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Moray Basin wader populations

R.L. SWANN AND G.P. MUDGE

Mid-winter counts on the Moray Basin between 1984 and 1988 located up to 39,626 waders each year making it the most northerly estuary in Britain to hold internationally important concentrations of waders. Details are given of the numbers of the main species through the year. Comparisons with counts in the early 1970s showed that Oystercatchers had increased, but Lapwing, Knot and Dunlin had decreased.

Introduction

The Moray Basin comprises the inner part of the Moray Firth from Brora in Sutherland to Findhorn Bay in Moray (Fig. 1). It is the most northerly estuarine complex in Britain to hold internationally important concentrations of wintering shorebirds (Salmon *et al* 1987). Regular counts of the area began in August 1970 organised by Andrew Currie as part of the BTO Birds of Estuaries Enquiry (BOEE). These counts continued up to March 1975 and although fairly good coverage was achieved, especially in the winters of 1972/73 – 1974/75, it was seldom complete for the whole basin. There were no further comprehensive counts until November 1981 when Fraser Symonds started work on the Moray Firth Britoil/NCC contract (Symonds & Langslow 1986). Regular and complete counts were then made at many sites throughout the basin at least once a month to February 1985. The first fully co-ordinated count of the whole Moray Basin was done in January 1985. Since the start of the 1985/86 winter there have been co-ordinated counts in October, December, January and February (Aspinall 1986).

Past reports of the BOEE have treated the Moray Basin as five distinct parts. We treat it as one unit because the coastline between Brora and Findhorn Bay forms an

almost continuous stretch of intertidal sands and mud-flats. It is broken only by two stretches of rocky or cliff coastline: a 23 km section between Portmahomack and Nigg in Easter Ross and a 12 km section between Cromarty and Rosemarkie on the Black Isle. North of Brora and east of Findhorn the coast also becomes predominantly rocky. Furthermore, studies of the movements of dyed birds in the basin in a single season (Symonds & Langslow 1986) showed that some species, particularly Knot and Bar-tailed Godwit were very mobile; for example 58% of the Knot marked in the Cromarty Firth in November 1982 were subsequently sighted outwith the firth at eleven sites in the basin. Any division of the complex into different sections would therefore be very arbitrary. Recent publications (Prater 1981, Thom 1986) have tended to treat the area as one unit but have also used early, often incomplete counts and this has resulted in underestimates of the total numbers of waders using the area.

The aims of the present paper are to give information on the arrival and departure of the species which are regularly present in the basin, together with up-to-date details of peak numbers, and to examine evidence for any changes in status for each species between the winters of 1972/73 – 1974/75 and those of 1985/86 – 1987/88.

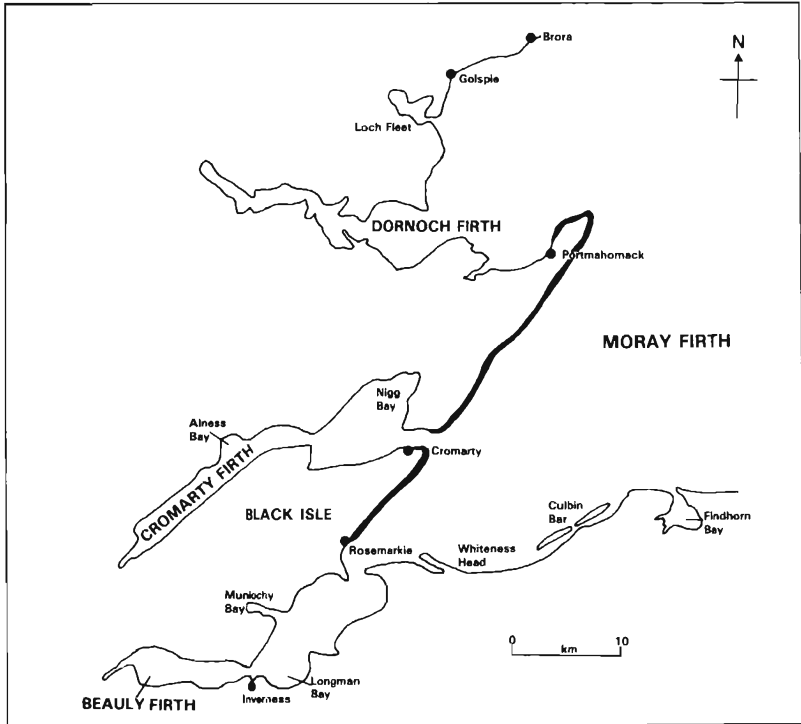


FIGURE 1. The Moray Basin, showing the main areas mentioned in the text. Solid line indicates rocky shore.

Methods

Recent mid-winter numbers in this paper are based on ten co-ordinated counts covering the whole Moray Basin in December 1985,86,87, January 1985,86,87,88, and February 1986,87,88. The highest single count each winter is taken as the mid-winter peak for that species. To decide which species the Moray Basin holds in internationally or nationally important concentrations (more than 1% of the total European or British population of that species) the means of the four peak mid-winter counts from 1985-88 have been used.

To examine changes in species status between the two main counting periods (1972-75) and (1985-88), eight sites in the

basin with comprehensive cover in both counting periods were compared. These were at Golspie-Brora, Loch Fleet, Udale Bay, Alness Bay, North Beauly, Longman Bay, Munlochy Bay and Findhorn Bay. For each site the nine counts from each December, January and February over the three-year period 1972-75 were compared with the nine counts for December-February during 1985-88 using *t* tests. For each species in the 1972-75 data set three counts (out of the 72) were missing. Values for these missing counts were interpolated from the mean of the two counts available for that month. For each site it was noted whether or not there had been a statistically significant

TABLE 1. Peak mid-winter counts of waders in the Moray Basin from 1984/85 to 1987/88, and the qualifying levels for each species for recognition as being of national or international importance (i.e. 1% of the national or international totals, from Salmon *et al* 1987).

Species	1984/85	1985/86	1986/87	1987/88	Mean	Qualifying level	
						National	International
Oystercatcher	11060	11316	14069	9842	11572	2800	7500
<i>Haematopus ostralegus</i>							
Ringed Plover	290	302	393	475	365	230	400
<i>Charadrius hiaticula</i>							
Golden Plover	47	57	111	282	124	2000	10000
<i>Pluvialis apricaria</i>							
Grey Plover	42	40	36	26	36	210	800
<i>Pluvialis squatarola</i>							
Lapwing	195	977	874	496	636	10000	10000
<i>Vanellus vanellus</i>							
Knot	4385	3693	1302	1792	2793	2200	3500
<i>Calidris canutus</i>							
Sanderling		38	34	57	43	140	150
<i>Calidris alba</i>							
Purple Sandpiper	185	120	200	66	143	160	?
<i>Calidris maritima</i>							
Dunlin	7390	7634	8646	4970	7160	4300	20000
<i>Calidris alpina</i>							
Bar-tailed Godwit	5555	5569	3765	3157	4512	610	5500
<i>Limosa lapponica</i>							
Curlew	2695	3013	3808	3955	3368	910	3000
<i>Numenius arquata</i>							
Redshank	4120	6268	4173	5359	4980	750	2000
<i>Tringa totanus</i>							
Turnstone	475	599	468	465	502	450	500
<i>Arenaria interpres</i>							
TOTAL	36439	39626	37906	30942	36229		

change in the number of each species. The species chosen for analysis were those regularly present in the basin which had a mean population size currently greater than 300. The one exception was Turnstone which was not found in sufficient numbers at the eight chosen sites to analyse.

Data in this paper outwith the mid-winter period are restricted due to the lack of co-ordinated counts. Average monthly counts are available for the Dornoch Firth, Cromarty Firth and Whiteness Head in 1981-85 (Symonds & Langslow 1985) and for Findhorn Bay from BOEE data and B.

Etheridge in 1985-88. In the species accounts, information on the percentage of, and arrival of, young birds is taken from Highland Ringing Group data and is based on the proportion of young birds in cannon-net catches.

Results

Details of peak mid-winter counts are given in Table 1. Four species, the Oystercatcher, Curlew, Redshank and Turnstone are present in internationally important numbers. Ringed Plover, Knot, Dunlin and Bar-tailed Godwit are present in nationally important

TABLE 2. Peak mid-winter numbers of waders in the Moray Basin from 1970-71 to 1974-75.

Species	1970/71	1971/72	1972/73	1973/74	1974/75	Mean
Oystercatcher	6620	5375	6955	12160	6470	7516
Ringed Plover	570	225	172	170	170	261
Lapwing	1915	905	500	1410	2330	1412
Knot	6370	11400	9339	1910	2130	6230
Dunlin	3115	3385	8563	7525	6425	5803
Bar-tailed Godwit	547	2036	2877	5386	779	2325
Curlew	1985	1515	1620	2065	2165	1870
Redshank	3360	3565	5045	4590	4475	4207

TABLE 3. The mean number (and standard deviation) of waders at eight sites in the Moray Basin in 1972-75 and 1985-88.

Species	1972-75		1985-88		Differences between years [†]
	Mean	SD	Mean	SD	
Oystercatcher	2504	423	4452	1127	***
Ringed Plover	83	35	103	40	ns
Lapwing	615	420	141	105	**
Knot	1398	1234	255	294	*
Dunlin	3137	1615	1376	360	**
Bar-tailed Godwit	705	324	521	385	ns
Curlew	981	198	922	332	ns
Redshank	1703	330	1777	557	ns

Note: [†] For all species 18 counts were used for the comparison (see text).

*** P<0.001 ** P<0.01 * P<0.05 ns not significant

numbers. Table 1 shows that for most species there is much variation in peak numbers from year to year. Despite this the Moray Basin regularly supports 30-40,000 waders in mid-winter making it second only in importance in Scotland to the Solway Firth, and on a par with the Firth of Forth for the number of waders present. It is the twelfth most important estuary in Britain for wading birds (Salmon *et al.* 1987).

Table 2 shows the peak number of waders recorded during the earlier counting period (1970-75). When compared with Table 1 it suggests that Oystercatcher, Ringed Plover, Dunlin, Curlew, Bar-tailed

Godwit and Redshank have increased and Lapwing and Knot have decreased. However, because the earlier counts were incomplete it is difficult to assess whether some apparent changes were due mainly to the improved coverage obtained in the recent counts. By comparing sites that were well covered in both counting periods it is possible to determine actual changes (Table 3).

The following species accounts comment on changes in numbers between the two census periods and detail the variation in numbers of each species present in the area throughout the year.

Oystercatcher The mean number at eight sites in the Moray Basin increased between the two count periods (Table 3). Numbers at five of the sites examined showed an increase (three were statistically significant) and three showed a decrease (two were significant).

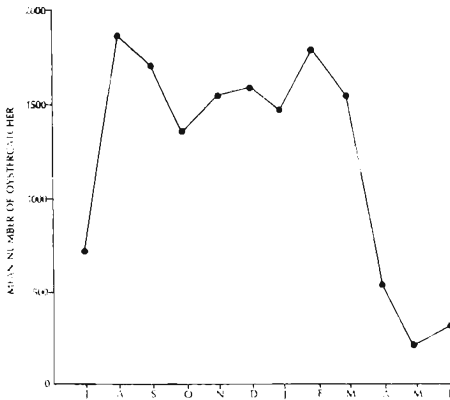


FIGURE 2. Mean number of Oystercatcher per month on the Cromarty Firth 1981-85. Data from Symonds & Langslow (1985).

Adult birds returning from their breeding grounds arrive back on the firths in July and immediately begin to moult. Numbers of both adults and young reach a peak in August and September (Fig. 2). Colour-dyeing (Swann 1985) and visual evidence (B. Etheridge *pers. comm.*) suggest that this peak is partly due to the presence of passage birds in the firths. Numbers remain high throughout the winter (November – March) but fluctuate as birds move between estuary and field feeding sites according to weather and tides. Severe weather can also lead to sudden influxes; in the December 1986 count there were 9900 in the basin but this increased to 14,000 in January 1987 just after a spell of very cold weather. By February numbers had dropped to 11,400. There is evidence of return passage at certain sites which often results in a peak in February or March. Most birds have left by the end of March except for immatures and non-breeding adults which summer on the firths.

Ringed Plover Tables 1-3 suggest an increase in numbers over recent years but this difference is not statistically significant. Birds are present in the basin all year. Flocks build up in July and adults start to moult then. During August transient flocks of non-mouling adults and young are also present at some sites; 200 were recorded from Findhorn Bay in August 1987. Numbers remain high up to September/October. During mid-winter, numbers appear to decrease as the larger autumn flocks disperse, but many birds may be overlooked at this time. By April birds are back on breeding territories. At certain sites, particularly Findhorn Bay (Table 4) and Culbin Bar, large flocks of Ringed Plovers are present during late April and May. These flocks fluctuate greatly in numbers from day to day and are probably northern birds using the Moray Firth as a staging area on their migration.

TABLE 4. Maximum spring (April/May) wader numbers in Findhorn Bay in four years.

Year	Ringed			
	Plover	Knot	Dunlin	Redshank
1981	?	600	?	1000
1986	800	600	300	1164
1987	1500	30	700	900
1988	?	1500	700	1800

Lapwing Table 3 shows that Lapwing numbers in the basin in mid-winter have dropped significantly in recent years. They start arriving on the firth in July and adults are in heavy moult. Large numbers can be present by August; 3402 were located in the basin in August 1970. Numbers remain fairly high till October (Table 5) and reach their lowest in January. Birds start to return in February and March, though the count of 3519 in March 1971 appears to be exceptionally high.

TABLE 5. Lapwing numbers on co-ordinated counts in 1985-87.

Year	Oct	Dec	Jan	Feb
1985/86	1408	977	108	161
1986/87	1906	874	99	487

TABLE 6. Average monthly counts of Knot at four sites in the Moray Basin 1981-1988. See Methods section for details of coverage; nc = no count.

Location	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Dornoch	0	0	177	44	51	639	1266	413	3	0	0	0
Cromarty	0	27	86	180	28	394	434	235	12	0	0	0
Whiteness	nc	23	115	2	249	442	265	227	50	nc	nc	nc
Findhorn	25	150	6	235	nc	7	66	130	136	310	30	8

Knot This species has decreased significantly in numbers (Table 3). First-year birds start to arrive in the basin during August and September with a few moulting adults. The first influxes of adults do not usually occur until late October, though in some years it can be even later with peak numbers anytime between December and February (Table 6). Numbers decline rapidly in March. In most years there is a build-up of passage birds at Findhorn Bay during April (Table 4). Up to 800 first-year birds may summer between Whiteness Head and Findhorn Bay.

Dunlin Although recent peak mid-winter counts are now higher than those in the 1970s (Tables 1 and 2) there has been a significant decrease in numbers in areas where coverage has been comparable (Table 3). The build-up in numbers of Dunlin varies throughout the Basin. At most sites only a few are present in July and August but numbers start to increase with the arrival of young birds in September and early October (Fig. 3). A large influx of adult birds which have moulted elsewhere starts during late October and November. Peak numbers are recorded in mid-winter (December-February) prior to departure during March. At Findhorn Bay flocks of both non-moulting adults and young pass through in August and September (Fig. 3), with further influxes particularly of young birds in October. Numbers then increase rapidly to a peak in January/February. In late April/May flocks of several hundred pass through although numbers vary from

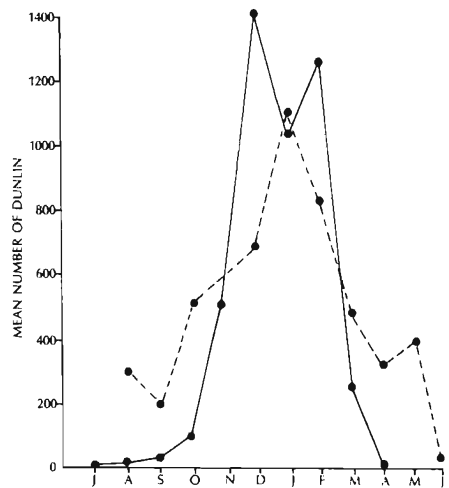


FIGURE 3. Mean number of Dunlin per month on the Cromarty Firth (solid line) and at Findhorn Bay (broken line). Data from Symonds & Langslow (1985) for Cromarty 1981-85, and BOEE for Findhorn 1985-88.

year to year (Table 4). Passage continues to early June, but very few Dunlin spend the summer in the Moray Basin.

Bar-tailed Godwit Table 3 shows no significant change in mean numbers in recent years. Adults arrive in July and immediately begin to moult at a few favoured sites, particularly Whiteness Head. During September numbers continue to increase as young birds arrive (Table 7). Major influxes of adults that have moulted elsewhere occur at other sites in the basin from October and peak numbers are not reached until January with

TABLE 7. Average monthly counts of Bar-tailed Godwits at three sites in the Moray Basin 1981-1988. See Methods section for details of coverage; nc = no count.

Location	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Dornoch	0	0	102	176	185	466	1155	484	30	1	0	0
Cromarty	88	282	336	382	290	474	678	461	70	14	1	0
Whiteness	308	594	557	310	490	374	526	462	454	250	nc	nc

most birds leaving in March. However, several hundred may remain till mid-April along the coast between Whiteness Head and Findhorn Bay. Up to 500 first-year birds may summer in the basin, mainly at Whiteness Head and Findhorn Bay.

Curlew Table 3 shows that mean Curlew numbers did not alter significantly between the two study periods. Numbers at five sites showed decreases, though none were statistically significant, whilst the other three sites showed increases, one of which was statistically significant.

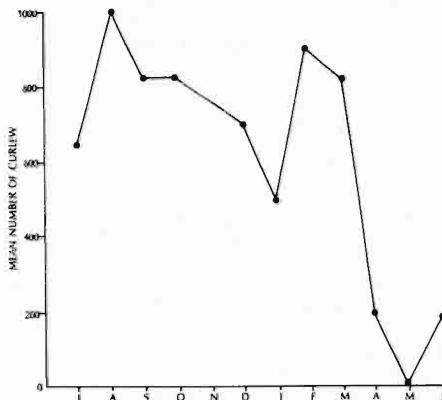


FIGURE 4. Mean number of Curlew per month on Cromarty Firth 1981-85. Data from Symonds & Langslow (1985).

The first birds arrive in late June and immediately start moulting. Numbers build up rapidly in July and reach a peak in August (Fig. 4). Thereafter numbers tend to drop. This is mainly because in winter many are feeding locally in fields near to the

estuaries. The high count in December 1986 coincided with a period of severe weather when coastal fields were frozen. Curlew numbers start to build up again in the firths during February and March prior to departure. Up to 350 Curlew summer in the Moray Basin.

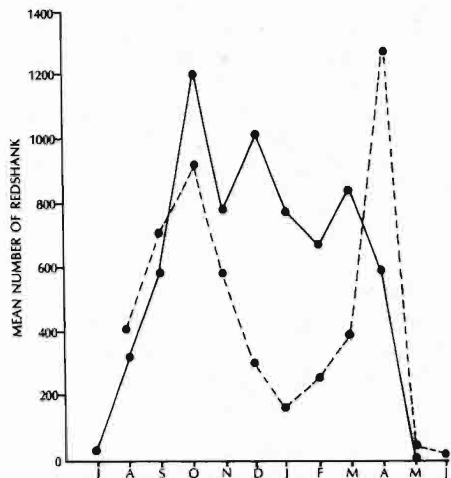


FIGURE 5. Mean number of Redshank per month on the Cromarty Firth (solid line) and at Findhorn Bay (broken line). Cromarty data from Symonds & Langslow 1985, Findhorn data from BOEE 1985-88.

Redshank No significant change in mean numbers was recorded between the two study periods (Table 3). Numbers at four sites showed a decrease (three of which were statistically significant) and four showed an increase (one of which was statistically

significant). Adults start to return by the end of July and begin moult. They are followed by young birds which arrive during August and September. Peak numbers are reached in October (Fig. 5) as many birds move through on passage. Numbers then remain stable throughout the winter, though severe conditions can lead to sudden influxes especially in December and January. Numbers reach another peak in March/April as birds from further south use certain sites in the basin, particularly Findhorn Bay (Table 4), as a staging post on their migration north. Most birds have left by the end of April and very few, apart from some local breeders, remain to summer.

Turnstone The early data are too fragmentary to allow any analysis on changes in status of this species. Adults start arriving in July and then moult. Numbers build up with the arrival of juveniles in September and by October large numbers are present and numbers remain high throughout the winter. In March birds start to concentrate at favoured sites where large flocks can build up. Departure does not take place till the end of April or early May.

Discussion

The Moray Basin is important for a variety of waders as a moulting and wintering site, a migration stop-over and a refuge during spells of severe weather. There is much annual variation in the peak winter counts of different species (Table 1). This appears to be at least partly due to the number of first-year birds in the population. Following a successful breeding season, wintering numbers of waders are greatly increased. For example Redshanks were present in the basin in 1987/88 in very high numbers, and the proportion of young caught at Inverness in September 1987 was the highest for the five years from 1983-87 (Table 8). Furthermore in mild winters such as that of 1987/88 more birds, especially Bar-tailed Godwits, Knot and Dunlin may remain on continental wintering areas thus reducing numbers

TABLE 8. Percentage of young Redshanks in September in cannon-net catches at Inverness.

Year	Number caught	Proportion (%) young birds
1983	78	40
1984	83	25
1985	149	35
1986	184	31
1987	361	58

in the Moray Basin. Conversely cold weather often results in big influxes of birds into the Moray Basin (Symonds & Langslow 1985).

A comparison of the change in status of waders wintering in the Moray Basin with national trends (cf. Salmon *et al* 1987) indicates that a local decline of Knot and Dunlin has mirrored national trends as has the local increase of the Oystercatcher. However, nationally Bar-tailed Godwit and Ringed Plover have increased and Curlew and Redshank have decreased over the same period, whereas locally these species have shown no significant change in status.

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(Revised ms. received 25 July 1988)

Wintering wildfowl and waders at Aberdeen, 1975-1986

M.V. BELL

The occurrence of wildfowl and waders outside the breeding season is described for the stretch of rocky shore from Aberdeen harbour entrance to Greg Ness 3 km to the south for the winters 1975/76 – 1985/86. The main species present were Teal, Eider, Goldeneye, Oystercatcher, Purple Sandpiper, Redshank and Turnstone; detailed counts are presented for them and the occurrence of other species is summarized. The importance of the populations in a local and national context is discussed. Over this period the numbers of the main species have remained stable apart from Goldeneye which increased. The status of many of the species discussed can be expected to change with the completion of a long outfall sewer in late 1988 which replaced the short outfall sewer at Girdleness.

Introduction

The large numbers of wildfowl and waders which are present at Aberdeen outside the breeding season were counted between October 1975 and April 1986. Concentrations of Eider *Somateria mollissima*, Goldeneye *Bucephala clangula*, gulls, and perhaps some waders were dependent upon the effluent from an outfall sewage pipe located at Girdle Ness (Fig. 1). In late 1988 this was replaced by a longer pipe which discharges c.2 km offshore; the counts presented here will serve as a baseline against which future counts under these changed conditions may be set.

Study Area

The area studied runs from Aberdeen Harbour south to Altens Haven and includes Balnagask golf course on Girdle Ness, the links at Nigg Bay and cliff top fields at Greg Ness (Fig. 1). The foreshore and intertidal zone at Girdle Ness comprise low rocky slabs and coarse shingle. Greyhope Bay and Nigg Bay are backed by coarse shingle beaches. At low tide a mixture of mud, pebbles and boulders is

exposed at Nigg Bay. The maximum width of the intertidal zone at a spring tide is c.50 m in Nigg Bay and less than 5 m beneath the 30 m high cliffs at Greg Ness. The whole area is very exposed to south-easterly gales.

Methods

Waders were usually counted at high tide. Ducks could be counted throughout the tidal cycle though the numbers of Goldeneye were always highest around high tide when sewage was discharged at Girdle Ness. Attempts were made to count the birds at least fortnightly but bad weather, inconvenient tides or other commitments often interrupted this ideal pattern. Over the study period an average of 25 visits including 15 complete counts was made each winter. All the counts refer to birds on the ground or sea, not those passing offshore. Wildfowl are taken here to include divers and grebes as well as ducks.

Results

Counts of the main species are presented as histograms (Figs. 2, 3) to give a visual

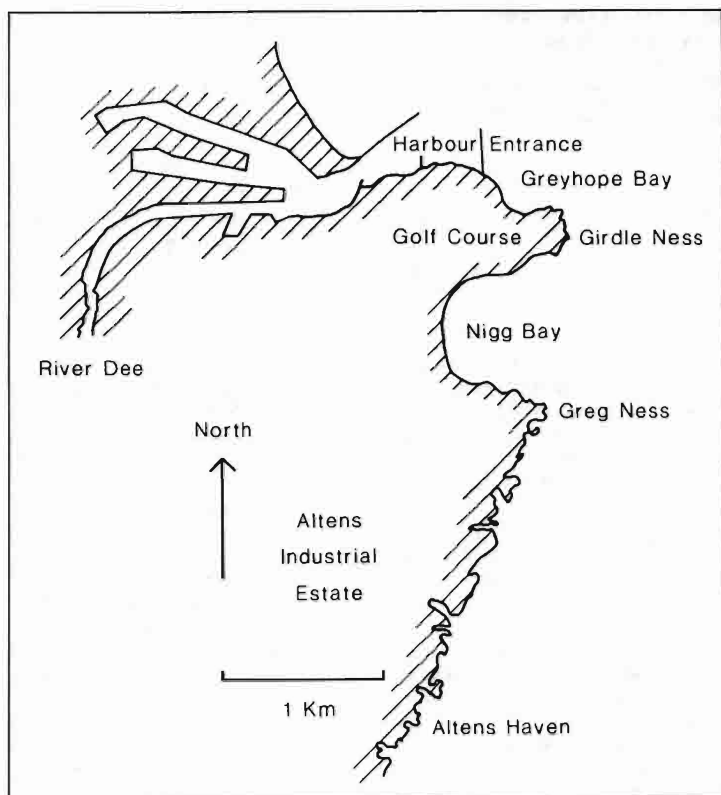


FIGURE 1. A map of the study area.

impression of the peak times for the various species and the differences between winters. Tables 1 and 2 present summaries of these data. Details are given in the following species accounts.

Wildfowl

Teal *Anas crecca* Teal fed in Greyhope or Nigg Bays and roosted there or on Greg Ness. They usually appeared in mid- to late October and departed in early to mid-April. Teal are not usually associated with a rocky shoreline. The nearest site holding appreciable numbers was the Don estuary 3 km north where c.100 were usually present in mid-winter. Although some interchange between the flocks at the Don estuary and Girdle Ness may have occurred, in most winters numbers at Girdle Ness were very steady.

Eider *Somateria mollissima* Eider fed mainly off the sewer outfall and the flock often spread out to 500 m either side of it. In rough weather they sheltered in the harbour entrance but in severe conditions they left for a few days together with Teal and Goldeneye. In early autumn all the Eider were usually found off Greg Ness and to the south. The flock at Girdle Ness built up from October onwards with large numbers not occurring until the New Year in some winters and often including birds colour-marked at the Ythan estuary breeding colony 20 km to the north (Fig. 2, Table 1). Numbers were highest in spring when there was a marked passage north of thousands of Eider (see North-east Scotland Bird Reports), and numbers at Girdle Ness could then change by several hundred from day to day. Usually by mid-April all had left Girdle Ness with just a few breeding birds remaining at Greg Ness. In spring

TABLE 1. The average of the maximum number of wildfowl and waders counted at Girdle Ness and Greg Ness for each month between winters 1975/76 – 1985/86.

Species	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	max
Teal	1	1	12	32	32	46	35	16	12	80
Eider	74	80	133	221	299	439	565	597	406	1180
Goldeneye	0	0	1	80	158	266	181	131	39	395
Oystercatcher	276	263	191	211	181	202	209	79	37	342
Purple Sandpiper	11	15	97	175	219	275	273	235	207	390
Redshank	80	128	80	73	48	36	58	52	44	217
Turnstone	224	286	270	300	240	241	277	276	283	477

1980 several hundred remained into May and June; many were found dead here and at the Ythan estuary and all were underweight. 1980 was a disastrous breeding season at the Ythan, thought to be due to a failure in the second year-class of mussels *Mytilus edulis* (see 1980 North-east Scotland Bird Report).

Goldeneye *Bucephala clangula* Goldeneye fed off the sewer outfall and in Greyhope Bay and the largest numbers were present each day around high tide. It was not clear where they spent the rest of the day but they usually roosted at night on the Don estuary. Numbers built up rapidly in the second half of November and continued to rise steadily into January when there was often a rather transient peak which coincided with hard weather (Fig. 2, Table 1). Table 2 shows that the wintering population here increased steadily each year since the 1975/76 winter.

Other wildfowl Small numbers of Mallard *Anas platyrhynchos*, Pochard *Aythya ferina*, Tufted Duck *A. fuligula*, Scaup *A. marila*, Long-tailed Duck *Clangula hyemalis* and Red-breasted Merganser *Mergus serrator* were seen fairly regularly while another twelve species were also recorded (Table 3).

Waders

Oystercatcher *Haematopus ostralegus* Oystercatchers fed in the intertidal zone at Girdle Ness and also on the golf course and links at Nigg Bay, with smaller numbers on the rocks and cliff top fields at Greg Ness. The main roosts were in Greyhope Bay, on the grass at Nigg Bay and at three sites from Greg Ness to Altens Haven. There was a peak of 250-350 birds in August or September, with generally lower numbers from 150-250 birds throughout the winter depending

TABLE 2. The average of the monthly maximum counts for each winter from the 1975/76 to 1985/86 winters for wildfowl and waders at Girdle Ness and Greg Ness.

Winter	Teal (Oct-Apr)	Eider (Oct-Apr)	Goldeneye (Nov-Mar)	Oyster- catcher (Aug-Feb)	Purple Sandpiper (Nov-Apr)	Redshank (Aug-Apr)	Turnstone (Aug-Apr)
1975/76	20	422	75	163	163	51	148
1976/77	26	382	129	188	126	70	232
1977/78	42	355	130	258	222	109	244
1978/79	40	307	150	262	242	84	271
1979/80	32	543	140	198	263	57	275
1980/81	29	339	174	216	250	56	281
1981/82	25	398	193	213	219	74	282
1982/83	31	243	181	228	233	47	280
1983/84	18	417	157	252	227	52	296
1984/85	17	356	225	180	218	64	270
1985/86	8	416	243	227	156	56	307

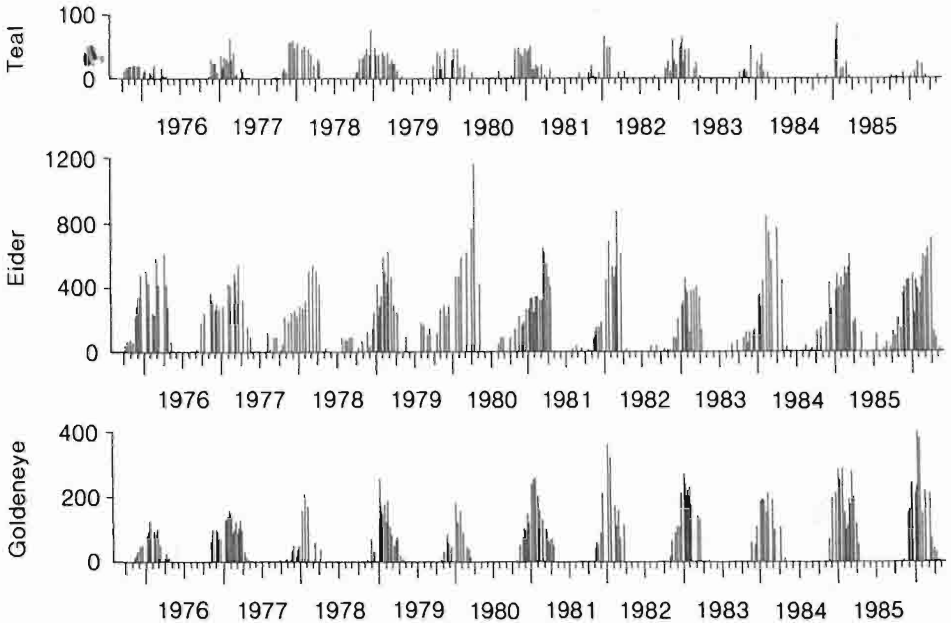


FIGURE 2. Histograms showing counts of Teal, Eider and Goldeneye at Girdle Ness and Greg Ness, Aberdeen between October 1975 and April 1986.

on frost, snow cover and rough weather (Fig. 3, Tables 1, 2). Numbers usually fell sharply in mid-February as birds moved inland. They apparently did not return to the coast during snow once they had moved inland and late spring snowfalls sometimes caused heavy mortality (Watson 1980). A few pairs remained to breed in cliff-top fields and on flat-topped factory roofs in the Altens Industrial Estate.

Purple Sandpiper *Calidris maritima* This species fed exclusively in the intertidal zone even during the roughest weather. The main feeding areas were round Girdle Ness and Nigg Bay and the main roosts were in Greyhope Bay, at Greg Ness and near Altens Haven. Small numbers of Purple Sandpipers were present from late July until early October after which there was a steady increase until December or January. The large flocks often remained until late April or early May (Fig. 3, Table 1). The normal wintering population between November and April was 200-250 birds (Table 2), and the mean winter peak was 301 birds between the 1975/76 and 1985/86 winters.

Redshank *Tringa totanus* Redshanks were less dependent on the intertidal zone than other waders and fed extensively on the grass. They formed mixed roosts with the Oystercatcher and Turnstone but also frequently fed on the links at high tide if the area was undisturbed. Numbers were more variable than for the other species, possibly reflecting the amount of disturbance on the links. They were usually highest in autumn and lowest in mid-winter (Fig. 3, Table 1).

Turnstone *Arenaria interpres* Turnstone fed regularly on the golf course and links with Oystercatcher and Redshank at high tide or during rough weather. The main roosts were with the other species in Greyhope Bay and at four sites between Greg Ness and Altens Haven. Turnstone arrived from mid-July and 150 could be present by the end of that month. However, there was not always a marked peak to the autumn passage, and numbers sometimes remained fairly steady right through the winter (1982/83) or showed a later peak (November 1978 and 1984, Fig. 3). Many birds left during severe frost or snow when

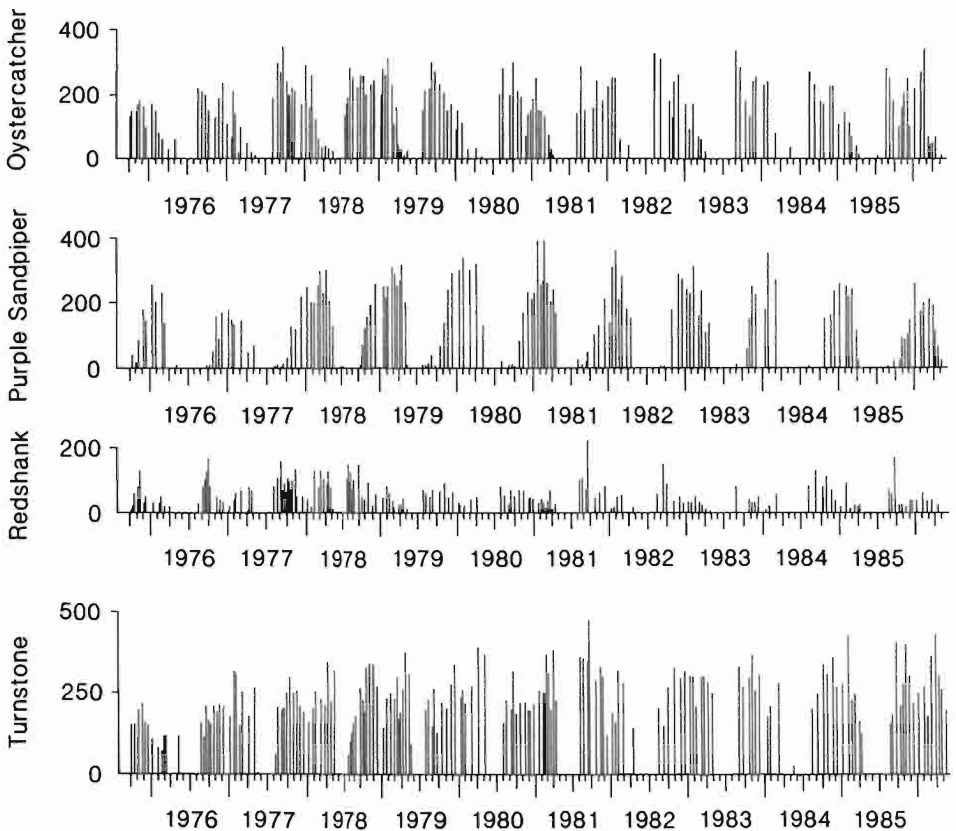


FIGURE 3. Histograms showing counts of Oystercatcher, Purple Sandpiper, Redshank and Turnstone at Girdle Ness and Greg Ness, Aberdeen between October 1975 and April 1986.

the grassy feeding areas were unusable, otherwise 250-300 remained throughout the winter (Fig. 3, Tables 1, 2).

Other Waders A variety of other waders occurred with varying degrees of regularity (Table 4).

Discussion

The wintering ducks and waders found at Girdle Ness and Greg Ness were with the exception of Teal, typical of a rocky shore. The numbers of Eider, Goldeneye, Purple Sandpiper and Turnstone were of national importance, comprising 1% or more of the British total for these species at times (Salmon *et al* 1987). The 1% population

levels were recently revised from 250 to 450 for Turnstone which no longer qualifies, but Goldeneye and Purple Sandpiper both regularly reached twice the 1% levels of 150 and 160 respectively.

In north-east Scotland the only sites to hold more Eider in winter were Fraserburgh and Rattray Head with regular flocks of c.1000 birds and maxima of 2920 and 4250 respectively since 1976, and the Ythan estuary where 500-1000 are usually present in mid-winter.

The Girdle Ness flock of Goldeneye was the largest in the area and with a mean January maximum between 1982 and 1986 of 338 was one of the largest in Scotland.

TABLE 3. Records of scarce wildfowl at Girdle Ness and Greg Ness.

Species	No. of sightings (most seen)	
Red-throated Diver <i>Gavia stellata</i>	8	(6)
Great Northern Diver <i>G. immer</i>	3	(1)
Great Crested Grebe <i>Podiceps cristatus</i>	4	(1)
Red-necked Grebe <i>P. grisegana</i>	1	(1)
Slavonian Grebe <i>P. auritus</i>	1	(1)
Barnacle Goose <i>Branta leucopsis</i>	1	(1)
Shelduck <i>Tadorna tadorna</i>	1	(1)
Wigeon <i>Anas penelope</i>	4	(1)
Mallard <i>A. platyrhynchos</i>	regular	(35)
Pochard <i>Aythya ferina</i>	24	(76)
Tufted Duck <i>A. fuligula</i>	26	(115)
Scaup <i>A. marila</i>	19	(15)
Long-tailed Duck <i>Clangula hyemalis</i>	13	(28)
Common Scoter <i>Melanitta nigra</i>	8	(2)
Velvet Scoter <i>M. fusca</i>	3	(1)
Smew <i>Mergus albellus</i>	2	(1)
Red-breasted Merganser <i>M. serrator</i>	regular	(14)
Goosander <i>M. merganser</i>	5	(1)

The only other appreciable coastal flock in north-east Scotland in the 1980s was at Fraserburgh where 50-100 birds were present at the sewer outfall. The flock at Girdle Ness built up over a month later and left earlier than the large flocks at the Loch of Strathbeg and Skene. This may have been due to the large number of drakes at Girdle Ness which is a feature of coastal Goldeneye flocks (Campbell 1977, Barrett & Barrett

TABLE 4. Records of scarce waders at Girdle Ness and Greg Ness.

Species	No. of sightings (most seen)	
Ringed Plover <i>Charadrius hiaticula</i>	regular	(18)
Golden Plover <i>Pluvialis apricaria</i>	23	(150)
Grey Plover <i>P. squatarola</i>	8	(4)
Lapwing <i>Vanellus vanellus</i>	regular	(240)
Knot <i>Calidris canutus</i>	regular	(70)
Little Stint <i>C. minuta</i>	3	(2)
Curlew Sandpiper <i>C. ferruginea</i>	3	(2)
Dunlin <i>C. alpina</i>	regular	(96)
Ruff <i>Philomachus pugnax</i>	15	(8)
Jack Snipe <i>Lymnocyptes minimus</i>	2	(1)
Snipe <i>Gallinago gallinago</i>	11	(8)
Woodcock <i>Scolopax rusticola</i>	12	(2)
Bar-tailed Godwit <i>Limosa lapponica</i>	9	(2)
Whimbrel <i>Numenius phaeopus</i>	2	(1)
Curlew <i>N. arquata</i>	regular	(60)
Greenshank <i>Tringa nebularia</i>	2	(3)
Green Sandpiper <i>T. ochropus</i>	1	(2)
Common Sandpiper <i>Actitis hypoleucos</i>	6	(3)

1985). The ratio of adult drakes to females and immatures at Girdle Ness varied from 0.9 to 1.5 (usually about 1.2) from late November to February, then decreased as the drakes departed first.

The coast of north-east Scotland is one of the most important areas in Britain for wintering Purple Sandpipers (cf. Moser & Summers 1987). Summers *et al* (1975) found about 2000 birds in a survey of the counties

of Banff, Aberdeen and Kincardine in the 1972/73 and 1973/74 winters, and these totals were placed in a British context by Atkinson *et al* (1978). A series of counts at Girdle Ness in 1973 before my surveys began showed a wintering population of 150-200 birds (Atkinson *et al* 1981). These counts, which are in line with my result, did not include Greg Ness. Extensive ringing studies of Purple Sandpipers on the wintering and breeding grounds have shown considerable site fidelity by wintering birds. A breeding female ringed in Norway in June 1978 was recorded in the following seven winters at Girdle Ness (Rae *et al* 1986). However, variations in numbers within and between winters suggest some local movement.

The rocky shores of north-east Scotland hold large numbers of Turnstone (Summers *et al* 1975, Moser & Summers 1987). At Girdle Ness and Greg Ness numbers remained remarkably constant over the study period, though they were low in the first winter which can only partly be explained by my unfamiliarity with the area. The other main site for Turnstone in north-east Scotland is between Fraserburgh and Rosehearty, where numbers have decreased considerably in recent years (North-east Scotland Bird Reports, and Bell 1984).

Several physical changes to the site over the eleven years were detrimental to birds. The clearance of a scrapyard and the improvement of parking facilities at Greyhope Bay caused increased disturbance of the main wader roost there. The construction yard for the new sewer at Nigg Bay destroyed several hectares of grass, and the expansion of the Altens Industrial Estate at Greg Ness in the 1970s covered many fields. The increasing use of the grass at Nigg Bay for golf practice caused disturbance here. A path constructed from Greg Ness to Cove in the 1976/77 winter greatly improved access to the cliffs to the south; this may have caused some disturbance at roosts, but also made possible counts along the whole length of coast at a single high tide.

In spite of these changes the only

species to show a decrease was Lapwing which were very scarce after the 1980/81 winter. This was probably due to the encroachment of the Altens Industrial Estate over the cliff-top feeding areas, and perhaps to increased disturbance over the grassy area at Nigg. However, there was a decrease of wintering Lapwing over the whole of north-east Scotland in the early 1980s (see North-east Scotland Bird Reports) so the decrease may have been part of a wider trend.

The new long outfall sewer at Girdle Ness will probably lead to the disappearance of the overwintering flock of Goldeneye and most of the Eider. The effect on the rocky shore waders is less certain but the long data set gives an opportunity to assess whether any future changes in numbers might coincide with the expected loss of nutrients along the foreshore from the former short outfall sewer.

Acknowledgments

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The distribution and status of the Chough in Scotland in 1986

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A survey of Choughs in Scotland in 1986 estimated the minimum population as 325-340 birds; 105 pairs were at nest sites, and of these 71 were confirmed as breeding. Breeding was restricted to Islay, Jura and Colonsay and, although Chough numbers were higher than in previous surveys, this bird still has a very limited distribution in Scotland.

Introduction

Historical records show that the Chough *Pyrhacorax pyrrhacorax* was once more widespread in Britain and Ireland, although its distribution has always been rather localized. It declined throughout the eighteenth and nineteenth centuries and is now completely absent from England; its distribution in Wales and Scotland is very limited compared to former times (Baxter & Rintoul 1953, Bullock *et al.* 1983, Warnes 1983). The reasons for the Chough's decline in numbers and the contraction of its range are not well understood but may include persecution, changes in land use and climatic factors (Bullock *et al.* 1983, Warnes 1983, Roberts 1985).

In Scotland, breeding Choughs have been confined to the Inner Hebrides and the Mull of Kintyre since at least the late 1930s (Baxter & Rintoul 1953). Islay has been its major stronghold for many years. Surveys of the Chough in Britain and Ireland were undertaken in 1963 (Rolfe 1966) and 1982 (Bullock *et al.* 1983). The former estimated the Scottish population at 70 individuals, which included 11 breeding pairs, while the latter estimate for Scotland was 171-211 individuals, which included 61-72 breeding pairs. Warnes (1983) reviewed the status of the Chough in Scotland in the light of the 1982 survey which had shown that 82-83% of the Scottish population was on Islay.

In recognition of its rarity, the Chough has been placed on Schedule 1 of the 1981 Wildlife and Countryside Act for Britain, and, in 1985, on Annex 1 of the European Community Directive on the Conservation of Wild Birds. The latter confers a responsibility on member States to conserve both the bird and its habitat. The need to meet the requirements of this legislation and to monitor population size and distribution, coupled with the increased possibility that land use change in response to new agricultural initiatives may adversely affect the Chough, led to the present survey. We describe our methodology in some detail to establish a baseline for future studies.

Methods

Area Covered

The areas surveyed are shown in Fig. 1. They included all the areas where Choughs had recently been recorded prior to the survey, except for Mull (G. Voules, pers. comm.). Particular attention was paid to:

Islay Since Islay is known to be the main stronghold of the Chough in Scotland, the entire coastline and all suitable inland sites were checked. The island was divided into three relatively discrete geographical areas, the Rhinns, the Oa and Elsewhere (Fig. 1), which correspond to those of Warnes' 1981 and 1982 surveys.

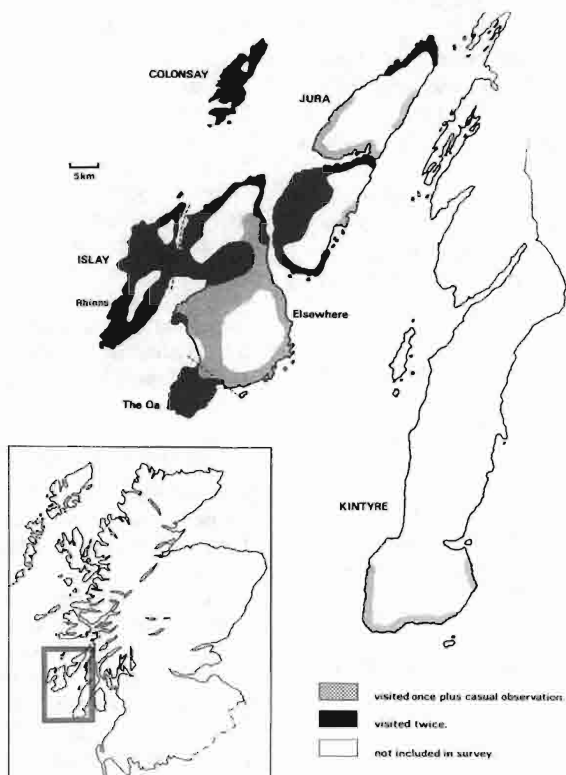


FIGURE 1. Areas surveyed in 1986, and the intensity of survey effort.

Jura All of the west coast, with the exception of c.6 km north of Corpach Bay, and much of the east coast and the interior of the island.

Colonsay The entire coastline and all potentially suitable inland areas.

Mull of Kintyre The coastline between Ballygroggan and Southend and all areas where Choughs had formerly bred.

Timing of Searches

The best time to look for nesting Choughs is late March and early April when nest-building birds can be very obvious. Later visits help to confirm breeding status. In this survey, searches for breeding Choughs began in the last week of March and continued until early June. Most areas were searched

twice but isolated areas, places clearly unsuitable for breeding Choughs, and those where no evidence of birds was found on the first visit, were searched only once (Fig. 1).

Searching Methods

All searching was done by *slowly* walking the area to be covered. At good vantage points and known nesting areas, the searcher would scan the area in view for 10-15 minutes. This method increased the likelihood of locating Choughs which were nest building, incubating (the incubating bird is fed by its mate) or feeding young. Thorough searching of potentially suitable sea caves and gulleys was also undertaken where possible, particularly in areas of low nesting density or where no birds were seen.

Status of Breeders

Assessment of breeding status is complicated by the fact that non-breeding birds may associate with a nest site (pers. obs.). To take this into account, the following categories were used:

Confirmed Breeding Attempt Sites where eggs or chicks were seen, or where the birds were observed incubating, feeding young or where young could be heard in the nest. Pairs were included in this category even if no young fledged.

Probable Breeding Attempt Sites where Choughs were present and nest building but breeding was not confirmed, largely because the site was inaccessible.

Pair Present Sites which Choughs were known to be visiting, but nest building was not completed or did not take place, no eggs were laid or no further breeding behaviour was observed.

Non-breeding Flocks

Numbers of non-breeding birds in flocks were also recorded, to assess the total population size.

Results

Breeding Numbers

One hundred and five pairs of Choughs were recorded at nest sites in 1986. Table 1 gives the numbers of pairs in each of the three breeding categories found in the areas surveyed.

Types of Breeding Site Used

Choughs used a variety of types of nest sites including, 1) ledges in caves, 2) sea gulleys, 3) under natural arches, 4) hollows or crevices in rock faces, and 5) used or unused buildings. The frequency of use of the different types of site in each of the areas surveyed is shown in Table 2. The use of buildings for nesting was significantly greater in the "Elsewhere" area of Islay than on the Oa or Rhinns¹, presumably due to the lack of natural nesting sites in the inland areas of "Elsewhere" rather than to any difference in the preferences of the birds.

Breeding Density and Dispersion

Comparatively small numbers (< 3%) were found nesting on the eastern coasts of Islay, Jura and Colonsay. Most birds on Islay nested on the coast (Fig. 2), the maximum distance from the sea being 5.7 km. Similarly, the three Jura nests were on the coast, as were six of the seven nests recorded on Colonsay. The breeding densities (number of nesting pairs per km²) of Choughs in the areas shown in Fig. 1 were as follows: Rhinns of Islay 0.27, Oa of Islay 0.33, Elsewhere Islay 0.05, Colonsay 0.14, Jura (southern half) 0.03.

Non-breeding Flocks

A non-breeding flock of 15-20 Choughs was recorded on the Oa, and a flock of 90-100 was seen regularly on the Rhinns. On

TABLE 1. The number of nest sites at which pairs of Choughs were recorded in Scotland in 1986.

Area	Confirmed	Probable	Pair present	Total
Islay				
Rhinns	31	13	12	56
Oa	19	2	2	23
Elsewhere	12	1	3	16
Total Islay	62	16	17	95
Total Colonsay	6	1	0	7
Total Jura	3	0	0	3
Total Kintyre	0	0	0	0
Total Scotland	71	17	17	105

TABLE 2. The number and proportion (%) of confirmed breeding pairs of Choughs in different nest site types in the areas surveyed.

Area	Cave	Gulley	Natural arch	Crevice	Building	Total
Islay						
Rhinnis	7(13%)	9(17%)	4(8%)	18(35%)	14(27%)	52
Oa	4(22%)	0	1(5.5%)	12(67%)	1(5.5%)	18
Elsewhere	4(25%)	0	0	2(13%)	10(62%)	16
Jura	2	0	1	0	0	3
Colonsay	1	0	0	4	1	6

Note: The precise location of some sites could not be determined, and these have been excluded from this analysis.

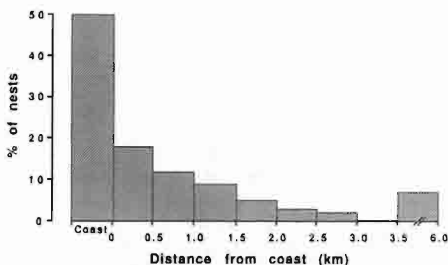


FIGURE 2. The proportion of Chough nests on Islay which were found at different distances from the coast.

Colonsay, a non-breeding flock of 10 birds was repeatedly observed. There was no evidence of non-breeding birds on either Jura or the Mull of Kintyre.

Total Scottish Population

The total number of Choughs (breeders and non-breeders) estimated to be in the areas surveyed in 1986 was 325-340, of which 90% were on Islay.

Discussion

The number of Choughs on Islay in 1986 (78 confirmed or probable breeding pairs) represented a 28-47% increase over the 1982 estimate of 53-61 breeding pairs. Numbers on Colonsay had also increased (seven pairs

now, one in 1982) but numbers on Jura were lower (three pairs now, six to eight in 1982) and none were found in Kintyre (one pair in 1982). We were unable to include Mull in the 1986 survey, but casual observations during other work did not locate any (*M. Madders*, pers. comm.).

Differences in coverage between the 1982 and 1986 surveys make it difficult to distinguish between increased survey effort and a genuine population expansion; even so the results are sufficiently different to indicate that the population has increased. To what extent this represents a continued recovery from former declines, or a favourable environmental change, is unknown. Islay remains the Choughs' stronghold in Scotland. Breeding densities were highest in the southern part of the Rhinnis of Islay and the south-west of the Oa; densities in the north-east of Islay were comparatively low and no birds nested in the south-east. On Colonsay, breeding densities were highest in the northern area. These differences in density may reflect local habitat suitability and/or nest site availability. In 1982 c.14% of the Choughs in Britain and Ireland were in Wales, 7% were on Islay, 7% on the Isle of Man, and the remainder were in Ireland. More recent counts are not available for these other regions, but assuming there has been no

change, the 325-340 found in Scotland in 1986 now represents c.12% of the British and Irish total.

The reasons for the restricted distribution of the Chough are not well understood but topography, climate, food availability and social organisation may be involved. In general, its distribution shows a strong westerly bias, presumably due to climatic influences on prey availability. The distribution of breeding sites on Islay showed a fairly close association with the occurrence of the climatic zone $O_1H_3T_1$ (Hyperoceanic Humid Northern Temperate) which indicates (for Scotland) a comparatively warm and humid climate with a reduced annual temperature range due to oceanic influence (Birse 1971). Only 8% of the confirmed breeding sites on Islay were outside this zone, despite 64% of the area of the island and 18% of its coastline being in cooler and wetter climatic zones. However since several of the Chough's former breeding areas in Scotland (such as Gigha, the Mull of Galloway, Burrow Head in Wigtownshire, and the Ayrshire cliffs) are also of climatic type $O_1H_3T_1$, climatic suitability is clearly not the whole story. Bullock *et al.* (1983), Warnes (1983) and Roberts (1985) all emphasized the importance of pasture and grazing animals in the feeding ecology of the Chough. The increase in the proportion of arable farming at the expense of pastoral regimes in the above areas may have contributed to the Chough's decline.

The results of this survey, which we suggest should be repeated at five-year intervals, do not give grounds for complacency as the concentration of the

Scottish population in such a small area makes it especially vulnerable. A better understanding of the Chough's population structure, behaviour and ecological requirements would help to frame a conservation policy for this enigmatic bird.

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APPENDIX. Results of statistical tests.
1. $\chi^2 = 13.35$, 2d.f., $P < 0.01$

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The food of some young seabirds on Fair Isle in 1986-88

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Some of Shetland's seabirds have come upon hard times and there is an urgent need for research on their main prey – the sandeel. Here we document the food fed to young seabirds on Fair Isle in 1986-88.

Introduction

During the 1980s numbers of some species of seabird in the main part of Shetland have declined and breeding success has been low (Heubeck *et al* 1986, Shetland Bird Report 1987, Heubeck 1988, Monaghan *et al.* 1989, Furness 1989). In 1988, few young were reared by Arctic Terns *Sterna paradisaea*, Kittiwakes *Rissa tridactyla*, Great Skuas *Catharacta skua* and Arctic Skuas *Stercorarius parasiticus* (Heubeck 1988). The reasons for these failures are unclear but changes in food supply have been suggested (Heubeck & Ellis 1986, Martin in press, Monaghan *et al* 1989). This paper summarizes what is known about the food brought in for chicks of thirteen species of seabird on Fair Isle between 1986 and 1988 and presents more detailed information on the diet of Puffin *Fratercula arctica* chicks for seven years between 1974 and 1988.

Methods

Food samples were obtained from a) regurgitations produced by young Herring Gulls *Larus argentatus*, Lesser Black-backed Gulls *L. fuscus*, Great Black-backed Gulls *L. marinus*, Kittiwakes, Great Skuas, Arctic Skuas, Fulmars *Fulmarus glacialis* and Shags *Phalacrocorax aristotelis* caught for ringing, b) loads of fish dropped by Puffins caught in mist-nets, c) fish found in colonies of Guillemot *Uria aalge*, Razorbill *Alca torda*, Black Guillemot *Cepphus grylle*, Arctic and Common Tern *Sterna hirundo*, and d) fish identified during observations from a hide, of young Guillemots (4 days in 1988) and Black Guillemots (4 days in

1987, 8 days in 1988). Fish or regurgitations were usually weighed, and the sandeels *Ammodytes* spp. were also measured (length to tip of tail) or, if partly digested assigned to 2 cm categories by reference to intact fish and then deep frozen for later examination. No fish from Kittiwakes or Shags were measured in 1987. Chick diet is expressed as percentage (by numbers) of specific items in the regurgitations or fish examined. Very few regurgitations contained more than a single item and those which did are mentioned below.

Breeding success was determined by a) regular checks of nests without disturbing the birds, using numbered photographs or diagrams, or b) for Puffin and Black Guillemot by checks of burrows after birds had laid and before the young fledged.

Results

Food of chicks

Details of the main food items fed to chicks, and the ranges of sampling dates are given in Tables 1 and 2. As the diet of seabird chicks can vary within a season and dropped fish may be unrepresentative of those actually eaten, comparisons which are based on small samples should be treated with caution. Nevertheless the general differences in diet between years are clear.

Fulmar Offal and small fish, probably from trawler discards, made up at least 65% of the diet each year. Fish identified included *Trisopterus* sp. (probably Norway pout *T.*

TABLE 1. Diet (% by number) of young seabirds on Fair Isle in 1986-88. The figure in brackets after the number of fish is the number of regurgitations or fish loads examined.

	Range of sampling dates	Total no. of fish in samples	% of samples which contained					
			Sandeel	Sprat or Herring	Gadidae	Butter -fish	Fishing offal or waste	Other items
Fulmar								
1986	24/7 - 11/8	?(24)	4	0	0	0	96	0
1987	10/7 - 22/7	?(14)	29	0	0	0	65	6
1988	1/7 - 10/8	?(37)	3	0	0	0	94	3
Shag								
1986	25/6 - 8/7	32(11)	100	0	0	0	0	0
1987	20/6 - 27/7	394(35)	100	0	0	0	0	0
1988	3/7 - 30/7	36(11)	93	0	0	0	0	7
Razorbill								
1986	24/6 - 16/7	26(26)	100	0	0	0	0	0
1987	18/6 - 14/7	31(31)	97	3	0	0	0	0
1988	3/7 - 30/7	4 (4)	75	25	0	0	0	0
Guillemot								
1986	15/6 - 1/7	47(47)	96	4	0	0	0	0
1987	20/6 - 3/7	30(30)	100	0	0	0	0	0
1988	14/6 - 8/7	89(89)	99	0	1	0	0	0
Black Guillemot								
1987	6/7 - 12/7	51(51)	37	0	0	61	0	2
1988	11/7 - 4/8	40(40)	0	0	15	48	0	37
Kittiwake								
1986	5/7 - 8/7	151(24)	100	0	0	0	0	0
1987	27/6 - 5/7	211(34)	100	0	0	0	0	0
1988	26/6 - 9/7	29 (8)	94	0	0	0	0	6

TABLE 2. Weight (g) and composition of loads of fish taken from Puffins on Fair Isle in 1974-88. In 1988, the fish under sprat could have been juvenile herring and there were also two Norway pout and one unidentified flatfish.

Year	Sampling dates (days sampled)	Mean weight \pm SE (n)	Total fish	% total fish					
				Sandeels		Whiting	Sprat	Rockling	Saithe
				large	small				
1974	10/7 - 14/7 (3)	?	47	64	11	25	0	0	0
1975	15/6 - 24/7 (6)	?	117	32	45	0	10	13	0
1976	16/6 - 27/7(10)	6.2 \pm 0.5(61)	212	88	6	0	0	3	3
1977	15/7 - 27/7 (5)	7.3 \pm 0.6(42)	277	5	89	1	4	1	0
1986	27/6 - 23/7 (6)	7.0 \pm 0.8(20)	44	26	70	2	0	2	0
1987	3/7 - 3/8 (3)	4.6 \pm 0.4(27)	32	22	78	0	0	0	0
1988	2/7 - 21/7 (5)	6.0 \pm 0.6(34)	159	5	37	51	5	1	0

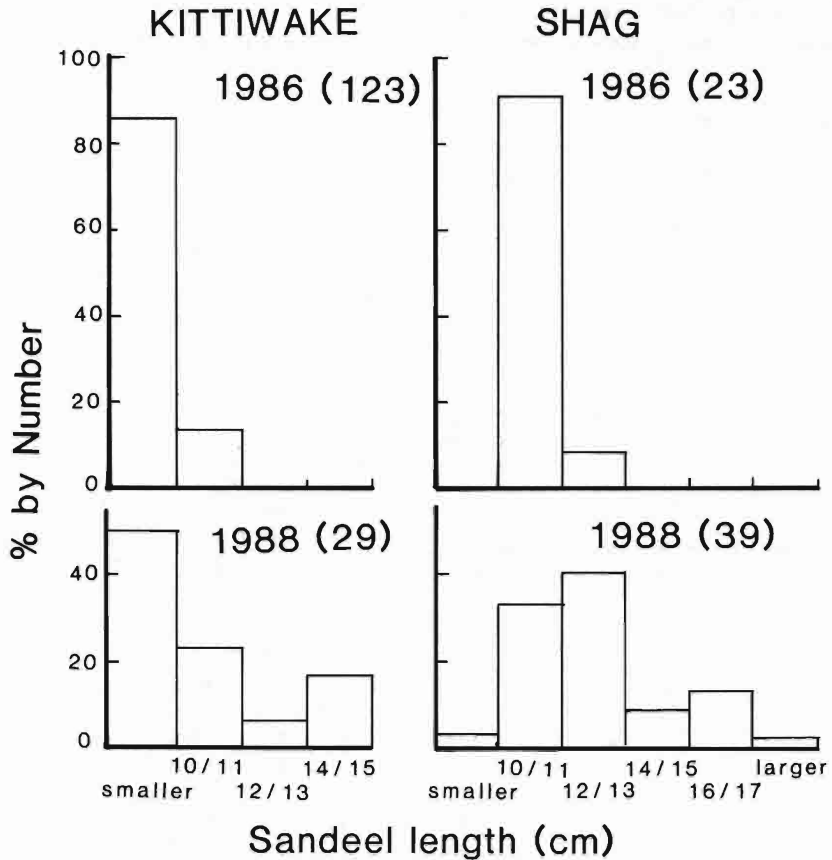


FIGURE 1. Size distribution (in 2 cm categories) of sandeels regurgitated by Kittiwake and Shag on Fair Isle in 1986 and 1988. The numbers of fish measured are given in brackets.

esmarkii) (3), whiting *Merlangius merlangus* (2), probable hake *Merluccius merluccius* (1), unidentifiable Gadidae (1) and a cartilaginous fish; sandeels were important only in 1987. Other items were a minute 'shrimp' and a whelk operculum.

Shag All the regurgitations contained sandeels and one sea-scorpion *Taurulus bubalis* was also recorded. In 1986 all the sandeels measured were between 10 and 13 cm long (Fig. 1). A much greater size range was apparent in 1988.

Kittiwake Except for a 1 cm-long 'shrimp' and an unknown fish in the same sample, all regurgitations consisted entirely of sandeels. Like Shags, Kittiwakes regurgitated more large sandeels in 1988 than in 1986 (Fig. 1).

Guillemot Sandeels made up 98% of the 166 fish identified; the exceptions were two sprats *Sprattus sprattus* and one *Trisopterus* sp. The mean lengths cm \pm SE (and sample sizes) of sandeels were $12.9 \pm 0.5(45)$ in 1986, $13.7 \pm 0.1(30)$ in 1987 and

$11.1 \pm 1.4(8)$ in 1988. Thus Guillemots brought in smaller sandeels in 1988.

Razorbill This species often carries several fish at a time for the chick so it is not known how many loads the 61 fish represented. All the items were sandeels except for two 11 cm long fish which were either sprat or herring *Clupea harengus*.

Puffin In the six years between 1974 and 1987 for which data were available sandeels were by far the commonest prey and made up 75–100% of the fish fed to chicks (Table 2). However, in 1988 sandeels formed only about 30% of the diet and Gadidae, mainly whiting with a few Norway pout, were the main prey. The only other year in which whiting formed a major component of chick diet was 1974. Despite the changes in species composition the weights of whole loads in 1988 were similar to those in previous years.

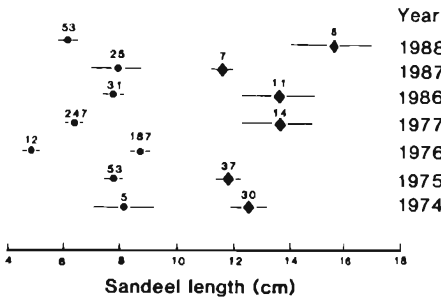


FIGURE 2. Mean lengths \pm 2SE of small (circles) and larger (diamond) sandeels brought ashore by Puffins on Fair Isle in seven summers. The numbers of fish measured are shown. Small sandeels were less than 10 cm long, larger were 10 cm or more long.

Sandeels of several different age classes are eaten by seabirds and these can be divided into the O-group (those hatched in the current calendar year and usually less than 10 cm long) and older fish (usually longer than 10 cm). The mean sizes of the two groups taken from Puffins in each year are shown in Fig. 2. The years 1976 and

1977 were unusual in that very few larger sandeels were taken even though there appeared to be good numbers of these size-classes recruiting into the Shetland sandeel populations (Kunzlik 1989). The few 4–6 cm long sandeels in 1976 came presumably from a late-spawning stock.

Black Guillemot Butterfish *Pholis gunnellus* were the commonest food of chicks in both 1987 and 1988. Although sandeels were the other main item in 1987 none were recorded in 1988 and their place was apparently taken by long-spined sea-scorpion *Myoxocephalus scorpius* (5), sea-scorpion (5), Yarrell's blenny *Chirolophis ascanii* (1) and a single minute rockling. All but three of the sea-scorpions were found lying in the colony, so many of these fish may have been too spiny or awkward for the chicks to swallow. Three flatfish were recorded in 1988 and one in 1987.

Other seabirds In 1986 no data were collected for species other than those mentioned above and the only additional record for 1987 was of five 5–6 cm sandeels dropped by Common Terns. In 1988 Arctic Terns brought in three sandeels 9–11 cm long. Regurgitations from Arctic Skua chicks collected between 24 June–14 July contained sandeels (3), other small fish (1), and the stomach of a bird (1). Those of Great Skua chicks collected between 3 July–6 August contained mammalian or bird flesh (5, one also had a piece of fish), young rabbit *Oryctolagus cuniculus* (1) and probable trawler discards (3). Young Great Black-backed Gulls regurgitated fish flesh (1) and a 10–12 cm sandeel (1) on 5 July. Lesser Black-backed Gull chicks regurgitations collected between 6 June–18 July contained a 14 cm Gadidae (1) and toast and fish offal together (1), whilst young Herring Gulls handled on 6 June–18 July regurgitated sandeels (3), fish discards (3), the remains of a Guillemot egg (1), a whole Guillemot chick (1) and a small oily fish.

TABLE 3. Breeding success (chicks reared/pair laying) of seabirds on Fair Isle, 1986-88. nc - not counted.

Species	1986		1987		1988	
	Pairs	Young/pair	Pairs	Young/pair	Pairs	Young/pair
Fulmar	548	0.47	494	0.53	453	0.38
Gannet	124	0.68	107	0.48	126	0.78
Shag	64	1.30	64	1.20	68	1.47
Kittiwake	1034	1.02	1497	1.00	315	0.09
Black Guillemot	nc	?	25	0.48	14	0.57
Puffin	nc	?	93	0.70	71	0.75
Arctic Tern	nc	?	211	0.00	345	0.003
Common Tern	nc	?	37	c.0.50	59	0.03

Breeding success

In 1986 the four species monitored had relatively successful breeding seasons (Table 3). In 1987, Fulmars, Shags and Kittiwakes showed little change in breeding success from the previous year but Gannets *Sula bassana* fledged markedly less young. Arctic Terns fledged no young at all. There was a wide disparity in the breeding success of the various species in 1988. Chick production was high for Gannets and Shags but there was almost a total failure among Kittiwakes and the two species of tern. Of the remaining species Fulmars fledged fewer young than in the previous two years, whereas breeding success was slightly higher in the Black Guillemot and Puffin.

Discussion

During the study sandeels were present to a greater or lesser extent in the chick diet of all the species of seabird sampled. The importance of sandeels during chick rearing is well known and has previously been demonstrated in a wide range of seabirds at colonies around Britain (e.g. Pearson 1968, Furness 1983, Ewins 1985, 1986, Harris & Wanless 1986). The only notable difference in the diet of any species on Fair Isle and elsewhere was that of the Fulmar. In 1986-88 sandeels made up only 3-29% of the chick diet which was a much lower proportion than the 72% recorded on

Foula, Shetland between 1978 and 1982 (Furness & Todd 1984) and 47% recorded on Yell, Shetland in 1984 and 1985 (Fowler & Dye 1987); it was, however, similar to the 3% on Foula in 1988 (Furness 1989).

Clearly 1988 stands out as a very odd breeding season. Kittiwakes, Common Terns and Arctic Terns all nested in record numbers (pers. obs.) but failed almost completely to raise their young. Fulmars did moderately well and Gannets, Shags and auks reared good numbers of chicks. Sandeels formed a much smaller proportion of the diet of Puffin chicks and were completely absent from that of Black Guillemot chicks in 1988 (Table 1). Although the sizes of sandeels taken from Puffins in 1988 were not markedly different to previous years (Fig. 2), Kittiwake and Shag regurgitations contained a higher proportion of large sandeels in 1988 than 1986 (Fig. 1).

In contrast, the mean size of sandeels found in the Guillemot colonies was lower in 1988 compared to either 1986 or 1987. However the situation in the Guillemot is confused by the fact that an unknown proportion of fish would have been used for display and such fish are generally smaller than those fed to chicks (Harris & Wanless 1985). Many of the 1988 fish may have been for display. There was nothing unusual in the measurements of sandeels from Puffins in 1988.

The large difference in breeding success between the various species in 1988 is consistent with the idea that there was a shortage of small sandeels at or near the sea surface. This would be expected to have a catastrophic effect on Kittiwakes and terns which feed in the top few centimetres of the water column. For these species there was apparently no alternative source of food and their young starved. In contrast, species which feed by pursuit-diving could either still find sandeels of a suitable size, e.g. Shag and Guillemot, or could switch to an alternative prey species e.g. Puffin and Black Guillemot. From studies on the Isle of May it is clear that the diet of young Puffins can change quite considerably over a period of years (Harris 1984). However, on the Isle of May the alternatives to sandeels, namely herring and sprats are of much higher energy value than the whiting which formed a large part of the chicks' diet on Fair Isle in 1988. On St Kilda, Western Isles, young Puffins which received a high proportion of whiting in their diet in the wild had relatively low fledging weights, and captive chicks fed *ad lib.* on a diet exclusively of whiting could not be reared successfully (Harris & Hislop 1978). Although the increased proportion of whiting did not apparently have an adverse effect on breeding success of Fair Isle Puffins, at Hermaness, Unst, Puffins in 1987 and 1988 brought in small loads of very small rockling and gadoids; chicks were found dead in this colony and breeding success was probably very low (Martin in press). It therefore seems likely that an increased dependence on whiting during chick rearing would ultimately result in a lower breeding success of Fair Isle Puffins.

Gannets on Fair Isle were more successful in 1988 than in the two previous years. This species feeds by plunge-diving so can exploit prey lower in the water column than either Kittiwakes or terns although it cannot dive as deeply as the pursuit-divers. It is also a much more efficient flier than the auks or Shag and has a potential foraging range in excess of 100

km which is considerably more than the estimated 30 km for auks and 15-20 km for Shags (Pearson 1968, Nelson 1978, Bradstreet & Brown 1985, Tasker *et al* 1987). The diet of Gannet chicks on Fair Isle was not sampled but it can apparently rear its young successfully on a wide range of fish species. Studies in Shetland and elsewhere have shown that the relative importance of sandeel, mackerel *Scomber scombrus* and herring can change over a period of years (Wanless 1984, Martin in press). The current recovery of herring stocks in the North Sea (Saville & Bailey 1989, updates from ICES Reports) is likely to be advantageous for the Gannet, which can take adult herring. It may, however, be detrimental to seabird species which depend on small sandeels as herring are major predators of sandeel larvae (Hardy 1924).

The biomass of spawning sandeels (i.e. 2 or more years old) around Shetland increased through the 1970s to a peak in 1984 and then declined; the decline in numbers of O-group sandeels was much more marked with a reduction of maybe 80% between 1982 and 1985 and the sparse data suggest that very few were present in 1988 (details in Kunzlik 1989). There is disagreement as to whether these changes are natural (Kunzlik 1989) or a result of the Shetland sandeel fishery (RSPB Press release, Shetland Fishing News). Some support for the former comes from the finding that Kittiwakes in many colonies as far south as the Firth of Forth were also less successful in 1988 than they had been in 1987 (pers. obs.). This suggests that the events recorded in Shetland were part of a more widespread phenomenon which was also apparent in areas without a human sandeel fishery.

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Hunting behaviour and attack success of a female Sparrowhawk between October 1987 and April 1988

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The hunting technique and attack success rate of a female Sparrowhawk were recorded at feeding stations being used to study the social interaction and foraging behaviour of Great Tits and Blue Tits. The bird was seen to use several hunting techniques but performances of the most frequently used method were highly stereotyped. A possible explanation for this stereotypy is discussed. The attack success rate was not significantly different from that found in previous studies.

Introduction

The range of hunting techniques used by wild Sparrowhawks *Accipiter nisus* was described only anecdotally (Owen 1932, Pounds 1936, Rudebeck 1950) until the tracking of radio-tagged birds by Newton (1986). This work revealed the use of a variety of hunting tactics but provided little information on the repertoire of individual birds.

Attack success rates are also little known. Brown (1976) stated that "more systematic observations are needed on this point" and the only quantitative data are those of Rudebeck (1950) who observed 190 attacks on potential prey by migrating Sparrowhawks, and Whitfield (1985) who recorded 33 attacks on coastal flocks of waders.

This paper presents data on the hunting behaviour and kill rate of a wild, female Sparrowhawk over a period of seven months.

Study Site and Methods

From October 1987 to April 1988, intensive observation of social interaction and foraging behaviour of a resident population of Great Tits *Parus major* and Blue Tits *P. caeruleus* was carried out at three feeding stations in gardens and deciduous woodland

at Ormiston Hall, East Lothian, Scotland. At each station, a wire-mesh peanut feeder was suspended 1 m above the ground on each of two poles positioned between 1.5 m and 3 m from the nearest cover. All three sites were within 200 m of each other. The sites were located as follows:

Site A Within an approximately square garden of 750 m², sheltered by walls 3-5.5 m high on three sides and containing several small shrubs and trees. No canopy was present but the walls, together with the trees that provided cover near the feeders allowed the Sparrowhawk to approach to within 6 m of the feeders without being seen by birds in the garden.

Site B In an open area with trees and small bushes. There was no canopy but the bushes near the feeders provided concealment for an approaching predator.

Site C In sycamore *Acer pseudoplatanus* woodland with scattered yews *Taxus baccata* providing cover at a lower level. A pile of dead branches which provided cover near the feeders could not conceal

an approaching hawk. However, even in winter the continuous cover of tree crowns may have provided some cover both for birds leaving the feeders and for an approaching bird of prey.

At site A observations were made from a permanent hide set into one of the walls of the garden, approximately 10 m from the feeders. At sites B and C a temporary hide was placed at a similar distance from the feeders at the start of each observation session.

During this fieldwork, a female Sparrowhawk, probably a first-year bird, was repeatedly seen hunting the birds at these feeding stations. The bird was watched closely on several occasions whilst it was perched in the garden. Although we cannot rule out the possibility that over the seven months of observations more than one bird was involved, on the occasions when it was seen well enough, the plumage details seemed consistent with one individual. The following data were recorded during each observation: site, date and time; the hunting technique employed, using the classification of Newton (1986); whether or not an attack was initiated (an attack was recorded if the Sparrowhawk changed its flight path or speed with respect to an apparent 'target' bird); the target species, and the success or failure of the attack. Newton divided hunting technique into:

Short-stay-perch-hunting (SSPH) A common technique in which the bird flies from perch to perch scanning its surroundings at each pause for up to several minutes. Between perches the bird flies low over the ground, thus concealing itself, so that the hunt can be converted to a full attack if vulnerable prey is seen. If the initial attack is unsuccessful the hawk may pursue its prey in a 'tail-chase'.

Stooping A rare technique in which the bird circles up to a height of over 100 m and then descends in a vertical stoop or

fast, downward glide. The bird does not flap its wings and does not attempt to conceal itself before grabbing its prey by thrusting its feet forward.

Contour-hugging flight (CHF) The bird flies fast and low making use of natural concealment such as woodland edges, banks, riversides and hedges. This is the most commonly seen hunting technique and may reflect detection of prey from up to a considerable distance since the bird is so frequently able to emerge from cover at precisely the right place to attack its intended victim.

Low quartering (LQ) The bird flies very slowly a few metres above the ground with its head angled down as though searching, and then, with legs extended, drops suddenly onto prey.

Statistical tests, denoted by superior figures are given in the Appendix.

Results

A total of 123 visits by the Sparrowhawk to a feeding station were witnessed; 111 were at site A, 7 at site B and 5 at site C. These represented hunting rates of 0.81, 0.10 and 0.23 hunts per hour of observation time, respectively.

Table 1 summarizes the data according to hunting technique, attack success and target species. At site A, the visual obstruction caused by the walls prevented the observer from distinguishing between CHF and SSPH as the means of approach to the site. Nevertheless, the flight-path once the garden was reached was very uniform. A last-minute upward swing, just clearing the wall and making the bird invisible from the garden for as long as possible was followed by a 'direct flying attack' (Newton 1986) at one of the feeders. This often ended in a kill attempt with the feet and legs extended and the bird turning on to its side as it passed the feeder. The bird's flight path was usually such that it entered the garden on a direct line to the feeders so that only

TABLE 1. Hunting technique, attack success and target species of a female Sparrowhawk. BT = Blue Tit, GT = Great Tit. Figures in parentheses indicate total number of 'dummy attacks' (see text).

Hunting technique *	Number of observations			Target species		
	Leading to attack		No attack	GT	BT	GT/BT
	Successful	Unsuccessful				
SSPH/CHF	11	43 + (11)	41	2	47	5
LQ	0	0 + (0)	6	0	0	0
Stoop	0	1 + (0)	0	0	1	0
SSPH/CHF followed by 'tail-chase'	1	3 + (0)	0	0	4	0
Unknown	1	2 + (2)	1	0	3	0

Note: * see text for full descriptions.

acceleration was required to convert the hunt into a full attack. At sites B and C, where no such convenient means of concealment exists, the 12 observations were distributed as follows: SSPH (6), LQ (4), CHF (1), unknown (1).

At site A, 106 observations were made where the hunting technique of the bird could be assessed. In 103 (97%) of these cases, the SSPH/CHF hunting flight was used. Overall, only 75 out of 123 (61%) hunts were converted into attacks and of these, 13 (17%) were successful. On at least 55 out of 75 (73%) occasions, the target of an attack was a Blue Tit, and 12 out of the 13 kills involved this species. In 13 out of 75 (17.3%) of attacks, there was no potential prey available in the garden either immediately before or during the passage of the Sparrowhawk, yet a complete flying attack was performed ending in a classic kill attempt at the unoccupied feeder. Excluding these 'dummy attacks', the success rate was 13 out of 62 (21%) attempts.

Discussion

Tinbergen (1946) and Rudebeck (1950) both suggested that little variation exists in the hunting behaviour of Sparrowhawks. In contrast, Newton (1986) describes seven broad categories of hunting technique and

four of these were used by the bird in this study. However, at the most frequently visited site, the bird developed a highly stereotyped hunting technique to the extent that it frequently performed complete attack flights even when it was clear to the observer that there was no potential prey at the site. Subjectively, it seemed that the bird was 'practising' or hunting on the 'off-chance'.

There is no reference in the literature to this degree of stereotypy in the hunting technique of a wild Sparrowhawk. However, a review of patterned and stereotyped behaviour by Fentress (1976) suggests that as the information processing load on an animal (i.e. the demands on the animal's 'attention') increases then two behavioural responses become more probable. Both reduce the processing demands of ongoing behaviour since they demand less processing capacity for performance and are relatively independent of sensory guidance. Firstly, previously established stereotyped behavioural sequences will occur and, secondly, current behaviour will become more stereotyped and immune to influence by environmental stimuli.

Examples of the first type of response are 'displacement' activities which occur when the animal is 'thwarted' by the absence of stimuli or is influenced by two or more conflicting sets of stimuli (Tinbergen 1952).

The second type of response is exemplified by cases where behaviour patterns become both autonomous and immune to external influence during rapid execution. Fentress (1976) gives examples from studies of voles and hunting dogs where rapidly performed movement sequences become more immune to sensory cues that play an important role during slower performance of the same motor pattern. Dawkins & Dawkins (1974) present analogous results from studies of pecking and drinking sequences in chicks and this type of response may also be analogous to the stereotyped hunting behaviour seen in the Sparrowhawk in this study. This bird may have initiated hunts at site A on the 'off-chance', without prior knowledge of the number of tits at the feeders, simply because the site regularly yielded prey. However, once initiated, the high speed SSPH or CHF hunting flights used may have placed sufficiently high attentional demands on the bird that only crucial external stimuli (e.g. the movement of a prey bird) were able to influence the course of the hunt. As an example of these attentional demands, Newton (1986) describes an incident where a juvenile Sparrowhawk was caught by hand whilst engrossed in an attempt to pull a Blackbird *Turdus merula* from a hedge. In contrast, a relatively mild inhibitory stimulus, in this case the apparent absence of a 'target' bird, might be insufficient to divert the bird from its stereotyped hunting flight. If this is true, then more leisurely hunting techniques such as LQ might not be expected to display stereotypy in their performance.

The failure of any of the six records of LQ to lead directly to an attack may reflect the use of quartering as a search strategy by the hawk (Morse 1973) rather than an attack technique as described by Newton (1986). Morse refers to the elicitation of high frequency alarm-calling (Hinde 1952) in tit flocks by a quartering Sparrowhawk and suggests that this means of prey detection may be used to determine the location of a subsequent attack. The fact that tits tend to remain in a behavioural 'freeze' for longer

after a Sparrowhawk flies over than after it actually attacks (Morse 1973) supports this idea.

A kill rate of 11% (of hunts) and 21% (of full attacks) is not significantly different from Rudebeck's (1950) total of 23 kills from 190 recorded attacks¹ (12%), or Whitfield's (1985) total of 7 kills from 33 attacks² (21%). The preponderance of Blue Tits in the total of 13 kills simply reflects their abundance relative to other prey species at the feeding stations. Rudebeck considered his data to over-estimate the true kill rate because he failed to record many unsuccessful attacks; he suggested 5% as being more accurate. In our study, the outcome of every attack was recorded and the observed kill rate seems genuine although as the data set is, we believe, based entirely on observations of one bird, the outcome of one hunt may not be independent of previous hunts at the same site.

All three studies were of Sparrowhawks hunting at sites with prolonged, high densities of available prey; Rudebeck's study involved large numbers of tired, grounded, passerine migrants at Falsterbo bird observatory; Whitfield's observations were of attacks on winter resident flocks of Turnstone *Arenaria interpres* and Redshank *Tringa totanus*, and this study is based on large numbers of Blue and Great Tits visiting repeatedly a high density, highly calorific winter food source (peanuts). It is the attraction of Sparrowhawks to these sources of unusually accessible prey that allowed repeated observations of hunting behaviour. This potential bias may mean that the above figures are an over-estimate of the kill rate over Sparrowhawk populations as a whole.

Acknowledgments

We are grateful to Dr N.P. Ashmole, Dr J.M. Deag and Dr D.P. Whitfield for comments on earlier versions of the manuscript. This work was carried out whilst J.D.W. was in receipt of a SERC postgraduate studentship.

APPENDIX. Results of statistical tests.

1. G-test: $G_1 = 0.58$, 1 d.f., $P < 0.40$.
2. G-test: $G_1 = 0.00004$, 1 d.f., $P < 0.90$.

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(Revised ms. received 27 February 1989)

Short Notes

Restricted winter range of a Merlin in west Galloway

It is stated in *BWP* (Vol. II) that male and possibly female Merlins *Falco columbarius* wintering in southern England may keep to restricted individual home ranges and show marked aggression towards other species there. No evidence for this behaviour was obtained from a study in west Galloway between 1965 and 1984 (Dickson, *BB* 81: 269-274). However in 1984/85 I did observe a brown Merlin which was apparently occupying a small range on the study area during the winter. This behaviour has not been noted subsequently.

The hunting range of c. 30 ha lay about 2 km from a small communal roost of Merlins to which this bird apparently returned at dusk. The range mainly comprised pasture with rough edges, rough pasture with rushes, and a stubble field. A flock of 300+ Skylarks *Alauda arvensis* overwintered in these fields, as did about 50 Meadow Pipits *Anthus pratensis*, 100 Chaffinches *Fringilla coelebs* and 100 Linnets *Fringilla cannabina* with other species such as Fieldfare *Turdus pilaris* occasionally present.

I made 32 visits on 22 dates between 23 December 1984 and 17 March 1985 and the Merlin, probably an adult female from the grey sheen on the lower mantle and upper tail feathers, was present on every occasion. It was not seen after 17 March 1985. It usually remained on its range until dusk and was once present 25 minutes after sunset.

Hunting flights were observed on 18 dates (Table 1). The most common hunting method (33 occasions) involved low, fast flights of c. 100 m from a perch or the ground at flocks of passerines just as they flew up. If the first attempt failed, it would sometimes suddenly twist and attempt to catch another bird. After an unsuccessful attack, the falcon would fly on for about 100-150 m before landing. By that time the prey species, after circling, would also be

preparing to land. The same hunting routine would then be repeated by the Merlin, sometimes soon after the earlier attempt.

On seven occasions, it chased passerines which had been flushed by a Hen Harrier *Circus cyaneus* and twice both species chased the same bird, unsuccessfully. On six occasions it was seen to stoop at birds in flight and once, to approach Skylarks on foot. It was also watched jumping from a fence post to strike at prey in the grass, and flying up from the ground in an attempt to catch a Meadow Pipit flying overhead. It was once seen apparently caching partly-eaten prey. G. Page & D.F. Whitacre (*Condor* 77: 73-83) noted a Merlin caching prey on four occasions in winter, once returning to eat it the next day.

TABLE 1. Number and frequency (%) of attacks on six prey species by a Merlin in west Galloway in winter 1984/85.

Species attacked	Attacks <i>n</i> (%)	Successful attacks <i>n</i>
Skylark	40 (81.6)	3-5
Linnet	3 (6.1)	0
Meadow Pipit	2 (4.1)	0
Chaffinch	2 (4.1)	0
Fieldfare	1 (2.0)	0
Lapwing	1 (2.0)	0-1
Totals	49	3-6

The Merlin showed aggression to Hen Harriers on four occasions, Peregrines *Falco peregrinus* on three occasions and Sparrowhawk *Accipiter nisus* once. It did not react to another Merlin flying across the fields once nor to Hen Harriers on 15 occasions, Peregrines on 10 occasions, Sparrowhawks on four occasions, Short-eared Owls *Asio*

flammeus once and Barn Owl *Tyto alba* once. Conversely, Hen Harriers were aggressive towards the Merlin on three occasions. Carrion Crows *Corvus corone* sometimes mobbed the Merlin as did a Common Gull *Larus canus* and two Lapwings *Vanellus vanellus*. Page & Whitacre saw a female Merlin chase other Merlins away from its hunting area on six occasions in California, but J.J. Craighead & F.C. Craighead (1969. *Hawks, Owls & Wildlife*. Dover, New York) considered that hawk winter ranges in

Michigan were undefended and conflicts there were exceptional.

The reasons for a winter range being occupied by a Merlin in west Galloway only in winter 1984/85 are unknown but the following factors may have contributed: January and February were exceptionally cold; prey was readily available and concentrated in a fairly small area all winter (although this is not an exceptional occurrence); the hunting area was close to a small communal roost.

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Siskins breeding in birch

Since publication of a short note on Siskin *Carduelis spinus* breeding in a Strathnaver birchwood (SB 14: 188), it has become apparent that this may be more established in the area than originally suspected, and therefore worth watching for elsewhere.

After discovery of the original nest in 1986, no attempt was made to find more. In 1987 the feeding station was kept supplied with nut bags as usual from April to July and an estimated minimum of six pairs visited them. From 1986 we noticed Siskins appearing more widely in the birchwoods of lower Strathnaver over a distance of approximately 12 km, and by spring 1988 we were seeing them in all birchwoods visited there.

In 1988 no nut bags were provided between early May and mid-June. On 17 June a nest was located near the top of a 7 m birch 30 m from the feeding station.

The eggs hatched on 26 June, so nesting was initiated at a time when the birds could not have been dependent on the food we provided. It also seems likely that more distant birds observed were outwith its influence. When the feeding station resumed operation on 15 June two males and one female were feeding on the nuts within an hour, and within 48 hours at least three males and six females had been seen. At the nest, the male fed green matter, which was clearly not peanuts, to the sitting female.

Siskins usually nest in pinewoods. Our recent observations of Siskins in the Strathnaver birchwoods in spring, at the feeding station in April to July and of two nesting pairs suggest that several pairs are now resident and nesting in these woods, and that they feed opportunistically rather than depend upon the food we provide.

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Gannets breeding on mainland Scotland

Troup Head is located 14 km east of Banff on the southern side of the Moray Firth. The main colonies of breeding seabirds are spread along 4 km of seacliff composed of metamorphic sandstone and conglomerate which rises to a height of c.110 m.

The first reported sighting of prospecting Gannets *Sula bassana* was in 1986 when birds were seen patrolling the cliffs. As far as we know nobody visited the site in 1987. On 9 May 1988 there were 24 Gannets on the ledges. Both adult and sub-

adult birds were present and some were apparently paired and occupying nests. On 29 July four chicks, estimated to be five weeks old were seen. By 5 September all four chicks were well on the way to fledging, one had lost most of its down, the other three were still partially covered with down.

Most of the Gannets occupied a single long ledge about 30 m above sea level, the remainder occupied smaller adjacent ledges. They may have displaced Guillemots *Uria aalge* because there is a dense Guillemot colony below the ledges and in early May Guillemots were present on the main ledge amongst the Gannets. The structure of the cliffs does not appear suitable for a substantial increase in Gannet numbers in the

immediate vicinity because there are only a few broad ledges on the cliff and these are scattered.

The only other colony of Gannets breeding on the British mainland is at Bempton in North Humberside. Here, too, Gannets have displaced Guillemots, and the colony is fragmented. All the other Scottish gannetries are on offshore islands, the three nearest to Troup Head being the long-established one at Bass Rock 175 km to the south, and to the north the Sule Stack colony 185 km away and the recently established Fair Isle colony 210 km distant.

We would like to thank M. Tasker and S. Wanless for assistance with field work.

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Red-necked Grebe breeding in Scotland

On 12 June 1988, a pair of Red-necked Grebes *Podiceps grisegana* was seen courtship-displaying (calling with head-bobbing and preening) in a secluded bay on an inland Scottish water. A single bird had been present earlier. On 14 June one adult was sitting on a nest platform and from time to time it left the nest and dived for green weed which it added to the nest. The nest had originally been built by a pair of Great Crested Grebes *Podiceps cristatus* which hatched three young towards the end of May.

Both Red-necked Grebes were nest-building on 18 June and at 1500 GMT next day there was one egg. At 0830 GMT the following morning the nest contained two eggs, one a fresh pale blue and the other stained which suggested that incubation had started. Everything appeared normal a week later on 26 June but when the nest was revisited on 30 June to determine the full clutch, it was empty. Only one adult was seen and it too had apparently left by 3 July.

The nest was in one metre of water on branches of straggly goat willow *Salix caprea* backed by mature trees and reed canary grass *Phalaris arundinacea* along the

water's edge. Like the original Great Crested Grebe nest, it was constructed of amphibious bistort *Polygonum amphibium* and water-milfoil *Myriophyllum* sp. The nest was well concealed by the willow and appeared to be fairly safe from avian and most mammalian predators. However on 3 July a dead half-grown mink *Mustela vison* was found 200 m away and in all probability mink were the cause of the nest failure.

This appears to be the first breeding record for Scotland. It follows records of summering birds in the same general locality in recent years. In 1980 a pair built a nest but did not lay. At least a single bird has been present on the same water every year since then, but there was a pair in 1983 and a pair with a single bird in 1985. In both these years the pairs were seen courtship-displaying and may have attempted to nest although this was not proved.

This record has been submitted to the Rare Breeding Birds Panel. For reasons of security the authors requested that their names be withheld from this note. Readers are reminded that a licence is required from the Nature Conservancy Council to visit the nests of Schedule 1 species. Ed.

Goosanders feeding on carrion

Goosanders *Mergus merganser* are large, agile, predatory ducks that mainly feed by pursuing small fish which they eat whole. In Scotland the diet can be varied but in most situations is dominated by juvenile salmonids (Mills, D.H. 1962. *Freshw. and Salm. Fish. Res.* 29. HMSO, Edinburgh). From 96 stomachs Mills recorded 331 fish of which 71% were juvenile salmon *Salmo salar*. The largest fish was a 31 cm pike *Esox lucius* which must have been near the upper limit for fish that could be consumed whole by Goosanders. The incident we describe below documents Goosanders eating a very large dead fish.

On the 16 March 1988 two adult drake Goosanders were watched feeding on the carcass of a salmon as it floated down the River Ness beside Inverness. The fish was estimated from its size to weigh c. 3 kg and was red in colour. The river was in spate after heavy overnight rain and the incident occurred immediately above the upper limit of the tidal reach. Both ducks picked and tore flesh from the fish as it lay on the surface, and they dived to do likewise whenever it was submerged as it rolled in the current.

About 10 Black-headed Gulls *Larus ridibundus* were attracted to the scene, but were kept away from the fish by the Goosanders which made threatening gestures whenever the gulls came within reach. The gulls did, however, pick up some scraps that were torn from the carcass by the ducks but which had dropped and floated downstream.

Large numbers of adult salmon die in Scottish rivers but we can find no previous record of Goosanders eating them. The ducks may have been hungry if, for

example, live fish had been difficult to catch with the river in spate. Something similar might have occurred on the River Dee, Aberdeenshire. The stomachs of nine Goosanders shot there in late April 1987 were examined: two, from drakes, contained very large salmonid vertebrae which, to judge from their size, came from salmon over 4 kg in weight; one, from an adult female, contained rabbit *Oryctolagus cuniculus* fur and large pieces of bone which could also have been taken along with flesh from a carcass in the river (M.J. Feltham pers. comm.).

Similar behaviour has been recorded in North America. Common Mergansers *M.m. americanus* gorge themselves on frozen, rotten fish in spring when live fish are difficult to obtain (Bent A.C. 1962. *Life Histories of North American Wildfowl*. Dover, New York). Salmon carrion is also recorded being eaten in North America by Mallard *Anas platyrhynchos*, Green-winged Teal *A. crecca carolinensis*, American Goldeneye *Bucephala clangula americana* (Bent 1962), Blue-winged Teal *A. discors*, Bufflehead *B. albeola* (Taverner P.A. 1938. *The Birds of Canada*. National Museum of Canada, Ottawa) and American Pintail *A. acuta* (D.N. Weir pers. comm.). There are records for two Western Palearctic duck species, Ruddy Shelduck *Tadorna ferruginea* and Mallard eating carrion, and three species, Scaup *Aythya marila*, Long-tailed Duck *Clangula hyemalis* and Eider *Somateria mollissima* eating dead fish (*BWP* Vol. 1) but no previous reference to sawbills eating salmon carrion in Britain.

We would like to thank M. Marquiss and D.N. Weir for comments on a draft of this note.

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The summer flocking of juvenile Starlings

In his monograph of the Starling *Sturnus vulgaris*, C.J. Feare (1984. *The Starling*. OUP) mentions an ecological separation between adults and juveniles in July and August; flocks feeding in trees were mainly juveniles whilst adults predominated in flocks feeding in grass fields. This could be associated with the fact that the juveniles are much less efficient at taking animal prey on the ground (Stevens, J. 1985. *Ibis* 127: 341-347). In central Scotland, I have noticed an even more dramatic segregation from June onwards when large flocks of juvenile Starlings, frequently unaccompanied by adults, appear on the upland grasslands often 10 km from major breeding areas. This phenomenon was not mentioned by Feare (1984) and, although probably familiar to many observers, there appears to be little mention of it in the literature. There is a statement in the *Popular Handbook of British Birds* that "As a rule it scarcely ascends above the limit of cultivation, though sometimes ranging up on to the high moors and pastures in autumn and winter", but this is misleading. The following note summarizes what published material I have traced and adds some detailed records of my own.

E.V. Baxter and L.J. Rintoul (1953. *The Birds of Scotland*. Oliver & Boyd, London) write that "small flocks, mainly composed of young birds, may be seen as early as the first week of June, wandering irregularly about the country". There is very similar comment by T.A. Coward (1969. *Birds of the British Isles and Their Eggs* (Barnes Edition). Warne, London). In neither case is the point made that these flocks extend their feeding range to upland areas distant from breeding areas. V.M. Thom (1986. *Birds in Scotland*. Poysler, Calton) notes that 7000 birds in a July roost in upland Peebles were almost entirely young birds. The formation of flocks of juveniles is certainly widespread since G.P. Dement'ev and N.A. Gladkov (1954. *Birds of the Soviet Union* Vol V. Israel Program

for Scientific Translations, Jerusalem) comment on it for several localities in European Russia.

I have found three unambiguous reports of the movement of juvenile Starlings to hill regions. C. Oakes (1953. *The Birds of Lancashire*. Oliver & Boyd, London) reports "Large flocks feeding on the hills after the breeding season normally contain a high proportion of birds in juvenile plumage, and in some instances, so far as examination will allow, flocks of many hundreds consist wholly of juveniles". B. Galloway and E.R. Meek (1983. *Northumberland's Birds* Part 3. Natural History Society of Northumbria) note "From late June onwards gathering and roosts of locally bred birds develop, often in the uplands. On 13 July 1947, for example, a flock of some 10,000 was watched on a Cheviot hillside". Finally, M.E. Massey (*Bird Study* 25: 167-174) found that Starlings were non-breeding midsummer visitors to a Welsh moorland at over 366 m, with a peak of 3000 juveniles in one flock; he further noted that this phenomenon was common in upland areas in south Powys.

My records are from various sites in the Ochil Hills, central Scotland. There are very extensive slopes at altitudes mainly between 300 m and 600 m which are heavily grazed by sheep and hence the vegetation is predominantly grassy. Heather *Calluna vulgaris* is limited to peat hags or to lower and flatter areas maintained for grouse shooting. The records in order of date through the summer are:

15 June 1978. 600 birds (85% juvenile) at c.300 m.

24 June 1976. 50 at 250 m on rough grass.

26 June 1978. 2000 at c.500 m. This was during a plague of antler moths *Cerapteryx graminis* which was also exploited by hundreds of Rooks *Corvus frugilegus* and Lesser Black-backed Gulls *Larus fuscus*.

11 July 1976. 450 juveniles at 540 m on mixed short and rough grass.

14 July 1985. 300 juveniles at c. 350 m.

The exploitation of antler moth caterpillars is a long-standing habit since H.S. Gladstone (1910. *The Birds of Dumfriesshire*. Witherby, London) noted that thousands of Starlings visited the pastureland at Eskdalemuir in June 1885

when an antler moth plague was at its height.

In conclusion it seems that 1) upland areas throughout Britain are visited in midsummer by Starlings that breed elsewhere, and 2) there is often a striking segregation of age classes with a great predominance of juvenile Starlings. This situation has not, so far as I am aware, been clearly reported for any other species of British passerine.

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Male-biased sex ratio in Pied Wagtails wintering in Highland Region

Most of the Pied Wagtails *Motacilla alba yarellii* which breed in the north of Scotland move south in autumn to spend the winter mainly in southern England (Davis, P. 1966. *Bird Study* 13: 147-162). However some, perhaps no more than a few hundred, spend the whole of the non-breeding season in Highland Region (Lack, P. 1986. *The Atlas of Wintering Birds in Britain and Ireland*. Poyser, Calton). We describe here evidence that these locally overwintering birds are predominantly males and probably mainly adults.

We sexed Pied Wagtails in the field by the coloration of the back, males being either black or black with some dark grey, while females are grey or grey with some dark grey. The sexes of the birds we have seen in Highland Region between November and February in 1983-88 are summarized in Table 1. In Caithness all those we were able to sex were males, though the sample was small. It is difficult to assess the age of Pied Wagtails in the field but those seen at close quarters which showed no contrast between the inner and outer greater coverts were taken to be adults (Svensson, L. 1984. *Identification Guide to European Passerines*, 3rd edn., Stockholm). All the Caithness birds had uniformly dark backs and a generally clean-cut appearance and so most, if not all, were probably adults.

The most detailed observations were

made at a roost in Inverness at the Rose Street multi-storey car park in the town centre after the birds had entered for the night. Despite the rather poor illumination provided by the artificial lights all except the occasional individual which kept to the shadows could be sexed with confidence. Although some females were identified here most birds were males. From their generally clean-cut appearance we judged that many of the birds were adults, but could not always be certain. On 28 February 1987, 34 individuals, about half those in the roost, were caught in a mist net. Of these 9 (26%) were first-year males, 15 (44%) were adult males, 3 (9%) were first-year females and 7 (21%) were adult females, giving a male/female ratio of 2.4:1 and an adult/first-year ratio of 1.8:1. The probability of the difference from a 1:1 sex ratio occurring by chance was about 7% for first year birds and for adult birds considered separately, and less than 2% (highly significant statistically) for first year and adult birds combined (Binomial tests). Three further mist-netting sessions were carried out here in March and April 1988 by IRKM and A.D.K. Ramsey, and again males outnumbered females by about 2:1 (Table 1). Nine (26.5%) of the 34 individuals caught in 1987 were retrapped in 1988, indicating a high roost site fidelity between seasons.

The sex ratio of Pied Wagtails in the

TABLE 1. Sex of Pied Wagtails wintering in Highland Region.

Date	Location	Sex			Comments
		♂	♀	?	
CAITHNESS					
9 Feb 84	Dounreay	1			
19 Nov 85	"	3			At roost
27 Nov 85	"	4			At roost
29 Dec 85	Thurso	1			
4 Jan 86	Scrabster	1			
27 Feb 86	Dounreay	1			
9 Jan/27 Feb 87	"	1			
INVERNESS					
29 Nov 86	Inverness	36	1	3	At roost
21 Feb 87	"	50	15		At roost
28 Feb 87	"	24	10		Caught at roost
11 Nov 87	Dalcross	1			
11 Nov 87	Inverness	1			
25 Nov 87	"	1			
16 Dec 87	"	10	3		At roost
17 Dec 87	"	1			
19 Dec 87	"	1	1		
28 Dec 87	"		1		
25 Jan 88	"	1			
7 Mar 88	"	30	15		Caught at roost
23 Mar 88	"	24	12		Caught at roost
7 Apr 88	"	11	2		Caught at roost

breeding season is approximately even and this is true also of those wintering, for instance, in Avon and Gloucestershire (R.M.S., unpublished). Overwintering in Highland Region by Pied Wagtails is presumably possible only in sites with access to a reasonably assured food supply and which avoid the worst extremes of the weather. *The Winter Atlas* shows the winter distribution in the Highlands to be mainly on low ground around the Moray and Beaully Firths. This is generally the mildest and most snow and ice-free part of the

Region. The advantages of remaining in Highland Region are presumably that a) the costs of migration to southern England are avoided, and b) there is ready access to the prime breeding sites either by holding territory on them throughout the winter or by returning to them sooner than birds which have overwintered further south.

We thank National Car Parks for permission to catch birds on their property and Andrew Ramsey for making available details of the birds mist-netted in 1988.

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Desmond Nethersole-Thompson 1908-89

Desmond Nethersole-Thompson died at Culrain on 2 March 1989, eight days short of 81 years. He was one of the most outstanding field ornithologists ever to work in Scotland.

His ornithological achievements are best understood with some appreciation of his unusual character. A large man in height and stature, he instantly drew people's attention because of his expressive face, sharp eye, and rich oratorical voice. He was a romantic, a visionary, and a competitive trophy hunter, all traits characteristic of our best explorers. It is probably incidental that his exploratory field was ornithology. His drive and determination led him into helping fashion a restructured and illuminated new area of field ornithology where long-term observations of behaviour and good field craft were paramount. They also led him into an opinionated presence in society, often on the side of the underdog, and into two marriages, both of which helped sustain him in his work. He was an unusual man; in some ways a great one.

A fiery temperament at times led him into controversy and breaking of social convention. Sometimes egotistical and impulsive, he did not always appreciate honestly held opinions that might differ from his purpose. Yet to most people he was warm-hearted and considerate. There was also a pensive, solitary side to him. He was even obsessive. He said you had to be to find many nests of Greenshank, Dotterel and Snow Bunting in Scotland, and I agree with him. These varied traits helped make it possible to meet the ornithological challenges that he set himself. Some individuals were hurt in the process but the wider world has benefited from his work.

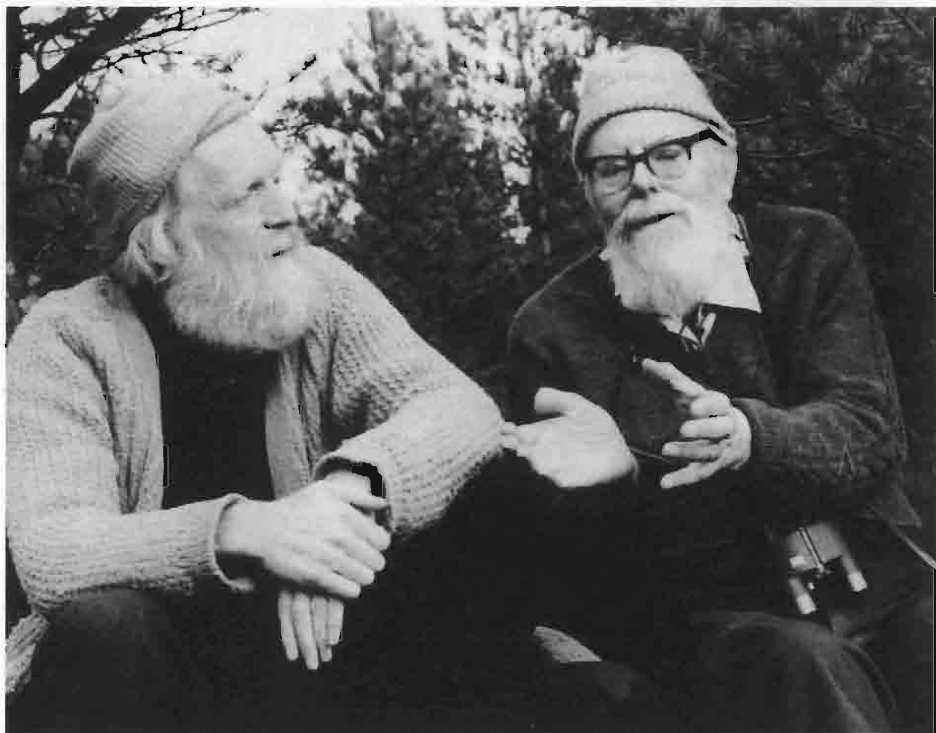
Of Irish descent but brought up in Lincolnshire, he was educated at St Paul's School and the London School of Economics. The old naturalists and egg collectors influenced him greatly, and he became an egg collector too. He described his early nest

hunting well in Chapter 1 of his book *The Snow Bunting*.

On vacation in 1933 he went to Rothiemurchus, where he met Carrie of Whitewell, a skilled nest finder who had shown nests to Francis Jourdain. He also had his first, but not last, experience of being hounded by the local laird, who on this occasion ordered him to leave at once or be run out by every gamekeeper and policeman in Speyside! Fortunately for Highland ornithology this was no match for the Nethersole-Thompson determination. In his own good time he returned to his schoolmaster's job in England, but in April 1934 rejoined Carrie in her quest to find a Snow Bunting's nest. That summer they camped on the high tops, studying Snow Buntings, Dotterel and Ptarmigan. He decided to stay in Speyside with Carrie, fired by a desire to study the Highland birds, and the rarer they were the bigger the challenge.

Their pioneering field work in the 1930s was done in isolation and without grants. They had no ready access to libraries or to discussion of their work with colleagues. Camping equipment and food were heavy. To continue the studies even in poverty, he had to sell some clutches to egg collectors in the 1930s. This illegal cropping was put to extra use by studying replacement clutches and their success. He openly wrote in his books that he had been an egg collector. In later decades, long after he had stopped taking eggs, many people type-cast him with this. Egg collecting had become unfashionable and a nuisance to serious study, but we should remember that fashions change and that many of today's ornithologists started by collecting eggs while schoolchildren.

The first time I became aware of him was in *The Handbook of British Birds*. Much of it comprised plumage descriptions of museum specimens, but there were also notes of a very different sort on habitat, territorial and sexual display, calls, incub-



Desmond Nethersole-Thompson (right) with Adam Watson recording a radio broadcast in Ardgay Wood in December 1982. Photograph courtesy of Chris Lowell.

ation and fledging periods. Notes attributed to D.N.-Thompson excited me most. He was a pioneer in field ornithology. Admiring the field craft of the old naturalists and egg collectors, he also brought a restless questioning of Nature, which was evident in such contemporaries as Frank Fraser Darling, David Lack and Julian Huxley. Sponsored by Huxley, he received a Leverhulme Research Fellowship in 1940-42. Carrie Nethersole-Thompson and he wrote an innovative paper on "Egg-shell disposal by birds" (*BB* 35), and in 1943 on "Nest-site selection by birds" (*BB* 37).

In 1942-47 he was an Irish volunteer to the British army and attained the rank of Captain. David Lack told me that during an exercise on difficult terrain in pitch darkness, Nethersole-Thompson was the only one who

completed it on time and undetected.

When a schoolboy in 1946 I went to Whitewell to see him, and also met Carrie and the family. We all shared a deep interest in the Cairngorms and their birds. He later wrote *The Greenshank* as a New Naturalist monograph (1951). Most of his work remained unpublished, however, as politics increasingly took up his time. After defeating the laird's wife as County Councillor for Rothiemurchus in 1945, he served on the council till 1964, was Labour Parliamentary candidate for Inverness-shire in 1950 and 1955, Chairman of Badenoch District Council in 1952-55, and Vice-President of the District Councils Association, Scotland, in 1957.

By this time, he had given up egg collecting and in the early 1950s the RSPB

employed him as their warden in Speyside. Before the Cairngorms National Nature Reserve was formed in 1954, he specified in a far-sighted report (1952. *Survey of the Birds of Rothiemurchus Forest and the Western Cairngorms*. Unpubl. report to the RSPB and the Nature Conservancy) which parts of the high tops and forest were best for birds and should be given the strongest protection. He protested strongly when most of these parts were left out of the Reserve. His rebellion was disliked by the bird Establishment, and between the early 1950s and early 1960s he was ostracised except by a few steadfast friends, of whom I was one. Later events have proved he was right about the Cairngorms, and his recommendations will be remembered when most of his critics on the issue are long forgotten.

He started a second family in the late 1950s in Sutherland, with Maimie. He readily acknowledged her influence in persuading him to quit politics and publish his past bird observations, and indeed the later publications would not have appeared without her unstinted assistance. He began a new study of Greenshanks in Sutherland, and the family helped with it. Three of them have since taken up ornithology professionally. Major essays and many notes were contributed to David Bannerman for his volumes on *The Birds of the British Isles* (1953-63). After *The Snow Bunting* monograph (1966), the bird Establishment began to accept Desmond Nethersole-Thompson again. In 1967-82 he received NERC grants for writing up his past studies and for the new Greenshank research. Monographs appeared on *The Dotterel* (1973), *Pine Crossbills* (1975), and, with Maimie Nethersole-Thompson, *Greenshanks* (1979) and *Waders* (1986). He wrote *Highland Birds* (1971), and combined with me on *The Cairngorms, their Natural History and Scenery* (1974).

In the early 1960s, many Peregrine Falcon eggs were found broken in the nest. Organo-chlorine pesticides were implicated and at first it was thought that these chemicals had caused abnormal changes in

the birds' behaviour so that they deliberately broke their own eggs. In discussion with Derek Ratcliffe, Desmond proposed instead that the shells might have become thinner and unable to bear the birds' weight. He suggested that measurements of egg-shells in collections would show whether shells were thicker before the introduction of organo-chlorine pesticides. This key idea proved of great importance in demonstrating internationally how pesticides had affected predators.

Nests, eggs and breeding behaviour fascinated him, and his publications show this clearly. He generally spent little time on what birds did outside the breeding season, but a notable exception was the early paper by Carrie and him on territorial behaviour and sexual display in Red Grouse (1939. *BB* 32: 247-254). For studying behaviour, he firmly believed in "arsing", sitting in one spot, immobile, for hours. "Legging" was a derogatory term he used for those who were so impatient and walked so fast that they found no nests and saw little of behaviour! Most times that I was with him in the field, he chose a spot with not a bird in sight or sound. We sat, often until cold and wet numbed us but then, nearly always, a bird appeared and did something that neither of us had seen before; his interpretations led to more observations, and we came off the hill elated.

The Royal Society of Edinburgh awarded him their Neill Prize in 1977-79, "for his distinguished ornithological work in Scotland over the past thirty years", and in 1983 the University of Aberdeen gave him the degree of honorary DSc. The day before he died, he received news that he had been made an Honorary Fellow of the Royal Zoological Society of Scotland.

Primarily a naturalist rather than a scientist, he had qualities which many scientific ornithologists lack – careful field craft, great persistence, excellent memory, and a belief that effective writing and speaking are much harder tasks than simply passing on information. Having written a book with him, I know he was better at

working hard and meeting deadlines than many scientists.

Although he denounced the pompous and pretentious, he always gave time and encouragement to those who were not well known. Sometimes prickly and irascible, he was always contemptuous of spineless attitudes, often fumed about politicians and brash tourist developments, and reacted angrily to those who undervalued his contributions. In later life he remained an entertaining conversationalist with a pungent wit, and poked humorous sarcasm and nicknames when referring to others.

He was a skilled communicator with people of all ages and walks of life, and also carried on much correspondence with ornithologists in many countries. An unusual characteristic was his ability, on seeing someone after a long absence, to pick up

and review the lines of discussion from the past. This recall was astonishing and warming. Another characteristic was the undivided attention he gave to anybody who was speaking to him. The conversation would usually turn to birds, and he then showed a deep interest, curiosity and enthusiasm.

The main achievement for which Desmond Nethersole-Thompson has already been acclaimed is the completion of four detailed species monographs based mainly on his own field observations and interpretations. Those who knew him well would consider no less important his influence and enthusiasm in stimulating and encouraging many younger naturalists. This will live on through his writings.

Adam Watson

Items of Scottish Interest

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

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

Scientific papers

- Anderson, G.I., Morrison, A., Jones, M. & Wanless, S. 1988. Isle of May National Nature Reserve summer wardens' report for 1988. Nature Conservancy Council, SE Scotland Region (42 pp). Includes detailed seabird and wader counts.
- Anker-Nilssen, T., Hope-Jones, P. & Rostad, O.W. 1988. Age, sex and origins of auks killed in the Skagerrak oiling incident of January 1981. *Seabird* 11: 28-46. About 55% of the Razorbills were of the form *islandica* and were probably from Scotland, but possibly the Faeroes.
- Bain, C. & Bainbridge, I. 1988. A better future for our native pinewoods? *RSPB Conservation Review* 2: 50-53.
- Bell, M.V. 1988. Feeding behaviour of wintering Pink-footed and Greylag Geese in northeast Scotland. *Wildfowl* 39: 43-53. A study covering nine winters.
- Bignal, E.M., Curtis, D.J. & Matthews, J.L. 1988. Islay: Land types, bird habitats and nature conservation. Pt.1: Land use and birds on Islay. Nature Conservancy Council, CSD Report no. 809 (257 pp).
- Bourne, W.R.P. 1988. Herring Gull and Lesser Black-backed Gull nesting in Rosyth Dockyard. *Sea Swallow* 37: 65.
- Bryant, D.M. 1988. Lifetime reproductive success of House Martins. Pp. 173-188 in *Reproductive Success: Studies of Individual Variation in Contrasting Breeding Systems* Clutton-Brock, T.H. (Ed), Univ. Chicago Press. A study in the Central Region of Scotland.
- Cadbury, C.J. 1987. Moorland birds – Britain's international responsibilities. *RSPB Conservation Review* 1: 59-64.
- Campbell, L.H., Bird, D.R., Suddaby, D. & Ellis, P.M. 1988. Breeding waders on croft and farmland in Shetland, 1987. Nature Conservancy Council, CSD Report no. 791 (65 pp). A study by the RSPB.
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- Davies, M. 1988. The importance of Britain's Twites. *RSPB Conservation Review* 2: 91-94. Describes the two separate populations of Twites in Britain, the Scottish and Irish birds which move very little, and a population in the southern Pennines of England which winter in the Low Countries.
- Dennis, R.H. 1987. Boxes for Goldeneyes: a success story. *RSPB Conservation Review* 1: 85-87. Describes their recolonisation of Scotland.
- Dennis, R.H. 1987. Osprey recolonisation. *RSPB Conservation Review* 1: 88-90. The number of breeding pairs in Scotland increased from 1 in 1954 to 43 in 1986.
- Dobson, R.H. 1988. The natural history of the Muck Islands, North Ebeudes. Pt.5 Landbirds. *Glasgow Nat.* 21: 407-422. Seabirds and wildfowl were dealt with in Pt. 3 (1986).
- East, M. 1988. Crop selection, feeding skills and risks taken by adult and juvenile Rooks. *Ibis* 130: 294-299. A study on agricultural land at Culterty Field Station, near Aberdeen.
- Ewins, P.J. & Kirk, D.A. 1988. The distribution of Shetland Black Guillemots outside the breeding season. *Seabird* 11: 50-61. Most Shetland birds form moulting flocks in local inshore waters, but some Foula and Fair Isle birds move considerable distances.
- Fowler, J.A. & Hodson, D. 1988. The Mallophaga of Leach's Petrels from North Rona, Scotland. *Seabird* 11: 47-49.
- Galbraith, H. 1988. Effects of egg size and composition on the size, quality and survival of Lapwing chicks. *J. Zool. London* 214: 383-398. This paper and the three that follow were based on studies in the Carse

- of Stirling, Scotland between 1984 and 1986.
- Galbraith, H. 1988. Adaptation and constraint in the growth pattern of Lapwing chicks. *J. Zool. London* 215: 537-548.
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- Gibson, J.A. 1987. The 1985 census of Gannets on Ailsa Craig. *Scott. Nat.* 1987: 49-52. An annual census of Gannets on Ailsa Craig has been made by the author since 1950.
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- Love, J.A. 1988. The reintroduction of the White-tailed Sea Eagle to Scotland 1975-1987. Nature Conservancy Council, Peterborough (No. 12 in their Research and Survey in Nature Conservation series). £4.00*.
- McNish, W.J. 1987 (1989). Threave Wildfowl Refuge. *Trans. Dumfriesshire and Galloway Nat. Hist. & Antiq. Soc.* 62: 5-8. Includes a list of birds seen on the Threave estate on the river Dee.
- Mayhew, P. & Houston, D. 1989. Feeding site selection by Wigeon in relation to water. *Ibis* 131: 1-8. This was part of a study over three winters at Caerlaverock on the Solway Firth where up to 800 Wigeon regularly winter.
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- Zonfrillo, B. 1988. The feather louse *Halipeurus gravis gravis* from a Sooty Shearwater in Scotland. *Seabird* 11: 17-18.
- Shetland, especially Arctic Terns, Kittiwakes, Great Skuas and Arctic Skuas.

Bird Reports

Argyll Bird Report for 1987 and 1988. (c.80 pp) C.A. Galbraith (Ed) 1989. c. £3.50*.

Arran Bird Report for 1987. (14 pp) Margaret Dunn (Ed) 1988. £1.00*.

Borders Bird Report for 1987. (80 pp) R.D. Murray (Ed) 1988. £3.00*. Includes a detailed 19 pp account of the 1987 census of sawbills and river birds in the basin of the river Tweed with nine distribution maps.

Canna Bird Report for 1987 and 1988. (16 pp) R.L. Swann & A.D.K. Ramsay (Eds) 1988*.

Clyde Birds, incorporating the Clyde Bird Report for 1987. (90 pp) I. P. Gibson (Ed) 1988. £3.00*. This new journal revives the earlier *Clyde Area Bird Reports* which covered 1973 to 1981, but now excludes Ayrshire, Arran and Bute. It includes special articles on the breeding wildfowl of Loch Lomond, and on a Sand Martin survey. Reports for 1982 to 1986 are in preparation.

Fair Isle Bird Observatory Report for 1988. (74 pp) N. Riddiford (Ed) 1989. £3.00*.

Fife and Kinross Bird Report for 1987. (40 pp) D. Dickson (Ed) 1988. £2.00*.

Forth Islands bird counts in 1988. R.W.J. Smith 1989. *Edinburgh Nat. Hist. Soc. J.* 26-27.

Moray and Nairn Bird Report for 1987. (48 pp) M. Cook (Ed) 1988. £1.00*. Includes an article on the large movements of Little Auks in Nov/Dec 1987.

Northeast Scotland Bird Report for 1987. (59 pp) M.L. Tasker (Ed) 1988. £2.00*. Includes articles on coastal wintering shorebirds, and on wintering wildfowl at Loch of Skene.

North Sea Bird Club Report for 1986. (87 pp) A. Anderson (Ed) 1988. £2.50*. Includes a 30-page systematic list of birds reported from 19 oil production platforms in the North Sea, and a report of an auk (probably a Razorbill) swimming at a depth of 140 m seen from a submersible.

Scottish Bird Report for 1987. (55 pp) Angus Hogg (Ed) 1988. £3.00*.

W.G. Harper

Multi-paper reports

RSPB Conservation Review 1987. Cadbury, C.J. & Everett, M. (Eds) 1987. Royal Society for the Protection of Birds, Sandy (96 pp). £3.00*. Includes 19 special topics, mainly on the work of the Society.

RSPB Conservation Review 1988. Cadbury, C.J. & Everett, M. (Eds) 1988. Royal Society for the Protection of Birds, Sandy (104 pp). £5.00*. Covers 21 special topics.

Seabirds and Sandeels: Proceedings of a Seminar held in Lerwick, Shetland, 15-16 October 1988. Heubeck, M. (Ed) 1989. Shetland Bird Club: 81 pp. Martin Heubeck and the Shetland Bird Club are congratulated on the speed with which these Proceedings have been published. The conference was held after the almost complete breeding failure of many species of seabird in

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