pattern, repeated each year. For hedges, low densities (strictly speaking, birds/km) of birds were recorded at all times of year except in late autumn and early winter, when high densities were recorded (Fig. 3a). The mean ($\pm$S.D.) of the peak values in monthly densities at this season was 45.03 ($\pm$25.91) individuals/km. The seasonal peak was largely due to finches, and to a lesser extent to sparrows, Blackbirds and other species.

Each winter, high densities of birds occurred among town buildings, and also, usually later in the winter, on town greens (Fig. 3b). The means of the maximum winter densities were 16.10 ($\pm$0.38) individuals/ha for town buildings, and 12.17 ($\pm$7.22) individuals/ha for town greens. The high densities were largely produced by gulls, sparrows, Starlings, and corvids among the buildings, and by gulls, Starlings, and corvids on the greens. The highest densities among country buildings were also in the winter (Fig. 3c). The mean of the peak densities among country buildings was 25.01 ($\pm$11.96) individuals/ha, and was largely produced by gulls, feral pigeons, Robins, Blackbirds, tits, finches, sparrows, Starlings, and corvids.

Fields (Fig. 3d) also showed a pattern of higher densities in winter, and lower densities at other times of year, but the difference in densities was not so marked as that for human habitations. The mean of the maximum winter densities was 3.33 ($\pm$0.30) individuals/ha. Gulls, Woodpigeons, and corvids formed the greater part of the higher winter densities in the fields, with fairly high densities also of finches and Starlings, and occasional large flocks of Fieldfares. Moors (Fig. 3d), showed the opposite pattern to fields, with low winter densities. The mean of the maximum monthly densities of birds found on moors was 1.73 ($\pm$0.82) individuals/ha. The low winter densities on the moors were reversed each year by a spring influx of waders, Skylarks, and Meadow Pipits, which remained throughout the breeding season. Gulls, Woodpigeons, Starlings, and corvids were also more frequent on the moors from spring to autumn than they were in the winter.

Low winter densities were also recorded in scrub, broad-leaved woods, and coniferous woods (Fig. 3e). In these three habitats densities were also low in summer, but higher in spring and





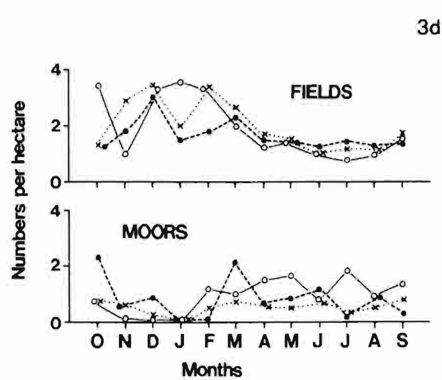
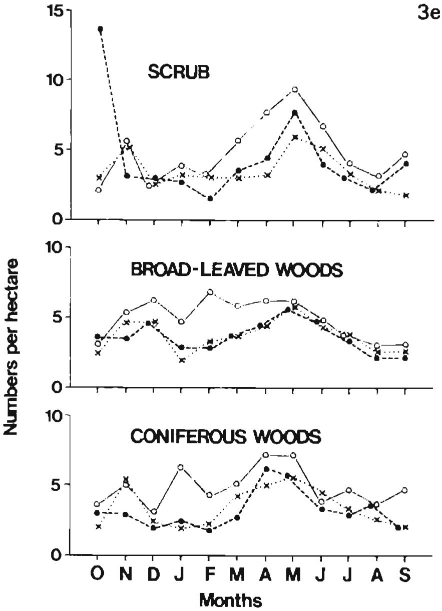
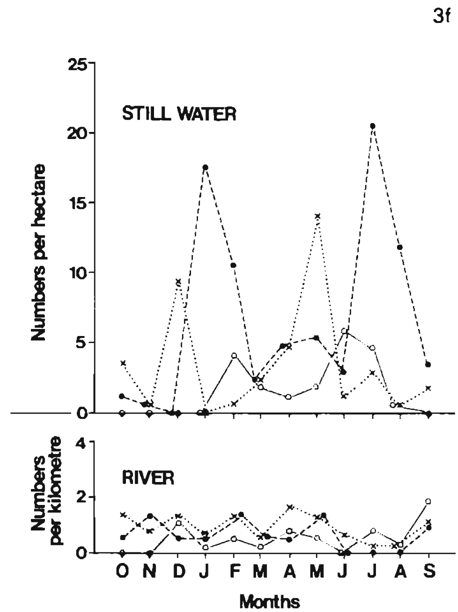


Fig. 3.(a-f) The densities of individual birds recorded each month in each habitat. Symbols as for Fig. 2.





autumn. In all three habitats seasonal fluctuations were greater than on fields and moors. The means of the maximum numbers of individuals/ha in the three habitats were: scrub, 7.70 ($\pm$1.72) in spring, and 8.14 ($\pm$4.72) in autumn; broad-leaved woods, 5.88 ($\pm$0.32) in spring, and 5.15 ($\pm$0.93) in autumn; and coniferous woods, 6.30 ($\pm$0.86) in spring, and 4.45 ($\pm$1.23) in autumn. The high spring peaks in these habitats were chiefly composed of Pheasants, Woodpigeons, Willow Warblers, thrushes, tits, Wrens, finches, Starlings, and corvids, with differences in their relative proportions between the three habitats. The autumn peaks were devoid of Willow Warblers, but contained the other species.

Still water (Fig. 3f) had mean maximum densities of 13.53 ($\pm$7.37) and 10.39 ($\pm$6.82) individuals/ha, which occurred roughly in late spring or summer, and in late autumn or winter, respectively. Breeding species on and around still water were Dabchick, Greylag Goose, Mallard, Moorhen, and Coot, but other species visited, namely Mute Swan, Heron, Canada Goose, Tufted Duck, gulls and Starlings.

On the river, a low density of birds was recorded all the year round (Fig. 3f). So few birds were recorded in burns that the results for this habitat are not illustrated.

Throughout the whole survey period, the mean monthly total of individuals/ha recorded in a single habitat was greatest among country buildings (13.81$\pm$5.59), followed by town buildings (9.69$\pm$3.28), town greens (4.94$\pm$3.65), scrub (4.30$\pm$2.40), broad-leaved woods (4.09$\pm$1.32), still water (3.97$\pm$5.13), coniferous woods (3.84$\pm$1.54), fields (1.88$\pm$0.86), and moors (0.77$\pm$0.57). For linear habitats the mean monthly total of individuals/km was far greater in hedges (9.49$\pm$13.98) than on the river (0.70$\pm$0.53) and in the burns (0.08$\pm$0.15). For the entire study area, the mean density of birds recorded each month throughout the survey period was 2.89 ($\pm$0.70) individuals/ha.

Discussion

The chief sources of variation in detectability in the present study are likely to be seasonal changes in cover in the habitats (especially in broad-leaved woods), and seasonal changes in bird behaviour (which may be different in different species).

In winter, when the trees have shed their leaves and vegetation has died down, birds ought to be more detectable. Yet the results show that in winter lower densities were obtained in most habitats, suggesting that many birds had left or died. Only in fields and around human habitations did the densities increase, and these habitats were the least affected by seasonal changes in cover. In late autumn in hedges, bird densities increased when the cover was reduced, but the increase was rather large to be explained entirely by exposure of previously undetectable individuals. It is likely that this increase was a genuine response to the autumn berry crop. This argument also applies to the late autumn peak in scrub and broad-leaved woods, where berries and nuts were apparent at a time of reduced cover.

Changes of behaviour with season are well-known. Many birds are particularly audible and active during the breeding season, and relatively quiet and inactive during the moult which follows. In scrub and woodlands there were definite troughs in the monthly density graphs following the peaks in May, at a time when summer visitors were still here, suggesting reduced detectability rather than reduced numbers. On the other hand, the spring peaks in scrub and woodlands coincided with the arrivals of many summer visitors, and these peaks may be a combination of increased detectability and increased densities.

Therefore densities obtained in late autumn and winter, when cover was reduced, may be more closely related to actual densities of birds present than densities obtained in summer by the transect method. Unfortunately the exact relationship between observed and actual densities is not easily discovered, especially outside the breeding season, unless the birds are individually colour marked, a very labour-intensive operation. All that can be claimed with confidence is that the observed densities were probably an underestimate of the actual densities present.

Species totals too may have been underestimated by the transect method. Golden Plover *Pluvialis apricaria,* Woodcock *Scolopax rusticola,* Tawny Owl *Strix aluco,* Grasshopper Warbler *Locustella naevia,* Sedge Warbler *Acrocephalus schoenobaenus,* Redstart *Phoenicurus phoenicurus* and Redpoll *Carduelis flammea* have all been recorded in the study area, though not on the present survey. They have mostly been sporadic records of few or single individuals. Tiainen *et al.* (1980), comparing their transect method with the mapping method during the breeding season, recorded 37 species by the transect method, but 45 species by the mapping method, in the same district. Personal observations on a year round basis suggest that it is the rarer species, only making chance appearances, which are more likely to be missed. A more complete tally of species in the present survey would have been unlikely to change radically the totals found using each habitat. Scrub and fields were used by most species (56 and 54 respectively), but in proportion to its area (46ha) scrub was much more popular than fields (354ha).

To some extent the number of habitats used by each species may also have been underestimated. For instance, Sparrowhawk, Buzzard, Siskin, Magpie and Hooded Crow were each only recorded in one habitat during the present survey, but from observations at other times they are known to use more than one. In general, commoner species were found using more habitats than rarer species, even though the complete range possible for both might have been underestimated.

Acknowledgements

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(Revised ms. received 20 November 1986)

Short Note

Unusual behaviour of Barn Owl at nest site

On 17th June 1985 I visited a Barn Owl *Tyto alba* nest site which contained 5 owlets almost 4 weeks old. As I approached the site the female left the nest and started flying in continuous circles just outside the building and about 25 metres off the ground. The wingbeats were faster than is usual for this species. The above action lasted for almost 5 minutes during which time the bird gave two warning screams, as described by Bunn *et al* (1982), before landing on a nearby tree. The nest site was visited again by G. Shaw and myself on 1 July 1986, when it also contained 5 owlets. During this visit the female repeated the circular flight and calls described above.

Madge (1985) describes a Barn Owl making a series of "threatening runs" when disturbed at a nest site, but the female I observed was not so aggressive. Despite numerous visits to individual nest-sites, this is the only site at which I have recorded a Barn Owl making this fast circular flight.

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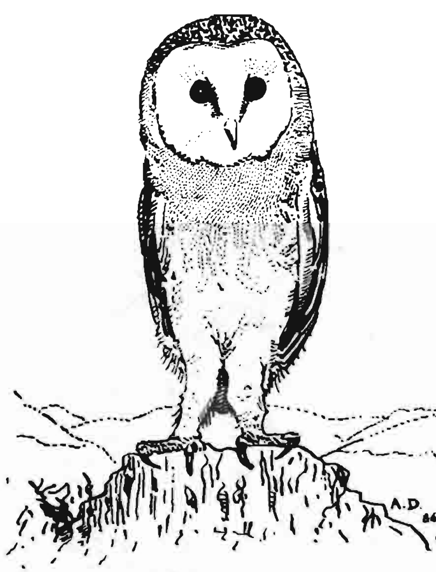

Barn Owl. **A. Dowell**

Bluethroats in Scotland during 1985

R.D. MURRAY

In mid-May 1985 a large-scale fall of migrants took place on the east coast of Britain. Although many species were represented, the spring of 1985 will be long remembered by birdwatchers because of the mass arrival of Bluethroat between 8 May and 20 May, when an estimated 480+ birds were seen in Scotland. Recent changes in the pattern of Bluethroat occurrences are also discussed.

Weather and arrivals

In April and early May 1985 cold northerlies held back the arrival of many spring migrants. This changed early in May as an anticyclone north of Britain merged with another over north-central Eurasia producing clear weather with an easterly airflow across Russia and Scandinavia. This airstream was to persist for almost two weeks and brought a variety of drift migrants.

The first Bluethroats *Luscinia svecica*, two on the Isle of May, occurred on 8th. A large fall took place on the north coast the following day, in heavy rain produced by fronts converging from the east and west. (Fig. 1, Table 1) More than 30 Bluethroats appeared, 21 of them on Fair Isle. Only a few birds followed on the 10/11th May, as the low pressure area over Germany filled, the winds slackened and the skies became clear over Britain.

On 12th May a deepening depression over Central Europe started moving northwards. Over the next few days it produced

TABLE 1 Bluethroat numbers on east coast of Britain May/June 1985. Birds observed daily (bird/days)

Area	8/9	10/12	13	14	15	16	17/18	19	20	21	22/27	28/11	Total
Shetland	15	11	3	2	4	13	5	4	4	7	17	2	87
Fair Isle	21	46+	70	35	55	38	10+	5+	17	15	37*	6+	355
Orkney	3	4	1	2	1	12	4	7	4	-	7	2	47
Highland	1	-	8+	-	13+	9	1	-	1	1	2	-	36
Grampian	-	1	2	16	4	1	-	-	1	1	1	1	28
Tayside/Fife	-	4	-	16*	16	9	3	3	2	2	4	-	59
Isle of May	2	-	-	100	100	50	6+	3+	3+	3+	6	1	274
Lothian/Borders	1	3	1	-	12*	5	7	2	-	-	-	-	31
Northumberland	5	18	19	42	37	16	5	5	3	2	1	-	153
Tyne and Wear	-	-	1	16	21	1	1	-	-	-	-	-	40
Cleveland	-	3	5	21	31	-	-	-	-	-	-	-	60
York/Humberside	2	10	10	24	33	10	9	9	5	1	7	-	120
East Anglia	2+	21+	11+	35+	8+	3	8+	3+	3+	4+	10	1	109
Totals	52+	121+	131	309	335	167	59	41	43	36	92+	13	1,399

Total bird/days - UK - 1,399 / Scotland - 917 (66%)

* includes a White-spotted Bluethroat

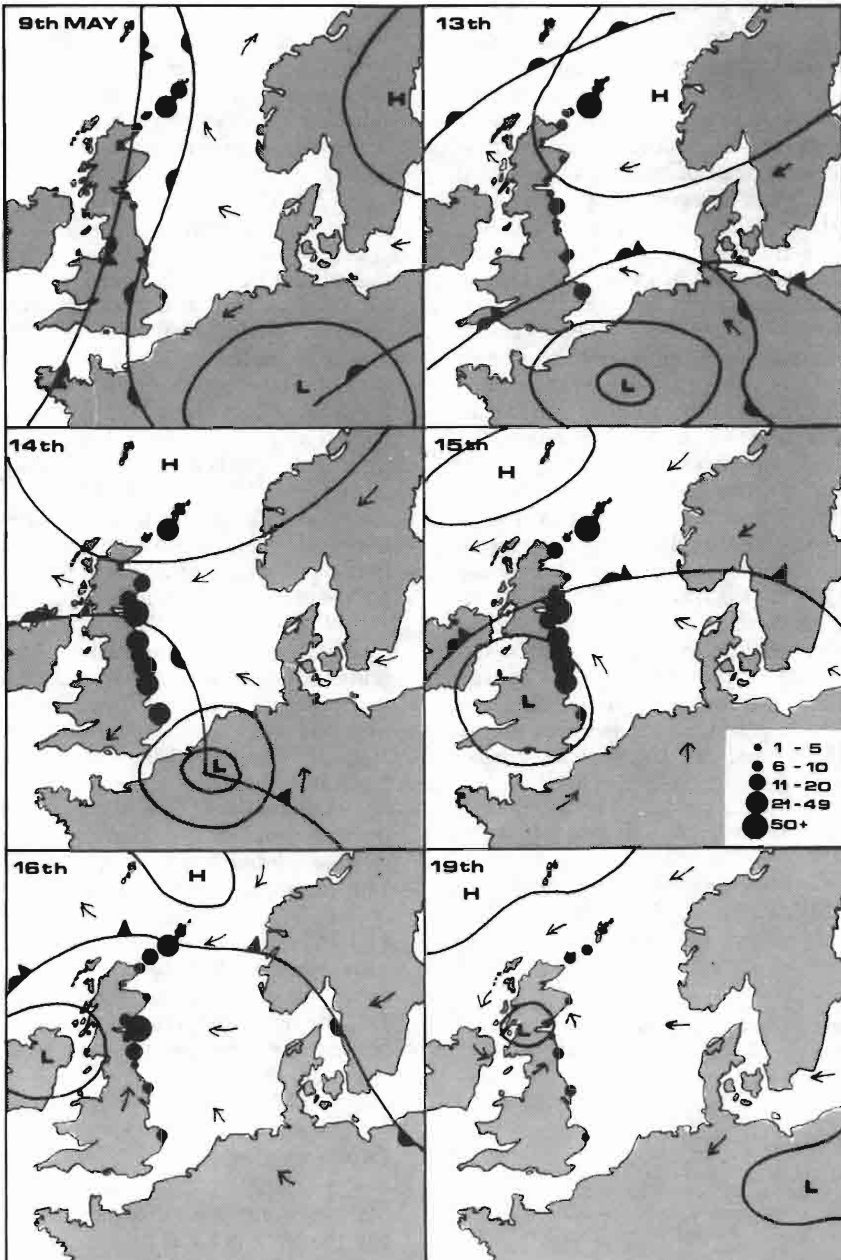

Fig. 1. Weather charts and Bluethroat arrivals - May 1985.

large falls of migrants. As pressure was high over northern Britain on 12 May most Bluethroats occurred in England, with 10 birds in Norfolk. The Scandinavian high pressure slipped westwards on 13th as the low deepened and moved over the Low Countries. The associated fronts produced heavy rain and haars on the east coast, with arrivals of 50 Bluethroats on Fair Isle, eight in northern Scotland and ten in Northumberland. A cold front which travelled northwards up the North Sea between 13-16th May brought heavy cloud, mist and thunderstorms (Fig. 1). More Bluethroats were to arrive over these three days than had ever been recorded in Britain before (Table 1), the total exceeding the combined Bluethroat count of 28 of the previous 30 springs. Mass arrivals took place on 14th, when the Isle of May had a minimum of 100 birds. Thirty others were reported in Fife, Grampian and Orkney and over 130 in England south to Norfolk. Further arrivals occurred on 15th, with 12 in Lothian and Borders, 13 in Caithness and another 20 on Fair Isle. Ten more arrived in Orkney the following day (Table 2).

The largest numbers appeared on the Isle of May and Fair Isle, with daily maxima of 100 and 70 respectively (Table 1). These very large numbers of Bluethroats were undoubtedly due to 'island effect', the manner in which islands concentrate the numbers of rarities simply because the birds are unable to go elsewhere and so are easily seen.

Clear skies on 16-18th May led to an exodus of birds, with very few arrivals. This changed on 19th as another depression passed across Central Scotland (Fig. 1). The easterlies and their associated rain grounded another, smaller, influx of Bluethroats. About 40 birds arrived at Fair Isle, Grampian, Lothian and Northumberland. The influx of 19/20th May was largely of females (19 out of 24 birds where the sex was determined), in contrast to the earlier arrivals where 50-100% of the sexed individuals were males. In Scandinavia males arrive on average five days in advance of the females in order to set up territories in preparation for the arrival of the females (Stavv 1975).

Numbers fell rapidly after 21st May, as the blocking anticyclone weakened and the normal westerly airstream reasserted itself. A few stragglers remained until the end of May and there were odd records in early June, all from Fair Isle, Isle of May and Norfolk.

A minimum of three birds of the Central European white-spotted race *cyanecula* were reported; at Fowlsheugh, Angus on the 14th (accompanied by a female, possibly *cyanecula*), at Eyemouth, Borders on the 15-18th and at Fair Isle on the 22nd. Although there have been only 10 records altogether of *cyanecula* in Scotland since 1968, three White-spotted Bluethroats have occurred twice before in a single spring, in 1969 and 1974.

TABLE 2 Estimated totals of Bluethroat present May/June 1985.

SCOTLAND		ENGLAND	
Shetland	40	Northumberland	c85
Fair Isle	c150	N. Tyne & Wear	29
Orkney	35	Cleveland	36
Highland/W. Isles	26	Humberside/ Yorkshire	71
Grampian	c32		
Angus	5	Norfolk	54
Fife	c25	Suffolk	5
Isle of May	c150		
Lothian	8		
Borders	13		
TOTALS	c484		280

U.K. total 764 birds*

* incomplete - only Scotland and English east coast surveyed

Other species

Major falls rarely involve only one species and the 1985 fall was no exception. Red-backed Shrikes *Lanius collurio* and Wrynecks *Jynx torquilla* were prominent, with more than 200 of the former, and about 40 of the latter, appearing in Scotland during the main influx. Nightingale *Luscinia megarhynchos* (4), Thrush Nightingale *L. luscinia* (4), Scarlet Rosefinch *Carpodacus erythrinus* (18-20), Rustic *Emberiza rustica* (4) and Ortolan Buntings *E. hortulana* (6) and at least 16 Grey-headed *Motacilla flava thunbergi* Wagtails were amongst the rarities. The mixture of species and races point to northern Scandinavia as the intended destination for the drifted migrants.

Some of the commoner migrants appeared in remarkable numbers, particularly Tree Pipit *Anthus trivialis* (200 Isle of May on 14th; 100+ daily, max 180 on 16th at Fair Isle), Wheatear *Oenanthe oenanthe* (650 on 14th at Fair Isle), Redstart *Phoenicurus phoenicurus* (150 Isle of May and 120 Fair Isle on 14th), Black Redstart *P. ochruros* (50 Fair Isle on 15th) and Whinchat *Saxicola rubetra* (200 Isle of May on 14th, 130 Fair Isle on 15th).

Change in the pattern of Bluethroat passage

The Bluethroat is recognised as a scarce, but regular, passage migrant in Scotland, more frequent in spring than autumn. According to Sharrock (1970) a total of 70 birds were reported from Scotland in the 10 years 1958-67. Since then the rate of occurrence has increased; 439 were reported in the 10 year period 1968-77; 461 in the 7 years 1978-84; and 483 in 1985 (Fig 2).

A proportion of this increase can be attributed to better observer cover but there is no doubt that Bluethroat have increased over the years. Although observer cover has improved generally in Scotland, the coverage at Fair Isle and the Isle of May has remained fairly constant. The observatories now record a smaller proportion of the Bluethroats in Scotland (declining from around 70% to 50%, using 5-year running means 1968-85), although there has been a net increase in the numbers reported from the two observatories, rising from a joint mean of 9/annum 1958-68, to 16/annum

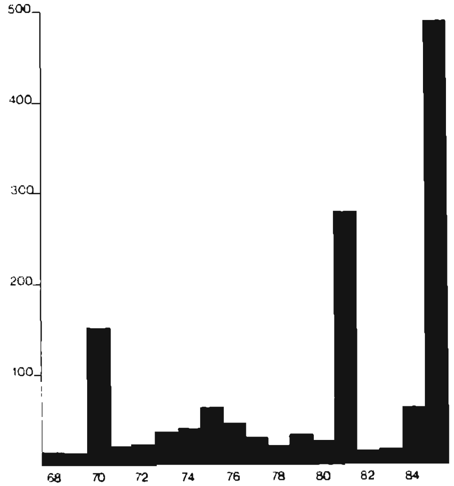

Fig. 2. Numbers of Bluethroat in Scotland 1968-1985.

1969-85 (excluding the 1970, 1981 and 1985 peaks, which would make the numbers/annum even higher in the latter period).

Fig 2 reveals two trends: slowly rising numbers that peaked in 1975 and then fell towards the 1980s; and occasional years with large scale invasions (1970, 1981 and 1985), which are increasing in size and may be occurring more frequently (the 1981 fall occurred in approximately analogous meterological conditions to that of 1985). Sharrock reported no spring invasions in 1958-67. If the influxes are excluded, the average gradually rose to about 20/annum in the late 1960s, and peaked at around 50-60/annum in the mid-1970s, then fell to 20-25 per year in the late 1970s and 1980s.

It is likely that the cause of the change in numbers is climatic. Wallace (1981) noted that the presence of a blocking anticyclone in the spring, bringing Fenno-Scandian migrants, was most marked in the mid-1970s, particularly in 1975 and 1976, when Bluethroat numbers peaked. However it is possible that the 'freak' conditions which precipitate massive falls, such as those seen in 1970, 1981 and 1985, are occurring more often.

The status of the Bluethroat has changed since the late 1960s, when passage occurred predominantly in the autumn (80% of all records 1958-67) and the species was only a vagrant in spring. At that time records were largely concentrated in southern and eastern England (Sharrock 1970). Most Bluethroats now occur in Scotland and during the spring.

Wallace (1981) described the declining autumn Bluethroat movements of the 1970s with such expressions as "hard to find" and "notably scarce". An analysis of records in Yorkshire since 1938 supports this statement. Spring numbers have increased dramatically, especially since 1968. In contrast, and countering arguments about increased observer cover and awareness, the numbers reported in autumn have declined equally dramatically, especially so after 1978 (Armitage unpub.).

One likely factor behind this trend is a lack of easterlies during the main southwards passage of Scandinavian Bluethroats in late August and early September (Stav 1975). The heaviest autumn passage of Bluethroats in Britain now tends to occur later, in mid-September and early October (Wallace 1981), several weeks after the main Scandinavian movement. The source of the Bluethroats migrating through Britain in autumn at present remains conjectural, but is likely to be Russia and Siberia, judging from the species that now commonly accompany autumn Bluethroats.

Sharrock assumed that most of the autumn Bluethroats recorded in Britain prior to 1967 belonged to the small proportion of Scandinavian birds orientated SSW to West Africa and the Mediterranean, rather than SE to Southern Asia (Zink 1973). If Sharrock was correct, the decrease in mid-autumn occurrences in Britain could reflect a reduction in this population. The timing of the decline of autumn Bluethroats in Britain (since 1968) coincides with the onset of the serious Sahelian droughts that have badly affected other wintering Palaearctic migrants. The lack of information on any changes in the numbers of male Red-spotted Bluethroat seen south of the Sahara in spring and the almost total lack of ringing recoveries from Africa means that this viewpoint must remain speculative.

Breeding by Bluethroats in Scotland

It was noticeable during the 1985 influx that a number of birds sang on the sunnier days. Several birds turned up well inland in suitable breeding habitat and a number stayed on, establishing territories.

11 May	singing male	Cleish Hills, Fife
26 May - 9 June	singing male (prob. unmated)	West Sutherland
31 May	singing male	Feardar, Grampian
16 June	male	Ben More, Sutherland
summered	pair bred, 2 fledged	"Inverness shire"
23 August	1 'alarming'	"Inverness-shire"

1985 produced the first record of successful breeding of Bluethroat in the British Isles. Breeding had occurred previously in 1968 but the male was never seen, and the nest was destroyed before hatching (Greenwood 1968). Since then, although males had occurred well inland during passage, only one had actually been seen singing in Scotland (*svecica* Spey Valley 1980). Single male *cyanacula* also sang in Nottinghamshire in 1979 and in Humberside in 1981.

The breeding of Bluethroats in the summer after a large spring influx paralleled what has occurred with other migrants from Scandinavia. Wrynecks first bred in Scotland in 1969, after an 'exceptional' spring when c117 birds were seen on passage. Since then Wryneck numbers have fluctuated, both as passage migrants and as breeders, but inspection of ten *Scottish Bird Reports* suggests that there is a positive relationship between good breeding numbers and strong spring passage.

Female Bluethroat at the nest. **R.T. Smith**

Red-backed Shrike first bred in 1977 after an 'unprecedented' fall of 185+ birds in the spring of that year. The breeding records of 1978 and 1979 occurred in years when numbers were similarly high (121 and 101). The lack of breeding records in subsequent years may be related to the very small numbers of migrants to appear in these springs.

The 200+ shrikes of 1985 produced summering birds at 3 sites while the 40 spring Wrynecks were followed by 15 singing birds. 1985 also produced a probable breeding of Black Redstart and at least three singing Scarlet Rosefinch, both species that were well represented in the spring fall.

It is doubtful whether Bluethroats will continue to breed unless there are further mass arrivals in spring. The spread of the Red-spotted *svecica* form in Europe suggests that this race is in an expansionary phase with range extension in several areas of Europe; Romania from 1967, Austria from 1975, Czechoslovakia from 1979, Switzerland and N. Italy from 1983 (*British Birds European News*). There is clearly no lack of Bluethroat habitat in Scotland and it may well be that it will join the other Scandinavian species; Redwing *Turdus iliacus,* Fieldfare *T. pilaris,* Temminck's Stint *Calidris temminckii,* Wood Sandpiper *Tringa glareola* and others (Murray 1979) that now breed regularly, if in small numbers, in Scotland.

Acknowledgements

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Short Note

Bluethroats killed by nesting Merlins in Scotland

Fresh prey remains found at plucking sites within Merlin *Falco columbarius* nesting territories in the central and eastern Scottish Highlands included two Bluethroats *Luscinia svecica* amongst c1800 items identified between 1980 and 1984. The first was found on 5 May 1981 near an inland Kincardineshire nest. Usually fewer than four Bluethroats are recorded annually in Kincardineshire, Aberdeenshire and Banffshire, but in 1981 at least 17 were seen on the east coast between 12 and 17 May, of which males were *L.s. svecica* (Knox & Bell eds. 1975-85). The second was a male found on 29 May 1984 at an inland Inverness-shire nest. A Bluethroat sang nearby in June 1982 and the first known British nest, in 1968, was within 20km of this territory (Greenwood 1968, per DNW).

Within their breeding range Bluethroats *L.s.s.* are taken by nesting Merlins, sometimes often; in habitat preference and size they are typical of Merlin prey (Witherby *et al* 1939, Olsson 1980). We know of no other records in Britain of Merlin preying on them.

Apart from the records above, male Bluethroats *L.s.s.* sang in suitable breeding habitat in Inverness-shire on 15 June 1980, and during summer at inland NW Scotland sites in 1984 and 1985 *(Brit. Birds* 75: 171, per GWR). In 1985 the second British breeding record also occurred in northern Scotland and was successful (SBR 1985). Some northern birds have expanded their breeding ranges into Scotland (eg Murray 1979), perhaps these records suggest Bluethroats are attempting to do likewise.

We thank the estates concerned for permission to visit Merlin territories and the Zoology Dept., University of Aberdeen, for access to examine bird skins.

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The arrival of Greenland Barnacle Geese at Loch Gruinart, Islay

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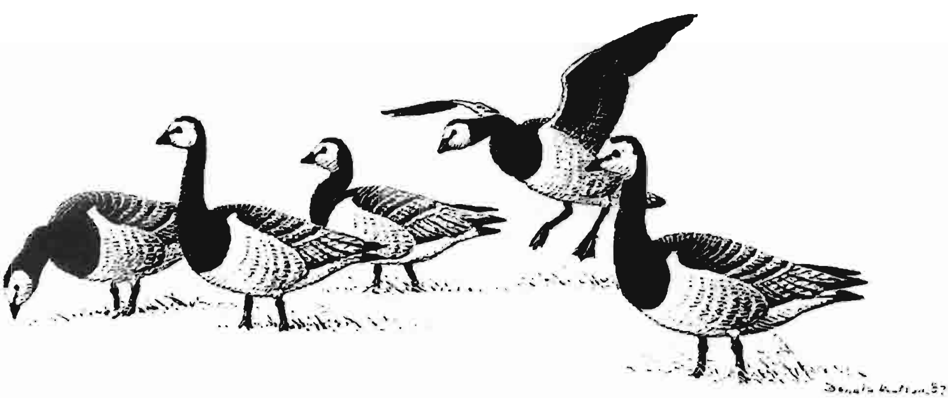
The arrival of Greenland Barnacle Geese on the island of Islay was monitored during autumn 1983 and 1984. In both years the arrival of geese showed a similar pattern: an initial concentration at Loch Gruinart, followed by dispersal to other parts of Islay and to wintering grounds elsewhere. The way in which this pattern affects any assessment of the over-wintering population is discussed.

Introduction

The world population of the Barnacle Goose *Branta leucopsis* consists of three geographically separate populations (Boyd 1961). The population breeding in north-east Greenland winters in coastal areas of north and west Scotland, and on islands off the north and west coasts of Ireland. The geese wintering on the island of Islay (Figure 1) have been monitored in a long series of November and March counts by the Wildfowl Trust (Ogilvie 1983a), aimed at estimating over-wintering numbers. The Greenland White-fronted Goose Study and the Nature Conservancy Council commenced monthly counts on Islay during the winter of 1982/83, to assess the distribution and abundance of geese on the island in relation to future sanctuary management. As a result the opportunity arose, for the first time, to monitor the arrival and build-up of numbers of Barnacle Geese on the island during 1983.

Here we present evidence that in autumn 1983 and 1984 a small area of Islay was being used by almost the entire Greenland population of Barnacle Geese. After this, a proportion of these birds moved to wintering grounds elsewhere.



Barnacle Geese. **Donald Watson**

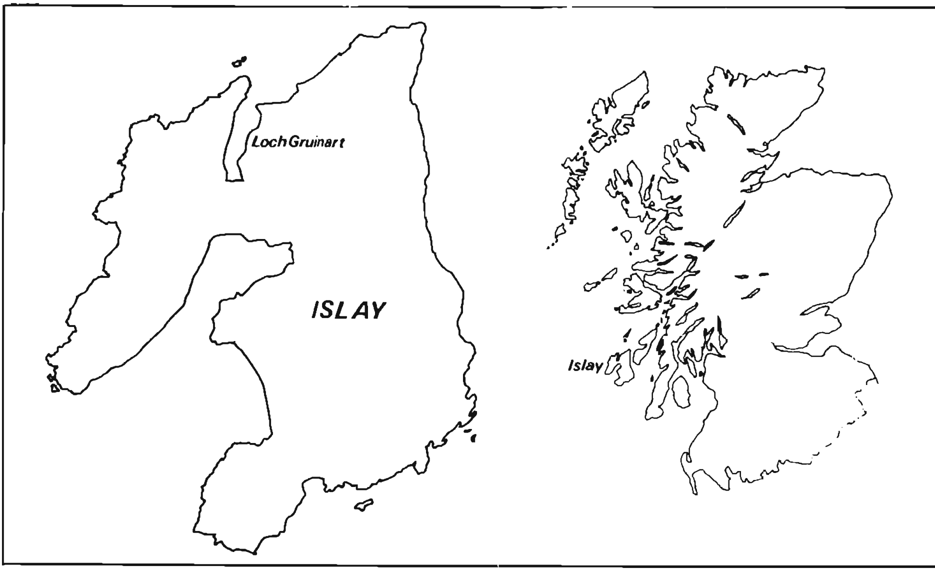


Fig. 1. The Island of Islay.

Methods

During the main arrival period in 1983 (11-31 October) 15 counts were made at Lochs Gruinart and Indaal, together with searches for geese dispersing to surrounding farmland. These were followed by two full island counts per month from November to April. During and immediately after arrival Barnacle Geese concentrated around Loch Gruinart and could be counted relatively easily by an observer from the roads around the loch and nearby farmland. Greater effort was required to estimate population size

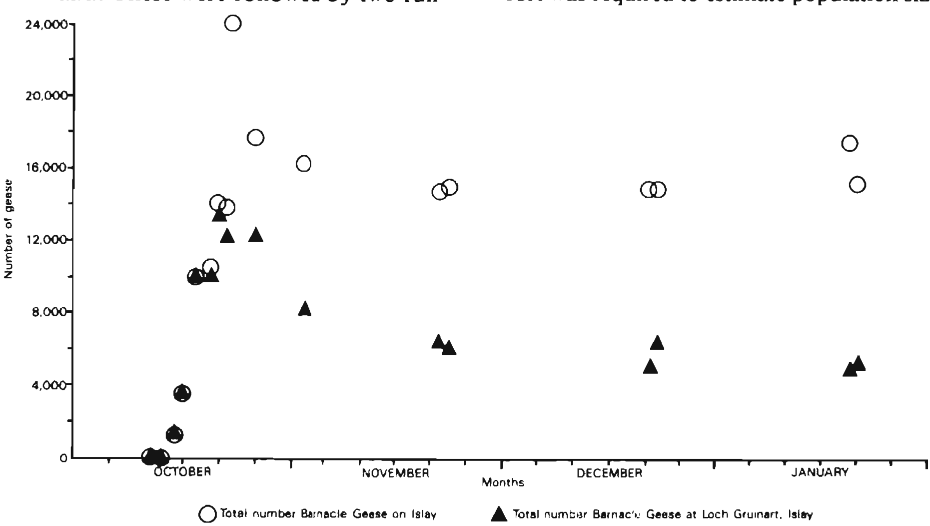


Fig. 2. Numbers of Barnacle Geese counted on Islay, 1983/84.

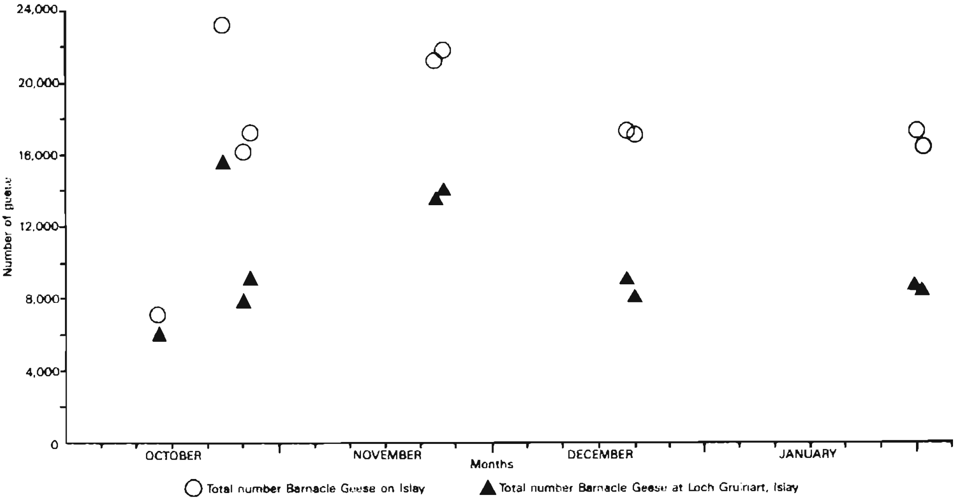


Fig. 3. Numbers of Barnacle Geese counted on Islay, 1984/85. Including data from Newton (1985).

once the geese had dispersed, and on the monthly counts all potential goose habitat on the island was surveyed on a single day. Four teams, each of two people in a vehicle, surveyed separate areas along routes devised to minimise under- or over-counting. Geese were usually counted from vehicles in the vicinity of roads and tracks with more inaccessible areas being covered on foot.

Results

The first geese seen arriving on Islay during the autumn of 1983 were observed at Loch Gruinart on 11 October. Major flights were noted arriving on 14 and 15 October and numbers increased to a peak of 20,425 on 22 October (Figure 2).

The first large numbers of Barnacle Geese seen elsewhere on Islay were simultaneously noted on 22 October, when 3,500 were counted in the Laggan and Duich areas. On this date, at least 23,900 Barnacle geese were present on Islay, 85% of which were at Loch Gruinart. Numbers declined after this date and had stabilised by the time of the monthly count in late November to give a mean overwintering population of 15,535 (S.D. 911, n = 10).

The arrival of geese in autumn 1984 was also monitored and a similar rise in numbers was recorded. However, a smaller proportion of the total population on the island was found at Loch Gruinart when numbers peaked on 22 October (Figure 3).

Discussion

The most recent assessment of the Greenland Barnacle Goose population on its wintering grounds was by aerial survey and ground counts in late March/early April 1983 (Ogilvie 1983b). The survey found 14,000 geese on Islay; 1,900 on the Inishkea Islands, Co. Mayo; and 9,352 scattered at a large number of coastal sites in west Scotland and Ireland. Our count of the Islay population at this time (15 March 1983) was 15,091.

The size of the Greenland population the following autumn can be estimated from the spring total, using figures for summer mortality and recruitment based on the proportion of juvenile birds in autumn flocks.

TABLE 1 Estimation of total Greenland Barnacle Goose population in October 1983.

	Counted in March 1983	Summer rate of mortality/ loss	Adults & Yearlings after summer mortality	Proportion of young	Estimated total October 1983
Islay	15,091[1]	4.8[4]	14,367	9.9%	15,946
Inishkea	1,900[2]	3.5[5]	1,834	6.0%	1,951
Elsewhere	9,352[3]	3.5	9,025	6.0%[6]	9,601
Total	26,343		25,226		27,498

Notes:
1. Ground count by Greenland White-fronted Goose Study & NCC.
2. Ground count by Cabot (in Ogilvie 1983b).
3. Aerial survey by Ogilvie (1983b).
4. Ogilvie (1983a); see text.
5. Cabot & West (1983).
6. Assumed to be similar to Inishkea production/loss.

The proportion of the world population using Islay in Autumn 1983 can then be assessed. On this basis the total Greenland population in October 1983 was in the region of 27,500 (Table 1). Of these, 87% were present on Islay and 74% used the Loch Gruinart area.

The arrival and departure of large numbers of geese was rapid, with 35-40% of the world population arriving on the island between 21 and 22 October, and 20% having left three days later. These events were repeated in 1984, but a secondary peak in numbers was detected on 22 and 23 November, some weeks after the main arrival of geese. This secondary peak may represent a delayed arrival of Barnacle Geese similar to that observed for Greenland White-fronted Geese *Anser albifrons flavirostris* (C.G. Booth pers. comm.).

The numbers of Barnacle Geese declined to just over 17,000 by the December 1984 count and remained at that level during the winter, indicating that birds had dispersed to wintering grounds elsewhere. Two important points emerge from these observations. Firstly, it is clear that, in some years at least, the island totals during the autumn (October/November) do not give a true indication of the number of Barnacle Geese over-wintering (December-March) on Islay. It is not possible to say how often this phenomenon has occurred in the past, but Ogilvie (1983a) suggested that an anomalously high count in early November 1967 may have been due to "a mass arrival of geese on the island including birds which afterwards left the island".

Secondly, although the Gruinart area has previously been recognised as one of the most important winter wildfowl haunts in Britain and of international importance for Barnacle Geese (Ratcliffe 1977), our counts for 1983 and 1984 suggest that the site is also of international importance for geese during migration.

TABLE 2 Size of the largest saltmarshes in western Scotland. Taken from NCC saltmarsh survey reports.

Rank order	Location	Size (ha)
1	Tong/Melbost sands, Western Isles	96
2	Loch Carron, Wester Ross	68
3	Loch Gruinart, Islay, Argyll	50
4	Crinan, Argyll	47
5	Bridgend Flats, Islay, Argyll	40

The reasons for the attraction of Loch Gruinart to migratory Barnacle Geese are probably related to traditional patterns of site and habitat use and the geographical position of Islay. Most British geese, despite considerable changes in diet associated with the exploitation of agricultural crops, still exhibit a traditional pattern of distribution related to their original habitats (Owen 1982). Loch Gruinart has one of the largest areas of saltmarsh in western Scotland (Table 2; NCC unpublished reports), and is likely to have had a long history of use by Barnacle Geese. As well as supporting considerable areas of saltmarsh and mudflats, it is now surrounded by extensive areas of agricultural pasture. This combination of traditional and contemporary habitats contributes to the attractiveness of the site. In addition, Islay is the most southerly of the Hebrides and is the last stop-over point before Ireland for birds migrating southwards. While migrating geese may be taking the opportunity to rest and feed on Islay for a short period, we are unable to judge the importance of Loch Gruinart in energetic terms until further studies have been carried out.

Further work is necessary to understand fully the use of this area by Barnacle Geese and its relationship with the staging area in south-west Iceland, and wintering areas in Ireland and western Scotland. This will necessitate simultaneous autumn and spring counts on Islay and at other sites, together with continued monitoring of marked birds.

Acknowledgements

These counts were made, as part of a larger project to monitor goose numbers on Islay, by the Greenland White-fronted Goose Study and the Nature Conservancy Council. We are grateful to J. MacKintosh, S. Newton, S. Percival, J. Stroud and R. Thaxton for assistance with the counts and to D. Cabot, A.D. Fox and N. Metcalfe for commenting on earlier drafts.

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Short Notes

Large passage of Skuas off Balranald, North Uist in May 1986

Significant movements of Pomarine Skuas *Stercorarius pomarinus* have now been recorded off Balranald, North Uist, almost annually in May since 1976, while a comparable passage was discovered off the west coast of Ireland at Slyne Head, Co Galway in 1979. These are the only two sites in Britain and Ireland where flocks of Long-tailed Skuas *S. longicaudus* are regularly recorded in May (Davenport 1981).

The largest movements previously reported occurred at Balranald in 1983, when 786 Pomarine and 387 Long-tailed Skuas flew north during the period 19-22 May (Davenport 1984). Far greater numbers of Pomarine Skuas occurred there in 1986; this article describes these movements in some detail.

A record total of 1,716 Pomarine Skuas was seen flying north at Balranald during 11-28 May, of which 1,545 occurred in four large movements, as shown in the accompanying table. The largest numbers were seen on 21 May, involving 766 Pomarines in five hours following the passage of an occluded front at 0800 hrs, and including a spectacular concentration of 354 Pomarine and 168 Long-tailed Skuas in only one hour between 0950-1050 hrs.

Since none of these movements was given complete coverage, an attempt has been made to extrapolate the figures and present estimated half-day totals, as shown in the table. These calculations are based on the fact that most spring skua movements at Balranald and Slyne Head follow a fixed diurnal pattern, involving five-hour periods in the mornings and/or evenings, starting at about 0600 hrs and 1700 hrs respectively, although some very large morning movements last up to seven hours, and indeed some may even continue all day (Davenport 1981, 1984).

Significant numbers probably occurred on other dates when only limited coverage was available, especially during 13-15 May when the prevailing wind continued from the NW. On this basis it may be reasonable to suppose that about 3,000 Pomarine Skuas passed Balranald during the period under discussion.

These observations modify our present knowledge of spring skua passage at Balranald as follows: (i) large movements of Pomarine Skuas have now been recorded throughout the period 28th April-26th May; (ii) flocks of Long-tailed Skuas have so far only been recorded between 10th-24th

Table Skua passage at Balranald, North Uist in May 1986 (J. Vaughan, H. Scott, G. Hopwood, G. Carey et al).

Date	Wind	Time	Pomarine			Long-tailed	
			total	largest flocks	half-day estimate	total	flock sizes
11/5	NW 4	0700-0800	83		600		
,,	NNW 4	1045-1230	171	43			
18/5	WSW 5	1700-2030	241	40	300	33	2,6,25
21/5	WSW 5	0945-1230	583	30,34,39, 42,86,90	700	168	1,10,15, 60,82
,,	SW 6	1645-1900	183	43	400		
26/5	WSW 5	2½ hrs	284		500		

May; (iii) both Pomarine and Long-tailed Skuas occur in flocks of up to 80-90 birds.

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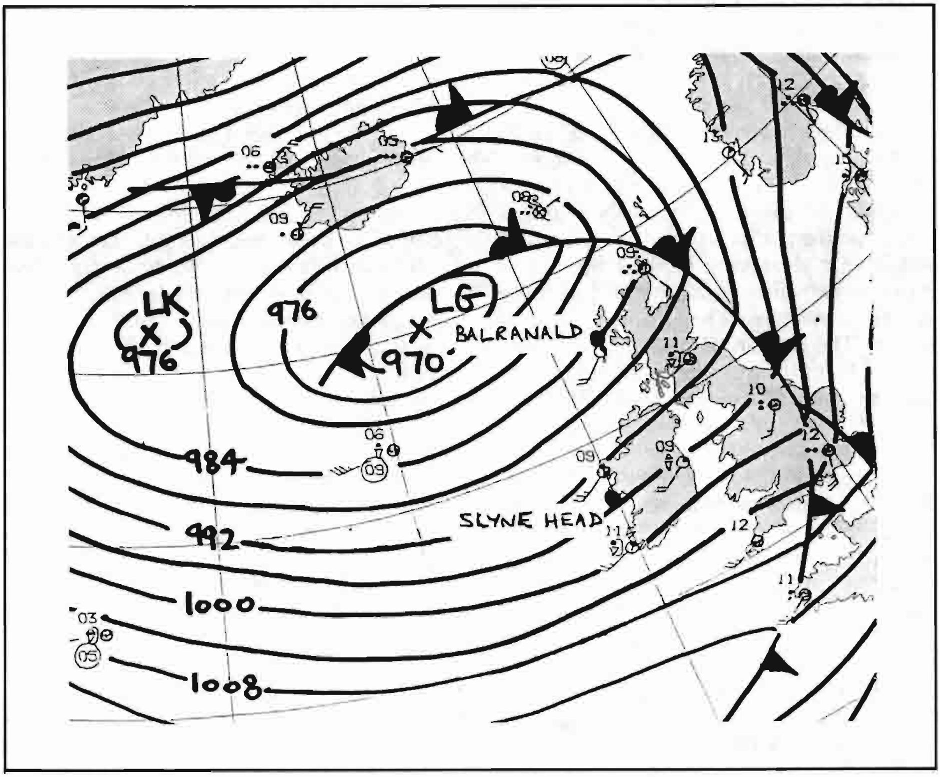

Fig. Atlantic weather map at 1200 hrs on 21 May 1986.

Sparrowhawk caching and returning repeatedly to prey

At 08.30 hrs on 8 April 1986, attracted by a sudden uproar among Jackdaws *Corvus monedula* and Rooks *C. frugilegus* in our garden, we found that the birds were mobbing a female Sparrowhawk *Accipiter nisus,* which was standing with wings spread over a struggling Jackdaw. Although clearly bothered by the mobbing corvids, which swooped low overhead, the hawk proceeded to pluck and tear at its still living prey, which it held down back uppermost. The Jackdaw's struggles continued for about 10 minutes after its capture; the mobbing birds left at about the same time.

The Sparrowhawk remained until 10.20 at the kill site, an open marshy area screened by bushes and trees. During this time I watched almost continuously with a telescope from a distance of 30m, but did not have a clear view of the corpse. The hawk spent alternating periods (lasting several minutes each) in plucking and in eating. The rhythm of both activities was strikingly uniform: plucking movements were repeated at a rate of about 30-40 per minute, while the upward pulling movements associated with the tearing of flesh occurred about 30 times per minute. Both activities were sometimes interrupted by periods of vigilance lasting 10-20 seconds, in which the hawk stretched its head upwards and looked around; one such episode was obviously associated with a Woodpigeon *Columba palumbus* flying overhead.

At 10.20 the hawk stopped eating, looked around without obvious signs of alarm, and took off, carrying its kill to a thicket of snowberry 15m away, where it was lost to sight. After waiting for an hour without seeing the hawk I went to the thicket and found the body of the Jackdaw, on the ground 5m in from the edge of the thicket. The stems of the bushes were dense but it might just have been possible for the hawk to fly to this point. The notable fact, however, was that there was no sign of further plucking. The hawk - without being disturbed - had carried its kill into cover and left it there.

At this stage I retrieved the corpse and examined both it and the kill site. Remains at the site comprised body feathers, tail coverts and rectrices, and some pieces of intestine. The corpse lacked the whole of the tail area, the back was entirely plucked and the flesh of the neck and the brain had been eaten (although part of the skull and the bill were still attached); the breast had not been plucked. The corpse now weighed 180g, while the original weight was probably about 245g (Hickling, ed. 1983).

I then replaced the corpse and kept away until 18.30, when I visited the site and found that the corpse had been moved about 1m and that fresh droppings were present. The breast had been plucked and the abdominal region had been largely eaten. The corpse now weighed 135g.

At 08.30 on 9 April I visited the thicket again, but unfortunately disturbed the hawk, which with difficulty flew up almost vertically to get out of the thicket. This time the corpse was found lodged between stems 0.5m from the new plucking site, which was 2m from that used the previous afternoon. Part of the breast had now gone, the bill was detached and the neck vertebrae were missing, and the flesh from the upper parts of the legs had been eaten. The upper and lower secondary coverts on both wings had all been removed, although the secondaries themselves - along with the primaries and their coverts - were still intact. The corpse now weighed 115g. I replaced it but a further examination at 18.30 showed no sign that the site had been visited again on 9 April.

At 08.30 on 10 April I found fresh splash droppings indicating that the hawk had paid another visit that morning. Some secondaries had been plucked and the small muscles along the ulna had been eaten; the thoracic cavity had been excavated from the dorsal side, though the shoulder girdle and sternum were still present and the breast muscles on one side were largely intact. The corpse now weighed 75g.

At 18.30 on 10 April the shoulder girdle, sternum and wings were missing and could not be found in spite of a search of the surrounding area. The remains of the bill, legs and lower part of the spine were still present and weighed 20g; the missing elements probably accounted for about the same amount. Making a small allowance for the other feathers and for drying out of the flesh, it appears that the hawk consumed approximately 185g of food, or about three quarters of the original weight of the prey. This food was taken in at least five meals, over a period of about 54 hours. Newton (1986) quotes data indicating that captive female Sparrowhawks eat 50-70g of food per day, depending largely on activity. It seems likely, therefore, that in the present case the Jackdaw provided the bulk of the Sparrowhawk's food during the three days concerned.

Both Sparrowhawks and Goshawks *Accipiter gentilis* have previously been recorded returning to large prey (Brown 1976; Uttendorfer 1939, quoted in Cramp, ed. 1980). Furthermore, Schnell (1958), in a study of a pair of breeding Goshawks in California, found that food items were cached near the nest for periods varying from one hour to "overnight" at the stage when the nestlings were too young to consume large amounts of food at single feedings; Schnell quoted similar observations by J.J. Craighead, who noted that the prey was wedged in the crotch of a tree. Schnell also recorded the male delivering a pigeon carcass to the nest more than 32 hours after killing it and after eating a substantial portion. Newton (1986) points out that female Sparrowhawks can carry items as heavy as themselves and comments that they "cannot eat such prey in one sitting, but they can at least get them to a safe caching site for consumption later". Newton does not, however, give explicit accounts of caching behaviour, so it seems worthwhile to put the present observations on record.

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Mixed clutch of Oystercatcher and Lapwing eggs incubated by an Oystercatcher

On May 5th 1983, at Kier Mains, near Stirling, an Oystercatcher *Haematopus ostralegus* nest was found containing three eggs. The shape, size and marking of one egg identified it as that of a Lapwing *Vanellus vanellus* (see plate). The female Oystercatcher was incubating when the nest was found. A similar mixed Oystercatcher/Lapwing clutch has been found in Galloway, containing two Lapwing eggs (Dickson 1978).

There are two possible explanations for the observed mixed clutches. A Lapwing may have laid an egg in the Oystercatcher nest. The benefit to the Lapwing in this situation is obvious: an extra egg is potentially brought to hatch, without the energy investment of incubation. Excluding cuckoos *(Cuculus sp.),* interspecific egg 'dumping' has been recorded previously in Britain by Herring Gulls *Larus argentatus* on Fulmars *Fulmarus glacialis* (Richards 1964) and also by Pochard *Aythya ferina* and Moorhens *Gallinula chloropus* on Ruddy Ducks *Oxyura jamaicensis* (Ladhams 1978).

An alternative explanation is that Oystercatchers stole the nest scrapes from incubating Lapwings but did not remove the eggs which had already been laid (H. Galbraith, pers. comm.). Purvey (1985) observed an Oystercatcher lay an egg in a Lapwing nest near Dundee, but in that case the Oystercatcher did not attempt to take over the nest. The advantage to the Oystercatcher of stealing a nest scrape would be to avoid the energy and time investment of building a scrape, thereby possibly allowing breeding to commence earlier. Oystercatchers which breed earlier produce more young than late breeders (Harris 1969).

In either case there may be disadvantages to the Oystercatchers in not removing the Lapwing egg(s). The extra egg(s) will require extra energy to maintain their temperature. In addition if the Lapwing egg(s) hatched before the Oystercatcher's own eggs the parent Oystercatchers may cease incubation to tend the young Lapwing (as in Dickson 1978). In this situation

An unusual nest of the Oystercatcher containing one Lapwing and two Oystercatcher eggs. (The rule is 20cm long). **J.R. Speakman**

the alien egg(s) would reduce fecundity.

In spite of these disadvantages the Oystercatchers may not have removed the Lapwing eggs because the stimulus cues presented by the eggs were incompatible with removal (Tinbergen *et al.* 1962). Oystercatchers may be unusually poor at distinguishing other eggs and egg-like objects from their own eggs, since they have also been recorded incubating stones (Holt 1970).

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Double-brooded Fieldfare nesting in Glenurquhart, Scotland

On 6 June 1986 I was informed that a Fieldfare was nesting in an orchard, in Glenurquhart, Highland. I visited the site on 12 June and found a nest containing five eggs, at a height of 2 metres in an apple tree. On 18 June the nest was revisited and found to contain one five-day old chick and four infertile eggs. The chick must therefore have hatched on 13 June; it was still in the nest on 25 June but had gone by 30th.

On 7 July a second Fieldfare nest was found, also in an apple tree, some 30m from the original nest. It contained five seven-day old chicks. On 10 July two were still in the nest, the rest being heard in undergrowth close by. The nest was empty on 15 July, when at least three young were seen being fed in an alder wood adjacent to the orchard. Previous reports of Fieldfares nesting in Scotland have tended to be in moorland valleys, hillside birchwoods or plantation edge (Thom 1986). This nesting site was in a fertile valley in an orchard bounded by arable land, pasture and a swampy alder wood. This also appears to be the first definite record of a Scottish Fieldfare having two broods.

The timing of the two broods is of interest (Table 1). The first egg of the second brood was laid only two days after the first brood had hatched (assuming a 13-day incubation period). This rapid re-laying may have been a response to the fact that only one egg in the first brood hatched. The solitary chick presumably could have been looked after by one adult whilst the other got on with the second brood. Fieldfares are supposed to be very demonstrative at nests containing young, and indeed were at the second nest. However on both visits to the first nest during the chick stage no adults were seen, probably due to the fact that one was brooding whilst the other was away feeding. On no occasion were more than two adults seen.

Table 1 Timing of two Fieldfare broods.

	First brood	Second brood
First egg laid	28 May	15 June
Incubation started	1 June	19 June
Hatching date	13 June	1 July
Fledging date	27/28 June	13/14 July

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Alarm calling and aggressive feeding site defence by Kestrels in autumn and winter

On 11 October 1984, while travelling along the A897 road between Kinbrace and Kildonan, Sutherland, I observed a female/juvenile Kestrel *Falco tinnunculus* 'mobbing' something at the top of a Scots Pine. I watched the Kestrel from inside the car at a distance of c40m for about five minutes. During that time it continually dived at the tree screaming a high pitched rapid 'Ke Ke Ke Ki Ki Ke' (a very similar call to the high alarm call given by some females when a nest containing large young is approached). I could not see what the Kestel was 'mobbing' and decided to investigate. As I left the car a Buzzard *Buteo buteo* flew from the tree towards me at a height of c20m, closely followed by the Kestrel. The Kestrel 'mobbed' and screamed at the Buzzard until the Buzzard was forced to land low down in a birch tree c150m away; the Kestrel then settled on a nearby tree. Twelve minutes later the Buzzard flew off. The Kestrel pursued it only a short distance then flew back to near the original Scots Pine and began hunting in the characteristic hovering flight. It was still hunting when I left five minutes later.

On the 16 December 1984 at the Sands at Forvie NNR, Newburgh, Aberdeenshire, I again witnessed similar behaviour. High pitched screaming typical of alarming raptors drew my attention to a female/juvenile Kestrel which was repeatedly 'mobbing' and screaming at a Short-eared Owl *Asio flammeus*. After a short period the owl saw me and flew off pursued by the still screaming Kestrel. The Kestrel returned and started hunting/hovering near to where I first saw the birds.

BWP Vol 2 describes Kestrels as usually silent away from nesting areas, silent outwith the breeding season, and usually completely mute during November-December (Cramp & Simmons 1980). It would appear that the excessive agression shown by these Kestrels was in defence of feeding sites, as both returned to the scene of conflict and started hunting, completely ignoring my presence. In Holland, Kestrels were territorial in winter when voles were scarce, and recent studies in Britain have shown that pairs or individuals will take up and defend winter territories (Pettifor 1983), Cavé 1968 & Village 1982, in Pettifor 1983).

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Merlin dusting at roadside

On 16 May 1986, while watching a breeding territory in Deeside, Grampian, I observed a female Merlin *Falco columbarius* dusting at the roadside. Dusting, previously described as 'dust bathing' or 'sand bathing', has been reported for falcons and presumably occurs regularly (Campbell & Lack, 1985). It is well developed in Peregrines *Falco peregrinus* being associated with the removal of ectoparasites (Ratcliffe, 1980). Wild Merlins are often elusive and observations of them dusting are probably rarely seen. The event described here occurred on a fairly busy road.

The Merlin flew from a favoured peat hummock and landed on the road c100m away from where I was concealed, then moved to the road edge where a mixture of sand and gravel had collected. Simultaneously she spread her wings, fluffed out her feathers and pushed her sternum-belly into the sand and gravel. She then flapped her wings and walked slowly forward with her sternum-belly still amongst the sand and gravel. She dusted like this for 4 mins before being disturbed by a car. After flying a short distance she came back and dusted for a further 2 mins until another vehicle disturbed her. She then flew to a boulder c80m away and preened intermittently for 20 mins before returning to the original hummock.

G.W. Rebecca, 31 Rainnieshill Gardens, Newmachar, Aberdeenshire

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Female Merlin standing guard over young. G.W. Rebecca

Siskins breeding in Birch

Current ornithological literature indicates that the Siskin *Carduelis spinus* is confined to conifers for breeding. However it seems probable that the growing practice of producing red peanut bags at bird feeding stations could allow Siskins to breed successfully in other habitats. For several years we have used a caravan on the edge of a birchwood in lower Strathnaver, Sutherland, as a base for our ornithological activities. Prior to 1983 we did not record Siskins in the wood, which lies 3km from the nearest conifer forest known to hold a good breeding population.

In mid April 1983 we hung two red bags on a tree, and by 24th a pair of Siskins were using them. By 14 May there were two males and three females, and by late June about five males and four females; accurate counting was impossible as birds were constantly coming and going. It soon became apparent that birds were regularly disappearing into specific areas of the adjacent birchwoods, but routine searching provided no evidence of nesting. As in subsequent years we provided nut bags up to the end of July.

In 1984 up to five bags were sited in the same place in late March, and by 30th a pair of Siskins were present. By 27 April there were at least two males, and by late June at least three pairs. Again they were observed flying into specific areas of the wood, but once more searching failed to give evidence of breeding.

Two pairs were at the bags by late April 1985, increasing to 3-4 pairs by early June. On 13 June one female appeared with a recently fledged juvenile, and on 19th two juveniles were present, although we had still not found a nest.

By 27 April 1986 we had attracted at least three and possibly up to six pairs. By early May a male was singing close to the feeding station. On 7 June a nest containing three young was located in a birch about 40m from the feeding station. It was sited about 4m high in a relatively stout upper fork of a spindly birch and could easily have been mistaken for the nest of a Redpoll *Carduelis flammea,* a common species in the area.

A hide was built, photographs obtained, and a close watch kept on the nest until 17 June when the birds fledged. For the first few days, chicks were fed on regurgitated peanut, but later the food matter was plainly green, presumably taken from the birches. During observation at least one other male was singing intermittently at various points within 50m, but no other nest was found despite close observation and searching. We did not see any juveniles at the nut bags.

G. & I. Bates, 105 Strathy Point, Strathy, Sutherland.

Items of Scottish Interest

Articles and Reports on birds in Scotland, mainly on status and distribution. (Previous lists 14(1): 55-56; 14(2): 87-88). References from widely available journals *British Birds*, *Bird Study* and *Ringing and Migration* are excluded. Most of these items are available for reference in the Waterston Library. Items marked with an asterisk are also available from the SOC Bird Bookshop postfree to SOC members at the price quoted.

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

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Natural History of Colonsay and Oransay — Report for 1986. (8 pp) J. Clarke & P. Clarke (eds) 1987. Mainly a detailed bird list for the islands.

Birds in East Lothian 1986. (36 pp) Alan Brown (ed) 1987. This unpublished report in photocopy covers the East Lothian District except for Musselburgh Lagoons and the Forth Islands.

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North-East Bird Report 1985. (48 pp) M.V. Bell (ed) 1986. * £2.00. Includes a 10-page article on wintering geese in Buchan.

North Sea Bird Club Report for 1985. (81 pp) A. Anderson (ed) 1986. Includes analyses of occurrence of selected species.

Shetland Bird Report 1985. (49 pp) P.M. Ellis (ed) 1986. * c. £3.00. Includes a paper on the recent decline of the Kittiwake in Shetland and one on bird ringing.

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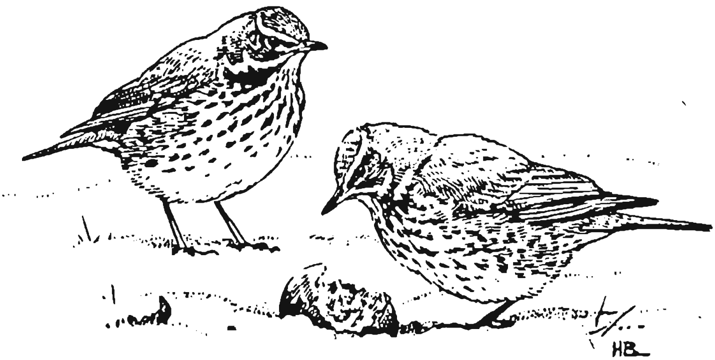
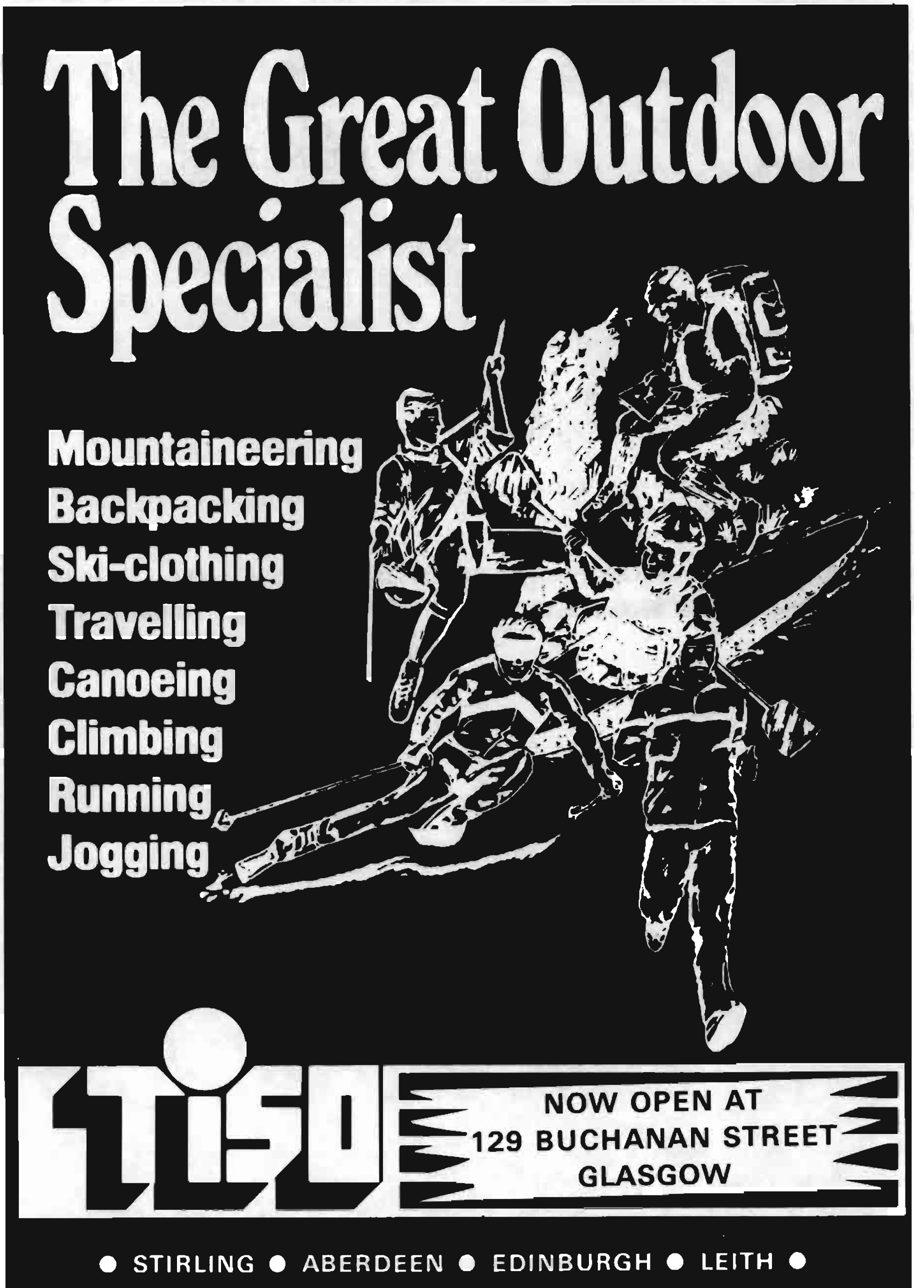
W.G. Harper

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