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The **Scottish Ornithologists' Club** was formed in 1936 to encourage all aspects of ornithology in Scotland. It has local branches which meet in Aberdeen, Ayr, the Borders, Dumfries, Dundee, Edinburgh, Glasgow, Inverness, New Galloway, Orkney, St Andrews, Stirling, Stranraer and Thurso, each with its own programme of field meetings and winter lectures. The Waterston Library at the Club's headquarters at 21 Regent Terrace, Edinburgh EH7 5BT is one of the most comprehensive ornithological libraries in Scotland, and is available for reference during office hours (Monday to Friday 9.00am to 5.00pm.). A comprehensive stock of Scottish local bird reports is held at the headquarters and may be purchased by mail order.

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East Greenland Barnacle Geese in Scotland, spring 1988

A.D. FOX, M.A. OGILVIE,
N. EASTERBEE AND E.M. BIGNAL

The East Greenland population of Barnacle Geese, which winters in northern and western Scotland and western Ireland, was censused by combined ground counts and aerial survey in late March 1988. The Scottish component of the population had increased since the last census, in 1983, from 20,820 to 26,950. This 29% increase had taken place solely at the main haunt, Islay (15,245 to 20,292). A 71% increase in Ireland has taken the total population from 26,467 in 1983 to 34,544 in 1988.

Protection under the Wildlife and Countryside Act 1981 has been the main reason for the increase. Elsewhere in Scotland the distribution, scattered over 34 different islands, showed some marked changes, in particular a decline in the Outer Hebrides and an increase on the islands off the north and west coasts. These changes are discussed in relation to the amount of sheep grazing and suitable grassland on these islands. Photography was used to verify many of the aerial counts, and revealed an acceptable level of accuracy.

Introduction

The three populations of Barnacle Geese *Branta leucopsis* breeding in arctic USSR, Svalbard and East Greenland winter respectively on the North Sea coasts of Continental Europe, the Solway Firth (Scotland/England) and in north and west Scotland and western Ireland. Extensive marking with individual leg rings and conventional metal rings has shown virtual separation of the three populations, with just a handful of birds in any year moving from one to another (Ogilvie & Owen 1984).

Censusing of the three populations is most easily done in winter, the Arctic breeding areas being extensive and of varying accessibility. Wintering populations on the Continent and on the Solway are concentrated and regular counts can be made. The third population, from East Greenland, is highly scattered in winter, from Orkney in the northeast of Scotland to the Blasket Islands, in Co. Kerry, southwest Ireland. Although the majority of the population winters on the island of Islay, birds have been found at over 100 different haunts within this extensive range, all but a few being offshore islands which are mostly uninhabited.

Away from Islay, the only practical method of determining how many geese are inhabiting this extensive range is to count them from the air. Visiting even a proportion of the haunts by boat within a reasonable time would be a major undertaking. Percival (1988) and Newton & Percival (1989) showed from studies of individually marked geese that there is some movement during the winter between Islay and Tiree/Coll, and perhaps other haunts, so it is essential that any census is carried out in as short a time as possible.

The technique of counting this

population from the air was pioneered in the late 1950s (Boyd 1968) and is now well established (see Methods). For reasons of cost, however, such surveys have been carried out only at about five-year intervals (e.g. Boyd 1968, Ogilvie & Boyd 1975, Ogilvie 1983a).

On Islay, where 50 – 70% of the total population winters, ground counts have been carried out every winter since the mid-1950s, often twice a winter and more recently monthly (Ogilvie 1983b; Easterbee & Bignal 1983 – 1988, Bignal *et al* 1988). These counts monitor a major segment of the population which, as the aerial surveys have shown, dominates changes in the population total. Age-ratio counts are also carried out on Islay each autumn to assess breeding success.

Elsewhere, there is a long series of ground counts from the principal Irish haunts of Inishkea, Co. Mayo (Cabot & West 1983) and Lissadell, on the mainland near Sligo (Irish Bird Reports). Sporadic counts have taken place at some Scottish haunts, more regularly in recent years, notably Colonsay, Coll and Tiree, and islands in the Orkney group (Scottish Bird Reports). These counts have, however, never been sufficient to enable any judgements to be made concerning the status of that part of the population that winters away from Islay.

The Barnacle Goose is the subject of special conservation measures concerning habitat protection under Article 4 of the EEC Directive on the Conservation of Wild Birds, which obliges member states to take account of "trends and variations in population levels" ensuring "their survival and reproduction in their area of distribution". It has long been known that there are considerable annual variations in the breeding success of Arctic nesting geese, which can have a major effect on population totals. Breeding success variation in the East Greenland Barnacle Geese, as with other species, is linked to meteorological conditions on the wintering grounds, as well as at staging areas used on migration and the breeding grounds (Fox & Gitay 1990).

The relatively small size of the population, its restricted distribution and its variability in breeding success, all make the East Greenland Barnacle Goose vulnerable to hunting as well as to modification or loss of habitat.

There has been conflict in some parts of Islay between farmers and conservationists concerning the large wintering flocks of Barnacle Geese there. In the late 1970s, an increase in formerly low levels of shooting brought about a marked reduction in numbers (Ogilvie 1983b). In 1981, the Wildlife and Countryside Act gave the species full protection. Shooting under licences issued by the Department of Agriculture and Fisheries, Scotland, to prevent serious agricultural damage was at a lower level than before and numbers have increased again (see below). In 1983, the Royal Society for the Protection of Birds purchased a large part of one of the most favoured feeding areas, at Loch Gruinart, and began management specifically for geese.

The 1968 Countryside Act empowers the Nature Conservancy Council to offer management agreements to owner/occupiers within Sites of Special Scientific Interest (SSSIs). Three SSSIs have been designated on Islay as Barnacle Goose sanctuaries and farmers within these have management agreements which provide payments and, in some years, free fertiliser in return for maintaining a required area of reseeded rotational grassland and agreeing not to shoot or deliberately scare the geese.

The three SSSIs, which include the RSPB Loch Gruinart Reserve, attract and hold an increasing proportion of the island's Barnacle Geese (Percival *et al* 1988, Easterbee & Kinnes 1989). These important changes on the major wintering haunt may be affecting the pattern of numbers and distribution elsewhere and merit further investigation.

Several of the traditional wintering haunts of Barnacle Geese away from Islay also qualify for protection as EEC Special

Protection Areas and "Ramsar" sites of International Importance. They qualify by virtue of the number of geese present and the proportion these represent of European or world populations, providing a need for regular information on these haunts.

Since Barnacle Geese prefer short grassland swards on which to feed, the suitability of offshore islands is determined largely by the presence of sheep or cattle. Historically, these were taken out to graze through the summer on many of the small, uninhabited islands off the west coast of Scotland. In recent years, twice-yearly compulsory dipping of sheep may have contributed to the abandonment of some islands for grazing, as previously, only one single end of season round-up would have been required to remove stock from an island. Aerial survey hence provides an opportunity to assess vegetation quality on the islands.

This paper reports on a census of Barnacle Geese at all known Scottish wintering haunts from Orkney to Islay in March 1988 (including the Northern Ireland coast where no birds were found). This was carried out at the same time as a similar aerial census in the Irish Republic by the Wildlife Service (Walsh & Merne 1988) thus providing information on the total East Greenland population.

Methods

The aerial survey was carried out (by ADF & MAO) between 21 and 28 March 1988 using a Cessna 172, four-seater, high-wing monoplane. Despite much cloud and some rain, flying was possible on all but one day. Because of poor conditions on the first survey, most of the Outer Hebridean chain was covered twice; only the second flight results have been used. Bad visibility initially prevented coverage of areas north of Jura during the main survey, but out and back flights from Glasgow were made to survey this area and the Northern Ireland coast.

Every island on which Barnacle Geese had been recorded on previous surveys was overflown as well as every other island on which the vegetation looked suitable for geese. It is quickly apparent from the air if an island has areas of grass on which the geese can feed or is covered in rank vegetation or bare rock to which they are unlikely to be attracted. Likely-looking areas on the mainland coast, and on the coast of the larger, inhabited islands, such as the Uists, Benbecula and Skye were also covered.

An assessment was made of the number of sheep or cattle present on each island, and the proportion of the island that appeared to be short grassland sward. Although subjective, it, as well as the stock counts, should be comparable with a similar assessment made by MAO during the 1983 aerial survey.

Full details of the aerial survey technique are given in Boyd (1968), but briefly each suspected haunt was approached at a height of no more than 250 m (800 feet) at a speed of *c.* 150 km/hr. This flushed the geese which became much more visible as a moving flock than when stationary on the ground. The pilot then endeavoured to position the plane so that the observers, one sitting next to him, the other behind, could see the flock well enough to count it, and if possible take photographs. This could involve tight circling or rapid turning to keep up-sun of the geese. Glare off the sea can render the geese nearly invisible.

Photographs cannot be relied on solely to provide counts. Apart from obvious hazards such as camera malfunction or loss of the film, it is not always possible to be certain that the whole flock is within the frame. There are also some flocks which cannot be photographed because of problems with light or background. Thus a visual count, or counts, were always completed before any photographs were taken. Colour slides were projected on to sheets of white paper and pencil marks put on each identifiable bird (overlapping birds within a flock pose some difficulties and we took the higher of the counts of any repeat

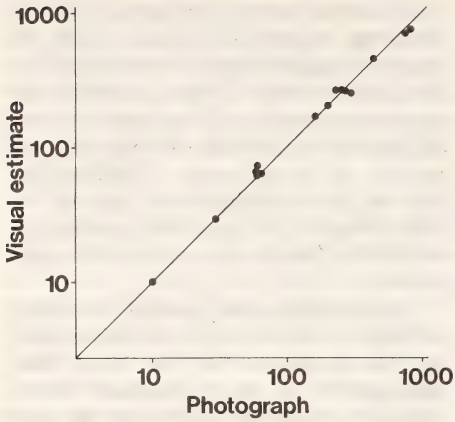

FIGURE 1. Plot of visual estimates against photographic counts of Barnacle Geese; the 15 pairs of data representing 15 different flocks. *Note axes are logarithmically transformed; the line indicates perfect agreement between the two methods.*

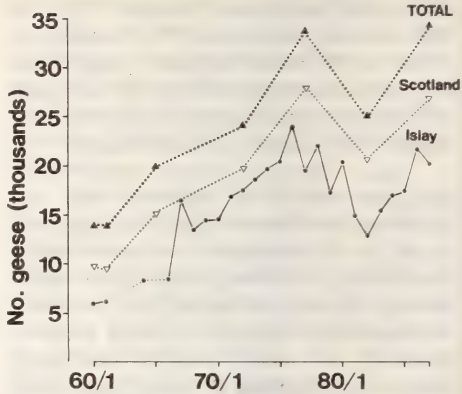

FIGURE 2. Total population estimates of East Greenland Barnacle Geese based on six aerial censuses, 1961-1988, plus annual Islay ground counts for the same period. *The Islay counts are for each winter until 1982/83 (Ogilvie 1983a); subsequently they comprise mean winter levels calculated from monthly counts (Bignal et al 1988).* ▲ *Scotland and Ireland* ▽ *Scotland* ● *Islay.*

photographs of the same flock), then the marks were tallied. In 15 cases, we could check a visual count against a photographic count. The mean difference was 0.4% (SE 2.2), which indicated no significant difference between the two techniques (Fig. 1).

The aerial survey information has been combined with the mean of two ground counts on Islay (Easterbee & Bignal 1988) on 28 and 29 March. A small flock of 55 geese found from the air on an islet off the southeast coast of the island has been added to the Islay total.

Results

A total of 6658 Barnacle Geese was counted in the course of the Scottish aerial survey, with ground counts of 19,730 and 20,745 on the two days on Islay (Easterbee & Bignal 1988). The average count including the additional offshore flock is thus 20,292, 75% of the Scottish total. In addition, 7594 were counted in Ireland (Walsh & Merne 1988), giving a population total of 34,544. Both the Scottish and Irish totals have increased substantially since the last census, in 1983, although the whole of the Scottish increase is confined to Islay (Fig. 2).

A breakdown of the counts for 1988, and previous aerial surveys, is shown in the Appendix. The various sites where geese were found away from Islay have been grouped into what are believed to be reasonably discrete areas, following Ogilvie & Boyd (1975). The groupings follow natural boundaries so far as possible (for instance, all the islands in the Sound of Harris are treated as one unit, or are restricted to single, well-separated haunts such as Eilean Mor, off Knapdale).

Geese were found in March 1988 at 34 sites (Appendix and Fig. 3); that on Garbh Reis, in the Sound of Jura, is a previously undocumented site and is sufficiently isolated from neighbouring sites to be treated separately. Previous surveys have found geese at between 38 and 58 sites (Ogilvie 1983a). The various groups can be

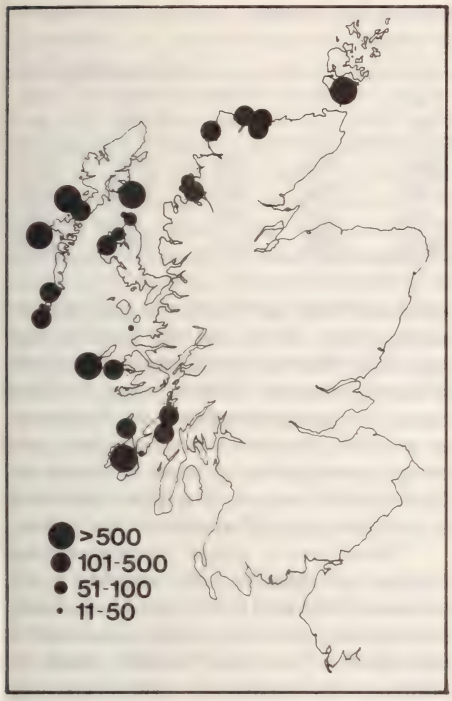

FIGURE 3. Distribution of East Greenland Barnacle Geese wintering in Scotland, late March 1988. Three sites (one south of Barra and two in the Sound of Harris) with under ten geese are omitted from the map, while counts at different sites in the Treshnish (4 flocks), Monach (2) and Shiant Islands (2) have been amalgamated for convenience.

further amalgamated into three main regions: the Inner Hebrides; the Outer Hebrides; and islands off the west and north coasts of the Scottish mainland. Beginning with Islay, the status of the Barnacle Geese in each region is now considered, along with the results of the survey of sheep and grass availability.

Islay

Islay held 59% of the total British and Irish population in March 1988, compared with 56 – 63% for the previous 15 years (Appendix). Changes in the numbers on Islay in this period have accounted for between two-thirds and three-quarters of the changes in the total population, and have completely swamped any increases or decreases elsewhere in Scotland (Fig. 2).

The 1983 census was held when the Islay population was at its lowest for over 10 years. During the late 1970s and early 1980s, shooting and disturbance of the geese on Islay greatly increased and this resulted in a significant decline in wintering numbers associated with an increase in annual mortality (Ogilvie 1983b). Breeding success in this period was also below average, probably as a consequence of the increased hunting pressure preventing geese reaching peak condition before their spring migration.

The numbers of Barnacle Geese wintering on Islay have recovered in the mid-1980s almost entirely as a result of the conservation and management changes that have taken place on Islay since the 1981 Wildlife and Countryside Act. The average number of geese being reported shot annually under licence is 628 (1983/84 – 1988/89 inclusive), which is less than half the estimated 1400 being shot in the late 1970s (Ogilvie 1983b). Very considerable areas of favoured feeding on the island are sanctuaries where no goose shooting takes place, and where pasture has been rotationally ploughed and reseeded.

Concerns by Islay farmers that the creation of managed sanctuaries for the Barnacle Geese would lead to a substantial increase in numbers over and above past peaks seem not to have been warranted. A programme of deliberate scaring in winter of 1978/88, combined with limited shooting under licence, was successful in reducing numbers outside the sanctuaries by persuading the geese to shift into them.

Inner Hebrides

Overall numbers in this area changed little between 1978 and 1988 (Table 1). There has been some increase in numbers present on islands close to the Kintyre and Knapdale

TABLE 1. Regional totals of Barnacle Geese in aerial surveys, 1961 – 1988.

Region	Mar 61	Apr 62	Mar 66	Mar 73	Apr 78	Mar 83	Mar 88
Inner Hebrides	993	1274	1694	784	1606	1646	1591
Outer Hebrides	2676	3016	4051	3183	3848	4199	3100
West & North coasts	571	476	863	759	1102	945	1967
TOTAL	4240	4766	6608	4736	6556	6780	6658

peninsula and in the Sound of Jura, including a flock of 195 on Garbh Reis. However, in 1988, numbers detected were low at Oronsay adjacent to Colonsay, on the Treshnish Islands off the west coast of Mull, and on Tiree and Coll (where the birds fly freely between the two islands and which are therefore treated as a single haunt (Newton & Percival 1989).

Either side of the aerial survey there were much higher ground counts from Oronsay of 382+ (5/6 March), 200 (Oronsay, 21 March although no count was made on Colonsay that day) and *c*.400 (16 April; J. & P. Clarke in litt), than the 125 found from the air on 21 March.

There were also several incomplete ground counts on Tiree giving minimum estimates of: 362+ (8 March), 446+ (9 March; D.A. Stroud), 760 (10 April), 400+ (13 April) and 462+ (16 April; K. Shepherd). These counts compare with 550 on Tiree and none on Coll counted from the air on 26 March.

Newton & Percival (1989) showed that individually marked geese moved between Islay and Tiree and Coll, the only islands among those listed that are easy to visit regularly. However, such movements seem mainly to involve birds arriving on Islay during the autumn migration (cf. Easterbee *et al* 1987) and then back-tracking the comparatively short distance to winter on Tiree or Coll, with only a little wandering to or from Islay in the course of the winter.

There was a slight increase in the number of islands with suitable grass between 1983 and 1988 (Table 2), the most striking change having taken place on the Garvellachs, four small islands which lie between Jura and Mull. In 1983, there were no sheep and the vegetation appeared rank and rough. In 1988, there were approximately 150 sheep on the four islands, all of which had areas of good grass.

Outer Hebrides and Skye

The islands round Skye which hold Barnacle Geese are all to the northwest of the main island and much closer to haunts in the

TABLE 2. Comparison between 1983 and 1988 aerial surveys in numbers of islands with geese, with sheep, and with suitable grazing. Additional totals for 1988 are islands not surveyed in 1983.

Region	1983				1988			
	With geese	With sheep	Grazing good	Grazing poor	With geese	With sheep	Grazing good	Grazing poor
Inner Hebrides	7	18	28	34	10	18	35	27
Outer Hebrides	24	19	52	37	16	38+9	58+7	31+5
W & N coasts	10	8	15	22	8	2+9	15+11	22+4
TOTAL	41	45	95	93	34	58+18	108+19	80+10

Outer Hebrides than to those in the Inner Hebrides, and are consequently placed in the former region.

The total counted in this region fell by just over 1000 between 1983 and 1988 while the number of islands with geese dropped from 24 to 16 (Tables 1 and 2). This was unexpected as, apart from a high count in March 1966, there had been a steady increase in numbers in the region since the first survey in 1961. There were declines in all but two of the island groups holding more than 250 in 1983, particularly noticeably in the Barra-Barra Head, Sound of Harris and Trodday groups (Table 1).

The only observable change in any of the groups since 1983 was the presence of a substantial house being built on the main island of the Ascrib group off Skye which could have contributed to the drop in numbers.

There has been a marked increase in the number of islands with sheep and a smaller increase in those with reasonable grass (Table 2), both of which might be expected to benefit the Barnacle Geese unless simultaneous measures are being taken to discourage them.

North and west coasts

The numbers of Barnacle Geese have more than doubled in the last five years (Table 1), though two less islands held geese in 1988 (Table 2). Numbers had increased at all island groups, but in particular at the Hoan Islands and Orkney. Since the discovery in the late 1970s of a flock of Barnacle Geese wintering in the Orkneys, numbers there have increased sharply. The flock frequents Switha, Swona and other islands in Scapa Flow (P. Reynolds, pers. comm.).

Geese have been irregular visitors to the Hoan Islands (Appendix), the count in March 1988 matching the previous peak in 1966. The presence of a large flock of geese on the main island, Eilean Hoan, may have been due to the island being managed for the geese by the RSPB since 1980 through increased sheep grazing (R. Dennis, pers. comm.); our subjective assessment of the grass quality changed from 'good' in 1983 to 'excellent' in 1988. None of the counts at the other island groups exceeded previous maxima, though all showed an increase on 1983. Overall, there was a sharp decline in islands with sheep since 1983 (Table 2), although those with reasonable grazing (which hold most of the geese) remained unchanged.

Discussion

The relatively small population of Barnacle Geese wintering in Scotland and Ireland has fluctuated in recent years, declining by 22% between 1978 and 1983, then increasing by 31% to the present. This increase is represented by a 29% increase in Scotland (exclusively on Islay) and a 71% increase in Ireland.

It is unlikely that any important Barnacle Goose haunts were missed during the March 1988 aerial survey. Not only were all traditional sites covered, but also all those for which there has been even a single count in past aerial surveys, plus many additional areas with suitable feeding habitat.

Islay continues to be by far the most important wintering area within the entire range of the East Greenland Barnacle Goose population. Mean overwintering numbers increased from 15,535 in 1983/4 to 20,384 in 1987/88 (Bignal *et al* 1988). The current, much-improved management regime there seems capable of sustaining at least the present numbers.

Despite considerable fluctuations in the numbers on Islay over the period of the last three surveys, there is little evidence that this has had any effect on the numbers elsewhere in Scotland. The striking increase in Ireland has been attributed, in part, to a long-term improvement in the protection offered to the species in the Republic (Walsh & Merne 1988).

The recent stability of numbers in the Inner Hebrides, including all the haunts nearest to Islay and therefore perhaps the

most likely to vary when numbers on Islay vary, contrasts with the sharp decline in the Outer Hebrides and an equally sharp increase on the islands off the west and north coasts of Scotland.

Cabot & West (1983) suggested that the Inishkea Islands, Co. Mayo, with the second largest group (2000 – 2500) of Barnacle Geese after Islay, have long since reached their carrying capacity, based upon more than 20 years of annual counts. If stability in numbers over a long period can indeed be interpreted in this way, then it may well be that the same is currently true of the majority of the Inner Hebridean haunts. However, one new haunt was discovered in the course of the survey and the Garvellach Islands have been considerably improved as potential goose habitat in the last five years, perhaps allowing for an increase in numbers in this region in the future.

The decline in the Outer Hebrides region is puzzling, since sheep densities appear to have increased and a more detailed examination of possible factors is needed in this area.

The sharp increase in the north and west coast islands region is in part due to direct management for the geese on the important haunt of Eilean Hoan as well as to the continuing increase in Orkney. This latter island group contains several uninhabited but sheep-grazed islands which look suitable for geese.

A major weakness of almost the entire sequence of aerial surveys of this goose population is that they have nearly all taken place at the same time of year, namely late March and early April. The reason for this is purely logistical. After the first survey in December 1959, it was concluded that the length of daylight and weather situation were both much more suitable for aerial surveys in the spring than in mid-winter. Even so, it has been quite usual on past surveys, to spend as many days grounded by bad weather conditions as actually flying.

The long series of counts on Islay (Ogilvie 1983b, Easterbee & Bignal 1983-1988, Easterbee & Kinnes 1989) have shown that there is, in some years, an increase in numbers there in March and April. Easterbee *et al* (1987) showed that, in the autumn of some years at least, virtually all the Greenland population may stage on Islay. Thus the optimal period for a true assessment of the overwintering distribution of geese lies between December and February. Ogilvie (1983a) suggested that the spring influx could be a pre-migratory movement of birds to Islay in search of better feeding than is available to them on their wintering site, while the use of sites such as Garbh Reis may also reflect such movements rather than correspond to new wintering sites.

It can therefore be seen that the counts of all the haunts away from Islay are not necessarily fully representative of their true mid-winter holding capacity and more information is undoubtedly needed concerning the distribution of Barnacle Geese in Scotland at other times of winter to compare with the late March-early April situation when the birds may be redistributing prior to their spring migration.

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APPENDIX. Numbers of Barnacle Geese counted during aerial surveys 1959 – 1988. Figures in brackets are interpolated means of counts from previous and subsequent years. * Figures relating to Islay come from ground counts at the time of aerial survey of other resorts (details in Ogilvie 1983a).

	Sites in group	Dec 1959	Mar 1961	Apr 1962	Mar 1966	Mar 1973	Apr 1978	Mar 1983	Mar 1988
INNER HEBRIDES									
Trodday	1	0	18	0	0	0	70	0	0
Brosdale	2	140	107	124	45	0	0	0	25
Eilean Mor (Kintyre)	1	0	14	44	196	110	436	210	295
Garbh Reis	1	0	0	0	0	0	0	0	195
Eilean Mor (Jura)	1	10	4	0	16	(8)	0	0	0
Oronsay/Colonsay	1	0	0	230	18	40	45	180	125
Soa	1	0	0	0	61	35	0	2	0
Treshnish	5	299	470	390	795	419	610	620	378
Tiree/Coll	3	25	380	484	534	143	390	619	550
Small Isles	2	0	0	2	(29)	(29)	55	15	23
SKYE AND OUTER HEBRIDES									
Isay	4	130	140	395	380	297	290	250	245
Ascribs	3	0	122	204	272	132	140	172	100
Trodday	4	60	108	47	236	143	94	225	70
Barra-Barra Head	11	49	142	171	443	80	154	371	91
Sound of Barra	6	86	452	415	360	336	455	375	340
South Uist	1	110	250	0	0	0	0	0	0
Monachs	3	480	519	860	1035	640	760	638	715
Sound of Harris	20	174	599	498	575	980	1330	1555	1007
Taransay	2	15	120	7	120	125	0	0	0
Gaskir	1	110	10	70	122	0	130	0	0
Shiants	3	290	214	317	483	450	420	580	532
Loch Roag	2	0	0	0	19	0	20	33	0
Loch Erisort	2	0	0	32	6	0	55	0	0
NORTH AND WEST COASTS									
Longa	1	56	15	20	0	(5)	10	0	0
Foura	1	0	0	11	0	(0)	0	0	0
Summer Isles	6	73	0	57	146	(122)	98	54	87
A Chleit	2	37	33	0	33	0	49	0	0
Chrona/Meall More	4	172	100	9	55	96	121	75	130
Roin Mor	2	21	64	0	74	190	65	61	160
Hoan Islands	2	(212)	180	244	425	6	220	0	432
Rabbot/nan Ron	3	(157)	179	135	130	350	339	255	350
Orkney	2	0	0	0	0	0	200	500	808
SCOTLAND (excl ISLAY)	103	2706	4240	4766	6608	4736	6556	6790	6658
ISLAY		2800	5500	4800	8500	15000	21500	14000	20292
IRELAND		2771	4161	4404	4718	4398	5709	4432	7594
GRAND TOTAL		8277	13904	13970	19826	24134	33815	25222	34544
PERCENTAGE ON ISLAY		33.8	39.6	34.3	42.8	62.7	63.6	55.5	58.7

Probable long-term sympatry of Common and Scottish Crossbills in northeast Scotland

A.G. KNOX

Common and Scottish Crossbills are now known to breed side-by-side in the Scottish Highlands. It is possible that Common Crossbills started to nest only in recent decades, when large areas of introduced conifers planted after the First World War began to mature. Historical information from northeast Scotland reveals that the species has probably nested alongside the Scottish Crossbill for some considerable time. This lends support to the argument that they should be treated as separate species.

Introduction

Crossbills *Loxia* spp. have a widespread but irregular distribution throughout the Scottish mainland. Two forms breed: the Scottish Crossbill *L. scotica* and the nominate race of the Crossbill *L. curvirostra* (here called the Common Crossbill). They both nest in coniferous forests.

The Scottish Crossbill is confined to the Highlands of Scotland mainly centred in Deeside, Strathspey, the eastern end of the Great Glen and the forests to the north and west. It is resident within this broad area (hereafter called the Highlands), although the birds often move from wood to wood between years (Knox 1986, 1987, 1990a).

The Common Crossbill is found across the Palearctic, from the Iberian Peninsula to eastern Siberia, and is highly irruptive (Svärdson 1957, Newton 1970, 1972). Common Crossbills can occur anywhere in Britain during their periodic invasions from the Continent (Sharrock 1976, Knox 1986). After a large irruption, Common Crossbills usually breed widely in suitable habitat. Small woods are normally occupied for only one or two breeding seasons, but Common Crossbills may be present in larger forests for decades, although often moving within each forest between years. These populations appear to depend for their continued existence on further immigration from the Continent, or elsewhere in Britain.

For a long time after it was originally described in 1904 the Scottish Crossbill was regarded as a subspecies of *L. curvirostra* (Knox 1975). Species are usually defined on the basis of reproductive isolation (Mayr 1970; see McKitrick & Zink 1988 for recent ideas on species concepts). As long as the Common Crossbill did not breed within the range of the Scottish Crossbill it was considered acceptable to treat the two forms as allopatric* subspecies. Until the early 1970s, the only claimed breeding of the Common Crossbill in northern Scotland was at Drumtochty, Kincardine, in 1903 (Harvie-Brown 1906), outwith the range of the Scottish Crossbill (Witherby *et al.* 1938, Baxter & Rintoul 1953).

* *Allopatric* populations occupy mutually exclusive geographic areas. *Sympatry* is defined as the occurrence of two or more populations in the same area; more precisely, the existence of a population in breeding condition within the cruising range of individuals of another population (Mayr 1969).

FIGURE 1. Map of northeast Scotland (the Grampian Region less the Moray District), showing locations and dates of historical records of crossbills. *Those without precise locations are not plotted. For further information see Appendix. The rivers marked are, from the north, the Deveron, Ugie, Ythan, Don and Dee. The recent distribution of the Scottish Crossbill is shown shaded (i.e. woods in which birds were found by the author between 1974-86). In recent years, Common Crossbills have been found in scattered woods throughout the northeast (Knox 1990a).*

But how realistic was this assumed allopatry? From 1974 to 1986 I studied crossbills in northeast Scotland (defined in Fig. 1), concentrating on Deeside, but obtaining additional information from the whole of the region. Full details are published elsewhere but, over the 13 years between 1974 and 1986, both Scottish and Common Crossbills occurred every year in forests along the valley of the River Dee (Knox 1990a). Scottish Crossbills nested each year. Common Crossbills nested in Deeside, sometimes in the same woods, in at least nine of those years. They also nested in nearby woods outwith Deeside, in a further two years. Identification of some of the breeding birds was confirmed for the first time, by specimens examined in the hand and by tape-recorded vocalizations.

The Scottish Crossbill was found only in woods along the main valley and tributaries of the Dee, from Glen Derry to Banchory. The single exception was a mixed flock of Common and Scottish Crossbills seen at Lonach, in upper Donside, in early spring 1986, but there was no indication of

nesting. Over the whole period, Scottish Crossbills were almost exclusively found in either old Caledonian Scots pine *Pinus sylvestris* forest (see Steven & Carlisle 1959), or plantations over 80 years old.

In contrast, Common Crossbills occurred at scattered localities throughout lower Deeside, lower Donside and the low ground in the east of the region. Their breeding range overlapped with the Scottish Crossbill from Banchory to Ballater in Deeside, but Common Crossbills were usually scarce over most of this area. Although they were sometimes present in the same woods as Scottish Crossbills, Common Crossbills were more often found in younger stands of introduced conifers. Outside the breeding season, Common Crossbills sometimes occurred further up Deeside, but Scottish Crossbills were never identified beyond their breeding range.

Preliminary results of this study led to the suggestion that the Scottish Crossbill was better treated as a separate species (Knox 1975, 1976; see Voous 1977, 1978).

The Scots pine, juniper *Juniperus communis* and yew *Taxus baccata* are the only conifers native to Britain. The Common Crossbill is usually found on the Continent in forests of Norway spruce *Picea abies*. Substantial plantings of this and other exotic species took place following the establishment of the Forestry Commission after the First World War (Anderson 1967). It is therefore possible that the birds started to nest in northeast Scotland (or elsewhere in the Highlands) only since these large forests matured in recent decades. The aim of this study was to see if it could be determined for how long Common Crossbills might have been breeding alongside, or within the range of, the Scottish Crossbill in northeast Scotland.

Methods

The collections of the Royal Museum of Scotland and the British Museum (Natural History) were searched for specimens of crossbills taken in the northeast or elsewhere in the Scottish Highlands. The literature was also examined for references to crossbills in the northeast prior to 1960, and the former distribution of suitable habitats was inferred from the history of forestry in the area.

Results and Discussion

Over the last two centuries, the ancient Caledonian pine forests of the northeast have never extended much beyond their present limits, although most individual woods are now smaller and some will have been lost altogether. Plantations were common even in the late 18th century, but much felling and replanting has taken place subsequently and planted woods now cover a larger area (Robson 1819, Steven & Carlisle 1959, Anderson 1967, Davies 1979). The general distribution of the different conifer woods has not changed greatly in the last 200 years. In recent decades, the Scottish Crossbill has never been found in the lowland woods of the northeast, even in years when the Common Crossbill has been absent. There is no reason to believe that the habitat preferences of either species have changed greatly over the last two centuries. It therefore seems likely that most historical records of crossbills in the northeast, apart from those from middle and upper Deeside, refer to Common Crossbills.

There are records of crossbills in the area back to the late 1700s, although most date from the middle of the 19th century (Fig. 1 and Appendix). This parallels the availability of historical information about most birds in Scotland (e.g. Baxter & Rintoul 1953), rather than suggesting that crossbills became commoner in more recent times. Prior to 1900, most records are from the lowland parts of the northeast where there would have been more observers than further inland. There are several instances of breeding during the 1800s, perhaps the most significant being at Manar and Keith Hall (both near Inverurie), the Loch of Skene, Huntly, Methlick and the nearby Haddo House. These are all well outside the present range of the Scottish Crossbill (Fig. 1).

Although not possible to prove conclusively, it seems likely that these and other records from sites outside the middle and upper Dee valley mostly or all refer to Common Crossbills. Occurrences from within the present range of the Scottish Crossbill may have been of either form, but those from the older pine woods probably refer to Scottish Crossbills.

It would have been surprising if Common Crossbills had not been breeding in the northeast. Common Crossbills have been irrupting into Britain for 700 years or more (Paris, quoted by A. Newton 1896). They have nested in England and even in southern Scotland for as long as reasonable records exist (since at least the early 1800s; Witherby *et al.* 1938). The collections of the Royal Museum of Scotland and the British Museum (Natural History) contain several skins of Common Crossbills taken in the nesting season from within the present range of the Scottish Crossbill, although none bears conclusive data on breeding. That sympatric breeding was not reported before presumably reflects the difficulty of telling the birds apart in the field (Knox 1990b); the Scottish Crossbill was not even described as a separate form until 1904.

It therefore seems that Common and Scottish Crossbills have almost certainly been living side-by-side for many generations. Since sympatry is unlikely to be a recent and transient phenomenon, this lends support to the argument that they should be treated as separate species.

APPENDIX

Historical records from within the present range of the Scottish Crossbill

Pre-1900

Male and female crossbills, presumably locally taken, were presented to the Montrose Natural History and Antiquarian Society by Mr James Brown, of Level, between Balmoral and Ballater, in 1844 (M.N.H.A.S. minute book, Montrose Museum). William MacGillivray knew crossbills well in upper Deeside, where they occurred in the parishes from Glen Muick (near Ballater) to Braemar. The birds were present at all seasons in rambling flocks in the pinewoods, remaining for uncertain periods and seeming to be nowhere stationary (MacGillivray 1855). In the 1880s crossbills were said to be breeding in Deeside (J.A. Harvie-Brown *in litt.* to Drummond Hay 1886).

1900 – 1960

Fifty or 60 birds claimed probably to be Common Crossbills were seen at Balmoral in 1927 from the first week of August to the 26th (Witherby 1927, H.F.W. 1927, Baxter & Rintoul 1953). This was a year of a large irruption. Scottish Crossbills were also said to be present in their usual small numbers until early July when young were observed (Witherby 1927). There was said to have been another invasion in Deeside in 1929 (Ritchie 1929) and four birds flew across the Dee to Aboyne on 20 July (Anon. 1929). In the 1930s there were two records of claimed breeding of Scottish Crossbill in Deeside: a male, two females and two young were seen at Braemar on 7 July 1935, and a family party was seen at Ballater on 17 July 1938 (Baxter & Rintoul 1953).

Several specimens of *scotica* were collected at Ballater in late August and early September in 1940, including a male moulting out of its streaked juvenile plumage. The skins are at the BM(NH). B.W. Tucker was at Braemar in July 1943 and found many crossbills in all the woods. He thought that they were mostly Common Crossbills (Tucker *in litt.* to Pennie 1956). There was no irruption that year, although there had been one in 1942 (Newton 1972).

Crossbills were present in Deeside every year from 1945 to 1955 (Nethersole-Thompson 1975, p. 245). Numbers were often high in Deeside in years when they were low in Strathspey, and *vice versa*. The pattern broke down in 1953 when there were very few crossbills in either area.

In 1955, Adam Watson noted that crossbills were numerous in Deeside throughout the year, and that they were often seen in other parts of Aberdeenshire. He commented on the scarcity of published breeding records, although he suspected that crossbills bred every year. Watson gives details of several instances of breeding: two fledged young near the Lion's Face, Braemar, on 21 July 1945; one fledged young being fed in Braemar village on 24 July 1945; a nest with four

or five very small young eight feet up in a small Scots pine near Birkhall, Ballater on 19 April 1946; one fledged young in Glen Derry on 13 June 1948; many fledged young, including some still downy, in woods at Derry Lodge on 9 June 1950; one downy young being fed in Glen Derry on 29 June 1950, and a fledged young with traces of down being fed in Glen Derry at the end of May 1955 (Watson 1955). When he was able to examine birds closely in the field, Watson considered the bills usually to have been heavier than *curvirostra* and similar to *scotica*.

On 19 February 1950 eight crossbills, probably Scottish, were seen in Glen Sluggain, near Braemar (Tewnion 1951). Crossbills claimed to be Scottish were seen in Deeside in summer 1958 (Anon. 1959).

Historical records from near the edge of the present range of the Scottish Crossbill, or unspecified areas

Pre-1900

A flock of crossbills, from which several birds were shot, was reported in the *Aberdeen Journal* on 21 July 1810. The species was said to be rare, the last flock having been seen about 17 years earlier (c. 1793). Crossbills are included on the *New Statistical Account* (N.S.A.) list of birds for the parish of Banchory-Ternan (N.S.A. 1834 – 1845). Specimens were obtained in the Banchory area in 1838 and the autumn of 1847 (Adams & Adams 1859). A decade later in the same area, crossbills were believed to be permanently resident and increasing (Adams & Adams 1859). Shortly afterwards, the species was considered to breed regularly in Aberdeenshire (More 1865). The first acceptable record of a Scottish Crossbill is a skin from Aberdeenshire, collected by George Sim on 12 December 1872, now in the BM(NH). The nest with eggs of a pair of Aberdeenshire crossbills was found on 13 April 1874 (Dewar 1874). A decade or so later, crossbills were again said to be resident in Aberdeenshire (J.A. Harvie-Brown *in litt.* to Drummond Hay 1886).

1900 – 1960

There was an irruption in 1910, and an immature crossbill was found at Torphins on 9 August (Eagle Clarke 1910). A female and two young birds were seen feeding on rowans *Sorbus aucuparia* at Durris in October 1917 (MacDonald 1918). In 1920, it was reported that crossbills with young were seen in the neighbourhood of Crathes, near Durris, almost every summer, and that it was believed that the birds nested in the woods there (MacDonald 1920). 1930 was yet another irruption year, with many crossbills in Aberdeenshire (H.F.W. 1930). A pair nested successfully at Arbeadie, Banchory, in 1943, being seen with two newly-fledged young from 25 April. Crossbills were also seen at Tilquhillie, Banchory, in March and April that year (Pennie 1956).

Historical records from areas outside the present range of the Scottish Crossbill

Pre-1900

Crossbills appear on a list of birds occurring in the parish of Lonmay in the early 1790s (O.S.A. 1791 – 1799). On 4 July 1821, crossbills were seen feeding near Gordon Castle, Huntly, Aberdeenshire, and young may have been heard (Nethersole-Thompson 1975). Crossbills are included on lists of birds for the parishes of Methlick, Peterhead and Banff (where they were said to be occasionally met with) published in the late 1830s and early 1840s (N.S.A. 1834 – 1845). Three males and three females were shot at Craigston, near Turriff, on 25 December 1853 (Edward 1854) and the following year, great numbers appeared at Methlick where they had previously been scarcely known, but since when they were often seen (Wilson 1899).

In the winter of 1848 – 49, several pairs were shot from flocks feeding in larches *Larix* spp. at Manar, an estate near Inverurie, where large flocks appeared in 1857. On 7 May 1860 a nest with four eggs was found at the top of a larch there, and another nest, with newly-hatched young, was discovered very high in a larch on 5 April 1862. Both nests were subsequently deserted, the eggs being taken from the first, and the young dying in the other after being 'forsaken'. A nest with young was found at Keith Hall, near Inverurie, in February about 1850, and birds appeared plentifully in the same wood from 6 August 1866 to 1 May 1867 (J. Walker ms., quoted in Sim n.d.).

In an article published in 1859, Thomas Edward (whose work was based mainly on the part of Banffshire near the town of Banff, rather than the portions far inland) noted that although crossbills had been a rarity in Banffshire twenty years earlier, they were no longer scarce. He believed that they nested, and had done so for some years (Edward 1859). He also reported seeing what he thought was a Parrot Crossbill near Banff, but this may have been a Scottish Crossbill which was then undescribed.

Single male and female crossbills were killed near Aberdeen in January 1862 (Smith 1863). In early spring 1865, a nest was found in a fir tree in a wood beside the Loch of Skene; a nest with eggs was found by Wilson at Methlick in the following year and, on 11 June 1867, a crossbill was shot from a flock at Pitfodels, near Aberdeen (Sim 1903). A pioneering study of bird distribution in Britain was published in 1865 in which it was noted that Edward had found the nest of the crossbill in Banffshire (More 1865). Crossbills apparently bred near Huntly in 1864 (Nethersole-Thompson 1975). A few years later, crossbills are included on a list of the breeding birds of Inverurie parish (Garrow 1871).

In an account of the birds of the parishes of Methlick and Tarves (Muirhead 1891), crossbills were reported to frequent the pine woods about Haddo House, near Methlick, in great numbers in winter and spring. A pair was seen at Gight on 1 May 1890, and the author believed that crossbills doubtless bred in the district although he knew of no nests (presumably unaware of the one found by Wilson in 1866, the details of which were not to be published until 1903). Only two years later, a nest with four eggs was found at Haddo, in early April 1893 (Harvie-Brown & Buckley 1895, Sim 1903).

In 1895, Serle reported that crossbills were winter visitors to Buchan, although they were plentiful about Gight. A small flock had been seen at Ravenscraig, near Peterhead, in October 1894 (Serle 1895). In Banffshire, crossbills were then increasing and said to be spreading rapidly east to Rothiemay, the Bin (both near Huntly), and into the Ythan and Bogie valleys (Harvie-Brown & Buckley 1895). Further south, in the Mearns, about 100 birds frequented Drumtochty Glen in the irruption years of 1886-87 (Nethersole-Thompson 1975). Some 30 – 40 crossbills were seen at Auchenblae on 7 February 1897 (Laidlaw 1898) and, on 23 July 1898, family parties were found at nearby Fordoun (Laidlaw 1899). At the turn of the century, crossbills were said to nest in Drumtochty Glen, and doubtless at other places in Kincardineshire (Simpson 1900).

1900 – 1960

A pair of Common Crossbills was reported to have nested at Drumtochty in 1903 (Harvie-Brown 1906) but, while this is quite possible, reasons for the identification of the birds were not placed on record. The Scottish Crossbill was not described as a separate race until 1904.

During the large irruption of 1909, a number were caught at Fraserburgh and at sea, where hundreds were reported drowning (Harvie-Brown 1910). About 20 landed on a steamer off Bervie and stayed for several hours (Baxter & Rintoul 1910). Later in the same year, 7 were seen at the Sinclair Hills on the Philorth Estate, near Fraserburgh on 15 December (Stewart-Menzies 1910). The following year, 1918, crossbills were said to be scarce at Banff (Rintoul & Baxter 1919).

Crossbills bred at Forglen House, near Turriff, in 1946 when three or four fledged young, still being fed, were seen on 12 June (Watson 1955).

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Brood feeding and division of parental care by Crested Tits

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Seven Crested Tit nests were observed during the three weeks prior to their young fledging. Five of the broods were also observed during the 17 days after leaving the nest. As the chicks approached fledging an increasing proportion of feeding visits was made by one adult; at four nests this was the male, at three nests the female. After fledging, the same parent continued to feed fledglings in two families, but both parents were seen feeding fledglings in at least one other case. Parental feeding visits were seven times more frequent to individual fledglings than to individual nestlings. Parents apparently continued to make feeding visits to fledglings at this rapid rate for at least 17 days, even though the fledglings' own foraging attempts steadily increased. Aggression between siblings increased as their foraging activities increased.

Introduction

Although the Paridae (tits) are one of the better studied families of small passerines (Perrins 1979), little is known about the immediate post-fledging period. The nestlings of most species of tits are fed by both parents and, on fledging, they remain dependant on the adults for a further 2–3 weeks (Hinde 1952). However, Deadman (1973) suggested that brood care by Crested Tits *Parus cristatus* differed from other Paridae in that the period from fledging to independence (*c.* 25 days) was long and that one adult deserted the brood at fledging leaving the remaining adult to look after the fledglings alone.

During a study of broods of Crested Tits in the Abernethy Forest, I collected data on the contribution made by each parent to feeding the chicks before and after fledging, as well as the development of foraging by the fledglings themselves and aggression between siblings. My aims were to examine in more detail the division of brood feeding by the parents before and after fledging, and to study the relationship between parental feeding and fledgling development in the immediate post-fledging period.

Methods

The study was carried out in *c.* 5 km^2 of the Abernethy Forest, Inverness-shire. Crested Tits were present in mature plantations of Scots pine *Pinus sylvestris* and in the unmanaged remnants of Caledonian pine forest. I studied seven pairs with nests in both woodland types. At least one adult from each nest was colour-ringed and the sex known; both adults were ringed and sexed at Nest 5 (Fig. 1).

Data were collected from mid-May 1987 (shortly after hatching) to 17 days after the chicks fledged. I visited each nest at least once every three days and observed for one hour. The order in which nests were visited was randomised so that observations at any one nest were not biased towards any particular time of day. During each one-hour observation period I recorded the

number of times an adult arrived to feed the young. Where possible the sex of this bird was noted. Each nest was observed for a minimum of 5 hours between the time the young hatched and fledged.

After broods had left the nest, I attempted to locate as many of the study families as possible. It proved very difficult to locate the family parties however, and only five of the fledged broods were located during the first 17 days after leaving the nest.

Once I had found a family I attempted to observe it for one hour, recording the number of times young were fed by their parents, foraged for themselves or had an aggressive encounter with a sibling. As it was impossible to watch the whole brood, after first counting the total number of fledglings present, one was chosen at random and watched for a period of 30 min, using the focal animal technique (i.e. if the target bird was lost to view, observations were immediately switched to another member of the brood and recording continued). After 30 min, a new individual was watched using the same technique. As the observations were not independent, the number of parental feeds, fledgling forages and chases were combined to give an hourly rate for each activity.

A parental feed was defined as a parent putting an item of food into the gape of a fledgling; when two distinct items were given, separated by a pause of more than two seconds, this was counted as two feeds. Although fledglings were sometimes partially hidden from view by foliage, feeding was usually accompanied by loud begging calls from the young, particularly when food was delivered and this was sometimes used to help define feeding incidents.

Foraging by a fledgling was characterized by a distinct peck at a branch or pine needle; when a series of pecks was punctuated by a pause of more than two seconds, two separate foraging incidents were recorded. Whenever there was any uncertainty over a parental feed or foraging by a fledgling, neither was scored. Thus the frequencies presented below will be minimum values.

The most obvious and frequent interaction between fledglings within a brood was chasing. Therefore the number of chases involving the focal bird was also noted and used to gauge the level of aggression between siblings.

Fifteen hour-long periods of observation were made of the five families. Three additional observations were also made where the identity of the adult and number of fledglings was obtained but the family was lost to view before one hour of focal animal measurements could be made. Most observations were made on three families as the other two were difficult to locate consistently. As the number of observations collected on individual families was generally insufficient to analyse separately, the dates on which observations were made were expressed as the number of days before or after fledging (the day of fledging being zero) and data from different families were combined. The results of statistical tests are given in the Appendix.

Results

Nestling period

Despite a wide variation in the number of feeding visits per hour made to the nest by adults on any one day, the overall frequency increased steadily as the nestlings grew, from an average of six visits per hour during the three days after hatching, to 15 visits per hour in the three days before fledging.[1]

The contribution to feeding visits made by each sex over the nestling period as a whole varied widely (Table 1). During the first 5 – 10 days feeding visits were made by both sexes. However, even at this stage one parent made consistently more of the visits at six nests (Fig. 1). This inequality became more pronounced as the chicks approached fledging but was not due to a sex difference. At four nests males made most of the feeding visits while females became

TABLE 1. Percentage of visits by male and female Crested Tits to feed their young at seven nests.

Nest	No. of 1-hr observation periods	Visits to the nest % by male	% by female	*n*
1	7	50	50	46
2	5	80	20	52
3	9	80	20	85
4	9	75	25	104
5	10	25	75	102
6	10	20	80	88
7	10	2	98	161

predominant at the other three. In the last four days before fledging both adults fed the nestlings in only 21% (n = 14) of the observation periods, compared to 83% (n = 40) in the previous 13 days. If the pairs were taking it in turns to feed broods, swapping over two or three times a day, the apparent predominance of one adult in nest feeding could have resulted from nests only being watched for periods of one hour. However, on five occasions, three of the nests were observed twice in the same day and the identity of the dominant nest feeder was the same during both sets of observations.

Fledgling period

When they left the nest, broods tended initially to be scattered in the canopy within a 10 – 20 m radius of the nest tree. The young called almost continuously and the parent brought food to them. After a day or two the family parties began to move through the forest more as a unit, with the young following the parent. By the end of the first week the young called less frequently, and only when the parent was in their immediate vicinity. At times fledglings appeared to be abandoned by the adult (between feeding bouts) for up to 30 min; similar behaviour has been noted for other tits by Hinde (1952). When this happened the fledglings tended to fall silent and remain motionless in the canopy, making them very difficult to locate. This could have resulted in an unintentional bias towards sampling those broods which were being actively fed.

At fledging, brood sizes were estimated as five young in four cases and four young in the fifth case (Nest 3, Fig. 1). Ringed adults were observed with less than the full brood on 11 occasions and the full brood on seven occasions (Fig. 1). Groups of fledglings were only ever seen accompanied by one parent.

The rate at which parents made feeding trips to nestlings increased markedly after fledging. The average number of feeding visits for four families during the three days prior to fledging was 15 visits per hour per brood, or 3 visits per hour per nestling, assuming that only one chick was fed on each nest visit. This compared with 21 feeds per hour per fledgling during the four days after fledging (average for the same four families) – a sevenfold increase in the number of feeding visits made per hour by each adult.[2] Although feeding rates recorded on any one day varied widely, the high initial level of parental feeding appeared to be maintained over the subsequent days.

A fledgling was first seen to forage for itself on the third day after fledging and the number of such attempts per observation period increased steadily between days 8 and 17.[3] There was no correlation between the number of times that the parent fed a fledgling and the number of times the fledgling searched for food itself.

Chasing of one fledgling by another was first seen 10 days after leaving the nest and increased thereafter. The number of chases per hour involving the 'focal' fledgling was positively correlated with the number of times that a fledgling attempted to forage for itself.[4] Although Crested Tit and Coal Tit *Parus ater* family parties were seen near to each other on a few occasions, there was no overt aggression between them. Different Crested Tit families were never seen together.

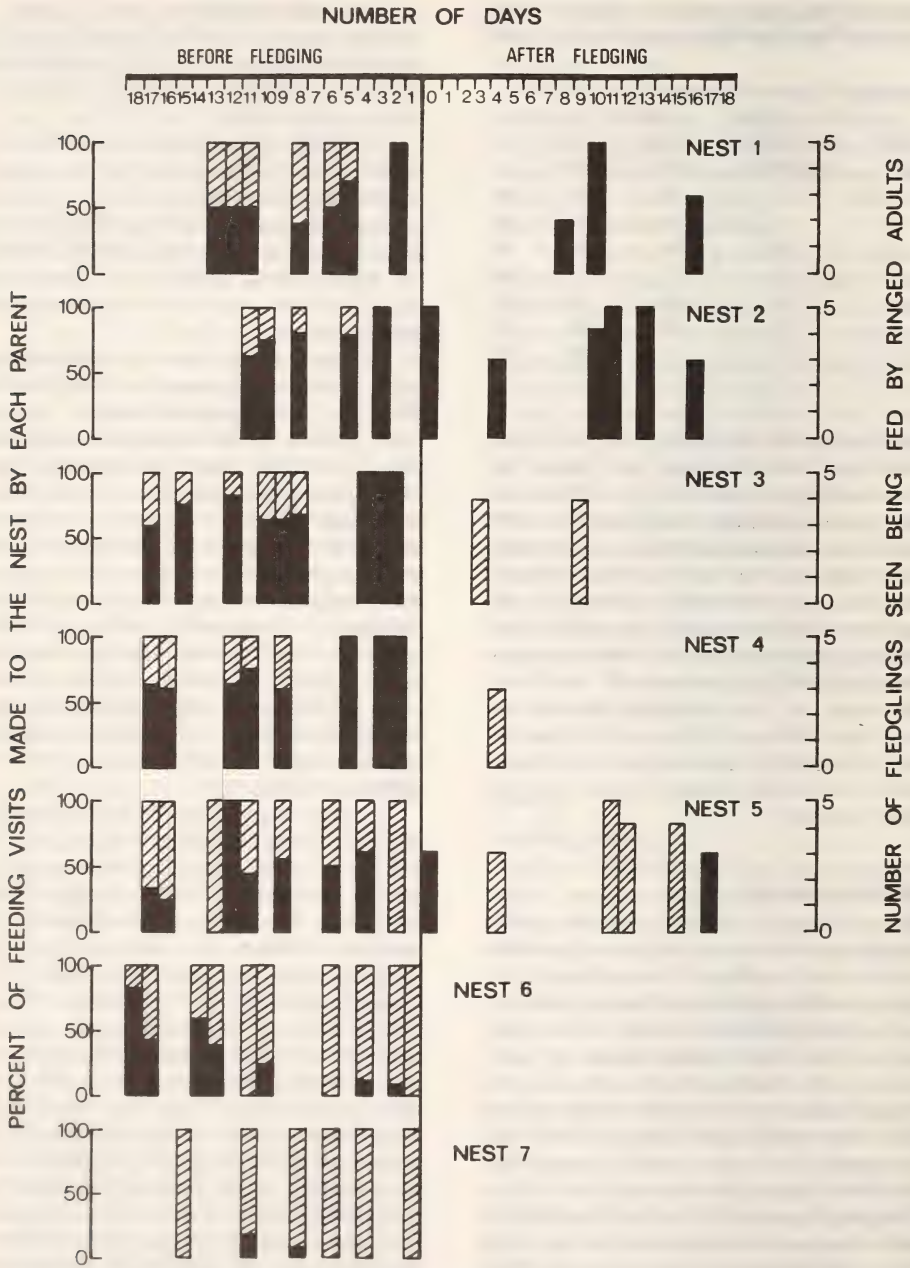

FIGURE 1. Contributions to brood feeding made by males (solid) and females (hatched) during the nestling and fledging periods.

Discussion

The main finding from this study was that one parent took on a progressively greater share of nestling feeding, so that just prior to fledging all the visits to the nest were being made by one member of the pair. The observations were not consistent with polygamous behaviour as in some cases it was the male and in others the female which ceased to feed nestlings. Furthermore, observations of a larger number of ringed birds from the same vicinity produced no evidence that any birds were attending a second brood (H. Young pers. comm.).

Although male and female Great Tits *Parus major* provide food for nestlings at different rates (Smith *et al* 1988), the cessation of nestling feeding by one of the pair has not been recorded for any other species of British tit (Perrins 1979). Such behaviour in the Crested Tit seems paradoxical in view of the increased number of feeding visits made to the nest as fledging approached. However in Dutch, English and Japanese pine woods, the increasing demands for food made on parents by nestlings may be offset, at least in part, by increases in both the availability and size of prey at this time (Kluyver 1950, Gibb & Betts 1963, Royama 1966).

Parental care of the young after fledging was also found to be more complicated than previously thought. Deadman (1973) noted that the groups of fledglings he located were all attended by a single adult and interpreted this to mean that one adult ceased to participate in brood care totally from around the time of fledging onwards. I found that the parent which had ceased to provide food for nestlings returned to feed fledglings in at least three cases (Nests 3, 4 & 5). In the case of the family with both adults ringed (Nest 5) both sexes were observed feeding fledglings on separate days.

Furthermore, assuming that I did not overlook any fledglings, some form of brood division appeared to have been taking place. Adults from nests 1, 2 & 5 were seen with incomplete broods during the first eleven days after fledging, and then with complete broods on subsequent days, so mortality or dispersal of young had not occurred upto this stage. However these alternative explanations cannot be ruled out as reasons for the small brood sizes recorded in the latter part of the fledgling period.

I could not tell whether broods were split and tended by one adult alternately, or divided between the pair, but the observations on the family from Nest 5 (Fig. 1) may indicate that broods were divided differently between the pair on different days. Although brood division does not occur in other British tit species (Perrins 1979) it has been noted in other passerines, including the Robin *Erithacus rubecula* (Harper 1985) and the Song Sparrow *Melospiza melodia* (Smith 1978).

The increase in the rate of parental feeding visits made to individual chicks after fledging could have been because adults fed more small prey items to fledglings than to nestlings, as was inferred by Royama (1970) in a study of food selection by Great Tits. Fledglings may be fed more frequently because adults are able to take chicks closer to sources of food, reducing travelling time and hence increasing the profitability of feeding smaller food items. Also, even though the feeding rate per chick is higher after fledging, the higher potential work load for adults may be offset by smaller brood sizes.

In one of the few other studies to examine parental care of fledglings and the transition to independent feeding, Davies (1976) found that adult Spotted Flycatchers *Muscicarpa striata* showed increasing unwillingness to feed fledglings, as well as reducing the size of food items. No evidence of such behaviour was seen in my study. However, the apparent maintenance of high feeding rates by parents may have been caused by a bias in the sampling towards those broods which were being actively fed. Also if the adults were leaving the fledglings for increasingly long periods of time, as has been shown to occur with other tit species

(Hinde 1952), then decreases in parental feeding effort as the family party period progressed could have gone undetected.

Aggression between siblings began during the second week after fledging, as in other species of tit (Hinde 1952). The coincidence of increased aggression with the rise in fledgling foraging is presumably a result partly of increasing contact (through increased mobility) and increasing competition, as dispersal of these family groups approaches.

Acknowledgments

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APPENDIX. Results of statistical tests

1. Least squares regression of the number of parental nest feeding visits per hour (F) to number of days before fledging (d) is $F = 14.81 - 0.57d, r^2 = 0.23, n = 73, P < 0.05$.
2. The number of parental feeds per fledgling per hour ($n = 5$) is significantly higher than number per nestling per hour ($n = 9$) in the four days after compared with the four days before fledging. Mann Whitney U test, $U = 0, P < 0.05$.
3. Fledgling foraging rates compared with the number of days after fledging. Rank Spearman Correlation, one-tailed test, $r^2 = 0.91, n = 15, P < 0.05$.
4. Fledgling foraging rates compared with increasing aggression. Rank Spearman Correlation, one-tailed, $r^2 = 0.73, n = 15, P < 0.05$.

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Maximum dive depths attained by auks feeding young on the Isle of May, Scotland

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Guillemots made at least one dive of 35 m or more during a feeding trip. In contrast, the deepest dives of Razorbills and Puffins were mainly 20 – 30 m.

Introduction

Most information on the depth to which seabirds dive comes from birds caught in fishing nets. Such records were once considered suspect as the birds could have been caught when the nets were being set or hauled but are now thought to indicate where in the water column birds were feeding (Piatt & Nettleship 1985, Wilson & Bain 1984).

Direct measurements of dive depths are, however, obviously desirable and simple capillary tube gauges have been used to measure the maximum depths attained by auks (Burger & Simpson 1986, Burger & Wilson 1988). Unfortunately, repeated submergence of such gauges to a constant depth can result in spurious estimates (Burger & Wilson 1988) so the birds must be recaught and the gauges removed before birds have made too many dives. This is often difficult to achieve without causing unacceptable disturbance in the breeding colonies. Seabirds on the Isle of May, Firth of Forth, are very tolerant of people and during the deployment of depth gauges on Shags *Phalacrocorax aristotelis* there in 1989 (Wanless *et al.* in press) it was found that capillary gauges could be read *in situ* through a telescope so that a maximum depth could be recorded after a single feeding trip. This note presents data on maximum depths attained by Guillemot *Uria aalge*, Razorbill *Alca torda* and Puffin *Fratercula arctica* using this method.

Methods

Following the method of Burger & Wilson (1988), gauges were made from 100 mm lengths of flexible, plastic tubing (1.6 mm internal diameter) lined with a thin layer of soluble indicator (icing sugar). The tube was sealed at one end and marked with a transverse, thin black line every 10 mm. Gauges weighed c. 1 g (0.1 – 0.25% of the weight of adults of the three species) and had a cross-sectional area of 2 mm^2 (0.2 – 0.4% of the cross sectional area of adult auks).

Tubes were attached (under licence) with a single small cable-tie to a few central upper-back feathers of 13 Guillemots, 12 Razorbills and 10 Puffins which were all feeding chicks on the Isle of May between 19 and 28 June 1990. The nest-sites of these birds were checked every few hours until the bird with a gauge had completed a single foraging trip, after which the length of undissolved indicator remaining in the tube was read using a x60 telescope from a distance of 5 – 30 m. We have no measure of the accuracy of our readings, but they were probably +/– 1 mm (equivalent to +/– 1-4 m over the depth range attained).

The maximum depth (metres) attained during the whole time that the gauge was deployed is given by:

$$d = 10.08 \left(\frac{Ls}{Ld} - 1\right)$$

Where Ls and Ld are the initial and final lengths of indicator in the tube (Burger & Wilson 1988).

Results

Ten (of 13) Guillemots and 11 (of 12) Razorbills were still carrying their depth gauges when they returned from their first feeding trip either on the day of release or early the next morning. Despite frequent checks, none of the Puffins was seen at the colony until the day after their gauges were attached. Six birds were resighted after 20 h, but three others were not seen for 36 h. These three and the one bird that returned without its tube were excluded from the analyses. Reading the lengths of indicator remaining proved easy for Razorbill and Puffin but as some Guillemots preened the upper ends of tubes under the back feathers we could determine only minimum depth values for six individuals.

TABLE 1. Maximum dive depths (m) of individual auks. + indicates a minimum value as the rest of the tube was hidden by the bird's feathers.

	Maximum depth of dive (m)		
	Guillemot	Razorbill	Puffin
	52+	32	33
	49	30	28
	49	26	28
	43	26	23
	40+	23	23
	40+	23	21
	35	23	
	23+	23	
	23+	23	
	10+	18	
		14	
Median	40+	23	25.5

There was strong evidence that Guillemots dived deeper than either Razorbills or Puffins. The four unequivocal Guillemot depths were all 35 m or more, as were three of the six minimum values (Table 1). In contrast, none of the records for Razorbills or Puffins reached 35 m; the deepest dives of these species were mainly between 20 and 30 m.

Discussion

Methodology

Visually assessing the length of undissolved indicator when the depth gauge was still on the bird rather than recatching an individual and measuring the length directly, substantially reduced the amount of disturbance to breeding birds and also allowed data to be collected from a bird too wary to be recaptured. The cable tie method of attachment was quick and easy to use in the field and ensured that gauges stayed attached for only a short time (or at the worst until the bird moulted), thus minimizing any disturbance to the birds carrying them. The only disadvantage was that some Guillemots preened the upper ends of their tubes under their feathers making it impossible to obtain an accurate reading.

Certain aspects of the feeding behaviour of diving birds have been shown to be affected by recording devices (Wilson *et al.* 1986) but effects can be limited by reducing the weight and cross-sectional area of the instrument. The gauges used in this study were both light and streamlined and should, therefore, have had little effect on diving performance. Burger & Wilson (1988) demonstrated that this design of gauge was likely to give inflated estimates if subjected to repeated submersions to the same depth. We also noted that repeated checks of the same gauge showed that the indicator was gradually lost; after several days spurious readings were obtained. Of the data presented in Table 1 those for the Puffin were most likely to be subject to this bias because birds were not resighted for 20 h.

The reason for this is unclear, but previous work on Puffins suggested that their behaviour at the colony may be upset by carrying devices. Concurrent observations of birds without gauges indicated that on average, an adult fed its chick 3 times/day (C. Wernham pers. comm.). Puffins tend to make many short dives during a feeding trip (Wanless *et al.* 1988) so during the time that birds were away they could potentially have made many dives.

Maximum depth and interspecific differences

None of the birds in our study approached the maximum depths of 68, 140 and 180 m so far recorded for Puffin, Razorbill and Guillemot respectively (Piatt & Nettleship 1985, Burger & Simpson 1986, Jury 1986). However, most of the sea within a 30 km radius of the Isle of May (which is the probable feeding range of auks during chick rearing (Bradstreet & Brown 1985)) is less than 60 m deep so there was little scope for birds to make very deep dives.

Dive durations of Isle of May auks indicated that Guillemots made significantly longer dives than Puffins or Razorbills (Wanless *et al.* 1988) which implied that Guillemots could potentially go deeper than the other two species. Our results from the maximum depth gauges also indicated that auks fed at different depths, with Guillemots generally diving to more than 35 m while maximum dive depths of Puffins and Razorbills were mainly between 20 and 30 m. Data from maximum depth gauges cannot elucidate whether the depth recorded is representative of the majority of dives during a trip or whether a bird just made one exceptionally deep dive in the course of a diving sequence, perhaps in pursuit of a fish. However, the differences we recorded are in line with those from other studies which also indicated that Guillemots made deeper dives than Puffins and/or Razorbills (Burger & Simpson 1986, Piatt & Nettleship 1985, Piatt in press).

Combining data on diving depths with information on the bathymetry in the feeding area may provide evidence of where in the water column a species normally feeds. Since most of the sea around the Isle of May is less than 60 m deep, our results suggest that Guillemots must have approached the seabed at least once while they were diving. Hislop & MacDonald (1989) also concluded that Guillemots fed near the seabed in the Moray Firth. The situation is less clear for Razorbills and Puffins. If these species were foraging in the same areas as Guillemots then the data suggest that they would have been feeding in the upper half of the water column. If, however, Razorbills were feeding in water less than 30 m deep, as suggested by Carboneras (1988) and Wanless *et al.* (1990), they too could have been foraging near the seabed.

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Movements of Cormorants from the Lamb, Firth of Forth

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Recoveries of Cormorants ringed as chicks on the Lamb in the Firth of Forth were concentrated in eastern Scotland from Grampian to the Borders. Others were recovered on the west coast of Scotland, the northwest and east coasts of England, and Northern Ireland, the Netherlands, France and Portugal. There were no age-related differences in the directions and distances travelled in winter. First-year birds were more likely to be shot than those more than one year old, though the percentage shot appears to have declined during the last 30 years.

Introduction

The breeding colonies of the Cormorant *Phalacrocorax carbo* in Scotland are restricted to a few localities, and in south-east Scotland their main stronghold is on the Lamb, an island off the Lothian coast near the mouth of the Firth of Forth (Mills 1965). Breeding was first recorded there in 1957 and the colony has a population of around 100 pairs (Harris *et al.* 1987).

The pattern of movements of Cormorants from their colonies has been studied by ringing chicks at many British colonies (Coulson 1961, Mills 1965, Balfour *et al.* 1967, Coulson & Brazendale 1968) but there had been very little ringing on the Lamb colony until the 1970s when the Tay Ringing Group made several ringing trips. This paper presents their results and updates a previous report by Oliver (1974).

Methods

The study was based on 196 recoveries from 767 birds ringed as chicks during the last 10 days of June 1970 – 1977 inclusive. All recoveries refer to dead birds. As 13 years have elapsed since the last birds were ringed, the recovery data are probably complete. The seasons autumn, winter, spring and summer refer to the months August – October, November – February, March and April, and May – July respectively. Recoveries of birds in year classes 1 (less than 12 months old), 2, 3 and 4 or over were treated separately.

Results

The seasonal and spatial pattern of recoveries is shown in Table 1. Dispersal of first-year birds was rapid with autumn recoveries as far away as southern England and France. In winter, recoveries were concentrated on the east coast of Scotland from Grampian to the Borders (Fig. 1), but there were also recoveries from the west coast of Scotland, the east and west coasts of England and from N. Ireland and the Continent. For each age group most recoveries occurred in winter (Table 1) and the median straight-line distances between the recovery location and the Lamb were 72, 105, 75 and 111 km for birds in their first, second, third and fourth (or more) year respectively. The percentage of recoveries to the north of the Lamb were 60, 47, 63 and 52% for the four age groups respectively. There were no significant age-related differences for the distances[1] or directions (north vs south)[2] to the recovery sites in

TABLE 1. Recoveries in autumn (A), winter (W), spring (Sp) and summer (Su) of four age classes of Cormorants ringed as chicks on the Lamb, Firth of Forth.

Location	1st Year				2nd Year				3rd Year				4th + Year				Total	%
	A	W	Sp	Su	A	W	Sp	Su	A	W	Sp	Su	A	W	Sp	Su		
SCOTLAND																		
North		1	1											2			4	2
Northeast	2	18	2			2	1			1				4	1		31	16
Central	4	12	3			1				2				4	1		27	14
Southeast		1	1													1	3	1
Southwest	2	3	1			1			2			1		2	1		13	6
Firth of Forth	12	6	2	3	1	4			1	2	2		4	8	1	6	52	26
ENGLAND																		
Northwest	1	1				1	1			2	1			1	1	1	10	5
Northeast	2	4	3	1		4					2		1	3			20	10
Southeast	1	7			2	1			1					3			15	8
South	3	2	5	2						1				1		1	15	8
N. IRELAND		1															1	1
FRANCE	1					1								1			3	1
PORTUGAL		1															1	1
NETHERLANDS		1															1	1
TOTAL	28	58	18	6	3	15	2	0	4	8	5	1	5	29	5	9	196	
Percentage	14	30	9	3	2	8	1	0	2	4	2	1	2	15	2	5		100

TABLE 2. Seasonal distribution and cause of death of different age groups of Cormorants from the Lamb.

Cause of death	1st Year				2nd Year				3rd Year				4th + Year				Total	%
	A	W	Sp	Su	A	W	Sp	Su	A	W	Sp	Su	A	W	Sp	Su		
Shot	2	24	4		2	3				1				4		1	41	21
Nets	4	2		1		1								1		1	10	5
Oil	3	1	1			1							1	2			9	4
Hit wires		2	1												1		4	2
Choked														1		1	2	1
Sick			1														1	1
Unknown	19	29	11	5	1	10	2		4	7	5	1	4	21	4	6	129	66
TOTAL	28	58	18	6	3	15	2	0	4	8	5	1	5	29	5	9	196	
Percentage	14	30	9	3	2	8	1	0	2	4	2	1	2	15	2	4		100

FIGURE 1. The distribution of winter recoveries of Cormorants from the Lamb (arrowed). *Numbers indicate the number of recoveries at locations marked by larger circles. There were also recoveries in France (2), Portugal (1), the Netherlands (1) and Northern Ireland (1).*

winter. Thirty-four per cent of the birds were recovered on rivers and lochs, including 12 on Loch Leven.

The cause of death was unknown for most of the recoveries. Of the other categories where cause of death was known, most were shot (Table 2); first-year birds were more likely to be shot than were older birds.[3]

Discussion

Coulson & Brazendale (1968) found that Cormorants from different colonies tended to winter in different but overlapping areas, due in part to the geographical location of each colony, but they thought that genetic differences could also influence dispersal. The nearest large colony to the Lamb is on the Farne Islands, from which the winter ringing recoveries show a more southerly component compared with those from the Lamb (Coulson & Brazendale 1968). The fact that winter dispersal appears to be unrelated to age was also noted by Coulson (1961).

Cormorants are shot by managers of fish stocks or fish farmers who believe that Cormorants affect fish populations. The percentage of recoveries of ringed Cormorants reported shot has been declining on the east coast. Coulson & Brazendale (1968) reported that 84% of recovered birds had been shot in 1940 – 49 (the worst decade since 1910), 55% in 1950 – 59 and 38% in 1960 – 64. Thus, the value of 21% for the 1970s and early 1980s (this study) suggests a continued decline in shooting. Most of the recoveries referred to the 1970s so this reduction was unlikely to have been influenced much by the 1981 Wildlife and Countryside Act which changed the status of the Cormorant to a protected species, though it is still possible to kill Cormorants under licence.

Acknowledgments

We thank fellow members of the Tay Ringing Group who took part in the ringing trips, and the RSPB for permission to ring the birds. M. Marquiss and R.E. Green commented on the draft.

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APPENDIX. Results of statistical tests.

1. Kruskal – Wallis one way ANOVA Chi-square = 0.08, ns
2. Chi-square = 1.3, 3df, ns
3. Chi-square = 7.7, 1df, P< 0.01

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Short Notes

Differences in weight:wing length relationships of Razorbill chicks at Hermaness and Fair Isle in 1989

In recent years several species of seabird have suffered a reduction of breeding output in Shetland (Heubeck, M. & Ellis, P.M. 1986. *BTO News* 143: 10; Heubeck, M. 1988. *BTO News* 158: 1–2; Heubeck, M. 1989 (Ed). *Seabirds and Sandeels*. Shetland Bird Club, Lerwick). In general, failures have been more severe in surface feeders such as Kittiwake *Rissa tridactyla* and Arctic Tern *Sterna paradisaea,* whereas species which dive to catch their prey appear to have been less affected (Harris, M.P. & Riddiford, N.J. 1989. *SB* 15: 119–125; Heubeck 1989). It has also been apparent that the level of decline has not been uniform throughout Shetland and some colonies have been more severely affected than others (Heubeck 1989). This note presents data on weight:wing length relationships of Razorbill *Alca torda* chicks at two Shetland colonies in 1989 – Hermaness National Nature Reserve on Unst, and Fair Isle, 160 km to the south.

As the exact ages of chicks measured was unknown, wing length was used as an indicator of age and its growth assumed to be unaffected by external conditions. Typically the Razorbill chick wing continues to grow throughout the three weeks between hatching and fledging (a term used for convenience, even though the chick cannot fly when it leaves the nest), whereas weight increases up to day 12 and then levels off or even decreases (Barrett, R.T. 1984. *Seabird* 7: 55–61; Birkhead, T.R. & Nettleship, D.N. 1985. *The Atlantic Alcidae*. Academic Press, London).

Wing lengths were measured to the nearest millimetre by taking the maximum chord length (excluding any down on feather tip) using a stopped wing rule. Weights were taken to the nearest gramme using a Pesola balance. Data from Hermaness were collected on 4 and 14 July, with *c*.50% of chicks estimated to have fledged on the latter date. Two other visits were made, on 27 June when most chicks were less than two days old, and 27 July, when all but one chick had fledged. Data from Fair Isle were collected between 19 June (when some well-grown chicks were present) and 11 July (when most chicks had fledged), with most chicks weighed and measured on five dates between 22 June and 1 July (69 chicks). Forty-three chicks were weighed and measured and six were reweighed on Hermaness; 84 were weighed and measured on Fair Isle.

Although few small chicks at Fair Isle were weighed and measured it is still clear that weights of Fair Isle chicks were much higher than those at Hermaness (Fig. 1). At a wing length of 60–65 mm, the mean weight of Hermaness chicks was 91.0 g (n = 12), 50% less than comparable chicks on Fair Isle (mean = 182.5 g, n = 11). Of the six chicks on Hermaness that were reweighed, four failed to gain weight over a ten-day period between 4 and 14 July. Weight changes (g) were +22, +11, 0, −1, −14, and −20. On Hermaness no chicks were found with wing lengths in excess of 66 mm, and as no larger chicks were found alive or dead it is assumed that Hermaness chicks fledged with shorter wing lengths than those on Fair Isle.

There are two possible interpretations of the data; either the weight:wing length relationship of Razorbill chicks always differs between Hermaness and Fair Isle, or the difference was due to Hermaness chicks receiving less or poorer quality food than those on Fair Isle. Although there is no evidence to disprove the former we consider it extremely unlikely. Moreover the weights of Hermaness chicks throughout their development are lower than values published for a range of five other colonies

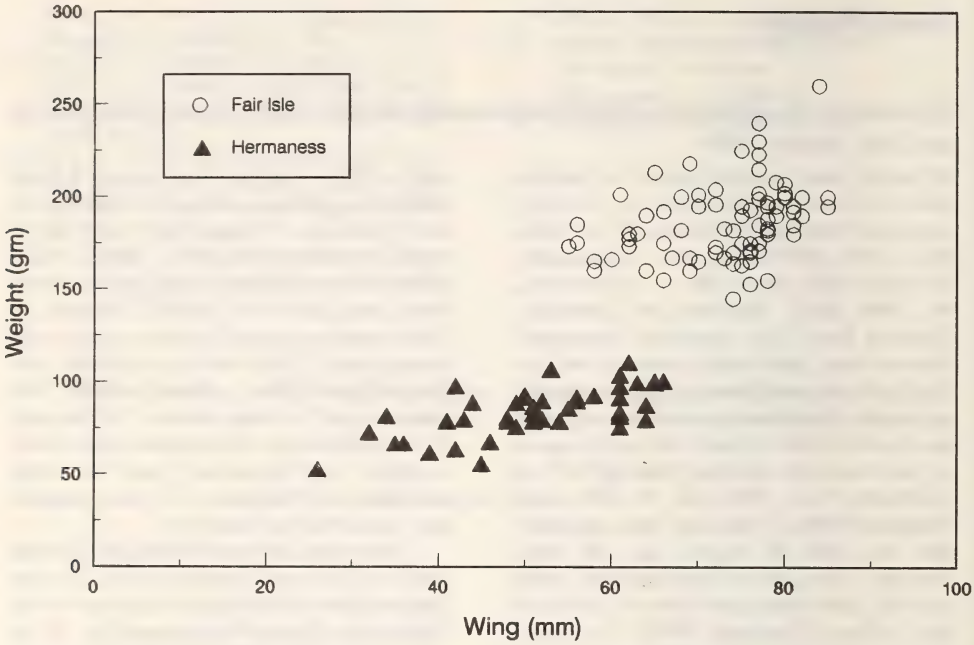

FIGURE 1. The relationship between weight and wing length of Razorbill chicks on Fair Isle and Hermaness, Shetland in 1989.

(Barrett 1984), and if growth of the wing *was* affected by external conditions the difference in weights between Fair Isle and Hermaness chicks would have been even greater.

We do not have measurements of the feeding frequency for chicks at the two colonies, but whereas birds on Fair Isle were seen to feed their chicks entirely on sandeels *Ammodytes sp.* adults at Hermaness frequently brought in small rockling *Rhinonemus sp.* which have a lower calorific value than sandeels (Birkhead & Nettleship 1985; Harris, M.P. 1984. *The Puffin.* Poyser, Calton).

The percentage of rockling in the diet of Puffin *Fratercula arctica* chicks at Hermaness has also increased in recent years in conjunction with a reduction in breeding success (Martin A.R. 1989. *Bird Study* 36: 170 – 180); it appears now that Razorbill chicks there are being similarly affected.

We thank P. Howlett, J. McKee, A.F. Silcocks and the Shetland Ringing Group for much help with the fieldwork, and M.P. Harris, M. Heubeck, M.G. Richardson and S. Wanless for improving the manuscript. The work on Fair Isle was commissioned by the Nature Conservancy Council. Hermaness data were also collected while under NCC contract.

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Pink-footed Goose numbers at arrival sites in eastern and central Scotland

The Icelandic/Greenlandic population of Pink-footed Geese *Anser brachyrhynchus* which winters in Britain has increased substantially in the last decade (annual goose count summaries in *Wildfowl*). The geese are also utilizing new areas and their status has changed dramatically at some sites. They arrive in Britain from the third week of September and by the end of that month and in early October very large concentrations occur at a few sites. In autumn 1988 on the weekend of 8/9 October there were 30,000 Pinkfeet at Loch of Strathbeg, a minimum of 40,000 in Strathearn and 40,000 at West Water Reservoir; Strathearn held 39,000 a week earlier. Numbers then fell sharply in Strathearn and at West Water Reservoir.

In early autumn 1989 a more detailed count was organised for the main Pinkfoot roosts in east and central Scotland (Table 1). Totals of 118,810 and 170,965 were found on 30 Sep/1 Oct and 7/8 Oct respectively. There were very large concentrations at Strathearn, West Water Reservoir and Hule Moss on the first weekend, and by 7/8 Oct a further four sites held over 10,000 geese. All sites showed an increase over the week between the two counts except Meikle Loch.

The pattern of arrival in 1989 was different from the last few autumns with low numbers in the north and exceptional numbers in the Lothians and Borders. The rise in importance of West Water Reservoir in the last few years has been remarkable, and the number at Hule Moss in Berwickshire in autumn 1989 was the largest on record. It is thought that this site also held very large numbers in early October 1988. Observers in all areas commented on major arrivals on 26 and 27 September. There were only 1700 in Strathearn on 25 Sep, while in Strathallan numbers rose by *c*.1000–1500 per day from 27 Sep to 4 Oct when 14,200 were present. Approximately 20,000 were at Strathbeg on 26 Sep but most passed through leaving just 7900 on 1 Oct. Birds also overflew Montrose where there were 4000 on 28 Sep but only 900 on 1 Oct. There was constant movement of Pinkfeet in the Perth area from late September with geese coming and going in all directions.

After 7/8 Oct numbers at Strathbeg increased to 26,950 on 15th and 32,000 on 22nd so the eventual peak here was of similar size but about two weeks later than in the previous four autumns. In Strathearn numbers fell to 16,000 on 22 Oct and only 5100 were present on 4 Nov. However numbers increased to *c*.15,000 at Loch Leven by 29 Oct with a record peak of 18,000 here three weeks later, while

TABLE 1. Numbers of Pinkfeet at arrival sites in east and central Scotland in September and October 1989.

Site	Region	30 Sep/ 1 Oct	7/8 Oct
Loch of Strathbeg	Grampian	7900	17600
Meikle Loch	Grampian	8520	5930
Montrose Basin	Tayside	900	11000
Loch Leven	Tayside	7000	9200
Strathearn	Tayside	28700	31000
Strathallan	Tayside	9200	10800
Upper Forth Valley	Central	220	3400
Cameron Reservoir	Fife	nc	*c*.2000
Aberlady Bay	Lothian	1900	2200
Fala Flow	Lothian	5100	11920
Gladhouse Reservoir	Lothian	320	3930
West Water Reservoir	Borders	29250	36250
Hule Moss	Borders	19800*	25735
TOTAL		118110	170965

nc = not counted
* count on 28 Sep

Cameron Reservoir also held 9500 on 18/19 Nov. West Water Reservoir continued to hold large numbers until late October (23,170 on 21/22 Oct) but then numbers fell to 4150 by 18/19 Nov. In contrast, numbers at Hule Moss had declined to *c*.4500 by 21/22 Oct and only *c*.2500 were present in the area on the weekend of the national count.

These results show that some sites are exceptionally important for Pinkfeet when they first arrive in Scotland. Some, such as Strathearn are of long standing, but others such as Loch of Strathbeg, West Water Reservoir, Hule Moss and Montrose Basin have become progressively more important in recent years. Conversely, some sites (Meikle Loch, Loch Leven and Gladhouse Reservoir) have become relatively less important in early autumn but are used by large numbers later in the winter.

Several sites in Tayside which can each hold several thousand Pinkfeet later in the autumn were not counted on 7/8 October and the above total represents a minimum number of birds present in eastern and central Scotland. Also it is not known how many were on the Solway or in Lancashire at this time though 21,500 were at Martin Mere by 19 October (*BB* 83:78). It therefore seems likely that the total population of Pinkfeet in Britain in autumn 1989 exceeded 200,000 for the first time.

The large number of Pink-footed geese found in early October suggests that a complete count of all sites in mid-October might offer a better assessment of their winter population than currently obtained from the national Wildfowl and Wetlands Trust counts in mid-November. In some years it is possible that some geese may still be in Iceland in the first part of October and numbers could be underestimated. However, counts in mid-November are also open to question as roosting and feeding behaviour can be unpredictable due to disturbance by shooting, temporary flooding and local variability in food supply at this time.

These counts were a cooperative venture involving the Central Scotland Goose Group and the Lothians and Borders Goose Groups. In particular, we thank J.Dunbar, R. Goater, P.R. Gordon, J. Kirk, I. Patterson, R.W.J. Smith, C. Smout, R. Walker and G. Wright for undertaking counts.

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Common Sandpiper stalking and catching small fish

On 26 July 1989 between 1650 and 1705 GMT an adult Common Sandpiper *Actitis hypoleucos* was seen foraging along the edge of a small shingle island in the River Tay at Aberfeldy, Tayside (NN 851 491). The bird was watched at a distance of approximately 50 m in very good light and partly with the aid of 8 × 30 binoculars.

When first noticed the sandpiper was feeding on the far side of the stony islet, which was about 2 m from the bank of a narrow, tree-covered island in the river. Initially, foraging consisted of quick pecks directed at the surfaces of the shingle and/or the shallow water. The bird was moving downstream and when it reached the end of the shingle it crouched and held its head low and horizontally. It then took slow deliberate steps. A sudden dash forward, involving between two and four steps, ended with the sandpiper stabbing its head into the water and emerging with a dark, rapidly-flexing object held crosswise in its bill. From its overall shape and movements the prey

item was clearly a small fish. The bird immediately ran towards the middle of the shingle and stunned or killed the fish by knocking it against the pebbles. The whole fish was then swallowed head first.

The bird continued to hunt in this manner as it moved upstream on the shingle margin directly opposite my elevated position on the south bank. With the aid of binoculars I could see ripples in the water made by small fish as they swam into deeper water in front of the stalking sandpiper. In the same manner as described above, the sandpiper caught and ate another two small fish as it worked its way to the upstream end of the shingle bar. For none of the fish was it possible to identify the species.

The bird stopped foraging at 1705 GMT after which it preened and roosted.

The third fish caught was about as thick, laterally, as the base of the bird's bill and just slightly longer than it. Mean measurements for bill length and bill depth (taken at the proximal end of the nares) of adult Common Sandpipers caught in Glen Clova, Tayside were, respectively, 25.3 mm +/− 0.4 SE (range 24 – 28 mm, n = 10) and 5.6 mm +/− 0.04 SE (range 5.0 – 6.3 mm, n = 52; own data).

Studies in England suggest that terrestrial invertebrates are the main prey of adult Common Sandpipers during the breeding season (Holland P.K. *et al* 1982. *Bird Study* 29: 99 – 110). The shingle areas within the linear riverine territories are mainly associated with the feeding activities of chicks from around 5 days old "up to and beyond fledging" (Yalden D.W. 1986. *Ibis* 128: 23 – 26). In both studies shuffle samples were used to assess potential aquatic prey. This method of sampling is likely to underestimate the availability of motile prey such as small fish. None of the above authors refers to small fish being taken as part of this species' diet during the breeding season.

The diet of the Common Sandpiper is "chiefly immobile or free-flying invertebrates, particularly insects" (*BWP* Vol. III: 594 – 605). It is also said to be "adept at stalking with head low and horizontal" when foraging on insects. The account in *BWP* describes a wide variety of terrestrial and aquatic insect prey, some spiders, crustaceans, molluscs and annelid worms but simply notes that small frogs, tadpoles and small fish are also taken. No information is given on species, mode of capture, frequency or time of year that fish are taken. None of the 117 stomach contents examined, from birds collected throughout the year across the USSR, Europe and North Africa, have contained evidence of small fish.

R.H. Kettles (1973. *BB* 66:397) describes one of two Common Sandpipers, at Staines Reservoir, Middlesex in January 1972, holding a small fish in its bill and "manipulating it against the concrete bank". The bird was not seen to eat the fish and there is no indication given as to whether the fish was alive or dead. Kettles cites a report in the London Natural History Society's Ornithological Bulletin (March 1973) of a Common Sandpiper, at the same location, which "found a small dead fish" and swallowed it "head first like a grebe". This fish was slightly longer than the bird's bill.

It seems that fish are an unusual prey for the Common Sandpiper. However observations of foraging birds on river shingle are generally difficult to make (Yalden D.W. 1986. *Bird Study* 33: 214 – 222) and I would appreciate learning of any similar observations to my own from elsewhere.

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Hunting distance of breeding Merlins in Grampian indicated by ringed wader chicks taken as prey

Little is known about the hunting distance of breeding Merlins *Falco columbarius* or whether the hunting ranges of adjacent pairs overlap (*BWP* Vol. 2). Merlins tracked by radio telemetry hunted at least 4 km from the nest in Wales (C.J. Bibby, pers. comm.) and in Alaska, foraging flights of six breeding males averaged from 3 – 5 km with the maximum flight greater than 8 km (Schempf, P.F. 1989. *The Raptor* 1: 22 – 24).

In 1986 – 88, as part of a study of farmland waders in southeast Grampian (N.P. & D.C.C. 1987, 1988. *Waders of Agricultural Land*. ITE Research Reports Nos. 1 & 2. ITE, Banchory) broods of Lapwing *Vanellus vanellus* chicks were ringed and colour-marked or their parents were colour-marked, to study movements and habitat use. These broods were monitored at one – to two – day intervals, so the age at which chicks disappeared could be estimated within at most two days. During collections of prey in Merlin breeding territories, G.W.R., B.L.C. & A.D. found the rings at two sites, A and B, in May-July from 13 of the Lapwings (Table 1). These territories were 5 km apart and a third, C, was situated midway between them (Fig. 1a).

Merlins from another nesting territory, D, about 15 km away, took two Lapwing chicks in 1988 which had been ringed on farmland adjoining the moor (Fig. 1b). The age of these chicks when killed was estimated by comparing their tarsus length

TABLE 1. Minimum distance between Merlin nest sites and sites from which 15 Lapwing chicks and one Golden Plover chick were taken as prey. + = Golden Plover, * = Lapwings from the same brood, af = arable farmland, hm = heather moor, m = marsh, pp = permanent pasture.

Year	Merlin nest territory	Habitat of last known location of chicks	Estimated age of chick, days (and date taken)	Minimum distance from Merlin nest to prey location km
1984	D	hm	10 (3/6)	3.8+
1986	A	af	5 (10/6)	5.6
1986	A	m	6 (29/5)	3.3
1986	B	m	32 (5/7)	2.9
1987	B	af	9 (27/6)	3.8
1987	B	af	16 (6/7)	3.3
1988	A	af	12 (9/5)	5.6*
1988	B	af	12 (10/5)	3.4*
1988	B	m	4 (14/5)	2.9
1988	B	af	4 (1/5)	3.6
1988	B	pp	4 (8/5)	2.0
1988	B	pp	5 (7/5)	2.0
1988	B	pp	5 (7/5)	2.0
1988	B	pp	9 (8/5)	2.0
1988	D	pp	15 (2/7)	3.8
1988	D	pp	17 (2/7)	3.8

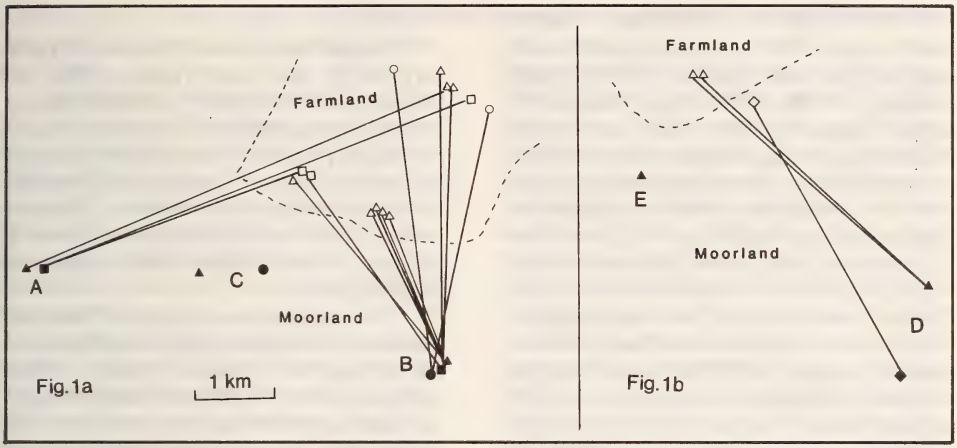

FIGURE 1. Merlin nesting territories A – E and sites from which ringed wader chicks were taken. *Open symbols = site where wader brood last located; solid symbols = Merlin nest site; 1984 = diamonds; 1986 = squares; 1987 = circles; 1988 = triangles.*

with that of chicks of known age (N.P. & D.C.C. unpubl. data). It was assumed that they had not moved far from their ringing site (see Redfern C.P.F. 1982. *Bird Study* 29: 201 – 208). A colour-ringed Golden Plover *Pluvialis apricaria* chick was found as prey in this territory in 1984 and details were known for it (R.A. Parr, pers. comm.) (Fig. 1b).

The ring recoveries showed that Merlins from nest territories A and B hunted the same farmland in 1986 and 1988 (Fig. 1a). In fact, in 1988, each took a chick from the same brood of two Lapwings (Table 1). In 1988 G.W.R. saw the male Merlin from nest territory E fly to the farmland hunted by the birds from nest territory D. We have also seen the male Merlin from nest territory A, on several occasions after a food delivery, fly directly through nest territory C in the direction of the farmland.

All but one of the Lapwing chicks was between 4 and 17 days old, and the mean weights for these ages would have ranged from *c*.15 – 62 g (N.P. & D.C.C. 1988). The 32-day-old Lapwing was caught and weighed the day before it disappeared, and was then only 88 g, which was light for that age.

Overall, the mean estimated age at which unfledged wader chicks were taken by these Merlins was 10.3 days +/− 7.1 s.d. and the mean minimum distance flown to catch them was 3.4 km +/− 1.1 s.d., range 2.0 – 5.6 (n = 16 chicks, Table 1). These hunting flights are similar to those obtained in Wales and Alaska, and the hunting ranges of at least two pairs were shared.

We thank the estates concerned for permission to study the Merlins and waders. We are grateful to R.A. Parr and A. Thorpe for additional ringing data, and L.D. Steele for some assistance with fieldwork. G.W.R. was employed by the R.S.P.B. in 1987 and 1988 during the time Merlin monitoring was undertaken.

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Merlin killing and retrieving a Dipper from a loch

On 22 April 1989 during northerly winds and frequent snow showers, I visited Loch Callater, at 500 m OD, near Braemar in upper Deeside. At 2014 GMT I saw a cock Merlin *Falco columbarius* strike a Dipper *Cinclus cinclus* c.30 m from the shore. As they lost height the Merlin dropped the Dipper into the water, hovered, then flew off in a wide circle. A few minutes later the Merlin returned to the now-motionless Dipper, hovered again and then dropped onto it with wings outstretched. After a pause it managed to lift the Dipper from the loch and struggle to the shore, where it landed. Some Common Gulls *Larus canus* arriving at the loch to roost started to mob the Merlin and it flew away still clutching the Dipper.

There is a previous record of a Merlin lifting prey from water; a female retrieved a Dunlin *Calidris alpina* which it had dropped in the sea when two Carrion Crows *Corvus corone* mobbed it (Galloway B. 1981. *BB* 74: 264).

Merlins mainly hunt open country and very rarely take such riparian birds as Dippers, Grey Wagtails, *Motacilla cinerea* or Common Sandpipers *Tringa hypoleucos* presumably because this habitat is usually too enclosed. Of 3748 prey items recorded by G.W. Rebecca in northeast Scotland between 1980 and 1986 there were only 2 Dippers, 5 Grey Wagtails and 3 Common Sandpipers.

The present observation is of interest because it describes success in killing and retrieving an unusual prey, which presumably the Merlin had taken because its main prey at this time of year, the Meadow Pipit *Anthus pratensis* was scarce in the cold weather. The Dipper, which weighs from 50 to 76 g, is also a rather heavy item for a cock Merlin 160 g to kill, so it is all the more surprising that such a bulky prey could be retrieved from water.

I should like to thank M. Marquiss and G.W. Rebecca for comments on an earlier draft and G.W. Rebecca for permission to quote unpublished data.

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Proximity of successful Ring Ouzel and Mistle Thrush nests

On 12 May 1990 in an area of upland scrub at 300 m OD in the Leithen Valley, Borders Region, I brushed against a rowan *Sorbus aucuparia* and accidentally caused a brood of two nestling Mistle Thrushes *Turdus viscivorus* to "explode" from their nest, which I had failed to notice in the tree. Their sudden departure elicited alarm calls from a nearby pair of Ring Ouzels *Turdus torquatus* (although not from the parent Mistle Thrushes). After a brief search, I located a Ring Ouzel nest containing three well-feathered young, close to the Mistle Thrush nest. Since it has been suggested that Mistle Thrushes may compete successfully against Ring Ouzels for territories in upland areas (Durman, R.F. 1978 *Edinburgh Ringing Group* 5: 24 – 27; Simms, E. 1978 *British Thrushes* Collins, London), I returned to the site on 21 May, by which time the Ring Ouzel brood had fledged, and took details of the nest sites.

The breeding site was a west-facing disused quarry, the steep slopes of which were largely grassed over, and the flatter top colonised by rowan and silver birch *Betula pendula*, with a dwarf shrub layer of heather *Calluna vulgaris* and blaeberry *Vaccinium myrtillus* and a field layer of grasses. It is in a traditional Ring Ouzel breeding area

(Murray, R.D. 1986. *Borders Bird Report* 1985: 50 – 52; Poxton, I.R. 1987. *SB* 14: 205 – 208).

The Mistle Thrush nest was in the main fork of a rowan, 1.05 m above ground-level, and the Ring Ouzel nest was 1.10 m below the lip of the quarry, on a ledge under the roots of a birch. The ground-distance between the nest-cup centres was 6.45 m and the vertical height difference was 1.05 m. The distance between the nest-cup centres was thus 6.53 m.

Durman (1978), in a treeless study area in the Pentland Hills, Lothian Region, recorded two instances between 1973 and 1977 of the two species nesting within 50 m of each other. In the same study area between 1979 and 1984, two instances were found of both species nesting within 100 m of one another and one instance of them nesting 10 – 15 m apart (Poxton, I.R. 1986. *SB* 14:44 – 48). Durman (1978) reported noticeable aggression between Ring Ouzels and Mistle Thrushes where both were ground-nesters during a period when the Mistle Thrush population in the Pentland Hills seemed high. In the same area, Poxton (1986) saw no aggression, even in the case of the two nests being only 10 – 15 m apart, but the Mistle Thrush population was low at that time (1979 – 1984) following the cold winters of 1978/79 and 1981/82.

This note shows that the two species can nest about 6.5 m apart and not only successfully, but concurrently, since their nest-building, incubation and nestling periods are of similar durations. It may be that the two species can co-exist, even when the Mistle Thrush population is presumably high following a series of mild winters, where one (Mistle Thrush) is able to nest in a tree and the other (Ring Ouzel) on the ground.

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Chaffinch egg hatched by Blue Tit

On 16 May 1989 I found a Blue Tit *Parus caeruleus* incubating nine eggs in the nest of a Chaffinch *Fringilla coelebs*. Five of the eggs had been laid by the tit, the other four by a Chaffinch. The nest was deep inside a hawthorn *Crataegus monogyna* hedge, about 30 cm from the top, beside a busy road at Kirkton, near Dumfries. On 19 May the tit was still incubating the same number of eggs but on 25 May one finch egg had hatched, either that morning or the previous day. On the 27th the young Chaffinch appeared to be thriving and no other eggs had yet hatched. On the 29th the nest contained five newly-hatched tits and two finch eggs but the young Chaffinch had disappeared. One finch egg was found broken below the nest but there was no sign of the missing chick. It was assumed to have died and been removed as Blue Tits will sometimes carry away small dead chicks. (Perrins, C. 1979. *British Tits* Collins, London). Two days later the nest was empty.

Blue Tits have occasionally been recorded using the old nests of other species including Blackbird *Turdus merula*, Song Thrush *Turdus philomelos*, Dunnock *Prunella modularis*, Wren *Troglodytes troglodytes*, House Martin *Delichon urbica*, Rook *Corvus frugilegus* and Greenfinch *Carduelis chloris* (Took, G.E. (and note by Jourdain, F.C.R.) *BB* 27: 72 – 73).

Usurpation has been noted by M.C. Radford (*BB* 45: 30) who watched a pair of Blue Tits drive Great Tits *Parus major* from a nest box containing eggs. However the only record I have found of Blue Tits hatching the eggs of other species concerns Pied Flycatchers *Ficedula hypoleuca* in Wales (Lovegrove R.R. & Hope Jones, P. *BB* 61: 268) where the young flycatchers and tits both fledged successfully.

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Little Ringed Plovers breeding in Fife

On the evening of 17 June 1989 at a disused gravel pit in Fife, I heard an unfamiliar bird-call. It was a Little Ringed Plover *Charadrius dubius,* which I watched back to a stony ridge where I located a nest. The four eggs were considerably smaller than those of the Ringed Plover *Charadrius hiaticula* and were a warm buff colour with dirty 'scratchings'. Both adults were calling near to the nest. About 150 m from the Little Ringed Plover's nest, I found a Ringed Plover's nest on a shingle tongue. Another pair of Ringed Plovers was holding territory some 200 m N of the first nest, but appeared to have failed.

In the early morning of 19 June, the Little Ringed Plover's nest was empty, although the eggs had shown no sign of chipping on 17 June. No eggshells were present in, or around the scrape. The adults were making a new scrape near the original nest site, and on 20 and 21 June I watched them in courtship display. I assumed that their nest had been lost.

On the evening of 22 June, the 'failed' pair of Ringed Plovers was present some 200 m from the empty Little Ringed Plover nest, whilst an adult Little Ringed Plover, much agitated, attacked them. As I watched, a tiny chick stood up, followed eventually by three others. They were very active in the fine weather, running around and feeding, with the adult Little Ringed Plover circling and calling constantly. I ringed all four chicks under licence. They were much smaller than Ringed Plover chicks and were bright buff, with finer bills. When I laid them down and retired 10 m, the adult landed making a soft 'peep' note. The chicks immediately ran to it and were brooded.

On 23 June the Little Ringed Plover chicks were in an area of wet pools in the NW corner of the pit, and from then on fed along the muddy edges. By 27 June, the pit had several pieces of earth-moving equipment in it, which were being used to fill the area with topsoil. The Manager of the nearby works agreed to delay the fill to allow the birds to fledge.

I visited the site daily thereafter and the four chicks remained near the pools. The Ringed Plover brood, which had hatched by 26 June, was established on the dry ridges in the middle of the pit. On 6 July, some gravel at the edge of the ponds used by the Little Ringed Plover chicks, was moved. I watched the brood whilst this operation started and the adults led them away from the site to another area in the SW corner. On 8 July, both family parties of plovers were in the same area, and much interaction took place.

Clearly, the Ringed Plover was dominant, both adults continually harrying the Little Ringed Plover pair with threat displays of bowed head and outstretched wings. After perhaps five minutes of harmony, the Little Ringed Plover male would walk back into the area in which the Ringed Plover chicks were feeding. The larger pair immediately chased the little male, which continued into flight on many occasions. It was fascinating to watch this confrontation, the more agile Little Ringed Plover usually avoiding the larger bird. I observed this behaviour for several hours and once saw the Little Ringed Plover adult knocked to the ground by the chasing pair, which landed on and buffeted him. The flight of both species contrasted markedly, with Ringed Plover using slow wing beats and much gliding, the other having a rapid sandpiper-like action.

By 12 July, the four Little Ringed Plover chicks were fully feathered and the first tentative flight was attempted in strong winds. This was 24 days from assumed hatching date. They still crouched if disturbed, but over the next three days, flights became longer and more controlled. All had departed by 16 July, four days after the chicks' first recorded flight.

Thereafter, they were not recorded at this site. However on 30 July, a ringed juvenile Little Ringed Plover was present at

a lagoon approximately one mile away. It was sharing the pool with two of the Ringed Plover juveniles seen there for several days.

The breeding site is now filled and unusable by the species. These are the first sightings and breeding record of the Little Ringed Plover in Fife, and only the second breeding record for Scotland. The first was in Lanark in 1968 (Stalker D. *SB* 5: 282 – 3).

A displaying male Little Ringed Plover was present at a nearby pit from 3 – 23 May 1990, but no female appeared. This site was being filled in by 23 May.

I would like to thank Mr J. Kerr and the Directors of the Sand and Gravel Company for their active co-operation, without which the story may not have had such a happy outcome.

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Nuthatch breeds in Scotland

The mature, well-wooded policies of many Border estates appear to be ideally suited to the Nuthatch *Sitta europaea*. One was seen at The Hirsel, Berwickshire in April 1928 (E.V. Baxter & L.J. Rintoul 1953. *The Birds of Scotland*. Oliver & Boyd, Edinburgh) and there have been occasional reports since then. In the eastern Borders generally, records of Nuthatch have become more frequent in recent years and V.M. Thom (1986. *Birds in Scotland*. Poyser, Calton) thought it likely that, in view of the increase in sightings, they would breed in Scotland.

On 6 May 1989, I found a clutch of six Nuthatch eggs in one of the nest boxes I had put up several years previously at The Hirsel. The box, designed for tits, had an entrance hole of 1⅛″ (28 mm) diameter, and was about 2 m above the ground. It was in an oak *Quercus* sp. on the edge of the deciduous woodland lining the banks of a stream valley. The interior of the box had been partly lined with mud and the back and one side had been plastered to the tree. Nest building was well advanced on 22 April, and it is estimated that the first egg was laid on 27 April, and that the young hatched on 16 May. All six young had fledged by 9 June. This is the first known successful breeding record for Scotland. The previous records are of one said to have been caught on the nest in Roxburgh in 1850 (this is unsubstantiated and not accepted) and of a pair which built a nest in Kirkcudbrightshire in 1927 (Thom 1986).

The nest box scheme I operate on The Hirsel is by kind permission of Sir Alec Douglas-Home; my thanks to him for his support and interest.

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Shore Larks nesting in Scotland in 1977

The first definite proof of breeding by Shore Larks *Eremophila alpestris* in Britain came from a nest found in 1977 (Batten L.A. *et al.* 1979. *BB* 72: 376), although the details given below have previously been withheld.

On 25 June 1977 I flushed a Shore Lark almost at my feet. It did not call and landed about 20 m away. Almost immediately there was a loud, sharp single note and a brighter-plumaged bird, presumably the male, landed 4 m in front of me. It then ran towards the first bird in a hunched attitude calling almost continuously. I looked down and saw a nest at the edge of a patch of short rushes. It was made of sedges and grasses and lined with white fibres from cotton grass *Eriophorum* spp. The cup was 68 mm wide inside, 50 mm deep and contained three very pale blue-green eggs marked with dense, pale buff-brown spots

and blotches. The darker markings were less dense than on a Skylark's *Alauda arvensis* eggs. At least one juvenile was seen at the site from 12 August to 7 September. The nesting habitat comprised gravel and flattened, rounded boulders interspersed with patches of short rushes and moss on a mountain top in the Central Highlands.

Previously a male summered in suitable breeding habitat in the Highlands in 1972, and a pair almost certainly nested there successfully in 1973 (Watson A. 1973. *BB* 66: 505 – 8). There were no reports in 1974 and only single males in 1975 and 1976 (Ferguson – Lees I.J. 1977. *BB* 70:15; Sharrock J.T.R. 1978. *BB* 71:23). Unusually many Shore Larks were seen in Scotland during the autumn and winter of 1976 (*SBR* 1976 – 1977). Following the cold, late spring of 1977 two singing males were found in suitable breeding habitat in addition to the breeding pair described here (Batten *et al* 1979). There has been no subsequent summer record.

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An observation of a Heron plunge-dive

Herons *Ardea cinerea* usually take prey from a standing posture on land or in shallow water (Lowe, F.A. 1954. *The Heron*. Collins, London; Cook D.C. 1978. *Bird Study* 25: 17 – 22). A number of less common hunting strategies are also cited by Lowe (1954). He describes Herons observed swimming after prey, picking fish from surface waters in flight like gulls, and plunge-diving for fish. R.V.A. Marshall (1961. *BB* 54: 202) also reports having observed Herons plunge-diving for fish at Abberton Reservoir, Essex. We report here an observation of a Heron both swimming and later plunge-diving in pursuit of ducklings in deep, open water.

The observation was made at 1130 BST on 16 May 1990 on Loch Kinord, Dinnet, NE Scotland. Weather conditions were mild, with low cloud and intermittent drizzle. Wind was light and the loch calm. We first observed the single Heron swimming in water at least 2 m deep (M. Lucas pers. comm.) about 50 m to the west of a large island (Castle Island) which lies at the NW end of the loch. The Heron was sitting high in the water with its neck erect in a similar manner to a Cormorant *Phalacrocorax carbo*. We noticed that the Heron was closing on a flotilla of ten Mallard *Anas platyrhynchos* ducklings (body length about 10 cm) which all dived when the Heron was a few metres away. The Heron lifted easily from the water and flew directly to the west shore of Castle Island where it stood looking back towards the ducklings which had resurfaced and continued to swim towards the same island. After a few minutes it flew directly over to the ducklings and plunge-dived amongst them from a height of 5 – 10 m. On impact with the water it grabbed one of the ducklings and immediately rose from the water and flew back to the same west shore of Castle Island. The duckling was held suspended by its neck at the tip of the Heron's beak. Once back on the shore the Heron swallowed the bird. The remaining ducklings, which had all dived as the Heron hit the water, resurfaced and swam directly to the south shore of Castle Island. The Heron had swallowed its prey before the other ducklings reached the island but it did not make any further attempts on them.

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Long-tailed Ducks wintering off the coast of the Outer Hebrides

Between 31 December 1985 and 5 January 1986, a group of colleagues (P. Bowyer, M. Green, S.A. Hinsley, C.J. Thomas, C. Todd, M.J. Wells) and myself made counts of wildfowl on the sea off the west coast of South Uist and Benbecula between Balivanich and Askernish. The coast was divided into sections, mostly corresponding to natural bays (Fig. 1), and each section was walked by two or more people who conducted counts from the best available vantage points using telescopes. This was done during moderately good weather when birds were visible up to 2 km offshore. Repeated counts on different days in section 4 showed that numbers were quite consistent from day to day during such conditions. Totals of 838 Long-tailed Ducks and 378 Eiders were counted (Table 1), the highest densities being in the central sections of South Uist. In addition, a large number of Long-tailed Ducks (perhaps as many as a thousand) was seen some distance offshore in the northern part of South Uist in heavy seas on 1 January, but it was impossible to obtain a reasonable count of these.

Previous counts of this area in 1971 – 73 gave totals of 150 – 300 Long-tailed Ducks (Brown, C. & Jenkins, D. 1973. *SB* 7: 404 – 405) and, in addition, Elkins (1974. *SB* 8: 201 – 202) estimated over 700 for the whole of the Outer Hebrides, of which about 300 – 400 were in Broad Bay on the east coast of Lewis. During an aerial survey in April 1977, 350 Long-tailed Ducks and 1000 Eiders were counted by H. Milne (in litt.). Buxton obtained peak counts of 340 off the coasts of the Uists, Barra and Benbecula, together with 220 off Harris and 200 off Lewis in the period 1979 – 83, making a total of 760 (Buxton, N. 1983. *Wildfowl in Lewis and Harris, Outer Hebrides*. Report to the Nature Conservancy Council).

In view of the fact that the 20 m depth contour is some 6 km offshore of the Uists (Norton, T.S. & Powell, H.T. 1979. *Proceedings of the Royal Society of Edinburgh* 77B: 141 – 153), there is scope for a large number of birds to be spread out feeding, completely out of sight from land. These may move closer inshore during bad weather as apparently occurred on 1 January 1986. It has been suggested that more Long-tailed Ducks may winter off the Western Isles than has previously been recognised. Our counts, covering only about 40% of the west-facing coast of the southern isles support this view.

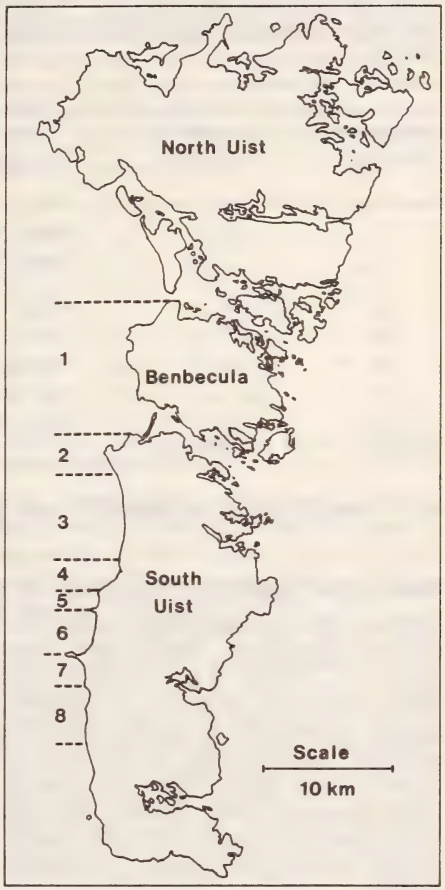

FIGURE 1. Sections of the coast of the Outer Hebrides along which wildfowl were counted in 1985/86.

TABLE 1. Counts of wildfowl off the west coast of South Uist and Benbecula in 1985/86. LTD = Long-tailed Duck *Clangula hyemalis*, E = Eider *Somateria mollissima*, CS = Common Scoter *Melanitta nigra*, G = Goldeneye *Bucephala clangula*, M = Mallard *Anas platyrhynchos*, R = Red-breasted Merganser *Mergus serrator*.

Section no. (see Fig. 1)	Length of coast (km)	Date counted	Species					
			LTD	E	CS	G	M	R
1	13	3 Jan. 1986	160	146		12		
2	6	1 Jan. 1986	79	153	39		11	10
3	7	"	77	5				
4	3	31 Dec. 1985	128	26				
5	2	"	74	42				
6	5	"	187	6				
7	4	"	47					
8	5	5 Jan. 1986	86					
TOTAL	45		838	378	39	12	11	10

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Inter-island flights by Sanderlings at dusk and dawn in Orkney

Daytime counts of Sanderlings *Calidris alba* on North Ronaldsay, Orkney, gave island totals of 11, 17 and 12 on 8, 9 and 10 May 1990 respectively. However, an estimated 200-500 Sanderlings were present during the nights of 7, 8 and 9 May on the beach of Nouster Bay at the south end of the island. Observations on 9 May showed that these birds started arriving at *c.* 2200 BST (dusk), and left by 0400 BST, when it was already daylight.

The only Orkney island that consistently has large numbers of Sanderlings by day is Sanday, mainly on the beaches of the Bay of Lopness and Bay of Newark, 10 – 15 km from North Ronaldsay. Totals of 283, 353 and 436 were counted on Sanday in April 1987, May 1988 and May 1989 respectively by the Tay & Orkney Ringing Groups (unpubl. data). Attempts to locate Sanderlings there at night in April 1987 were unsuccessful. It seems likely that the large numbers of Sanderlings which spend the night on North Ronaldsay involved the birds from Sanday.

If this suggestion is correct it poses two questions. Why don't the Sanderlings spend the night on Sanday, and why do so few occur on North Ronaldsay by day? Sanday has been colonised by rats *Rattus norvegicus* but North Ronaldsay is free of them. Rats can take a large toll of night-roosting birds in certain situations (van der Elst & Prŷs Jones. 1987. *Oryx* 21:219 – 222) so roosting Sanderlings could be vulnerable to such predation on Sanday. Other waders on Sanday also have different distributions by night compared with day; for instance, hundreds of Purple Sandpipers *Calidris maritima* and Turnstones *Arenaria interpres* occur on the outer rocks of the Holms of Ire (islets off Sanday) by night but only tens occur there by day. The reason why Sanderlings leave North Ronaldsay by day may be due to lower food availability. A comparison of the invertebrate densities on the beaches of Sanday and North Ronaldsay would test this idea.

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Capercaillie numbers on three Loch Lomond islands

In the Loch Lomond area of western Scotland reports of Capercaillie *Tetrao urogallus* have become scarce in recent years. Suitable habitat has decreased there as plantations with a rich ground cover have been replaced by dense unthinned and unbrashed stands (J. Mitchell pers. comm.). However recent habitat changes on the islands of Inchcruin, Inchmoan and Inchconnachan in the loch appear to have been slight. The ground vegetation includes lush dwarf shrub growth beneath open-crowned Scots pine *Pinus sylvestris*, and on Inchconnachan, sizeable larches *Larix* sp. On these islands persecution of predators and shooting of Capercaillie has been slight in recent years.

Counts of Capercaillie were made between 1977 and 1989 in late winter. Four to eight counters beat in line and one or two stationary counters watched for flushed birds from strategic sites, often from a boat. When Capercaillie flew into areas where they could have been flushed again, allowance was made by subtracting these birds from the total (maximum) seen to give a minimum estimate. For subsequent estimation of density, an average of the maximum and minimum estimates was used.

Counts were nearly always highest on Inchmoan and Inchconnachan; no Capercaillie or obvious signs of them were found on the 1989 visit to Inchcruin (Table 1). When numbers for the three islands are combined, the 1989 count, equivalent to 14.2 Capercaillie/km^2 was the lowest. The highest count, equivalent to 35.8 Capercaillie/km^2, was in 1981.

The counts indicate that even in a high rainfall area in the west of Scotland high densities of Capercaillie can persist. That mild western sites can support Capercaillie is known from their former occurrence, before forest destruction, in Ireland and by the record of the introduced population on the Isle of Arran (Harvie-Brown, J.A. 1879. *The Capercaillie in Scotland.* Douglas, Edinburgh). However, except in years of unusually good weather, poorer chick survival can be expected in the wetter west (Moss, R. 1986. *Ibis* 128: 65 – 72).

TABLE 1. Numbers of Capercaillie on three islands in Loch Lomond between 1977 and 1989. When two figures are given, they refer to minimum and maximum estimates (see text).

Date	Inchcruin	Inchmoan	Inchconnachan
20.3.77	4 – 10	nc	nc
21.3.77	5 – 10	nc	nc
22.3.77	nc	26	3
12.1.80	3 – 4	12 – 13	nc
16.3.80	5	11	16 – 19
31.3.81	2 – 6	11 – 20	19 – 28
28.3.82	4	7 – 8	9 – 11
29.3.89	0	6 – 16	5 – 7
Area km^2	0.3	0.5	0.4

nc = no count

Capercaillie have been seen flying between the Loch Lomond islands and the lochside woods, but we do not know to what extent the relatively high counts on the islands reflect immigration to good habitat at a time of considerable habitat loss around the loch. The population in the Loch Lomond area may be in decline as there were none on Inchcruin in 1989, and there are no recent records from the islands of Inchcailloch, Torrinch and Inchtavanach (J. Mitchell pers. comm.). On Torrinch and Inchcailloch breeding was confirmed between 1972 and 1976 (J. Mitchell *Loch Lomond Bird Reports*) and I found fresh signs on Inchcailloch in March 1977 and counted nine on Inchtavannach that year. Neither birds nor signs were recorded there on visits in March 1980, 1981, 1982 and 1989.

I acknowledge a Kilgour Senior Scholarship, Aberdeen University Studentships & CSIC-CICYT support. I thank all who helped especially J. Mitchell.

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OBITUARY

R.D. SMILLIE 1920–90

The news of the death of Ruby Smillie, and shortly after of her husband Jimmy, will have been received with great sadness by members who knew them. After a very short illness, Ruby died on 30 April 1990.

Ruby joined the SOC as a part-time secretarial assistant in February 1963 and retired as Membership Secretary in May 1983. During these 20 years she built up a reputation for her encyclopaedic knowledge of Club members. Her book-keeping and records were meticulous, and she could give up-to-date membership details as soon as she was asked. She needed no computer for speed or accuracy, but cheerfully learnt how to use one after she retired and returned to the office to help Fair Isle with secretarial work. She took a great interest in all Club members, many of whom may not have met her personally, but on mentioning a name she could tell you to which branch they belonged and, more often than not, their address and when they joined.

Ruby was not only an extremely able and efficient membership secretary, but she was renowned for her friendliness and the welcome she gave anyone who called at the Club offices. Many will have met her and Jimmy at conferences when they were both behind the Organizer's Desk, ready to renew old acquaintances and welcome newcomers with a warm and friendly greeting. They were also known to many ornithologists of international repute, whom they met as part of the team which manned the SOC Bookshop on the famous Scottish Bird Islands Study Cruise organised by the Club in 1966 (*SB* 4:272–286). Over the years visitors to Regent Terrace, who had been on the Cruise, were delighted to greet Ruby again or to know that she was still working for the Club. She corresponded with some of them for many years afterwards.

Although Ruby was employed by the Club for over 20 years, she was not just a member of staff, but a truly committed Club member, and this was recognised when she was elected as an Honorary Member in 1983 after she had retired. She would have been delighted to know of our continued presence at 21 Regent Terrace, a "home" she had known for so long. Ruby's sudden and unexpected death came as a great shock. Sadly, Jimmy, who will be remembered for his self-effacing manner, dry sense of humour and the tremendous support he gave Ruby, died a few hours after her funeral on 5 May 1990. He had supported the Club and its activities for many years. They will both be remembered with great affection, and our sympathy goes to their family for their grievous loss.

A.D. Peirse-Duncombe

Items of Scottish Interest

The papers and reports on birds in Scotland listed here deal mainly, but not exclusively, 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 postfree to 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.

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Scottish Snow Bunting numbers in summer 1970-87

A. WATSON AND R. SMITH

More summering Snow Buntings were recorded in Scotland in 1970-87 than in previous decades. Birds are known to have reared young on eight hills in the Cairngorms and east Mounth, on 12 in Inverness-shire and Ross-shire, and two in Sutherland. Adult sightings were made on 9 other hills in the Cairngorms and east Mounth, and on 31 other hills west and north of the Cairngorms. Cock numbers found on a regularly studied area in the Cairngorms fluctuated over the study period but were higher than previous counts there.

Introduction

The Snow Bunting *Plectrophenax nivalis* is one of Britain's rarest regularly breeding birds (Sharrock 1976), and in the Scottish Highlands is at a southern margin of its largely arctic breeding distribution. Nethersole-Thompson (1966) summarized his own and most other Scottish summer records up to the early 1960s, and later (1976) some notes by a number of other observers. Thom (1986) briefly mentioned some observations from all of Scotland. Milsom & Watson (1984) summarized their records from part of the central Cairngorms in 1971-77, and A.W. studied a larger area there in 1970-86. In 1987, R.S., A.W. and others increased the effort there, and R.S. began an intensive study with marked birds in 1988. This paper summarizes the frequency and distribution of breeding and summering records for Scotland in 1970-87. It also considers the evidence for changes in numbers since previous work and during 1970-87.

Methods

The records came from:– a) our own observations, mostly in the Cairngorms and east Mounth, b) unpublished notes for all of Scotland, made by various observers and given to A.W., and c) published annual bird reports, which we followed up by requesting further details from regional recorders and original observers. Only our own observations in the central Cairngorms were made regularly, thus allowing comparisons between years. Elsewhere, records were sporadic, and on many hills the bird's presence was recorded in only one summer.

A few wintering birds stay on Scottish hills until early May (R.S., unpublished data from marked birds). We have therefore only included observations of single adults or pairs after the middle of May as summering birds. Nearly all observations were in June-August.

To protect the birds we give no precise locations. A "hill" is a separate, distinct hill, not a subsidiary top or summit; above 3000 ft (914 m), this means a "Munro" as in Donaldson (1984). Some hills, where an adult or pair was seen in summer, had only one known site each such as a corrie or part of a plateau. On other hills, Snow Buntings were seen in two or more such sites per hill, often in the same year. In this sense, the term "site" is in any one summer effectively equivalent to a territory.

Results

Summering birds were seen at 62 hills and 104 sites during 1970-87, and fledged young

at 35% and 39% of these respectively (Table 1). There were also many records of nests and of adults carrying food, but adding these to Table 1 does not increase the figures there. Many hills had only one or two recorded sites each, occupation of which was found only sporadically. This does not mean that occupation was sporadic, as we have no reports of 'nil observations' except for our own data from the Cairngorms (without these one cannot say whether a lack of records for a site is due to observers going there and finding no birds, or to no observers going there).

On the fairly intensively covered area in the central Cairngorms, numbers fluctuated considerably from year to year (Fig. 1). When the number of cocks there in 1971-87 was compared with year, there was no significant trend. Annual cock numbers seen in 1970-87 there exceeded those recorded in 1929-66 in the whole Cairngorms massif (Nethersole-Thompson 1966).

The number of hens seen in the central Cairngorms in 1971-87 was far less than the number of cocks (Fig. 1). Cocks may have been in excess, but the far less conspicuous hens are easily overlooked unless observations are intensive.

Discussion

The figures of 62 hills and 104 sites where summering birds were found in 1970-87 are much higher than the figures in previous estimates of Scottish breeding numbers (Nethersole-Thompson 1966, Thom 1986, 6-21 pairs Nature Conservancy Council 1989). If the maximum percentage occupancy of sites (79%) in the intensive area in the central Cairngorms (Fig. 1) is extrapolated to all of Scotland, up to 82 sites would be occupied in peak years. However, hills with only one or two known sites may be marginal, with lower occupancy than the Cairngorms, so the figure of 82 is probably an overestimate. On the other hand, this effect would be counter-acted by birds being on hills or parts of hills not visited by bird watchers whose reports on sightings came to us. The records are therefore far too incomplete to estimate breeding numbers

TABLE 1. Number of hills and sites where adult Snow Buntings were recorded summering (feeding fledged young in summer), and maximum number of cocks recorded on any hill in any one summer during 1970-87, (a) west and north of the Cairngorms, and (b) in the Cairngorms and east Mounth.

		Number of hills where summering (fledging)	Number of sites where summering (fledging)	Maximum no. of cocks
(a)	Inverness-shire	14 (6)	22 (7)	3
	Inverness-Ross march	3 (2)	3 (2)	1
	Ross	11 (4)	11 (4)	2
	Sutherland	10 (2)	10 (2)	1
	Shetland	3 (0)	3 (0)	1
	West Perth	2 (0)	2 (0)	1
	Argyll	2 (0)	2 (0)	1
(b)	Cairngorms west	6 (4)	21 (8)	6
	central	4 (2)	19 (15)	13
	east	1 (1)	5 (2)	2
	East Mounth	6 (1)	6 (1)	1
	Total	62 (22)	104 (41)	

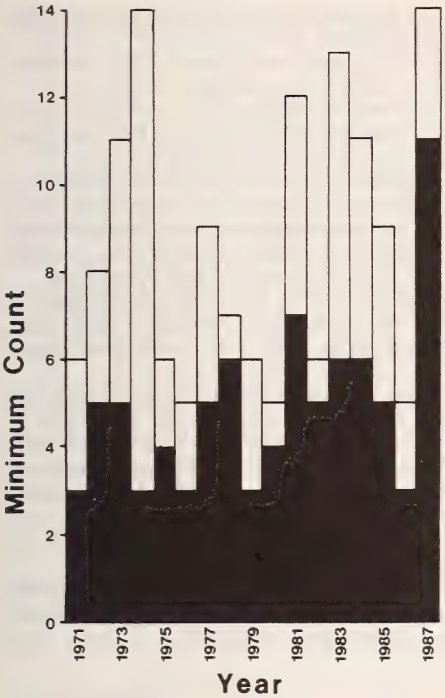

FIGURE 1.

accurately, but the number of sites occupied may have been up to 50 in some years.

The higher numbers seen in the central Cairngorms since 1970 have led to the suggestion that numbers in all of Scotland have increased (Nethersole-Thompson 1966, Thom 1986). Although our records for the central Cairngorms and elsewhere in Scotland are consistent with this suggestion, the scale of the presumed increase may be an overestimate due to an increase in observer effort. With easier and faster road access and transport, more leisure time, and higher incomes, the number of summer hill walkers and bird watchers has increased greatly in recent decades (Nethersole-Thompson & Watson 1981; Watson 1984, 1991; Aitken 1985). A similar argument has been put forward to explain higher counts of Dotterel *Charadrius morinellus* in Scotland in recent years (Watson & Rae 1987).

Nethersole-Thompson (1966) gave details of earlier records back into the last century. This indicated more records in decades around the turn of the century than in the 1920s and 1930s. His own observations in the Cairngorms showed fewer records in the 1930s than in the 1940s-early 1960s. He suggested (1966, 1976) that these differences related to climatic variation, with low numbers during warmer periods such as the 1930s, but he did not expand on which climatic factors were involved, apart from mentioning snow cover. The possibility that the number of cocks on part of the central Cairngorms in 1971-77 was related to snow cover there at the beginning of June has been rejected (Milsom & Watson 1984); if anything, the association was negative. However, the statistical drawbacks of small sample size due to the small number of birds would make any analysis of doubtful reliability.

A human cause of changes in numbers (e.g. Watson 1979) cannot be ruled out. A possible confounding factor is artificially increased food in summer (scraps from hill walkers) and in winter (scraps and reseeded areas at ski centres, upland car parks and roads, scraps from hill walkers, and feeds left outdoors for deer, sheep and cattle). The frequency of predators may also be lower, due to their avoidance of walkers and skiers.

Human-induced climatic change through global warming is a serious threat, and there is much interest in climatically sensitive species as indicators. The Snow Bunting is a possible indicator, especially in Scotland at a southern margin of its breeding range. In addition to future annual observations on the main breeding areas of the Cairngorms and Ben Nevis massifs, observations should include some hills where birds have been seen only irregularly, to establish whether irregular sightings are due to sporadic visits by observers or to birds being present in some years but not

others. Annual visits to such hills are essential if a more reliable estimate of trends in Scottish summering numbers is to be obtained.

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(Ms received February 1991)

Snow Buntings in Caithness

K.W. BANKS, H. CLARK, I.R.K. MACKAY,
S.G. MACKAY AND R.M. SELLERS

Snow Buntings spend up to five months of the year in Caithness typically between November and late March. They occupy a variety of habitats including sand dunes and rough pasture mostly at altitudes less than 100 m asl and within 10 km of the sea. Over the period 1976-88 the wintering population is estimated to have varied between 100 and 2500 birds with a mean of 1100. The wintering flocks, which usually consisted of 10-300 birds, were distributed mainly in clusters of key sites to which birds returned year after year. Ringing also showed there to be appreciable site fidelity between seasons although differences between sites were apparent. These and other observations on the social biology of wintering Snow Buntings are discussed in terms of a simple model, the principal features of which are extensive movement between flocks within restricted areas of 10-50 km^2 in extent, high site fidelity to these areas between seasons and little interchange between such areas within seasons.

Introduction

The winter distribution of the Snow Bunting *Plectrophenax nivalis* in the British Isles shows a pronounced easterly bias, the most important areas being Shetland, Orkney, the east coast of Britain from Caithness to Kent and the Cairngorms (Lack 1986). The species' winter biology is still poorly known though recent progress, based in part on our earlier studies in Caithness and elsewhere, has been made on winter weights, pre-migratory fattening, biometrics, population structure and the birds' origins and movements (Bakker *et al* 1978, Rae & Marquiss 1989, Banks *et al* 1989, 1991). In this paper we describe some further results concerning the timing of occurrence, social biology, habitats and population size of Snow Buntings wintering in Caithness.

Materials and Methods

Data for this study were obtained from two main sources. Information on site fidelity and movements is based on ringing activities at Keiss Links (58°31′N, 3°03′W) on the east coast of Caithness over the five winter seasons 1985/86-89/90 and at Dunnet (58°35′N, 4°01′W) on the north coast of Caithness in the winters of 1986/87 and 1987/88. Birds were caught in "whoosh" nets regularly baited with grain, and were aged and sexed according to methods described in Banks *et al* (1990). Most of the birds caught at Keiss were colour-ringed. Data on flock sizes and distribution in Caithness were taken from the Caithness Bird Report (1976-82) and from records made available to us by the Caithness Bird Recorder, Mr E.W.E. Maughan, for the period 1983-88. These were supplemented by our own field surveys carried out between 1985/86 and 1989/90. Snow Buntings appear to have been much more numerous in some seasons that others (see below) and so for some parts of the analysis only data

collected in the period 1983-88 have been used. The biasses inherent in these data are unknown, but we assume that they provide a reasonable representation of the Snow Bunting's occurrence in Caithness in the winter months.

Results

Timing of occurrence

Snow Buntings are present in Caithness for about 5 months of the year, typically from November to late March, though small numbers are usually seen in September and/or October and early April in most years. The mean date of first sightings in 1983-88 was 7 October (6 seasons; range 4 September – 22 October) and mean last date 20 April (5 seasons, range 8 - 30 April). There is also a remarkable record of a freshly dead female found on 14 May 1972 on Morven (Collett & Manson undated). No systematic counts have been made in the early part of the season but it is evident that the build up in numbers tends to be a fairly gradual process extending over a period of 4-8 weeks. The departure, by contrast, is much more rapid lasting usually little more than 2-3 weeks. Immediately prior to their departure the birds gain weight through the deposition of sub-cutaneous fat and most leave as soon as sufficient reserves for migration have been accumulated (Banks *et al* 1989). There appears to be a fair degree of synchrony in the commencement of pre-migratory fattening, ringing evidence from Dunnet in 1986/87 suggesting that males begin on average *ca* 9 days ahead of females. Estimated mean departure dates were 17 March for males and 26 March for females (see Banks *et al* 1989 for details).

Flock sizes

Snow Buntings are social birds and in Caithness form flocks of typically between 10 and 300 individuals. The largest recorded were 900-1000 in March 1979, 1000-1500 in March 1987 and 2000 in 1975 (Collett & Manson undated). These are amongst the largest ever seen in the British Isles, though flocks up to 5000 strong have been noted in Orkney (Booth, Cuthbert & Reynolds 1984). Flocks usually consisted entirely of Snow Buntings; even at particularly favourable sites where other species such as Skylarks *Alauda arvensis*, Reed Buntings *Emberiza schoeniclus* and finches occured, Snow Buntings remained somewhat apart.

The seasonal variation in flock size over the years 1976-88 is shown in Fig. 1. Not surprisingly flock sizes were much smaller on average in the main arrival and departure periods but remained roughly the same throughout the winter months. The median flock size was appreciably larger in

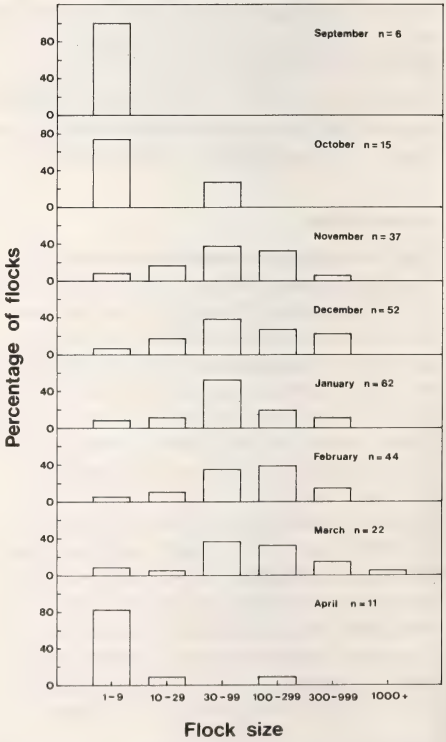

FIGURE 1. Seasonal variation in flock sizes of Snow Buntings wintering in Caithness, 1976-88. *(n = number of flocks).*

the winters of 1986/87 and 1987/88 than in the other seasons considered.

Distribution

The distribution of sightings of Snow Buntings in Caithness in the period 1976-88 is shown in Fig. 2. Most were from the north coast between Reay and Dunnet Head and the Wick area on the east coast. The main inland records were from the Calder area. There have been few records from the agricultural land between Thurso and Wick, the high coastal areas south of Lybster and between Dunnet Head and Keiss, or the

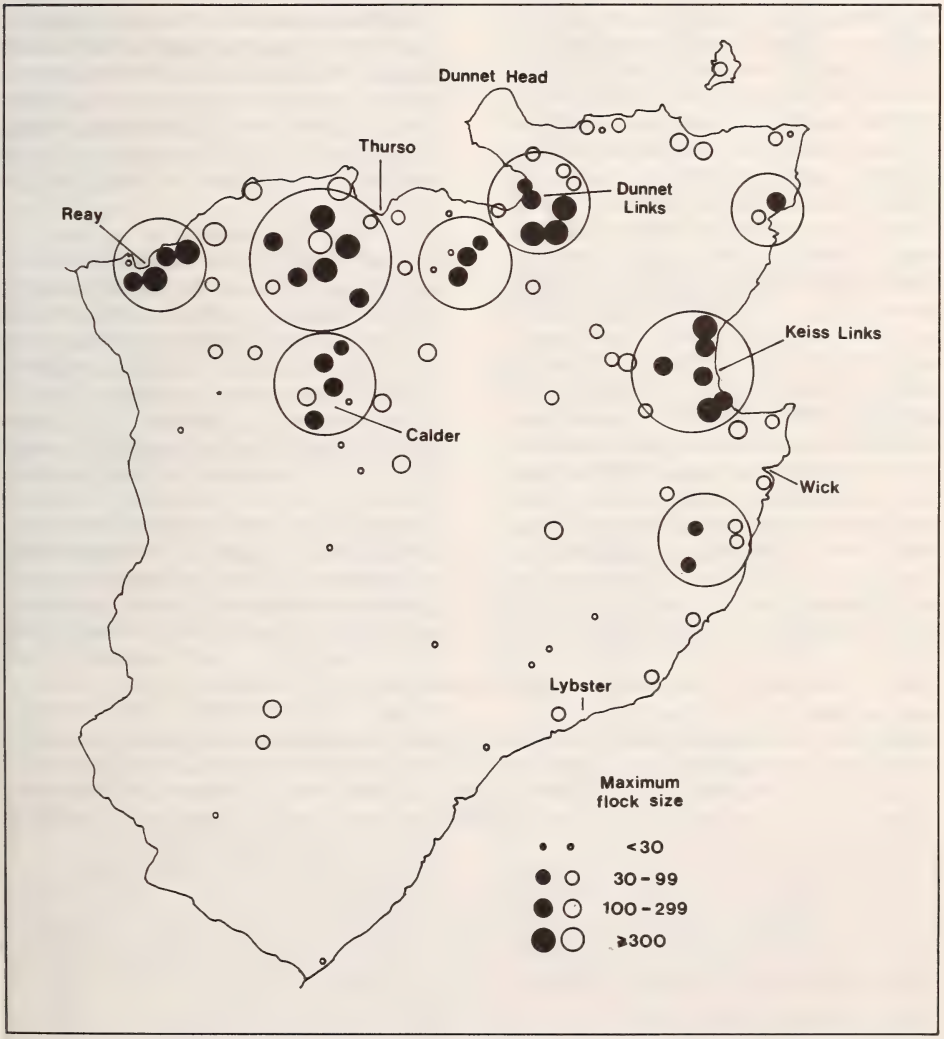

FIGURE 2. ***Distribution of Snow Buntings wintering in Caithness.*** *Solid symbols show sites used regularly in the period 1983-88, open symbols other records, 1976-88.*

flow county of west Caithness. The absence of sightings from the latter area could simply be a result of the difficult access to this part of Caithness in the winter months. However there is only one record from the Causey Mire (A895 between Georgemas and Latheron) from which we have ourselves made a number of unsuccessful searches for Snow Buntings, so we doubt that this is an important wintering area for the species.

In Fig. 2 we have differentiated between sites used regularly in the period 1983-88 (for which we have most data), and all other sites for the entire period, 1976-88. Regular is used here to mean occurring in at least four of the six winters 1983-88. Many of the records from earlier years also relate to these sites. The regularly used sites seem to form a number of clusters (the large circles in Fig. 2), covering areas of 10-50 km^2. Such a pattern could arise from a single flock moving locally between a number of feeding sites or several flocks exploiting locally favourable conditions. Our field observations suggest, however, that the situation may be more complex than either of these two simple pictures. Based mainly on observations of birds at Keiss, Dunnet and Glengolly (near Thurso) we have noted on a number of occasions two flocks coalescing or a large flock dividing into two smaller ones which then flew off in different directions. It was also quite noticeable at these and other sites that flock sizes varied appreciably within a particular season. We have also been able to locate flocks feeding simultaneously at two or more sites within a particular cluster.

Site fidelity

The observation that birds return repeatedly to particular sites implies some degree of site fidelity both within and between seasons and we have been able to investigate this directly on the basis of our ringing at both Dunnet and Keiss. A summary of the number of birds handled is given in Table 1.

Site fidelity between seasons

The numbers of Snow Buntings retrapped at the same time in successive winters were relatively small. At Keiss, for instance, only 3.7% of the birds ringed in the first winter were caught again in the second, and only 2.2% of birds ringed in the second winter were retrapped in the third. Of the birds ringed at Dunnet in the second winter only 4.4% were retrapped there the following winter. If, however, the number of retraps is expressed as a percentage of the number of individuals caught in that season then a significant difference between the two sites becomes apparent. Thus in the 1986/87 and 1987/88 seasons 0.7% and 3.3%

TABLE 1. Numbers of Snow Buntings caught in Caithness.

Site	Period of trapping	No. ringed	No. colour ringed	No. controlled	No. retraps from earlier season(s)	Total No. individuals caught
Keiss	Jan 86 – Mar 86	162	0	0	—	162
Keiss	Dec 86 – Apr 87	837	802	3	6	846
Keiss	Nov 87 – Apr 88	520	516	5	18	543
Keiss	Nov 88 – Mar 89	142	0	3	21	166
Keiss	Dec 89 – Mar 90	41	0	1	6	48
Dunnet	Jan 87 – Mar 87	411	0	5	—	416
Dunnet	Dec 87 – Mar 88	114	0	2	18	134

respectively of the birds caught at Keiss had been ringed there the previous winter, while at Dunnet 13.4% were retraps from the previous year, a highly significant difference.[i] Males were slightly more likely to be retrapped in the following season than females (4.8% males v. 3.0% females at Keiss in 1987/88 and 20.4% males v. 11.7% females at Dunnet in the same season). Given that probably no more than a third to a half of the birds present in winter 1986/87 were ringed, that many of these birds will have died in the subsequent breeding season and roughly half of the birds caught in 1987/88 were first-years (which cannot, of course, be retraps from the previous winter) it is clear that in some years a substantial proportion of the birds returned. This is perhaps of the order of 5% and 20% of birds caught at Keiss in 1985/86 and 1986/87 respectively and well over 50% of those marked at Dunnet in 1986/87. We conclude, therefore, that the Snow Bunting can show a fair degree of site fidelity between seasons but that this varies between sites and between years.

Site fidelity within seasons

On a number of occasions in the second winter of the study when no trapping was being done, flocks of Snow Buntings on the ground near the bait at the Keiss ringing site were scrutinised from a distance through binoculars and the number of ringed birds present counted. The proportion of ringed birds present in the flocks on these occasions is given in Table 2 together with the total number of birds ringed for the winter at this site prior to the dates specified. There was no trend for the percentage of ringed birds in these flocks to increase in proportion to the total number ringed. Similarly at Dunnet in the 1986/87 season retraps of birds ringed earlier in the season remained constant at about 30-45% throughout the winter.

i. (χ^2 = 20.69; P < 0.001; test made using 2×2 contingency table comparing birds ringed with retraps from the previous season at the two sites)

TABLE 2. Percentage of ringed birds in flocks of Snow Buntings wintering at Keiss Links, Caithness, 1986/87.

Date	Cumulative total ringed	Size of flock	% with rings
24 Dec 86	240	200	10
26 Dec 86	240	40	30
29 Dec 86	253	150	10
4 Jan 87	413	100	18
15 Feb 87	696	102	12
23 Feb 87	713	24	17
30 Mar 87	813	20	10

TABLE 3. Mean number of handlings for Snow Buntings caught in Caithness.

Site	Season	No. individuals	No. handlings	Mean No. handlings per bird
Keiss	1985/86	162	183	1.13
Keiss	1986/87	846	956	1.13
Keiss	1987/88	543	600	1.10
Keiss	1988/89	166	210	1.27
Keiss	1989/90	48	55	1.15
Dunnet	1986/87	416	578	1.39
Dunnet	1987/88	134	156	1.16

A further insight into the turnover rates of birds at both Dunnet and Keiss can be obtained from the number of times individual birds were handled (Table 3). At Dunnet in 1986/87 some birds were caught up to six times, with a mean number of handlings per bird of 1.39. Males were more likely to be retrapped here than females. Over the same period at Keiss the mean number of handlings per bird was 1.17, an appreciable difference.[ii] We infer that the

ii. (χ^2 = 15.41, P < 0.001; test made using 2×2 contingency table comparing number of birds handled once, with those handled more than once)

turnover rate of birds at Keiss was higher than at Dunnet especially during the 1986/87 winter when sample sizes were largest. During the same period there were 25 "same day" retraps at Dunnet and only one at Keiss.

In the winter of 1986/87, when catches were highest, the number of Snow Buntings caught far exceeded the biggest flocks ever recorded at either site. Thus 846 and 416 birds were ringed during this winter at Keiss and Dunnet respectively whereas the largest flock sizes were 250 and 150 respectively. Superficially these results seem to indicate a regular turnover of birds throughout the winter at both sites, but this is to neglect the part played by trap-shyness. It would be possible, for instance, to interpret our findings in terms of a comparatively large and relatively sedentary local population (such as the clusters in Fig. 2) in which new birds were much more likely to be trapped than those which had already been ringed. Whatever the true position regarding site fidelity within seasons it seems clear that our two ringing sites differ appreciably in this respect.

Movements

Despite having ringed over 2000 birds and colour-ringed almost half of these (all at Keiss) we have had remarkably few recoveries, retraps or sightings of our birds away from where they were ringed. No birds ringed at Dunnet have been found elsewhere in Caithness, and only 7 birds from Keiss have provided information on local movements. These included 4 birds, all adult males, which moved from Keiss to Dunnet, a distance of 15 km NW (no movements in the opposite direction were recorded), an adult male from Keiss to Scrabster Hill, near Thurso (28 km WNW), a female from Keiss to Kirkwall, Orkney (60 km N), and a first-year male from Keiss to John O'Groats (14 km NNE).

We have also recorded a number of longer distance movements (>100 km) the timing of which suggests that they were birds of passage making their way southward in late autumn or northwards in late winter (further details in Banks *et al* 1991). About 80% of the birds in Caithness are identified on plumage grounds as being of the Icelandic race, *P.n. insulae* (Banks *et al* 1991). Ringing recoveries are consistent with this, our ringing having generated twelve movements between Caithness and Iceland.

Habitats

Snow Buntings utilise a variety of habitats within Caithness of which the most important are sand dunes and the strand line (Dunnet, Keiss), weedy fields (especially turnip fields), stubble, pasture, unimproved grassland and heather moorland. Unfortunately the bulk of the records we have give no details about habitat so we are unable to quantify their relative importance though we suspect that most of the sites would be classified as rough grassland.

It is apparent from Fig. 2 that the bulk of the sites used were near the coast: overall 70% were within 5 km and 90% within 10 km of the sea. In terms of altitude, 52% of sites were less than 50 m asl and 89% less than 100 m sl. Only two sites were above 200 m asl.

Size and variability of the winter population

To estimate the size and variability of the wintering population we have taken the largest flock size from each of the "clusters" shown in Fig.2 and summed these for each of the 14 seasons for which we have data. Some allowance has been made for birds seen away from the main wintering sites. The wintering population estimated in this way varied between 100 and 2500 birds with a mean of 1100 (all figures rounded to nearest 100) as shown in Fig. 3. Of particular note are the high counts in 1986/87 and 1987/88, seasons when there were also unusually high numbers wintering in Orkney (Orkney Bird Report 1986-88), and also the very low counts in

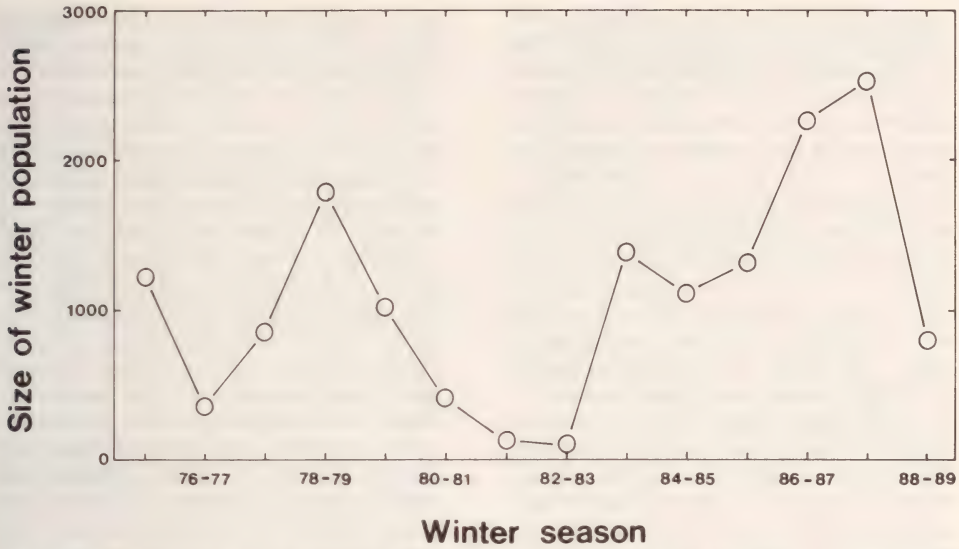

FIGURE 3. Variation in the numbers of Snow Buntings wintering in Caithness, 1975/76-88/89.

1980/81-82/83. It should be emphasised that the counts on which these figures are based were not collected in a systematic way and we consider it likely that some birds will have been overlooked. Double accounting is also a potential problem but, by choosing only one count within each cluster, albeit the highest, any error from this source is likely to be minimal. At the very least we believe that these figures give a reasonably reliable index of relative abundance as well as an indication of absolute abundance.

Discussion

Flocking and site fidelity

The picture of the Snow Bunting's social biology which emerges from this study is a complex one. In general the birds appear to occupy a fairly extensive area or "super-territory" within which they form into one or more flocks. The choice of feeding sites seems to be quite conservative, with flocks returning repeatedly to favoured spots both within and between seasons. Evidence on the extent to which individual birds are site faithful within seasons is more equivocal. Retrap data suggest fairly low site fidelity within seasons, though this may result from trap shyness rather than a significant turnover of birds. There is, however, definitely some movement between "super-territories" as shown by retraps or sightings of ringed birds (movements up to 60 km have also been recorded elsewhere in Britain – see Banks *et al* 1991), though the very small number of such movements we have found in Caithness suggest that comparatively few birds undertake such movements.

This pattern is presumably a consequence of the abundance and distribution of the Snow Bunting's food, which we take to be relatively predictable. Social birds with a much less predictable food supply tend to be more nomadic in the non-breeding season, feeding where food is locally abundant, and moving on when it is exhausted.

A striking feature of the present results is the difference between the Dunnet and Keiss study sites. Thus site fidelity between seasons was comparatively high at Dunnet,

but moderate to low at Keiss, recapture rates within seasons were higher at Dunnet than at Keiss and females were more abundant at Keiss than Dunnet. The reasons for these differences between sites only 15 km apart are uncertain, but we suspect that they are connected with the local food supply. Dunnet appears to be the more favourable site (birds are apparently more site faithful both within and between seasons; males, the dominant sex, are more common than at Keiss, and all movements between the sites were from Keiss to Dunnet, not the other way), but quite what features are so desirable is unclear. Both sites are centred on sand dunes dominated by marram ammophila arenaria, the most significant differences being in the adjoining land. Dunnet beach, for instance, collected much rotting seaweed and had an abundant invertebrate fauna; Snow Buntings regularly fed along the strand line there. The beach at Keiss, by contrast, collected virtually no seaweed and was very rarely visited by Snow Buntings. Inland from Dunnet is a large tract of botanically-rich machair-like grassland known as the Moss of Greenland which was visited sporadically by the Dunnet flock. At Keiss the equivalent area is farmland (pasture plus some arable land) together with an area of botanically-poor grassland. Away from the dunes the Keiss flock resorted mainly to an area of stubble. Predator pressures as judged by the number of sightings of birds of prey (principally Merlins *Falco columbarius*) appeared to be about the same at the two sites.

Population size

The estimated mean wintering population of the Snow Bunting in Caithness during the 14 years for which data are available was 1100 birds, a figure which we suspect may be an underestimate. This represents 7-11% of the British wintering population, which is given in the Winter Atlas (Lack 1986) as 10,000-15,000 individuals, and emphasises the importance of Caithness as a wintering area for the species. The variability of the winter population has been commented on by a number of earlier workers (*e.g.* Nethersole-Thompson 1966, Lack 1986) but ours appears to be the first attempt to estimate this variability. Even though our data extend over only a comparatively short run of years we find the highest total to be approximately 25 times the lowest. We cannot be sure that our figures are typical of Britain as a whole but suspect that they reflect trends at least in the north of Scotland. Most of the birds wintering in this area originate from Iceland (Banks *et al* 1991) and it is probably to here that one must turn to account for the variability. Most Snow Buntings breeding in Iceland remain there for the winter, showing only seasonal movements from the high altitudes of the breeding range to lower ground in the winter (Breuil 1989). The factors that determine how many migrate to the British Isles are unknown but population size, food availability, weather and perhaps the number of migrants from Greenland are the most likely. We suggest that the variable numbers in Caithness reflect the varying percentage of birds which migrate. That individual birds migrate in some years but not in others is illustrated by a bird ringed as a first-year male at our Keiss site in January 1986 and retrapped at Keiss in December 1986 and in Iceland in January 1990. The wintering population in Britain shows a marked bias towards females (Rae & Marquiss 1989, Banks *et al* 1991) in some years but there is an insufficiently long run of data to test whether the sex ratio and the population size are correlated. It should be emphasised, however, that the sex ratio can vary between sites within a particular season and is, by implication, at least partly determined by local factors.

Acknowledgements

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The breeding distribution and habitat requirements of the Lesser Whitethroat in Strathclyde

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Since 1983, our continuing research has shown that the Lesser Whitethroat is making tentative inroads into Strathclyde. Breeding however is extremely localised, with only three sites having regular breeding success. We therefore attempted to establish why the species has such a restricted breeding distribution in Strathclyde.

Introduction

The Lesser Whitethroat *Sylvia curruca* is a relatively common breeding bird in England, and in ideal downland habitat the breeding density can be as high as 3-6 pairs per km^2 (Sharrock 1978). In Scotland, however, the Lesser Whitethroat is still a relatively scarce breeding species, with a breeding distribution confined mainly to the south east corner, the Lothians in particular, where da Prato (1980) estimated there to be 50-100 pairs. By the mid 1980s the species had expanded its range into other parts of Scotland, as indicated by first county breeding records for Aberdeenshire in 1977, Angus in 1981 and then Caithness and Orkney in 1988 (Scottish Bird Reports 1977-90). Occupied territories were first discovered in Strathclyde during 1983 and the first confirmed breeding record for Renfrewshire was at Paisley in 1986 (pers. obs.).

From a European perspective, the breeding range of the Lesser Whitethroat has also been expanding northwards and westwards. In Norway, there has been a definite westward expansion of the breeding range (S. Eldøy pers. comm.). Northern Ireland could be on the verge of having its first breeding record, for a singing male was located in suitable breeding habitat during May 1985 (Irish Bird Report 1985). These records suggest that the species is undergoing a marked range expansion into northwest Europe.

Study areas and methods

Previously known breeding sites were visited every May during the eight year study period to ensure that occupied territories were used each year. In an attempt to locate new breeding territories, we surveyed sixteen random 5 km squares spread through Ayrshire and Renfrewshire, searching for singing males and suitable breeding habitat. The presence of a pair, or of a singing male, noted on at least two occasions a week or more apart, and occupying the same territory on two or more consecutive years, was taken as evidence of regular breeding. All potential breeding records obtained from county bird reports were also investigated during the study period.

Although Lanarkshire was not well recorded, during the eight year study period one regular breeding territory was located (R. Nisbet pers. comm.). Only Ayrshire and Renfrewshire in the Strathclyde region were found to hold a regular number of Lesser Whitethroat territories. Seven of these regular breeding territories were examined to determine their habitat structure and plant species composition.

To investigate why certain areas of superficially similar habitat did not contain

Lesser Whitethroat territories, seven additional sites were chosen as controls. These sites were not used by Lesser Whitethroats during the study period. This allowed us to ask why there were none and to seek out any vegetational differences between occupied territories and control sites.

Breeding habitat

Lesser Whitethroat territories were recorded in areas where mature hawthorn *Crataegus monogyna* scrub was interspersed with a dense mosaic of bramble *Rubus* sp., dog rose *Rosa canina*, gorse *Ulex europaeus* and in some cases willow *Salix* sp. These five plant species were particularly prevalent in all occupied territories and the control sites. Such scrub areas usually formed habitat islands surrounded by pastoral farmland. The seven territories studied were uniform in several respects. They were either found on disused railway embankments or on regenerating hillside scrub. All areas were practically impenetrable, making vegetation analysis extremely difficult and painful! Perhaps it also explains why so little is known about the breeding biology of this species.

Searching methods

When suitable breeding habitat was discovered in a surveyed area, thirty minutes were allocated to detect any singing males. If no song was heard within that time, a ten-minute long tape lure was played twice with a five minute interval in order to elicit a response. Whenever an occupied site was located, another two visits a week apart were made to establish site fidelity. Observations continued throughout May to determine territory size and habitat utilisation.

Habitat analysis methods

At the end of July, when the breeding season was over, ten randomly spaced transect lines were placed in each territory. Four one metre square quadrats were placed at five metre intervals along these lines. In each quadrat, the percentage cover of the five predominant plant species, hawthorn, bramble, dog rose, gorse and willow, were estimated from ground to canopy level in four one metre height bands. The data recorded from these vegetational surveys were then used in multivariate analyses to describe the habitats in terms of all the plant species combined, rather than just one species at a time.

Results

Singing birds

The best time to search for breeding Lesser Whitethroats was found to be during early May when the males were extremely vociferous and highly conspicuous throughout the day. Males sang almost constantly from exposed sprays of the hawthorn canopy or during feeding forays along the edge of the scrub. On two occasions, a male was observed singing in a short gliding flight across the territory, descending on slow shivering wing beats. Females were much harder to locate, as they tended to skulk in the thickest cover, only appearing briefly when the tape lure had been played.

At times, the Lesser Whitethroat was found to be the loudest songbird in the vicinity and the distinctive penetrating rattle could be heard up to 200 metres away. Our observations over the study period have shown that singing is quite intense during the first fortnight of May, but the amount of song gradually diminishes towards the latter half, until no song is heard from territories known to be occupied during June and July. Since breeding Lesser Whitethroats have such a short song period, a fortnight in most cases, the time in which one can locate and observe singing males is extremely limited.

Territorial behaviour

Our observations indicated that males singing in June and July are unmated, and

we call these transient males. These birds have a characteristic tendency to sing from widely-separated song posts around the periphery of established breeding territories, or singing in habitat totally unsuitable for breeding. Territorial males were sometimes highly aggressive to one another especially when on adjacent territories. Fighting was observed with fierce skirmishes down onto the ground. Tape luring occasionally induced a similar response, with males flying directly to confront the tape recorder and a startled observer!

The Study Sites

Occupied territories

The seven occupied sites are listed, along with some descriptive data, in Table 1. Only 2-3 breeding territories were recorded in Renfrewshire during the study period, and all were within a 1km^2 area. These sites were two disused railway tracks near Dykebar and a disused limestone quarry at Brownside Braes. Ayrshire was the major stronghold of the species in Strathclyde, with 6-8 breeding territories annually since 1985. Sampled sites were located at Heads of Ayr, Burton Farm and Bracken Bay. In Lanarkshire, only one regular breeding territory was located, at Baron's Haugh.

The habitats present at these sites were as follows:

Site 1, Dykebar railway track: One small regular breeding territory, located in the overgrown hawthorn scrub (4m+). With an extensive mosaic of bramble, dog rose, gorse and willow understorey on the embankments, both north and south facing.
Site 2, Dykebar railway track: Another small territory, again located on a nearby railway track which runs alongside site 1. The habitat is similar too, with mature hawthorn (4m+) and a dense understorey of bramble, dog rose, gorse and willow; both north and south facing embankments.
Site 3, Disused limestone quarry: A large territory, of which the boundaries cover the entire quarry area. The habitat is mainly mature hawthorn scrub (4m+) with a dense shrub layer of bramble, dog rose and gorse. The site is situated on a north facing slope.
Site 4, Heads of Ayr: This site could almost be regarded as a colony because up to three pairs vied for territory each year in a confined area of suitable habitat. The site contains both mature hawthorn (3-4m+) and dense patches of blackthorn (2-3m+), the latter in good quantities. Although the understorey contains bramble, dog rose and gorse, it is patchy throughout the site. The site is situated on a NNE facing slope.

TABLE 1. Features of the study sites with occupied territories.

Site no.	District/Site description	Altitude (m)	Territory size/area (ha)	Year of survey	Grid reference
	RENFREWSHIRE				
1	Dykebar railway track	45	0.58	May-July 1986	NS 492 610
2	Dykebar railway track	50	0.62	May-July 1986	NS 492 609
3	Disused limestone quarry	75	1.32	May-July 1986	NS 486 607
	AYRSHIRE				
4	Heads of Ayr (2 territories)	15	0.86	May-July 1986	NS 294 185
5	Burton farm	85	1.06	May-July 1989	NS 315 174
6	Bracken bay	61	2.38	May-July 1987	NS 266 180
	LANARKSHIRE				
7	Baron's Haugh	30	0.81	May-July 1988	NS 746 552

PLATE 1. Heads of Ayr, Ayrshire, up to 2-3 pairs regularly breed here.

PLATE 2. Disused railway tracks at Dykebar, Renfrewshire, where the first county breeding record occurred.

T. Byars

PLATE 3. Breeding habitat at Dykebar, note the dense mosaic-like structure of the scrub vegetation.
T. Byars

Site 5, Burton farm: A large territory, situated in regenerating hillside scrub on a north facing slope. The habitat comprises mature hawthorn scrub (3m+) with an extensive and dense understorey of bramble.
Site 6, Bracken bay: A regenerated section of the disused railway embankments provides an extensive territory for just one regular breeding pair. The site contains mature hawthorn (4m+) and a mature stretch of blackthorn (2m+). The understorey is mainly gorse with small bramble patches on the north and south facing embankments.
Site 7, Baron's Haugh: One small territory located on raised embankments, facing east and west. The territory was in mature hawthorn scrub (3-4m+) with an impenetrable shrub layer mainly of bramble, dog rose and gorse.

Control sites

The seven sites lacking Lesser Whitethroats, which were taken as control sites, were surveyed to provide comparable data. These sites are listed in Table 2, and their habitat characteristics were as follows:

Site 8, Dykebar disused railway: A large area of open hawthorn scrub (3-4m+) with extensive gorse and bramble understorey, situated on a north facing slope.
Site 9, West Brownside Braes: A smaller area of open hawthorn scrub (3-4m+) with a dense gorse understorey, again situated on a north facing slope.
Site 10, East Brownside Braes: Raised embankments covered with mature hawthorn scrub (3-4m+) with sparse bramble, dog rose and gorse understorey. The embankments face north and south.
Site 11, Dalry coal bing: Overgrown hawthorn scrub (2-3m+) with mixed bramble, dog rose and gorse understorey on a SE facing slope.
Site 12, River Caaf: Mature hawthorn scrub (2-3m+) with sparse bramble, dog rose and gorse understorey on a steep south facing slope.
Site 13, Kilwinning disused quarry: Extensive hawthorn scrub (3-4m+) with poor bramble and gorse shrub layer.
Site 14, Rowanside burn: Open hawthorn scrub (3-4m+) with extensive gorse, bramble and dog rose understorey on a steep south facing slope.

*Differences in vegetation between sites**

We carried out statistical analyses to test for differences between the occupied territories

* The Appendices have been lodged with the SOC in the Waterston Library and may be consulted on request.

TABLE 2. Features of the study sites without occupied territories, i.e. used as controls.

Site no.	District/Site description	Altitude (m)	Territory size/area (ha)	Year of survey	Grid reference
	RENFREWSHIRE				
8	Dykebar disused railway	45	0.72	May-July 1990	NS 492 611
9	West Brownside Braes	75	1.92	May-July 1990	NS 484 607
10	East Brownside Braes	100	1.49	May-July 1990	NS 485 605
	AYRSHIRE				
11	Dalry coal bing	50	0.84	May-July 1990	NS 295 513
12	River Caaf	70	0.51	May-July 1990	NS 281 482
13	Kilwinning disused quarry	50	1.32	May-July 1990	NS 317 447
14	Rowanside burn	90	1.75	May-July 1990	NS 237 457

and control sites. No significant differences were found for individual plant species at each of the height bands. However, when we used multivariate methods, which analyse the differences between samples in terms of **all** the species taken together, we did obtain significant results. One such method was classification using the TWINSPAN programme (Hill 1979), splitting up the samples successively into groups which can be regarded as classes or types of vegetation. This successfully classified all the samples, generating eight vegetation classes (see Appendix A*) which may be summarised thus: –

Class A, Mixed: hawthorn rather sparse, but with large amounts of miscellaneous species at all height bands up to 4m.

Class B, Dog rose: again hawthorn is sparse and main plants are dog roses up to 3m high.

Class C, Hawthorn: dominated by dense hawthorn up to 4m high, with little of other species.

Class D, Hawthorn/Bramble: much hawthorn up to 3m high and dense bramble in 0-1m height band.

Class E, Bramble/Gorse: fairly dense bramble up to 1m high and dense gorse up to 2m high, with very little hawthorn.

Class F, Bramble: no hawthorn at all, but very dense bramble up to 1m high and fairly dense up to 2m, together with miscellaneous species.

Class G, Willow: characterised by dense willow, especially in 3-4m height band, but also with some miscellaneous species at ground level.

Class H, Willow/Dog rose/Mixed: dog rose up to 1m and willow between 2m and 4m, but with dense miscellaneous herbs below 1m.

The occurrence of these classified samples in the occupied territories versus the unoccupied control sites is shown in Table 3 and we found there to be a significant difference in plant community structure between occupied and unoccupied sites (χ^2 = 23.24, 7 d.f., P<001). So there were differences between the two groups in terms of the combination of plant species. Of particular interest is the more frequent presence of bramble-containing classes in the occupied territories (especially Class F).

TABLE 3. Comparison of the occurrence of samples in the different vegetation classes between occupied and unoccupied sites. Values in the table are the numbers of samples in each category (e.g. 12 samples in vegetation class A were in occupied territories) and the relationship between vegetation types and occupied/empty sites is statistically significant (χ^2 = 23.24, d.f. = 7, p < 0.001).

Vegetation Class	Occupied	Unoccupied
A, Mixed	12	4
B, Dog rose	19	16
C, Hawthorn	75	95
D, Hawthorn/ Bramble	33	30
E, Bramble/Gorse	55	48
F, Bramble	44	27
G, Willow	11	0
H, Willow/ Dog rose/Mixed	3	0

We also used another technique (linear discriminant analysis; see Appendix B*) which indicated significant differences between occupied and unoccupied sites in the 0-1m, 1-2m and 2-3m height bands. While these differences depended much on hawthorn, it is the combination of all five plant species which differentiates the territories from the control sites. In particular, in the 0-1m height band, it is the mosaic structure of hawthorn, bramble, dog rose, gorse and willow which influence the suitability of habitat for the Lesser Whitethroat.

Discussion

The Lesser Whitethroats is a rare breeding warbler in Strathclyde, where a small population of only 9-12 pairs manage to

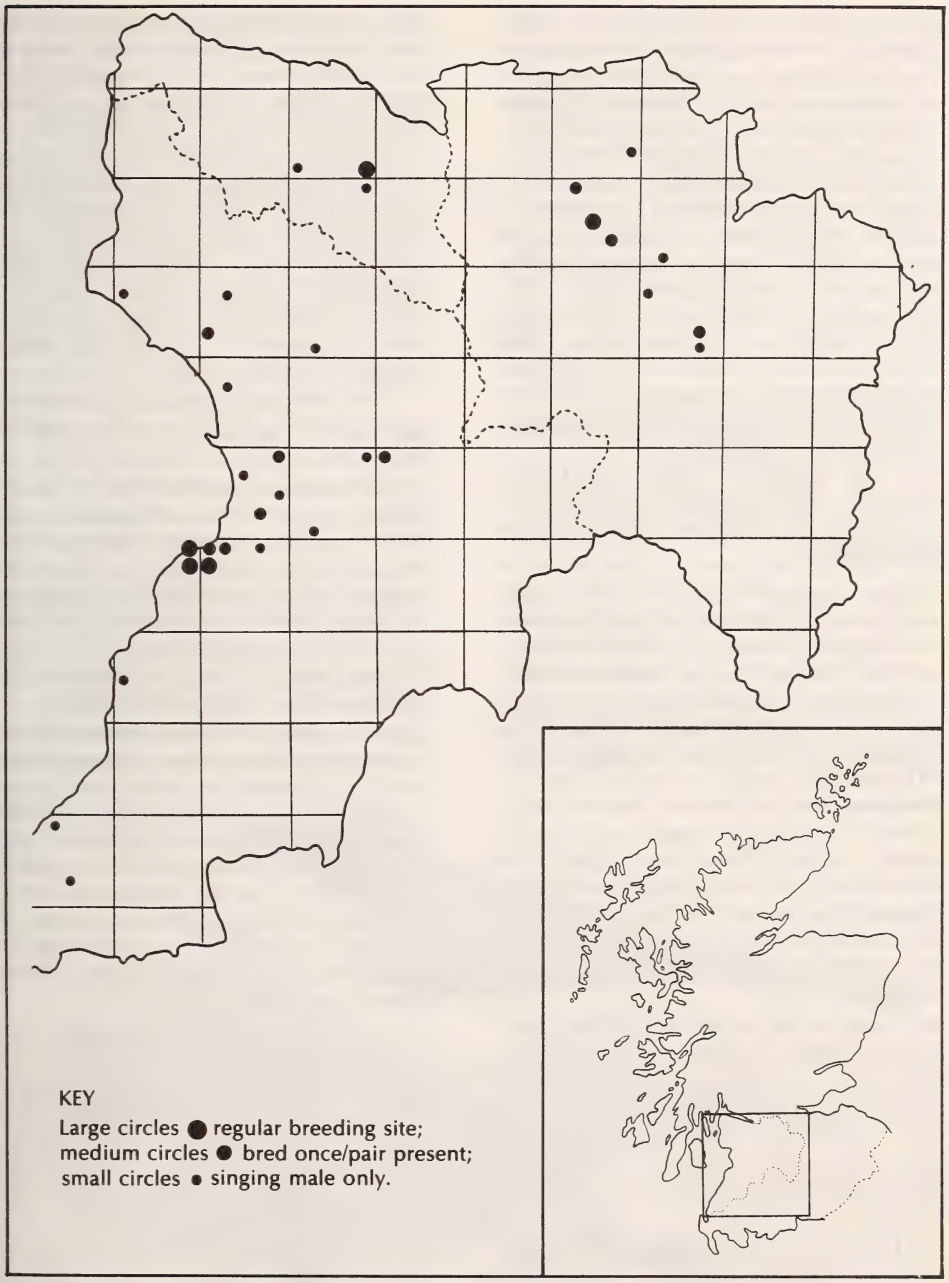

FIGURE 1. Lesser Whitethroat sites in Strathclyde during the 1983-90 survey.

hold territory on a regular basis. The majority are confined to just three main sites in the entire region. Ever since the initial colonisation of 1983, this small breeding population has not increased significantly. By contrast, in the Lothians the species has consolidated and expanded in terms both of breeding distribution and of the number of regular breeding pairs. A 1735 ha study site in East/Mid Lothian, held around twenty territories in 1984 (da Prato 1985). In 1989 there were 47-53 territories in the Lothian region, according to the Lothian Bird Report (McGarry 1989). The earlier figure of 50-100 pairs (da Prato 1980) was only an **estimate**, and is thus not strictly comparable with the later **actual** counts.

The reasons why the Lesser Whitethroat has not had the same success in Strathclyde, could be linked to three major factors.

1: The Lesser Whitethroat is on the northwesterly extremity of its European breeding distribution, therefore adult birds arriving back to breed in Strathclyde must be in such low numbers that they cannot sustain new colonisations elsewhere. This happened in 1990, when breeding Lesser Whitethroats failed to arrive back in Renfrewshire for the first time in eight years. This left three vacant territories in suitable habitat. If there were surplus birds in the vicinity, it is reasonable to assume that the territories would have been filled before the end of May. However, the only bird that did appear was a transient male, singing during late June.

2: It may be the lack of suitable hawthorn habitat which accounts for the limited breeding distribution of the Lesser Whitethroat in Strathclyde. It is this specific type of hawthorn scrub which was found in our study to be different in structural composition when compared to superficially similar control sites.

3: The climate, e.g. cold wet summers, could be slightly unsuitable for the Lesser Whitethroats' breeding requirements. This may restrict the breeding population in the west through the climatic effects on prey availability. Mason (1976) suggested that range limitation of this species in Britain may be related to diet. It is interesting to note that the distribution of Lesser Whitethroats in the Lothian region shows a clear affiliation with the occurrence of the climatic zone known as EE. This zone represents a warm dry lowland region below 200 metres (Birse 1971); and in Strathclyde the only other similar climatic region is located on a narrow coastal strip which includes the Heads of Ayr.

Our studies suggest six important aspects found in all of the seven recorded territories.

1: It is the integrated effect of all five major plant species in forming the dense mosaic structure, especially at the 0-1 metre height band, which appears to be a breeding requirement for the species. This preference for mosaic habitats reflects similar findings in Finland, where Haila *et al.* (1987) found that the Lesser Whitethroat is adapted to habitats with a mosaic-like structure.

2. All seven recorded territories were below the 100 metre contour line. Although there may be exceptions, we found that there is a general lack of suitable breeding habitat above 100 metres. This may be because poor soil quality or exposed ground is unsuitable for the optimum growth of hawthorn scrub. This factor could be important in terms of national distribution, as colonisation in general may be confined as a result to areas below 100 metres.

3. All seven recorded territories were situated on a sloping surface, either on steep hillsides or disused railway embankments. This may be an indication that ideal hawthorn habitat requires a well drained soil for optimum growth and plant species diversity. da Prato (1980) suggested that Lesser Whitethroat territories were specifically located on warm south facing banks. However, we found no correlation between south facing slopes and territory

location; in fact the three territories at the Heads of Ayr were situated on a NNE facing slope.

4. Grazing farm animals were denied access into the recorded territories by means of wire fencing or by the sheer density of the scrub itself. Many times during our survey we would spot from a distance what appeared to be extensive hawthorn canopy only to discover that once beneath the "pristine" canopy, there lay a completely denuded zone from ground level up to one metre. Such areas had evidently been grazed by sheltering cattle and so rendered useless in terms of breeding habitat.

5. The mature hawthorn canopy was found to be 3-4 metres in height and open in structure. This feature of hawthorn canopy may be important for the warblers' spatial feeding requirements (cf. da Prato 1980).

6. Dense bramble patches were present in all seven territories with good coverage in the 0-1 metre height level. We believe that bramble is an essential component of Lesser Whitethroat breeding habitat in Strathclyde (see Table 3). According to the information from BTO nest record cards (Mason 1976), the average nest was in the 0-1 metre height band. This may explain why that particular height band differed in vegetation comparison between occupied territories and control sites. The nest record cards indicate that, of the eight plant species recorded, the highest proportion of nests (47%) were located in bramble. According to Barlein *et al.* (1980), there are great regional differences in the plants in which *Sylvia* warblers nest across Europe. They stated that bramble has a unique significance as a nest bearing plant for four British *Sylvia* warblers, including the Lesser Whitethroat.

If the Lesser Whitethroat is to increase from the known population of 9-12 pairs in Strathclyde, the species might have to expand into inferior habitats. Suitable breeding sites are few and far between in Strathclyde and, if the species has saturated all of the available habitat, this could be the reason why the population has remained constant for eight years.

Conservation

During our research we discovered that two of the major sites are currently under threat by development, Dykebar in Renfrewshire

Lesser Whitethroat *J.J. Sweeney*

and the Heads of Ayr in Ayrshire. Hopefully the habitat and the Lesser Whitethroats can be saved by conservation measures brought about by the new Nature Conservancy Council for Scotland and the respective district councils. Recent negotiations between the farmer and the NCCS over the Heads of Ayr site have resulted in amicable agreements for both parties, thereby saving the entire site from scrub clearance. Management plans have now been drafted in order to maintain and expand the unique habitat specifically for the Lesser Whitethroat.

If such measures are not taken, then this enigmatic warbler may soon disappear as a breeding species in Strathclyde.

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Changes in the breeding status of Black-throated Divers in Scotland

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Extensive surveys in the 1980s confirmed breeding by Black-throated Divers in one year or another at 153 distinct sites. The Scottish population in 1985-89 comprised about 156 territorial/breeding pairs. At least 22 sites once occupied by Black-throated Divers have apparently been abandoned. This is interpreted as evidence of a recent population decline. Most recorded losses were in the 1970s and early 1980s, largely at the edges of the Scottish breeding range.

Introduction

This paper reviews short and long term population trends in Black-throated Divers *Gavia arctica* (BTD) and re-assesses the current size of the Scottish breeding population on the basis of confirmed breeding records in 1985-89.

In Britain BTDs breed only in Scotland. No attempt to count the Scottish population had been made before 1985, although the distribution was mapped in 1968-72 for the *BTO Atlas of Breeding Birds in Britain and Ireland* (Sharrock 1976). The first comprehensive survey was carried out in 1985. It estimated that there were 151 summering territories, with breeding confirmed in 66 of them (Campbell & Talbot 1987).

Concern has been widely expressed about the current status of Scottish BTDs resulting from the relatively low breeding success noted in the 1970s and 1980s (Bundy 1979, Dennis 1973 *et seq.*, Thom 1986), the perceived threats from increased human activities on some of the divers' breeding lochs (Cramp & Simmons 1977, Parslow 1973, Thom 1986) and the influences of general environmental changes such as hydro-electric developments, conifer afforestation (in the catchment areas of lochs) and habitat degradation due to overgrazing and burning. Campbell & Talbot (1987) obtained insufficient data to make a reliable assessment of recent changes in population. Since then, all known previous breeding records have been systematically collated. In addition, further field surveys were carried out in 1986, 1987, 1988 and 1989.

Sources of information

Published site records are few due to the need for confidentiality with this protected species. As a result most data are from the following sources:

1. Egg collections; 20 museums provided information on 148 clutches.
2. Records submitted to Scottish bird recorders.
3. British Trust for Ornithology nest record cards (137).
4. Appeals for past records in ornithological, wildlife and angling publications and all local Scottish newspapers.
5. Information from apprehended egg collectors, via the RSPB Investigation Section.

6. Records from Nature Conservancy Council upland bird surveys in 1980-87.
7. RSPB monitoring through site visits and correspondence from 1971-1989, including specific surveys in 1976, 1977, 1981 and 1983-89. In 1985, each possible breeding loch was visited 1-3 times in May-June (details in Campbell & Talbot 1987). In 1986-89, repeat visits were made to virtually all lochs on the mainland and Inner Hebrides which had past records of BTDs. Additional possible sites were also sought. The presence of adults and evidence for breeding were recorded on standard cards.

With the exception of specific surveys under item 7 above, it is only very rarely that reports were received of visits to lochs when no BTDs were seen. This is a shortcoming which complicates evaluation of status changes. All records were stored on a database held by the RSPB which is to be updated.

Definitions and assumptions

A 'site' is defined as a loch, or a part of a loch, or a group of adjacent lochs, occupied by a single territorial/breeding pair. A site is assumed to be 'currently confirmed' if eggs or unfledged chicks are known to have been present in any year between 1985 and 1989.

Breeding is assumed to have been 'confirmed' in the 'past' if, before 1985, eggs are known to have been taken or if breeding was reported by a reliable observer.

A past breeding record is assumed to be 'unconfirmed' if it relates to a report of breeding by an observer whose reliability was not known to the authors. In all but one of these cases there was just one such record per site.

A site with confirmed breeding in the past is assumed to be 'currently deserted' if birds were either absent on three or more visits in 1985-89, or if only a single bird was seen on 25% or less of four or more visits made to the site. A visit comprised a thorough search in May or June in any or all years 1985-89. In six cases, a site was placed in this category following one or two negative visits by RSPB staff supported by reliable local information.

The likelihood of wrongly classifying a site as deserted using these criteria is very low (Table 1). This was assessed by examining attendance records (average of 11 visits per year in 1986 and 1987) at sites in detailed study areas where breeding was known to occur. For example, one or more adult BTDs were seen on 88% of May/June visits to known breeding lochs, giving a probability of 0.1 of recording no adults at

TABLE 1. The probabilities of wrongly classifying a known breeding site as deserted using the defined criteria (see text). Probabilities were calculated from the proportion of May/June visits when no BTDs, or just one, were seen.

	Number of breeding lochs	Total visits May/June	Probability of recording no adult birds in May/June single visit	3 visits	Probability of seeing only a single bird on 1 in 4 visits
Sutherland					
1986	25	346	0.101	0.0010	0.0003
1987	26	319	0.113	0.0014	0.0004
Ross-shire					
1986	19	163	0.123	0.0019	0.0005
1987	21	181	0.171	0.0050	0.0013
Overall	91	1009	0.121	0.0018	0.0005

a single visit. For sites where breeding regularly occurs year after year, the probability of seeing birds is the same whether visits all occur in a single year or are spread across several years. However, at the small number of sites where breeding is not regular, the schedule of visits could affect the chances of detecting birds.

The current status at a site is classed as 'uncertain' if less than three visits were made to it in May or June 1985-89, or if adults were present on 26-50% of three or more visits but there was no evidence of breeding. If one or two adults were present on >50% of such visits then this site was designated as holding a 'territorial pair'. The latter case applied to nine sites in total. These cut-off percentages were based on experiences at sites studied in detail.

Results

The 1980s population

We now know of 153 'sites' where breeding was confirmed at least once in the 1980s; 142 of these sites were occupied in 1985-89 (Table 2). In a small number of sites, the same pair may have bred at different lochs in different years, thus inflating the above figures. In areas in West Sutherland and Ross-shire where BTDs were studied in detail in 1983-1988, we knew of six such examples among 66 pairs. Where known, these were recorded as single sites. If this situation was proportionally the same throughout Scotland, the number of distinct confirmed sites (equivalent to territorial pairs) would be reduced from 142 to 135.

Due to the extensive and largely remote potential breeding range of BTDs in Scotland, there are inevitably a number of sites of which we are still unaware. On the basis of a clear picture of coverage over the years, we believe that this number is unlikely to exceed 10 sites. Also there are 35 sites where breeding has been confirmed in the past but where the birds' current status is not certainly known (Table 2). Birds have been seen on 50% or more visits in 1985-89

TABLE 2. Number of Black-throated Diver breeding sites by Region/District.

Region/ District	Confirmed breeding 1985-89	Confirmed breeding before 1985		Single unconfirmed report of past breeding	
		currently deserted	current status uncertain	currently deserted	current status uncertain
Caithness	9	1	0	0	2
Sutherland	47	6	6	2	6
Ross-shire	38	0	6	3	2
Inverness	6	1	0	2	0
Skye & Lochalsh	3	3	0	0	4
Badenoch & Strathspey	2	3	1	0	0
Lochaber	8	1	6	1	1
Tayside & Central	9	0	3	0	2
Strathclyde & SW Scotland	9	7	3	4	5
Outer Hebrides	11	0	10	0	3
Totals	142	22	35	12	25

at nine of these sites, although at eight others we have no record of a recent May/June visit by an observer. Additionally, we know of two sites that currently hold regular territorial pairs but where breeding has never been confirmed.

Our best estimate of the size of the Scottish breeding population in 1985-89 is built up as follows:

Number of distinct territories with confirmed breeding	135
Sites with confirmed breeding in the past and territorial pair now present	9
Sites with current territorial pair but no confirmed breeding past or present	2
Allowance for undetected sites	10
Total territorial/breeding pairs	156

This is very close to the single-year survey result for 1985 of 151 summering territories obtained by Campbell & Talbot (1987).

Deserted sites

The main evidence for changes in numbers is based on the current status of sites where breeding has been known in the past. At least 22 such sites are now occupied (Table 2). This is a relatively large figure compared with the 142 currently confirmed breeding sites. There are few sites for which annual reports are available, particularly before 1970, and as a result it is usually difficult to establish the regularity of past breeding and also the distinctiveness of pairs at adjacent sites. However, at most of these sites breeding was recorded in two or more earlier years (77%) and no other occupied sites are known within a 5km radius (82%, Table 3). Six sites were well established, with breeding confirmed in five or more years (14 years at one site). 64% of known losses involve sites where breeding last occurred in the period 1971-84, although this is when the bulk of available information was collected.

The scale of change is better appreciated by looking at the current status of those sites where breeding was first reported in the more distant past (Table 4). Of the 47 sites where breeding was confirmed before 1940, 26% are no longer occupied. We are uncertain of the current status of a further 19%. Of those, where the current status is known, 32% no longer support breeding BTDs. At two of the 12 unoccupied sites, there is another currently-occupied territory within a 5km radius.

TABLE 3. Circumstances at past sites where Black-throated Divers no longer breed or where their current status is uncertain.

	Breeding last reported:			
	before 1940	1941-1970	1971-1984	Total
Total number of deserted sites	7	1	14	22
Deserted sites with no current site within 5km	6	2	10	18
Deserted site where breeding had been recorded in 2 or more years	5	1	11	17
Deserted sites where breeding had been recorded in 5 or more years	1	0	5	6
Sites where current status is uncertain	6	7	22	35

TABLE 4. The current breeding status of Black-throated Divers at sites where confirmed breeding was first reported prior to 1940.

	Status in 1985-89			
First confirmed breeding:	Site occupied	Site unoccupied	Uncertain	Total
prior to 1900	16	8	3	27
1900-1940	10	4	6	20
Total	26	12	9	47

Sites now deserted are present throughout the breeding range (Table 2), but losses are proportionally larger, in relation to the number of currently used sites, away from the core areas of Sutherland and Ross-shire. Indeed, they occur mainly in peripheral areas at the northern, eastern and south-western edges of the range. 86% occur outside a line connecting the outermost of all the currently known sites on the mainland and inner isles. Status changes in the Outer Hebrides are unclear due to the particularly high density of freshwater lochs and, except for 1985, a lack of comprehensive surveillance.

Due to extensive searching and documentation in recent years, we know of many more sites now than at any time in the past. Breeding has been confirmed at 153 sites in the 1980s compared with 92 sites in the 1970s and just 48 sites in the 1950/60s. However, at none of the 53 sites documented for the first time in the 1980s can we confidently state that breeding had not occurred previously. At 26 of these sites BTDs had been noted during previous decades but breeding had not been proved, and 20 of the remaining 26 sites are at least 1km from the nearest vehicular access and are not regularly visited by observers.

In addition to the documented losses, there are three categories of sites where available information is less clear-cut (Table 2). An unknown proportion of these 72 will constitute additional deserted sites.

Comparisons with 'The Atlas of Breeding Birds'

The nature of coverage differed considerably between the *British Trust for Ornithology Breeding Atlas* (1968-72, Sharrock 1976) and recent BTD surveys (1985-89), making direct comparisons difficult. A broad comparison (Table 5) suggests that there has been a reduction of up to 27% in the number of 10km squares with breeding or territorial pairs present (or 20% if it is assumed that all sites of uncertain current status hold pairs). The real magnitude of this change depends upon the degree to which the criteria for proof of breeding were adhered to during the Atlas survey. A small number of Breeding Atlas records are now regarded to be of doubtful validity and in 3-4 cases a single pair may have been scored in more than one 10km square. However, the results do support the earlier trends noted from examination of historical records.

Short-term changes in West Sutherland

A study area in West Sutherland of about 3000 km^2 has been surveyed in detail in 8 years over the period 1977-88 (Table 6). The frequency of site visits and knowledge of territories and nest sites have all increased over the years and a total of 34 breeding territories were identified.

The evidence suggests that the number of pairs occupying territories remained

TABLE 5. Number of 10km squares holding breeding or territorial Black-throated Divers in 1968-72 (BTO Atlas) and 1985-89. Atlas totals include squares with breeding classed as confirmed or probable. 1985-89 totals include all 142 confirmed breeding sites and 11 regular territorial pairs.

Area	Atlas	1985-89	Difference (%)	Present 1968-72 but not recorded 1985-89	Not recorded 1968-72 but present 1985-89
Caithness	4	3	−25	1	0
Sutherland	36	35	−3	11	9
Ross-shire	34	23	−32	15	4
Inverness	5	6	+20	2	3
Skye & Lochalsh	8	2	−75	6	0
Badenoch & Strathspey	1	2	+50	0	1
Lochaber	15	6	−60	10	1
Tayside & Central	6	10	+67	1	5
Strathclyde & SW Scotland	22	10	−55	13	3
Outer Hebrides	14	9	−36	8	3
Total	145	106	−27	67	29

stable between 1984 and 1988. The apparent increase in total pairs is a result of more widespread surveillance. There is no evidence to suggest that sites given insufficient or no coverage in earlier years were not then occupied. Only one breeding territory has become and remained unoccupied. Three others have been apparently unoccupied for one year, and five for two or more years.

Discussion

Past documentation of the numbers and locations of BTD territories has been very poor. In just a few cases are there clues to the total numbers within geographical units. Harvie-Brown & MacPherson (1904) refer to at least four pairs in the Arisaig district (Lochaber), an area where we currently know of none. In North Uist, Harvie-Brown & Buckley (1888) knew of three or more breeding pairs and Gray (in Baxter & Rintoul 1953) knew of five pairs. We have just one recent record of confirmed breeding, but coverage here has been poor. In south-western parts of the breeding range, we know of no current breeding pairs on Skye, Mull, Coll, Islay, Jura, Arran or the Kintyre peninsula, all areas with past records of one or two breeding pairs (although some are classed here as unconfirmed). Harvie-Brown (1895, in Sharrock 1976) gives these areas as outside the breeding range, but this was apparently incorrect because we now have details of some confirmed 19th and early 20th century records from here (McWilliam 1931). There are also old records of breeding in Orkney (Baxter & Rintoul 1953) and museum-held clutches reputedly taken in Orkney (1877) and in Shetland (1898 and 1919), but we know of no recent breeding records from the Northern Isles.

There is clearly no means of assessing the full size of the Scottish population at any time in the past, and it is therefore difficult

TABLE 6. Annual occupancy of 34 breeding territories in West Sutherland, 1977-88.

Year	Confirmed breeding	Territorial pair	Total pairs	Territories with insufficient surveillance	Territories apparently unoccupied
1977	12	10	22	11	1
1981	10	9	19	11	4
1983	13	14	27	4	3
1984	19	11	30	3	1
1985	25	5	30	1	3
1986	26	4	30	0	4
1987	26	5	31	0	3
1988	20	10	30	0	4

to be sure of the direction and scale of any change in numbers. We currently know of many more sites than have been documented in past decades, but this is undoubtedly due to the great deal of concerted effort put in during the 1970s and 1980s. The best available evidence for status changes rests on the history of occupancy of individual sites. We know from detailed studies in West Sutherland that BTDs there show a high degree of site fidelity from year to year (Table 6; Mudge & Talbot, unpubl. obs.). Deserted sites are, therefore, assumed in most cases to represent lost pairs and the balance of evidence thus points to a population decline. In a small proportion of cases (see Table 3), the apparent loss may be due to movement of the pair to a nearby loch. In the absence of marked birds there is no evidence of whether or not movements over longer distances can occur between years.

The fact that most deserted sites occur around the edges of the breeding range is consistent with an overall decline. In such a situation, changes are likely to be more pronounced in peripheral areas. Similar circumstances could arise with a stable population if there was simply a faster turnover of pairs and sites at the periphery. The available evidence in 1991 does not lend support to this latter scenario.

In general texts, where comment is made, most authors have considered BTDs to be declining in numbers. The decline appears to have been substantial in the early part of the 20th century (MacKenzie 1918; Gilroy 1923; Alexander & Lack 1944; W. Marshall in Baxter & Rintoul 1953; Parslow 1973; Sharrock 1976). Human persecution through egg collecting, shooting of adult birds and breaking of eggs to protect fishing interests, is widely held to have been the cause (Harvie-Brown 1906; Alexander & Lack 1944; Rankin 1947; Baxter & Rintoul 1953). These pressures are generally less strong at present but breeding success is still very poor (Mudge & Talbot, in prep.). Angling-related persecution apparently continued until quite recently. At one loch in East Sutherland, for instance, it is reported that around the 1950s adults were shot and/or eggs broken each year to 'save the trout', and at an Inverness-shire loch, eggs were shaken in most years in the 1950s to destroy the embryos. There are no recent breeding records for BTDs at these sites.

A relaxation of human persecution may have allowed an increase in numbers in the 1940s, 1950s and 1960s. There is no useful information on possible changes in the core mainland areas, but a south-westward extension of the breeding range (re-colonisation ?) was noted between 1951

and 1974 with breeding pairs appearing on Arran and in Ayrshire, Galloway and Central. Such an extension would be unlikely to occur if the overall population was in decline at that time. This is because recruitment would be expected to be concentrated even more heavily on natal areas at a time when gaps are appearing in the existing breeding range. The evidence presented in this paper then points to another phase of decline in the 1970s and 1980s, perhaps as a consequence of the consistently low breeding success observed in these years (Mudge & Talbot in prep.).

We now have good baseline knowledge of the current number and distribution of breeding pairs and are well placed to detect and document future changes. It is important that monitoring is continued in view of the current low level of chick production, and the potential threats to breeding lochs from increased human encroachment, acidification of the loch waters, and land use changes in catchment areas.

Acknowledgements

We are grateful to the vary large number of people who have contributed records of breeding BTDs, to the museums who made available information concerning their egg collections, and to the BTO for access to their nest record cards. Dr L.H. Campbell, Dr C.J. Bibby and G. Elliott made helpful comments on the manuscript.

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The spring passage of Long-tailed Skuas off North Uist in 1991

D.L. DAVENPORT

Introduction

The spring skua passage at Balranald, North Uist has been studied since 1976 (Davenport 1984, 1987). In 1991 there was an unprecedented passage of Long-tailed Skuas *Stercorarius longicaudus*, with 1,340 counted between 12-21 May, plus a total of 622 Pomarine Skuas *S. pomarinus* between 11-22 May.

Methods

Balranald was manned between 11-22 May. Coverage was fairly .continuous (except during frontal rain) because westerly winds prevailed throughout this period, but special effort was made to watch after the passage of fronts because such conditions often produce the largest movements.

Results

Skua passage was recorded daily between 11-22 May and the largest movements (but not necessarily the day totals) during this period are shown in the accompanying table. The fact that nearly all these movements began in the middle of the day was dictated by the weather conditions, and was not due to any lack of available coverage in the mornings.

Passage and associated weather conditions

Most skua passage at Balranald starts when the wind veers from S or SW to W, NW or N, often following a trough or a front, and the separate movements on May 11, 12 and 13 all come into this category. Early on the 12th there was a warm front and eight hours

TABLE. Skua passage at Balranald, North Uist in May 1991.

Date	Wind	Time	Pomarine	Long-tailed	
				total	largest flocks
11/5	NW4	1100-1500	59	—	
12/5	W5	1100-1900	120	424	18,18,21,27,40,70,110,112
13/5	NW4	1330-1830	70	15	6,8
14/5	NW4	0530-1100	20	14	6
14/5	NW4	1800-1930	15	25	25
18/5	SW5	1115	—	51	51
19/5	SW5	1030-1630	53	536	6,13,15,15,16,20,25,40, 40,50,60,70,80,85
19/5	W4	1815-2015	50	4	
20/5	W4	1200-1800	74	67	4,4,13,20,20
21/5	W5	1345-1945	72	180	180

rain, followed by a cold front in late morning, and although the subsequent clearance was permanent, it was followed by low overcast for the rest of the day with some patchy drizzle. This produced a typical movement of 120 Pomarine and 30 Arctic Skuas in 8 hours, in the middle of which there was an exceptional total of 424 Long-tailed Skuas in 4 hours in only 8 flocks, including two large flocks of 110 and 112 birds.

A trough on 13 May produced a calm morning with drizzle, and in the afternoon there was a movement of 70 Pomarine and 15 Long-tailed Skuas in 5 hours. The wind and weather conditions then remained steady over the next three days, resulting in a typical pattern of skua passage in the mornings and evenings, although the numbers were smaller than expected, with 35 Pomarine and 39 Long-tailed Skuas in 7 hours on the 14th, and very few on 15-16 May.

On 18 May another cold front, preceded by four hours rain, was quickly followed by a flock of 51 Long-tailed Skuas. However, soon afterwards the cloud cleared and the wind dropped very rapidly, and skua passage was negligible for the rest of the day.

On 19 May there was another four hours rain in the morning followed by a clearance. However, because this was a warm front the conditions were rather worse than on the 12th, with the overcast lower and heavier, poorer visibility, and a greater risk of drizzle. This produced another exceptional total of 536 Long-tailed Skuas in 6 hours in only 14 flocks, accompanied by 53 Pomarines which were apparently labouring in the poor conditions. This movement was halted by a weak cold front with two hours rain in the afternoon, after which there were 50 Pomarines in the next 2 hours in slightly improved conditions, but only four Long-tailed Skuas. There was also a total of 29 Arctic Skuas in 8 hours during the day.

On 20 May the weather was dominated by sea fog, but this cleared before midday, producing a movement of 74 Pomarine and 67 Long-tailed Skuas in the next 6 hours, after which the fog closed in again. A cold front, preceded by two hours rain, finally reached Balranald on the morning of the 21st, followed by a permanent clearance, although it remained overcast for four hours. However, no flocks of skuas appeared until five hours later, after which there was a movement of 72 Pomarines in 6 hours, with just one large flock of 180 Long-tailed Skuas.

Behaviour of Long-tailed Skuas on passage

Long-tailed Skuas at Balranald tend either to go by at close ranges, including crossing the headland or the RSPB reserve (Pomarines never cross the land at Balranald), or at long ranges of up to two miles. Distant groups of up to 10 birds typically keep very low in single file, with regular spacing between each bird, and with less periods of banking and gliding than in Pomarines, making them more difficult to see. Both species fly high in level flight in calm weather, but in normal conditions of moderate or fresh winds the low-flying flocks (usually the largest flocks) will climb up high intermittently, which the Pomarines at Balranald never do. This is presumably in order to sight their route past the headland and through the offshore islands. For instance, the flock of 112 on 12 May was first seen about five miles away and over 10 minutes before they were seen again as they reached Balranald.

Most of the large flocks of Long-tailed Skuas in 1991 were distant and travelling in long straggling lines, rather like flocks of Arctic Terns. Typically about two-thirds of the flock formed a nucleus at the front, with the remainder in a thin line trailing behind. Many flocks were seen only because they were already flying high, and many of the others were impossible to count accurately until they did likewise. Rather more surprising was the discovery that climbing flocks were prepared to continue upwards

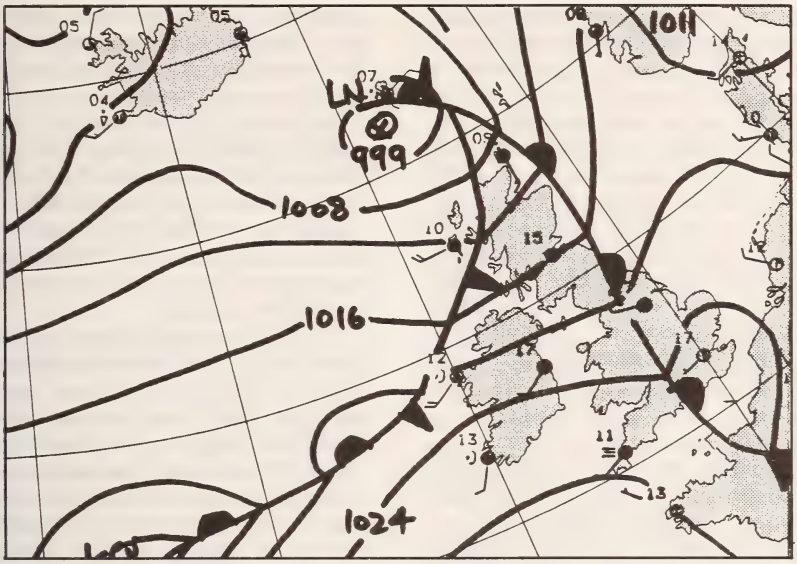

FIGURE 1. Atlantic weather map at 1200 hrs on 12 May 1991. On this date there was continuous rain between the warm and cold fronts, and the Long-tailed Skuas passed Balranald after the cold front.

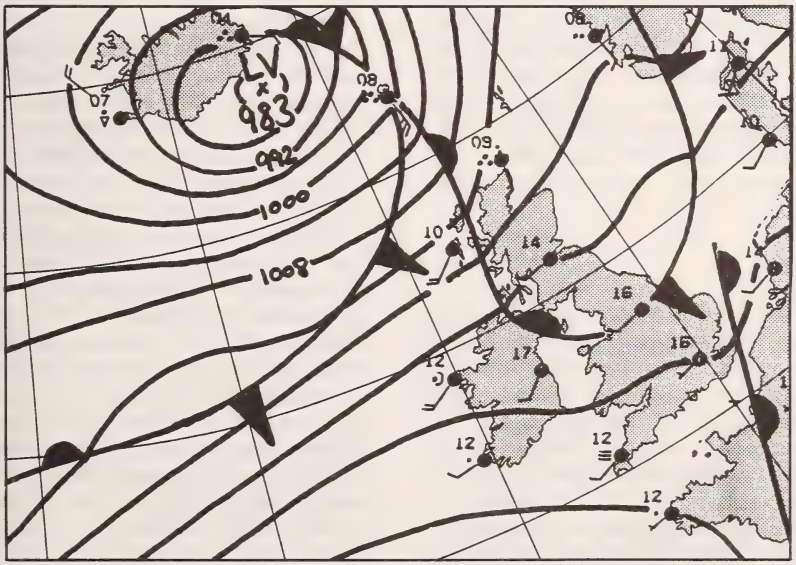

FIGURE 2. Atlantic weather map at 1200 hrs on 19 May 1991. On this date the Long-tailed Skuas passed Balranald in a break in the rain between the warm and cold fronts.

through low overcast in very poor weather conditions, as demonstrated by the flock of 51 on the 18th (descending again about a mile later) and flocks of 25 and 40 on the 19th. A group of 5 Pomarines, which were attempting to remain attached to the flock of 25 Long-tailed Skuas and had started climbing, were left stranded when the flock disappeared into the cloud, and immediately returned to sea level. I saw comparable behaviour on 21 May 1983 when two Pomarines, already attached to a group of seven Long-tailed, failed to follow them across the reserve. In 1991 only a few ones and twos crossed the headland, and the only birds seen to fly over the RSPB reserve were the flock of 27 on the 12th.

Also in 1991 several observations were made by Tim Dix at Ardivachar Point (South Uist), about 15 miles SSE of Balranald. A total of 45 Long-tailed Skuas was seen on 14, 18, 20 and 21 May, and although there was simultaneous coverage at both sites on all these dates, only four of these birds were seen to pass Balranald, which suggests that the remainder went high over North Uist. In addition a group of three was seen to head inland at Paible (North Uist), about 4 miles SE of Balranald, on the 16th. The change in direction of the coastline suggests that Paible would be the best site to see flocks of Long-tailed Skuas intending to bypass Balranald by heading overland.

Discussion

As already stated, most skua passage at Balranald follows frontal rain (and thereby usually occurs in relatively clear weather) when a typical movement of up to 100 Pomarines in 4-7 hours might be accompanied by one or two flocks of Long-tailed Skuas, and often by none at all. The table shows that the movements on May 11, 13, 14 and 21 all fit into this category.

The exceptional numbers of Long-tailed Skuas on 12 May and 19 May were apparently the result of the poor weather conditions, involving winds of force 5 and fronts with several hours rain, followed by low overcast and intermittent drizzle. Such conditions apparently not only bring them close inshore, but also prevent them from passing the Outer Hebrides as quickly as they would like. It seems that they are far more adaptable at coping with adverse weather conditions than Pomarines, and a high proportion prefer to fly high and/or go overland when confronted with an unfamiliar coastline.

If this suggestion is correct, it follows that Long-tailed Skuas probably occur in greater numbers than was previously thought, but they can be seen from Balranald only under very particular weather conditions. For instance, it now seems likely that several large flocks would have been seen on the 18th if the weather had not improved so rapidly, and again on the 21st if the cold front had not reached Balranald until over five hours later.

Previous observations at Balranald and other sites

The largest skua movements at Balranald in previous years are listed here in order to put the 1991 observations into context, and all counts of more than 180 Pomarine and 70 Long-tailed Skuas are included. In May 1982 there were 185 Pomarines in 3½ hours on the 2nd and 345 Pomarines in 4 hours on the 4th. There were no Long-tailed Skuas in this movement, because it was too early in the month. In May 1983 there were 786 Pomarine, 152 Arctic and 387 Long-tailed Skuas between the 19th-22nd, including day totals of 436 Pomarines on the 19th, 182 Pomarines and 271 Long-tailed on the 21st. This movement of Long-tailed Skuas was unusual because it consisted entirely of very small groups, averaging three or four birds, and a total of 81 flew across the headland or the RSPB reserve on the 21st-22nd. In retrospect the fact that it was overcast all day on the 21st, with two hours heavy drizzle in mid-morning, was significant.

In May 1986 there were several large counts of Pomarines including 254 on the 11th, 241 on the 18th and 284 on the 26th, a total of 779 in only 9 hours. In addition there was an exceptionally concentrated movement involving 766 Pomarines in 5 hours on the 21st, accompanied by 168 Long-tailed Skuas in only four flocks. In May 1987 there was just one large movement involving a day total of 703 Pomarine and 77 Long-tailed Skuas on the 17th.

Elsewhere spring movements of Long-tailed Skuas have only been seen at two other sites: at Slyne Head (Co. Galway) there were counts of 22 on 23 May 1979 and 15 on 13 May 1981, while at Wats Ness (Shetland) there were flocks of 18 and 33 on 21 May 1987, and 119 (including a flock of 105) on 22 May 1991. Other sites where observations might be attempted are Neist Point (Skye) and the coast between Aird Brenish and Gallan Head (Lewis). Observers wishing to see Long-tailed Skuas should bear in mind that flocks have so far only occurred at Balranald during 9 – 24 May, and that none are seen if offshore winds occur throughout this period, as happened in 1989 and 1990.

Acknowledgements

The main observations in 1991 were made by Trevor Bowley, John Metcalf and myself throughout the 12th-22nd May, with Alan Dawe and friends during the 12th-16th May, Ken Dummigan during the 13th-16th May, Jeff Stenning during the 18th – 20th May, and Rupert Perkins on the 19th May.

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Shore-bird populations on the Orkney coastline in winter

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A survey of the numbers and distribution of shore-birds on the coast of the Orkney Islands was carried out during the winters 1982-3 and 1983-4. Most of the coastline (many sections of cliff were omitted from the survey) was walked at low tide and totals of 51,000 waders, 15,000 gulls and 8,500 dabbling ducks counted. The most numerous waders were Curlews (17,700), Redshanks (6,900), Turnstones (6,000) and Purple Sandpipers (5,700). Densities of waders on sandy beaches and rocky shores exceeded the average density for British estuaries. There were 9,000 Common Gulls and 5,000 Wigeon.

Variations between the two winters were checked by carrying out a repeat survey on Sanday. The numbers of Purple Sandpipers, Turnstones, Curlews and Ringed Plovers were similar for the two winters. Variation between observers in counting and day to day variations in numbers made it difficult to obtain precise estimates. The most precise counts were for Turnstones and Purple Sandpipers.

For eleven species of shore-birds the Orkney coastline supports nationally or internationally important populations.

Introduction

In 1969 the British Trust for Ornithology initiated a monthly survey of birds inhabiting estuaries (the Birds of Estuaries Enquiry (BOEE)) in order to quantify the numbers and distribution of shore-birds (waders, gulls and wildfowl) present there (Prater 1981). Other coastal habitats, which also support many shore-birds were not surveyed, so the national populations of many species remained uncertain and the relative importance of estuarine versus non-estuarine shore to various species could not be determined. Attempts were made to estimate the national population of some species, eg. the Sanderling *Calidris alba*, mainly a sandy beach species (Prater & Davies 1978) and the Purple Sandpiper *C. maritima*, a rocky shore species (Atkinson *et al.* 1978), based on casual records published in local bird reports. These estimations highlighted the limitation of our knowledge on the numbers and distribution of these species.

In order to measure the size of the populations of open-shore (i.e. non-estuarine) waders and thus complement the BOEE, the Tay Ringing Group undertook a survey of waders on 330km of rocky coast from Berwickshire to Morayshire between 1971 and 1974 (Summers *et al.* 1975). This survey was extended to include Caithness, east Sutherland and east Ross-shire (115 km)

in 1982, when it included all shore-birds on sandy as well as rocky shores (Summers & Buxton 1983). Buxton (1982) carried out a similar survey of the Outer Hebrides between 1978 and 1982. The survey of the Orkney Islands reported here was a continuation of these surveys and a summary of a preliminary report (Tay & Orkney Ringing Groups 1984) has already been incorporated into a subsequent national survey of non-estuarine waders (Moser & Summers 1987). In this paper, details of the numbers and distribution of shore-birds on the coastline of the Orkney Islands in winter is described, and compared with the neighbouring archipelago of Shetland where a survey was conducted in winter 1984-85 (Summers *et al.* 1988).

Study areas

The Orkney Islands are composed almost entirely of Old Red Sandstone which is a sedimentary rock laid down in a huge, shallow freshwater lake during the Devonian period, 350 million years ago (Bailey 1971). The coastline of Orkney has been described by Mather *et al.* (1975). In total, it has about 800km of coastline, as measured on a 1:50,000 scale. Most of this (71%) is composed of low rocky shore, 18% are high cliffs over 15 metres, whilst the remaining 11% is of sand (Fig. 1).

FIGURE 1. The Orkney Islands showing shore types (thick line: cliff, thin line: low rocky coast, stipple: sand or shingle) from Mather et al. 1975) and sections of coast that were not surveyed (|——|).

The islands with the highest proportion of sandy beach are Shapinsay, Sanday and Stronsay. These are mainly in the north-eastern sector of the archipelago. In contrast, cliffs dominate the coastal scenery of South Ronaldsay, Westray, Hoy and west Mainland, mainly round the southern and western edges of the archipelago (Fig. 1).

Although the kelp *Laminaria* spp. forests are usually out of reach of inter-tidal animals, kelp plays an important role in the ecology of rocky shores and sandy beaches, because it can provide a massive input of detritus onto these shores. Although kelps provide most of this, several other brown and red sea-weeds also contribute. The strandings of kelp are uneven along the coast, being concentrated by the configuration of the coast and the action of the offshore currents. Such banks of stranded kelp can reach a depth of a metre or more and provide a rich food supply for scavenging amphipods. Banks, which have been left high and dry by a series of spring tides, eventually begin to rot and decay and in this warm mulch kelp flies *Coelopa frigida* lay their eggs and the resulting maggots feed. Both amphipods and insects are food for waders (Summers *et al.* 1990).

Methods

All the inhabited islands were surveyed: Mainland, Hoy, South Ronaldsay, Burray, Sanday, Westray, Shapinsay, Stronsay, Papa Westray, North Ronaldsay, Rousay, Egilsay, Graemsay, Flotta, Wyre, Auskerry and Eday. Some of the smaller islands were also visited: Glims Holm, Lamb Holm and Hunda. Most of the coastline on these islands was visited but sections of high cliff which, from previous experience, were known to have few or no waders were excluded. About a third of suitable habitat on North Ronaldsay and many tiny islands were not surveyed. Fig. 1 shows the unsurveyed sections and Table 1 shows the length and area of each habitat surveyed on each island.

The islands were surveyed during 22-30 January 1983 and 17 December 1983 to 29 January 1984, when a winter maximum of birds was present.

The counting method was designed to give the best estimate of the wader population present in the inter-tidal zone at low tide. It became apparent during the survey that many waders, ducks and gulls used inland fields to some extent for feeding and for roosting. As a result, the shore counts underestimated the total Orkney population for many species, though for several the underestimation was small.

Counts were carried out whilst walking along the shore between half ebb and half flood, when one would expect birds that feed on the inter-tidal zone to be present. Waders tend to concentrate at the water's edge, following the tide out and in. Because some waders are cryptic, we walked close to the water's edge so as not to miss these birds. Only those birds which were passed by the observer, flew behind, inland or out to sea were counted. Ducks and gulls resting offshore, or over-flying the coast, and birds in fields adjacent to the shore were also counted and noted as being in these habitats.

The shore was further classified according to substrate type; rock (pebble beach, boulder shore and bedrock), sand or mud. Changes in the shore habitat were noted on a map so that the lengths and areas of each section could be calculated later. Lengths were measured from 1:50,000 maps and area determined by cutting out each section from either 1:25,000 or 1:10,560 (6 inch to the mile) and weighing the pieces of paper. These weights were then converted to area using a standard area of paper whose weight was known.

Generally about 10km of shore was walked by each observer each day and sections were demarcated by natural breaks in shore type, e.g. where a sandy beach and rocky shore met, to lessen the chance of local movements by birds affecting the count. The team worked in a given area each

TABLE 1. The lengths and areas of each habitat surveyed on each island in Orkney during winters 1982-83 and 1983-84.

	Length (km)				Area (hectares)			
	Rock	Mud	Sand	Total	Rock	Mud	Sand	Total
S. Ronaldsay	38.2	1.1	3.1	42.4	262.2	7.9	55.1	325.2
Burray	15.2	—	1.8	17.0	116.2	—	11.4	127.6
Hunda	4.8	—	—	4.8	19.5	—	—	19.5
Lamb & Glims Holm	5.3	—	0.4	5.7	28.9	—	10.1	39.0
Hoy	45.1	—	2.8	47.9	323.7	—	34.8	358.5
Flotta	20.7	—	—	20.7	140.2	—	—	140.2
Graemsay	8.0	—	0.7	8.7	54.9	—	3.3	58.2
Mainland	180.2	3.3	15.3	198.8	1464.4	17.9	202.0	1684.3
Shapinsay	30.4	—	4.5	34.9	143.4	—	33.3	176.7
Rousay	33.2	—	—	33.2	130.4	—	—	130.4
Wyre	8.9	—	—	8.9	44.8	—	—	44.8
Egilsay	10.3	—	1.8	12.1	62.5	—	9.9	72.4
Eday	32.9	—	3.4	36.3	166.4	—	47.9	214.3
Stronsay	46.4	—	5.8	52.2	492.3	—	97.6	589.9
Westray	52.2	—	8.8	61.0	447.8	—	153.0	600.8
Papa Westray	16.1	—	1.5	17.6	127.9	—	13.9	141.8
Sanday	66.5	—	33.1	99.6	1089.5	—	610.8	1700.3
N. Ronaldsay	11.2	—	1.5	12.7	178.4	—	11.3	189.7
Auskerry	3.9	-	—	3.9	23.5	—	—	23.5
TOTAL	629.5	4.4	84.5	718.4	5316.9	25.8	1294.4	6637.1

day so that a long continuous length of coastline was surveyed. Again, this was done to minimise the effects on the counts of local movements by birds (Summers *et al.* 1984).

Because the survey was conducted over two winters, there might have been major differences between the two years, making it unrealistic to treat the data as being representative of the winter situation in Orkney. Therefore, in order to make a comparison between the two winters, the island of Sanday was revisited during the second part of the survey, and we selected those sections which contained large numbers of waders for re-surveying (Fig. 2). Only the waders were re-counted because it was not possible to get precise counts of gulls and ducks.

The raw data and preliminary report have been deposited in the libraries of the Scottish Ornithologists' Club, British Trust for Ornithology, Nature Conservancy Council and the Royal Society for the Protection of Birds (Tay & Orkney Ringing Group 1984, Summers & Underhill 1985).

Results

Differences between the two winters

The data for the waders in the two winters on Sanday are shown in Table 2. Counts for the two main habitats have been separated. The sandy coast refers mainly to the open

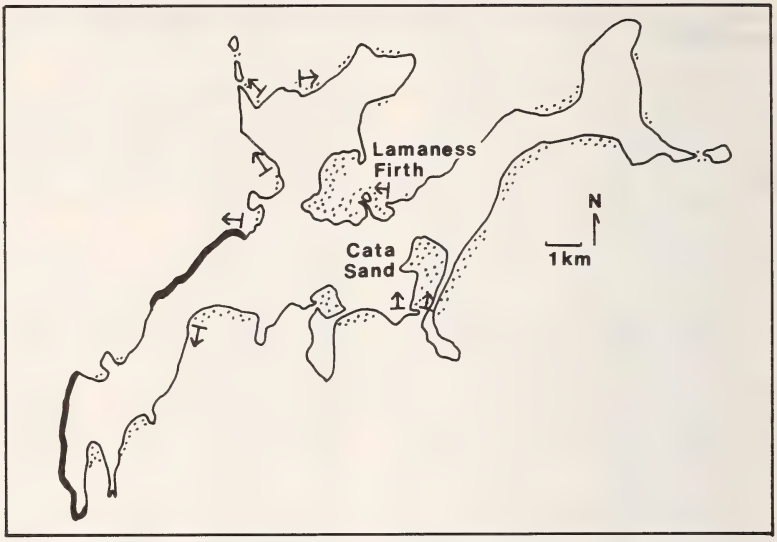

FIGURE 2. The coastline of Sanday showing shore types (thick line: cliff, thin line: low rocky coast, stipple: sand or shingle) and sections that were not surveyed in both winters (↦ ↤).

sandy shore as the two large bays, Cata Sand and Lambaness Firth, were not included (Fig. 2). For some species (Turnstone *Arenaria interpres*, Ringed Plover *Charadrius hiaticula*, Curlew *Numenius arquata* and Purple Sandpiper), the counts in the two winters were similar. Bar-tailed Godwits *Limosa lapponica* and Sanderlings were more numerous on the second count but, as the two large bays which held the greatest concentrations of these species were not surveyed, it is difficult to be sure of the differences between the two years. Numbers of Oystercatchers *Haematopus ostralegus*, Golden Plovers *Pluvialis apricaria*, Lapwings *Vanellus vanellus* and Redshanks *Tringa totanus* were smaller in the second winter (Table 2). Overall, the truly rocky-shore species showed small differences between the two winters and the differences in those species which also use fields were not greater than one might expect on successive days (Summers *et al.* 1984). We therefore combined the data for the two years.

The numbers counted during the winter survey

The total numbers of waders counted on each island are shown in Table 3, and these totals have been split for the two main shore types, rocky shores and sandy beach, in Tables 4 and 5 respectively. The numbers for muddy shore are not shown separately. Mainland had the largest number of waders, almost half of which were Curlews. Sanday had the second highest total but had a greater variety of species compared with Mainland. This was due to its long sections of sandy coast resulting in populations of waders normally associated with soft shores. Thereafter, South Ronaldsay and Westray had the largest numbers.

The total numbers of dabbling ducks and gulls recorded for each island are shown in Table 6. Again, most ducks were seen on the Mainland, and Sanday had the second highest total. The largest numbers of Herring Gulls *Larus argentatus* and Great Black-back Gulls *L. marinus* were on Sanday. The most abundant gull was the

Common Gull *L. canus*, which was also very abundant on fields.

The total number of Oystercatchers counted during the survey was 2777, and they also occurred inland (27 on Papa Westray, 13 on Stronsay and 80 on Eday). Their distribution on the coast was relatively even throughout the islands, but with higher densities on rocky shores than on sandy beaches (Fig. 3, Tables 4 & 5).

Ringed Plovers were found all round Orkney during the survey, associating particularly with sandy beaches (Fig. 4, Table 5). The coastal total probably represents most of the winter population for Orkney, since they were seen inland only occasionally (30 on Stronsay). Grassland is the main winter habitat of the Golden Plover so the coastal count (Table 3) will represent only a small proportion of the Orkney population. Totals of 1100 were seen on fields in Westray, 860 on Stronsay and 125 on Egilsay. The Lapwing is similar to the Golden Plover in that they winter mainly on grassland (60 were counted on Rousay, 90 on Eday and 100 on Stronsay).

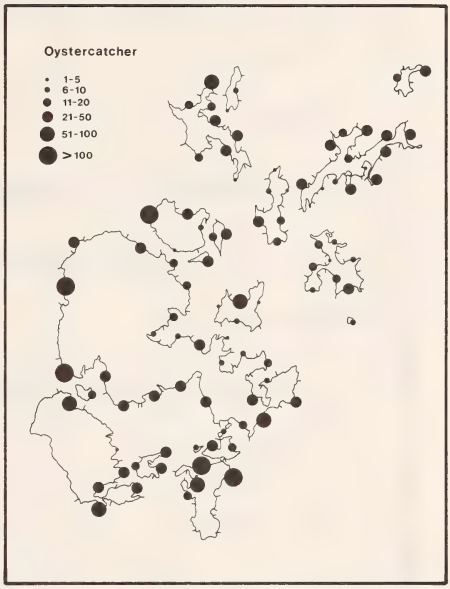

FIGURE 3. The distribution of Oystercatchers on the coast of Orkney in winters 1982-83 and 1983-84.

TABLE 2. Wader totals on selected portions of Sanday in each winter's survey.

	Rock (33.3km)		Sand (17.1km)		Total	
	1982-3	1983-4	1982-3	1983-4	1982-3	1983-4
Oystercatcher	185	121	29	26	214	147
Ringed Plover	133	99	103	143	236	242
Golden Plover	297	114	0	0	297	114
Grey Plover	2	9	4	3	6	12
Lapwing	99	22	0	35	99	57
Turnstone	793	744	45	64	838	808
Purple Sandpiper	928	901	1	50	929	951
Dunlin	225	226	91	168	316	394
Knot	0	1	0	0	0	1
Sanderling	50	154	161	146	211	300
Redshank	489	298	107	16	596	314
Bar-tailed Godwit	1	88	28	32	29	120
Curlew	390	401	73	12	463	413
Snipe	26	30	2	2	28	32

	Oystercatcher	Ringed Plover	Grey Plover	Golden Plover	Lapwing	Turnstone	Purple Sandpiper	Dunlin	Knot	Sanderling	Redshank	Bar-tailed Godwit	Curlew	Snipe	Jack Snipe	Woodcock	Total
S. Ronaldsay	366	40	10	54	480	255	106	100			610	22	2779	41			4863
Burray	67	38		300	150	33					24		374	1			987
Hunda	7	9				24	1				22		1	2			66
Lamb & Glims Holm	6				2	7	1				20		86				122
Hoy	282	94		18	370	188	118				458		881	8			2,417
Flotta	64				31	218	48				153		33	8			555
Graemsay	18	34	2	11	5	43	73	2			63		27	23			301
Mainland	846	485	4	1223	2004	1774	952	433	18		2555	54	10282	77			20747
Shapinsay	70	40		47	238	220	18				225		1,421	18			2297
Rousay	204	35		24	46	192	270	52			141		80	60			1,104
Wyre	23	2		1	1	58	41				57		3	14			200
Egilsay	53	72		16	20	318	242	2			143		55	39	1	1	962
Eday	62	39			97	413	252	5			418		92	23			1,401
Stronsay	115	168		46	15	377	712	39		167	300	47	277	144			2407
Westray	219	136		147	79	579	1079	100		177	815	1	561	61			3954
Papa Westray	10	93			4	38	167				3	12	1	330			358
Sanday	307	279	14	477	121	1149	1247	1288		474	899	616	762	54			7687
N. Ronaldsay*	51	51		177		75	276	34		40	32	17	6	4			763
Auskerry	7					40	70				8		8	25			158
TOTAL	2777	1615	30	2541	3703	6001	5673	2055	18	858	6946	769	17729	632	1	1	51349

* Count incomplete

TABLE 3. The number of waders counted on the coast of Orkney in winters 1982-83 and 1983-84.

	Oystercatcher	Ringed Plover	Grey Plover	Golden Plover	Lapwing	Turnstone	Purple Sandpiper	Dunlin	Knot	Sanderling	Redshank	Bar-tailed Godwit	Curlew	Snipe	Jack Snipe	Woodcock	Total
S. Ronaldsay	323	28			480	238	99	70			508		1967	41			3754
Burray	66	36		300	150	31					24		172	1			780
Hunda	7	9				24	1				22		1	2			66
Lamb & Glims Holm	6				2	7	1				20		86				122
Hoy	252	19		18	330	164	113				439		812	8			2155
Flotta	64				31	218	48				153		33	8			555
Graemsay	15	12	2	11	5	41	61				62		27	23			259
Mainland	693	280	3	923	1704	1736	945	298	12		2365	8	9548	72			18587
Shapinsay	70	40		18	108	62	16				210		221	18			763
Rousay	204	35		24	46	192	270	52			141		80	60			1104
Wyre	23	2		1	1	58	41				57		3	14			200
Egilsay	39			16	17	241	178	2			106		54	37	1	1	692
Eday	61	22			84	411	252	5			414		86	23			1358
Stronsay	111	109		46	15	365	712	37		82	293	47	277	134			2228
Westray	205	59		105	49	437	1,079	2		2	613	1	396	54			3002
Papa Westray	7	52			4	31	71				3		1	30			199
Sanday	270	151	2	297	112	1040	1156	265		220	735	143	611	45			5047
N. Ronaldsay	44	9		177		73	266	25		1	26	12	6	1			640
Auskerry	7					40	70				8		8	25			158
TOTAL	2467	863	7	1936	3138	5409	5379	756	12	305	6199	211	14389	596	1	1	41669
Density	46	16		36	59	102	101	14		6	117	4	271	11			784

TABLE 4. The number and density (numbers/km^2) of waders on the rocky shores of Orkney in winters 1982-83 and 1983-84.

	Oystercatcher	Ringed Plover	Grey Plover	Golden Plover	Lapwing	Turnstone	Purple Sandpiper	Dunlin	Knot	Sanderling	Redshank	Bar-tailed Godwit	Curlew	Snipe	Total
S. Ronaldsay	43	12		54		17	7	30			93	22	812		1090
Burray	1	2				2							202		207
Hunda															
Lamb & Glims Holm															
Hoy	30	75			40	24	5				19		69		262
Flotta															
Graemsay	3	22				2	12	2			1				42
Mainland	141	197	1	300	325	29	7	110	6		117	46	452	1	1732
Shapinsay				29	130	158	2				15		1200		1534
Rousay															
Wyre															
Egilsay	14	72			3	77	64				36		1	2	269
Eday	1	17			13	2					4		6		43
Stronsay	4	59				12		2		85	7			10	179
Westray	14	77		42	30	142		98		175	202		165	7	952
Papa Westray	3	41				7	96					12			159
Sanday	37	128	12	180	9	109	91	1023		254	164	473	151	9	2640
N. Ronaldsay	7	42				2	10	9		39	6	5		3	123
Auskerry															
TOTAL	298	744	13	605	550	583	294	1274	6	553	664	558	3058	32	9232
Density	23	57	1	47	42	45	23	98		43	51	43	236	2	713

TABLE 5. The number and density (numbers/km^2) of waders on the sandy beaches of Orkney in winters 1982-83 and 1983-84.

	Mallard	Wigeon	Teal	Black-headed Gull	Herring Gull	Great Black-back Gull	Common Gull
S. Ronaldsay	120	190	37	65	167	104	416
Burray	80	84	6	1	9	5	59
Hunda	58	38	208			5	2
Lamb & Glims Holm					1	2	1
Hoy	37		41	28	39	99	560
Flotta	17		7	5	35	44	18
Graemsay	7	60		1	16	8	53
Mainland	961	1,755	604	498	555	301	3,403
Shapinsay	113			11	1	32	2,228
Rousay	42	77	8	5	137	71	265
Wyre	36	57	25		2	8	
Egilsay	77	176	145	1	31	5	101
Eday	41	66	59		106	83	26
Stronsay	140	498	12	40	482	163	205
Westray	55	456	144	57	184	370	180
Papa Westray	45	3	36		6	14	
Sanday	229	1,386	262	11	939	1,046	1,281
N. Ronaldsay*					64	87	140
Auskerry	7	42	3		200	200	5
TOTAL	2,065	4,888	1,597	723	2,974	2,647	8,943

* Partial count, and ducks not counted

TABLE 6. The numbers of dabbling ducks and gulls counted on the coast of Orkney in winters 1982-83 and 1983-84.

Numbers of these species on the shore (Table 3) are dependent on the weather conditions (Baillie *et al.* 1986). They become more numerous on the shore when cold weather makes grassland invertebrates less available.

The Turnstone is one of the few waders that is typically seen on rocky shores in winter (Lack 1986). Thus, the count of 6001 (Table 3) is probably close to the total Orkney population, though some were seen foraging on the grass fields (160 on Papa Westray, 115 on Eday and 110 on Stronsay) and birds will have been missed on the small islands that were not visited. They were fairly evenly distributed throughout Orkney (Fig. 5) and occurred commonly on sandy beaches (Table 5) as well as rocky shores (Table 4).

The total number of Purple Sandpipers counted during the survey was 5673 (Table 3), and their distribution was biased towards the north east of the archipelago (Fig. 6). They were seen on fields only at high tide at night when roosting around pools on flooded fields on Sanday. Therefore, the

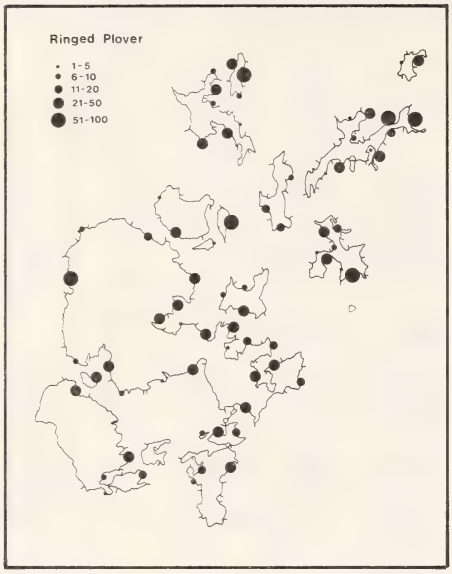

FIGURE 4. The distribution of Ringed Plovers on the coast of Orkney in winters 1982-83 and 1983-84.

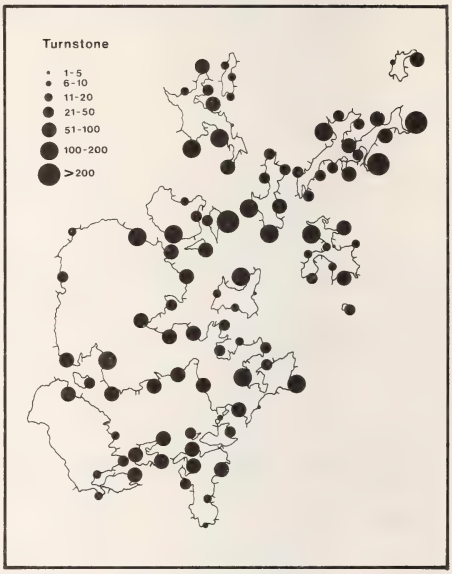

FIGURE 5. The distribution of Turnstones on the coast of Orkney in winters 1982-83 and 1983-84.

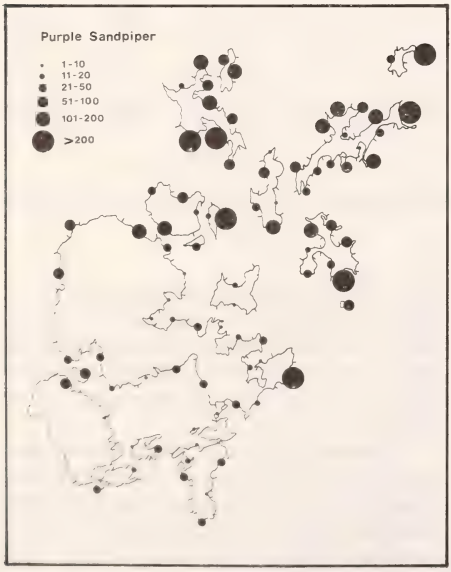

FIGURE 6. The distribution of Purple Sandpipers on the coast of Orkney in winters 1982-83 and 1983-84.

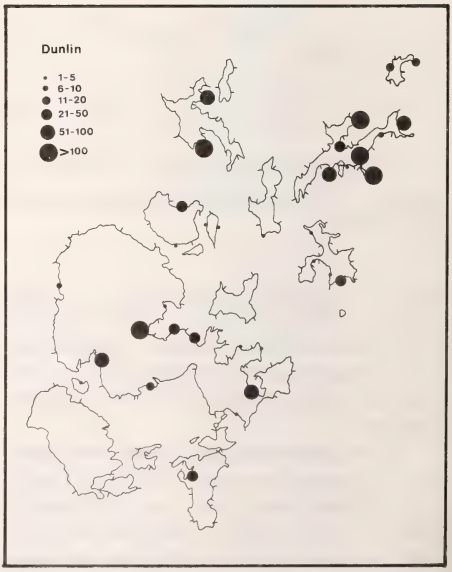

FIGURE 7. The distribution of Dunlins on the coast of Orkney in winters 1982-83 and 1983-84.

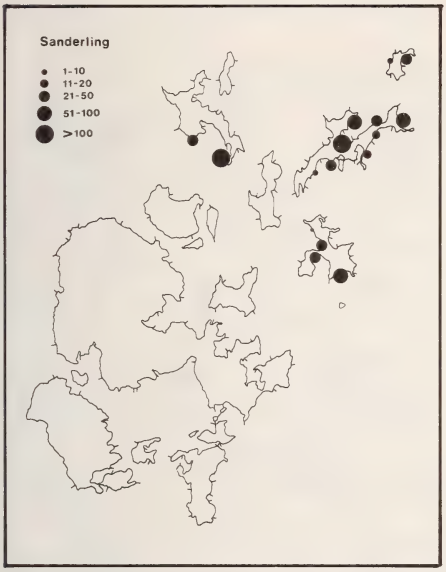

FIGURE 8. The distribution of Sanderlings on the coast of Orkney in winters 1982-83 and 1983-84.

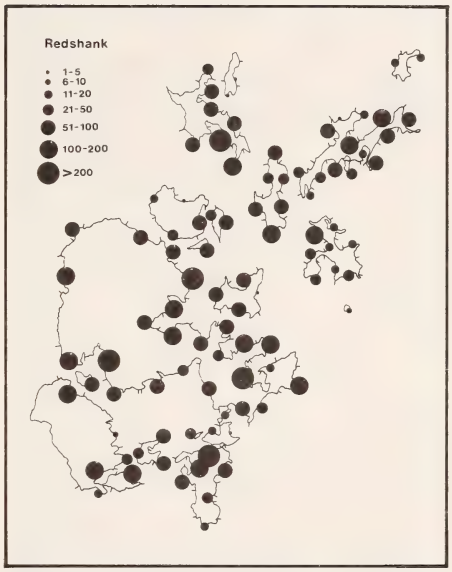

FIGURE 9. The distribution of Redshanks on the coast of Orkney in winters 1982-83 and 1983-84.

total counted probably represents most of the Orkney population, although there will have been uncounted birds on the smaller islands that were not visited.

Most of the 2055 Dunlins counted (Table 3) were on the few bays of fine sand on Sanday and at Sandi Sand, Deerness (Fig. 7). A few were seen inland (150 on Westray and 70 on Stronsay). Only 18 Knots *Calidris canutus* were seen, all at Sandi Sand, Deerness. The 858 Sanderlings counted (Table 3) probably represent the bulk of the Orkney population as they were seen inland only at high tide. Sanderlings were restricted to the northern isles, particularly Sanday (Fig. 8).

Redshanks were common throughout Orkney; almost 7000 were counted in the present survey, particularly on the rocky shores throughout the islands (Table 4, Fig. 9). They were also common on the grass fields (100 on Eday and 217 on Stronsay). The total of 769 Bar-tailed Godwits (Table 3) was found on sandy shores (Table 5), particularly in the bays of fine sand on Sanday (Fig. 9). Although generally found on shores, some did feed inland, even at low tide (50 on Stronsay).

Curlews were the most abundant wader (Table 3) and occurred mainly on Mainland and South Ronaldsay (Fig. 11). Almost 18,000 were counted on the coasts and there were many inland (1143 on Mainland, 35 on Rousay, 750 on Eday, 970 on Stronsay, 185 on Westray and 85 on Papa Westray). Given that the field counts were incomplete it is likely that the total Orkney population exceeds 25,000.

Despite the fact that Snipe *Gallinago gallinago* are normally associated with marshes and fresh water, quite large numbers, 632 (Table 3), were found on the shores, particularly the rocky shores (Table 4).

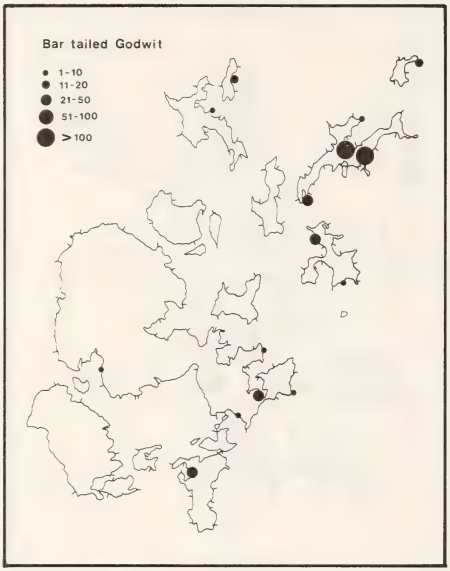

FIGURE 10. The distribution of Bar-tailed Godwits on the coast of Orkney in winters 1982-83 and 1983-84.

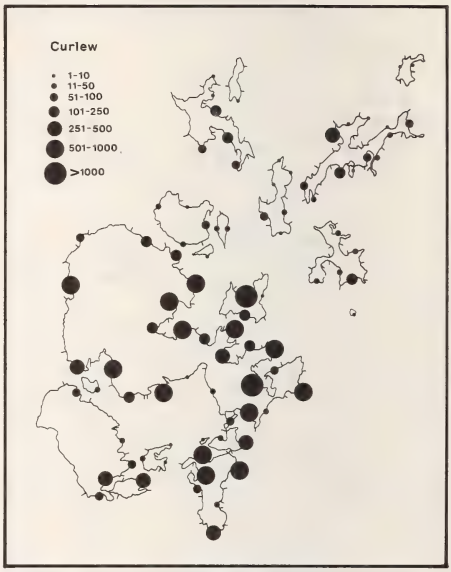

FIGURE 11. The distribution of Curlews on the coast of Orkney in winters 1982-83 and 1983-84.

Discussion

Repeat counts of waders along sections of rocky shore have shown that there are differences between observers: in particular, less exprienced observers tend to underestimate numbers (Summers *et al.* 1984). There are also species differences because cryptic species are more difficult to count than conspicuous ones (Spearpoint *et al.* 1988). Further, there are day-to-day variations in the numbers of waders using a particular section of coast, especially for those species which also use inland habitats for feeding, such as Oystercatcher, Lapwing, Golden Plover, Curlew and Redshank (Summers *et al.* 1984). Only for those species which are virtually restricted to the inter-tidal zone and are site faithful, such as the Turnstone and Purple Sandpiper (Atkinson *et al.* 1981, Metcalfe & Furness 1985), can one achieve reasonably precise counts, ie variation of less than 20% between repeat counts (Summers *et al.* 1984). By designing our counting to survey long sections of coast each day, we largely overcame the counting problems associated with short distance movements by waders along the coast.

The present survey spanned two winters and repeat counts on Sanday showed that only the numbers of Ringed Plovers, Turnstones, Purple Sandpipers and Curlews were similar in the two winters, ie differences of less than 11%. Numbers of Oystercatchers, Golden Plovers, Lapwings and Redshanks were smaller in the second year and numbers of Sanderlings and Dunlins increased. Given the variations in numbers associated with differences between observers, together with day-to-day variations in numbers and between-year differences, it is felt that precise information was obtained only for the Turnstone and Purple Sandpiper. However, the information on the other species does give

an indication of populations occurring on the Orkney coastline.

The recorded density of waders on the rocky shores of Orkney (784/km^2) falls within the values obtained on the mainland of Scotland from Fife to Caithness (202-1258/km^2) (Summers & Buxton 1983). In comparison, densities on estuaries can be as high as 4940/km^2, but the average for all estuaries in Britain is only 486/km^2 (Prater 1981), lower than that found on either the rocky shores or sandy beaches (713/km^2) of Orkney. Densities on the sandy shores were as high as on the rocky shores. Part of the biological richness of the sandy shores stems from the stranded kelp which originates from sublittoral rocky shores. The rotting kelp provides a food source for crustaceans and insects on which waders feed (Summers *et al.* 1990).

Although the neighbouring archipelago of Shetland has a longer coastline (1,500 km compared with Orkney's 800 km), far fewer waders winter in Shetland (12,000 compared with Orkney's 51,000) (Summers *et al.* 1988). Shetland has few sandy shores so Grey Plovers, Bar-tailed Godwits, Knots and Sanderlings are rare. However, even the rocky shore species are less abundant and it is thought that this is related to the nature of these shores. Only 18% of the Orkney coast is cliff whereas Shetland has 29%, and cliffs tend to be avoided by waders (Summers *et al.* 1988). Also, the low rocky shores of Orkney have broad intertidal areas whereas the hard metamorphic and igneous rocks of Shetland result in a narrow intertidal zone. Therefore, the area of shore available to waders in Shetland is less.

Several species used fields as well as the shore for feeding so that our survey did not give a total for the Orkney population. The inland habitats of Orkney have been and are being greatly modified, as marshes and moors are turned into farmland, particularly to grass fields for grazing, hay or silage. This has had an impact on the wintering birds because so many species of waders and other birds (Starlings *Sturnus vulgaris* and Common Gulls) forage on these fields (Lea & Bourne 1975). It is possible that the creation of pasture has led to an increase in the number of waders wintering in Orkney. Heppleston (1982) found that fields were important to Lapwings, Curlews, Redshanks and Golden Plovers, but less so to Oystercatchers, Turnstones and Dunlins. There were 2-3 times more waders in the fields at high tide than at low tide, showing that many waders move from the shore to fields in response to the tides. It would be useful to extend our survey to find out more about the numbers and distribution of waders on fields.

The Ramsar Convention on Wetlands of International Importance came into effect in December 1975. Britain became a contracting party to the convention, thereby promising to safeguard wetlands of international importance. The convention drew up criteria on which to identify wetlands of international importance and two of these were that the wetland should regularly support at least 20,000 waterfowl, or support at least one percent of a biogeographical population of one species of waterfowl. For each species, Salmon *et al.* (1989) listed the number which would represent one percent of the Western European population (Table 7). On a similar basis, if a wetland contains at least one percent of the national total, then that wetland may be regarded as nationally important for that species (Table 7). For several species, the Orkney population exceeds these one percent values showing that Orkney is nationally and internationally important for these species (Table 7). As a result of our findings, the Nature Conservancy Council have recommended the designation of the following sites as Special Protection Areas and Ramsar sites: North Ronaldsay, south Westray, south-east Stronsay, east Sanday and north Mainland. It is hoped that these sites will be designated in the near future. Although open coastline is not as threatened as estuaries by the influences of man it is

TABLE 7. Numbers qualifying for international and national importance (Salmon *et al.* 1989) set beside the totals for the coast of Orkney. Only those species for which Orkney is either nationally or internationally important are shown.

	International qualifying level	National qualifying level	Population on the Orkney coast
Wigeon	7,500	2,500	4,800
Teal	4,000	1,000	1,600
Oystercatcher	9,000	2,800	2,800
Ringed Plover	500	230	1,600
Golden Plover	10,000	2,000	2,500
Turnstone	700	450	6,000
Purple Sandpiper	500	160	5,600
Sanderling	1,000	140	860
Redshank	1,500	750	6,900
Bar-tailed Godwit	1,000	610	770
Curlew	3,500	910	18,000

certainly not immune to them. For example, there are proposals to harvest the kelp forests off Sanday and Switha which, if they went ahead, would reduce the food base in the form of stranded kelp upon which the waders rely.

Acknowledgements

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C.J. Corse, Garrisdale, Lynn Park, Kirkwall, Orkney.
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A census of the large inland Common Gull colonies of Grampian

M.L. TASKER, A. WEBB
AND J.M. MATTHEWS

A census of two large Common Gull colonies on hills in Grampian found that they contained a total of between 25,000 and 40,000 pairs. This remarkable figure represents just under half of the British and Irish population and 6% of the world population of this species.

Introduction

In Scotland, Common Gulls *Larus canus* nest typically in relatively small groups, frequently on small marshy areas or beside the coast. In Grampian there are two very large Common Gull colonies nesting on the tops of moorland hills overlooking agricultural land. The first is in the Correen Hills, north of Alford and the other in the Mortlach Hills to the south-east of Dufftown (Fig. 1). Common Gulls were recorded in the Correen Hills by Sim (1903), who noted a few pairs on the Hill of Drumbarton in 1890. This particular hill no longer holds Common Gulls as it is overgrown with a maturing conifer plantation.

Bourne *et al.* (1978) noted the presence of these colonies and estimated that 4000-5000 pairs of Common Gulls were breeding on the Correen Hills, along with small numbers of Lesser Black-backed Gulls *L. fuscus* and Herring Gulls *L. argentatus*. These authors noted two sub-colonies in the Mortlach Hills, both of around 1000 pairs, also with other species of gull present. Preliminary inspection in 1986 indicated that these colonies were probably considerably bigger than the estimates made in the 1970s, so a formal survey of numbers was made in 1988-1989. A search of the literature and an appeal for records was undertaken to put these colonies in context. Sites on suitable nearby hills were checked.

Methods

The colony in the Correen Hills comprised five sub-colonies (Fig. 2), while that in the Mortlach Hills was divided into six (Fig. 3). Two visits to each colony were made in late May and early June, either in 1988 or 1989. Warm dry days were chosen in order to minimise the effects of disturbance caused by the survey, both on the gulls and on other species nesting on these hills. The boundaries of the sub-colonies were mapped approximately during the first visit. On the second, one person laid out a grid of bamboo poles, each 100m apart, throughout each sub-colony. This person also plotted the boundary of the sub-colonies as

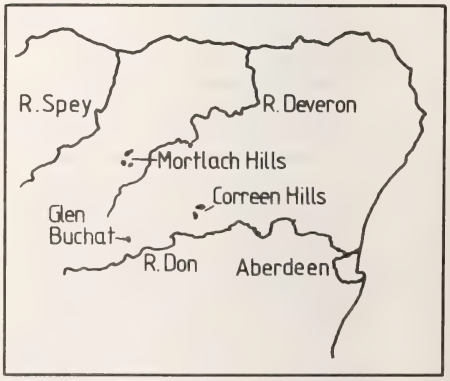

FIGURE 1. The location of large Common Gull colonies in northeast Scotland.

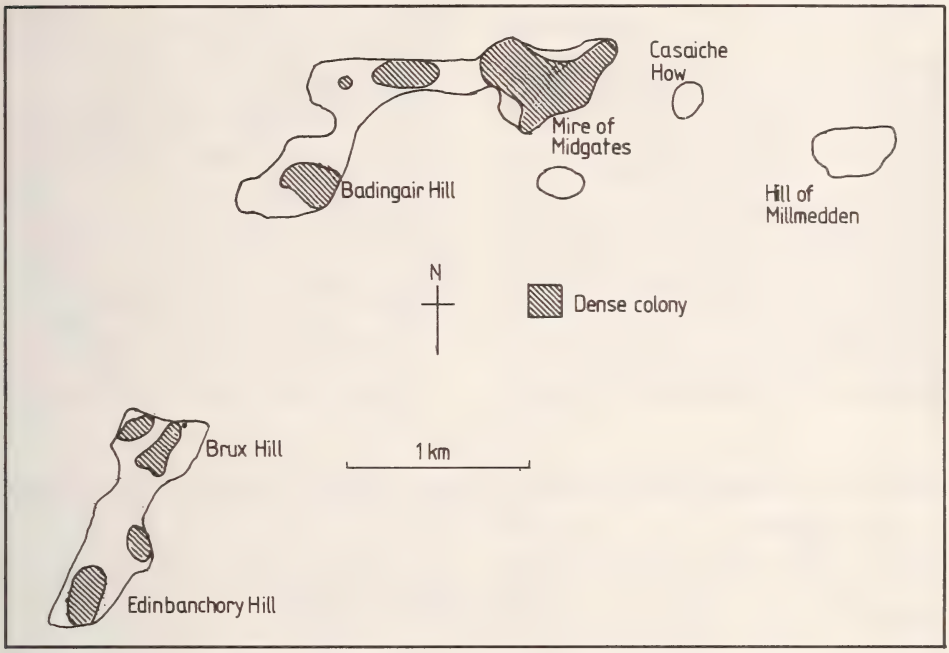

FIGURE 2. The location of sub-colonies of Common Gulls, indicating dense parts of the colony, in the Correen Hills.

accurately as possible, based on the location of the grid. One or two other counters, using a piece of rope 9.77m long, recorded the number of nests within a 300m^2 circle centred on these poles. Numbers of eggs were recorded for each nest. For those nests with no eggs, an assessment was made as to whether the nest was active: fresh soil or nest material implied an "active nest".

The colony boundaries and densities of nests (two categories: active and all) at each sampling point were then plotted onto large-scale maps. In some sub-colonies there were obvious areas that were at much higher densities than others. The distribution of densities within sampling circles in these sub-colonies was bimodal. Sampling circles holding either seven or more active nests or a total of more than ten nests were categorised as being in dense parts of the colony and were delineated on the maps. The colony area and the area of each of the dense and less dense parts were then calculated using a planimeter. Numbers of nests (both active and all) in each part of each sub-colony were then calculated by multiplying colony area by the mean density of nests in that part. Standard errors and 95% confidence limits were calculated. Numbers of apparently occupied territories in the two smallest sub-colonies in both the Correen and Mortlach Hills were estimated by eye. The vegetation was also described within each sample circle, but these results are not analysed in detail here.

Results

A total of 13,950 active nests was estimated to be present in the Correen Hills, out of an estimated total of 24,450 nests (Table 1). Equivalent figures for the Mortlach Hills were 10,750 and 16,200. The largest sub-

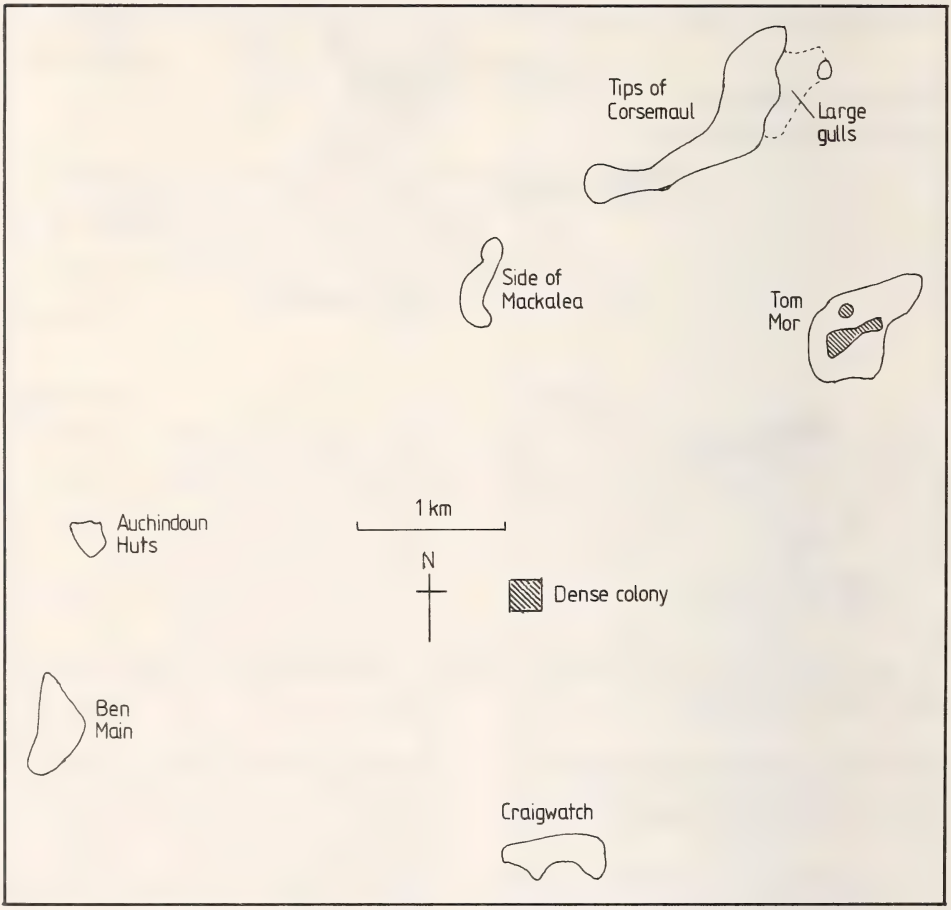

FIGURE 3. The location of sub-colonies of Common Gulls, indicating dense parts of the colony, in the Mortlach Hills.

colony was that on the northern Correen Hills of Badingair and Mire of Midgates, which held 9200 active nests among a total of 17,000.

Counts of other gull species found 50 pairs of Black-headed Gulls *L. ridibundus* in both the Craigwatch and Auchindoun Huts sub-colonies of the Mortlach Hills, and 4 pairs of Great Black-backed Gull *L. marinus*, 37 pairs of Herring Gull and 110 pairs of Lesser Black-backed Gull to the immediate east of the Tips of Corsemaul sub-colony. One pair of Lesser Black-backed Gulls nested in the Hill of Millmedden colony on the Correen Hills with 40 pairs of Lesser Black-backed Gulls and two pairs of Herring Gulls on low ground to the south of the Mire of Midgates. 40 pairs of Lesser Black-backed Gulls, with 10 pairs of Herring Gulls were present on the east side of Edinbanchory Hill.

The search for further large Common Gull colonies found only one other with

more than 100 pairs. This was in Glen Buchat (Fig. 1), where two sub-colonies held 793 (+/− 290) active nests of a total of 993 (+/− 329) nests, based on 15 sampling circles of 300m^2, distributed at 50m intervals. About 100 pairs were found at two other sites in the early 1980s during recording for the *North-East Scotland Bird Atlas* (Buckland *et al.* 1990). These were at Corrennie to the south of Alford and Presendye to the north of Tarland. Visits to these sites in 1989 found about 50 pairs at the former, and none at the latter. At least 8 other sites held 50 or less pairs of Common Gull in north-east Scotland.

Discussion

The total number of pairs breeding in each colony probably exceeds the number of active nests at any one time, but by how much is difficult to tell on the basis of these surveys. Within a colony, laying of eggs occurs over a protracted period; under ideal circumstances, a study on the phenology of the laying season should be undertaken in order to determine the proportion of nests that are active at the time of an individual count compared with the total number active during the breeding season. The count of active nests provides a minimum number

TABLE 1. Numbers of Common Gull nests present in sub-colonies on the Correen and Mortlach Hills. (i) Active nests, (ii) All nests (including active nests).

(i) Active nests	No. of plots	Mean Density (nests/100m^2)	Area (ha)	Numbers (95% confidence)
(a) Correen Hills				
Badingair/Midgates (higher density)	29	2.57	27.89	7181 (+/− 1532)
Badingair/Midgates (lower density)	31	0.67	29.90	2058 (+/− 560)
Brux/Edinbanchory (higher density)	13	2.72	11.00	2990 (+/− 528)
Brux/Edinbanchory (lower density)	26	0.57	24.79	1271 (+/− 424)
Hill of Millmedden[1]				350
Casaiche How[1]				100
Total				13950 (+/− 3044)
(b) Mortlach Hills				
Tips of Corsemaul	56	0.66	51.24	3385 (+/− 745)
Tom Mor (higher density)	7	2.72	5.05	1374 (+/− 101)
Tom Mor (lower density)	26	1.00	28.00	2800 (+/− 608)
Ben Main	18	1.00	18.19	1785 (+/− 725)
Craigwatch	16	0.77	16.31	1217 (+/− 554)
Auchindoun Huts[1]			3.36	100
Side of Mackalea[1]				80
Total				10731 (+/− 2733)

(ii) All nests	Mean Density (nests/100m²)	Numbers (95% confidence)
(a) Correen Hills		
Badingair/Midgates (higher density)	4.42	12342 (+/− 1414)
Badingair/Midgates (lower density)	1.54	4597 (+/− 966)
Brux/Edinbanchory (higher density)	4.20	4626 (+/− 355)
Brux/Edinbanchory (lower density)	0.97	2415 (+/− 740)
Hill of Millmedden[1]		350
Casaiche How[1]		100
Total		24430 (+/− 3475)
(b) Mortlach Hills		
Tips of Corsemaul	0.96	4910 (+/− 922)
Tom Mor (higher density)	3.39	1711 (+/− 216)
Tom Mor (lower density)	1.59	4458 (+/− 921)
Ben Main	1.70	3133 (+/− 1466)
Craigwatch	1.10	1819 (+/− 627)
Auchindoun Huts[1]		100
Side of Mackalea[1]		80
Total		16211 (+/− 4152)

Notes
1: Estimate made by eye

of pairs breeding. Pairs of Common Gulls may build or start more than one nest within their territories; this has been recorded for Lesser and Great Black-backed and Herring Gulls elsewhere (Cramp & Simmons 1983), but not for Common Gulls; however this may be due to lack of study. In the present survey, it was assumed that each pair had either one active nest, or none at all. The non-active nests could have either been alternative sites, established earlier in the breeding season, or sites of pairs that discontinued the breeding attempt after making a nest scrape.

The use of a regular, as opposed to a random, pattern of quadrats is not ideal; it does not allow for the possibility of regularity in the distribution of nests within the colony. There was however no evidence of this, with the distribution of numbers in each quadrat being approximately normal (after the separation of some sub-colonies into higher and lower density areas). One advantage of a regular sampling pattern is that the colony boundaries can be checked rapidly and accurately, thus giving a higher precision to the estimate of colony area. In addition, quadrat locations can be found rapidly; an important feature when limited numbers of counters are available or time within a colony is limited, either by landowner request, or the need to keep disturbance to a minimum.

The colonies on Correen and Mortlach

Hills are the largest in Britain and may be the largest in the world. There has been no full survey of breeding Common Gulls in Britain. Cramp *et al.* (1974) found a total of 12,400 pairs nesting on the coast in 1969/70, a figure revised to 13,000 pairs by Lloyd *et al.* (1991). These latter authors found 15,700 pairs in coastal colonies in 1985/87. Sharrock (1976) estimated a British and Irish total of 50,000 pairs, based on an average of 50 nesting pairs within just over 1000 occupied 10km squares found during 1968-72. Lloyd *et al.* (1991) updated this total to 71,400 for the mid-1980s.

The sum of totals given for the western Palearctic by Cramp & Simmons (1983) exceeds 560,000 pairs, while Lloyd *et al.* (1991) estimated the world population at about 580,000 pairs. The largest colony recorded in the literature is one of between 10,000 and 11,000 on Langwerder in Germany (Nehls 1973). This count followed a period of prolonged growth that started in the early years of this century (Kumari 1976), so it is possible that numbers nesting there are even larger now. The largest colony in Denmark in 1974 was of 7000 at Amager and there were a further 5 colonies holding over 1000 pairs (Moller 1978). There have been substantial declines in Scandinavian countries, where the largest numbers breed (Evans 1984).

The reasons for the presence of these two large colonies can be speculated upon. As mentioned above, a small colony was present in the Correen Hills in 1890, but the next recorded visit to the site was not until 1972-73, when Swann (1974) estimated 2000-3000 pairs were present; a count in 1974 showed 3000-4000 pairs were present. Numbers had increased to 4000-5000 pairs in 1976 (Bourne *et al.* 1978) and 5250 in 1977 (W.R.P. Bourne in Knox & Bell 1978). A drop to 2500-3000 pairs in 1978 was recorded by A.F.G. Douse in Knox & Bell (1979), and 3000 birds were seen there in 1984 (W.J. & E.H. Foubister in Bell *et al.* 1985).

Bourne *et al.* (1978) recorded 1000 pairs at both the Tips of Corsemaul and Craigwatch in 1977, while 1000 and 300 pairs were found at these sites respectively in 1978 (A.F.G. Douse in Knox & Bell 1979). 1550 pairs were recorded for the Mortlach Hills in 1985 (Hogg 1986). None of the counts at either colony was conducted in any formal manner, so it is difficult to determine trends in numbers, or when any major increases may have occurred.

Local opinion is that numbers nesting on lowland mires in north-east Scotland have declined, both through drainage and planting with conifers (e.g. Bourne *et al.* 1978). At present, both the Correen and Mortlach Hills offer undisturbed sites overlooking agricultural land that has good food supplies (Douse 1981). Both hills are used primarily as grouse moors, and it is likely that the activity of the gamekeepers keeps these hills relatively free of predators, both of Grouse *Lagopus lagopus* and Common Gulls.

The location of some of the sub-colonies is likely to change due to forestry. The sub-colonies at Craigwatch in the Mortlach Hills, the Hill of Millmedden and the eastern part of the Mire of Midgates in the Correen Hills and the colony in Glen Buchat are all in areas planted with young conifers. It is likely that these sub-colonies will move as the trees grow and the canopies close.

Acknowledgements

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A re-examination of the Operation Seafarer estimates of Arctic Tern populations for Orkney and Shetland

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An examination of the raw data for the national seabird census carried out in 1967-70, 'Operation Seafarer', shows that many of the counts of Arctic Terns on Shetland were made too late in the breeding season and probably did not cover all of Shetland; they are therefore likely to be underestimates of the true figures. The counts for Orkney appear to lack these problems although there has been some confusion in past published accounts of what the totals actually were. This re-analysis has implications for the assessment of the importance of recent seabird failures on Shetland.

Introduction

Recent seabird breeding failures have drawn attention to the trends in seabird numbers on Orkney and Shetland. Bourne (1989 abcde) has suggested that the recent breeding failures of Arctic Terns *Sterna paradisaea* on Shetland should be seen in the light of an apparent increase in the Shetland breeding population between 1969 and 1980. On the basis of the following analysis it is here suggested that there is no firm evidence of any such increase.

Methods

Data sources

There are two published complete surveys of Arctic Tern numbers on Orkney and Shetland. Copies of the summaries of the 'Operation Seafarer' (OS) data (Cramp *et al.* 1974) are lodged with the RSPB at Sandy. The tabulated data consist of: the colony name, grid reference, date of visit, an estimation of the accuracy of the counts and the numbers of pairs of nesting Arctic Terns at the site. Data for 1980 are from Bullock and Gomersall (1980, 1981).

Counting methods

For OS, nest counts may have been the commonest methods used for estimating numbers but this is not explicitly made clear. Bullock & Gomersall estimated nesting numbers by counting birds flushed from colonies and relating the numbers of birds in the air to the number of nests in the colony. Here the possibility that both these methods may give unreliable estimates of nesting numbers has been disregarded and the counts are simply taken at face value.

Results

Population size

The Orkney totals given by OS and Bullock & Gomersall are very similar in the two surveys (Table 1) even though the totals for different islands differ between the two surveys, but those for Shetland are very different.

The Orkney total has been the subject of different estimates over the years. The published OS figure of 12,300 pairs (Cramp *et al.* 1974) chose to disregard the estimate of 17,500 pairs from the North Hill, Papa

TABLE 1. Counts of Arctic Terns breeding in Orkney and Shetland in 1967-70 (Operation Seafarer) and 1980 (Bullock & Gomersall 1980, 1981). All figures refer to pairs.

SHETLAND

	1967-70	1980
Unst	2002	1393
Yell	447	5354
Fetlar	750	2372
Whalsay	1164	3468
Mainland	2090	10611
Papa Stour	375	4394
Foula	262	4200
	7090	31792

ORKNEY

	1967-70	1980
Westray	9927	2282
Papa Westray	17865	7563
Sanday	1180	3179
Stronsay	0	2430
Eday	190	669
Rousay	643	4951
Shapinsay	41	169
North Ronaldsay	950	1537
Mainland	657	1682
Hoy/Graemsay	68	1699
Walls/Flotta	207	2317
South Ronaldsay	449	4501
	32177	32979

Westray colony because it was considered unreliable. Lloyd *et al.* (1975), when reviewing tern population trends, reinstated the figure of 17,500 pairs and stated that the colony might have been even larger than this (based on nest densities in 1974 and the extent of the colony in 1969). Lloyd *et al.* (their Table 4) give Orkney totals for 1969, based on OS, as 27,795 pairs on the Westray group and 384 pairs on other Orkney islands. Bullock & Gomersall (1980, 1981) pointed out that Lloyd *et al.* inadvertently omitted 4,000 pairs from their Orkney total. Thus the actual OS estimate of Orkney Arctic Tern numbers was 32,179 pairs. This figure is very similar to that arrived at in 1980, although the distribution of birds throughout Orkney was quite different.

One remaining puzzle for anyone wishing fully to understand what OS found on Orkney is to explain how the use of an (undisclosed) lower estimate for a colony estimated at 17,500 pairs could lead to a total Orkney population of 12,300 pairs (Cramp *et al.* 1974); more than 17,500 pairs lower than the now accepted total of 32,179 pairs.

OS estimated the Shetland Arctic Tern population as 7,660 pairs. The present author's analysis of the OS data gives a different, but broadly similar, figure of 7,090 pairs (some of the data are presented as ranges which probably leads to the discrepancy). The OS estimates for all Shetland island groups, except Unst, are lower than the Bullock & Gomersall estimates (Table 1).

Coverage

Bullock & Gomersall claimed to have achieved complete coverage of the coast of Orkney and Shetland and of most inland areas. It is difficult to assess what coverage OS achieved but it is striking that there are large parts of Shetland where no colonies were reported in OS (Figure 1). By simply looking at the distribution of colonies, which were recorded, it is clear that those which were near to seabird cliffs probably stood a higher chance of being recorded during OS than those located in areas with few other breeding seabirds. There are numerous examples of Arctic Tern colonies which have had a long history of occupancy in the period following OS and which do not appear in the OS database. The Dalsetter colony, 405164, held an estimated 900 pairs in 1980 and has been continuously occupied ever since. OS reported no Arctic Tern colonies at the southern end of Yell, yet this area has held substantial colonies totalling several hundred pairs since at least 1974 (Bullock & Gomersall 1980). If these gaps

FIGURE 1. Shetland: the shaded areas are ones from which no Operation Seafarer counts are recorded and therefore may be ones in which Arctic Tern colonies were overlooked.

indicate lack of coverage then this could have led to numbers being greatly underestimated. Orkney appears to have been completely covered by OS since the distribution of colony locations is similar to that recorded by Bullock & Gomersall (even though the number of birds at individual colonies differed markedly between surveys).

Timing

The OS counts were made between early June and early August. On Orkney, 89% of the terns recorded during OS were counted in the second half of June (4% in early June, and 2% in early July; for 4% no information on date is given) but the Shetland counts were made much later; 70% of the counted terns (where counting date is given) were recorded from visits made in July (39% of unknown date, 10% in early June, 10% in late June, 27% in early July and 15% in late July). Some counts of currently large Shetland colonies were made after most Arctic Terns would have fledged and left their colonies. For example, counts on Out Skerries were made on 24 July 1970, many of the Yell counts were made on 19 or 23 July 1970, the Scalloway islands were surveyed from 11-16 July 1969, Mousa was visited on 14 July 1969, and many Papa Stour colonies were counted from 15-21 July 1969. The median laying date for Arctic Terns on Shetland in 1987 was 2 June, and in 1988 was 31 May, on Orkney the median laying date in 1988 was 30 May and in 1989 was 28 May (Monaghan *et al.* 1991). This suggests that, with a six week period between laying and fledging (Cramp 1985), half of the successful nests should have fledged by mid-July. And by this time, practically all nests which are going to fail will have failed. Bullock & Gomersall collected data between late May and mid July.

Year

More than 97% of the terns counted during OS on Orkney were counted in 1969. The Shetland counts came from 1967 (3%), 1968 (< 1%), 1969 (54%) and 1970 (42%). Thus if terns changed their distribution between 1969 and 1970 there is scope for either double counting of birds in both years or for birds to have been missed in both years.

Discussion

On Orkney, OS achieved complete coverage in one year (1969) and nearly all counts were made at an appropriate stage of the nesting season. The Arctic Tern population on Orkney in 1969 was very similar to that estimated in 1980: around 32,500 pairs. It seems reasonable to conclude that Arctic Tern numbers on Orkney were broadly similar in the two years, although it is impossible to say how they might have changed in the interval.

The Shetland counts are more difficult to interpret. Doubts have previously been expressed about the completeness and accuracy of the OS totals for Arctic Terns on Orkney and Shetland (Bullock & Gomersall 1980, 1981; Harris 1974). The lack of records from much of Shetland suggests that coverage during OS was incomplete. Some areas of Shetland, including the normally large colonies on Papa Stour and Mousa, were visited too late in the season to provide useful data. It is therefore suggested that the OS estimate of Arctic Tern numbers for Shetland be regarded as an underestimate of unknown size.

Bourne (1989 abcde) has suggested that the current breeding failures of Arctic Terns on Shetland should be seen in the light of an apparent increase in the Shetland breeding population between 1969 and 1980. On the basis of this analysis there seem to be no grounds for believing that such an increase took place on either Orkney or Shetland, and it is here suggested that the low breeding success and decline in numbers of Arctic Terns on Shetland (Walsh *et al.* 1990) should be taken seriously.

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The breeding birds of Hermaness, Shetland

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Forty-eight species of bird are known to have bred on the Hermaness National Nature Reserve, which has one of the largest seabird colonies in Britain. In excess of 100,000 seabirds of thirteen species breed regularly with the numbers of Gannet, Great Skua and Puffin of particular importance. Unfortunately, in common with other Shetland colonies, breeding success of many seabird species has declined in recent years as sandeels, which dominated the diet of many species, have become harder to find.

Introduction

Hermaness National Nature Reserve (NNR), on the island of Unst in Shetland, includes, with the outlying skerries of Muckle Flugga and Out Stack, the northernmost land in the British Isles (Fig. 1). The reserve covers 980 hectares rising to 200m at Hermaness Hill, with base rocks mainly of schist and gneiss. The coastline consists almost entirely of cliffs, rising to 170m at the Neap, most seabirds nesting on the higher west cliffs. The vegetation of the peninsula is mainly blanket bog dominated by heather *Calluna vulgaris*, common cottongrass *Eriophorum angustifolium*, and deergrass *Scirpus caespitosum*, with crowberry *Empetrum nigrum* co-dominant in drier areas. Acidic and maritime grassland is present around the periphery. The reserve is part of the Burrafirth Common Grazings and is grazed by Shetland sheep all year. Some peat-cutting occurs near the Loch of Cliff and there are currently over 3000 visitors each year.

There is a long history of conservation on Hermaness beginning in 1831 when the then laird, Dr.L. Edmondston, began to protect the few breeding Great Skuas *Stercorarius skua*. In 1891 the Edmondston family employed a keeper to increase protection on the site, a role later taken over by the Royal Society for the Protection of Birds (RSPB), which included Hermaness in it's Watcher scheme from 1907-1960. The original NNR was declared in 1955, with an extension added in 1958, and the reserve is managed by the Nature Conservancy Council (NCC) under agreements with the Buness Estate and, for the Muckle Flugga skerries, the Northern Lighthouse Board.

Wardening on-site has been carried out only in 1978 and since 1985, with MGP warden in 1988-90. Additional work on the reserve has been undertaken by visiting researchers, with one group lead by ARM visiting almost annually since 1972. Since 1976 the Shetland Oil Terminal Environmental Advisory Group (SOTEAG) has conducted annual monitoring of selected seabird species, co-ordinated by MH. Most of the information on the NNR is contained in unpublished reports to the NCC and SOTEAG so this paper has been prepared to summarise all information on the breeding birds up to and including the 1991 breeding season.

Methods

As different census methods have been used over the years, details of count units are

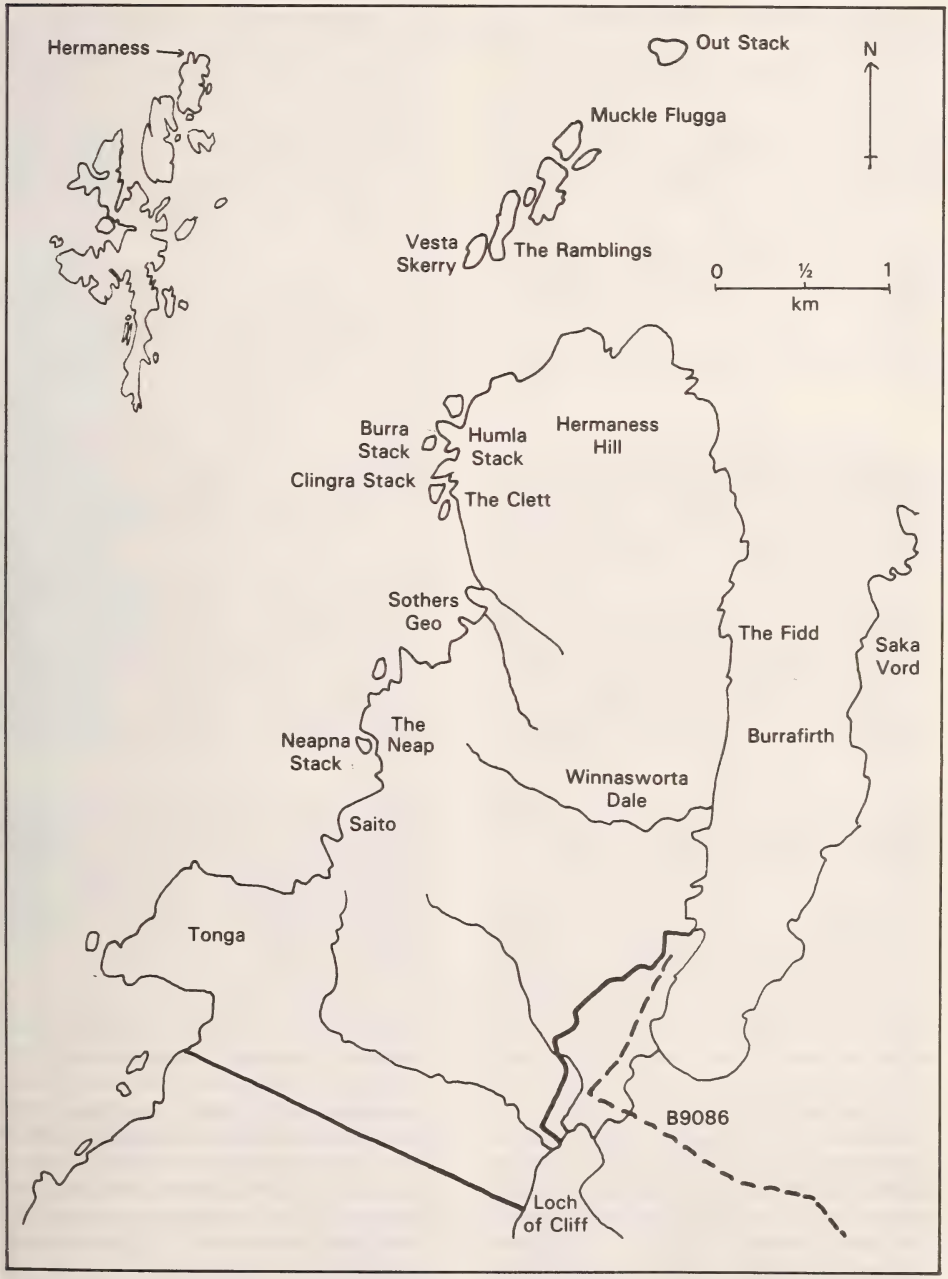

FIGURE 1. Map of Hermaness National Nature Reserve showing locations mentioned in the text.

given in the species accounts, with relevant information on census methods. Counts for 'Operation Seafarer' in 1969 quoted 'pairs' in Cramp *et al.* (1974), but the original count units are used here wherever possible. In many cases reference has been made to original reports so some figures vary from already published sources. Most recent surveys have used either the Apparently Occupied Nest (AON), the Apparently Occupied Site (AOS), or the Apparently Occupied Territory (AOT) as their units, although sometimes the number of individuals was the only unit that could be used.

Nearly all counts have been land-based, although some cliff-faces are visible only from the sea: only Gannet *Sula bassana* and Kittiwake *Rissa tridactyla* have been censused from the sea, and no complete survey of the Muckle Flugga skerries has been attempted.

Breeding success of some seabirds has been monitored in selected study plots since 1988 or 1989. Monitoring of Kittiwake is carried out using photographs so that all nesting attempts are known (Harris 1987), with similar techniques used for Fulmar *Fulmaris glacialis*, and also Gannet from 1991. For other species the number of breeding attempts are estimated by taking a series of June counts followed by counts of the number of large chicks likely to fledge taken later in the season. Breeding productivity was calculated as being the mean number of chicks fledged per pair attempting to breed in the sample areas, except for Fulmar for which the mean number of occupied sites in June was used as an estimate of the number of pairs.

Comments on breeding species

Red-throated Diver *Gavia stellata.* The RSPB watchers recorded just one or two pairs in the 1920s and 1930s. Between 1958 and 1974 there were 5-7 pairs present. Since 1976 monitoring, largely carried out by J.D. Okill for SOTEAG, has revealed 7-12 nesting pairs, with 7 in 1990 and 8 in 1991. 14 sites have been used, two of which are no longer suitable due to silting or disturbance. Breeding productivity has been relatively poor since 1988 (Table 1), compared with figures of 1.00 chicks per pair in 1986 and 1.09 chicks per pair in 1987 from the 11 pairs present in those two years (J.D. Okill pers. comm.).

Fulmar. Prospecting commenced in 1894, with breeding confirmed in 1897 when there were already 57 occupied sites (Fisher 1952). The breeding population was estimated to have reached 1000 pairs by 1939, 1500 by 1944 and 2000 by 1949 (Fisher 1952). Recent counts, all excluding the Muckle Flugga skerries, are of 5880 sites in 1965 (Dott 1967), 8491 in 1969, 9669 in 1974 (Albon *et al.* 1976, Harris 1976) and 14,582 AOS in 1986. Occasional breeding attempts are made even on Out Stack, where there was an AOS in 1989 and 1990. Monitored productivity is fairly low (Table 1), and although comparable with figures elsewhere in Shetland for the past three years, productivity has declined in Shetland recently (Heubeck 1989, Walsh *et al.* 1990, 1991).

Manx Shearwater *Puffinus puffinus.* Large numbers bred on Unst last century, especially around Burrafirth, but breeding ceased sometime in the first half of this century (Saxby 1874, Venables & Venables 1955). A bird was heard calling in flight at Sothers in 1974.

Storm Petrel *Hydrobates pelagicus.* A colony present in the 1950s presumably still exists on Muckle Flugga, although this colony is not listed by Lloyd *et al.* (1991). A stranded bird was found ashore in daylight in 1987 and a dead bird found in 1991. (A. Sinclair pers. comm.). Breeding was also confirmed between the Neap and Tonga in 1938/39 and was suspected for some time afterwards (N. Gordon unpubl.), but extensive searches of the mainland coast have failed to provide any proof of recent

TABLE 1. Productivity (chicks reared per pair) of certain species of seabird in monitored plots on Hermaness, 1988-91. Sample sizes given in brackets; * = all known nesting attempts; + = mean figure calculated from two plots.

	1988		1989		1990		1991	
* Red-throated Diver	0.56	(9)	0.88	(8)	0.71	(7)	0.88	(8)
+ Fulmar	—		0.36	(277)	0.37	(276)	0.32	(311)
Gannet	—		0.81	(357)	0.65	(372)	0.75	(457)
Shag	—		0.29	(42)	0.51	(68)	1.02	(83)
* Arctic Skua	0.03	(33)	0.07	(28)	0.42	(24)	(0.50	(28)
Great Skua	—		1.03	(66)	0.69	(39)	1.14	(44)
+ Kittiwake	—		0.45	(181)	0.48	(179)	1.06	(164)

breeding. However, remains have been found recently in Great Skua pellets and non-breeding birds have been attracted to tape-lures.

Gannet. Recorded ashore on the Muckle Flugga skerries in the 1860s (Saxby 1874), but breeding was not confirmed until 1917 when there were a few pairs on Vesta Skerry (Fisher *et al.* 1939). The colony spread to Burra Stack in 1920, Humla Stack soon afterwards, Neapna Stack in 1928 and the Neap in 1930 (Fisher *et al.* 1939, RSPB watchers' reports). Since then Saito, Clingra Stack and the Rumblings have been colonised. Early counts of the colony include 2045 pairs in 1938 (Fisher *et al.* 1939), 2611 pairs in 1939 and an estimated 3150 pairs in 1949 (Venables & Venables 1955). As parts of the colony can only be viewed from the sea land-based counts of 3450 nests in 1965 (Dott 1967), and 5225 nests in 1974 (Albon *et al.* 1976, Harris 1976) are incomplete. 'Operation Seafarer' included an aerial survey of 5894 pairs in 1969 (Cramp *et al.* 1974). Confusion over count criteria led to a wide range of counts by SOTEAG between 1977-84, but Hermaness has always been a difficult colony to count, partly due to the high proportion of non-breeders, not all of which are segregated into clubs (Murray & Wanless 1986). In 1986 a revised census produced a total of 9904 AON, with any site containing nest material included as an AON (Wanless 1986). Of the non-breeding population of 6820 birds, only about half were in discrete clubs. Full details of a repeat census in 1991 are not available at the time of writing but there was no evidence of any significant change in the breeding population. (S. Murray pers. comm.). Productivity has been good but rather variable in 1989-91 (Table 1), possibly due to variation in technique, which was standardised in 1991.

Cormorant *Phalacrocorax carbo.* Saxby (1874) recorded a colony on Muckle Flugga last century but there are no other records.

Shag *Phalacrocorax aristotelis.* This species nests principally on boulder beaches on Hermaness, making assessment of the breeding population difficult. Only numbers of individual birds can be censused although in a sample in 1974 more nests were counted than birds with a ratio of between 1.5 – 2:1 (Albon *et al.* 1976), while in 1990 68 active nests were found south of Tonga where only 35 birds could be observed. The following counts all exclude the Muckle Flugga skerries – 315 birds in 1965 (Dott 1967), 887 'pairs' in 1969, 937 birds in 1974 (Albon *et al.* 1976), 1170 birds in 1978 (late count), 962 birds in 1986 and 268 in 1989. This recent decline in birds attending the colony

is reflected in late June counts of active nests with eggs or young in the boulder beaches between Humla Stack and the Clett: 199 nests in 1974 declined to 151 in 1986, 93 in 1987, 73 in 1988 and 42 in 1989, but increased to 68 in 1990 and 83 in 1991. It is suspected that in recent years many birds are not attempting to breed, a common response to poor feeding conditions by this species (Lloyd *et al.* 1991). Breeding success in 1988-90 was very poor although no accurate figure is available for 1988 (Table 1). There was a welcome increase in productivity in 1991 to a level more comparable with recent figures from two other Shetland sites (Heubeck 1989, Walsh *et al.* 1990, 1991).

Wigeon *Anas penelope.* Saxby (1874) records a nest last century but this is the only breeding record.

Red-breasted Merganser *Mergus serrator.* The RSPB watcher reported 2 broods in 1918, the only confirmation of breeding.

Eider *Somateria mollissima.* Breeds regularly but 19 nests found in 1974 is the only indication of numbers. The RSPB watchers' reports suggest the species was commoner in the 1920s.

White-tailed Eagle *Haliaeetus albicilla.* Bred formerly but became extinct sometime before 1859 (Saxby 1874), probably because the eyrie on Saito was robbed almost annually in the 1840s (R. Matthewson in *New Shetlander* 137 (1981).

Merlin *Falco columbarius.* Single pairs have bred twice, in 1957 and 1981.

Peregrine *Falco peregrinus.* Single pairs have bred, either at Tonga or the Neap, regularly prior to 1933 and occasionally during 1951-76.

Oystercatcher *Haemotopus ostralegus.* Breeds regularly but the only censuses are of 18 AOTs in 1989 and 16 in 1990.

Ringed Plover *Charadrius hiaticula.* The RSPB watchers recorded breeding fairly regularly in the 1920s and 1930s but the only recent attempts were beside Loch of Cliff in 1981 and 1989.

Golden Plover *Pluvialis apricaria.* Breeds regularly with counts of 5 pairs in 1974, between 5-8 AOTs during 1985-90, and 11 AOTs in 1991.

Dunlin *Calidris alpina.* The RSPB watchers' reports suggest that breeding did not take place in the 1930s but the species now breeds regularly with 23 pairs in 1974 and a maximum of 31 AOTs during 1985-89.

Woodcock *Scolopax rusticola.* Saxby (1874) was shown a nest and saw the incubating bird last century, this being one of only two Shetland breeding records (Berry & Johnston 1980).

Snipe *Gallinago gallinago.* Breeds regularly with 45 AOTs censused in 1989, although this may be an underestimate.

Whimbrel *Numenius phaeopus.* First recorded breeding last century (Evans & Buckley 1899) with sporadic breeding since. Breeding records were most frequent in the 1950s and 1960s (N. Gordon unpubl.) while the most recent but unsuccessful attempts were by 2 pairs in 1987.

Curlew *Numenius arquata.* Bred regularly and in increasing numbers in the 1920s and 1930s according to the RSPB watchers, but only sporadically since the 1950s. Recently there have been single pairs in 1987, 1988 and 1990 and 4 AOTs in 1989, but none bred in 1985, 1986 or in 1991 when the only occupied territory was abandoned early in the season.

Common Sandpiper *Actitis hypoleucos.* The only known breeding attempts were in 1979 and 1982.

Red-necked Phalarope *Phalaropus lobatus.* Breeding was suspected during the 1920s and 1930s and was confirmed by the RSPB watcher in 1935 and 1937. There are no recent breeding records.

Arctic Skua *Stercorarius parasiticus.* Raeburn (1888) recorded 30 pairs in 1885 and 60-100 pairs in 1887, attributing the increase to the easing of persecution from collectors. In 1922 there were 200-300 pairs (Pitt 1922) with the RSPB watchers recording similar numbers in the 1930s. However, by 1958 there were only 50-75 pairs (Eggeling 1958) while in 1970 57 nests were located (L. Johnston unpubl.) and 54 nests were found in 1974 (Albon *et al.* 1976). Breeding last took place on the former stronghold of Hermaness Hill in 1986 and now most territories are on the periphery of the reserve. Recent counts were of 31 AOTs (23 nests) in 1987, 33 AOTs (26 nests) in 1988, 28 AOTs in 1989, 24 AOTs (19 nests) in 1990 and 28 AOTs in 1991. Since 1988 at least productivity has been low (Table 1), with figures much lower than those given by Furness (1987). However, similar figures have been obtained elsewhere in Shetland recently, presumably due to the breeding failure of other seabirds from which Arctic Skuas kleptroparasitise most of their food (Heubeck 1989, Walsh *et al.* 1990, 1991). On Hermaness predation of chicks by Great Skuas is also an important source of mortality (pers. obs.).

Great Skua. In 1774 Low (1879) recorded this species from the adjoining hill of Saxa Vord, but as he did not visit Hermaness Hill the first record for the site was not until 1831 when the 3 pairs were the only ones in Britain outside Foula (Evans & Buckley 1899). Under protection the population rose to 50-60 pairs in 1850, but by 1871 pressure from collectors had reduced the total to less than 5 pairs (Saxby 1874). For the next 20 years never more than 12 pairs nested (Evans & Buckley 1899), until the employment of a keeper on the hill in 1891 (Clarke 1892) lead to an almost immediate change in fortune. There were 16 pairs in 1897 (Evans & Buckley 1899), 42 pairs by 1907 (Cramp *et al.* 1974) and in 1922 "the watcher counted over eighty nests after which he lost count" (Pitt 1922). By 1949, Venables & Venables (1955) estimated the total Unst population at 350-400 pairs. In 1958, 340 pairs on Hermaness were estimated from nest searches (Eggeling 1958) and using similar techniques in 1965 Dott (1967) gave a figure of 286 pairs and 24 'non-breeding pairs' which was presumably used in the 'Operation Seafarer' estimate of 300 pairs (Cramp *et al.* 1974). In 1974 a team of eight walked the entire reserve in 5m transects, then used correction factors to allow for missed nests or broods to derive a figure of 786 pairs from 739 nests located (Albon *et al.* 1976). A similar survey in 1985 using wider transects produced a total of 616 pairs, very probably an undercount, but used by Ewins *et al.* (1988) in calculating the Shetland population. In 1989 a survey using techniques recommended by Furness (1982) located 896 AOTs. In view of this the Shetland population can probably be upgraded by 280 from the 5647 AOTs given by Ewins *et al.* (1988). The non-breeding population in four club sites on the reserve has peaked at between 185-190 birds in 1989-1990. Occasional breeding failures on Foula and Noss (Walsh *et al.* 1990, 1991) were followed by reduced productivity on Hermaness in 1990, although productivity was high in 1989 and 1991 (Table 1). In recent years some dead chicks have been found, presumed predated by other Great Skuas while left unattended by their parents.

Common Gull *Larus canus.* The RSPB watchers recorded a declining population in the 1920s which was extinct by 1936. The only recent breeding records were of single pairs in 1987 and 1988 and 2 pairs in 1990.

Lesser Black-backed Gull *Larus fuscus.* Recorded as common by the RSPB watchers and N. Gordon (unpubl.) up until the 1950s but none were recorded in 1965, 1969 or 1974 (Dott 1967, Harris 1976). The only recent breeding record is of one AOT in 1986.

Herring Gull *Larus argentatus.* The only complete counts are of 45 pairs in 1969, 52

pairs in 1974 (Harris 1976) and 42 AOTs in 1989, the latter count including one AOT on the Muckle Flugga skerries.

Great Black-backed Gull *Larus marinus.* The only complete counts are of 6 pairs in 1969, 15 pairs in 1974 (Harris 1976) and 20 AOTs in 1989, including 5 on the Muckle Flugga skerries, one of which was on Out Stack where a nest has been recorded in the past (Rankin 1947). 2 pairs were present on Out Stack in 1991 (J.D. Okill pers. comm.).

Kittiwake. From the accounts of the flocks flying to the Loch of Cliff to bathe (Saxby 1874) the Hermaness colony must have been very large in the past. However, recent counts indicate a continuing decline. Land-based counts, excluding the Muckle Flugga skerries, produced totals of 3303 nests in 1965 (Dott 1967), 4831 nests in 1969, 3888 nests in 1974 (Harris 1976), 2105 AONs in 1985, 1243 AONs in 1989 and 1135 AONs in 1990. Counts from the sea, including the Flugga and other colonies not visible from the land are of 3872 AONs in 1981 (Richardson 1985), 3497 AONs in 1987 and 2280 AONs in 1991. The population therefore declined by over 40% between 1981 and 1991, with the decline being particularly marked around Saito and the Neap where many colonies have been abandoned. There is evidence that some birds have moved to colonies elsewhere on Unst. A good breeding season in 1991 followed much poorer breeding success in 1989 and 1990 (Table 1), though still higher than productivity recorded at most other Shetland colonies in those years (Heubeck 1989, Walsh *et al.* 1990, 1991). However, the decline in the breeding population at Hermaness began before recent declines noted elsewhere in Shetland (Heubeck *et al.* 1986, Heubeck 1989). The reason for this decline on Hermaness is unclear, but predation by Great Skuas at the colony has been noticeably high for at least 40 years (Lockie 1952, Andersson 1976, Heubeck *et al.* 1987, pers. obs.).

Common Tern *Sterna hirundo.* A sporadic breeder amongst Arctic Terns *Sterna paradisea* at the Fidd, first recorded in 1974 with the highest count of 54 pairs in 1980 (Bullock & Gomersall 1981). No Arctic Terns were recorded in 1980 although it is very likely that some were present. The most recent breeding records are of 4 pairs possibly rearing one chick in 1988, and at least 7 pairs rearing 6 chicks in 1991, including 4 pairs at a new colony at Fiska Wick.

Arctic Tern. The RSPB watchers recorded breeding in the 1920s and 1930s. A few pairs have bred in most recent years at the Fidd, the highest count (apart from the count in 1980 noted above) being 18 pairs in 1974 (Harris 1976). Birds had not bred successfully for many years until 1991 when 12 pairs reared 9 chicks in two colonies. The record of a large colony between the Neap and Tonga in 'Operation Seafarer' data in 1969 would appear to be erroneous.

Guillemot *Uria aalge.* All counts have been land-based although an estimated 30% of birds are not visible from land, including those on the Muckle Flugga skerries. The earliest available counts indicate an increase in the population from 8730 individuals in 1965 (Dott 1967) to 15,983 in 1969, 18,228 in 1974 (Albon *et al.* 1976, Harris 1976) and 22,760 in 1978 (a late census which was probably an underestimate). Recent counts have been of 14,374 individuals in 1987, 15,074 in 1988, 15,948 in 1989, 12,779 in 1990 and 17,158 in 1991. Annual monitoring of six sample plots since 1976 has revealed a similar pattern (Fig. 2). The 1990 count was just 43% of the maximum in 1977, but it is likely that the very low counts in 1989 and 1990 were due to lower colony attendance rather than being due to a decrease in the breeding population. In 1991 colony attendance increased, but there still appears to be an underlying trend for a decrease in the breeding population. Population changes on Hermaness mirror those at other Shetland colonies, with an

FIGURE 2. Mean annual counts of Guillemots at monitored plots on Hermaness.

increase followed by a decline since the early 1980s, believed to be caused largely by increased winter mortality (Heubeck *et al.* 1991). Productivity on Hermaness has not been assessed accurately. It was believed to be lower than normal in 1989 and 1990 but improved in 1991.

Razorbill *Alca torda.* Most nest in boulder beaches making an accurate assessment of the breeding population difficult. Comparison between the following June counts is probably not very reliable, but a recent decline is suggested by totals of 780 individuals in 1965 (Dott 1967), 2060 in 1969, 1100 in 1974 (Harris 1976), a late count of 1844 in 1978, 942 in 1986, 787 in 1989, 471 in 1990 and 622 in 1991. Two recent pre-breeding counts of most of the coastline in May revealed 1488 individuals in 1989 and 1127 in 1990. Accurate breeding productivity figures are not available but near complete breeding failure was suspected in 1989 and 1990 (Pennington *et al.* 1990, pers. obs.). In 1991, however, biometrics of chicks indicated a greatly improved breeding season.

Black Guillemot *Cepphus grylle.* Only small numbers breed, mostly along the Burrafirth shore, with June or July counts of 15 birds in 1965 (Dott 1967), 20 in 1969, 14 in 1974 (Harris 1976), 35 in 1978 and 26 in 1986. A pre-breeding census in 1983 gave a total of 22 birds (Ewins & Tasker 1985).

Puffin *Fratercula arctica.* Most burrows are on steep slopes or in scree where the usual quadrat sampling method is impossible so no accurate population estimate of the colony exists. In 1987 counts of birds present in the evening were made and a correction factor derived from the ratio of adults to burrows in a control area. However, abnormal behaviour due to breeding failure affected the results so that the figure of *c.*25,000 pairs probably reflects the number of breeding attempts surviving

to the census date. The actual breeding population is estimated to be up to 50,000 pairs, with Harris (1976) regarding the population of Hermaness and Saxa Vord combined as being of a similar order to that of St Kilda. There are no indications of any recent change in the size of the population through monitoring of burrows in a permanent transect at Sothers Geo since 1974 (Harris 1984, Lloyd *et al.* 1991). However, the account of Saxby (1874) suggests that the colony was much smaller last century. Reduced breeding success has been suspected since 1986 with few adults seen carrying food in July, mean food load weight *c.*30% of the 1974 level (Martin 1989) and large numbers of dead chicks seen in 1988 and 1989. In 1989 productivity was estimated to be 0.04 chicks per occupied burrow from a sample of 158 nests (J. McKee pers. comm.). However, 1990 was the best breeding season since at least 1985, with over 50% of a small sample of chicks fledging, although losses of eggs and small chicks were not assessed, and 1991 was considered an even better breeding season (P.M. Ellis pers. comm.).

Rock Dove *Columba livia.* Breeds regularly in small numbers, but there are no census figures.

Skylark *Alauda arvensis.* An abundant breeding species but never censused.

Pied Wagtail *Motacilla alba.* A pair bred beside Loch of Cliff in 1986.

Grey Wagtail *Motacilla cinerea.* A pair bred in Winnasworta Dale in 1990: there are no breeding records for Shetland outside Fair Isle prior to 1990 (Shetland Bird Report 1990).

Meadow Pipit *Anthus pratensis.* Breeds regularly but the only census is of 28 AOTs in 1989.

Rock Pipit *Anthus petrosus.* Breeds regularly but the only census is of 36 AOTs in 1989, including one pair on Muckle Flugga.

Wren *Troglodytes troglodytes.* Breeds regularly with 29 AOTs in 1989, excluding any on Muckle Flugga where there was a pair in 1988.

Wheatear *Oenanthe oenanthe.* Breeds regularly but the only census is of 49 AOTs in 1989.

Blackbird *Turdus merula.* First recorded breeding by the RSPB watcher in 1934. Has bred sporadically since, most recently 2 pairs on the cliff at Saito in 1980, and a probable breeding record on the north side of Tonga in 1991.

Raven *Corvus corax.* Breeds regularly with 2 pairs recorded in 1938 by the RSPB watcher, 3 AOTs in 1983 (Ewins *et al.* 1986), 4 AOTs in 1987-89 and 5 in 1990. These territories are all on the mainland but a pair bred on Muckle Flugga in 1957 (W. Eggeling unpubl.).

Hooded Crow *Corvus corone.* An irregular breeder with recent records of single pairs in 1986 and 1989-91, 3 pairs in 1987, but none in 1988.

Starling *Sturnus vulgaris.* Breeds regularly on the cliffs with a census of 23 AOS in 1989, although this is probably an underestimate.

Twite *Carduelis flavirostris.* Breeds regularly in small numbers but never censused as most pairs nest on sea-cliffs.

Two other species deserve mentioning. In 1970, 1972 and 1974-87 a Black-browed Albatross *Diomedea melanophris* summered with the Gannets on Saito, building a nest from 1975 onwards (Sutherland & Brooks 1979). After an almost three year absence, the bird reappeared in the springs of 1990 and 1991. In 1974 Redwing *Turdus iliacus* was erroneously listed as breeding on Hermaness (Shetland Bird Report 1974).

Discussion

The greatest ornithological significance of Hermaness lies in its seabird populations. Hermaness holds significant proportions of

TABLE 2. Populations of seabirds on Hermaness and their percentage of the Shetland and British Isles populations.

	Count & unit		Year	% of Shetland population	& of British % Irish pop.
Fulmar	14582	AOS	1986	6.2	2.6
Gannet	9904	AOT	1986	57.6	5.2
Shag	962	ind.	1986[1]	13.8[2]	2.0[2]
Arctic Skua	28	AOT	1991	1.2	0.7
Great Skua	896	AOT	1989	15.1[3]	11.0[3]
Herring Gull	42	AOT	1989	0.8	>0.1
GBB Gull	20	AOT	1989	0.6	>0.1
Kittiwake	2280	AON	1991	4.5	0.4
Arctic Tern	11	prs.	1991	>0.1	>0.1
Guillemot	17158	ind.	1991	10.6	1.5
Razorbill	787	ind.	1989[1]	5.6	0.4
Black Guillemot	22	ind.	1983[1]	0.2	>0.1
Puffin	50000	prs.	est.	*c*.40.0[4]	*c*.10.0[4]

Notes. Percentages calculated from figures in Lloyd *et al.* (1991). [1] most recent Hermaness census not used as counts since date given believed to be underestimates. [2] assuming each individual on Hermaness equivalent to one pair. [3] including revised Hermaness population. [4]assuming Hermaness population is as given.

the Shetland and of the British and Irish populations for a number of species (Table 2). However, despite the colony's obvious importance, relatively few accurate censuses have been carried out. On the mainland most species have only been censused from land although parts of the colony are invisible except from the sea. Offshore, the Muckle Flugga skerries have never been accurately censused except for Gannet and Kittiwake, although a significant number of Guillemots in particular are known to breed there.

Additional problems with censusing apply to particular species. Gannets on Hermaness are censused according to slightly different criteria compared to other British and Irish colonies because of the high proportion of immatures (Wanless 1986, Lloyd *et al.* 1991). Shags are poorly censused as counts of individuals on Hermaness consistently underestimate the number of nests, although for comparison with other areas the 1986 Hermaness census of individuals was divided by two by Lloyd *et al.* (1991) to estimate the number of pairs present. Nest searches of all boulder beaches carried out from the sea would be the only way of accurately censusing Shags on Hermaness. Razorbills also nest on boulder beaches on Hermaness and are therefore difficult to census, especially as colony attendance in this species is known to be very variable (Harris 1989). Few accurate censuses of Great Skuas have been carried out and the 1985 census, used in British population estimates by Batten *et al.* (1990) and Lloyd *et al.* (1991) is believed to be an underestimate. Using the 1989 Hermaness census the British population would be *c*.8200 pairs rather than the figure of 7900 usually quoted. Puffins are the least accurately censused of all the seabirds breeding on Hermaness, with the only

attempt at a census in 1987 believed to be an underestimate.

However, three species of seabird breeding on Hermaness are of particular importance (Table 2). The Gannet colony is the sixth largest in the British Isles and contains approximately 4% of the world population (Lloyd *et al.* 1991). The revised Great Skua population represents over 6% of the North Atlantic population and, because the Great Skua is geographically isolated from the South Atlantic populations of skuas, sometimes considered to be conspecific, this figure effectively represents the proportion of the world population (Furness 1987, Lloyd *et al.* 1991). The Puffin population, while it's exact size remains uncertain, is undoubtedly of significant size in British terms, although representing only a small proportion of the world population (Harris 1984, Lloyd *et al.* 1991).

Last century, however, Hermaness would have appeared a very different place, with apparently fewer Puffins, very few Great Skuas and no breeding Gannets or Fulmars. The colonisation by Fulmars was an early part of the species' spectacular spread (Fisher 1952); Gannets have increased over the same period with the ending of harvesting by remote human communities (Nelson 1978) while Great Skuas have increased largely due to protection (Furnesss 1987). The causes of any long-term changes in the Puffin population are unknown.

Many seabird populations have increased this century but in recent years many of Shetland's seabirds, including those on Hermaness, have suffered reduced breeding success, and in some cases decreases in breeding population or colony attendance (Heubeck 1989, Walsh *et al.* 1990, 1991, Lloyd *et al.* 1991). Although a number of factors are involved, including increased winter mortality of Guillemots and Razorbills (Underwood & Stowe 1984, Mead 1989, Heubeck *et al.* 1991), and predation by Great Skuas on Kittiwakes and Arctic Skuas, the most important factor would appear to be a reduced availability of food, especially sandeels *Ammodytes marinus* during the breeding season (Heubeck & Ellis 1986, Heubeck 1988 & 1989, Walsh *et al.* 1990). Dietary studies have shown that most seabirds on Hermaness were feeding their chicks largely on sandeels until at least the mid 1980s, but by 1990 most species have shown sometimes dramatic changes in diet (Martin 1989, pers. obs.). For those species monitored on Hermaness in 1989-91, only the productivity of Gannet could be considered high in all years. Productivity of Fulmar, Great Skua and Kittiwake was low, and that of Shag, Arctic Skua and Puffin very poor in at least one year of monitoring (Table 1). Productivity of Guillemot and Razorbill was not accurately assessed, but was obviously poor in 1989 and 1990.

The 1991 breeding season saw a welcome increase in breeding productivity for seabirds not only at Hermaness but throughout Shetland. This was undoubtedly due to a greater availability of sandeels, although the reasons for the increase in the sandeel stock are unclear. It is highly unlikely that the increase was due to the closure of the commercial sandeel fishery in Shetland in 1991, although the closure must still be regarded as the correct decision. A slight increase in the Shetland sandeel stock in 1991 was predicted by Scottish Office Agriculture and Fisheries Department scientists in December 1990, but it was also expected that this improvement would be short-lived as the incoming 1990 year class appeared poor. Although the increase in the 1991 sandeel stock exceeded expectations, this should only serve as a further indication of how little is known about the sandeel population. Until there are signs of both a sustained improvement in the sandeel stock and an increase in seabird productivity over a number of seasons it would be wise to remain cautious about the future for seabirds on Hermaness and elsewhere in Shetland.

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The breeding Gulls of Coll, Inner Hebrides 1969-70 to 1989-90

J.G. BLATCHFORD & J.R. WRIGHT

Different workers have estimated breeding gull populations for the island of Coll on several occasions over the past 20 years, and estimates often include Gunna, Soy Gunna, Soa, and sometimes the Eilean Mor group. While these populations are important their inclusion makes comparisons between different years difficult. By adopting a colony by colony approach and concentrating entirely on the mainland of Coll (including only minor islets which can be clearly observed from the shore) we feel we have been able to make valid comments on recent changes in the breeding populations of gulls. In particular we have been able to clarify the previously confusing records for the Lesser Black-backed Gull and Herring Gull populations. We find that Lesser Black-backed Gulls have increased by at least 300% over 20 years, while the Herring Gull population has increased much less. We go on to suggest a method which might allow the more accurate monitoring of future population trends for these two species in the Inner Hebrides.

Introduction

During May 26 – June 3 1989, and May 25-June 2 1990 a party of 4 staff and 8 students from St. Mary's Sixth Form College surveyed the mainland of the island of Coll. Unless it has been specifically indicated otherwise in the text the techniques of counting, numbers of observations, routes walked and overall effort were kept as similar as possible to those made by one of us during June 13-19 1969 and June 5-12 1970 (Blatchford, J.G. 1971). This enabled us to compare the figures from each survey directly. Counting methods were those recommended for Operation Seafarer 1969-70. Observation of incubating birds from a distance was followed by walking through colonies counting individual nests. Where large numbers or mixed colonies were involved, the number of adults flying overhead was also counted. (For instructions for Operation Seafarer 1969-70 see Lloyd, Tasker & Partridge: *The Status of Seabirds in Britain and Ireland,* Appendix IV: 307-316). During the course of this work, Broad & Cadbury published *Breeding seabirds of Coll and Tiree* (1989). Subsequently we have been able to obtain the records for Coll from the Seabird Colony Register (SCR) for the period 1969-1987 from the Nature Conservancy Council (NCC Seabird Colony Register data for 1969-87). This SCR data has allowed us to consider the gull populations colony by colony.

TABLE 1.

Gull population of Coll (in pairs)			
Species	1969-70	1986-88	1989-90
Black headed Gull	—	28	12
Common Gull	12	19	29-31
Great Black-backed Gull	11 (19)	47 (186)	28-30
Lesser Black-backed Gull & Herring Gull together	286 (686)	908 (1234)	951

Notes:
(1) 1969-70 figures are from Blatchford (1971), adjusted for mainland only using SCR data. 1986-88 figures are from Broad & Cadbury (1989). 1989-90 figures are based on our own survey results – now lodged with the SCR.

(2) Figures are for mainland of Coll including only minor islets which can be clearly observed from the shore. Figures in brackets are estimates for Coll including Gunna, Soy Gunna, Soa and the Eilean Mor group (called "whole island" estimates in text.)

Comment on species

Black-headed Gull *Larus ridibundus.* Black Headed Gulls appear to be very mobile on the island. The colony of 20 pairs recorded at 'North Friesland – NM 186541' in 1987 (NCC 1969-87) was not there by 1990. It was reliably reported that it had moved by 1989 to 'Hyne – NM 204545'. In 1990 it had moved to 'West of Loch Ronard – NM 198556' and comprised 10 pairs. The 1989 site at Hyne had been taken over by a colony of 18 pairs of Common Gulls. In 1990 we found another two pairs on a small islet at NM 220625.

Common Gull *Larus canus.* Common Gulls would appear to move in a similar fashion. There has been no record of a Common Gull colony at 'Cnoc na h-Osnaiche – NM 195589' since 1969 (NCC 1969-87), although 7 pairs of Herring Gulls were reported to be there in 1989. As mentioned above, 18 pairs of Common Gulls seem to have taken over a colony of Black headed Gulls at Hyne.

Great Black-backed Gull *Larus marinus.* In our experience, Great Black-backed Gulls seem to be solitary nesters, preferring raised areas or isolated rocky hillocks. When we approached, they usually left the site early to reappear later from a different direction. Our figures, for nests actually found, are minimum numbers and we therefore consider that the 47 pairs estimated for 1987 (NCC 1969-87) is a more realistic figure than our 19-23.

Lesser Black-backed Gull ***Larus fuscus*** **& Herring Gull** ***Larus argentatus.***
Lesser Black-backed Gulls and Herring Gulls seem to have increased dramatically over the twenty years since 1969/70. There seems to be a remarkable agreement over the locations of most of their important breeding colonies (see Fig. 1a), and over the size of their joint breeding population of approaching 1000 in recent years. What is less well-known is the proportion of the two species within this population. We first became aware of this after our 1989 survey when we read in *Breeding Seabirds of Coll and Tiree* (Broad & Cadbury 1989) that the estimate for the mixed colony at 'Moorland at NM 252596' was 143 pairs of Herring Gulls and 23 pairs of Lesser Black-backed Gulls. Our own estimate had been almost exactly the reverse – 25 pairs of Herring Gulls and 150 pairs of Lesser Black-backed Gulls. On our return to the island in 1990 this colony was re-counted with great care. We diverged from our policy of maintaining counting effort at 1969-70 levels and our estimated went up to 25 pairs of Herring Gulls and 200-500 pairs of Lesser Black-backed Gulls. The increase probably reflects the extended period of observation in some part, but we also felt that the colony had actually expanded since the previous year. Alerted to the problems of counting in this remote and relatively difficult part of Coll

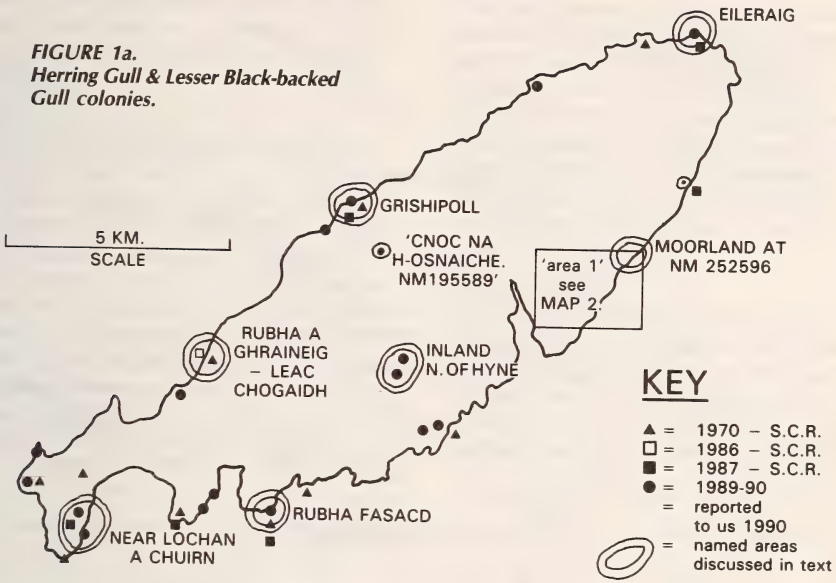

FIGURE 1a.
Herring Gull & Lesser Black-backed Gull colonies.

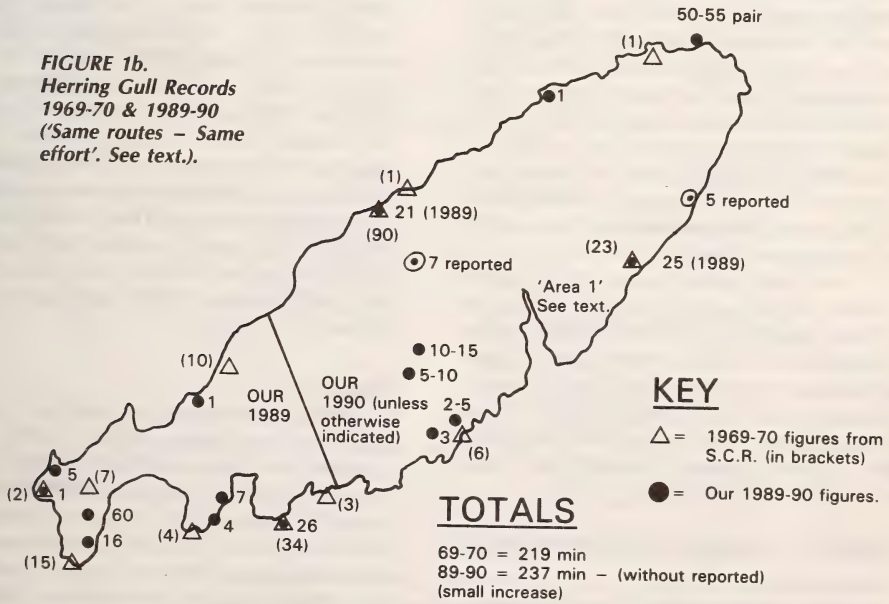

FIGURE 1b.
Herring Gull Records 1969-70 & 1989-90 ('Same routes – Same effort'. See text.).

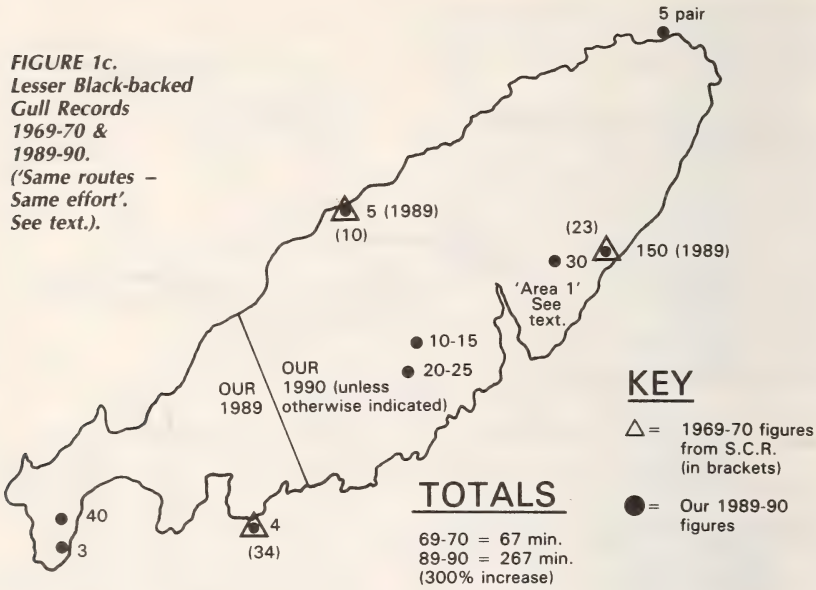

FIGURE 1c. Lesser Black-backed Gull Records 1969-70 & 1989-90. ('Same routes – Same effort'. See text.).

we searched the whole area extremely carefully and believe we have discovered new (or previously missed) colonies. It became increasingly difficult to match our colonies with those previously reported, and therefore to compare individual colony records with our own. In order to demonstrate the confusion that has arisen in this area our initial analysis considers the recent records for the moorland area north of Arinagour (Area 1 – see Fig. 2).

Our 1990 figures for the whole of area 1 were: 160-180 pairs of Herring Gulls and 357-447 pairs of Lesser Black-backed Gulls, compared with 1987 figures of 210-278 pairs of Herring Gulls and 29-52 pairs of Lesser Black-backed Gulls (NCC 1969-87) and 1986-88 figures of 225 pairs of Herring Gulls and 62 pairs of Lesser Black-backed Gulls (Broad & Cadbury 1989).

Details for colonies 1-5 shown on Fig. 2

COLONY 1

There is general agreement that this colony is longstanding and at NM 252596. It is even possible that this is the 'breeding colony of several hundred pairs – of Lesser Black-backed Gulls – on level moor north of Arinagour in June 1955' referred to by Morton Boyd (1958). As noted above our 1989 and 1990 estimates for this colony do not agree with previous records. We returned to this colony in 1990 specifically to check our identification and recording and remain convinced that Lesser Black-backed Gulls greatly outnumber Herring Gulls. We suggest that an error may have led to an inverstion of the figures quoted by Broad & Cadbury.

COLONY 2.

In 1989 we estimated 30 pairs of Lesser Black-backed Gulls while in 1990 the number had fallen to 15-20 pairs. There were no Herring Gulls present either year. Broad & Cadbury give 33 pairs of Herring Gulls and 4 pairs of Lesser Black-backed Gull for a colony 'East of Loch a'Chrotha' in 1986-88 (Broad & Cadbury 1989), although there is no similar record in the

Seabird Colony Register for 1987. We suggest a similar error occurred for this colony, and that the figures are best interpreted as a small mixed colony which is decreasing.

COLONY 3.
Our 1990 figures for this colony were 5 pairs of Herring Gulls and 35 pairs of Lesser Black-backed Gulls. Broad & Cadbury recorded 25 pairs of Herring Gulls and 5 pairs of Lesser Black-backed Gulls 'East of Loch Urbhaig' (1986-88), and the same figures are given for NM 238579 'Loch Urbhaig – Loch nan Geadh' in 1987 (NCC 1969-87). Once again we suggest that the figures have become inverted and that these figures represent a small mixed colony which has recently increased slightly.

COLONY 4.
This is a large mixed colony with an estimated 30 pairs of Herring Gulls and 100 pairs of Lesser Black-backed Gulls. Broad & Cadbury recorded 49 pairs of Herring Gulls and 10 pairs of Lesser Black-backed Gulls in square NM 2358 'Between Loch a' Chrotha and Loch nan Geadh'. It is not clear whether they refer to our colony 4. The SCR has no record of any colony in this square for 1987.

COLONY 5.
In 1990 we recorded 105-120 pairs of Herring Gulls and 42 pairs of Lesser Black-backed Gulls in this colony. In fact it is probably better considered as a small LBB colony adjacent to a larger HG colony. Neither Broad & Cadbury nor the SCR have

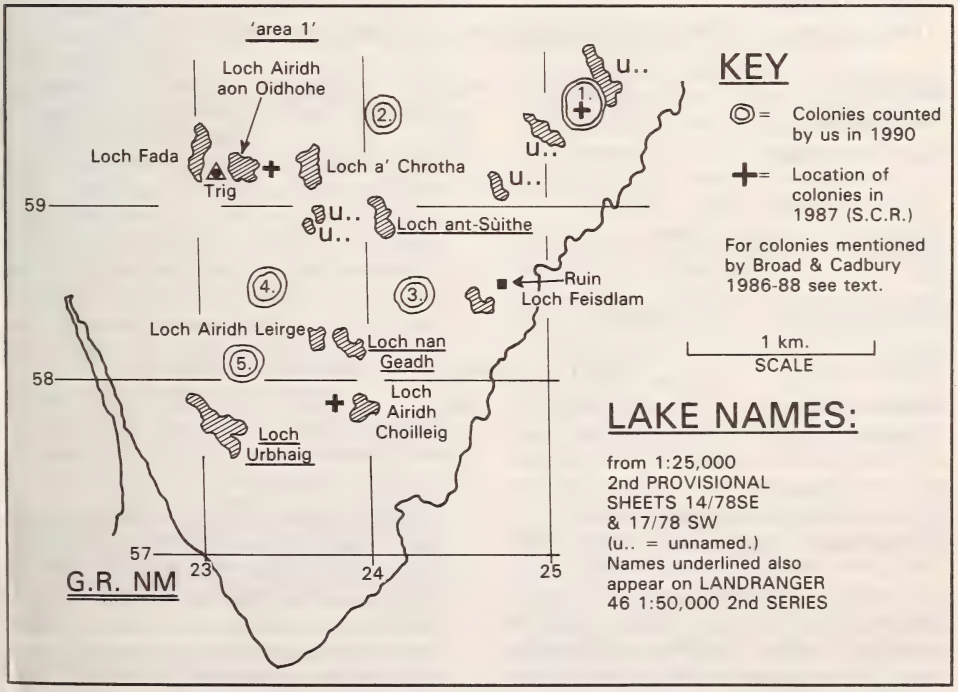

FIGURE. 2 Location of colonies of Herring Gulls and Lesser Black-backed Gulls reported in area 1 in recent years.

any record of a similar sized colony in this area. This is a significant colony that has, it seems, previously been missed.

Colonies previously recorded in this area but not so far discussed

The SCR has a record of 60-103 pairs of Herring Gulls and 2-5 pairs of Lesser Black-backed Gulls at NM 234592 'Loch a' Chrotha' for 1987. We did not find this colony, nor is it mentioned by Broad & Cadbury for 1986-88. The map reference would place this colony in plain view of the trig point and it is unlikely that we would have overlooked it in 1990. The SCR also has a record of 2 pairs of Herring Gulls at NM 243574 'Meal nan Muc'.

Records for other significant sites

EILERAIG

On a small grassy island overlooked by cliffs, just off the coast near Eileraig, we estimated 50-55 pairs of Herring Gulls and 5 pairs of Lesser Black-backed Gulls. Broad & Cadbury have 40 pairs of Herring Gulls and 10 pairs of Lesser Black-backed Gulls for 1986-88, while the SCR has 42 pairs of Herring Gulls and 10 pairs of Lesser Black-backed Gulls for 1987.

NEAR LOCHAN A CHUIRN

To the east of Lochan a Chuirn there is a large mixed colony. In 1989 we estimated 60 pairs of Herring Gulls and 40 pairs of Lesser Black-backed Gulls at this site. Broad & Cadbury have 250 pairs of Herring Gulls and 30 pairs of Lesser Black-backed Gullts for 1986-88, while the SCR has 300-350 pairs of Herring Gulls and 30 pairs of Lesser Black-backed Gulls. Our estimates might very well be on the low side, but the figures still suggest a significant movement away from this site. Further south, on the coast near Port a Mhurain we recorded 16 pairs

Records for other major colonies with several records

'Grishipoll point – NM 183596' (counted by us in 1989 and 1990)

SPECIES	1970 (1)	1987 (1)	1986-88 (2)	1989 (3)	1990 (3)
Herring Gull	90	125	125	21	53
Lesser B B Gull	10	15	15	5	6

(1) NCC 1969-87
(2) Broad & Cadbury 1989
(3) Our own survey results

'Rhubha Fasacd – NM 169523'

SPECIES	1970 (1)	1987 (1)	1986-88 (2)	1989 (3)
Herring Gull	34	26	23	26
Lesser B B Gull	34	5	5	4

(1) NCC 1969-87
(2) Broad & Cadbury 1989
(3) Our own survey results

Here, as with Grishipoll there is evidence for the long term trend of movement away from these 'traditional' sites. This might be due to increasing use of Coll by holidaymakers who visit these scenic areas.

of Herring Gulls and 3 pairs of Lesser Black-backed Gulls in 1989. Broad & Cadbury have 75 pairs of Herring Gulls at this site for 1986-88, while the SCR has no record for 1987. Again these results suggest a rapid decline in the colonies in the southern end of the island, maybe associated with increasing leisure use.

INLAND NORTH OF HYNE

North of the road, between the cairn and Loch Boidheach we found two small mixed colonies which together contained 15-25 pairs of Herring Gulls and 30-40 pairs of Lesser Black-backed Gulls in 1990. There are no other records for colonies in this area. It might well be that these are relatively new colonies. If birds are being displaced from the more accessible and scenic areas this sort of site might well increase in importance. It is interesting to note that these two 'new' colonies are quite close to the area to which the Black-headed Gull colony moved to 1990 (see above).

NM 158513 – 'RUBHA A GHRAINEIG – LEAC CHOGAIDH'

The SCR records 41 pairs of Herring Gulls and 1 pair of Lesser Black-backed Gulls from this site for 1986, and 10 pairs of Herring Gulls for 1970. There is no record for 1987, and the site is not mentioned by Broad & Cadbury for 1986-88. We found no colony at this site, although we walked this stretch of coast in 1989.

MINOR UNSPECIFIED SITES

In 1989-90 we recorded Herring Gulls from 10 other sites (see Fig. 1b). Together these small colonies or individual pairs accounted for an additional 36-39 pairs. In 1986-88 Broad & Cadbury give 42 pairs at sites not already discussed (e.g. Ben Feall) or at minor unspecified sites and the SCR only 3 pairs.

Population trends

Our original intention was to walk the same routes in 1989-90 as one of us (JB) had in 1969-70 during Operation Seafarer. During 1990 we spent considerable time and effort exploring the moorland north of Arinagour and also revisited Grishipoll Point (See above.) In our analysis we deliberately exclude these records since the larger estimates resulted from much greater 'effort'. We also discount two colonies of Herring Gulls reported to us but not visited by us – these colonies account for 12 pairs of Herring Gulls. The figures presented below therefore represent our best attempt at a direct comparison between the 1969-70 and 1989-90 survey results. In 1969-70 minimum figures were used, so our minimum estimates for 1989-90 are presented.

HERRING GULL

In 1969-70 there were 219 pairs and in 1989-90 237 pairs, a possible slight increase.

LESSER BLACK-BACKED GULL

In 1969-70 there were 67 pairs, in 1989-90 267 pairs. This increase of 300% represents a 15% per annum increase – very close to the 14.3% quoted for the Isle of May average between 1930 and 1972. (Thom 1986, p.214).

In 1969-70 Lesser Black-backed Gulls accounted for 23% of the total combined Coll population. It is interesting to note here that the 'Operation Seafarer' figures quoted for the whole of Argyll in 1969-70 give an almost identical ration of 24.7% (Thom 1986 pp. 213 and 215). Our figures show that by 1989-90 Lesser Black-backed Gulls account for 53% of the total combined Coll population.

The combined Herring Gull and Lesser Black-backed Gull population was 505 pairs. Using these figures to extrapolate from table 1 to a 'whole island' population, which includes Gunna, Soa etc. we get 1209 pairs. This is remarkably similar to Broad & Cadbury's 1234 pairs.

If we include our 1990 minimum estimates for the moorland north of

Arinagour, our 1990 estimates for Grishipoll point, and the two Herring Gull colonies reliably reported to us in 1990, our 'mainland only' estimates go up to 439 pairs of Herring Gulls and 512 pairs of Lesser Black-backed Gulls.

Note that these estimates still show Lesser Black-backed Gulls accounting for approximately 53% of the total combined population.

Leaving our 'same routes – same effort' approach and comparing these higher figures directly with 1969-70 estimates we calculate a 100% increase in Herring Gulls and 664% in Lesser Black-backed Gulls.

Future trends

Bearing in mind the problems mentioned above we suggest that for monitoring future trends three of the colonies on the "moorland north of Arinagour" (colonies 3, 4, and 5 on Fig.2) should be used. We suggest this because the relative remoteness and difficulty of the terrain gives it some immunity from human interference, and also because it is a small and discrete area that can reasonably be surveyed in one day by any interested persons who find themselves on Coll. These three colonies together have 140-155 pairs of Herring Gulls and 177 pairs of Lesser Black-backed Gulls – i.e. 53%-56% of the total combined population, a microcosm of the island – giving a total combined population of 317-332 (roughly one third of the total island popultion).

Conclusions

Black Headed Gull – maintain a small presence on the island, but the nesting sites are likely to change from year to year.
(12 pairs)

Common Gull – maintain a similar small presence with some movement.
(30 pairs)

Great Black-backed Gull – significant increase over 20 years.
(30-50 pairs)

Lesser Black-backed Gull – have increased by at least 300% (maybe as much as 700% over 20 years, but this phenomenon has previously been obscured.
(c.500 pairs)

Herring Gull – there has been a significant increase (maybe as much as 100%) over 20 years.
(c.450 pairs)

(Note – figures in brackets are our own estimates for current mainland populations).

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Short Notes

Egg retrieval by Slavonian Grebe

During late June and early July 1990 I maintained almost daily observation of a pair of Slavonian Grebe *Podiceps auritus* incubating a clutch of 4 eggs at Loch Ruthven RSPB nature reserve, Inverness-shire. The Slavonian Grebe nest was a substantial structure built largely from leaves and stems of bottle sedge *Carex rostrata* and water horsetail *Equisetum fluviatile*. During heavy rain on 1 July the water level in the loch rose substantially causing at least one of the adults to work for many hours bringing in new nest material to build up the nest. Although grebe nests float, the buoyancy of nest material is insufficient to completely counteract the effects of large increases in water level. Despite the efforts of the birds the nest became less stable, the nest material was less compact and the rim of the nest cup was depressed. Also, the whole structure now tilted considerably as the adults moved on and off.

Despite the instability of the nest, the nest and clutch of eggs survived intact until 5 July when at 1547 hrs one of the eggs rolled down the side of the nest as the incubating adult shuffled around on the nest platform. The egg remained floating alongside the nest and at first the adult grebe did not react, but after a few minutes it stretched its head down to the egg and was able to roll it back into the nest. This was achieved quite easily by rolling the egg up against the side of the nest using the underside of the bill. Shortly afterwards, at 1550 hrs, the egg again rolled out of the nest and was soon retrieved in the same way. At 1625 hrs the off-duty Slavonian Grebe came towards the nest to relieve the incubating bird. However, as its partner moved off the nest, an egg was held within its breast feathers and fell into the water. The changeover was completed without attending to the floating egg and the situation remained unchanged when I left at 1800 hrs.

The following morning at 0900 hrs I discovered that all 4 eggs were back in the nest and remained so when I checked again that evening. I was not able to observe the nest again until the morning of 8 July by which time one of the eggs had hatched and the chick was being brooded. Three eggs remained in the nest. Two changeovers were observed that day without incident but during the third at 1728 hrs the incubating bird rolled an egg out of the nest as it slid off the nest. During subsequent observations neither adult showed any interest in the egg and it remained floating near the nest while the pair hatched a second chick and left the vicinity of the nest.

On 20 July, long after the family had left the nest site I broke the deserted eggs. The floating egg contained a fully developed embryo, while the remaining unhatched egg in the nest had no development.

That the floating egg was so near to hatching explains its high buoyancy. Clearly if such an event happened early during incubation the egg would have sunk and would have been lost. It is likely that in the first instance, egg loss was caused by the change in nest structure and increasing instability of the nest resulting from the rise in water levels. As the nest became less well bound and the nest cup flattened so the possibility of eggs rolling out was increased. The ability to retrieve eggs lost in this way must be a useful ability for a species nesting so close to the water surface whose nest structure is liable to become unstable.

M.J. Pollard, Royal Society for the Protection of Birds, Munlochy, Ross and Cromarty, IV8 8ND.

(Egg retrieval is a well known phenomenon in gulls and geese at least, and has been described eg by G P Baerends & R H Drent 1982. *Behaviour* 82, 1-416 and K Z Lorenz & N Tenberger 1939. *Tierpsychol.* 2: 1-29, but retrieval from water is unusual. Eds.)

Black-throated Diver attacking and killing Red-throated Diver

On 24 August 1990 I made the following observations on Black-throated Diver *Gavia arctica*, and Red-throated Diver *Gavia stellata* nesting on two lochs approx. 1 km apart. The loch on which the Black-throated Divers were nesting was approx. 1.5 × 0.75 km and the Red-throated Diver loch was 0.2 × 01 km. The Black-throated Divers had one fledged juvenile and the Red-throated Divers had two large young.

At approx. 1100 hrs an adult Red-throated Diver flew out from its breeding loch at a height of 30 m over the south west end of the Black-throated Diver loch. However, it circled back and made a near vertical stoop towards the south end of the Black-throated Diver loch. It then flew on without landing on the loch, gained height and circled back over the middle of the loch before again diving down onto the loch. When the diver was on the water surface a juvenile Peregrine *Falco peregrinus* was seen to make a number of dives at the Red-throated Diver, missing it narrowly each time as the Red-throated Diver ducked to avoid being hit. Although I had not seen the Peregrine earlier it is most likely to have brought about the stooping behaviour of the Red-throated Diver in its attempt to avoid capture, forcing it to land on the Black-throated Diver loch. A few minutes after its attack on the Red-throated Diver the Peregrine flew off and landed on the south shore of the loch.

During the Peregrine attack the Black-throated Diver pair were on the loch about 100 metres away – the juvenile was not on the loch at the time. Almost immediately after the Peregrine had flown off an adult Black-throated Diver swam towards the Red-throated Diver and proceeded to attack it. Initially the Black-throated Diver grabbed the Red-throated Diver by the neck and submerged its victim several times as well as beating it with its wings. During the next 20 minutes the Black-throated Diver made repeated stabbing actions with its bill – striking the Red-throated Diver on the head. The Red-throated Diver put up little apparent defence or signs of counter aggression against the attack. During two or three brief pauses in the attack the Red-throated Diver raised its head but the Black-throated Diver immediately resumed its assault.

After about 25 minutes the attacks became less frequent. The Red-throated Diver now showed few signs of movement apart from slight movements of its wings. As soon as the Red-throated Diver was dead and floating on its back the attacking Black-throated Diver swam away, joined the other Black-throated Diver and about two minutes later flew off to the west end of the loch where they were joined by the juvenile Black-throated Diver which flew onto the loch. Some time later the dead adult Red-throated Diver was washed up on the east shore of the loch. The crown of its head was bare of plumage and the exposed flesh red and bleeding from the attack – there were no other obvious signs of injury.

Cramp & Simmons 1979, BWP Vol I, discussed territorial aggression of Black-throated Diver and stated 'Fights are rare and similar to those of Red-throated Diver ie. with stabbing, wing beating, and spearing; occasionally a participant gets killed, whether from spearing or drowning (Sjölander 1968). There is no mention of such interactions between Black-throated Divers and Red-throated Divers. It is possible that encounters/aggressiveness between these species are more frequent than previously known, particularly where breeding pairs are in close proximity to each other.

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Hen Harrier stalking prey

Hen Harriers *Circus cyaneus* typically quarter low over open ground when hunting. They have also been recorded hunting on the ground, alighting and then waiting for prey to appear before grabbing it (*BWP* Vol. 2). R.C. Dickson once saw a female prowling in heather, apparently stalking young Meadow Pipits *Anthus pratensis* (Watson, D. 1977. *The Hen Harrier*. Poyser, Berkhamsted).

On 24 May 1990 while driving over a moor in Perthshire I saw an adult male Hen Harrier interacting with Red Grouse *Lagopus lagopus*. The Harrier was diving at a pair of grouse which I presumed had a brood of small young. It attacked in typical fashion about twenty times over a ten minute period, but was thwarted every time by the grouse which flew up at it. The female was particularly aggressive and made contact a few times. The Harrier then settled about 30 m from the grouse and, for the next few minutes, the pair of grouse occasionally popped their heads up from the deep heather. The Harrier then flew to a bare piece of ground about 10 m from the grouse and stalked along the edge of the deep heather with head well down so as to appear almost horizontal. When it got to within 2-3 m of the grouse they again flew at it. The Harrier stalked like this three times and then tried stalking at the other side of the deep heather but with the same result. Finally, it flew off out of sight and I left 5 minutes later when it had not returned. At that time the grouse had not moved from the safety of the deep heather.

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Aerial chases by Merlins in autumn and winter

Spectacular aerial chases by Merlins *Falco columbarius* in autumn and winter have not been well documented, apart from those performed at their communal roosts (e.g. see Dickson 1973; Sys 1982). Macintyre (1936) noted that when two adult Merlins meet while hunting they often 'play' together in the air for short periods but he gave no details. I have recorded aerial chases on 11 occasions between 1968-89, so they may be rather more common than previously published accounts suggest.

All these chases were in west Galloway; seven were in October, two in January and two in February. They were by males and 'brown' Merlins together on five occasions, by two brown Merlins on five and by three brown Merlins on one. Calls were heard on only three occasions but they may have occurred more often than this when the birds were out of earshot or were flying away. Most chases occurred near ground level but three of them took place at a height of over 40-50 metres, mainly over low ground such as farmland or low-lying moors and only once over upland stubble. On two occasions the birds touched talons during a chase, once this involved a male and brown bird and once two brown birds. A male was seen dropping his talons twice as he flew ahead of a brown Merlin in one chase. The birds were seen 'fluttering' together on two occasions, once a male and brown bird together and once two brown birds. The chases lasted at least 1-2 minutes and the longest was about one hour long (albeit including some rests on fence posts). On one occasion a male and brown bird broke off their aerial chase to harass a 'ringtail' Hen Harrier *Circus cyaneus* and on another a brown Merlin interrupted its aerial chase to attack a Woodpigeon *Columba palumbus*. During these chases the Merlins frequently landed on fence posts or

trees or bushes often beside or near each other.

The significance of these aerial chases is difficult to interpret but it is also difficult to obtain information on the relationships between birds in winter. At their winter roosts chases were thought to be important in forming, strengthening or maintaining pair bonds (Dickson 1973) but Sys, on the other hand, thought they were only playful in character. Cramp & Simmons (1980) state that display flights (in the breeding season) are rather inconspicuous and rarely observed, but 14 courtship displays have been recognised in the north American subspecies and these include aerial courtship (Johnsgard 1990) although apparently not spectacular aerial chases, but on a few occasions tail chasing by a female chasing her mate has been seen. If aerial chases occur almost entirely in non-breeding periods, there must be some advantage in them taking place then at a time when energy efficiency must be at a premium. While these chases in autumn and winter could be interpreted as exuberant or 'playful', I am inclined to think that they might have a more direct function.

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Correspondence

(The Editor welcomes correspondence on suitable topics in *Scottish Birds*. It is essential, however, that all letters are addressed to the Editor and that personal or libellous comments should be avoided.

eds)

The seabirds of Troup Head

The contribution by C.J. Lloyd & S.G. North on the seabirds of Troup Head (*Scottish Birds* 14: 199-204), and another by C.S. Lloyd & M.L. Tasker on those of north-east Scotland (*North-east Scotland Bird Report* 1986: 42-50), both overlook some previous references, the proper acknowledgement of "Operation Seafarer" data (about which I have already complained once in *Scottish Birds* 11: 129), and misinterpret the Guillemot records. Since A.J.M. Smith and I have also overlooked some earlier references to this site and failed to explain past counting methods in a previous review of north-east Scottish seabirds using some of the same data (*North-east Scotland Bird Report* 1977: 36-42), which was not mentioned either, it may be useful to enlarge upon them.

The remarkable seabird colony on Troup Head, which has now become the second British mainland Gannetry, first appears to have been described at length by the Rev. James Smith in 1850 (*Zoologist* 8: 2905-2914). He also subsequently encouraged the local cobbler-naturalist Thomas Edward of Banff to publish his original observations in many branches of natural history, including the birds of Banffshire, observations for northeast Scotland in the first national survey of British breeding birds, early beached bird surveys, and various observations on Troup Head, described in his biography by Samuel Smiles in 1876 (*Life of a Scotch Naturalist – Thomas Edward, Associate of the Linnaean Society*. Popular Edition, 1897, John Murray.).

Copies of the original instructions for the first national census of all British breeding seabirds, "Operation Seafarer" in 1969-70, were deposited with summaries of the results for public consultation, on condition that there is proper acknowledgement to the Seabird Group who organised the survey, with the RSPB, BTO, NCC (Britain), Irish Wildbird Conservancy (Ireland), Edward Grey Institute (Oxford), and Aberdeen University Library. While the unit counted was normally the "apparently occupied nest", since Guillemots construct no nest it was asked that they be counted individually, and the figures were then converted into pairs comparable with those recorded for other species by assuming that each bird represented a pair for reasons set out on p. 176-177 of the book reporting the results (Cramp, S., Bourne, W..P., & Saunders, D. 1974. *The Seabirds of Britain and Ireland*. Collins.).

Unfortunately, while in 1969-70 the Guillemots usually seem to have been recorded individually in the way requested, this is not often noted on the recording cards. In consequence it has apparently often been assumed that the birds were counted as pairs, so that the totals are not comparable with those obtained by subsequent counts of individuals. In fact the totals recorded during "Operation Seafarer" in 1969-70 appear closely comparable with those obtained by the current Seabird Colony Register, which has continued to ask for records of individual birds but has not always obtained them. I

checked the totals reported during Operation Seafarer for Troup Head among other sites from both the air and sea in the early 1970s myself, and there has certainly been an increase of Guillemots there since then.

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Inter Island flights by Sanderlings at North Ronaldsay

R W Summers, in his short note on 'Inter island flights by Sanderlings at dusk and dawn in Orkney' (*SB* 16(1): 46) asks 'why do so few (Sanderlings) occur on North Ronaldsay by day' and suggests 'the reason why Sanderlings leave North Ronaldsay by day may be due to lower food availability'. He cites daytime island counts of 11, 17 and 12 on 8, 9 and 10 May 1990 respectively.

Experience in 1986 suggests, however, that very large numbers of Sanderling fed by day on North Ronaldsay, and I was led to conclude that this may be a typical feature of spring migration there. In the second half of May 1986 counts for Sanderling on the island were:

19th	20th	21st	22nd	23rd	24th	25th	26th	27th	28th	29th	30th
43	52	25	575	300	80	7	500	175	325	680	400

My own observations in this period concentrated on 26-30 May, when the birds were certainly feeding on the island all day.

While it may be that there has been a change in behaviour between 1986 and 1990, there was certainly food available in 1986, and the birds did not leave, but exploited it.

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Research Index

The following is an index of fieldwork and research presently undertaken with specific Scottish interest. This Index will be updated yearly. The present list has been compiled alphabetically by the institutes where the research is based but several institutes circulated did not reply. If you are doing research in this area but not represented here, please put us right by sending details to the editor.

Aberdeen University:

Cosgrove, P. The importance of conservation zones for bird populations in upland spruce forest, concentration on broadleaf strip, unplanted stream edges, marshes etc, in otherwise unbroken conifer. Based at Kielder, Northumberland (PhD study).

Dunnet, G.M. The Fulmar on Eynhallow in Orkney (since 1950) concerned primarily with population dynamics, longevity and, recently, recruitment.

Dunnet, G.M. & Heubeck, Martin. Monitoring programme (since 1778) in breeding seabird populations in Shetland, as well as changes in seabird and waterfowl wintering populations in two areas – Yell Sound and Sullom Voe and the Bluemull/Colgrave Sounds area of north-east Shetland.

Gorman, Martyn L. & Reynolds, Peter. Feeding ecology of raptors (Short-eared Owl, Hen Harrier and Kestrel) in Orkney, particularly concerned with the effects of changes in land-use.

O'Hanrahan, B. Bird population density and diversity in relation to plant and insect diversity on agricultural set-aside fields, near Newburgh, Grampian (PhD study).

Patterson, I.J. & Fuchs, R.M.E. Management of grassland to provide reserves for wild geese; experiments with different mowing, grazing and fertiliser regimes at the RSPB reserve at the Loch of Strathbeg, Grampian.

Patterson, I.J. & Ollason, J.G. Bird population density and species diversity in upland spruce plantations, in relation to different management regimes especially changes in compartment size; based at Kielder, Northumberland and Cowal, Argyll.

Patterson, I.J. & Laing, R. Monitoring of wildfowl and wader numbers on the Ythan estuary, Grampian. Twice-monthly counts throughout the year, with special emphasis on the Eider Duck in the breeding season.

Rae, S. Habitat use by Ptarmigan, especially in the breeding season, in relation to vegetation type and productivity, cover and other environmental factors (PhD study).

Edinburgh University:

Carter, Adrian. Feeding behaviour and microhabitat distribution of waders on rocky shores, especially in East Lothian (PhD study).

Cresswell, Will. Behaviour and ecology of a predator-prey system: Sparrowhawks and Redshanks, concentrated on Tynninghame, East Lothian (PhD study).

Deag, John. Studies on communication and social organization in tits, with field work mainly at Ormiston, East Lothian.

Hanna, Laurel. Barn Owl population genetics (PhD study).

McAfferty, Dominic. Ecological energetics of Barn Owl (PhD study).

McGrady, Mike. Ecology of urban Sparrowhawks (PhD study, recently completed).

Scott, Graham. Social behaviour and communication in Blue Tits (PhD study).

Taylor, Iain. Long-term study (started 1978) of Barn Owl ecology and conservation. Has been monitoring, since 1980, changes in Lapwing breeding density in relation to agriculture.

Wilson, Jeremy. Population biology of Dippers on the Midlothian South Esk. Social organization and communication in Great Tits (PhD study 1986-1989).

St Andrews University

Adhikerana, A.S. Singing behaviour in Coal Tits (PhD study).

Graves, J.A. & Ortega-Ruano, J. Mating and reproductive success in Shags on the Isle of May.

Halley, D. A study of recruitment in Guillemots on the Isle of May (PhD study).

Mann, N.I. & Cobb, J.L.S. Song and breeding in Willow Warblers.

Slater, P.J.B. Field and laboratory studies on the development and organisation of bird vocalisations.

Williams, J.M. Habitat matching and cultural changes in Chaffinch song (PhD study, now completed).

Stirling University:

Alves, Marie-Alice. Behavioural ecology of Sand Martins (PhD study).

Bell, Mike. Wildfowl counts. Breeding wader surveys. Raptor monitoring.

Bryant, David. Energy requirements of wild birds. Populations and ecology of estuarine birds (especially Forth). Hirundine and Dipper breeding ecology.

Johnstone, Ian. Territorial behaviour in Robins and Dippers (PhD study).

Newton, Anne. Breeding ecology and survival rates of Dippers and Swallows.

Newton, Steve. Wildfowl ecology and populations. Dipper population ecology. Peregrine monitoring.

Ward, Sally. Egg laying and incubation behaviour in Swallows and Dippers (PhD study).

Wernham, Christine. Breeding ecology of Puffins (with ITE Banchory – PhD study).

Items of Scottish Interest

Recently published papers and reports on birds in Scotland. Most are available in the Waterston Library for reference. Those marked with an asterisk are available from the SOC at the prices quoted, but please add 50p for postage and packing regardless of the number of items ordered.

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

Scientific papers

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Crossley, J. (1991). Monitoring of breeding success of cliff-nesting seabirds in Orkney in 1990. *Nature Conservancy Council CSD Report no. 1163.* 12 pp and maps.

Cunningham, P., Stroud, D.A. & Fox, A.D. 1990. Greenland White-fronted Geese in the Outer Hebrides. *Hebridean Naturalist* 10: 64-68.

Dott, H.E.M. 1991. Unusual concealment behaviour by Coot. *British Birds* 84: 107. An occurrence in Lothian.

Dunn, P.J. & Hirschfeld, E. 1991. Long-tailed Skuas in Britain and Ireland in autumn 1988. *British Birds* 84: 121-136.

Elliott, G.D. & Avery, M.I. 1991. A review of reports of Buzzard persecution 1975-1989. *Bird Study* 38: 52-65.

Evans, I.M., Pienkowski, M.W. & Dennis, R.H. 1991. Experimental re-introduction of Red Kites. *Nature Conservancy Council CSD Report 1224,* 50 pp.

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Fox, A.D. 1991. History of the Pochard breeding in Britain. *British Birds* 84: 83-98. Includes a useful survey of occurrences in Scotland.

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Furness, R.W. 1990. Foula seabird studies 1990. Unpublished paper Univ. Glasgow. 7pp.

Furness, R.W. 1991. Numbers and population trends of Manx Shearwaters on Rhum. *Nature Conservancy Council CSD Report no. 1168,* 36 pp.

Galbraith, H. & Watson, A. 1991. A flight characteristic of recently fledged Lapwings. *British Birds* 84: 151-152. Based on a study in Scotland.

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Bird Reports

Argyll Bird Report for 1990. S.J. Petty (Ed) 1991. 74 pp. £3.50*. Includes a paper on "Wintering wildfowl in Argyll" by S.F. Newton & A.V. Newton.

Arran Bird Report for 1990. Margaret H. Dunn (Ed) 1991. 20 pp. £1.50*.

Ayrshire Bird Report for 1990. Angus Hogg (Ed) 1991. 56 pp. £2.50*. Includes several short articles including one on "Horse Island RSPB Reserve" by David Fairlamb.

Bavelaw Marsh Bird Report for 1990. Allan Brown (Ed) 1991. 9 pp, in "Bavelaw Marsh Nature Reserve Annual Report 1990.

Borders Bird Report no. 11 for 1989. R.D. Murray (Ed) 1990. 82 pp. £3.75*. Several short papers including "Quail in the Borders 1989" and "First successful breeding of Nuthatch in Scotland" by R.D. Murray, and a "Gazetteer of Borders Place Names".

Caithness Bird Report for 1989. E.W.E. Maughan (Ed) 1990. 41 pp. £2.60*.

Caithness Bird Report for 1990. E.W.E. Maughan (Ed) 1991. 65 pp. £2.20*.

Canna Bird Report no. 14 for 1989 and 1990. R.L. Swann 1990. 16 pp.

Central Region Bird Report for 1989. C.J. Henty (Ed). Pp 31-51 in *Forth Naturalist and Historian* vol. 13, 1990.

Clyde Bird Report for 1989. Iain P. Gibson (Ed) 1991. 76 pp. Includes a report on "Quails in the Clyde Area 1989" by Neil Darroch.

Colonsay and Oronsay Bird Report for 1990. A 7 pp. unpublished report by J. Clarke and P.M. Clarke 1991.

Dunbartonshire and Stirlingshire, Peregrine report for 1990. A 2 pp. unpublished report by John Mitchell, 1990.

Fair Isle Bird Report for 1990. Pp. 15-60 in *Fair Isle Bird Observatory report no. 43.* P. Harvey & V. Thom (Eds) 1991. Includes a short report on "seabirds and sandeels" by Pat Monaghan. £3.50*.

Isle of May Bird Observatory Report for 1989. Ian Darling (Ed) 1990. 48 pp. £2.50*.

Loch Lomond, Heronry report for 1990. A 1-page unpublished report by John Mitchell in a longstanding series.

Loch Lomond, 1990 census of territorial waders. A 1-page unpublished report by John Mitchell in a longstanding series.

Moray and Nairn Bird Report for 1989. Martin Cook (Ed) 1990. A 61 pp report now out-of-print.

Moray and Nairn Bird Report for 1990. Martin Cook (Ed) 1991. 71 pp. £2.75*.

North-East Scotland Bird Report for 1990. Andy Webb (Ed) 1991. 80 pp. £3.50*. Includes six additional short articles.

North Sea Bird Club Report for 1989. Sandy Anderson (Ed) 1990. 47 pp.

Orkney Bird Report for 1990. Chris Booth, Mildred Cuthbert & Eric Meek (Eds). 70 pp. £2.50*. Includes short articles on the Mute Swan survey and on the North Ronaldsay Bird Observatory in 1990.

Outer Hebrides Bird Reports for 1986 to 1988. Peter Cunningham (Ed). Reprint held of pp. 48-63 of *Hebridean Naturalist 10*; 1990.

Perth & Kinross Bird Report for 1989. Wendy Mattingley & Ron Youngman (Eds). 30 pp. £3.00*. Includes "Perthshire's first Firecrest" and other short articles.

Perthshire (Central and Southwest) Peregrines and Ravens in 1990. Patrick Stirling-Aird 1991. A 2 pp unpublished report in a long-running series.

Shetland Bird Report for 1989. Pete Ellis (Ed) 1990. 86 pp £2.75*. Published by the Shetland Bird Club. Includes an 11 pp article on "The occurrence of warblers in Shetland 1969-88" by Kevin Osborn & Mike Pennington.

Shetland Bird Report for 1990. Kevin Osborn (Ed) 1991. Short articles include "Population changes and breeding success of seabirds on the Isle of Noss 1981-1990" by A. Silcocks (4 pp).

St Abbs Head National Nature Reserve Seabird Report 1990. K.J. Rideout & P. Norman 1991 34 pp.

St Abbs Head National Nature Reserve Bird Log 1990. K.J. Rideout & P. Norman 1991. 28 pp. A report to the National Trust for Scotland and Nature Conservancy Council, Borders Sub-Regional Office, Galashiels.

W.G. Harper

European journals in the Waterston Library

Many members are probably unaware of the wealth of material available in the Library beyond the extensive range of books. Thanks to the efforts of Bill Harper, many foreign journals are regularly received on an exchange basis and are available for members to consult. This arbitrary selection of some 50 articles is taken from the following journals received in 1991:

Netherlands:	Limosa, Dutch Birding
France:	L'Oiseau, Alauda
Switzerland:	Nos Oiseaux, Der Ornithologische Beobachter
Belgium:	Aves, Le Gerfaut, Mergus
Germany:	Die Vogelwelt, Limicola, Bonner Zoologische Beiträge, Die Vogelwarte, Ökologie der Vögel, Corax
Austria:	Egretta
Spain:	Ardeola
Italy:	Rivista Italiana di Ornitologia
Sweden:	Vår Fågelvärld
Norway:	Vår Fuglefauna, Cinclus
Denmark:	Ornis Scandinavica, Dansk Ornitologisk Forenings Tidsskrift
Finland:	Ornis Fennica, Lintumies
Iceland:	Bliki
Ireland:	Irish Birds

Articles are arranged in species order; square brackets indicate that the article is in the original language (usually, but not invariably, with an English summary – I might be able to arrange a translation for anyone interested); the abbreviated reference gives the journal number and year.

Divers to Ducks:

Lehtonen, L. Behaviour of a flock of Black-throated Divers on Lake Alakivijärvi in September 1990 – Orn Fenn 2/91.

Hustings, F. [Explosive increase in breeding Black-necked Grebes in the Netherlands 1983-89] – Limosa 2/91.

Dias, P.C. [Breeding Ardeidae of Portugal] – Alauda 1/91.

Berthelot, J.Y. & Navizet, G. [The blue nape and display of the Cattle Egret] – Nos Oiseaux 424/91.

Collins, R. & Wheelan, J. The Mute Swan in Dublin – Irish Birds 2/90.

van Dijk, K. [Origin and age composition of moulting Mute Swans on Lake IJsselmeer] – Limosa 2/91.

Olson, K.M. [Occurrence of two forms of Bean Goose in Denmark] – Dansk Orn Tidssk 3-4/90.

Fouquet, M. [Migration and overwintering of the Greylag Goose in France] – L'Oiseau 2/91.

Torsteinsson, B. *et al* [Barnacle goose consorting with pair of Greylag Geese] – Bliki 10/91.

Béroudet, P. [Transcontinental movements of young Eiders in 1988] – Nos Oiseaux 423/91.

Birds of Prey:

Draulans, D. [Breeding and nesting success of raptors ... in NE Belgium] – Gerfaut 4/88.

Blanco, J.C. *et al* [Variations in diet and foraging behaviour of a wintering Red Kite population) – Ardeola 2/90.

Willemyns, F. [Immature White-tailed Eagle stays 5 weeks in Zeebrugge] – Mergus 1/91.

Svensson, L. [Distinctions between female Hen Harrier and Pallid Harrier] – Limicola 3/91.

Joubert, B. [Timing of reproduction in Goshawk in Haute-Loire] – Nos Oiseaux 423/91.

Watelet, M. [Status of Rough-legged Buzzard in Wallonia and the invasion of 1986-87] – Aves 3/90.

Latja, R. & Savolainen, J. [Breeding records of Golden Eagle in N Finland] – Lintumies 3/91.

Fernández, C. & Purroy, F. [Geographical trends in the food habits of Golden Eagle in Navarra] – Ardeola 2/90.

Sunyer, C. & Vinuela, J. [Migration and wintering of Merlin in Spain] – Ardeola 2/90.

Grouse to Cranes:

Huber, B. & Ingold, P. [Numbers and distribution of Ptarmigan in a Bernese Oberland gamepark]– Orn Beob 1/91.

Chapatte, B. *et al* [On the aberrant behaviour of a Capercaillie in the Jura] – Nos Oiseaux 424/91.

Spidsoe, T.K. & Stuen, O.H. Age determination of Capercaillie chicks – Cinclus 2/91.

Ryelandt, P. [Status of the Corncrake in Fagne and Farmenne] – Aves 4/90.

Ryelandt, P. [Biology, status and protection of the Corncrake] – Vogelwelt 1-2/91.

Ullman, M. Distinctions between Demoiselle Crane and Crane – Dutch Birding 3/91 (original in Swedish in Vår Fågelvärld).

Waders to Auks

Dietrich, S. & Hötker, H. [Where do N Frisian Avocets moult ?] – Vogelwelt 3/91.

Alström, P. Field identification of Lesser Sandplover –[Var Fagelvarld 2/91.

Nyenhuis, H. Migration routes of Woodcock in NW Europe] – Vogelwarte 3/90.

Groen, N.M. [Origin of Black-tailed Godwits wintering in Morocco] – Limosa 2/91.

Kennerley, P. & Bakewell, D. Identification and status of Nordmann's Greenshank – Dutch Birding 1/91.

Danielsen, F. *et al* Marine distribution of seabirds in NE Atlantic between Iceland and Scotland 1987 and 1988 – Dansk Orn Tid 1-2/90.

Dvorak, M. [First breeding of Yellow-legged Herring Gull in Austria; its breeding distribution in inland Central Europe] – Egretta 1/91.

Orbie, G. [Sandwich Tern, new breeding bird for Belgium] – Mergus 1/91.

Barthel, P. [Distinction between Common and Arctic Tern, with further notes on Forster's and Roseate Terns] – Limicola 1/91.

Schmidt, C. [Identification of Marsh Terns] – Limicola 3/91.

Hatchwell, B.J. & Birkhead, T. R. Population dynamics of Guillemots on Skomer Island – Orn Scan 1/91.

Pigeons to Woodpeckers:

Furlani, M. [Regional differences in diet of Barn Owl in Mt Conero Park] – Riv It di Orn 3-4/90.

Bavoux, C. *et al* [Aspects of the breeding biology of Scops Owl] – Alauda 2/91.

de Wavrin, H. [The Nightjar in Wallonia] – Aves 3/90.

Gory, G. [Effects of ringing on a breeding population of Swifts] – L'Oiseau 2/91.

Bekken, J. [Woodpeckers and forestry] – Var Fuglefauna 1/91.

Sudbeck, P. [A new hybrid: Green × Grey-headed Woodpecker] – Ök der Vögel 1/91.

Rinden, H. [The White-backed Woodpecker – a victim of forestry] – Var Fuglefauna 1/91.

Passerines:

Daulne, J.M. [Distribution of the Dipper in the Aisne basin] – Aves 1/90.

Tyler, S.J. & Ormond, S.J. Biology of Dippers in the Atlas Mountains outside the breeding season – Bonn Zoo Beitr 1/91.

Sibeet, J.K. *et al* [New breeding records of Fieldfare in Ile de France] – L'Oiseau 2/91.

Thorstensen, S. [Mistle Thrush breeding in Iceland] – Bliki 10/91.

Olsen, K.M. [The River Warbler in Denmark with notes on field identification] – Dansk Orn for Tidsskr 1-2/90.

Ullman, M. [Distinguishing Willow Warbler and Chiffchaff in the field] – Vår Fagelvärld 3-4/91.

Daunicht, W.D. [Differences in plumage between Treecreeper and Short-toed Treecreeper] – Limicola 2/91.
Bauer, H.-G. [Differences in voice between Treecreeper and Short-toed Treecreeper] – Limicola 2/91.
Brugière, D. & Duval, J. [Status of the Raven in the North Massif Central] – Nos Oiseaux 424/91.
van der Elst, D. [Reduction in numbers of Serin in Wallonia] – Aves 2/90.
Thiess, H. [Mealy Redpoll invasions in N Germany and their cause] – Corax 2/91.
van Noorden, B. [A slender hope for the Ortolan Bunting ?] – Limosa 2/91.
Lovaty, F. [Abundance and distribution of the Ortolan Bunting in Lozère] – Nos Oiseaux 424/91.

Michael Murphy

Advice to Contributors

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

Reference should be made to recent issues of *Scottish Birds* for guidance on style of presentation, use of capitals, form of references, etc. Papers should be typed on one side of the paper only, double-spaced and with wide margins; two copies are required and the author should also retain one. Headings should NOT be underlined, nor typed entirely in capitals. Scientific names should follow the first text reference to each species and should follow Voous' 'List of Recent Holarctic Bird Species' as given in *The British Birds' List of Birds of the Western Palearctic* (1984).

Tables, maps and diagrams should be designed to fit either a single column or the full page width. Tables should be self-explanatory and headings should be kept as simple as possible, with footnotes used to provide extra details where necessary. Each table should be on a separate sheet. Maps and diagrams should be in Indian ink and drawn so as to permit reduction to half their original size. If necessary they may be submitted without lettering and accompanied by a photocopy showing the lettering required. Captions should be typed on a separate sheet. Relevant line-drawings (in ink) will be welcomed, as will photographs (preferably black & white glossy prints).

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The Scottish Ornithologists' Club was formed in 1936 to encourage all aspects of ornithology in Scotland. It has local branches which meet in Aberdeen, Ayr, the Borders, Dumfries, Dundee, Edinburgh, Glasgow, Inverness, New Galloway, Orkney, St Andrews, Stirling, Stranraer and Thurso, each with its own programme of field meetings and winter lectures. The Waterston Library at the Club's headquarters at 21 Regent Terrace, Edinburgh EH7 5BT is one of the most comprehensive ornithological libraries in Scotland, and is available for reference during office hours (Monday to Friday, 9am to 5pm). A comprehensive stock of Scottish local bird reports is held at the headquarters and may be purchased by mail order.

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Research Progress Report

G.M. Dunnet

A Forty-three year study on the Fulmars on Eynhallow, Orkney

In the 1930s, 40s and 50s a great deal of interest focused on the biology of the North Atlantic Fulmar *Fulmarus glacialis*. The species, apart from its population on St Kilda which had been established for centuries, spread from the Sub-Arctic and began breeding in Shetland in 1878. Since then it has colonised most of the coastline of Britain. Being a conspicuous and spectacular bird the progress of its colonisation of the British coastline was well observed and documented and was fully described in a New Naturalist book, The Fulmar, by James Fisher, in 1952. Before the war, V C Wynne-Edwards studied Fulmars at sea off the Labrador coast and came to the conclusion that adults may not breed every year, but probably every second year or so. There was also much speculation about the age at which fulmars breed for the first time, and Eric Duffy, stationed on Fair Isle during the war, noted that there were many more apparently adult Fulmars present at the breeding colonies there than could be accounted for by the number of occupied nests. He assumed that these 'extra' birds may be young birds not yet breeding, and non-breeding adults. He postulated that Fulmars may not breed for the first time until two or three years old and thereafter as adults in alternate years. James Fisher in a short chapter on the biology of the Fulmar in his book, was able to demonstrate that in some situations adults did breed in consecutive years, and further speculated from very limited evidence that young Fulmars may spend the first three years or so of their life at sea followed by about four years 'prospecting' at breeding colonies or new breeding locations and would then lay for the first time at the age of about seven. The expansion of the breeding range of the Fulmar was almost certainly associated with a dramatic increase in numbers, so that the facts that they did not begin to breed until they were seven and then laid only a single egg which could not be replaced, and with a fledging success likely to be of the order of 50% or less, implied that breeding adult Fulmars must live for a long time. Fisher speculated that he would not be surprised if some birds lived to be 50 years old. None of these controversial and exciting ideas had been tested by direct field studies of marked individual Fulmars.

While visiting Orkney with a party of students in the summer of 1950, the late Dr Robert Carrick and I were introduced to the bird sanctuary of Eynhallow, then owned by the late Miss Jean Robertson, by the late George T Arthur, the well known Orkney ornithologist. On Eynhallow we found Fulmars nesting in very accessible places: on the ground at the base of walls, on low cliffs and on ruined buildings. It immediately occurred to us that here we could have a splendid opportunity on an undisturbed, uninhabited island to carry out studies of individually marked Fulmars with a view to solving some of these problems. George Arthur was able to persuade Miss Robertson, who held the island in trust and maintained it as a bird sanctuary in memory of her father, Duncan J Robertson, who himself was an excellent Orkney naturalist, that we should be given the privilege of access to the island for the purpose of studying the Fulmars. Little did we know that this was the beginning of a study which has been maintained continuously until the present time and that some of the birds and I myself have met each other regularly on the island for over 40 years. I, at least, have enjoyed it.

With no long-term plans in mind we began in 1950 to seek to determine whether or not adult Fulmars breed every year. We

addressed this by catching breeding adults off their egg or chick and giving them individually distinguishable combinations of coloured rings as well as the numbered BTO rings. We marked 11 birds in 1950, one from each of 11 nests. In July 1951 we found some of the 1950 birds nesting again, and caught and marked an additional 66 breeding adults including pairs from several nests. By the breeding season of 1952 we had established that some birds bred in three consecutive years, some pairs nested together in two consecutive years and that both birds which failed in one year and those which bred successfully bred in the following year. We therefore concluded that normally Fulmars, once they start breeding, do breed in consecutive years, thereby demonstrating that the breeding pattern proposed by Wynne-Edwards for Fulmars in the Arctic did not apply in Orkney.

We ringed Fulmar nestlings in each of these years but found none returned as breeders.

From 1953 to 1957 inclusive both Robert Carrick and I were in Australia, but the study was continued during those years by Vero Wynne-Edwards, Sandy Anderson and Eric Duffy. These observers continued to record the presence of ringed breeding birds each year, caught and coloured ringed additional breeding adults, and ringed the nestlings.

When I returned to Aberdeen to establish the new Field Station at Culterty in January 1958 the Eynhallow project had not produced answers to any of the other questions that had interested us. For example no Fulmar ringed as a nestling had been recovered breeding on Eynhallow, and we had no idea of how long Fulmars lived. Accordingly I felt that the study on Eynhallow, which had already been running for eight years, constituted a valuable investment in marked birds and decided that it should be developed and carried forward. Two new primary objectives were established. The first was to determine the age at which Fulmars breed for the first time. Up until that time we had ringed Fulmars with soft aluminium rings and we had plenty of evidence that over the years some of these fell off. It seemed very likely that rings might be falling off the legs of young Fulmars before they had returned to nest. Accordingly we used new much more durable rings made of monel and subsequently incaloy to overcome this problem. The second main objective was to attempt to determine how long Fulmars live and clearly, if they were long lived, we would need to have the same type of durable metal rings, but also types of colour rings which were colour-fast and durable over long periods of time. We devised a method, based on bill measurements, to estimate the sex of individual Fulmars with a considerable degree of confidence. The study then continued over the years with three basic data collecting visits to the island each year. We went first at the end of May (the end of the egg laying season), again in the middle of July when the nestlings were hatching, and again in late August to ring the surviving fledgelings. On the first two of these visits we identified every colour-ringed bird we could, and caught any bird with only a metal ring, or with imperfect colour ring combination, so that their identity could be determined and new rings could be put on. This routine has been maintained over 43 years, but in some years additional projects were undertaken. For example, for four years we covered the entire egg-laying period, but found the effects of our disturbance were quite significant.

The first attempt to estimate the longevity of Fulmars was published in 1963. The simple approach to the problem was to measure the rate at which colour ringed breeding adults disappeared from the breeding population. This involved many assumptions, some of which were more likely to be true than others. The concept is simple: if we start off in year 1 with 100 colour ringed breeders, and detect 90 of these in year 2 and only 81 of them in year

3 then we have a mean annual survival rate of breeding adult fulmars of 90% (.90). To get such data in the field, we have to identify as many as possible of the ringed birds in year 1, detect and identify all of these which survive into year 2, and again, in year 3, identify all of the survivors of the first group of 100 which are breeding in year 3. In practice this is impossible to achieve because some birds lose their rings or otherwise become unidentifiable, some birds may lose their egg early and not be available for detection and identification later in the breeding season, and some birds may be breeding but not detected by the observers. All of these 'errors' have the same effect on the calculations: they over-emphasise the number of birds that have disappeared and are assumed to have died. In other words, the resultant estimate of survival rate is too low. A further basic assumption underlies the use of this method. It is that all breeding adult Fulmars have the same survival rate, regardless of their age. It will be clear that when we catch an unringed breeding adult off its egg or chick we do not know its age, and are therefore unable to avoid making this assumption. The assumption is known to hold for many small short-lived birds with survival rates of under 50% per year, but it is very unlikely to hold for long-lived birds. We also have data over many consecutive years on the presence in the colony of individually known breeding birds. In many cases birds, which have not been seen in a particular year, are recorded breeding subsequently and therefore, of course, are assumed to have been part of the breeding population throughout. This makes the data set much more informative, but more difficult to handle. In 1963 we estimated a mean survival rate for breeding adult Fulmars of 0.9378 (93.78% per annum) which led to an estimate of the mean duration of adult life of 15.58 + 1.93 years.

As the data continued to accumulate they became very difficult to validate, to handle and to process. In 1974 a computer database was designed so that all the available and verifiable data could be stored in such a manner that they could readily be accessed for examination and statistical analysis. This task, covering the previous 26 years of the study, was undertaken by janet Ollason who listed, checked and put into the database all the data accumulated up to that time. Subsequently the data for each year have been added so that analyses can access all the data available. Using the database and thereby accessing very much more data than were available to us in 1963, we have made a number of estimates of survival rate of Fulmars, and the latest is a mean annual survival rate of 0.986 (standard error 0.0042) giving a mean duration of adult life of approximately 35 years. We have calculated this separately for males and females and there is very little difference between them. It is important to realise that this estimate is still based on the concept of constant survival rate throughout life and, although we have made numerous attempts using the data available to us to demonstrate that survival rate decreases with age, we have not been able to do so over spans of up to 20 years of adult breeding. The real problem is that such a small number of birds survive to be 'old' that the disappearance of any one of these in a particular year brings about a substantial increase in the mortality rate calculated for that cohort in that year.

In 1963, 14 years after our study began, we caught our first Fulmar which had been ringed as a nestling breeding on Eynhallow. It was 7 years old – exactly as predicted by James Fisher! However we now have over 50 birds which were ringed as nestlings in Orkney and whose age we therefore know, recorded breeding on Eynhallow. The youngest is five years old and the oldest 20 years old. However it is very likely that these older records are birds which may have bred previously without being recorded. Indeed we cannot be sure that the first time we recorded a bird at a nest, was the first time that it actually bred. Given these problems

we use the modal age of first breeding (i.e. the age at which most birds do breed) rather than the mean, and for males the mode is 8 years and for females 12 years old. It is interesting to consider why young Fulmars do not breed at ages earlier than these.

From the fledging success of Fulmar pairs which include one young breeder of known age, we have been able to demonstrate that pairs containing a young male can breed as successfully as experienced pairs, whereas pairs including a young female improve their breeding performance over the first 6-8 years or so of their breeding experience. Supporting this difference between males and females, we have also been able to show that females which breed for the first time when younger than the modal age of first breeding do much less well than females which breed for the first time when older than the modal age. Further, the main difference in breeding success is not at hatching (therefore involving the quality of the egg or the efficiency of incubation) but survival of the young to fledging: parental care of the nestling by the female therefore seems to be the limiting factor. These relationships do not hold good for male Fulmars.

Once Fulmars become established as breeders they show a remarkable fidelity both to their nest site and to their mate. Pairs generally stay together at the same nest site for a run of years, but changes do take palce often as a result of breeding failures. Breeding Fulmars are very restricted in their distribution at land, so that new nest sites are normally within a few tens of metres of previous ones and new mates are often found among neighbouring breeders.

In general breeding success of Fulmars averages about 35% from egg to fledging.

Over the period of study the breeding population of Fulmars on Eynhallow has shown an increasing trend, consistent with what has been happening around the British coastline in general. However the trend has not been smooth, and there have been quite dramatic changes between years in the numbers of birds breeding. Our estimate of the size of the breeding population comes from the numbers of occupied nests counted at the beginning of June each year, when egg laying has ceased. This number is corrected for the early loss of eggs, using an average figure derived over four years of intensive study of the complete laying period.

We are particularly interested in the factors which determine the numbers of breeding Fulmars on Eynhallow, and have carried out detailed analyses and modelling of the relationship between changes in the numbers of breeding birds between years, and the estimated adult mortality of breeding adults, the number of new nest sites, and the recruitment of new breeders (that is unringed birds) to the breeding population in each year. All of these measurements have some degree of error associated with them, but our analysis showed very clearly that variations in the survival of breeding adults from one year to the next has little influence on the size of the breeding population. Bearing in mind that our estimate of the survival rate of adults in any year is based on data from a run of subsequent years (that is birds not seen in a particular year may be recorded in later years and are therefore known to have been alive but not seen) does not exclude the possibility that intermittent breeding of established adults may influence the numbers of birds breeding in any particular year. However the number of new recruits to the breeding population had by far the greatest influence on the variation of the numbers of birds breeding. New recruits are by definition first-time breeders, and a vast majority of these are unringed birds of unknown age and from an unknown source. It is difficult to calculate precisely the number of such birds in the population in any year, owing to the fact that about 30% of our established breeders are unringed. However we are able to conclude that inexperienced breeders, who breed much less successfully than

experienced birds, may not have the same degree of fidelity to nest site or perhaps even nest colony, as breeding adults. Recruitment may not be a once for all arrival and establishment of a bird in a local breeding population, but may be much more complex with birds moving between sites or colonies in their early breeding years. It is very difficult indeed to get information on this since we need marked birds, and the catching and marking may well influence whether or not the bird will remain in the population. However these calculations did highlight the need for better information on the process of recruitment of new birds to the breeding colony, and the behaviour and success of new and inexperienced breeders.

This brought a completely new element to the study. Hitherto our information had been derived almost entirely from breeding Fulmars caught off the nest. Now we required information about birds who as potential recruits were prospecting Eynhallow before becoming established in the breeding population. This raised two problems: firstly how to catch such birds; and secondly how to identify them. The first was overcome by using the Icelandic fleigh to catch Fulmars as they flew along the clifftops, and this could be done in almost any month of the year. In the course of a PhD project, 449 birds were captured in this way and these included many unringed birds, a number of birds ringed as nestlings and not yet recorded breeding, and colour-ringed breeding birds. Useful new information was obtained from all of these, especially during the months outside the breeding season. All birds caught were individually coloured ringed. While there are considerable problems of interpretation, especially regarding the status of individual birds, we estimated that the number of Fulmars visiting Eynhallow is between two and five times the number that breed there. Even making allowances for intermittent breeding among both inexperienced and experienced breeders, there is a large number of potential recruits visiting the island, and a high proportion of those marked were not seen again on Eynhallow.

The study continues, seeking to understand better the processes of recruitment, and the nature of intermittent breeding.

The following reference includes a complete list of our Fulmar publications:

Dunnet, G.M. 1991. Population Studies on the Fulmar on Eynhallow, Orkney Islands. *IBIS* 133 suppl. 1:24-27.

Research Progress Report

P.J.B. Slater

Variations in the Song of the Chaffinch

This article takes its title from one written exactly 40 years ago by Peter Marler (1952). As a young botanist employed by the Nature Conservancy he was carrying out survey work in various highland glens and became fascinated by the way in which the songs of the Chaffinches *Fringilla coelebs* appeared to differ from one glen to the next. Indeed, so interested did he become that he renounced his botanical career and went to work for Professor W.H. Thorpe, who was studying the development of Chaffinch song at Cambridge. Thorpe was then the leading authority on bird song in Britain, so Marler got a good start on his own work in the area. From Cambridge he went to America, and he has probably contributed more than anyone else to our understanding of bird song in the course of the past few decades. But it all started with Scottish Chaffinches.

Although Marler's first descriptions of Chaffinch song were done by ear, they are remarkably accurate. Today those of us who study song have the benefit of the sound spectrograph. This machine prepares charts (or sonagrams) from tape-recordings and gives a detailed picture of the pattern of the sound. As sonagrams are increasingly used to illustrate sounds in bird books, such as *The Birds of the Western Palearctic*, they are becoming increasingly familiar to bird watchers. Four examples from Chaffinch song are shown in Fig. 1, and will be discussed further below. They have enormous practical advantages for scientists studying song, because the plots they provide are extremely detailed: songs can be compared and tiny differences spotted. I was lucky to have one of these machines available when I first became interested in Chaffinch song, some 25 years after Marler. In my case it was the few males that sing in the small and scattered pockets of woodland in Orkney that set me wondering (Slater & Ince 1979). So I recorded and sonagrammed their songs, became fascinated by their variations, and have been studying Chaffinches on and off ever since.

Some male Chaffinches have only a single type of song, which they sing in virtually identical form over and over again. But some may have up to six different types. They sing each one several times in a row before switching to one of the others, and tend to cycle round all the different songs at their disposal before returning to the first again (Slater 1983). Fig. 2 is a map of Binscarth wood in Orkney showing the territories I found there when I first started studying Chaffinches. It shows the repertoire of each male, the different song types labelled by different letters. Clearly, not only do the birds vary a lot in how big a repertoire they have, but the songs vary in how widespread they are as well. Some birds sing songs unique to themselves (like E, X and Y); other songs may be sung by half the birds in the wood (such as B in this example). The sharing is very striking: Chaffinch song is quite complicated, with its series of different phrases (the trill) followed by the terminal flourish. Where I have labelled two songs with the same letter, they are made up of precisely the same sequence of phrases.

How does this great similarity arise? The answer is simply that young birds learn the songs that they sing from others round about them, and they often do so with great accuracy (see Fig. 1). Thorpe (1958) showed this originally, and we have also found that they may learn either as young adults, when they are just setting up their territories, or in the summer before when they are still juveniles. In this case, rather remarkably, they memorise the sounds they hear and reproduce them months later when they start to sing themselves (Slater & Ince 1982).

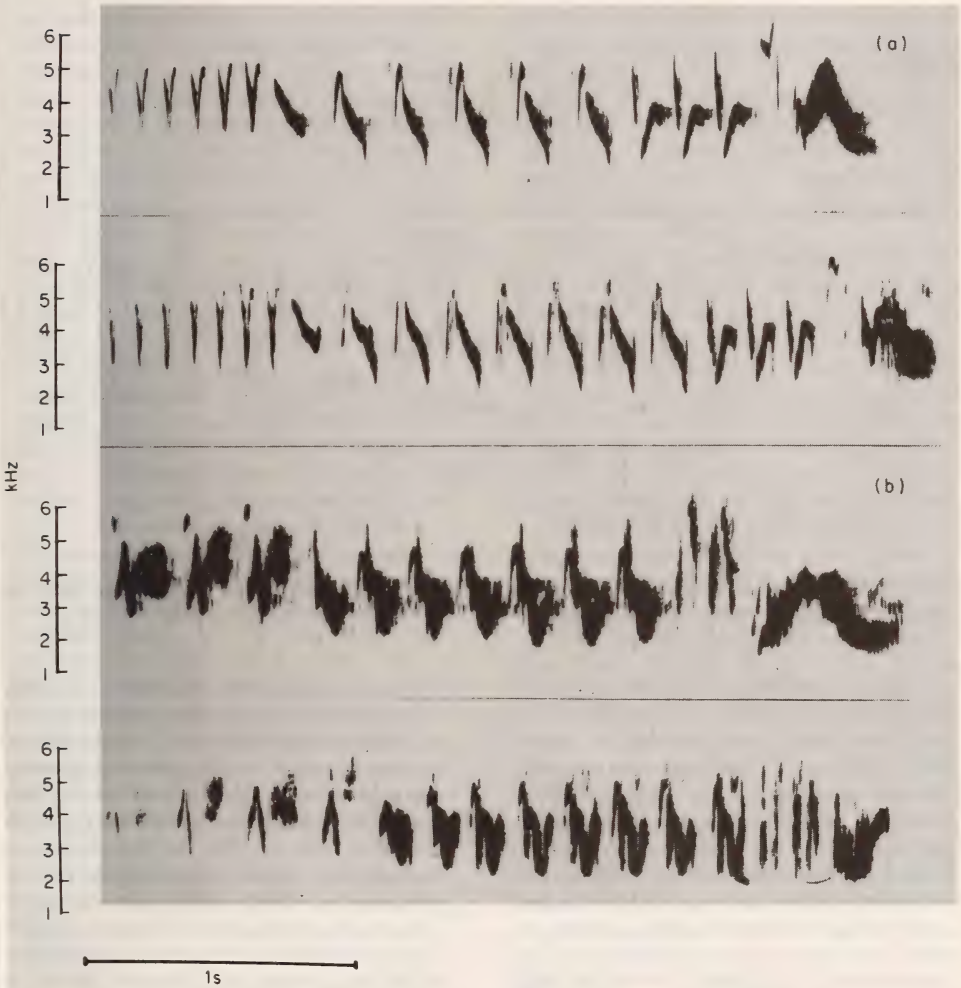

FIGURE 1. **Four sonagrams of chaffinch songs. These charts are plots of frequency (in 1000s of cycles per second, or kiloHertz) against time, the trace being black where there is energy at that particular point. The upper pair of songs (labelled a) are virtually identical to each other, as are the lower two (b), because the second of each pair was recorded from a young male that had been trained with a tape-recording of the song shown above. The young birds concerned were, in fact, hatched in Sussex, but trained with songs from Orkney, so that they sang songs totally unknown to the area from which they came. The lower song in (b) is also unique to that bird. The final section in the song on which it was trained rises and then falls. As can be seen from the sonagrams, the young bird copied the rising part, but omitted the subsequent downwards sweep (After Slater & Ince 1982).**

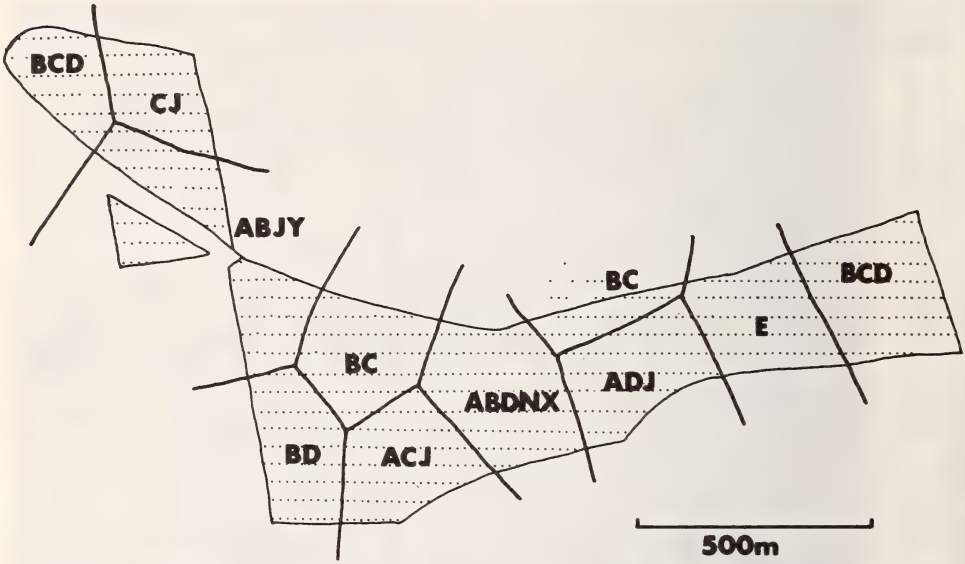

FIGURE 2. **A map of Binscarth wood, Orkney, showing boundaries of the territories of the male chaffinches nesting there. The letters indicate the song types possessed by each of the males.**

Male Chaffinches do not move far from where they hatch to where they breed so a good deal of song sharing in a wood such as Binscarth is perhaps to be expected. On the other hand, recordings at Balfour wood on Shapinsay, some 12 km away, showed that the two commonest songs were G and H, and quite distinct from any at Binscarth. Subsequently, I did find a bird in the village of Finstown close to Binscarth that sang both of these types: in my excitement I startled someone who happened to be passing by assuring them that the bird up there came from Shapinsay! I presume that he had learnt these songs on that island before moving to Finstown to breed.

Some of the songs labelled as different types in Fig. 2 are really quite similar, perhaps differing in the structure of just one phrase. Types X and Y, for example, are very like C. This led us to propose that new song types arise because birds do not always copy accurately: they may blend phrases from the songs of two neighbours, they may miss out a section, or they may improvise to create some new feature. This appears to be the main reason why there are so many songs in one area. Most of the time the birds copy songs exactly, but sometimes (we think perhaps 15% of the time) they do so inaccurately so that a new type is created (Slater *et al.* 1980). Thus, new songs are continually arising and, conversely, some of the songs which do not get copied disappear when their owners die. We now have a lot of evidence that this is exactly what does happen. One pointer, for example, comes from recordings that were made in the same wood 18 years apart (Ince *et al.* 1980). The songs present had changed almost totally, but three were still the same: this number matched almost exactly what one would expect if young birds setting up territories for the first time had copied songs accurately 85% of the time, but produced new songs on the remaining 15%.

These changes with time may also

account for changes with distance, like those between the birds at Binscarth and those on Shapinsay. In a way this is just like human dialects, but in other ways it is a bit more complicated. By listening to a person one can often tell where they come from to within a fairly short distance. But the songs of Chaffinches in Orkney do not all have some feature that other Chaffinch songs lack. They vary enormously amongst themselves and their characteristics overlap a great deal with ones from other places. If you played me a Chaffinch song, I certainly could not tell you where it came from – unless I happened to have heard it there myself. There is perhaps one exception to this, and that is the 'kit'. Some Chaffinches on the continent produce a 'kit' at the end of their song, which sounds just like the call of a Great Spotted Woodpecker *Dendrocopos major*. It is widespread: for example, I have heard it both near Berlin and in the foothills of the Dolomites in northern Italy. But it has never been recorded in Britain. So, if I hear a 'kit', I will know I must be abroad, but not all the birds in an area do it so that lack of a 'kit' does not tell me anything about where I am. Peter Marler was right: Chaffinch songs do vary from glen to glen, but the variations are rather more complicated than he supposed.

Thus, a lot of the variation in Chaffinch song, from place to place and from time to time, is because they learn their songs and they do not always get it quite right. In a way, this rather simple answer just takes the question one stage further back: why do they learn their songs? This question is not an easy one to answer. A rather nice idea is that song learning may help to match the song to the habitat in which it is sung. If young birds learn songs some distance away from the bird they copy, the sounds they will imitate will be those that reach them best. In a dense wood rapid trills get disrupted by echoes off the trees and would thus tend not to be copied. There is evidence for this in some other species where songs do vary between the different sorts of habitat that they occupy. But this idea does not appear to apply to Chaffinches as Williams (1991), who has recently examined the songs of Chaffinches in Fife and in Speyside, totally failed to find any relationship between the characteristics of their song and those of the wood in which it is sung.

Another suggestion is that birds may learn song so that they interact better with neighbours. Again, there is evidence of this in other species. Often small groups of neighbours share song types and, when they sing at the same time as each other, they will match the songs that they produce. But this is not likely to be true of Chaffinches as the amount of sharing they show is close to random and some of them do not match neighbours at all. The bird in Fig. 2 who sang song type E would clearly have a language problem if he needed to match his neighbours!

So, the reasons for song learning are not clear. Indeed, it may just be an evolutionary legacy. Many bird calls are learnt, including the Chaffinch 'chink', the form of which varies from place to place. Perhaps the calls from which song evolved were learnt, so the learning process was locked into the system before song even arose. But it seems clear that song learning has all sorts of other consequences, like the variations discussed above. It may also be a reason why birds like the Chaffinch have several different song types in their repertoire. If some songs are more effective than others, in repelling rivals or attracting mates, then having an armoury at one's disposal may be a key to success.

Study of the song of Chaffinches has certainly helped us to answer various questions about the remarkable variety that the songs of birds display. We now understand more about why it varies with time and between areas. But a lot of questions remain to be answered. With luck, Chaffinches will help us with them too.

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Adult female merlin on breeding grounds

Status, distribution and breeding biology of the Merlin in north-east Scotland, 1980-1989

G.W. REBECCA, B.L. COSNETTE, J.J.C. HARDEY AND A.G. PAYNE

Surveys for breeding Merlins were carried out in north-east Scotland during the 1980s. Breeding was confirmed at 81 separate nesting areas. They were associated with heather moor, old Caledonian pine forest and recently afforested moor at altitudes of between 190 and 750 metres. The population was estimated at 80-90 pairs and was considered to have been stable during the survey period. In approximately two-thirds of the nesting areas that were checked breeding was confirmed, with fledged young reared in approximately two-thirds of them. Average productivity was between 1.7 and 2.2 fledged young per pair and the sex ratio of the young was one to one. Of known nests, 89% were on the ground amongst heather, 7% were in old crow nests in trees and 4% were on crags. Predation and the apparent effects of pesticides were the main causes of nest failure.

Introduction

During this century the Merlin *Falco columbarius* has been widely reported as a declining species over much of its British breeding range. Loss of breeding habitat, disturbance and persecution are thought to have caused earlier declines (Prestt 1965, Parslow 1967). More recent studies in Northumbria, Orkney, the Peak District and Wales describe continuing declines.

Reduced breeding success, degradation and loss of breeding habitat, increased disturbance, weather and the effects of organochlorine pesticides and other pollutants were all implicated (Newton *et al* 1981, 1982, 1986; Roberts & Green 1983, Bibby 1986, Meek 1988, Newton & Haas 1988). One exception was in Shetland where, following the loss of half the breeding population in the early 1980s, numbers had recovered to the original estimated level by 1987 (Ellis & Okill 1990). In 1984 the Merlin was considered to be the only British breeding diurnal raptor still in decline despite a wide reduction in pesticide use (Newton 1984). Recent evidence shows that the Hen Harrier *Circus cyaneus* was also declining (Bibby & Etheridge *in press*). A national Merlin breeding survey during 1983 and 1984 resulted in a suggested British population of between 550-650 pairs with about 330-430 in Scotland (Bibby & Nattrass 1986). It was estimated that around 80-100 pairs could be present in north-east Scotland (Rebecca & Payne 1985). This paper reviews the breeding of Merlins in north-east Scotland (Fig. 1) and presents data from all nesting areas monitored between 1980 and 1989.

Historical Background

During the latter half of the 19th century Merlins occurred as breeders on the uplands and in some lowland areas of north-east Scotland. They were probably a common breeding species in the 1850s around Braemar and elsewhere on Deeside and also in the Banchory-Ternan area of north Kincardineshire (MacGillivray 1855, Adams & Adams 1859). In Banffshire they bred on the main hill ranges and on moorland almost at sea level (Edward 1856). They also bred on low altitude moorland in Buchan, Aberdeenshire (Serle 1895). Human disturbance was evident: for example, a pair were shot at the nest in Buchan in 1898 and a nest was robbed in south Kincardineshire in 1895 (Sim 1903, Harvie-Brown 1906). By the turn of the century they appeared to have declined in Aberdeenshire and Kincardineshire (Sim 1903). Although not quantified, this decline paralleled the national trend (Parslow 1967). There appears to be no published information on breeding distribution or numbers during the first half of this century. Scattered records gleaned mainly from gamekeepers indicate that they were still breeding on the hills and were probably widespread but uncommon. During the early 1950s five or six pairs bred on upper Deeside below 600m above sea level at a density estimated at about one pair per 40km^2 (Nethersole-Thompson & Watson 1981). Following concern over the status of some birds of prey, the British Trust for Ornithology (BTO) organised a national enquiry covering the period 1953-63. Banffshire and Kincardineshire were not represented. In south Aberdeenshire, a noticeable decrease was reported (Prestt 1965). The BTO Atlas, covering fieldwork during 1968-73, recorded Merlins in 25 10 × 10km Ordnance Survey (10-km OS) squares within the study area. Breeding was confirmed in ten squares, considered probable in four and considered possible in eleven (Sharrock 1976). During the early and late 1970s at least one pair per 16-20km^2 were found on the Kincardineshire moors (N. Picozzi in Nethersole-Thompson & Watson 1981; G.W.R., P.H. Shaw & L.D. Steele *pers. obs.*). The present study began in 1980, attempting to estimate overall breeding numbers and monitor breeding performance.

Study Area

This study primarily covered the upland heather *Calluna vulgaris* moors and hills of the counties of Aberdeen, Banff and Kincardine, now all part of Grampian Region (Fig. 1). Areas that were apparently unsuitable for breeding Merlins (Cramp & Simmons 1980) such as extensive mature tree plantations and land above 750 m were not surveyed intensively. In some years

suitable looking lowland mosses, maritime heath and sand dune systems were also visited.

At the time of this study in Grampian, dry heath (heather moor) occupied about one half of all the natural or semi-natural habitat. Where trees such as birch *Betula spp.*, rowan *Sorbus aucuparia* and Scots pine *Pinus sylvestris* occurred on the moorland, they were usually found scattered along burn sides or in areas where muirburn was impracticable or had ceased. There were remnants of Old Caledonian pine forest at Glen Tanar and on upper Deeside. Hill farms were situated along glens with fenced fields and shelterbelts occasionally reaching 500 m a s l. There were no extensive areas of grassy sheepwalk of the type utilized by

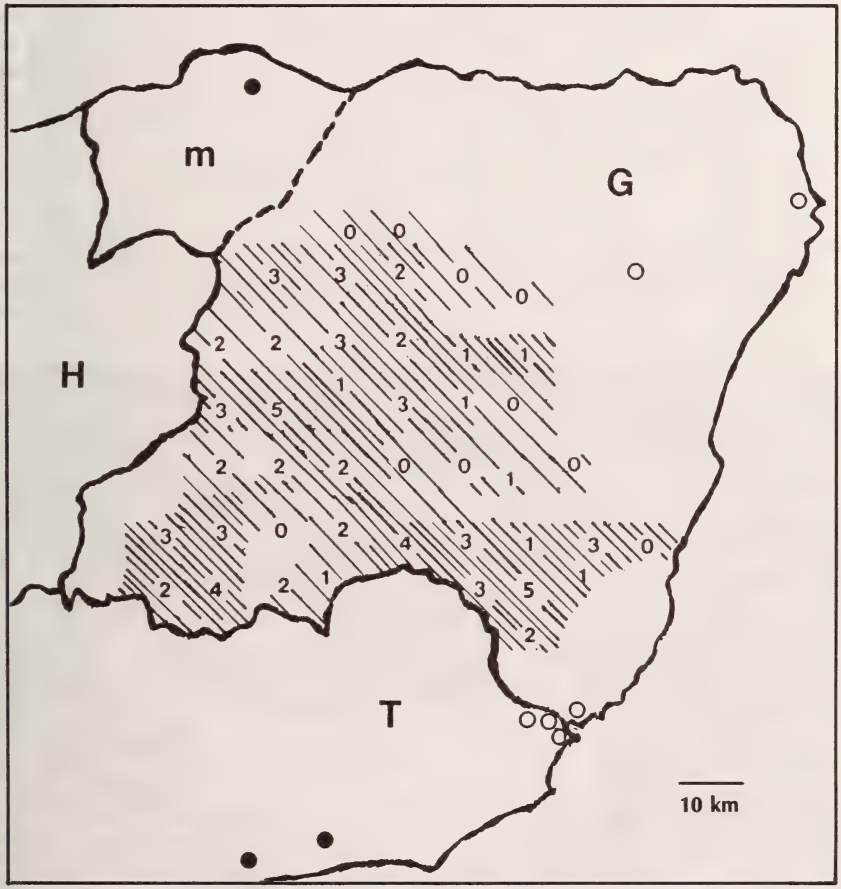

FIGURE 1. **Map of north-east Scotland Merlin study area (upland Grampian Region less Morayshire) showing maximum number of breeding pairs located in 10 × 10 km OS squares in any year 1980-89 and recoveries, away from breeding areas, in Grampian and Tayside Regions, of chicks ringed within the study area. Open circles = yearlings, solid circles = adults. G = Grampian Region, H = Highland Region, T = Tayside Region, m = Morayshire, close hatch = well surveyed areas, open hatch = moderately surveyed areas, no hatch = poorly or not surveyed areas.**

Merlins in other upland areas of Britain such as in Northumbria or Wales (Newton *et al* 1978, Bibby 1986). The moorland was managed primarily for Red Grouse *Lagopus lagopus* and red deer *Cervus elaphus*. Muirburning and grazing pressure, especially from sheep and deer, maintained the open moorland and largely prevented the regeneration of native trees. Since the late 1940s large areas of the lower moorland hills have been converted to commercial conifer plantations. Grampian Regional Council Department of Physical Planning (1987) and Buckland *et al* (1990) give detailed accounts of the physical landscape, vegetation, land use and habitats of the study area.

Methods

Merlin nesting areas were defined as in Newton *et al* (1978). Nesting areas were also known to be occupied in consecutive years. Tree nest sites and crag sites have been used for at least three years and at two areas the same patch of heather was used in 12 and 19 consecutive seasons (Cramp & Simmons 1980). A list of such areas in north-east Scotland where breeding had previously been confirmed or was considered to have been probable was compiled. Most of these areas were monitored annually and additional areas of apparently suitable habitat but not previously noted as nesting areas were searched. Information was also received from ornithologists, birdwatchers, naturalists, hill walkers and estate staff. In an attempt to increase the annual total of nesting areas that were monitored, other ornithologists were invited to participate and interested gamekeepers were encouraged to help in particular areas.

Areas were visited during March-May to search for signs of occupation or a nest.

Female Merlin brooding young G.W. Rebecca

Female Merlin with prey near nest : July. B.L. Cosnette

A nesting area was considered to have been occupied if a pair or single Merlin was seen or heard, or if moulted Merlin feathers or several fresh pellets, droppings and prey remains were found.

Breeding was considered to have been confirmed if courtship display, including the feeding of the female by the male, copulation or nest scraping was seen (Feldsine & Oliphant 1985); if eggs, shells or young were found; or if masses of prey remains, pellets and droppings were found along with moulted Merlin feathers. If nests were located visits were made to record clutch size and brood size at 3-13 days from hatching and again at 14-24 days to ring and sex the young using a combination of measurements and weight (Picozzi 1983). Clutches showing signs of depletion, i.e. broken shells or fragments, were excluded from clutch size analysis. Most nesting areas were visited to count young seen flying or obviously capable of flight. When the expected number of fledged young were not observed the area around the nest was searched for casualties. Despite this a minimum count was recorded at some nesting sites. Some were not visited until after the young had dispersed when it was possible to determine that at least one had fledged by finding moulted down away from the nest. Occasionally nesting areas were located for the first time in autumn or winter by finding down and other signs of breeding. Seven nests found between 1980 and 1983 and not visited after the ringing

of the brood are each assumed to have fledged at least one young. Where nests failed completely (i.e. no young fledged) we tried to identify the cause. Feathers, hair and droppings found near the nest or the condition of Merlin corpses gave clues towards identifying predators. Wounds caused by mammal bites were compared with skulls of museum specimens using the size and spacing of the canine teeth to aid identification. The altitude of a nesting area was calculated by averaging all known nest site heights previously plotted on 1:25000 scale maps. Unhatched eggs, collected under licence, and corpses were examined by the Institute of Terrestrial Ecology (ITE) or Department of Agriculture and Fisheries for Scotland (DAFS) to determine levels of organochlorine pollutants (DDT, dieldrin & aldrin), polychlorinated biphenyls (PCB) and mercury. Statistical tests, denoted by superscript numbers, are given in the Appendix 1.

Results

Breeding survey

The cumulative total of known nesting areas increased annually from 25 in 1979 to 91 in 1989 (Table 1), while the number of nesting areas checked on an annual basis rose from 24 to 81 (Table 2). During the study period, breeding was confirmed in 81 discrete nesting areas. They were located at altitudes of between 190 and 750 m a s l, with most between 200 and 500 m (Fig. 2). Only one nesting area was found in each of the 100-199 m and 700-799 m ranges. In the earlier years survey work was concentrated in the lower altitude ranges resulting in proportionally more breeding attempts found there overall (Fig. 2). The proportion of breeding attempts that fledged at least one young varied between 67% and 76% for the altitude ranges. No significant difference in this proportion was found between altitude ranges[1] or between nests above and below 400m[2]. Breeding success was also found to be unrelated to altitude in

TABLE 1. Cumulative total of known Merlin nesting areas in NE Scotland, 1980-89.

		confirmed breeding	probable breeding
pre	1980	22	3
end	1980	25	2
end	1981	30	—
end	1982	39	1
end	1983	47	—
end	1984	54	—
end	1985	60	—
end	1986	70	1
end	1987	74	3
end	1988	81	4
end	1989	87	4

Northumberland during 1961-76 (Newton *et al* 1978). Breeding pairs were located in 78% of the upland 10-km OS squares that were searched (Fig. 1). In well surveyed squares three to five pairs were located. The distance between occupied nesting areas was observed to vary between 0.5 and 6.0 km.

Despite repeated thorough searching, breeding Merlins were not detected in some large areas of apparently suitable upland habitat. A survey in Kintyre has also reported no breeding Merlins over large areas of apparently suitable habitat (Petty 1985).

Breeding was also not confirmed on the low lying mosses and moorland (where it occurred in the 19th century, see Historical Background), maritime heath or sand dune systems. Survey work there was not intensive, although individual summer sightings of Merlins were followed up by visits to nearby suitable looking areas. The possibility of a small number of breeding pairs in these areas cannot be ruled out.

Occupation of nesting areas

Over the 10 years breeding pairs were located on 328 occasions. Of the pairs located 20 were not revisited the same year.

TABLE 2. Occupation of nesting areas and breeding performance of Merlins in NE Scotland, 1980-89. Numbers right of colons are areas not revisited the same year, ringing done at 14-24 days.

	no. of nesting areas monitored	no. with only signs of occupation	no. (%) where breeding confirmed	no. (%) of pairs rearing at least one young to ringing	flying	no. (%) of pairs failing to rear young
1980	24	4:2	15 (63):3	10	10 (83)	2 (17)
1981	25	5:3	14 (56):1	13	13 (100)	- (0)
1982	28	7:3	21 (78):2	10	10 (53)	9 (47)
1983	45	8:5	32 (71):1	21	20 (65)	11 (35)
1984	48	7:3	29 (62)	21	20 (69)	9 (31)
1985	54	5:2	37 (69):3	22	21 (62)	13 (38)
1986	62	7:2	44 (71):3	31	30 (73)	11 (27)
1987	65	6:2	43 (66):4	27	27 (69)	12 (31)
1988	76	11:3	45 (59):2	30	30 (70)	13 (30)
1989	81	4:2	*48 (59):1	30	30 (63)	18 (37)
TOTAL	508	64.27	328 (65):20	215	211 (68)	98 (32)

* one area had probable bigamy (Cosnette, 1991)

For the remainder, 215 reared young to the ringing stage (14-24 days), and 211 (68%) of them each reared at least one young to fledging; 98 breeding pairs failed completely. In addition, signs of occupation were found, but breeding not confirmed that year, at 64 nesting areas during the survey period, 27 of which were not revisited the same year (Table 2). In approximately two thirds of the nesting areas that were checked breeding was confirmed.

Occasionally a Merlin in brown plumage summered in a nesting area, apparently without breeding. Evidence that there were unmated birds within the population was obtained when in two pairs the female and in another two pairs the male was replaced during the nesting period (Cosnette 1985, Rebecca *et al* 1988, Rebecca 1991). There was also one case of apparent bigamy (Cosnette 1991).

Nest site description

The nest site was known for 292 breeding attempts: 89% were on the ground, 7% were in old Crow *Corvus corone* nests in trees and 4% were on crags (Table 3). They were associated with heather moorland, old Caledonian pine forest or recently afforested heather moor.

TABLE 3. Number of known Merlin nest sites in NE Scotland, 1980-89 (left of colons) and number of these which fledged at least one young (right of colons).

	ground	crag	tree
1980	9:7	1:1	
1981	10:10	1:1	
1982	17.9	1.0	
1983	23.14	3:1	1:1
1984	23.15	2.2	2:1
1985	30:18	2:1	1:0
1986	36:26	1:0	4:2
1987	32:22		6:5
1988	37:26		5.4
1989	44:27		1.1
TOTAL	261:174	11:6	20:14
(%)	(89):	(4):	(7):

tree sites all in old crow nests

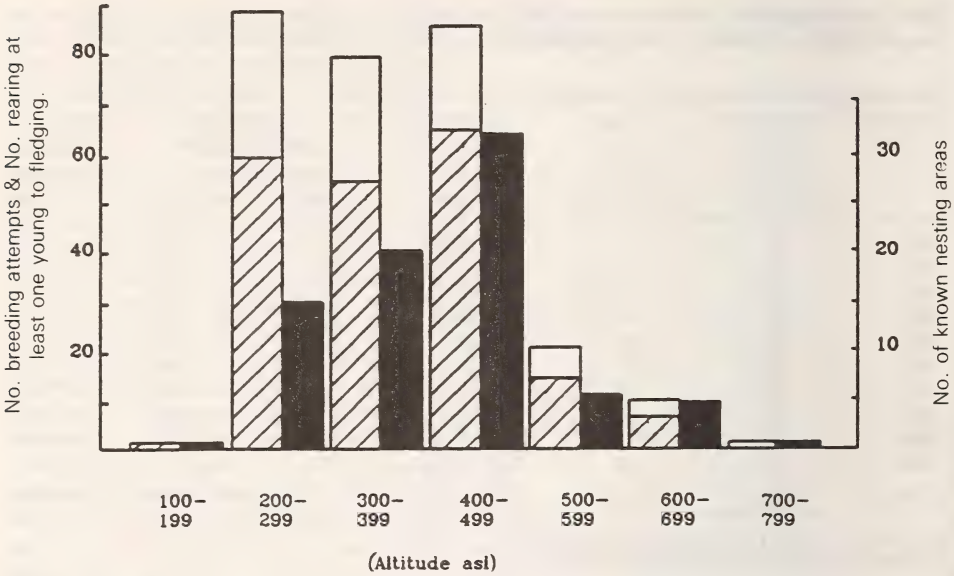

FIGURE 2. Altitude of known Merlin nesting areas in NE Scotland ■. Number of breeding attempts monitored 1980-89 □ and number rearing at least one young to fledging ▨.

Ground nests, with one exception, were in heather between 30-70 cm high and situated on hillsides or in glens. Eleven were next to small trees (ten Scots pine, one Larch *Larix*), one was next to a tree stump, four were next to fence posts and 11 were behind boulders. The remainder were in uniform stands of heather but many had similar landmarks nearby. When on recently afforested moor, nests were in small patches of uplanted heather and once in a mixture of bilberry *Vaccinium myrtillus* and bracken *Pteridium aquilinum*. Nests were usually a scrape on the bare ground or in moss but occasionally a substantial amount of vegetation was accumulated during incubation. One clutch, incubated for about two weeks past the hatching date, was on a pad of vegetation measuring 30 cm diameter and 7 cm deep. On three occasions exactly the same nest scrape was re-used, twice in consecutive years and once after a gap of two years.

Tree sites were all in old Crow nests. nine of them were in isolated Scots pines, three on moorland and six on recently afforested moor. Two nests in isolated rowans were also on recently afforested moor. Seven nests were in Scots pines in old Caledonian pine forest, six near the open moor and one about 300 m into the forest. The remaining two were about 30 m from the open moor in 10 m high unthinned lodgepole pine *Pinus contorta* plantation. The same crow nest was re-used on four occasions, twice in consecutive years and twice after a gap of one year.

When nesting on crags they used open ledges on the face or short heather (10 cm) at the top of the crag. The actual nest site usually changed annually but on one occasion the same ledge scrape was used in two successive years. One crag was used for at least nine consecutive years.

Kestrels *Falco tinnunculus* once used the same ledge scrape as the Merlins (in a

different year) and also used the same crow nest on four occasions, twice before the Merlins and twice after. At tree and crag nesting areas there were usually alternative sites available and for Merlins, there were always potential ground sites nearby. Occasionally both species nested successfully within 100m of each other. In some nesting areas the Merlins changed nest site from ground to tree and from crag to ground and vice versa in consecutive years.

Adult male Merlin portrait. B. Cosnette

Where Hen Harriers and Short-eared Owls *Asio flammeus* were also present they were often found nesting near the Merlins, occasionally all three within 200 m. There was probably benefit to each species regarding awareness of, and defence against, potential predators. The Merlins basically tolerated the harriers and owls early in the breeding period but once the young hatched and especially after brooding ceased they would harass and mob them regularly. Peregrines *Falco peregrinus* apparently displaced Merlins from nesting areas on several occasions and one was found at a Peregrine plucking site. In four Merlin nesting areas where Peregrines became established Merlins did not nest within a 2 km radius. In addition, at four other nesting areas where Peregrines nested in heather banks for one year, Merlins were absent that year. During the study period the number of breeding Peregrines increased dramatically in north east Scotland (Hardey 1992).

Tree sites were successful on 14 out of 20 occasions, ground sites successful on 174 out of 261 occasions and crag sites successful on six out of 11 occasions (Table 3). Crag sites could have been classed as ground sites on the basis of being vulnerable to similar predators. Analysis showed there was no significant difference between the success rates of the three nest site types[3]. In Northumbria tree sites were significantly more successful than ground sites, but in Wales this was not the case (Newton *et al* 1986, Bibby 1986).

Clutch size, brood size, sex ratio and dispersal of young

The mean annual clutch size ranged between 4.0 and 4.6 and averaged 4.4 $\pm$ 0.6 standard deviation (n = 195). The mean brood size for nests still viable at 3-13 days from hatching was 3.7 $\pm$ 0.9 SD (n = 164) and at 14-24 days it was 3.5 $\pm$ 1.0 SD (n = 160). The mean number of fledged young per successful nest counted was a minimum of 3.0 $\pm$ 0.9 SD (n = 166) (Table 4). For a large number of confirmed breeding attempts pairs were located early in the breeding season (March-April i.e. before laying). They were followed through to the ringing stage (14-24 days) and then for the majority their subsequent number of fledged young was counted. Including failed nests this gives more accurate figures for productivity (Table 5). Average brood size per pair at 14-24 days was 2.2 $\pm$ 1.9 SD (n = 249) and at fledging was at least 1.7 $\pm$ 1.7 SD (n = 232).

For 147 broods where the young were

TABLE 4. Clutch and brood size of Merlins from nests found at all stages in NE Scotland, 1980-89. Clutches showing signs of depletion excluded, flying count is a minimum, includes five repeat clutches 1×1, 2×3, 2×4.

	clutch							brood																
								3-13 days						14-24 days						flying					
	1	2	3	4	5	6	$\bar{x}$	1	2	3	4	5	$\bar{x}$	1	2	3	4	5	×	1	2	3	4	5	×
1980				3	5		4.6	1	1	1	2	2	3.4	1	1	1	2	2	3.4	1		2	2		3.0
1981			1	5	1		4.0		1	4	3		3.3	1	2	3	3		2.9	1	4				2.8
1982			1	9	3		4.2		3	2	5		3.2		3		5		3.3		3	1			2.3
1983			1	10	2		4.1		1	2	10		3.7		1	2	5		3.5		3	4	2		2.9
1984				10	5		4.3		2	5	7	1	3.5		2	3	6	1	3.5		5	6	4		2.9
1985				10	12	1	4.6		2	3	6	6	3.9	1	3	3	7	1	3.3	1	4	8	4		2.9
1986	1		1	13	11		4.3	1	1	2	16	1	3.7	1	3	3	16	1	3.5		6	14	9		3.1
1987				17	12		4.4	1	2	4	9	5	3.7	1	4	4	10	5	3.6	1	8	10	7	1	3.0
1988			1	16	16		4.5			4	17	7	4.1			4	18	6	4.1	1	2	9	14	3	3.6
1989			1	17	10		4.3	1	1	6	12	4	3.7	1	2	8	12	2	3.5	3	6	10	6	1	2.9
TOTAL	1	-	6	109	78	1	4.4	4	14	33	87	26	3.7	6	21	31	84	18	3.5	8	41	64	48	5	3.0
± SD							±0.6						±0.9						±1.0						±0.9

SD standard deviation

TABLE 5. Productivity of Merlins found occupying nesting areas early in the breeding season (March-April i.e. before egg-laying) and followed through in NE Scotland, 1980-1989.

	nesting areas with young aged 14-24 days								nesting areas with fledged young							
	no. of areas	no. of young						$\bar{x}$	no. of areas	minimum no. of young						$\bar{x}$
		0	1	2	3	4	5			0	1	2	3	4	5	
1980	9	2	1	1	1	2	2	2.7	6	2	1		1	2		2.0
1981	7		1		3	3		3.1	3		1	2				2.5
1982	17	9		3		5		1.5	12	9		3				0.7
1983	21	11		1	2	7		1.7	19	12		1	4	2		1.1
1984	18	7		1	3	6	1	2.2	17	8		2	5	2		1.6
1985	28	14		3	4	6	1	1.7	28	15		4	5	4		1.4
1986	31	10	1	3	3	13	1	2.4	31	11		4	9	7		2.2
1987	35	12	1	4	4	9	5	2.3	35	12	1	6	9	6	1	2.1
1988	40	13			4	17	6	2.8	39	13	1	2	9	11	3	2.3
1989	43	18	1	2	8	12	2	2.0	42	18	3	6	9	5	1	1.7
TOTAL	249	96	5	18	32	80	18	2.2	232	100	7	30	51	39	5	1.7
± SD								±1.9								±1.7

SD standard deviation

known to have fledged the sex ratio was very close to one to one, with 264 males and 258 females. On an annual basis the ratio occasionally differed by up to a factor of two (Table 6).

After fledging the young usually remained in the nesting areas for about two weeks and then dispersed. During the 1970s and 1980s over 600 young Merlins were ringed in the study area and 17 have been recovered away from the nesting areas. Those recovered within Grampian and Tayside are shown in Fig. 1. The others were: five from England, two from south-west France and one from south-east Spain. For England, two were found in their first year, 220 km away in Northumbria and 440 km away in Lincolnshire, two in their second year, 390 km away in Lancashire and 570 km away in Gloucestershire and one in its third year 540 km away in Cambridgeshire. In France one was shot near La Rochelle 1210 km away within four months of fledging, the other was found near Arcachon 1375 km away in its second year. The Spanish recovery was near Alcira 2025 km away and was also found within four months of fledging. All recoveries were found in autumn or winter and, for the British ones, at lower altitudes than the nesting areas and mainly in association with coasts or estuaries, for example four were found in their first winter near Montrose basin, Tayside (Fig. 1). In ten cases the recovery circumstance was recorded: three were shot (one in a flock of Starlings *Sturnus vulgaris*), four hit windows (two subsequently released), one hit a van when making a kill, one hit wires and one had a broken wing. These recoveries away from nesting areas of Merlins ringed as chicks show a similar pattern to those from all of Britain up to 1986 i.e. moving to lower altitudes and estuaries and occasionally reaching the continent (Heavisides 1987). It is interesting to note that none were found north of Grampian Region.

TABLE 6. Sex ratio of nestling Merlins in NE Scotland, 1980-89. Broods sexed at 14-24 days and known to have fledged.

	no. of broods	sex female	male
1980	6	12	9
1981	9	15	11
1982	7	13	11
1983	8	8	19
1984	11	19	11
1985	14	28	17
1986	22	35	45
1987	23	48	34
1988	24	40	58
1989	23	40	39
TOTAL (%)	147	258 (49)	264 (51)

Age ratio of breeders

The ratio of brown-backed (first year) to blue-grey backed (adult) males seen at nesting areas was 0:10 in 1980, 0:11 in 1981, 0:16 in 1982, 0:23 in 1983, 2:25 in 1984, 0:31 in 1985, 2:35 in 1986, 1:37 in 1987, 0:38 in 1988 and 3:43 in 1989; overall 8:269. Two of the apparently paired first year males were subsequently replaced by adult males during the nesting period (Rebecca *et al* 1988). After taking these two cases into account the overall proportion of first year male breeders was 2%. We could not ascribe age to females in the field. After 1983 we aged females that were caught or found dead at the nest by plumage characteristics (Cramp & Simmons 1980). The ratio of first year to adults was 0:8 in 1984, 1:12 in 1985, 0:7 in 1986, 0:4 in 1987, 1:8 in 1988 and 0:6 in 1989; overall 2:45 equivalent to 4% first year female breeders. This was considerably less than the 18% and 8% first year females and males found in Northumbria and the 18% and 6% first year females and males found in Shetland (Newton *et al* 1986, Ellis & Okill 1990).

Nest failures and pollutants

Approximately one third (32%) of all breeding attempts failed completely (Table

2). The types of complete failure were recorded for 104 nesting attempts (Table 7). In 23% of the nesting failures evidence of laying or of incubation was not found. In 30% of complete failures the clutch was depleted and then deserted, failed to hatch or was broken (small eggshell fragments found), suggesting that the eggs might have been affected by organochlorine pesticides and that the birds had probably broken them (Newton *et al* 1982). Predation accounted for 43% of the failed nests and 4% failed due to human disturbance (twice deliberately). 12 females were depredated at ground nests along with their clutch or brood. One female was a road casualty. The 13 complete broods which died in the nest were all at ground sites. Corvids took some clutches and killed a brood but it is possible that the clutches had already been abandoned. The Merlins were often seen driving off crows, raptors and other large birds and they appeared competent when dealing with crows. A Golden Eagle *Aquila chrysaetos*, a Hen Harrier and a Short-eared Owl each killed a female on the nest and these predators were also suspected of taking young Merlins. Foxes *Vulpes vulpes* were probably the main mammalian predator as their signs were often found near failed nests. A stoat *Mustela erminea* and a mink *Mustela vison* each killed a female on the nest and a 'wild cat' *Felis spp.* killed a brood. Deliberate disturbance by gamekeepers occurred at two nesting areas in the earlier years. Predation and the apparent effects of organochlorine pollutants accounted for 73% of the failures. Pesticides may also have been implicated in those cases where clutches were apparently not laid or not incubated (23%), but other factors (e.g. weather, age of female) could have been the cause. Unhatched eggs from 49 clutches were

TABLE 7. Types of complete nest failure in Merlins in NE Scotland, 1980-89. Includes three repeat clutch failures and three first clutch failures where repeat clutches successful.

	no evidence of incubation or laying	clutch depleted & deserted, unhatched or small fragments	clutch disappeared or depredated	female depredated at nest with clutch, brood		brood died depredated by bird, mammal, ?			human disturbance
1980		1	1						1[1]
1981									
1982		5		1		1	1		1[2]
1983	4	4		2			1		1
1984	2		2	1	1		1	1[3]	1
1985		8	4		1	1	1	1[4]	
1986	4	3	4			1			
1987	3	4	1		1	2	1		
1988	3	4	3	1[5]	1		1		
1989	8	2	4	3	1				
TOTAL	24	31	19	13		13			4
(%)	(23)	(30)	(18)	(12.5)		(12.5)			(4)

[1] pair killed, [2] nest destroyed, [3] brood disappeared, [4] brood starved, [5] female was road casualty at the incubation stage.

TABLE 8. Mean eggshell index and mean Organochlorine, PCB and Mercury levels in Merlin eggs, NE Scotland 1980-89 (n = 53). HEOD, DDE and PCB units are p.p.m. in lipid, Mercury units are p.p.m. dry weight. % shell thinning calculated using pre DDT mean shell index of 1.26, eggshell index = wt (mg)/l × b (mm).

	eggshell index	% shell thinning	HEOD	DDE	PCB	Mercury
arithmetic means	1.06	16.2				
geometric means			4.82	118.10	49.28	1.96

individual results in Appendix 2a

analysed by ITE at Monks Wood Experimental Station for concentrations of organochlorine residues (DDE, the main metabolic breakdown product from the insecticide DDT and HEOD, derived from the insecticides dieldrin and aldrin), industrial polychlorinated biphenyls (PCB) and mercury (mainly from agricultural and industrial sources) as described by Newton *et al* (1982) and Newton & Haas (1988) (Appendix 2a). Mean eggshell index was 1.06 (range 0.78-1.35) equivalent to a 16% mean reduction in thickness compared to the mean thickness prior to the use of DDT (Newton *et al* 1982) (Table 8, Appendix 2a). The geometric mean concentrations were: DDE 118.10 ppm (range 44.17-340.83), HEOD 4.82 ppm (range 0-32.55), PCB 49.28 ppm (range 9.07-219.49) and mercury 1.96 ppm (range 0.52-6.01) (Table 8, Appendix 2a). These results are similar to those for unhatched Merlin eggs from all of Britain for 1981-86 (Newton & Haas 1988).

Young fledged from 32 of the nests where unhatched eggs were collected and the other 17 failed completely (Appendix 2a). 20 corpses were analysed at Monks Wood or DAFS Edinburgh, and results are shown in Appendix 2a. DDE, dieldrin and PCB residues were found at levels described as low and background and were similar to those now found in some other predatory birds.

Discussion

Status and Distribution

As the survey was extended annually additional nesting areas were continually being located. Breeding was confirmed at 81 discrete areas but not at ten nesting areas known from the 1970s. For reasons unknown these areas may no longer be viable as nesting areas. Merlin nesting areas are often used in successive years (summarised in Cramp & Simmons 1980). This was also found in north-east Scotland. The annual occupancy by breeding pairs at known nesting areas averaged about two thirds of those monitored. With no earlier quantitative data available it is difficult to assess the status of this population. An indication of the status can be derived by examining and comparing occupation of nesting areas, trends and productivity from other studies where some knowledge of past status was known. This does not take into account possible immigration or emigration. However, there was no indication that either occurred on a large scale in north east Scotland during the study period. There were no breeding season recoveries or controls of Merlins that had been ringed outwith the study area. Nor were there any from elsewhere of Merlins ringed within the study area.

In three widely separated breeding

studies, where the populations were reported to be in decline, annual occupancy of nesting areas was 14-24% in Orkney 1981-87 (Meek 1988), 23-39% in Northumbria 1974-83 (Newton *et al* 1986) and 40-60% in Wales 1970-84 (Bibby 1986). In Shetand population recovery was recorded between 1984-87 with occupation of nesting areas by pairs of 34-45% (Ellis & Okill 1990).

In a delimited intensively studied part of Deeside, the area surrounding every previously recorded nest site within the discrete nesting areas was searched annually during the study period. The occupancy by breeding pairs averaged 13 (n = 10-15), which represented about 68% occupation of the known nesting areas (G.W.R., B.L.C., A. Duncan & L.D. Steele *in prep*). In the remainder of the present study area not all nesting areas were monitored annually but the average proportion of those examined that were occupied by breeding pairs was 65%, similar to the 68% found in the intensively studied area, so the figure for occupancy could be general. There was no evidence of any decline during the study period and the population in north-east Scotland was considered to have been stable.

Despite this, some extensive areas of apparently suitable habitat did not hold any breeding Merlins. In these areas prey numbers, predator level and land use appeared no different from areas where Merlins were breeding. Some apparently alternative nests sites were separated by up to 3.5 km. This may have reflected a naturally low density level or an artificially depressed population. It was subsequently discovered that on one sporting estate, with the potential to hold three to four pairs of Merlins, illegal persecution of raptors, including Merlins was occurring up to about 1988. Two other Merlin nests were interfered with by gamekeepers on two other sporting estates (in 1980 & 82) and persecution cannot be ruled out as a possible reason why some areas were devoid of Merlins. If every known nesting area had been examined and all additional suitable habitat within the study area surveyed in a single year a population of 80-90 pairs could have been present.

Recent studies in Wales and Northumberland have shown that Merlins have adapted to using new breeding sites. They are now commonly found nesting in old crow nests at the edge of, or in, maturing conifer plantations (Parr 1991, Little & Davison *in press*). During this study, mature conifer plantations and their edges were not searched because, at that time, the habitat was not considered suitable (Cramp & Simmons 1980). Surveys were concentrated in open country and to a lesser extent in old Caledonian pine forest.

In 1987 a pair of Merlins were found breeding at the edge of a maturing lodgepole pine plantation (B. Etheridge *pers. comm.*). In 1991 a second conifer forest plantation site was located, but about 60 km from the first site (Rebecca 1992). There are large areas of maturing conifer plantations in the study area so future surveys for breeding Merlins should include forest edges as well as the remnant low-lying moors and mosses where the remaining habitat still appears suitable.

Breeding biology

These Merlins laid clutches that were on average slightly larger, $\bar{x}$ 4.4 than those from Wales $\bar{x}$ 4.3 (Roberts & Green 1983, Bibby 1986) and Northumbria and Shetalnd, $\bar{x}$ 4.2 (Newton *et al* 1986, Ellis & Okill 1990). Clutches were also 0.5 eggs per clutch larger than the average for Orkney (Meek 1988).

Brown (1976) and Olsson (1980) calculated that Merlins should fledge 2.5 young per pair to maintain numbers. Bibby (1986) suggested that if Merlins have similar survival rates to Sparrowhawks *Accipiter nisus* and bred at two years, productivity would need to be about 2.6 fledged young per pair for numbers to remain stable.

Overall productivity in north-east Scotland was between 1.7 and 2.2 fledged young per pair (and was probably nearer the latter figure). The population was considered to have been stable during the 1980s with an occupancy of nesting areas, by pairs, of 65%. These figures suggest that an output of no more than 2.2 young fledged per pair can be sufficient to maintain numbers. In an expanding urban population in Saskatoon, Canada productivity was 3.7 fledged young per pair (Oliphant & Haug 1985). In contrast the study area reporting the most serious decline was Orkney, productivity there was 1.3 fledged young per pair (Meek 1988). Brown's calculation (1976) allowed for Merlins to live for two years and rear 3.2 young per successful pair. The Merlins in north-east Scotland fledged between 3.0 and 3.5 young per successful pair and the vast majority found breeding were adults i.e. more than one year old.

More details are needed on adult survival, age of first breeding and fidelity to breeding regions to assist in assessing occupation and productivity from geographically separate study areas. For example, it was suggested, in north Wales that some Merlins may have moved from one study area to another following habitat degradation (Roberts & Green 1983).

Almost a third of all breeding attempts failed to produce fledged young, about half of them due to predation. This population must have been vulnerable to predation because most nests were on the ground. 12 females were known to have been killed at the nest. This was a considerably higher figure than reported from other breeding studies (Williams 1981, Roberts & Green 1983, Newton *et al* 1986, Meek 1988, Ellis & Okill 1990). It is possible that commercial conifer plantations provide a safe haven for predators such as foxes and crows and, with the reduction of gamekeepers following the afforestation of grouse moors, these predators are likely to increase. If so, Merlins that breed near maturing plantations, of which there are many in the study area, could be subjected to a higher predator level unless they switch to three nesting.

The apparent effects of pollutants accounted for at least 30% of the nests that failed completely and unhatched eggs from a further 49 nests reduced potential productivity, as did individual eggs that broke during incubation. Altogether 53 unhatched eggs were analysed. Average organochlorine, PCB and mercury levels were similar to the average levels found for the whole of Britain from 1981-86 (Newton & Haas 1988). There was no evidence that organochlorines or PCB, at the levels reported by Newton & Haas, influenced productivity. However in clutches where mercury levels were above 3 ppm productivity fell markedly. The mean mercury level from north-east Scotland at 1.96 ppm was below this. One egg from 1982 and seven since 1987 contained mercury higher than 3ppm. The fact that so many eggs did not hatch gives cause for concern. Mean eggshell thickness for unhatched eggs was 16% lower than the DDT era mean. Where whole clutches and individual eggs broke it is likely they were thinner than those that failed to hatch. Raptor populations that showed an average of more than 16-18% eggshell thinning over several years were all declining (Newton 1979).

The future

In north-east Scotland Merlin nesting areas should remain suitable so long as there are no widespread land use changes. Probably the most serious threat to the population is the afforestation of extensive areas of moorland with conifers. Some breeding sites, known from earlier decades, have been lost to maturing conifer plantations. Fewer forests have been planted since 1988, following changes in tax legislation and the introduction of environmental assessments for certain new forestry schemes. In

addition conservation bodies in north-east Scotland, such as the Scottish Natural Heritage and the Royal Society for the Protection of Birds, are now consulted on forestry applications over 30 hectares in size and can argue the case to retain Merlin habitat. The Merlin is an Annex I species under the EC Directive 79/409/EEC on the Conservation of Wild Birds, and in theory their nesting areas and hunting ranges should be protected from damaging factors. Under this directive "The species mentioned in Annex I shall be the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution" (Article 4). However, there is little information available on the extent that breeding Merlins use the surrounding habitat. For example, Merlins in south-east Grampian hunted at least 5.6 km from the nest (Rebecca *et al* 1990) but it was not known how often. Further study is needed to ascertain what quantity of open habitat and forestry is necessary to sustain Merlin breeding populations.

Another potential threat to the heather moorland is overgrazing by deer and sheep. Subsidies on hill sheep have been reduced so this threat has also decreased and it is possible also that deer numbers will reduce in the future given the expressed concern of the Red Deer Commission and others.

The recurring effects of pollutants continue to be a serious problem. It is alarming that the Merlin is still affected by these chemicals, particularly DDT and that overall numbers in Britain have not recovered to the same extent as other bird eating raptors such as the Peregrine and Sparrowhawk (Ratcliffe 1984, Newton & Haas 1984). It is essential to monitor the situation and to continue to collect unhatched eggs and corpses for analysis. It is planned to continue studying the Merlin population in north-east Scotland and to survey the remaining suitable habitat during the 1990s.

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APPENDIX 1. Results of statistical tests.

1. Chi-square = 2.39, 3df, ns
2. Chi-square = 1.73, 1df, ns
3. Chi-square = 0.84, 2df, ns

APPENDIX 2(a). Eggshell indices, Organochlorine, PCB and Mercury levels in Merlin eggs, as described in Table 8.

	eggshell index	% shell thinning	HEOD	DDE	PCB	Mercury	nest successful = s failed = f
1980	0.91	28	5.50	80.00	46.00	—	s
	0.95	25	5.40	174.00	77.00	—	s
1981	1.05	17	2.16	131.65	15.35	1.63	s
			10.62	140.52	75.72	1.34	s
			5.88	253.53	71.37	2.29	s
	1.11	12	6.29	176.16	45.36	1.18	s
1982			4.46	141.96	89.88	6.01	f
	1.20	5	3.51	47.08	21.35	0.80	s
	1.15	9	1.37	114.16	12.79	0.82	s
	1.00	21	3.68	142.14	141.14	2.75	f
	1.00	21	8.66	114.33	58.51	1.60	s
	1.01	20	5.86	92.79	43.69	2.63	f
1983	+		9.96	148.89	81.19	0.52	s
	+		19.88	147.40	92.66	2.74	
	0.78	38	4.71	114.41	116.76	1.58	s
			11.31	88.64	37.37	1.00	s
	+0.79	37	n d	170.93	30.52	2.44	f
	+0.80	36	n d	114.60	15.24	3.00	
1984	0.96	24	7.61	48.79	32.53	0.86	f
			13.71	157.94	102.80	1.25	s
	0.82	35	4.99	200.83	44.32	2.21	s
	0.88	30	4.62	88.00	56.31	2.17	s
	0.89	29	5.49	97.25	47.84	2.42	f
			6.84	132.57	45.93	1.35	f
1985			5.49	133.79	9.07	1.26	f
	1.23	2	0.68	176.03	68.26	0.67	s
	1.02	19	17.36	340.83	101.22	3.75	f
	1.21	4	3.75	163.27	12.33	1.24	f
	1.00	21	3.52	89.87	14.98	1.12	f
1986	1.19	6	4.88	92.68	15.68	2.17	s
	1.22	3	6.97	115.28	30.11	0.81	s
	0.97	23	12.89	220.21	54.36	3.24	f

	eggshell index	% shell thinning	HEOD	DDE	PCB	Mercury	nest successful = s failed = f
1987	1.21	4	1.98	52.78	16.67	2.14	s
	1.02	19	1.81	178.92	27.71	1.98	s
	1.25	1	3.05	110.31	34.73	2.70	s
	0.94	26	14.17	141.73	159.45	4.34	f
	1.03	18	32.55	189.15	77.36	4.18	s
			7.35	65.71	9.80	1.68	f
1988	0.98	22	3.58	105.79	116.01	3.68	s
	1.17	7	6.17	98.77	117.78	1.94	s
	+1.06	16	0.65	121.35	51.89	3.07	f
	+1.03	18	7.66	152.20	219.49	4.30	
	1.20	5	11.51	102.96	55.59	2.56	f
	1.21	4	8.62	166.09	165.23	5.15	s
	1.17	7	2.19	124.11	99.73	2.98	s
1989	1.35	7*	n d	44.17	32.77	2.24	s
	1.09	13	8.14	97.67	78.29	1.79	s
			3.49	100.78	51.94	2.46	s
	1.01	20	5.20	118.80	54.00	4.66	f
	1.22	3	3.52	126.02	152.44	0.69	s
	+1.17	7	2.57	61.09	64.63	2.49	s
	+1.22	3	n d	52.70	46.62	1.87	
	0.90	29	7.46	157.97	57.63	2.11	s

* shell thicker than pre DDT mean, + eggs from same clutch, n d not detected, — not tested

APPENDIX 2(b) Organochlorine, PCB and Mercury levels in liver tissue of Merlins. a = adult, y = yearling, n = nestling. Units are as described in Table 8.

	age	Dieldrin	DDE	PCB	Mercury
1983	n	0.09	0.24		
1985	n	0.06	0.34		
	n	0.06	0.49		
	n	0.06	0.64		
	n	0.08	0.52		0.21
	n	0.14	0.66		
	n	0.09	0.49		0.09
	n	0.11	0.55		0.12
	n	0.05	0.21		0.18
	n	0.04	0.20		
	n	0.04	0.44		
	n	0.04	0.47		
	a	0.16	2.32		0.65
1987	a	0.22	1.07	0.74	5.39
	y	0.42	1.30	0.34	1.62
	n	0.08	0.84	0.50	1.48
	n	0.11	0.22	n d	0.88
	n	0.09	0.20	n d	0.68
1988	a	0.05	0.44	0.53	1.58
1989	n	0.03	0.06	0.12	0.58

n d not detected

Distribution and number of feral Greylag Geese in Scotland

ALLAN W. BROWN AND GERALD DICK

The results of an enquiry on introduced Greylag Geese revealed 2,673 birds for Scotland in 1989 including some additional data for 1990 and 1991. Apart from the well known sites of release, information about feral geese was gathered from areas not previously documented. The current situation is discussed with regard to distribution and population trend.

This paper is dedicated to John Berry who initiated much of the early research on geese in Scotland.

Introduction

The Greylag Goose, *Anser anser*, was formerly a widespread breeding species in Britain but the native population, comprising 2,500-3,000 birds, is restricted now to north-west Scotland centred on the Uists (Owen *et al.* 1986, Paterson 1987, 1991, Thom 1986). Resident birds which occur elsewhere in Scotland at present are the result of reintroductions which have established feral populations. After a dramatic decrease of Greylag numbers early this century (Berry 1939), mainly due to persecution, efforts were made to establish feral flocks in south-west Scotland in the 1930s. An attempt to assess the establishment and size of the feral population in Britain and Ireland (Owen & Salmon 1988) suggested a total population in 1986 of over 13,700 birds, with at least 2,300 in Scotland.

The latter were based around four main locations – Loch Tummel (Tayside), Loch Achray (Central), Duddingston Loch (Lothian) and Galloway (Fig. 1). The purpose of this paper is to provide additional data on the establishment of feral groups throughout Scotland with an estimate of population size for the period 1989-91.

Methods

In September 1989 the Goose Research Group (Greylag Goose Sub Group) of the International Waterfowl and Wetlands Research Bureau (IWRB) contacted the Scottish Ornithologists' Club concerning the intention to publish an Inventory of Introduced Greylag Goose Populations. For the population in Scotland information was requested on each site or population, including year and origin of introduction, population size and trends, number of young produced per year and any other relevant material.

Given that published data on the size of feral flocks was likely to be incomplete, recording forms were sent to all SOC recorders to obtain the information required and enable a comprehensive assessment to be made of the distribution and size of the feral population in Scotland. Most of the results are for 1989, but some additional data for 1990 and 1991 have been incorporated.

Results

Recording forms were returned from all recorders and the results for each Region

(and District where appropriate) are given below (Fig. 1, Table 1).

Borders

Occasional sightings of birds in Tweeddale (Murray 1986) and elsewhere in the Region (*Borders Bird Reports* 1979-89) are thought to be from the Lothian population but no feral population has become established. However, in 1990 and 1991 one pair bred successfully at Baddinsgill Reservoir, Tweeddale.

Central

Wildfowlers released Greylag Geese in the area of Lochs Achray and Venacher in 1970 and 1971 (50 and 20 birds respectively) establishing a reserve for the Wildfowlers Association of Great Britain (WAGBI, now British Association for Shooting and Conservation BASC). BASC interest in the site apparently ceased around 1979. Owen *et al* (1986) and Owen & Salmon (1988) refer to a feral flock of 200 birds being established and still present in this area in 1985-86. However, although the maximum population of 200 birds was attained by the late 1970s, since then the release site has become overgrown, disturbed and subject to erratic water levels. This has resulted in the disappearance of the birds (C.J. Henty pers. comm.).

By the late 1980s the population had been reduced to about 50 birds which were based at Loch Katrine. These may have been the origin of the scattered breeding pairs now noted in the Trossachs, with occasional pairs or broods around the Lake of Menteith.

It seems likely that the counts referred to by Owen *et al* (1986) and Owen & Salmon (1988) are of wild/wintering birds as

FIGURE 1. *Regions of Scotland and breeding records of feral Greylag Geese after Thom (1986).*

FIGURE 2. *Regions of Scotland and main breeding sites of feral Greylag Geese, 1989-91.*

TABLE 1. Estimate of Minimum Number of Breeding Pairs and Minimum Total Population of Feral Greylag Geese in each Scottish Region in 1989-91.

Region	Number of Breeding Pairs	Total Population
Borders	1	2
Central	5	50
Dumfries & Galloway*	88	1,469
Fife	6	56
Grampian	3	6
Highland	48	331
Lothian	30	300
Orkney	6	12
Shetland	3	6
Strathclyde	16	55
Tayside	31	368
Western Isles	5	18
Total Scottish Population	**242**	**2,673**

*** Data refer to 1988**

opposed to feral flocks as they were in October and April (C.J. Henty pers. comm.). Both references are likely therefore to misplace and overestimate the present population which no longer occurs in the Achray – Venachar area; it is restricted to a small and scattered breeding population in the Trossachs, probably originating from the feral release in the early 1970s with a small group based on Loch Katrine. In 1991 only a few summer pairs (5+) were found in the Trossachs (C.J. Henty pers. comm.).

Dumfries and Galloway

The history of feral Greylag Geese in south-west Scotland has been well documented (Young 1972 a, b, Shimmings *et al.* 1989) and need only be summarised here. The species was introduced to the area around 1930 using birds reared from eggs taken from the indigenous Greylag population on South Uist, Western Isles. The initial release site was at Loch Inch near Stranraer (Wigtown) but during the 1930s further releases took place at Monreith (Wigtown). Since then the population has spread naturally, especially through Wigtown and Stewartry but also into Nithsdale. However, in addition a flock of about 30 birds was introduced to Glenkiln, Nithsdale, in the early 1980s for wildfowling purposes and three broods were recorded there in 1989 (E.C. Fellowes pers. comm.).

By 1971 the total population was estimated as 1,160 birds, and at least 129 breeding pairs reared 300 young (Young 1972a). Owen & Salmon (1988) considered the population as stable at around 1,500 birds in 1985-86 while Shimmings *et al.* (1989) recorded 1,469 birds in June 1988 at 18 sites with at least 88 pairs breeding and rearing 354 young.

The main centre of the population is still around Loch Inch (White Loch) with other concentrations at Castle Loch, Loch Dornal and Loch Moan (all Wigtown). Some of these areas also support substantial moulting and post-breeding flocks.

Fife

Smout (1986) refers to only a few pairs of feral birds trying to breed in recent years although wild birds are known to have bred at Morton Lochs and possibly Tentsmuir in 1930. A small flock formerly based around Tayport has not been reported for several years (D.E. Dickson pers. comm.). However, at least two pairs bred in Newport-on-Tay in 1990 and 1991 (J. Berry pers. comm.). A flock of up to 50 birds is present at Beveridge Park, Kirkcaldy (with three broods in 1991), but its origin and date of introduction is not known. One pair was present at Loch Gelly in 1990 and 1991 (B. Little pers. comm).

Grampian

A small flock was introduced to the Ballater area of Kincardine & Deeside in the early 1970s. The origin of these birds is not

known but the 2-3 pairs that now occur between Lochs Muick, Ullachie and Davan show no signs of increase (K. Shaw pers. comm.).

Highland

Feral Greylags have been released into several areas as follows, apparently from the native stock in north and central Sutherland and/or from the population in South West Scotland: –

a) Sutherland: Introductions occcurred at Loch Brora in 1937, and these resulted in 200 birds there in 1952; they were then reduced to only 30-40 birds and numbers have remained stable since then. The native stock on Loch Badanloch was reinforced in the 1960s to 60 pairs, and the population there is now about 500 birds; breeding has also occurred at Loch Shin (Owen *et al* 1986). In the 1950s around 10 birds were released in the Migdale/Spinningdale area and after remaining low in numbers up to the mid 1970s (maximum 30-40 birds), a noticeable increase has occurred in recent years. Breeding has extended to Loch Fleet and the overall population numbers between 200-300 birds (R.H. Dennis pers. comm.). The total feral population is likely to be a minimum of 285 birds with 30 breeding pairs. The presence of native stock is known to have resulted in inter-breeding with the feral birds, thus complicating assessment of the feral and native populations in this area (Thom 1986).

b) Ross & Cromarty: In the early 1960s about six birds were released at Loch Maree, and the population there has remained at 3-5 pairs.

c) Badenoch & Strathspey: In the early 1970s 5-10 birds were released at Loch Laggan, and 2-3 pairs still breed there. In the early 1980s they colonised the Inch Marshes and in 1989 they reached the Boat of Garten. The total population is thought to number 10-15 pairs. (R.H. Dennis pers. comm.).

d) Caithness: No feral population is known (E.W.E. Maughan pers. comm.) although breeding of native birds was reinforced with feral birds in the 1960s and mainly occurs around Loch Calder (Owen *et al.* 1986).

Lothian

13 feral Greylags were introduced to Duddingston Loch in Holyrood Park, Edinburgh, on 3 March 1961. The birds originated from eggs collected from the population at Loch Inch, Wigtown (J. Berry pers. comm.; Anderson & Waterston 1961). They were not recorded in wildfowl count data until 1965 (Owen & Salmon 1988). Since introduction, the population has become well established and, by the late 1970s, 200 birds regularly occurred in Holyrood Park with up to 15 pairs breeding at Duddingston Loch (Andrews 1986).

Holyrood Park has remained the principal base for the flock, holding 250-350 birds, the maximum in November 1990. 5-7 broods and 30-40 young have been found regularly at Duddingston Loch. However, the 1980s have also seen a considerable dispersal of breeding pairs and flocks throughout the Region, especially from spring to autumn (*Lothian Bird Reports* 1979-90). Breeding pairs have even occurred on the islands of Fidra and Inchkeith in the Firth of Forth.

Threipmuir Reservoir, by Balerno, is now an important location for flocks in late spring and autumn, holding 70 birds on occasion and with up to 7 pairs present (2-3 pairs regularly breeding) since 1984. The presence of a flock of up to 60 birds in the Aberlady/Dirleton/Eyebroughty area of East Lothian in summer since 1981 suggests that this area is used as a moult site. Since 1988 a small flock has become established in winter at Linlithgow Loch, West Lothian, with 25 birds in 1989 increasing to 50 in 1990.

Interestingly, it appears that most of the Lothian population returns to Holyrood Park to winter, although the presence of Icelandic wintering birds at Threipmuir Reservoir and the possibility that they mix

with the feral flock there in late autumn makes it hard to be sure about this.

It is estimated that the Lothian population consists of at least 300 birds with a minimum of 30 pairs breeding.

Orkney

1-2 pairs of unknown origin are thought to have been released in Orkney around 1984, and a further 19 birds in 1987. They occur on the West Mainland in the Kirkwall area and on Shapinsay and are believed to be increasing, although only six pairs were recorded breeding in 1989 (C.J. Booth pers. comm.).

Shetland

The first recorded breeding of Greylags occurred on Unst in 1985 (Scottish Bird Report 1986) and since then 2-3 pairs have bred annually and rear 10-15 young (D. Suddaby pers. comm.). There is no evidence to suggest that these birds were introduced to the island and they may well be wild birds either of Icelandic origin or from native Scottish stock, although the latter seems unlikely given that population's restricted range.

Strathclyde

Data here can be divided into three distinct areas:

a) Birds in the south of the Region, in the former county of Ayrshire (now Kyle & Carrick), form part of the introduced south-west Scotland population of Dumfries & Galloway. Feral birds were first recorded in Ayrshire in the mid 1950s and first bred at Loch Goosey in 1963 (R.H. Hogg pers. comm.; Young 1972a). No breeding birds were located by Shimming *et al* (1989) but a small stable or slightly declining breeding population of up to ten pairs is still present around Barrhill. R.H. Hogg (pers. comm.) considers that further expansion of the population is unlikely due to afforestation in the upland areas.

b) In the rest of mainland Strathclyde small populations have been introduced from sources unknown and become established since the mid 1970s at several locations in the Clyde Valley/Glasgow areas such as Hogganfield Loch, Lochend Loch and Kilmalcolm area. Hogganfield is the main centre with up to 35 birds present in 1990, while the breeding population overal is probably at least six pairs (I.P. Gibson & B. Zonfrillo, pers. comm.).

C) Most birds recorded in Argyll & Bute have been primarily on the islands and are thought to be native birds which have colonised from the Western Isles. No details have been obtained of a 'sizeable' flock of feral birds believed to occur on Bute (M. Madders pers. comm.).

Tayside

A small flock was introduced at Lochs Tummel and Faskally, Perth & Kinross, around 1964 when six adults and seven juveniles were seen. Only 16 were present in June 1975, but there were 103 in June 1980 and then the population built up to a peak of 278 (including 61 young) in June 1983 (Scottish Bird Report 1984). It appeared to decrease to under 100 birds by 1988. However, 1989 saw a dramatic increase, with 226 birds (including 40 young) present in July.

Smaller groups totalling 20-30 birds in 1988 occur at the nearby Loch Rannoch and Dunalastair Reservoir, but most of the population remains around the south side of Loch Tummel (W. Mattingley pers. comm.). The breeding population is probably around 25 pairs.

In addition, in early autumn (August/September) 1987 and 1989, between 60 and 100 birds were recorded at the Loch of Clunie, West of Blairgowrie, and breeding there was also confirmed in 1989. It seems likely that this group may represent a separate feral colony of unknown origin (W. Mattingley pers. comm.; *Perth & Kinross Bird Report* 1989).

In the 1960s occasional breeding took place at Loch Leven but a pair with young in 1982 was the first confirmed breeding

there for several years (Wright 1986). 48 young were recorded in 1988 and 62 birds (19 of them young) in 1989 (*Perth & Kinross Bird Report* 1989) suggesting a breeding population of over five pairs. It is thought that these are injured birds from the Icelandic population and that their failure to increase into a sizeable flock may be because the young depart with the wild birds (A. Lauder pers. comm.).

Western Isles

Within the main breeding area for the native population in the Uists there are no known feral flocks. However, on Lewis, which holds only 10-15 pairs of native birds (Thom 1986), there is a stable flock of 18 birds (5+ pairs) by Stornoway where they were first introduced about 1980 (W.A.J. Cunningham pers. comm.).

Table 1 presents a summary of the results with an estimate of the number of breeding pairs and total population for each Region. This suggests a minimum Scottish breeding population of 242 pairs and a minimum total population of 2,673 birds.

Discussion

Baxter & Rintoul (1953) made no mention of feral Greylag Geese while Bannerman (1957) referred to feral birds in south-west Scotland and Caithness and Sutherland but with little detail. Feral birds are probably not recorded by many birdwatchers, especially when they hybridise so easily with native geese as well as other goose species. However, results of this assessment of the feral Greylag population indicate it is very much a part of the Scottish avifauna. Indeed it appears to be more widespread and numerous than suggested by Owen & Salmon (1986) because they concentrated on the main long established flocks which are still the principal centres of the population, except for that in Central.

If, as seems likely, the population has been under-recorded then it is likely that other smal flocks exist elsewhere in Scotland. These may have arisen from introductions which have never been reported, while other releases that have failed will not have been submitted as part of this survey e.g. the small flocks that existed in Aberdeenshire in the 1970s (Buckland *et al.* 1990). Also, injured wild birds will on occasion attempt to breed and may be confused with members of the feral population.

Most introductions in the 1960s and 1970s were for wildfowling purposes, mainly from eggs obtained from the south-west Scotland population, and it appears that Caithness and Sutherland was a favoured release area (Owen *et al.* 1986). This must have caused problems in identifying feral birds when in close proximity to the native stock and some mixing of the groups is likely to have occurred. Elsewhere it appears that the released birds remain in fairly discrete groups with little or no migratory movements, even when joined by Icelandic birds during the winter months.

This would suggest that a co-ordinated census of the breeding and total population of feral Greylag Geese would readily identify the overall population of each specific group without the need for any concern over movement between grops which would complicate population assessment. Such a census would be a useful means of assessing more completely present distribution and whether or not the introduced birds, in the absence of new introductions, are dispersing and colonising new sites around their original release area as has happened in south-west Scotland and, more recently, in Lothian and in Highland.

The factors affecting the successful establishment and subsequent expansion of a feral flock are likely to include the level of shooting, predation and disturbance, the availability of suitable nest sites and the extent of available feeding. The last of these is balanced against the potential to cause damage to crops, which results in increased

shooting pressure or control of numbers through egg collecting.

Shimmings *et al.* (1989) have shown that the average increase in the South West Scotland population was only 2.4% per year for the period 1966-88 compared to 13% for Britain as a whole. They felt this was due to human persecution keeping the population in check. The weather also may be an important factor for a sedentary population as severe winters may increase mortality. The recent run of relatively mild winters in Scotland may be the reason for the increase in dispersal of the Lothian birds during the 1980s.

Owen & Salmon (1988) estimated the feral Greylag population of Scotland at 2,300 birds in the years 1985-1986 while this survey found 2,673 (Table 1). This is about the same number as in the native population (2,500-3,000 birds). These figures clearly indicate that the population growth of 13% p.a. predicted by Owen & Salmon (1988), which would have led to a population of 3,750 birds in 1990 in Scotland, did not occur. Although the feral stocks may have increased locally (e.g. in Lothian), on the whole population growth seems now to be limited by availability of suitable and safe nesting sites, and by disturbances (and probably persecution) as well as shooting.

The origin of most of the released birds can probably be traced back to the native Scottish stock. These introductions served mainly to benefit wildfowlers, rather than to increase the population whereas, to prevent a further decrease in numbers, an end to persecution and to habitat deterioration would have been a better conservation tool.

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Colonisation and population growth by Gannets at Fair Isle

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This paper records the colonisation, in 1974, and growth of the Fair Isle Gannet colony. There were two periods of rapid expansion, 1974-83 and 1985-89. There was no population growth in 1990-91. By 1985 birds were breeding at eight localities. Each locality was occupied by non breeders, in 'clubs', prior to breeding, and increases in numbers of birds ashore preceded increases in the breeding population. Population growth was considerably greater than overall North Atlantic population growth, peaking at 48.8% per annum in 1985-89, and was achieved largely through recruitment from other colonies. Breeding success was lower than that published for some long established colonies. Food brought to chicks included herring, mackerel and sandeels and chicks continued to fledge during a period of sandeel shortages. Non breeders were ashore at a number of new localities from 1986 and space is not a limiting factor for further population growth.

Introduction

The growth of the North Atlantic Gannet *Sula bassana* population this century has been well documented (Gurney 1913; Wynne-Edwards, Lockley & Salmon 1936; Fisher & Vevers 1943-44, 1951; Cramp, Bourne & Saunders 1974; Nelson 1978; Wanless 1987). Scotland is of international importance for the species. Population growth led to the estabishment of six new colonies, three of them Scottish, between 1970 and 1985 (Wanless 1987). Fair Isle was one of these and this paper describes the colonisation and growth of this colony.

Material and Methods

Information gathered included counts of birds ashore, number of apparently occupied nest sites, the dates on which birds were first noted ashore, breeding success, food brought to chicks and feeding behaviour of adults. Apparently occupied nest sites were defined as sites suitable for breeding and occupied by one or two adults with at least some nest material present. Successful fledging was defined as live chicks large enough to fledge at the last observation. Data were collected from vantage points on Fair Isle and supplemented by observations from the sea. The last date for information used in this paper was July 1991, and 1990 the last year for breeding success data.

Results

Counts of birds ashore. The first Gannets seen ashore were 7 in 1969 (Table 1). Up to 450 were seen regularly ashore from 1972 to 1984. It was not possible to demonstrate the exact rate of increase of birds ashore because counts were made irregularly.

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Baillon's Crake, Porzana pusilla, Fair Isle, Shetland, September 1991 *(Dennis Coutts)*

(D.E. Dickson)

(I.G. Cumming)

Chimney Swift, Chaetura pelagica, St Andrews, November 1991

Pied Wheatear, Oenanthe pleschanka, Shetland, October, 1991 *(Dennis Coutts)*

Pied Wheatear, Oenanthe pleschanka, Shetland, October, 1991 *(Dennis Coutts)*

TABLE 1. Maximum counts of Gannets ashore at Fair Isle, 1969-88.

1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
7	0	0	30	300	101	8	nc	450+	208
1979	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**
190	400	310	289	450	450	1100	4000	2000	1000

nc = no count

However, there was a large increase from 1985, with maximum counts in 1985-88 2.5 to 9 times higher than the maximum 1977-84 count. No counts were made in 1989-91.

A considerable increase of club birds occurred from 1985 and this heralded an acceleration in the rate of increase of breeding pairs, which from 1986-89 averaged 48.8% per annum, the highest sustained increase of any four year period. No new localities were colonised after 1985, but non breeders were regularly ashore from 1986 in a number of new areas, including Haaluv in the west, Gumpin in the south-west and Da Burrian in the south-east of the isle.

Nest counts and colonisation of new localities. The number of nests increased annually until 1990, apart from 1984 when a 45% decrease occurred. (see Table 2). The first breeding locality was Dronger, where the first nests were built in 1974. Yellow Head was colonised in 1978, Inner Stack in 1980 and Kirki Stack (also known as Outer Stack), Toor o Ward Hill and Matchi Stack in 1981. One pair bred on a narrow Sheep Rock ledge and two pairs bred at North Felsigeo in 1982. There were no further breeding attempts at Sheep Rock, and North Felsigeo was temporarily abandoned in 1983 and 1984. The latest locality to be colonised was Kame o Guidicum, in 1984. Breeding localities are marked in Figure 1.

The mean rate of increase during the main period of expansion, 1975-89, was 30.1% per annum. However, there were large annual variations. There was a marked initial colonisation, slow growth in 1978-79 and three years of rapid growth in 1980-82. A decline in the rate of increase in 1983 was the prelude to the only marked decrease, in 1984. This was followed by a period of strong increase in 1985-89 and a levelling off of the population in 1990-91. There was a similar pattern to peak numbers of birds sitting ashore. In all years, a large proportion of birds ashore were non breeders. This was established by their choice of locality (e.g. the storm washed Da Fless) and the inclusion in these 'clubs' of birds in various stages of immature plumage. Most immatures were, however, in third to fourth year plumage (i.e. an estimated one to two moults short of full adult plumage).

Arrival dates of Gannets. Birds were first ashore in late June or July in 1969 and 1972-73 but in 1974 four were ashore on 26 April and in 1975 the first date ashore was 11 April. As the population grew birds came ashore earlier, attending nest sites in March in each year, 1976-80, and prior to March in 1981-91. The earliest recorded date was 7 February in 1981. There was no observer coverage in the early part of subsequent years, but island inhabitants confirmed that birds were ashore by at least the end of

TABLE 2. Number of occupied nest sites on Fair Isle by locality, 1974-91, and annual rates of change in breeding population, 1976-91.

	KG	MS	TW	NF	DL	KS	IS	YH	SR	Tot	% change from previous year
1974					3					3	
1975					17					17	
1976					27					27	59
1977					34					34	26
1978					36			1		37	9
1979					38			2		40	8
1980					c50		2	6		c58	45*
1981		3	27		nc	nc	nc	nc		100+	72*
1982		nc	nc	2	nc	nc	nc	nc	1	172	72*
1983		nc	nc		nc	nc	nc	nc		c200	16*
1984	3	6	40		41	4	14	13		121	−45*
1985	5	9	40	2	49	12	5	16		138	14
1986	15	16	65	47	58	17	17	23		258	87
1987	12	14	53	118	51	19	16	21		304	18
1988	18	20	69	190	78	47	34	32		488	61
1989	14	27	79	213	89	167	56	31		676	39
1990	14	24	81	218	67	164	55	31		654	−3
1991	15	19	92	243	71	163	53	31		687	5

Key: KG = Kame o Guidicum; MS = Matchi Stack; TW = Toor o Ward Hill; NF = North Felsigeo; DL = Dronger ledges; KS = Kirki Stack; IS = Inner Stack; YH = Yellow Head; SR = Sheep Rock; nc = nests present but individual locality count not recorded
*** % change in each year, 1980-84, approximate: calculated from imprecise figures**

February, and probably early February, in all years 1981-91.

Breeding success. Breeding success was monitored annually in 1974-77 and from 1986. Only casual observations were made in 1978-85, leading to comments such as 'most chicks fledged' (FIBO Reports 1979-81). Measurement of breeding success in 1974-77 was achieved by counting all nests with eggs or tightly incubating adults and recording the number of young which when last seen were at fledging or near fledging age. The same criteria were used in 1986-90 but breeding success was measured from annual samples of 107-159 nests, the sample comprising all nests readily visible from mainland vantage points. Each nest in the sample was watched to confirm presence of an egg but nests where eggs were not seen, because of prolonged incubation by an adult, were also included. The sample comprised 48% of the total number of nests in 1986 but had declined to 22% in 1989 as more and more nest sites became established on outer stacks. The mean breeding success in 1975-77 was 0.58 chicks per nest (range 0-0.78) and 0.66 in 1986-90 (range 0.48-0.78) (Table 3).

Food and feeding. Seven food samples regurgitated by chicks and adults attending chicks were collected at Matchi Stack and one at Kame o Guidicum in 1989. A single mackerel *Scomber scombrus* was present in one sample and two mackerel in another. The other samples were all herring *Clupea harengus*, comprising a single fish in each

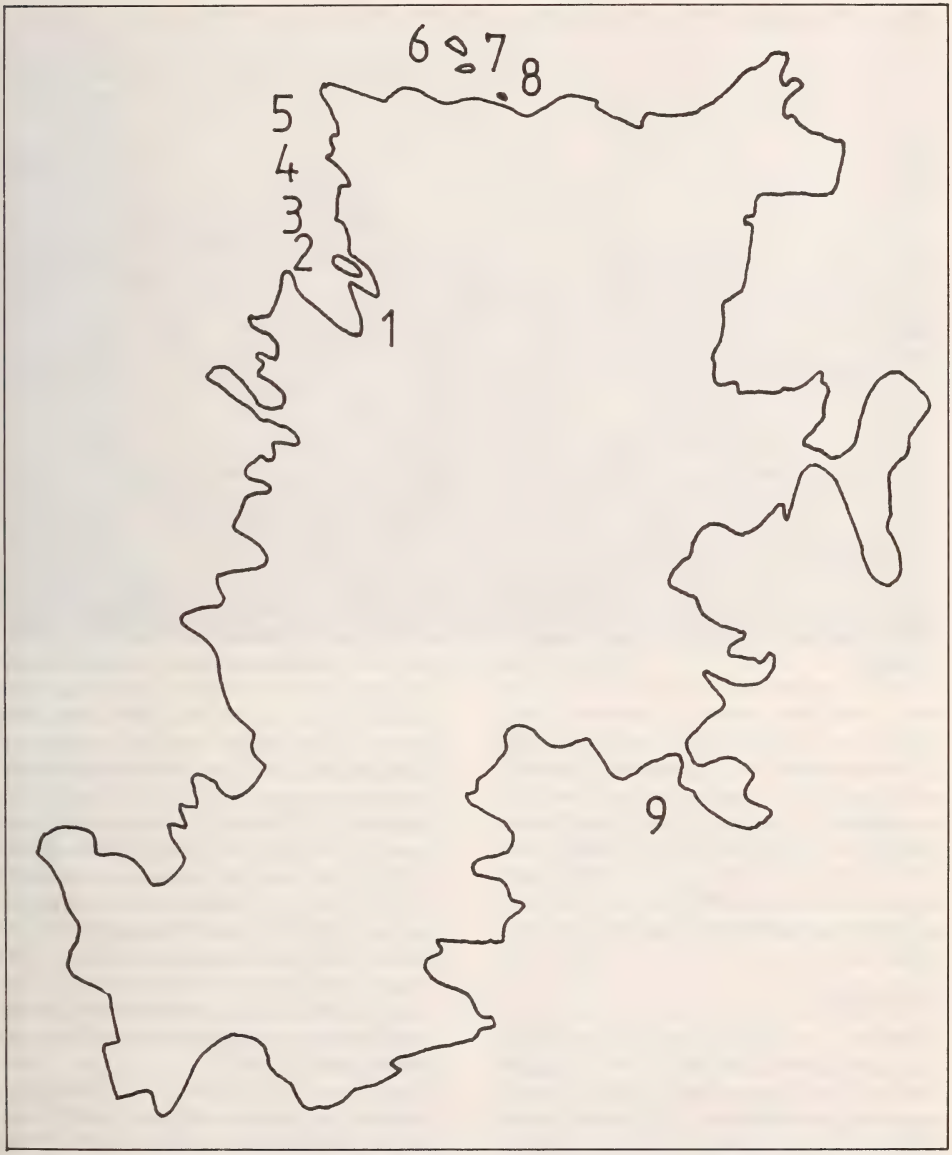

FIGURE 1. Sketch map showing the positions of Gannet breeding localities on Fair Isle.

KEY:

1 = Kame o Guidicum	2 = Matchi Stack	3 = Toor o Ward Hill
4 = North Felsigeo	5 = Dronger ledges	6 = Kirki Stack
7 = Inner Stack	8 = Yellow Head	9 = Sheep Rock

TABLE 3. Breeding success at monitored nests, Fair Isle, 1974-77 and 1986-90.

	Monitored nests	No. of chicks fledging	Mean success rate
1974	3	0	0
1975	8	3	0.38
1976	18	14	0.78
1977	26	15	0.58
1986	124	84	0.68
1987	107	51	0.48
1988	126	98	0.78
1989	147	114	0.78
1990	159	95	0.60

of 3 samples and 2 in each of the other three. Three of the 'double' samples (2 herrings and one mackerel) were hardly digested complete fish, one herring measuring c 350mm and each of the other five fish c 300mm. A single regurgitated mackerel was obtained from an adult attending a chick at Yellow Head in 1985. Adults were occasionally observed plunge diving offshore, particularly off the stacks of the north coast and were also observed flying long distances from the isle, most frequently in the direction of Shetland. Although analysis of 1991 food regurgitates are not yet complete, 14 out of 16 samples obtained from Yellow Head and Matchi Stack in 1991 comprised sandeels. This was not unexpected because 1991 was the first year of sandeel abundance for which we have food data.

Discussion

Colonisation of Fair Isle occurred soon after a 21 year period, 1949-69, in which the North Atlantic Gannet population increased at a rate of approximately 3% per annum (Nelson 1978). Growth and expansion at Fair Isle occurred during a period (1969-85) when the North Atlantic population continued to increase at an estimated rate of 2% per annum (Wanless 1987). Growth on Fair Isle in 1975-89 was at a rate of 30.1% per annum and it reached 48.8% per annum in 1985-89. Both colonisation and subsequent growth on Fair Isle were the result of the long period of growth of the North Atlantic population. Gannets do not usually breed before five years of age (Nelson 1978) so there was no possibility of recruitment by birds hatched on Fair Isle to the breeding population prior to 1980. Annual colony increases of more than 5% are considered to indicate net immigration (Nelson 1978). Apart from 1984, when there was a 45% decrease in the number of breeding pairs, the smallest annual rates of increase in the period 1974-1989 were 9% and 8%, in 1978 and 1979 respectively. Thus immigration to the breeding population of birds fledged at other colonies continued to play a major part in the Fair Isle growth to at least 1989. The origin of colonists was not known, the only ringing evidence being rather inconclusive – a Hermaness 1980 hatched bird rescued from discarded fish net on a Fair Isle beach some distance from nest sites in May 1988.

Nelson (1978) showed that some new colonies, such as Bempton and Great Saltee, showed a sudden and rapid increase whereas this tended not to happen at populous and long established colonies. Wanless (1987) demonstrated that rates of increase at east Atlantic gannetries were smallest at long established and larger colonies. This may have been due to lack of space for further

Gannets have colonised Fair Isle's north coast and outlying stacks. **N. Riddiford**

massive expansion in densely occupied colonies. Nevertheless, the rate of increase at Fair Isle in 1969-85 was the highest of any North Atlantic colony except at other small colonies on the Shetland island of Foula and Hovsflesa in Norway (Wanless 1987). Birds sitting ashore and occupying nests may have attracted potential first time nesters, thus encouraging strong recruitment and growth.

Data on breeding success were obtained in the three years following colonisation and from 1986. Success in both periods was lower than the breeding success of approximately 0.75 chicks per nest recorded from three British colonies by Nelson (1978). The 1986-90 success rates were calculated from samples of nests in the longest established parts of the Fair Isle colony. Nelson (1978) found that inexperienced birds at Bass Rock, Scotland, hatched 20% fewer eggs than experienced breeders. More recently, established nests on Fair Isle's outer stacks probably included a greater proportion of first-time and inexperienced recruits to the population. Results obtained from monitored sites may therefore have over-estimated breeding output of the colony as a whole.

In 1986-90 Fair Isle and Shetland seabird species which were primarily surface sandeel feeders were experiencing breeding failures, apparently as a result of food shortages (Heubeck 1989; Harris & Riddiford 1989; Harvey *et al.* 1989). Gannets were not affected because they were able to obtain prey below the surface by plunge diving, have a large foraging range (Nelson 1978), and are able to find alternative food sources.

In other colonies it has been shown that 'clubs' comprise pre-breeders some of which probably eventually contribute to the breeding population (Nelson 1978). Though some club birds sat in unsuitable breeding

Dronger, the first site to be colonised by Gannets. **N. Riddiford**

sites, non breeders were known to have assembled at all eventual breeding localities and this may have been a necessary prelude to colonisation of the locality. The size of the club was probably an indication of subsequent rates of recruitment. Thus population growth in the mid 1970s followed an early club peak in 1973, and another major period of recruitment in 1980-82 may have been related to the count of 450+ in 1977. Rather lower peak numbers in 1978-82 presaged the lower rate of increase in 1983 and the only marked decrease, in 1984.

The only reversal to the trend of annual population growth prior to 1990 was in 1984, when counts revealed 45% fewer nests than in 1983. The reason for this decrease was not known, but suggested an atypically high loss of breeding birds, little or no recruitment or both factors combined, and this may also have contributed to years of relatively small growth in 1983 and 1985. It may also have been a factor in the two year absence of nests at North Felsigeo after 1982; and the failure of birds to permanently colonise Sheep Rock despite successful fledging of a chick there in 1982 and the existence of suitable looking broad ledges at the south-east corner which had attracted birds in the pre colonisation years of 1969 and 1972-73. This short-term decrease coincided with a decrease in the rate of increase in 1982-85 in four of five Norwegian colonies (Montevecchi *et al.* 1987) and a decline in 1984 at two monitoring plots at Noss, Shetland (Tyler & Dixon 1984).

One of the most popular club locations throughout the 1970s-80s was the tip of Dronger, a large area of horizontal, stepped rock strata capable of supporting a very large number of breeding pairs. Unlike the nearby breeding locality of Dronger ledges

it is accessible, being at the base of a steep grassy slope. Disturbance is low as the steepness of the slope discourages most humans from visiting the area but sheep probably make more frequent incursions and this may be sufficient, at present, to discourage nesting attempts. Other recently attended locations were offshore stacks, some of which could potentially support a considerable number of breeding pairs. Thus, though some localities such as Yellow Head were probably at maximum carrying capacity by 1989, space should not limit further growth. Though the second phase of dynamic expansion, from 1985, appeared to have ended by 1990, peak counts of non breeders ashore in 1986-88 consistently numbered 1000+ and the possibility remains of a further period of growth, particularly if the North Atlantic Gannet population continues to increase.

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Counts of Seabirds in Easter Ross in 1969-91

R.L. SWANN

This paper records counts of seabirds on the Easter Ross coast of the Moray Firth. The Firth holds internationally important colonies of seabirds the largest being on the east coast of Caithness, where approximately 141,770 auks and 76,851 pairs of other seabirds were counted in 1977 (Mudge 1986). In Grampian, there is another large and well documented colony at Troup and Pennan Heads, estimated in 1986 to hold 17,500 auks and 20,600 pairs of other seabirds (Lloyd & North 1987). Between these large colonies, the Inner Firth holds only small numbers of breeding seabirds, mainly gulls and terns (Lloyd *et al.* 1991), except on the coast of Easter Ross and particularly the North Sutor of Cromarty. Although there has been a lot of ringing there since the 1960s, little has been documented about it. Seabirds along the whole coast from Nigg Ferry to Portmahomack (Fig. 1) were counted in 1969 as part of the 'Operation Seafarer' project (Cramp *et al.* 1974) with the

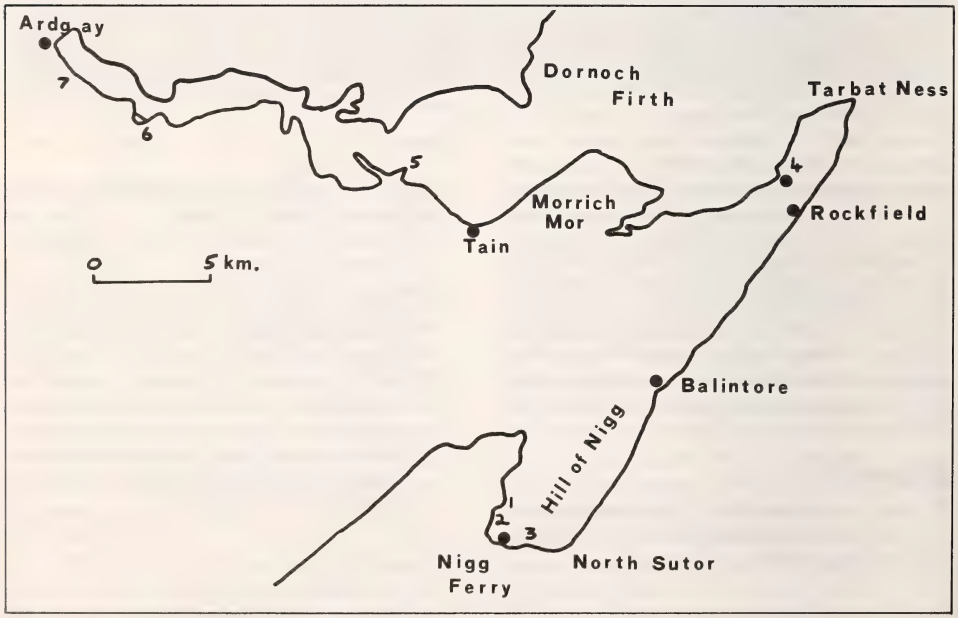

FIG. 1 **Places where seabirds were counted in East Ross 1969-91.**

KEY

1 BP Oil Terminal
2 Highland Fabricators
3 Castlecraig Quarry
4 Portmahomack
5 Ardjachie Point
6 Mid Fearn Mere
7 Ardchronnie Quarry

intention of a recount in 1984-1987 for the Seabird Group/NCC Seabird Colony Register. These counts provided the information for species totals and details of regional changes in seabird breeding numbers produced in 'The Status of Seabirds in Britain and Ireland' (Lloyd *et al.* 1991). However, the coasts from Balintore to Portmahomack and around Nigg Ferry were omitted from the second survey. In addition, counts of gulls for the North Sutor itself may have been underestimates because most were done from the sea so that parts of the colony were overlooked. But in May and June 1991, all breeding seabirds between Nigg Bay and Portmahomack were counted, and information was also gathered from smaller colonies on the south side of the Dornoch Firth.

Methods

All colonies were visited on foot between 26 May and 28 June and in addition the North Sutor was also counted from the sea. Units and methods used follow recommended counting techniques (Seabird Group/NCC Seabird Colony Register Instructions). Apparently occupied sites were counted for Fulmar *Fulmarus glacialis*, apparently occupied nests for Cormorant *Phalacrocorax carbo*, Shag *Phalacrocorax aristotelis*, Kittiwake *Rissa tridactyla*, gulls and terns and individual birds on land in the case of Guillemot *Uria aalge* and Razorbill *Alca torda*. We used the method for measuring breeding productivity developed by Harris (1989) photographing or sketching a colony in mid May and following the status of each nest through a series of visits till the number of large chicks fledging was noted. This was done at North Sutor in 1990 and 1991 for Kittiwakes and in 1991 for Cormorants. In addition reasonably accurate counts were made at Nigg of the numbers of fledged young terns and of Great Black-backed Gulls *Larus marinus*, produced inside a fenced area.

Results

Most seabirds were at the North Sutor. Counts in 1969, 1984 and 1991 (Table 1) show an apparent continuing increase in the numbers of Cormorants, Shags, Kittiwakes, Guillemots and Razorbills. Both Herring *Larus argentatus* and Great Black-backed Gulls declined, whilst Fulmars peaked in the mid 1980s and then declined. For Cormorant the 1969 figure was very low. In 1969 110 nests were located on the South Sutor, giving an overall total of 197 nests in the area. In recent years, all the birds nested on the North Sutor in two distinct groupings.

Table 2 shows numbers at other places on the Easter Ross coast between Balintore and Portmahomack. Herring Gulls mostly declined, particularly south of Rockfield, though a new colony appeared north of Portmahomack and 9 pairs nested on roof tops in Portmahomack. Fulmars also

TABLE 1. Numbers of seabirds counted at the North Sutor.

	1969	1984	1991
Fulmar	779	1393	1014
Cormorant	87	203	259
Shag	25	30	136
Herring Gull	2950	350	404
Great Black-backed Gull	325	10	93
Kittiwake	400	329	568
Guillemot	750	933	1270+
Razorbill	60	41	95
Black Guillemot	0	2	4

Notes: For units see text.
Herring and Great Black-backed Gulls were counted in 1986 not 1984 and the figures quoted are the maximum counts taken from estimates. The Guillemot figure for 1991 is an underestimate as it was known that many chicks had already left the colony. A truer figure would lie between 1500 and 2000 birds. The 1991 counts may be high for some species due to a combination of counts from both land and sea. (The 1984 counts were mainly from the sea.)

TABLE 2. Numbers of seabirds counted on the East Ross coast from Hilton to Portmahomack.

	Hilton-Rockfield		Rockfield-Tarbat Ness		Portmahomack-Tarbat Ness	
	1969	1991	1969	1991	1969	1991
Fulmar	550	431	252	188	0	0
Herring Gull	2750	38	300	200	0	115
Great Black-backed Gull	7	2	4	6	0	7
Arctic Tern	6	1	0	126	25	0

Note: The 1969 counts were done in mid-July and are therefore likely to be underestimates.

showed a decrease on this section of coastline.

Terns nesting at Dunskeath, Nigg Ferry in 1969 have been displaced by Highland Fabricators Oil Platform Yard and the BP Oil Terminal for the Beatrice Field. The increase shown in Table 3 is due to terns and gulls now nesting within the confines of the yards (mainly at the oil terminal) where they are relatively free from disturbance and predators.

Elsewhere in the area 100 pairs of Great Black-backed Gulls and 250 pairs of Common Gulls *Larus canus* nested on the Hill of Nigg in 1969, but none now do because the hill has been reclaimed for agriculture. Six pairs of Common Gulls nest in the quarry at Castlecraig. The Morrich Mor held 16 pairs of Common Gull, 200 pairs of Herring Gull, 1000 pairs of Sandwich Tern *Sterna sandvicensis* and 20 pairs of Common Tern *Sterna hirundo* in 1969. Now only six pairs of Common Gulls nest there plus another 20 pairs on the old airfield. Although stupification exercises were carried out by the RAF in the early 1970s, increased disturbance on the bombing range and high fox predation are thought to be responsible for the drop in numbers. West of Tain there was a colony of 100 pairs of Arctic Terns *Sterna paradisaea* at Ardjachie Point in 1969. In 1991, 2 pairs of Common Terns and 5 pairs of Common Gulls attempted to breed but failed. A small Common Tern colony now exists on a small island in Mid Fearn Mere, where 20-30 pairs have nested in recent years along with 10-20 pairs of Black-headed Gulls *Larus ridibundus*. This is now the only colony of Black-headed Gulls in the area. All those previously found on inland lochs and pools have disappeared, but 120 pairs of Common Gulls and 20 pairs of Herring Gulls nest in the actively worked Ardchronnie quarry 2.5 km east of Ardgay.

TABLE 3. Numbers of seabird counted at Nigg Ferry.

	1969	1991
Common Gull	0	15
Herring Gull	0	3
Great Black-backed Gull	0	27
Common Tern	30	115
Arctic Tern	30	72

Numbers of young Cormorants and Great Black-backed Gulls fledged per occupied nest in 1990 and 1991 in Easter Ross were very high, that of Kittiwakes average, with terns very variable (Table 4). Arctic Terns had almost total failure in 1990.

Discussion

In Easter Ross between 1969 and 1991, major increases in numbers were recorded for Cormorants (31%). Shags (444%),

TABLE 4. Breeding productivity of selected East Ross seabirds.

	1990		1991	
Cormorant			2.54	(n=37)
Great Black-backed Gull			2.0	(n=20)
Kittiwake	0.84	(n=98)	0.89	(n=114)
Common Tern	0.57	(n=65)	1.2	(n=117)
Arctic Tern	0.03	(n=63)	0.65	(n=72)

Note: Units are the number of young fledged per occupied nest. Sample sizes are given in brackets.

Kittiwakes (42%), Guillemots (100+%) and Razorbills (58%). Fulmars showed a smaller increase of 3.2%. Gulls, however, showed major decreases (−60% for Great Black-backed Gulls and −87% for Herring Gulls).

The Cormorant colony at North Sutor is the second largest in Scotland (Lloyd *et al.* 1991). In 1991, breeding productivity was high (Table 4). The Shag colony is also doing well and has shown a very large increase in numbers in recent years unlike many other colonies where Shags have declined (Walsh *et al.* 1991). Guillemots, Razorbills and Kittiwakes also appear to be continuing to increase in numbers despite widespread decreases recorded in other regions (Walsh *et al.* 1991). Fulmar numbers appear to have peaked and are now declining. The biggest declines have been amongst the large gulls, and occurred in the early 1970s (A. Scobbie pers. comm.). Numbers now appear to have stabilised at a much lower level. Counts were made of apparently occupied nests, but it was noted that all colonies held substantial, but varying numbers of non-breeding adults.

Why have some seabirds continued to increase but the gulls have decreased in numbers? Major declines of Herring and Great Black-backed Gulls in SW Wales were shown to be coincident with botulism poisoning of adult birds feeding on refuse dumps during the breeding season (Sutcliffe 1986). There is no evidence of this in Easter Ross. In the late 1960s and 1970s, the Moray Firth was the location of a large winter fishery for 0-1 year old sprats *S. sprattus* which peaked in 1966 and had collapsed by 1979/80 (McKay 1983). There has been a decline in the amount of Herring and demersal fish caught in the Moray Firth since the 1960s. Overall, the amount of time spent fishing in the Moray Firth by both seine netters and light trawlers dropped from around 200,000 hours a year 1963-69 to 100,000 hours a year 1972-81, and to even lower levels more recently (Hopkins 1986). Hudson & Furness (1988) have shown that discards from fishing boats provide an important food supply during the breeding season for a number of seabird species including Fulmar and gulls. The demise of these fisheries may well be responsible for the major decrease in gull numbers since 1969. The remaining gulls plus the Kittiwakes and auks are now mostly feeding on sandeels and a few sprats (pers. obs.). Sandeels still appear to be available in large numbers, supporting not only the seabirds but also seals (P. Thomson pers. comm). The breeding productivity figures also support the view that this food is still fairly plentiful locally.

The increase in numbers of some species is unlikely to be totally due to high breeding productivity. There is evidence from ringing of movements into the North Sutor colony. Three Guillemots ringed as chicks in Caithness have been caught at North Sutor, two of which were definitely breeding. One Kittiwake chick ringed in Caithness was also breeding and a two year old Shag colour ringed as a chick in Caithness was defending a site on North Sutor in 1991.

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Operation Seafarer and Arctic Terns

W.R.P. BOURNE AND
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Recent criticism of 'Operation Seafarer' tern counts in Shetland on the grounds that they must have been low because they were made late in the season and did not cover the whole of Shetland fails to allow for the fact that the organiser of the entire enquiry camped at two of the sites involved and personally examined most of the rest at the peak of the breeding season. The history of Arctic Terns in the northern Scottish isles is re-examined; their breeding success is known to have fluctuated with the number of sand-eels present which may in turn be related to the number of larger fish for at least 75 years. There may have been an exceptional concentration to exploit a flush of sand-eels in north-west Orkney in the early 1970s. The birds then dispersed throughout first Orkney and then Shetland as well over the following decade, and despite seven lean years there may still be two to three times as many in Shetland as there were in 1969-70.

Introduction

Since it appears from a contribution by Avery (1991) that it has already been forgotten how the first comprehensive national census of all British and Irish breeding seabirds, 'Operation Seafarer[1], was organised, and he questions the results for the Arctic Tern *Sterna paradisaea* in Orkney and Shetland in particular, it may be useful to re-examine them and their implications.

Operation Seafarer

'Operation Seafarer' was based on over a century of surveys of individual seabird species culminating in three decades of decennial censuses of the Gannet *Sula bassana* and Fulmar *Fulmarus glacialis* organised by James Fisher, subsequently joined by John Coulson with the Kittiwake *Rissa tridactyla*. When Bourne (1965) observed, at the start of the discussions that led to the formation of the first Seabird Group, that such surveys wasted labour and resources, and it would be more economical to count all our seabirds in the process, Fisher enthusiastically agreed. Therefore one of the first actions of the Group was to appoint him Chairman of a Census Committee set up to carry out the first comprehensive census, which he christened 'Operation Seafarer' after the 7th century Anglo-Saxon poem which first mentions several important species including the 'stearn' (Fisher 1966). Unfortunately, owing to his early death, he never received fair credit for this initial planning.

The Census Committee first convened a meeting of experienced observers. It was agreed that, while current counting

techniques were often imprecise, owing to imminent North Sea oil development it was more important to have a baseline against which to show its impact (eventually small, perhaps owing to the precautions taken), than to refine them; and indeed, many difficulties have still not been overcome. It was decided to use as the basic unit an apparently occupied nest-site, except for the Common Guillemot *Uria aalge* which builds no nest, when the birds would be counted, and record the results for all species on one card for each colony. While Bourne made the preliminary arrangements as secretary of the Group, once finance became available from superfluous funds subscribed for the Torrey Canyon Seabird Appeal the Group advertised for a full-time organiser, and appointed Saunders.

The formation of the Seabird Group led to many offers of assistance from the public and other organisations including the RSPB. Several RSPB staff helped run the Group, while the Chairman, Stanley Cramp, later also agreed to serve the Group and then, when we lost James Fisher, its Census Committee in the same capacity, making the facilities of the *Birds of the Western Palearctic* available for the preparation of the report (Cramp *et al.* 1974), greatly expediting its publication. Since there appears to be confusion in Scotland over the role of the Nature Conservancy Council, it should also be noted that, while many of their individual staff were very helpful and they were given a copy of the results as a public service which has served as the basis for subsequent activities, they played no other part in the original Operation Seafarer. We have therefore became rather sensitive over the regular attribution of its results to them (Bourne 1991).

The census was carried out by over a thousand volunteers. It was obvious that the northern isles of Scotland would present difficulties, so in addition to sending some 15 individuals and parties there, a major expedition organised by Norman Hammond was sent to north-west Orkney (Hammond 1975), and the Organiser took a caravan to Shetland in the summers of both 1969 and 1970 to fill in gaps. Bourne also visited and flew with Cramp around both Orkney and Shetland to see that the results there seemed reasonable and no major colonies had been missed. Our conclusions were reported soon afterwards to conferences organised by the Nature Conservancy Council on the Natural Environment of first Shetland (Bourne and Dixon 1974) and then Orkney (Lea and Bourne 1975) attended by all the most knowledgeable people, and nobody disagreed with them.

Progress was reviewed by the census committee several times a year. The discrepancies were considered at length, and most time was spent on the unprecedented number of terns reported from north-west Orkney. This was one of about half a dozen issues still left unresolved when the report (Cramp *et al.* 1974) went to press, all of which, except for the total numbers of the nocturnal petrels, have since been dealt with and would not have made much difference. It is not clear that any other investigation of British seabirds has either received such close supervision, or made its results so freely available, without which it would have been difficult to criticise them.

Observations of Arctic Terns in Orkney

In this type of enquiry discretion has to be left to the observers over how they count the nests or birds, depending on the species involved, the type of terrain, and the time and resources available. Terns present problems because both breeding and non-breeding birds may come and go erratically throughout the season, and it may be difficult to find all the nests without either causing the birds to desert, or making the eggs and young unduly vulnerable to predators. In view of this, particular emphasis, greater than for any other group, was laid in the original counting instructions for terns (Lloyd *et al.* 1991, appendix IV)

on the need to avoid disturbing individual birds for more than twenty minutes when it was not realised how large some of the northern colonies might be. In such cases we sometimes counted the nests in only part of the colony and assessed what proportion it formed of the whole.

Conventional wisdom before 'Operation Seafarer' held that Arctic Terns normally breed in scattered pairs in the south of England, in colonies of tens or hundreds further north and in Ireland, and a few thousands on the Farne Islands and northern isles of Scotland. When our results conformed very well to this pattern, except for a still unequalled grand total of some 27,500 pairs in north-west Orkney including 17,500 in one colony on Papa Westray, the Census Committee therefore spent considerable time discussing this, and searching for precedents. The most important proved to be the distortion of the results of the first census of the Black-headed Gull *Larus ridibundus*, owing to the inclusion of an exaggerated estimate for one large colony (Marchant 1952), and we wished to avoid creating a similar problem.

It was therefore decided by the census committee, and confirmed after considerable further discussion by the Executive Committee of the Seabird Group, including representatives of the three main national ornithological societies and the Chairman and several senior staff of the RSPB, that it might be better to publish in the report an admittedly cautious estimate of the total number of Arctic Terns found in Orkney which was still much larger than anything previously reported in Europe, and leave the full figures on file, where they remain available for examination. The counts were still being repeated at the time of publication of the report, by which time the total was already changing (Hammond 1975), and were duly published a year later (Lloyd *et al.* 1975). We suggest that it might be as well if some other people were also more careful over what they say about Arctic Terns.

Observations of Arctic Terns in Shetland

While the inhabitants of Shetland have always been interested in seabirds, nobody had previously tried to count them all. Therefore when it was found that despite the assistance of both local people and a number of visitors the cover might not be very good, it was decided to send the Organiser, who knew where the gaps were, in his caravan to cover them during 10-22 July 1969 and 2-20 June 1970. The situation in the areas on Mainland for which Avery (1991: Fig. 1) was unable to find counts was as follows: –

1. ***East coast of South Mainland.*** This area was visited by the Organiser who camped at Scatness in both summers, the visit in 1970 occurring in June, but failed to find any significant number of terns. The large colonies reported there and at Sumburgh by Bullock & Gomersall (1980) and at Garthness by Monaghan *et al* (1989) were certainly not present at that time.

2. ***East coast of Mainland from Lerwick south to the Bay of Okraquoy.*** This area was covered on 18 July 1969, when no terns were found. While this may have been rather late in the season, there should still have been some birds present if there had been large colonies there.

3. ***South Nesting.*** Examined on 8, 10 and 11 June 1970. Small inland colonies might have been missed, but none on the coast.

4. ***Whiteness, Weisdale, Sandsound Voe area.*** Much of the shadowed area was visible from various places, while the islets were covered by Dr Peter Stanley. The extreme south-west from Spoot-hellier to Ayre of Deepdale was visited on foot on 20 July 1969.

5. ***Interior of Walls and Sandness.*** The coast was covered on foot from Voe to Footabrough north to Melby on 16 June

1970. Since no birds were seen flying inland this area, which was still nearly blank in 1980, was not examined.

6. ***Brindister to Aith Voe***. This area was covered on 15 June 1970.

7. ***South side of Olna Firth***. Examined from the road on the north-east shore in June 1970.

8. ***Interior of North Roe***. The organiser camped at Collafirth between 2-7 June 1970, and saw several hundred Arctic Terns fishing in the firth on the 4th. No birds were noticed flying inland, where none were reported in 1980.

9. ***Collafirth to Lunna peninsula***. Examined on 5 and 7 June 1970.

We are unable to comment on the situation in Yell and Unst from personal experience on the ground, but they were supposed to be covered by experienced people, and few terns were visible from the air. In view of the situation on Mainland we doubt if many Arctic Terns were missed anywhere in Shetland in 1969-70. It is notable that the count of 347 pairs breeding on Whalsay in June 1969 was made by a resident, while the total of 375 pairs reported from Papa Stour in July 1969 had risen to 500 or more pairs by the time Saunders visited this island on 17 June 1970, so that an increase may already have been under way towards the thousands found later (Bullock & Gomersall 1980).

It is perhaps unfortunate that it did not occur to us at the time that we would later be criticised, not because of the unprecedented number of birds found in Orkney, but because of the small number found in Shetland, otherwise we might have listed all the places where they were absent.

Discussion

It is surprising that in view of a previous complaint that he misrepresents data (Bailey 1989a) both the RSPB and the Editorial Committee of *Scottish Birds* did not see fit to check the reliability of the statements by Avery (1991) before publication. In fact the situation on Orkney was fully explained in the original report on 'Operation Seafarer' (Cramp *et al.* 1974: 164), and the results reported there revised after further checking with our approval by Lloyd *et al.* (1975) shortly afterwards. While, as Bourne (1989a) has already observed in a publication quoted by Avery (1991), we may have missed a few terns in Shetland in 1969-70, there is also independent evidence that no more than 10-12,000 pairs were found there when many Orkney birds had apparently already started to move to Shetland in 1978 (Berry & Johnston 1980), and it would not have been difficult to ask us whether we had any observations for areas which did not appear to have been counted. Perhaps it may be useful to record what we deduce may have happened.

In fact, as stressed by Bailey (1989b) with regard to conditions in the sea, the whole situation is rather complicated. There is a long history of seabird fluctuations (Bourne 1990). Some factors affecting tern breeding success are listed by Galloway & Thomson (1914) in a report on observations during the first British ringing of Common Terns *Sterna hirundo* on the Sands of Forvie in the Grampian Region between 1907-14. Many young died in the middle of the season in both 1910 and 1912, sometimes in association with droughts or gales, which buried some dead young in sand. Most chicks appeared to have died of starvation due to a shortage of their main food sand-eels *Ammodytes*, but more died in 1910 where there was more cover, where some bodies appeared to be gnawed by rats.

The fact that such considerations are not confined to Common Terns was also first shown then by a report by Bain (1913) that in May 1913 thousands of Arctic Terns settled on the Pentland Skerries and started to lay, then suddenly left the island for a month in early June, but returned to lay

again in July. A possible explanation was provided by the Head Lightkeeper on the Out Skerries, T.E. Arthur, who reported that the Arctic Terns also appeared short of food and suddenly deserted their hatching eggs during fine weather in July following the arrival of immense shoals of mackerel *Scomber scombrus*, whiting *Gadus merlangus* and dogfish which appeared to have consumed all the sandeels (Tulloch 1915).

Nobody seems to have paid much further attention to the terns in the northern isles until our census in 1969-70. At this time there was a shortage of larger fish around the north of Scotland variously attributed to overfishing and a reduction of the turbulent inflow of Atlantic water into the North Sea past Orkney (Corten 1990), and the sea in this area was literally boiling with shoals of the smaller fish on which the larger fish and seabirds feed in a way that is no longer seen (Bourne, pers. obs.), which may explain the accumulation of Arctic Terns found in north-west Orkney. Thus a colony on Papa Westray then was larger than any previously reported in Europe, and the only similar reports found are of 'hundreds of thousands' of Arctic Terns breeding on Sable Island off Nova Scotia in 1913 where there were less than 2,000 in 1971 (A.R. Lock, quoted by Nisbet 1973), and the past collection of 100,000 eggs annually from Gronne Ejland in Disco Bay, West Greenland (Salomonsen 1967), in two other areas where local marine turbulence also leads to an exceptionally high plankton and fish production.

The huge accumulation of some 27,800 pairs of terns in the Westray area in 1969 appears to have begun to disperse throughout Orkney when there were disturbed breeding seasons in the mid 1970s (Hammond 1975, Lloyd *et al.* 1975, Lloyd 1976). In 1975 and 1976 many terns also bred on Foula, and then apparently dispersed around Shetland (Berry & Johnston 1980, Furness 1981), so that after further good breeding seasons totals comparable to that for Orkney in 1970 were present in both groups by 1980 (Bullock & Gomersall 1980). Then, following an increase of the larger fish and collapse of sandeel recruitment (Kunzlik 1989), there was a series of poor seabird breeding seasons after 1983, which Bourne (1989b) has suggested may also have been partly due to unusually fine weather which led to the early stratification of the water at sea, so that the fish swam deep, and it became difficult for aerial seabirds such as the terns, which require moderately rough water, to be able to surprise their prey (Dunn 1973), to catch them.

It therefore seems likely that the failure of 8000 pairs of Arctic Terns to raise more than two young in Shetland in the fine summer of 1990 promptly followed by the appearance of 24,000 pairs which raised 30,000 young in the cold, late summer of 1991 (Anon. 1991) was at least as closely related to the weather, oceanography and inter-relationships between marine organisms (Bourne and Vauk 1988, Aebischer *et al.* 1990) as to a ban on catching sandeels. In any case, it would appear that any future widely-publicised predictions of the imminent extinction of terns should be treated with caution.

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Rare Migrants

Baillon's Crake, Fair Isle, Shetland

Just after noon on 28 September 1991, DS had brief views, approximately 15 seconds, of a small crake (*Porzana* sp.), skulking away from him in dense reed grass (*Phalaris arundinacea*) along the Meadow Burn, Fair Isle. After an unsuccessful search other observers were summoned, notably T. Francis, R.J. Johns and S.J.M. Gantlett. After a further half hour of unsuccessful searching it was decided to leave the area and return after lunch to sit and wait for further glimpses. Having agreed on this most observers started to head back to the road and north. SJMG was the last to make his way back to the road when the crake ran across in front of him and into the burn, followed by SJMG who made a spectacular dive and catch!

DS took the crake from SJMG and 'bagged' it. At this stage it was identified as a juvenile Little Crake (*P. parva*) due mainly to the fact that it lacked any white spotting on the lesser and median coverts. PVH arrived with the Observatory mini-bus and the crake was taken to the observatory.

In the 'bird room' at the Observatory PVH took the crake out of the bag and immediately began to wonder about the identification. It showed a very small primary projection and extensive barring on the fore flanks – both good features for Baillon's Crake (*P. pusilla*), but the one feature that 'stuck' for Little was the lack of white spotting on the median coverts, as given by Wallace (1976), *BWP* Vol 2 (1979).

At this point the crake was handed to N.J. Riddiford who was asked to do a full in the hand description while DS and PVH searched the relevant literature. Finally a wing formula was taken and this again pointed strongly to Baillon's. So we had a crake showing the structure of Baillon's (although it is difficult to know how primary projection in the hand would relate to that in the field), with intermediate biometrics and several plumage features in favour of Baillon's and one in favour of Little Crake.

After a photographic session the crake was released in the Observatory garden where it performed well skulking amongst the vegetables and, as most observers agreed, looked like an obvious Baillon's Crake – showing a very small primary projection (c. 1 cm), extensive flank barring, a lot of white on the scapulars and (in the hand) a white leading edge to the wing. It continued to perform well in the area of the Observatory garden until 1 October when the weather became much colder and wetter. Unfortunately it was found dead at first light on the 2nd.

The following details were taken in the hand by NJR and added to after examination of the corpse by PVH.

Description

AGE: Juvenile.
SEX: Female (by dissection, per G. Jamieson)
WEIGHT: 28.5g (when trapped), 24.8g (when found dead)
WING FORMULA: p10 -12mm, p9 wingpoint, p8 wingpoint, p7 -2mm, p6 -5mm, p5 -7mm, p1 -26mm. Longest tertial = p6.
(NOTE: Wing formula follows the convention for non-passerines)
DETAILED DESCRIPTION:
UPPERPARTS: Crown and forehead, feathers black centred with rich buff fringes, the dark area tapering to a point above the bill. Supercilium rich chestnut buff, from eye broadening above bill and extending to rear of ear covert, becoming a paler almost orange buff behind eye. Lores similar but slightly paler. Cheeks rich warm buff. Ear coverts dirtier brownish. The richest colour on the face was the fore supercilium. Nape, feathers as crown but with broader ginger buff fringes and less evident black centres (due to overlapping of fringes). Mantle, feathers with black centres and broad ginger fringes but with black and white

bands and white fringes on inner and outer webs of many feathers. This giving a complex admixed black, ginger and white appearance to the upper mantle, the distribution of the white appearing very random. Back similar to mantle but feathers with narrow ginger fringes and less prominent and more scattered white areas. Uppertail coverts black centred but with much broader ginger fringes and large areas of white on both inner and outer webs (but mainly inner webs). The white appeared variously within the black centre or within the ginger fringe or in place of the ginger fringe. The shape of the white also varied from being in longitudinal lines down the inner webs, to forming wavy lines across the feather or even circles with black centres! towards the tip of the feather.

UNDERPARTS. Chin and upper throat white, malar area rich orange ginger running into lower throat and across breast. Sides of neck and breast a dirtier brownish ginger. Foreflanks ginger brown with admixed black and white areas on some of the feathers towards the shoulder area. Rest of flanks from just below shoulder area extensively barred with greyish black and white. Individual feathers with grey then thin black band then white band then grey then broad ginger area then black band then white band again and then grey then broad ginger then blackish line and white tips i.e. almost a barring pattern repeated in triplicate. Centre of belly and lower breast white with suggestion of ginger buff toning on vent. Some feathers (especially towards flanks) with broadish grey subterminal bands and broad white tippings. Undertail coverts appearing extensively barred black and white with detail of feathers as follows, broad black bases then white bands followed by broad black band then white band and then narrower black band then another white band followed by another black band and then a white tip, some of the feathers had some ginger buff areas admixed in their distal half usually on the fringes of the feathers.

REMIGES: Lesser coverts grey with relatively broad duller ginger brown fringing. Median coverts same but centres blacker, two of longest with slightest black and white tips to inner webs. Greater coverts, greyish bases with distal halves ginger. On inner webs about two thirds from base a black white black mark, on some feathers the white almost forming a circle within the black, with black within the circle. Tips of all Greater coverts with blackish subterminal band then white band (V shaped with point of v pointing to base) and fine black tips. Alula, all three feathers greyish black but with broad white fringe to outer web of outermost feather extending from base to two thirds down feather. Primary coverts greyish black. Primaries greyish black with outermost with broad white fringe to outer web. Secondaries greyish black with narrow white tips to all but one. Tertials greyish black centres with pale ginger brown fringing but on outer webs several (two to four) patches of black white black banding between tip and half way up feather. Some of the white patches almost forming circles. Underwing coverts – under primary coverts grey with ginger brown tone with some white tipping on inner webs. Lesser and Median underwing coverts mid grey with zig zag white barring the bars bordered finely with black. These merged to give three or four zig zag white lines across underwing. Underwing greater coverts darker grey with black subterminal line and white tip. Rest of underwing pale grey.

RECTRICES: Feathers with blackish central band to tip and broader duller ginger brown fringing.

BAREPARTS: Bill dark horn upper mandible with fairly broad green cutting edge at base narrowing to disappear at about two thirds. Lower mandible base to two thirds yellowish green with horn outer third. Gape bluish grey. Eye, pupil dark, iris greenish towards pupil becoming brick red towards outside of eye. Legs dull greyish with greenish tone and slight rosy tint to tarsus (especially so in field). Toes similar. Nails grey with slight olivy tinge.

IDENTIFICATION: Of the crakes on the British list, Baillon's Crake most closely resembles Little Crake. With good views both are separable on size, structure and plumage features (*BWP* 1979, Wallace 1976) as was the Fair Isle bird in the field. However, in the hand, the Fair Isle bird was found to be intermediate with regards to some of the biometrics – being long winged for Baillon's and short winged for Little, the same being for tail length. The rest of the biometric measurements fitting within the ranges given for Baillon's (see Table 1 below). The main feature that caused

TABLE 1: Measurements in mm of Little Crake (*P. parva*), Baillon's Crake (*P. pusilla*) (From BWP Vol. 2, 1979) and the Fair Isle Baillon's Crake.

All measurements given are for Females

	Wing	Tail	Tarsus	Bill	Total Length	Toe (inc. nail)
Little	96-108	50-58	29-32	16-19	180-200	38-42
Baillon's	87-94	40-46	25-29	15-17	170-190	33-38
Fair Isle bird	96	47	27.5	16	179	36

confusion and the initial mis-identification of this bird was the degree of white spotting on the upperwing coverts. Several observers presnt mentioned that Little Crake show no white spotting on the wing coverts whereas Baillon's Crake do. After consulting Wallace 1976 and *BWP* Vol. 2, 1979 it became evident that some of the literature is misleading. Wallace states that the wing coverts for immature Baillon's Crake are warm brown with several lines of obvious white flecks whereas for Little Crake they are uniform olive brown with one line of white flecks. *BWP* states a similar pattern – for Baillon's Crake, inner (median?) and greater coverts red brown with black centres marked with small white dots or streaks outlined by black and for Little Crake, uniform olive brown (adult) with white spotting on the greater coverts (juvenile).

The Fair Isle bird had an upperwing pattern similar to that stated for Little Crake: no white spotting on the lesser or median coverts (apart from two feathers with very small white spots on the inner webs of the lower median coverts, these not being visible in the field), the only white spotting being on the greater coverts. As the plumage showed only slight wear, meaning that white tips could not have worn or broken off, it seems likely that Wallace (1976) had mistaken the scapulars for the wing coverts. The scapulars did show several lines of white markings, and in the field the scapulars cloak much of the wing coverts. The only coverts visible being the greater coverts which in both species show some white spotting in juvenile plumage, more so in Baillon's Crake than Little Crake.

The Fair Isle bird was (eventually) identified as a juvenile Baillon's Crake because of the small size and squat ball-shaped structure with short primary projection and on plumage features – rich buff supercilium, ginger brown mantle, extensive white spotting/streaking on the mantle and scapulars, heavy barred flanks extending from vent to fore flanks, white edge to outer primary (although some juvenile Little Crakes can show this feature) and the colouration of the bill and legs. The degree of white spotting on the wing coverts being of no consequence in separating Baillon's Crake from Little Crake. Although if white spotting is present on the median coverts then the bird would almost certainly be a Baillon's Crake.

RANGE: Breeds from Iberia and France discontinuously eastwards through Asia to Japan and Australasia; also southern Africa. Winter distribution poorly known but majority of European population probably Africa south of the Sahara. (Dymond *et al* 1989).

Baillon's Crake is a vagrant to Britain, although sporadic breeding occurred in the 19th Century. Since 1958 there have only been 6 accepted records, none of which were in Scotland (Dymond *et al* 1989). The last Scottish record was of a female shot on Fair Isle, 11 May 1929 (Thom 1986).

Summary

A juvenile female Baillon's Crake was present on Fair Isle from 28 September to 2 October 1991, when it was unfortunately found dead. The identification of this bird

in the hand was initially confusing largely due to the description of the extent of white spotting on the wing coverts in some of the relevant literature. The last Scottish record was of a female shot on Fair Isle, 11 May 1929.

Acknowledgements

We would like to thank N.J. Riddiford for taking the "in hand" description and D. Coutts for supplying a photograph.

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Pied Wheatear in Shetland: the fifth record for Scotland

The 9th October 1991 was a dull day with light north-westerly winds. I had just called over Dave Suddaby and Alan McCall to see an Ortolan Bunting *Emberiza hortulana* in a sandy and blighted "tattie rig" adjacent to the Sumburgh Hotel, when I caught a brief glimpse of a bird with a mostly white tail disappearing behind some nettles. After a few seconds a small pale wheatear with a dark, mottled throat hopped past a gap in the nettles. It then hopped out of the nettles and I could see its sandy-earth brown upperparts with obvious pale fringes, so I shouted to D.S. and A.M. "its a Pied" *Oenanthe pleschanka.* After several minutes D.S. went to phone out the news whilst A.M. and I continued watching the first-winter male Pied Wheatear, sometimes at very close range, as it fed from the fence line along the side of the 'tattie rig'. The apparent colour tone of the upperparts varied between pale sandy-brown to dark earth-brown depending on the light conditions, background and how wet the bird was. It was very tame and throughout its stay it remained along the same section of fence until it was last seen on 13th October.

Description

SIZE AND SHAPE. In comparison to Northern Wheatear *Oenanthe oenanthe* (which it was sometimes alongside), it was smaller, much slimmer, longer tailed, longer winged and finer billed. The head was more rounded, with a steeper forehead than a Northern Wheatear. The primary projection was slightly longer than the exposed tertials and the tips of the primaries fell just short of the upper margin of the incomplete dark tail bar. The tail was obviously notched.

HEAD AND NECK. Forehead and sides of head earth-brown, slightly less greyish than the rest of the upperparts. Centre of crown greyish-earth-brown, paler than mantle, but becoming darker at the rear. The pale ginger fore-supercilium was separated from the pale sandy-buff rear-supercilium by a very thin brown line just in front of the eye which ran upwards and backwards at an angle. Supercilium flared behind the eye and extended to the nape where it was broadest. Lores

dark grey with pale tips to each feather. Eye-stripe, behind the eye, and ear-coverts black with pale, sandy-grey tips to many feathers. Slightly darker than throat. Eye-ring thin and white, only present on the lower lid. Each chin and throat feather was black with a pale, sandy-grey tip, giving the chin and throat a 'blotchy' appearance. There was a long, black drop-shaped streak on the right hand side of the malar region. The throat was divided from the breast by a thin off-white line, forming a pale necklace. Nape slightly greyer than rear of crown, forming a greyish shawl across the nape and upper mantle.

UPPERPARTS. Mantle grey-earth-brown, slightly greyer on the upper part. Each feather three-toned, with a black base, grey-earth-brown main section and extremely thin pale, sandy-grey tip. When seen from the rear, perched against a darker background, the pale tips formed thin scales arranged in fairly neat lines. Scapulars similar to mantle but noticeably darker. Rump and uppertail-coverts white. The white area appeared long but fairly narrow and extended forward to the base of the tertials on the closed wing. Central tail feathers black with sandy fringes and broad white tips. Other tail feathers, except outermost mostly white with black restricted to drop-shaped marks on the outer web of each feather, just before the tip. The proximal extent of the black marks was only abut one fifth of the way along the tail. The inner web of each feather appeared to be all white. Each feather had a broad pale gingery tip which itself gradually became paler towards the tip. Outer tail feathers similar to the others, but the black on the outer webs (which also had pale gingery tips) ran forwards for almost half the length of the tail. This could only be seen if the bird was perched, facing away and with the tail fanned. On the closed tail, seen from the side, the outer webs appeared to be whitish.

WINGS. Tertials black with broad, but not very clearly defined, pale sandy-buff fringes. Greater coverts black with broad, pale sandy-buff fringes and even broader and paler sandy-buff tips, forming an obvious wing bar. Median coverts black, with relatively narrow pale, sandy-buff fringes and broader tips. Lesser coverts black with very broad, pale, sandy-buff fringes, which almost obscured the centres. Primary coverts black with relatively narrow pale, sandy-buff fringes and tips. Alula black with a very narrow sandy-buff fringe and tip. Secondaries black with broad, pale gingery-buff fringes and tips forming a pale but warm-coloured wing panel. Primaries black with narrow, pale sandy-buff fringes and broader off-white tips. Axillaries and underwing-coverts black.

UNDERPARTS. Upper breast pale, sandy-buff in the centre with a fairly bright peachy wash, but dark, grey-earth-brown at the sides. Lower breast, belly and flanks uniform, pale sandy-buff. Vent and undertail-coverts pale, buffy-white.

BARE PARTS. Bill, eye and legs black.

BEHAVIOUR. The call was a rasping 'cherrk', quite different from the hard 'chack' of a Northern Wheatear. The stance was more horizontal than Northern Wheatear. The feeding action was very characteristic, it fed from the fence, dropping to the ground and either returning directly to the fence or only hopping a few steps before returning to the fence. It never spent any length of time on the ground, hopping along as a Northern Wheatear often does.

The Pied Wheatear breeds from Bulgaria, Rumania and southern Russia eastwards through southern Siberia, central Asia, Iran and north-west Afghanistan to Lake Baikal, Mongolia, northern China and the Himalayas, between 54 N and 27 N. It winters in southern Arabia, northeast and east Africa south to northern Tanzania (British Ornithologists' Union 1971).

There are four previous Scottish records; a female shot Isle of May 19 October 1909 (the first British record), a female shot Swona, Orkney 1 November 1916, an adult male trapped Bridge of Don, Aberdeen 26 September to 7 October 1976 (Dymond *et al.* 1989) and a first-winter male trapped Fair Isle 10 October 1989 (Rogers *et al.* 1990). Pied Wheatears have become considerably more regular in Britain in recent years. The 1976 Aberdeen record was only the 5th British record (Rogers *et al.* 1978, Knox & Ellis 1981), whereas the 1989 Fair Isle record was the 20th British record (Rogers *et al.* 1990). Up to the end of 1990 there had been 22 records accepted by the

British Birds Rarities Committee (BBRC) (Rogers *et al.* 1991).

October 1991 brought an unprecedented influx of this attractive wheatear to Scotland, with two further records, both first-winter males at Lerwick, Shetland on 17 October (*Birding World* 4: 343) and at Thornton Loch, Lothian on 27-29 October (*Birding World* 4: 343). In addition during 1991 there was a first summer male at Spurn, Humberside on 20 June later relocated at Scarborough from 22-23 June (*Birding World* 4: 191) and a male at Penare, Cornwall from 1-5 November (*Birding World* 4: 379). Although all the 1991 records were photographed they still await formal acceptance by BBRC.

Summary

A first-winter male Pied Wheatear was present at Sumburgh, Shetland from 9-13 October 1991. This was the fifth record for Scotland and preceded two further Scottish records during October 1991.

Acknowledgements

I would like to thank Paul Harvey and Dave Suddaby for commenting on the manuscript and Dennis Coutts for providing the photographs.

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Chimney Swift in St Andrews : a first for Scotland?

At 8.45 on Friday 8 November 1991 JAG saw a swift which appeared small and short-tailed but lacked a white rump flying over the Bute Medical Building parking lot. JAG then rang RWB at work, who suggested some sort of *Chaetura*, perhaps a Chimney Swift, and RWB soon joined JAG at the Bute Medical Building, where the swift continued to perform obligingly for the next 40 minutes. RWB ran home and got a pair of binoculars. It was obviously a *Chaetura*, with rapid bursts of slightly bat-like flight, small size and cigar-shaped body and, with the aid of the binoculars, details of the plumage confirmed the suspicion of a North American Chimney Swift *Chaetura pelagica*.

The bird repeatedly circled over the town, passing along the Bute Building and close over our heads each time before going out over the gardens to the south, then back out of sight to the east. Thus we are able to watch it many times at ranges down to 1 meter, in sunshine and shade, until about 9.40 when it vanished. Only P.J.B. Slater and P.J. Branscombe also managed to see it during this time, and agreed with the identification. It was seen again briefly in the neighbourhood by Sam Taylor later in the afternoon.

The next day it reappeared in the same place and was seen by several hundred birdwatchers over the course of the day, at times resting on the building. Amazingly,

Chimney Swift, Chaetura Pelagica, photographed 8/11/91 on Bute Medical Building, University of St. Andrews
Mary Macintyre

a Common Swift *Apus apus* was also in the area, and on occasions the two could be seen together. The Chimney Swift was last seen briefly on the morning of Sunday 10 November before rain started when it disappeared for good.

Identification

Obviously small and fat-bodied (tapered like a cigar), the swift had a rather short, rounded tail, and wings shorter and less pointed that an *Apus*, which was confirmed later that morning when a Common Swift appeared in the same area: this appeared large, thin-winged and black. Rapid bursts of flaps, interspersed with glides on down-angled wings gave it a 'bat-like' flight, and when the tail was fanned occasionally the spiked tip was visible. Plumage was brown, dark but less so than Common Swift, and somewhat paler on the chest; however there was no pale throat or any whitish area in the plumage. When it rested on the building the spikes at the tip of the tail were clearly visible, and the back appeared to be a slightly paler brown than the wings.

The Chimney Swift is a North American species, the range of which extends east of Missouri and Mississippi rivers from the great lakes in the north and

to Florida and Texas in the south. It winters in Brazil. It is 5¼″ (13 cm) long, being larger and darker than the rather similar Vaux's Swift *Chaetura vauxi* which is 4¾″ (12 cm) long as well as somewhat paler below and on the rump than the Chimney Swift. The range of Vaux's Swift is much further west, being along the coast of the Pacific, and it has never been recorded in the Western Palearctic. Length of Common Swift is 6½″ (16 cm).

Three previous records of Chimney Swift are reported in *The Field Guide to the Rare Birds* as having been accepted by the British Birds Rarities Committee, and they are as follows:
Porthgwanna, Cornwall (2 between 21-27 October 1982); Isles of Scilly (1 on 4-7 November 1986); Grampound, Cornwall (1 on 18 October 1987).

There was apparently also a possible Chimney Swift at Coldingham on 5 November 1983 which is still under consideration by the BBRC (*Birding World* 4: 400).

The St Andrews bird also awaits the BBRC's formal acceptance.

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Short Notes

Aberrant plumages in a pair of Peregrines in north Scotland

In 1991 I checked a coastal Peregrine, *Falco peregrinus*, site in North Sutherland. There had been no recent breeding record, although the site is traditional with breeding from the 1940s, but only single birds having been seen over the last decade.

On my first visit, on 11 April a female Peregrine glided out to sea when approached at about 100 m, and circled without calling, in poor visibility about 300 m away. No male was seen. An old Raven nest nearby was a potential nest site.

On 31 May, a Peregrine was seen incubating on the Raven nest. The bird did not flush, and was judged to be a male, though the light was not good. There was no sign of a second bird.

On 25 June, a pair were alarming over the nest which held three eggs. One egg was the usual reddish colour, the second was significantly paler, and the third was almost white. The smaller male quickly disappeared, but the female continued circling, this time in better light.

This bird was unusually dark, almost sooty black without a hint of the normal grey or blue upperparts or pale underparts. After several approaches the bird landed on the nest and stood by the eggs. Seen through a telescope, the dull dark back was very apparent, and the underparts were of a dull mid to dark grey shade, with barring of a slightly darker shade just discernible. The 'moustache' was not clearly defined on the dark face.

After 10 minutes the male arrived with a kill and passed it to the female which left immediately. At this point it became apparent that the male also exhibited unusual plumage, with no brightness in the colour, the upperparts being dull blue-grey, the underparts pale and barred. The bird did have the usual 'moustache', and there was a light patch on the right shoulder. The overall impression was of a rather poor example of female plumage. The bird stood for about a minute before moving forward to cover the eggs.

On 4 July, the female was seen to be incubating. Midges and haze made detailed viewing impossible.

On 18 July, the female was seen to be standing on the edge of the nest which still contained three eggs, presumably infertile. Through a 60X telescope, at about 120 m, the female's bill, legs and orbital ring were clearly yellow. No white or pale colour was discernible at all, but the face was slightly paler than the back, with the 'moustache' just discernible. After some minutes the bird took off, when the overall impression was of a uniform sooty colour.

That one bird of a pair should have obviously aberrant plumage should be considered unusual, that both could be so seems remarkable. Conversations with observers familiar with Peregrines have revealed no other records of similar plumage. It is unfortunate that the eggs failed to hatch, but it will be interesting to see the results of successful breeding if the birds return to the site for the next season.

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Merlin feeding on rabbit carrion

On 3 August 1989 in east Tayside a Merlin *Falco columbarius* landed on a roadside fence post. It flew to a fresh rabbit *Oryctotagus cuniculus*, which had been run over, and ate several pieces of meat. No attempt to take insects was made. When observers tried to get closer it flew off.

Merlins are not generally regarded as

carrion feeders. They usually chase and kill their prey (Newton, I. 1979. *Population Ecology of Raptors*. Poyser, Berkhamsted; *BWP* Vol. 2). In Wisconsin, USA, one fed on injured Purple Martins *Progne subsis* which had been run over by a vehicle. It appeared to select active wounded Martins rather than dead ones (Haugh, E. 1985. *Raptor Research* 19: 103). There are also two records of migrating Merlins feeding on carrion. In 1956 a female took scraps of meat provided for it on a weather ship in the North Atlantic (McLean, I. & Williamson, K. *British Birds* 51: 157-58) and in 1986 on a production platform in the North Sea one scavanged at least two bird carcasses (Rebecca, G.W. 1989. *North Sea Bird Club Report* 8: 69-77).

The offshore records could reasonably be assumed to be of very hungry birds, perhaps accounting for this uncharacteristic behaviour. However, the observation described above came from a period of good weather in mid-summer with plentiful food supply. While the Merlin was on the post, it was observed at close range for several minutes through a telescope. It was presumed to be a juvenile due to its fresh plumage (adults would be in moult), dark streaking on the underparts (*BWP* Vol. 2) and slightly unco-ordinated movements. It was probably a female judging by size. Perhaps it had only recently become independent and was struggling to catch food.

Thanks are due to Graham W Rebecca for helpful comments.

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Alarm calls used by a presumed Spotted Crake in the Grampian Region

While there are long-standing rumours that Spotted Crake *Porzana porzana* occur in the Grampian Region, more recently there had been only three records of the presence of apparent autumn migrants along the coast until 1989 and 1990, when they were heard calling at three sites by D.J. Bain and others (*North-East Scotland Bird Report*). Since a statement on the last occasion that "a pair and young were seen at one site" apparently derives from a second-hand report of an observation by me of a little-known call of this bird whose use may provide the most easily-obtainable evidence for the occurrence of breeding, it may be useful to place on record what I actually replied to an enquiry about the record from the recorder.

On the evening of 28 June 1990 I visited what appears to be one of the three known sites with Gordon Simpson in search of Grasshopper Warblers *Locustella naevia*. While we were wading round the edge of a uniform open patch of sedges about a metre high and fifty metres across growing in standing water a few centimetres deep we suddenly heard an extremely loud, regularly repeated alarm call about 3m away in a small patch of sallows *Salix caprea*, and another bird calling in a more subdued manner from more sallows further away on the other side of the open area. The call was an explosive, abrupt 'trrt...trrt...trrt...' repeated continuously at intervals of a couple of seconds like a metronome which was new to me although I know all the usual waterbird noises, notably Water Rail *Rallus aquaticus* alarm calls, which we also heard a few minutes later in a lusher part of the marsh.

We tried to see the birds without disturbing them further, but were unable to detect the slightest movement, although they continued to call loudly at very close quarters for the ten minutes or so that we remained in the area, and started again immediately when we returned the same way about twenty minutes later. I concluded that

they could only be Spotted Crakes, which I have seen elsewhere in the past, and decided that since from the intensity of the calling they must have young it would be best to leave them in peace. We later saw a small rallid which appeared to come from the same area flutter over the sedges to land in an open space some way away as we left the marsh, which might have been either a Spotted Crake or possibly a Water Rail, though I was unable to see any long red bill.

The main problem with the location of Spotted Crakes in the north of Scotland appears to be that they normally only use their "song" which has been compared to the musical whistle of a whip through the air (and not a whip-crack) erratically in the small hours. Presumably the call described here was the 'quitt', 'quick' or 'kick' also attributed to them in the *Handbook of British Birds*, and the 'hard ke(a)ck' said to indicate parental anxiety in the *Birds of the Western Palearctic*. Judging by the behaviour of the birds that we encountered, and the fact that I have never heard this call before during many visits to suitable marshes, its use provides firm and obvious evidence for the presence of small chicks, though I suggest recorders should report when this sort of evidence is used.

It should perhaps be stressed that the main problem with conservation of these birds does not appear to be disturbance, though clearly it should be minimised, but the progressive EEC-subsidized drainage of their habitat. Perhaps it might therefore be better if instead of being kept secret some of their sites were publicised, in the hope that the authorities, who seem rather dilatory in this respect (see *BTO News* 134: 12), would make more effort to conserve them.

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Waxwings actively searching for insects

An invasion of Waxwings *Bombycilla garrulus* into Britain during late October and November 1990 allowed us to carry out a fairly intensive ringing and behavioural study of this irruptive winter visitor.

In Grampian, Waxwings fed predominantly on berries (mainly various rowans and whitebeams) but also apparently on insects.

JC first saw a gradually increasing flock of Waxwings on 8 November 1990 in a group of sycamore trees *Aser pseudoplatanus* near Aberdeen city centre. The birds appeared to be feeding on insects as they were seen daily for lengthy periods at this site, continually active amongst the branches. Closer observations by us both on 17 and 18 November revealed that the birds were indeed spending periods of up to an hour actively searching for insects among the sycamores. Up to 100 birds were present, dispersed throughout the trees, searching along and beneath branches and around the buds. One tree which still retained many dead leaves was particularly favoured, presumably as more insects could be found there.

At favoured berry sites the normal behaviour of Waxwing flocks involves bursts of feeding activity interspersed with resting periods on nearby elevated perches such as trees or TV aerials. However, in this case birds were flying up to 0.25 km from surrounding berry trees back to this line of sycamores to rest and seek out insects. As the berries within commuting distance diminished so did the attraction to these particular sycamores, but insect-searching was again observed in some sycamores closer to a berry site. Between 18-22 November a flock of around 260 Waxwings converged on a line of whitebeam trees *Sorbus aria* feeding in bursts with resting periods on nearby trees and TV aerials. On

21 November following their drinking in roadside puddles, about 10-15 Waxwings were observed insect-searching in two nearby sycamore trees. The identification of two colour-ringed birds indicated that the same individuals were involved in both insect and berry feeding during one period of observations.

After the dispersal of the large Waxwing flocks from Aberdeen at the end of November 1990, active insect searching was not observed again despite regular observations of smaller Waxwing flocks throughout the winter until early May 1991.

Waxwings are chiefly insectivores in summer and frugivores in winter. The transition from one food type to another occurs gradually according to weather and insect abundance (Greschik 1934; Holzinger 1972, cited in *BWP* Volume V, S. Cramp *et al.*). In winter in Britain, Waxwings can often be seen flycatching from elevated perches during spells of warmer weather. This opportunistic feeding is possible due to the emergence of flying insects, induced by a rise in temperature. Waxwings actively searching for insects seem quite unusual in Britain. In 1959, birds at Nigg in elder bushes and at Montrose on a damson tree were thought to be searching for and taking insects, but it was difficult to be quite certain, as both elder and damson might be visited in search of the fruits (MacMillan, *Scottish Birds* 1: 102-108). Another record reports birds in Dundee in 1937 which seemed to be finding insects under the eaves (Baxter & Rintoul, *The Scottish Naturalist*, 226: 93-101).

All correspondence to Raymond Duncan.

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Jim Church.

Female natal philopatry in a Scottish Wigeon population

An estimated 300-500 pairs of Wigeon *Anas penelope* breed in the British Isles (Sharrock, J.T.R. 1976. *The Atlas of Breeding Birds in Britain and Ireland*). The majority of this breeding population is found in the upland areas of sheep-grazing and moorland in Scotland and Northern England.

A local population of 13-15 pairs of breeding Wigeon, representing 3-5% of the British population, has been monitored since 1989 in a glen in Upper Deeside, Grampian. In 1989, 25 ducklings of various ages were trapped, ringed (with a BTO metal ring), measured and then released. Subsequent observations suggested that most of these ducklings fledged successfully. A further eight and six ducklings were ringed (with a BTO metal ring and colour-rings) in 1990 and 1991. The lower numbers ringed in 1990 and 1991 were a result of poor breeding success, probably due to bad weather. During observations in 1990 two metal-ringed female Wigeon were seen in the study area. One was trapped on a nest on 20 May and was found to have been ringed as a duckling at nearby pools in 1989. In 1991, a colour-ringed female Wigeon was observed in the area. Its behaviour on 13 May suggested that it had a nest somewhere in the glen but unfortunately the nest was never located. This bird had been ringed as a duckling at the same site in 1990.

Natal philopatry (returning to the natal area to breed) is rare amongst birds generally (Greenwood, P.J. 1980. *Anim. Behav.* 28: 1140-1167), but is usual for females of a variety of ducks (e.g. Savard, J.P.L. & Eadie, J.McA. 1989. *Condor* 91: 198-203). Our observations for two duck Wigeon appear to be the first published records of natal philopatry for this species.

All correspondence to Raymond Duncan.

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Judy Cooper and Alan Leitch.

Correspondence

(The Editor welcomes correspondence on suitable topics in *Scottish Birds*. It is essential, however, that all letters are addressed to the Editor and that personal or libellous comments should be avoided.

eds)

Letters

Sawbill ducks at fish farms in Argyll

The SOC Clyde Branch Committee has expressed criticism of the paper on the above subject, published recently in *Scottish Birds*, 15: 145-150 (1989). Their comments are as follows: –

'We are most concerned that the paper by D.N. Carss gives credence to the allegations that Goosanders have been making holes in fish farm nets. The "strong circumstantial evidence" does not bear up to cross-examination, and in particular the following possibilities were not taken into account: –

a) **human involvement, i.e., vandalism by anglers, which is known to occur at Loch Awe. The timing of damage may coincide with the presence of Goosanders, but it also coincides with the start of the game fishing season.**
b) **other mammalian involvement, with the most likely culprits being otter or American mink.**
c) **the birds being attracted to the vicinity of the nets by escaping fish, (due to a) above), rather than with the *intent* of tearing holes in the nets.**
d) **the birds being attracted to wild fish, which themselves have been attracted by waste food from the cages.**
e) **the farm manager may have presented prejudiced information.**

The paper presents no proof, or experimental evidence, that Goosanders damage, or are capable of damaging, fish cages. We believe it to be highly unlikely that they could do so, unless nets were so badly maintained by their owners that they became weak and worn, and in such circumstances the owners should be held responsible for the outcome.

It is of considerable concern to us that the SOC has published a paper which may create further undeserved pressure on Goosanders by angling interests (see *Scottish Bird News* 15: Goosander Culls in the Borders). The "discussion" made no helpful comments about resolving the alleged problem by means other than shooting the birds. Goosander's bills are designed for grasping fish, not "sawing" nets open; if indeed they were damaging nets this would merely serve as proof of the inadequacy of the material being used'.

Bernard Zonfrillo for and on behalf of
The SOC Clyde Branch Committee,
28 Brodie Road, Glasgow G21 3SB.

Sawbill ducks at fish farms in Argyll: a reply to the Clyde Branch

I welcome the SOC Clyde Branch Committee's interest in my recent paper (Carss, 1989). Their remarks certainly require comment, and I shall answer them in turn.

I am well aware that fish cages are the targets for vandalism but find it hard to believe that vandals would visit a farm almost daily merely to fray the nets of cages holding smaller fish. It is the cages holding

larger fish which are their targets and the clean-cut slashes made by vandals are quite unlike those believed to have been made by the ducks. Furthermore, although the fishing season for wild brown trout begins on 15 March, in open flowing water systems there is no close season for either charr or rainbow trout. Therefore on Loch Awe, an established rainbow trout fishery, angling continues throughout the year.

At no time were otters or their tracks and signs seen in the area of the fish farm and although mink were occasionally present, there was no evidence that they were there when this damage was recorded.

I feel it is unlikely that Goosanders would be attracted to most of the fish released by vandals as they would be too large to swallow. As to their *intent*; I have watched birds at fish farms for many hours and would be reluctant to comment on their intentions, which cannot be determined by observation alone. In my paper I do not ascribe intentions at all.

Birds, and other diving predators, may well be attracted to the fish living outside farm cages. I studied this in detail at Loch Awe and several other cage sites in Argyll. At freshwater sites it was farm escapees, rather than wild fishes, which were concentrated in high numbers in the waters adjacent to the cages. These fish were present throughout most of the year but on the whole they were too large for the ducks to swallow (Carss 1990a).

I visited the Loch Awe farm every few days for over two years and built up good working relationships with the managers and staff and I am sure that the information I received from them was the truth as they perceived it. It was not my intention to *prove* that Goosanders damaged cage nets in my paper, merely to report that staff at the farm believed this to be the case, and that as a result, birds were shot.

Along with a colleague, Dr Mick Marquiss, I am currently involved in a six year investigation into the predator-prey relationships of sawbill ducks and juvenile salmon. This brings me into contact with the appropriate licencing authorities and I can assure the Clyde Branch that my paper has certainly not increased the pressure to 'control' Goosanders. On the contrary, it highlighted the vulnerability of the small, local breeding population in Argyll.

I also stated in my paper that trials were needed to produce more effective underwater anti-predator nets as the existing weighted sheets of neeting were rather ineffective. I did not discuss all the methods available to fish farmers for reducing bird predation at their site because I did not believe that *Scottish Birds* was the most appropriate publication for such material. However, I have published such information elsewhere (NCC 1989, 1990, Carss 1990b, Carss and Marquiss 1992), much of which has also been incorporated into Guidelines produced by the fish farming industry itself (SSGA 1990).

I agree it is unlikely that Goosanders can tear holes in new netting but, as the Clyde Branch suggest, many cage nets are very worn. Nets become weakened by constant immersion and regular exposure to sunlight to kill off algal growth; Goosanders are certainly capable of fraying such nets. If this is the case, it gives a clear indication to the fish farmer on how such damage might be prevented without recourse to shooting a scarce bird.

I trust that the above comments will allay the reservations and fears of the Clyde Branch. I once again thank them for their interest in my paper and would encourage them to read my other publications.

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D.N. Carss, Institute of Terrestrial Ecology, Hill of Brathens, Banchory, Kincardineshire AB31 4BY.

(This correspondence is now closed. eds.)

Richard's Pipits on Stronsay

In the Winter 1991 edition of *Scottish Birds* (16:148), under Scientific Papers, my own paper on Richard's Pipits *Anthus novaeseelandiae*, which appeared in *British Birds* 83:505), is mentioned as referring to 'Behaviour of birds on Fair Isle'. In fact, the vast majority of my own sightings of Richard's Pipits behaving in the manner mentioned have been on Stronsay. For some reason 'BB' edited my paper and made no reference to the Stronsay birds, thus creating a misleading picture. The whole gist of my letter revolves round the amount of traffic on roads in particular, during 'falls' of migrants in the autumn, and it is a fact that many of the roads on Stronsay have less traffic on them during the course of a day than even the Fair Isle roads.

Of the eight Richard's Pipits I have seen on Stronsay at least six were first seen feeding in the road and the other two were first seen flying along the road and had probably been flushed from it. Several of the birds were seen subsequently feeding along the edges of roads in the manner of Pied Wagtails, and my own feelings are that if left undisturbed the species may prefer to feed in this manner particularly in wet conditions. I have seen 3-4 of the species (all newly arrived birds) feeding in the road on Fair Isle. All those feeding in this way were seen pecking from overhanging grass at the verges.

Naturally, the birds are very popular with visitors and the main point of my paper is that if they are left undisturbed they may prefer not to frequent areas of long grass, although it is understood that the species can and will tolerate such habitat. At busy birdwatching 'sites', the birds are soon inadvertently driven away from roads, either by traffic, birders or other disturbances, leading to a false impression of their 'preferred' habitat and, of course, where to look for them during 'falls'.

John Holloway, 'Castle', Stronsay, Orkney.

Items of Scottish Interest

Most of the following papers and reports on birds in Scotland are available in the Waterston Library for reference, and we have included all that have come to notice in the period September 1991 to March 1992. The last list of this kind was in SB 16: 147-150. We would be glad to learn of any that have been missed, and indeed to receive reprints or copies of papers on any aspect of ornithology or natural history.

Bird reports marked with an asterisk are available from the SOC at the prices quoted, but please add 50p for postage and packing, regardless of the number of items ordered.

Scientific papers

Avery, M.I., Suddaby, D., Ellis, P.M. & Sim, I.M.W. 1992. Exceptionally low body-weights of Arctic Terns on Shetland. *Ibis* 134: 87-88. (Comment on a previous paper only).

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Baines, D., Goddard, J. & Hudson, P. 1990. Capercaillie in Scotland. *Game Conservancy Ann. Rep.* 22: 153-156.

Bourne, W.R.P. 1991. Dark-rumped Storm Petrels in the North Atlantic. *Sea Swallow* 40: 63. Of potential Scottish interest since several have been reported from Tynemouth.

Caldow, R.W.G. & Furness, R.W. 1991. The relationship between kleptroparasitism and plumage polymorphism in the Arctic Skua. *Functional Ecol.* 5: 331-339.

Craik, J.C.A. 1991. More serious than Shetland? *Seabird Group Newsletter* 60: 2-4. Formerly secure breeding sites for seabirds on the numerous grassy and rock-strewn islets off the west coast of Scotland are being heavily predated by Mink.

Dougall, T.W. 1991. Winter distribution and associated movements of northern Pied Wagtails as shown by ringing. *Ringing and Migration* 12: 1-15.

Doyle, P. 1991. Movements and habits of the Sparrowhawk offshore in the North Sea. *North Sea Bird Club Ann. Rep.* for 1990: 54-68.

Dunnet, G.M. 1991. Population studies of the Fulmar on Eynhallow, Orkney Islands. *Ibis* 133 Suppl. 1: 24-27.

Grant, M.C. 1991. Nesting densities, productivity and survival of breeding Whimbrel in Shetland. *Bird Study* 38: 160-169.

Hamer, K.C. & Furness, R.W. 1991. Sexing Great Skuas by discriminant analysis using external measurements. *Ringing and Migration* 12: 16-22. A study on Foula, Shetland.

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Heubeck, M. 1991. Reprieve for Shetland's seabirds? *Seabird Group Newsletter* 60: 2. Twice as many Arctic Terns are thought to have nested in 1991 than in 1990.

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Heubeck, M. & Suddaby, D. 1991. Post-mortem examination of Little Auks, Shetland, December 1990. *Seabird* 13: 51-53.

Jacobsen, O.W. 1991. Rooks attacking Oyster-catcher in water. *British Birds* 84: 395. An occurrence in 1984 near Newburgh, Grampian.

Keller, V.E. 1991. Effects of human disturbance on Eider ducklings in an estuarine habitat in Scotland. *Biol. Conserv.* 58: 213-228.

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Proceedings of the 5th International Symposium on Grouse. David Jenkins (ed) 1991. 128 pp. Published in *Orn. Scand.* 22(3): 213-228.

RSPB Conservation Review no. 5. C.J. Cadbury (ed) 1991. 97 pp. £7.00 post free from RSPB, The Lodge, Sandy, Bedfordshire SG19 2DL. Includes 'Species and Habitat Action Plans' for White-tailed Eagle, Corncrake, Roseate Tern, and lowland wet grasslands.

Waders breeding on wet grasslands. H. Hötker (ed) 1991. Proceedings of a Workshop held in Ribe, Denmark, September 1989. Published as a Supplement to *Wader Study Group Bulletin* 61.

Bird Reports

Angus and Dundee Bird Report for 1990. M.S. Scott (ed) 1991. 46 pp. *£3.00 Berwickshire Bird observations 1990, in *Hist. Berwickshire Naturalists' Club* 45: 79-82.

Borders Bird Report no. 12 for 1990. R.D. Murray (ed) 1991. 80 pp. *£3.75. Includes reports on Mute Swan census, Ruddy Duck, and Tweeddale rookeries.

Colonsay and Oronsay (Natural History of) 1991. An 11 pp unpublished report by J. Clarke & P.M. Clarke 1992.

Dumfries and Galloway Region Bird Report for 1990. A. Donald Watson (ed) 1991. 31 pp. *£2.75.

Dunbartonshire and Stirlingshire Peregrine report for 1991. A 2 pp unpublished report by R. Broad and J. Mitchell. 1991.

Fife Bird Report for 1990. D.E. Dickson (ed) 1991. 54 pp. *£2.50. Includes short articles on Weather in Fife 1990; Nightingale in Mainland Fife; Chough in Fife; Rare & Scarce Birds in Fife in the Eighties.

Forth Area Bird Report 1990. C.J. Henty (ed) 1991. In *Forth Naturalist & Historian* 14: 27-48.

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Islay Bird and Natural History Report for 1990. M. Ogilvie (ed) 1991. 24 pp. *£1.50.

Livingston Bird Report for 1991. Livingston Ranger Service (ed) 1992. 20 pp. *A few free copies are available at SOC, but please send post & packing charge.

Lothian Bird Report for 1990. O. McGarry (ed) 1991. 109 pp. *£4.00. Includes 24 pages of special reports.

North Sea Bird Club Annual Report for 1990. P. Doyle (ed) 1991. 73 pp.

Outer Hebrides Bird Report for 1989 and 1990. T. Dix & P. Cunningham (eds) 1991. 116 pp. *£4.00. This is the first separate publication of a bird report for the Outer Hebrides, and is a very fine production. Shorter bird reports have for a number of years been published in the *Hebridean Naturalist.*

Perth and Kinross Bird Report for 1990. W. Mattingley & R. Youngman (eds) 1991. 35 pp. *£3.10.

W.G. Harper

Advice to Contributors

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

Reference should be made to recent issues of *Scottish Birds* for guidance on style of presentation, use of capitals, form of references, etc. Papers should be typed on one side of the paper only, double-spaced and with wide margins; two copies are required and the author should also retain one. Headings should NOT be underlined, nor typed entirely in capitals. Scientific names should follow the first text reference to each species and should follow Voous' 'List of Recent Holarctic Bird Species' as given in *The British Birds' List of Birds of the Western Palearctic* (1984).

Only single quotation marks should be used, and numbers one to ten should be written out whereas 11 and above should be written as numerals. Dates should be written '11 August 1991' or 'the 11th' if no month is mentioned.

Tables, maps and diagrams should be designed to fit either a single column or the full page width. Tables should be self-explanatory and headings should be kept as simple as possible, with footnotes used to provide extra details where necessary. Each table should be on a separate sheet. Maps and diagrams should be in Indian ink and drawn so as to permit reduction to half their original size. If necessary they may be submitted without lettering and accompanied by a photocopy showing the lettering required. Captions should be typed on a separate sheet. Relevant line-drawings (in ink) will be welcomed, as will photographs (preferably black & white glossy prints).

Authors are responsible for checking their own proofs and returning them promptly. Text changes (as distinct from correction of printer's errors) at the proof stage involve extra cost and will only be accommodated under exceptional circumstances.

European journals in the Waterston Library

Many members are probably unaware of the wealth of material available in the Library beyond the extensive range of books. Thanks to the efforts of Bill Harper, many foreign journals are regularly received on an exchange basis and are available for members to consult. This arbitrary selection of some 30 articles follows on from the list in Vol 16 No 2, and is taken from the following journals received in the period Nov 1991 to Mar 1992:

Netherlands:	*Ardea, Limosa, Dutch Birding*
France:	*Alauda*
Switzerland:	*Nos Oiseaux, Der Ornithologische Beobachter*
Belgium:	*Aves, Le Gerfaut, Mergus*
Germany:	*Die Vogelwelt, Limicola, Corax*
Austria:	*Egretta*
Spain:	*Ardeola*
Sweden:	*Vår Fågelvärld, Ornis Svecica*
Norway:	*Vår Fuglefauna, Cinclus*
Denmark:	*Ornis Scandinavica, Dansk Ornitologisk Forenings Tidsskrift*
Finland:	*Ornis Fennica, Lintumies*
Ireland:	*Irish Birds*

Articles are arranged in species order; square brackets indicate that the article is in the original language (usually, but not invariably, with an English summary – I might be able to arrange a translation for anyone interested); the abbreviated reference gives the journal number and year.

Divers to Ducks:

van Nes, E.H. & Marteijn, E.C.L. [Waterbird population development in the first two years of a new freshwater lake] – *Limosa* 4/91.

Coppee, J-L. [Analysis of observations of Divers at the Eau d'Heure dams] – *Aves* 1/91.

Leibl, F. & Zach, P. [Migration, population size and breeding biology of Black-necked Grebes in NE Bavaria] – *Vogelwelt* 1/92.

Harris, M.P. & Wanless, S. Importance of the lesser sandeel in the diet of the Shag – *Orn Scand* 4/91.

Nilsson, L. & Pirkola, K. Migration pattern of Finnish Bean Geese – *Orn Svec* 2/91.

Nehls, G. [Numbers, annual cycle and feeding ecology of the Eider in the Waddensee] – *Corax* 3/91.

Ydenberg, R. & Guillemette, M. Diving and foraging in the Common Eider – *Orn Scand* 4/91.

Birds of Prey:

Bekhuis, J. & Zijlstra, M. [Increase in Dutch breeding population of Hen Harrier] – *Limosa* 4/91.

Norriss, D.W. Status of the Buzzard as a breeding species in the Republic of Ireland – *Irish Birds* 3/91.

Shirihai, H. & Forsman, D. Steppe Buzzard morphs at migration and their separation from Long-legged Buzzard – *Dutch Birding* 6/91.

Grouse to Cranes:

Mjelstad, H. Displaying intensity and sperm quality in the Capercaillie – *Cinclus* 4/91.

Rinne, J. [Following Crane migration by satellite] – *Lintumies* 5/91.

Waders to Auks

Brader, M. [The Bar-tailed Godwit in Austria] – *Egretta* 2/91.

Pulliainen, E. & Saari, L. Breeding biology of Wood Sandpiper in Eastern Finnish Lapland – *Orn Fenn* 3/91.

Noordhuis, R. & Spaans, A.L. Interspecific competition for food between Herring and Lesser Black-backed Gulls in the Waddensee – *Ardea* 1/92.

de Mesel, D. [Yellow-legged Gulls in Belgium: an analysis] – *Gerfaut* 1-4/90.

Densley, M. Ross's Gulls in Siberia – *Dutch Birding* 5/91.

Durinck, J. *et al* [Winter food of Guillemots in the Skaggerrak] – *Dansk Orn For Tidsskr* 3-4/91.

Pigeons to Woodpeckers:

Michelat, D. & Giraudoux, P. [Size of Barn Owl territories during breeding season] – *Alauda* 3/91.

Sierro, A. [Ecology of the Nightjar in Valais] – *Alauda* 4/91.

Passerines:

Virtanen, H. [Occurrence and nesting biology of Woodlark in S W Finland]– *Lintumies* 6/91.

Dierschke, V. & Dierschke, J. [Migration of Red-throated Pipit through Central Europe] – *Limicola* 6/91.

Peris, S.J. *et al.* [Factors affecting Dipper numbers in West-central Iberia] – *Ardeola* 1/91.

Borgström, E. [Distribution and breeding ecology of the Dipper in Värmland] – *Orn Svec* 2/91.

Ullman, M. [Wheatears: a particularly exciting genus] – Vår Fågelvärld 1/92.

Vergauwen, G. [Lanceolated Warbler in Zeebrugge Oct 91] – *Mergus* 3/91.

Schlenker, R. [Flight direction of Reed Warblers through South Germany] – *Ök der Vögel* 1/91.

Tyssandier, Ph. [The Orphean Warbler in France] – *Alauda* 3/91.

Christen, W. [Decline of Whitethroat and Corn Bunting in the Aare plain] – *Orn Beob* 2/91.

Tombre-Steen, I. [Breeding biology of Parrot Crossbill] – *Vår Fuglefauna* 4/91.

Tyrberg, T. Crossbill evolution in the West Palearctic – *Orn Svec* 1/91.

Michael Murphy

REQUEST FOR REPRINTS ON OWLS.
Authors of articles or publications dealing with owls and wishing them to be listed in the second edition of *A Working Bibliography of Owls of the World* are asked to send reprints to:

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Two issues of *Scottish Birds* are published each year, in June and in December. *Scottish Birds* is issued free to members of the Scottish Ornithologists' Club, who also receive the quarterly newsletter *Scottish Bird News* and the annual *Scottish Bird Report*. These are available to non-members at a subscription rate (1992) of £30.

The Scottish Ornithologists' Club was formed in 1936 to encourage all aspects of ornithology in Scotland. It has local branches which meet in Aberdeen, Ayr, the Borders, Dumfries, Dundee, Edinburgh, Glasgow, Inverness, New Galloway, Orkney, St Andrews, Stirling, Stranraer and Thurso, each with its own programme of field meetings and winter lectures. The Waterston Library at the Club's headquarters at 21 Regent Terrace, Edinburgh EH7 5BT is the most comprehensive ornithological library in Scotland, and is available for reference during office hours (Monday to Friday, 9.00 – 17.00 hrs). A comprehensive stock of Scottish local bird reports is held at the headquarters and may be purchased by mail order.

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Research Progress Report

I. NEWTON

A 20-year study of Sparrowhawks in Eskdale

In the late 1950s, Sparrowhawks *Accipiter nisus* over much of Britain suddenly declined in numbers, and disappeared altogether from some eastern districts. This was attributed to the agricultural use of organochlorine pesticides, which the hawks accumulated from their prey. The most toxic chemicals, notably aldrin and dieldrin, killed the hawks directly, while the less toxic DDE (derived from DDT) lowered breeding success through causing eggshell-thinning and breakage. Hawk numbers thus declined from a combination of increased mortality and reduced reproduction. The problem had been investigated in the 1960s by Ian Prestt and Derek Ratcliffe, in the former Nature Conservancy. When I began my studies in the 1970s, restrictions had already been imposed on the use of organochlorines, and Sparrowhawks were increasing again. In one of the areas in which I worked, the Esk Valley around Langholm in Dumfriesshire, the population seemed in 1972 to have recovered fully and, despite some slight shell thinning, showed no obvious depression in breeding success. At the time this population therefore acted as a standard, against which to compare the trends and breeding of Sparrowhawks elsewhere.

I have continued to study this population to the present day, collecting data from the same 200 km^2 area in a consistent manner throughout. In each year, I have searched all the woodland in the area in an attempt to find all the nests. I have climbed to the nests frequently, to obtain laying dates, clutch and brood sizes, and to ring the young, and recovered any prey items that were present. In each year I have also trapped for ringing and identification as many of the breeding adults as possible, enabling their individual histories to be followed. Because females spend more time at the nest, however, they proved easier to catch, and provided much larger samples than males. The overall objecive was to find what factors influenced numbers and nest success.

Over the 20 year period from 1972 to 1991, the breeding population remained remarkably stable (Figure 1). Nest numbers fluctuated between 29 and 39, or by no more than 15% on either side of the mean level of 34, with no long-term trend. Within these limits, high nest numbers occurred in years when March-April were relatively warm and dry, and low nest numbers when March-April were cold and wet. The general stability was associated with relative consistency in the amount of nesting habitat over the years.

Within areas of suitable woodland, nests were regularly spaced, about 0.6-0.8 km apart, reflecting the territorial spacing of adjacent pairs. However, most nests were much further apart, because they were separated by areas of open country or by unsuitable woodland. In this mainly coniferous area, the woodland was managed for timber production. In every year, some patches were felled and re-planted, and from about 20 years on, each stand was thinned every five years or so, when a proportion of trees was removed. Thus, as a stand aged, the trees became bigger and more widely spaced. In the absence of management, the same process would have occurred through tree mortality, but over a longer period, as in a natural forest. Most Sparrowhawk nests were found in young stands, about 20-35 years old, and as any given stand aged, occupancy and nest success progressively declined (Table 1). Few nests were found in stands older than 40 years, though those same stands were well used in earlier years.

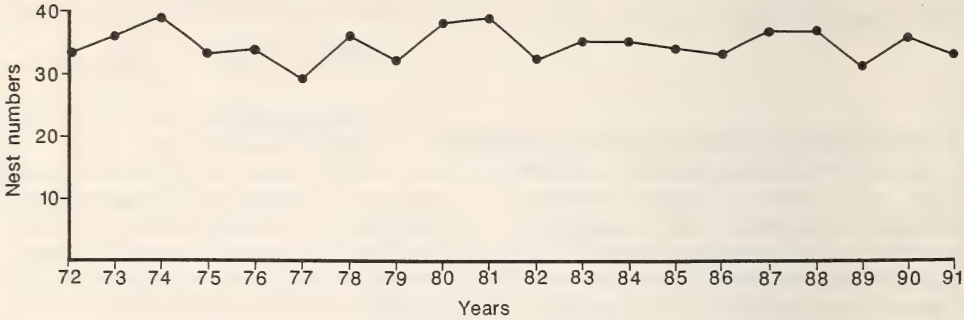

FIGURE 1. **The numbers of Sparrowhawk nests found each year during a 20-year period in a 200 km^2 area in Eskdale, Dumfriesshire.**

In this area, then, general stability in the numbers of breeding Sparrowhawks was associated with a system of rotational forest management, which ensured a fairly constant age structure in the total forest over time, and plenty of stands in the younger age-groups. Although the number of nests changed little over the years, their distribution within the area changed slowly, as older stands were abandoned and younger ones taken up.

In the younger stands of 20-35 years old, Sparrowhawks produced, on average, more than enough young per nesting attempt to offset the usual annual adult mortality, but in the older stands of 35-50 years they produced too few. These older stands therefore acted as 'sinks', whose sporadic occupation was maintained largely by continual net immigration from the most productive younger stands.

It was not obvious why Sparrowhawks bred better in younger woods than in old ones, but study of the causes of breeding failures offered clues. The main causes of failure were non-laying (having built a nest), egg desertion and chick starvation. All these proximate causes could be attributed to a single underlying problem, namely food-shortage. Moreover, because all these types of failure occured more frequently in old woods than in young ones, Sparrowhawks may have had more difficulty in catching their prey in mature, open stands than in young, dense ones. Males fitted with radio-transmitters did most of their hunting within 0.5 km of their nests. Within these areas, they showed a strong preference for hunting in young woods, spending much more time there per unit area than they spent in older woods or in other, more open habitats. In continental Europe Sparrowhawks were also less likely to be killed by Goshawks in young stands than in old ones, but Goshawk predation was not important in Eskdale. The general conclusion was that Sparrowhawks thrived best at a particular stage in forest succession, and in Eskdale benefitted from the prevailing forest management, which ensured a continuing availability of young woods.

From trapping records, the annual survival of breeding females was estimated at 58%, on average, but varied between 37% and 72% in different years, partly associated with rainfall. In general, the more days on which rain fell during October - March, the lower the survival between one breeding season and the next. These large annual variations in adult survival were not reflected in the year-to-year changes in nest numbers. In each year, the recruitment of new breeders was generally sufficient to make up for the loss of old breeders since the previous year, so that nest numbers were largely maintained. New breeders were

drawn from the non-breeding contingent. These birds, mostly in their first two years of life, had apparently been excluded from nesting largely by the territorial behaviour of established breeders. Partly as a result of competition for nesting territories, many Sparrowhawks did not start breeding until their second or third year of life. Non-breeders that were fitted with radios spent most of their time in areas not used for breeding, such as farmland.

The trapping of adults at nesting territories has shown that, while about 70% of survivors nest on the same territory in successive years, 30% change territories between one year and the next. This applied to both sexes. Territory changes did not occur at random, however, because birds were more likely to change territory after a breeding failure than after a success; they were more likely to move from a poor territory (old woodland) than a good one (young woodland); and they were more likely to move between their first and second year of life than subsequently. To some extent, these trends were inter-related, because young birds were more likely to nest on poor territories and to fail in their breeding than were older ones, but statistical analysis revealed that the three trends were also to some extent independent of one another.

The combination of mortality and movements meant that, on individual territories, the turnover in occupants was high. Most birds were present on particular territories for only one year, but some stayed up to eight, with a mean residence period of 1.5 years. So the continued occupation of certain territories was produced by many birds occupying them in succession, but most staying for only a short period. One territory was occupied for ten successive years, but by a different female each time. Many of these females were found in later years nesting on other territories nearby. In general, regular territories, in young woods, tended to be occupied every year by birds which remained for longer-than-average periods, while other territories, in older woods, were occupied sporadically, mainly by young birds which later moved elsewhere.

Sparrowhawks in south Scotland fed primarily on birds, the smaller male concentrating on smaller species (5-120g, especially 5-80g) than the larger female (chiefly 20-120g, also up to 500g). About 97% of all prey items recorded were birds, and included all the species available locally up to the size of Woodpigeon *Columba palumbus*. However, a few species were numerically especially important, namely Chaffinch *Fringilla coelebs*, Song Thrush *Turdus philomelos*, Blackbird *T. merula*, Robin *Erithaca rubecula* and Starling *Sturnus vulgaris* in the breeding season, with the addition of Redwing *T. iliacus* and

TABLE 1. **Occupancy and nest success at Sparrowhawk nesting places, according to years from first occupation. Most woods were first occupied at around 20-25 years of age, when they were first thinned. Thereafter, with increasing age of wood, both occupancy and nest success gradually declined.**

	Years from first occupation				
	1-5	6-10	11-15	16-20	21-
Number of nesting opportunities*	152	114	68	36	11
Number of nests (%)	140(92)	85(75)	31(46)	9(25)	0(0)
Number successful (%)	106(76)	53(62)	14(45)	4(44)	0(0)

*Calculated as the number of potential nesting places times the number of years.

Fieldfare *T. pilaris* in winter. The remaining 3% of the diet consistent of mammals, mainly voles and young rabbits, with no reptiles, amphibia or invertebrates.

Like many other birds, Sparrowhawks nested at a time of year when food was most readily available. In south Scotland, they depended heavily on easily-caught fledgling song-birds. In each year, the first hawk eggs were laid around the end of April, soon after fledgling prey first become available, and others followed in May. By the time the hawks had chicks, in June-July, young song-birds were at their most plentiful. None-the-less, as mentioned above, food-shortage seemed to be the main cause of individual breeding failure, manifest in non-laying, late-laying, small-clutches, egg desertions and chick mortality. All these problems were alleviated in experiments when extra food was provided artificially.

Weather also affected breeding, probably through its influence on food-availability. Annual variations in mean breeding success ranged between 1.4 and 2.8 chicks per nest and could be explained largely in terms of the weather in March-April. The occurrence of many cold wet days in this period was associated, not only with reduced nest numbers, as mentioned above, but also with late laying and poor success, whereas the occurrence of many warm dry days in this period was followed by early laying and good success. The weather seemed to influence the breeding of the song-birds on which Sparrowhawks relied, but also affected the hawks directly. During nest watches later in the season, the hawks brought in few prey items on wet days, so that their young often lost weight. It seemed that rain itself interfered with hunting.

Because I was able to follow the same Sparrowhawks year after year, I was also able to record lifetime reproductive success: the total numbers of young raised by individuals during their entire lives. The importance of such measures is that they approximate Darwinian fitness, reflecting the contributions that individuals make to future generations. Among Sparrowhawks, lifetime reproduction depended largely on the number of breeding attempts, which in turn depended on age of first breeding (1-3 years) and longevity (up to 10 years). On average, some 72% of individuals which left the nest died before they could start breeding at 1-3 years of age. A further 6% nested but failed to raise young. The remaining 22% bred successfully, but varied greatly in the numbers of young produced. Most successful birds bred only once, so raised only 3-5 young, the number usually found in a brood. Others bred more than once, and the most productive females raised more than 20 young during their lives. In fact, the most productive 5% of individuals in one generation produced more than 50% of young in the next. I am now trying to understand which factors predispose some individuals to fail and others to breed well. Such factors include features of the birds themselves and of their habitat. It is already apparent that territory quality plays a major role, because birds which spent most of the breeding lives nesting in young woods reared the most young.

The main conclusion to emerge from this work on Sparrowhawks concerns the over-riding importance of food-supply in influencing breeding density and nest success. Comparing nest spacing in forests in different parts of Scotland, the mean distance between nests was inversely correlated with the densities of song birds measured in the local woods: hawk nests were furthest apart in districts where prey were scarcest. The effect of food supply on breeding density is apparently mediated by territorial behaviour, as pairs space themselves according to the food-supply. Through territorial behaviour in Eskdale, annual recruitment to the breeding population was regulated, so that the numbers of new breeders added each year approximately matched the numbers of old ones lost. By this mechanism, the annual

fluctuations in breeding density were relatively small. Other factors also influenced the performance of individuals, possibly through their influence on food availability, as shown by the correlations between forest age and performance and between weather and performance.

From a research viewpoint, Sparrowhawks are not the easiest of birds to study. Not only are they difficult to observe, but their nests are hard to find and reach. More importantly, they are not readily amenable to experiment, so most of our understanding must rest on observational evidence only: on correlations between changes in numbers and breeding performance on the one hand and changes in environmental variables on the other. Some aspects have yielded to experiment, however, notably the role of territorial behaviour in limiting breeding density (some removed breeders were soon replaced by others), and the role of food supply in breeding success (pairs given extra food raised more young than unfed pairs). None-the-less, no-one who was concerned solely with mechanisms of population regulation, with no interest in the birds themselves, would choose to study Sparrowhawks.

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Research Progress Report

JEFF GRAVES AND JOSE ORTEGO RUANO

Shags on the Isle of May: Who Mates with Whom?

Some birds live for many years, successfully rearing one or more broods each year after they become adults. Others either die young, or fail to find a mate, or nest in places where their clutch is more likely to be lost. They may also fail to rear young for many other reasons. There is thus a lot of variation in the numbers of descendants that birds leave. Since those that leave the most surviving offspring will be at an advantage, it is interesting to examine just how the successful achieve this feat. It is straightforward to count up the numbers of young that each pair of birds rears every year and then, with a long-term study, to see how many they rear in a lifetime. But unfortunately this is not all there is to it. When a female mammal gives birth, we can be sure that the infant is her own; although, if she mated with more than one male there may be some doubt about who its father may be ('paternity uncertainty'). It is rather more complicated in birds. Extra-pair mating may lead one or more of the young in a nest to be the offspring of some other male than the one that tends them, but there may also be 'egg-dumping', or intra-specific brood parasitism. This is where the female lays an egg in a nest that is not her own but of the same species, so that neither of the pair that rears the chick are its parents. Given the amount of work that many birds must expend in raising their brood, egg-dumping is rather a good strategy. A bird that lays an egg a day in its own nest has a lot of work ahead of it; one that lays its eggs in the nests of others has none. Only in recent years has the frequency both of egg-dumping and of extra-pair mating amongst birds been recognised. The former is now known to occur in over a hundred species (Andersson 1984). The latter has been observed in many different bird species, but the difficulty has always been to know whether it actually resulted in chicks whose father was not the male of the pair that reared them.

New biochemical techniques have allowed us to come to grips with this question in the last ten years or so. Unless they are identical twins, individuals all have a different spectrum of genes, half inherited from each parent. Where a gene differs between two individuals, this leads to differences in one of the proteins that are a major constituent of an animal's body. By examining these proteins using a method called electrophoresis, which will separate ones that are slightly different from each other, we can detect whether a bird has a protein whose structure is different from those of one or both parents. If it does, then it is very likely to be the offspring of a different pair or of an extra-pair mating by its mother. Unfortunately, proteins do not vary very much, and unrelated birds may have a similar spectrum, so that the chick may not belong to the pair tending it even if it shares the structure of several different proteins with them. In a study of Indigo Buntings in the United States, David Westneat (1987) estimated that only 40% of the time could he be sure that a chick was not the offspring of the male at its nest. Even if he was sure in a particular case, he could not easily tell which of the other males in the vicinity was its real father.

Better methods were clearly required to allow us to tell who is related to whom in a group of birds. The new technique of DNA fingerprinting, which has become well known for its human applications in forensic medicine and in paternity suits, offers just such a possibility for studies of birds. The method was developed by Alec Jeffreys, at Leicester University (see Jeffreys

et al 1985), and it permits a very high degree of uncertainty that two birds, such as a chick and the male that is rearing it, are not related.

The chance of getting it wrong, and thinking the birds are parent and offspring when they are not, is less than 1 in 10,000! It is not therefore surprising that many recent studies of breeding systems in birds, more than 30 to date, have used DNA fingerprinting.

Birds are particularly suitable for fingerprinting because, unlike mammals, their blood contains a large amount of DNA, so only a small blood sample is needed to carry out the analysis. This can easily be obtained without harming the bird. The method works because there are regions of DNA that vary enormously between individuals, but the extent of this variation depends on how closely they are related. The DNA is split up into sections, and electrophoresis is used to separate these out on a strip of gel: the smaller pieces move more quickly and so migrate further along the gel. A piece of DNA known as a 'probe', which is radioactively labelled, is then added and this binds to the DNA on the gel. A photograph reveals the radioactivity and shows a pattern rather like a supermarket bar code, each bar being a different segment of DNA. If the bar code of a chick is compared with that of its parents, nearly all of its bars are found to match those of one or other parent. But if it has several bars with no equivalent in either parent we can be certain that one or both of them is not really its parent at all. An example is shown in Figure 1.

We started studying the breeding behaviour of Shags on the Isle of May in April 1990. In the last two years we have observed all the courtship and matings that have taken place in a small colony of 25-30 pairs, all of them colour ringed. We have used DNA fingerprinting to identify the parents of each of the chicks that fledged in both these years. We also took blood samples from the birds in the colony in 1987 and 1989, and from these we already knew that some chicks (18%) were not fathered by the pair-male at their nest. Of the broods we examined in those earlier years, 22% had at least one chick with this 'extra-pair paternity'.

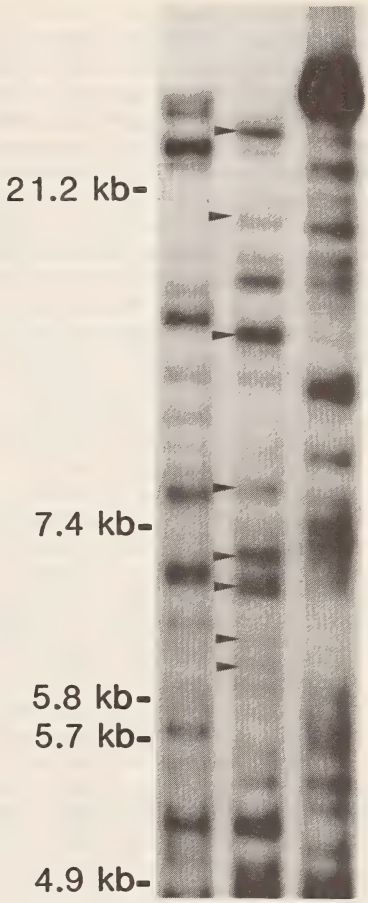

FIGURE 1. **An example of extra-pair paternity revealed by DNA fingerprinting. The chick's fingerprint is in the middle with the male's on the left and the female's on the right. The arrows point to bands not found in either parent. The chick shares over half its bands with the female but only 25% with the male. The lengths of the DNA fragments (in thousands of bases, or kb) are shown on the left.**

In 1990, the Shags on the May, in common with several other seabird species, had the worst breeding season for over 20 years. The 25 pairs on our colony that got as far as laying eggs fledged only seven young (an average of 0.28 chicks per nest, compared with the usual 1.0-1.2). We do not know the reasons for this failure, though they doubtless relate to the birds' inability to find enough of the sandeels on which they mainly feed their young. In line with this, Mike Harris and Sarah Wanless (pers. comm.) found that the sandeels that were brought back in 1990 were significantly smaller than in recent years. In 1991, the colony fared a little better: 22 pairs laid at least one egg and 15 chicks fledged, giving an average of 0.68 chicks per nest.

Surprisingly, all of the 22 chicks that fledged in these last two years were fathered by the male at their nest, giving a significantly different picture from what we obtained in the two earlier ones. The likely explanation is that the pressures that lead to bad breeding success also reduce extra-pair paternity, and we are going on to examine this more closely with a larger group of birds. A surprise in these results is that extra-pair matings were just as high in 1990 and 1991 as before. In both years we observed around 2000 matings, and 17-22% of these were not with the female's nesting partner. This is very much in line with the level of extra-pair mating we had found earlier (Graves *et al* 1992).

The birds vary a good deal in whether they mate with individuals other than their nesting partner. In particular, those females that successfully fledged chicks in both 1990 and 1991 showed very little extra-pair mating, and significantly less than the ones that laid but failed to fledge any chicks. We could also detect this difference by comparing the behaviour of the same female between the two years: those that successfully fledged chicks in one year of the study, but failed in the other, had significantly more extra-pair matings in the year that they failed. This relationship leads us to expect that high fledging rates in a population will be related to high levels of extra-pair paternity, although this is not something that has so far been found in any other species.

Why might we get this rather curious result? Shags have a long reproductive life: they start breeding at the age of two, and some live till they are 14 or 15 years old. Once adult, only about 11% of birds die each year. This means that any one brood is not particularly valuable to them, as it would be to an animal that bred only once or twice. Rather than working hard to rear a brood in difficult conditions, and perhaps stressing itself and so lowering its survival over the winter, it may be better for a bird to stop trying to breed in a particular season and wait for better conditions. Nicholas Aebischer (1985) found that the decline in the number of breeding Shags that occurred on the Isle of May 20 years ago was not due to a crash in the population, but to large numbers of birds not attempting to breed for two consecutive years. This would not be an option open to birds with high annual mortality, because their chances of surviving to the next breeding season would be too low.

Extra-pair matings in Shags are not forced on females, but are actively sought by them. In most cases they take place at the male's nest after a female has approached a displaying male. The link between this behaviour on the part of the female and her lack of success in fledging chicks, could be because she tends her chicks less well or because her nesting partner does so. Perhaps females with partners or nest sites that are less satisfactory attempt to change by seeking to become the pair female on a different nest where either the male or his site is better. However, this seems unlikely as we have only twice observed paired females moving to a different partner in this way. Another possibility is that females may seek extra-pair matings with males that will father better offspring than their own partner. We have no way of

testing this yet, as none of these matings has led to any offspring in the two years we have studied them.

Another possible reason why females that mate outside the pair fledge fewer young is an intriguing one. Perhaps males that have a higher risk of having chicks that they did not father in the nest are less prepared to work hard at tending the brood than those with greater paternity certainty. Anders Møller (1988) found just such an effect in Swallows, using experiments that altered the number of extra-pair matings that the females in his colony had. In Shags we have found no egg dumping by other females, so female confidence that the eggs in their nest are their own should be very high. If we can study the birds during a breeding season when most pairs fledge chicks, we will be able to test the idea that males whose partners mate outside the pair work less hard at provisioning the chicks than those whose partners do not.

While it is true that the great majority of bird species are monogamous, detailed studies of their behaviour have shown that some extra-pair mating occurs in almost all species studied so far. DNA fingerprinting has opened up new possibilities for discovering just how this effects the relationships between individuals in a colony. It has certainly shown that the breeding system of Shags is more complex than we had hitherto imagined, and raised some intriguing questions for the future.

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Recent status change of some birds on Islay

M.A. OGILVIE

Recent status changes of a number of species of birds occurring on Islay, Inner Hebrides, are reviewed. Barnacle and Greenland White-fronted Geese have both increased roughly three-fold in the last 30 years largely due to favourable changes in farming practices, yet Greylag Geese have almost disappeared in the same time. Several species of ducks wintering on Loch Indaal have increased. One possible reason may be nutrients reaching the loch from agricultural run-off and sewerage encouraging more plant and animal food for the birds. Common Scoters and Red-breasted Mergansers are also summering in larger numbers. Numbers of Bar-tailed Godwits have fluctuated, in Loch Gruinart as well as in Loch Indaal.

Nearly all the birds of prey have increased in recent years, with a cessation of persecution probably the main reason. Corncrakes are declining, though management agreements with farmers and crofters may help. Choughs increased to a peak about five years ago but numbers have since declined a little. Nest sites in old buildings are being maintained through grants.

Introduction

The following review makes no claims to be complete. It is one person's survey of what has happened to a number of species on one island in the Inner Hebrides since about the 1960s with, in some cases, a retrospective look back to the last century. Some data have been easy to come by and are presented here as a reasonably true record of what has occurred. Almost all the original data used by Booth (1975) and Elliott (1989) in writing their books on the birds of Islay have been available to me but I have re-analysed and, in some cases, re-interpreted them. Other information remains buried in people's notebooks but perhaps I shall make sufficiently wild guesses to stimulate its (in some cases, overdue) publication.

It is usually true to blame all negative status changes of birds in Britain, and further afield, on man's activities though this may mean that more natural causes are overlooked. Certainly on Islay, almost every status change I shall discuss can probably be attributed to man's activities, either deliberate or unwitting.

My selection of species has been governed mostly by the availability of information and my personal interest in the species. Thus it will come as no surprise that geese figure largely here, though former colleagues may be surprised at my recent addiction to birds of prey. As it happens, the majority of species discussed in detail have increased in the period under review, but a few have decreased and others also in decline are mentioned in brief.

GEESE

Three species of geese winter on Islay, Barnacle *Branta leucopsis*, Greenland White-fronted *Anser albifrons flavirostris* and Greylag *A. anser*, in that order of abundance. Two have increased greatly in the last 30 years, one has, perhaps surprisingly, declined.

Barnacle Goose

This species has wintered on Islay, as well as on many other islands in the Inner and Outer Hebrides, for as long as records exist. Precise figures, though, are unsurprisingly scarce. Gray (1871) was told of "very large flocks" particularly at Loch Gruinart and Ardnave. Harvie-Brown and Buckley (1892) wrote of "thousands in Islay, Jura, Colonsay and ... on most suitable islands" and also commented that "they do great damage to grass", from which it would appear that less has changed than is sometimes thought. There are other reports of large flocks from the same period and into the first part of the 20th century, though information from the 1920s and 1930s is hard to come by. Berry (1939) contacted five local observers who reported increases over the previous 25 years in two areas on the island, no change in two more and a decrease in a fifth, this last because of the construction of an airfield. No figures are given, however.

Boyd (1968) assembled all post-war counts and estimates known to him, from the earliest available, in December 1952. Some were clearly 'guestimates', e.g. "8000-10000" and "over 10000", others gave the impression of being more accurate, e.g. "just over 5000". Boyd agreed with Atkinson-Willes (1963) who described the

Barnacle Geese flying, Islay. *Morley Hedley*

status thus: "Taking the island as a whole the normal numbers are estimated at about 5000-6000, but by February there is usually an increase to 7,500 and in some seasons as many as 10,000 may be present for short periods."

In the early 1960s, Boyd began a series of early November counts which I took over in 1964 and have continued to the present day (Fig. 1). There have been many other counts during the same period, including a long run of spring counts which I started in the late 1960s. In March 1983, a team from the Nature Conservancy Council began a series of monthly counts which continued until 1986-7, then reduced to two or three per winter. Variations between these counts and my own, as well as variations through a winter, have tended to be small, rarely more than 15% and usually less than 10%. A pattern apparent in the 1970s of an increase in the spring is now less regular, with decreases recorded during several recent winters. An arrival peak in October 1983 and 1984 of considerably more birds than subsequently wintered on the island, reported by Easterbee *et al* (1987), has not occurred in any autumn since.

The large and rapid growth in numbers of Barnacle Geese on Islay that took place during the 1960s and 1970s can be attributed to a combination of better feeding on the island coupled with low mortality. Agricultural improvements during this period included a much greater use of artificial fertiliser and more frequent reseeding using more reliable seed mixtures, while the increased number of sheep kept

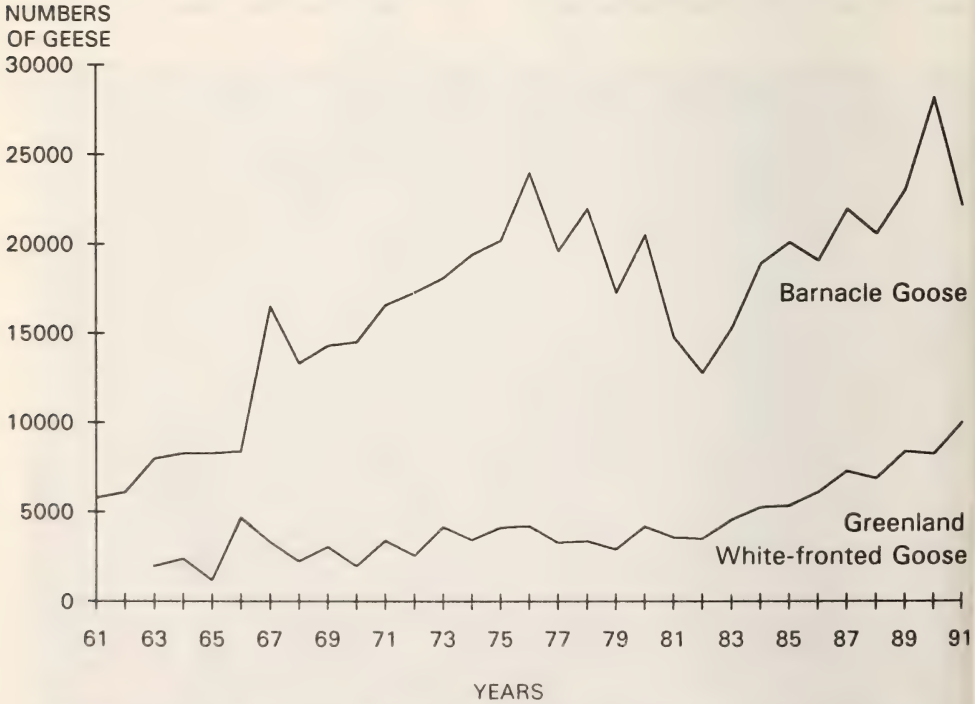


FIGURE 1. November counts of Barnacle and Greenland White-fronted Geese on Islay, 1961-1991.

on the improved pastures produced the kind of short swards attractive to the geese. The mean breeding success during this period exceeded the calculated annual mortality by several percentage points per annum. Shooting of Barnacle Geese on Islay was comparatively light, being largely restricted to a few private shoots each winter.

The situation altered in the late 1970s when, in response to increasing complaints from farmers, the law was changed to allow shooting throughout the winter instead of the hitherto restricted season of December and January. This encouraged the marketing of the shooting to paying visitors and consequently the numbers of geese shot more than trebled, coinciding with, and probably contributing to, a run of poor breeding years. This produced the sharp downturn in numbers shown in Figure 1, when the November total dropped from 24,000 in 1976 to 13,000 in 1982.

The Wildlife and Countryside Act of 1981 changed the rules again. The Barnacle Goose became a fully protected species, though with licenced shooting permitted to prevent serious agricultural damage. Over the next few years, management agreements covering three SSSIs were negotiated between the NCC and the rather few farmers involved, compensating the latter for feeding the geese but also prohibiting the shooting of them. In 1983, the RSPB acquired most of the Gruinart Flats as a reserve. This has probably always been the most significant area for Barnacle Geese on the island. Although badly run down at the time of acquisition, the land has since been greatly improved through ploughing and reseeding as the RSPB have successfully encouraged as many geese as possible to remain on their land.

With a combination of active management for the geese and decreased shooting, breeding success rose once more, as did total numbers. The increase from the low of 13,000 in November 1982 to 28,000 in November 1990 was even steeper than the previous period of growth. However, the sharp drop to 22,000 in November 1991 was a timely demonstration of the very marked effect on arctic-breeding goose populations of the vagaries of the weather. The breeding season of 1990 had produced 23.7% young birds present in the flocks on arrival on Islay, the second highest percentage since annual age samples began in 1959. This was immediately followed, in 1991, by the worst ever recorded, with a mere 4.7% young birds. Estimates of annual mortality in the last ten years have fluctuated between about 10% and 18%.

While the management agreements and the RSPB reserve were clearly contributing through the 1980s to the well-being of this important group of Barnacle Geese, representing about two-thirds of all the discrete Greenland-breeding population, the majority of the agricultural community on the island were far from happy. Those with management agreements were receiving significant annual payments, while those outside the SSSIs, a much larger number of farmers, received nothing at all. Up to 70% of the Barnacle Geese could be found within the SSSIs in the autumn but this proportion fell to below 50% by late-winter as the birds dispersed in search of more feeding, then usually picked up again in the spring. In winter 1988-9, a goose scaring scheme was operated by the Islay Forestry, Farming and Wildlife Advisory Group, funded by the Manpower Services Commission. Teams of scarers worked in areas outwith the SSSIs, endeavouring to persuade the geese by non-lethal scaring that life would be more congenial within the managed areas. This was reinforced by a fairly high level of shooting, mainly by the large estates.

In the next three winters, up to 1991-2, a different goose scaring scheme was operated, funded jointly by NCC and the Department of Agriculture and Fisheries for Scotland. This involved making payments directly to the farmers to help them with the extra costs of scaring, whether through purchasing static scaring devices or paying for time and fuel used in mobile

disturbance. The payments per farmer were well below the level received by those with management agreements, and the farmers concerned were virtually unanimous in saying that the payments were far too low and the scaring was having a negligible effect on goose numbers or distribution. My own observations, carried out for the Department of Agriculture, showed not just a decline in flock size through each winter, which is to be expected, but a reduction in flock size between winters 1988-9 and 1989-90 and again between 1989-90 and 1990-1, despite increased overall numbers of geese. My interpretation was that the scaring was having at least this beneficial effect of breaking up the larger flocks. An increase in flock size between 1990-1 and 1991-2 might be attributed to the farmers' own belief that there was no effect, leading to a reduced effort.

No direct monitoring of the efficacy of different types and levels of scaring was carried out but some incidental observations suggested that devices which issued loud and irregular warbling noises, including some supposedly audible to geese but not to humans, did discourage geese from coming too near. However, as with every other scaring device ever tried against birds, it is necessary to vary the type and location of the device at frequent intervals, a strategy not always open to farmers with limited labour available.

For winter 1992-3, and hopefully for the foreseeable future, a new goose management scheme has been proposed by Scottish Natural Heritage. It will apply to the whole island and be based on a headage payment for geese on each holding. At the time of writing (August 1992) the details are still being discussed with interested parties, but it should offer adequate payments to all landholders outside the SSSIs as nearly equivalent as possible to the payments being made to those inside. This will be a voluntary scheme but it is hoped that there will be a high take-up, leading to a final recognition by all involved that the geese can be conserved at an adequate level through a scheme which effectively subsidises the farmers and crofters who bear the brunt of feeding them.

It has been suggested that the scheme, which will bring about a significant reduction, even a cessation, of licenced shooting, will lead directly to a further increase in numbers. Predictions about trends in goose populations have a poor track record among goose biologists, including myself, and on this occasion I am declining to speculate, though I will monitor future events with great interest.

Greenland White-fronted Goose

Historical information about this species on Islay and on the adjacent Inner Hebrides is much harder to come by than for the Barnacle Goose; a difficulty is that this race of the Whitefront was not described until 1948. However, Gray (1871), referring just to the White-fronted Goose, stated that "in the West of Scotland, its headquarters are in the island of Islay" and was told that they showed "a great partiality for certain fields" and that "they go in flocks of from three to four to one hundred or more", both traits which are still exhibited today.

Harvie-Brown and Buckley (1892) had nothing to add to this but Scot-Skirving (1878) reported another long-standing habit, though one showing signs of recent change, namely that of using small fields and ignoring larger ones, even at the expense of being easier to shoot on the small fields. More recently, Berry (1939) reported local observers as saying that in the previous thirty years Whitefronts on Islay had "increased enormously".

Post-war counts began, as with Barnacles, in the 1950s, but were fewer and nearly all demonstrably incomplete. Hugh Boyd and then myself commenced what we hoped were more complete counts in the early 1960s, though some of the early ones are almost certainly under-representations. The full series of early winter counts since 1964 is shown in Figure 1. Allowing for

Greenland White-fronted Geese, Islay. ***Morley Hedley***

increasing experience producing more complete counts, there is only a slight upward trend over the first 20 years, (1964-5 to 1973-4 - 2900, range 1200-4700; 1974-5 to 1973-4 – 3700, range 2900-4560). Since 1983, however, the numbers have increased steadily to a record 10,000 in 1991.

Prior to 1981, when the subspecies was given full protection in the Wildlife and Countryside Act, it was not shot particularly heavily on Islay, certainly not as much as the Barnacle, despite wider availability. However, the increase in Barnacle shooting in the late 1970s, and particularly the larger numbers of shooters visiting the island, did bring about an increase in Whitefront shooting in some areas. Since 1981, it has been possible to shoot Whitefronts only under licence and these have been issued much less frequently than has been the case with the Barnacles, while the numbers shot in any winter have been very much less than in the years prior to that date.

Breeding success does not vary by as much as in the Barnacles, a reflection of the easier breeding conditions in West than East Greenland. However, mean breeding success in the last seven years (20.2%) has been higher than in any previous similar period back to the mid-1960s (1964-5 to 1970-1 – 15.8%, 1971-2 to 1977-8 – 14.0%; 1978-9 to 1984-5 – 12.9%). This increase, coupled with declining mortality on the island, will have played a large part in the growth in numbers wintering. There have also been significant changes elsewhere in the range, with much reduced shooting in Ireland and considerable work on safeguarding and managing wintering haunts there, all helping to bring about an overall population increase from c.16,500 in 1979 to the present 28,000. Islay's increase over the same period from 3700 to 8000-10,000 in the last three years has thus been proportionately greater than the growth in the total population.

Simultaneously with the growth in numbers wintering on Islay has come a change in feeding habitat. Formerly, most of the Whitefronts fed mainly, if not exclusively, on bogs, marshy and rush-filled fields, and older pastures. Nowadays, between a half and two-thirds of the birds feed on recently improved pasture, including new reseeds. This change, which makes the geese much more visible, could be linked to the virtual cessation of shooting. Certainly the birds are much less wary than they were even ten years ago.

The increasing numbers, and greater visibility, of the geese has, not unexpectedly, led to complaints that they are causing agricultural damage. Although no measurements of this have been made, whereas they have for the Barnacle Goose, the Whitefronts on improved pasture are certainly feeding on the same foods as the Barnacles, albeit in smaller numbers and at a much lower density. Flock size in the Whitefronts remains much smaller with a mean range of 80-120 compared with 300-600 in the Barnacles (own data). Occasional large flocks, 1000-1500, do occur but only on stubble fields or harvested root crops where the birds are taking split grain or discarded leaves. This compares with regular counts of 3000-4000 Barnacle Geese in a single field, especially in autumn.

Neither the RSPB reserve nor the SSSIs normally hold more than small numbers of Greenland Whitefronts, except occasionally on stubbles. The goose scaring schemes did not differentiate between the species and so farmers outwith the SSSIs were receiving payments to scare either or both. The new Scottish Natural Heritage scheme will be making payments based on overall numbers of geese regardless of species thus recognising the obvious, that the Whitefronts are causing agricultural damage, something there has been a reluctance by some conservationists to admit in the past.

As with the Barnacles, I am loathe to predict what will happen to Whitefront numbers but it seems unlikely that the recent upward trend will level off just yet.

Greylag Goose

It is remarkable to turn from the previous two species, both of which have trebled their numbers on the island in the last thirty years, to one which has declined almost to vanishing point in the same time, without obvious reason.

Greylags were wintering in small flocks on Islay in the last century, though less commonly than the Greenland Whitefront (Gray 1871). By the time that Berry (1939) carried out his survey, local observers were reporting large fluctuations in numbers and suggesting that the increase in numbers of Greenland Whitefronts over the previous thirty years (see above) had been at the expense of the Greylags. However, no evidence is presented for this theory. Baxter and Rintoul (1953) summarised the above and other evidence and stated that "about 70 years ago a considerable number wintered on the Islay; they decreased and now only a few winter on that island".

The next statement on the situation comes from Atkinson-Willes (1963) who reported that "although restricted to a single locality, have recently shown a striking increase, and now total upwards of 500 throughout the winter". This was based on counts by Boyd and myself, which have continued to the present. The peak count was of 665 in November 1964, but it had dropped to 217 the next year. There were still about 300 in 1968-9 but there has been no count over 200 since 1975 and in some recent years the total has failed to reach 100.

For many years, the Greylags have been restricted to the upper Laggan valley and to sites around the head of Loch Indaal. The Laggan valley flock, usually the largest, is almost always found mixed in with Greenland Whitefronts, which would seem to deny the theory that the latter have ousted the Greylags. In nearby Kintyre, Greylags and Greenland Whitefronts appear to co-exist satisfactorily.

The decline in Greylags on Islay took place at a time of rapid increase in the Icelandic population of this species and, although the origin of the Islay birds has never been proved beyond doubt, those wintering on the Kintyre peninsula, less than 30 km away, and on Bute, do belong to the Icelandic poopulation and increased at the same time. If, though, the Islay birds were of Outer Hebridean origin, as has been suggested, then a change in the opposite direction might not be so surprising if this then poorly studied group of birds altered either in numbers or wintering distribution. However, despite a considerable increase in wintering Greylags on Coll and Tiree in recent years, some at least of which are Outer Hebridean birds, there has been no corresponding recovery of the species on Islay.

Without anyone particularly wanting even more geese on Islay, it does seem strange that the Greylags have decreased at a time when farming changes so clearly favourable to two other kinds of geese were taking place. Greylags have not shown themselves slow at adapting to farming changes elsewhere in Scotland.

DUCKS

There is almost no past history of duck numbers on Islay. Irregular counts of some species were first made by visiting ornithologists, including goose counters, during the 1950s and 1960s, but it was not until Gordon Booth moved to the island in the late 1960s that regular winter wildfowl counts of the major wetlands began, particularly Loch Indaal and, less frequently at first, Loch Gruinart. Since 1980, coverage has been almost monthly throughout the year. Freshwater lochs on the island tend to hold relatively few birds.

I have analysed all available counts since 1969-70 for the two sealochs, adding casual counts to the run of monthly wildfowl counts. However, it is not certain that the coverage of Loch Indaal has been the same for all the counts, some of the earlier ones, in particular, may not have included quite as much of the shoreline as have more recent ones. Also, the seaducks occasionally take some finding and it may be that since I came to live on the shore of Loch Indaal in 1986, I spend more time looking for them than did some previous counters.

The following accounts concentrate on six species, Wigeon *Anas penelope*, Pintail *A.acuta*, Scaup *Aythya marila*, Long-tailed Duck *Clangula hyemalis*, Common Scoter *Melanitta nigra* and Red-breasted Merganser *Mergus serrator*, all wintering in Loch Indaal, and all of which appear to have shown changes in numbers over the last 20+ years. All six occur in larger numbers in Loch Indaal than anywhere else on the island. At their other haunts there has either been no change in status or the data are too fragmentary to show it.

Loch Indaal is a long fairly narrow sealoch though with a reasonable cycle of about 24 hours for a complete change of water. One small river, the Sorn, and several burns flow into it having passed through agricultural land. Also flowing in is the largely untreated sewage from the villages of Bowmore (c.1000 inhabitants), Bridgend (c.100), Bruichladdich (c.100) and Port Charlotte (c.200). Perhaps as significant as all these put together are the waste products from two distilleries, at Bowmore and Bruichladdich. Bowmore is probably the more important as it is nearer the head of the loch and discharges into shallower water. The waste, which consists of a potent mix of nitrates, nitrites and phosphates, together with particles of crushed barley, has presumably been discharged into the loch since the distilleries were founded, Bowmore in 1779 and Bruichladdich in 1882. Normally three mashes are produced every 24 hours so that the quantities of nutrients flowing into the loch must have had an enormous cumulative effect on the invertebrate and plant life which in turn will have affected the birds which feed on them.

Pollution it may be to some people, but it must surely have had an extremely beneficial effect on the numbers of birds wintering on the loch and around its shores. Just in the last few years, the Bowmore Distillery discharge has ceased to go direct into the loch but instead goes via the settlement tanks of the public sewer so that crushed barley probably no longer reaches the loch, but it is doubtful if there has been any reduction in the other components of the discharge.

Wigeon

Loch Indaal has extensive beds of *Zostera* and marine algae particularly on the east side of Bowmore, so it is not surprising that it is popular with Wigeon. In the autumn and early winter, flocks of Whooper Swans *Cygnus cygnus* also feed here. The Wigeon take full advantage of the swans' ability to upend during the high tide period and pull weed to the surface. Each upending swan quickly attracts an attendant scrum of Wigeon.

Counts of Wigeon in Loch Indaal since 1970-1 are summarised in Table 1. The two columns give the average annual maximum (= mean of three highest counts per season) together with the peak count. I have used a season of July to June, though for this species virtually all the counts are concentrated between September and April.

The counts in the 1970s were reasonably complete and showed a lot of fluctuation. Leaving aside the very low counts in 1980-1, for which I can find no explanation, the counts for the next four winters tended to be lower than previously. In the last six winters, since 1986-7, there has been an increase in wintering Wigeon, most noticeably doubling in the last two winters.

There have been no direct measurements of the amount of food for Wigeon in Loch Indaal but there is evidence of increasing amounts of *Zostera*. The extensive *Z.marina* beds lie at or below low-water mark but if winter tidetrack is anything to go by these have increased substantially in the last few years. Additionally, in 1991 I discovered quite large patches of *Z.nana* growing on the tidal sandflats within the area favoured by the Wigeon. *Z.nana* had not previously been reported from Loch Indaal and, indeed, was known only from a single bay in the south-east of the island. If the growth in marine algae has parallelled that of the *Zostera* then an increased food supply may explain the recent increase in Wigeon numbers. The 150-250 wintering in Loch Gruinart, the second largest flock on the island, have shown little change in the last few years and there is no other evidence that the increase in Loch Indaal has been at the expense of other haunts on the island.

Pintail

Prior to 1982-3, this species was a casual visitor in very small numbers, the birds staying for a few days or weeks at most. If any occurred on the island at all it was most likely at a fresh water loch such as Ardnave in the north-west. Since 1982-3, however, the species has become regular on Loch Indaal and has increased rapidly (see Table 1). They spend their time mainly in the channel of the River Sorn where it crosses the intertidal sandflats or dibbling at the tide edge.

Thom (1986) stated that the winter maxima of Pintail wintering in Scotland in recent years varied between 1500 and 3380. As in the rest of Britain, there are a few large flocks and many much smaller ones. Thom listed only the Solway and Cromarty Firths as major sites, where over 1000 occur. Flocks of over 100 away from these areas are found regularly only on the inner Clyde. Elsewhere, hardly any flocks exceed 20, which puts the Loch Indaal flock, now peaking at over 50 in three of the last four winters, as of at least regional interest. Over the whole of Britain, Pintail have declined in recent years and in 1990-1 were only at about 50% of their level ten years previously (Kirby *et al* 1991).

TABLE 1. Average maxima and peak annual counts of ducks on Loch Indaal, Isle of Islay, 1969-70 to 1991-2.

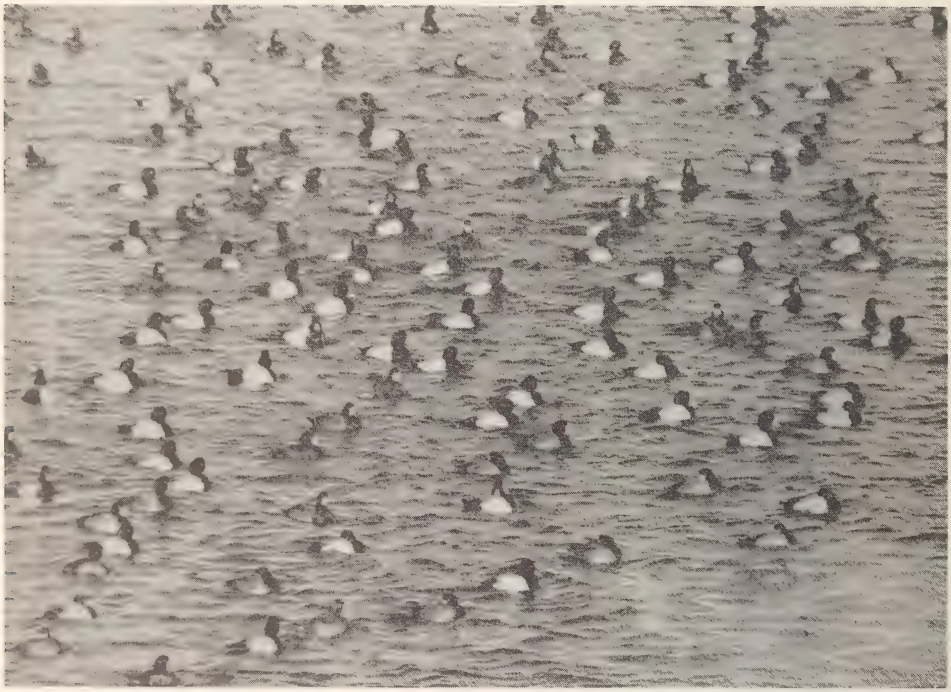
Season	Wigeon		Pintail		Scaup		Long-tailed Duck		Common Scoter		Red-breasted Merganser	
	Ave max	Peak count	Ave max	Peak count	Ave max	Peak cont	Ave max	Peak count	Ave max	Peak count	Ave max	Peak count
1969-70	(150)	155	-	0	800	1100	-	0	-	10	-	0
1970-1	565	749	-	1	1191	1407	0	0	36	60	97	171
1971-2	431	480	-	2	1082	1097	0	0	3	5	52	99
1972-3	(270)	400	(1)	2	1050	1500	1	1	0	12	122	220
1973-4	562	647	0	0	933	1000	1	1	18	43	27	40
1974-5	504	564	0	0	1000	1000	-	2	2	6	113	150
1975-6	315	345	(2)	3	1167	1300	0	0	30	60	43	55
1976-7	415	450	(2)	7	1227	1300	0		5	15	46	80
1977-8	288	345	-	1	1083	1200	1	1	17	42	50	69
1978-9	-	115	-	3	521	nc	-	1	3	8	nc	nc
1979-80	312	800	-	5	793	950	2	5	15	46	32	73
1980-1	46	91	0	0	640	500	1	1	7	81	9	26
1981-2	419	615	0	0	1052	915	-	2	26	45	53	101
1982-3	220	270	7	8	901	785	2	6	34	70	16	19
1983-4	169	209	2	6	557	770	0	0	10	26	17	24
1984-5	312	348	7	14	836	1189	0	0	61	86	14	19
1985-6	295	341	7	11	1160	1505	4	5	45	100	70	87
1986-7	402	623	19	23	756	817	7	8	112	165	182	189
1987-8	555	688	28	32	931	1198	6	8	87	94	109	120
1988-9	431	527	44	51	858	1230	4	6	125	141	91	106
1989-90	466	615	32	37	383	442	11	13	147	171	139	240
1990-1	699	798	46	53	647	660	10	10	108	130	120	172
1991-2	1115	1799	44	61	1202	1430	12	16	223	232	264	350

Notes.
Count season runs from July to June
'Ave max' is average of highest three counts in season; if placed in brackets, then only two counts available to average; "-" = only one count in season
'Peak count' is highest count in season

Scaup

I have been unable to discover any pre-war counts of Scaup for Islay. The bird was known to winter here in the last century but no details are given in any of the books consulted. Scattered counts in the 1950s enabled Atkinson-Willes (1963) to describe Loch Indaal as an important site with maxima up to 1500, dependent either directly or indirectly on the Bowmore distillery discharges. This remains the situation today, but the wintering population has shown some marked fluctuations since more regular counts began in 1969-70 (see Table 1). Although the flock of Scaup is usually quite easy to find, rarely straying far from the inner part of the loch, it is much harder to count when the sea is choppy and the coincidence of a careful counter with a really flat calm day is probably needed to produce a really accurate peak count.

Throughout the first nine winters of counts, the annual mean maximum hardly



Part of Scaupflock, Islay. **Rodney Dawson**

dropped below 1000, while the peak count varied between 1000 and 1500 birds. Since 1978-9, however, despite more frequent counts, the mean has only three times risen above 1000 and in only half the winters has the peak count been above this level. Marked annual fluctuations are shown in maximum counts at other Scaup resorts in Britain and Northern Ireland, including at the only two sites with more Scaup than Loch Indaal, the Solway (1500-4000) and Loughs Neagh and Beg, Northern Ireland (1200-1600). National indices (Kirby *et al* 1991) do not help as the long-term picture remains grossly distorted by the disappearance after 1976 of the 10,000-30,000+ that had previously wintered on the Forth. None of these, certainly, moved to Islay.

It is possible, therefore, that all that is being seen is the variation in breeding success and mortality being experienced by these birds which are presumed to breed in Iceland. One fear was that the sharp drop between 1988-9 and 1989-90 reflected the change from direct discharge into the loch of the Bowmore distillery waste. However, the return to former levels in winter 1991-2 hopefully means that such an effect, if any, has been merely temporary. The flock remains comfortably above the level of 40 which qualifies it as of national importance (Kirby *et al* 1991) and not so far below the internationally important qualifier of 1500.

Long-tailed Duck

Numbers of this species are very small (see Table 1) but in the last thirty years it has increased from a less than annual visitor, with one or two individuals staying for short periods in the 1960s and 1970s to, in each of the last three winters, over ten birds on

Loch Indaal for several months. Whilst the numbers are trivial in a Scottish context, there are only a few places in Argyll and the Inner Hebrides where Longtails occur and no other site that currently holds even such a small regularly wintering flock.

Quite why Longtails should begin to winter regularly on Loch Indaal is unknown, though there is evidence from the increasing numbers of Red-breasted Mergansers (see below) that there may have been some recent growth in fish stocks within the loch.

Common Scoter

Meaningful statements concerning the status of this species are perhaps more subject to counting problems than for some of the other seaducks on Loch Indaal, because the birds habitually spend much time in the outer part of the loch and are often only clearly visible through a telescope. On the other hand, there is plenty of evidence from counts in the 1960s and 1970s that regular birdwatching visitors to the island knew of their presence and made attempts to find and count them. Thus the picture revealed in Table 1 for the period up to 1984-5 of a small wintering population averaging 20-30 and peaking at 70-80 is probably close to the truth.

In the winter following my arrival on the island in May 1986 I immediately became aware of the presence of a flock of Common Scoters because I could not only see them but often hear them displaying from my house. I have since paid them quite a lot of attention including counting them at least monthly and often more frequently. The considerable increase in numbers shown in Table 2 which seemed to begin in 1986-7 may well, therefore, be at least partly attributable to my efforts, but the subsequent sharp increase in 1991-2 is certainly genuine.

Moreover, Common Scoters are now present throughout the year on Loch Indaal, as shown in Table 2. It is as difficult to explain this change, with as many birds in some summer months as in the winter, as it is to explain the overall increase. However, the status of Common Scoters as a breeding bird on Islay appears not to have changed over the last 30 years or more. When they were first discovered nesting in the 1950s, Meiklejohn and Stanford (1954) reported at least five pairs present at the one site. This is still the situation today, though very frequent counts suggest that perhaps another five to seven pairs use the breeding loch in the early part of the summer, presumably for feeding, and then move away to small pools to breed. The original observors would not necessarily have spotted these extra birds at the time of their visit. Scoters have been seen flying from the main breeding site to Loch Indaal, but the true extent of the connection with the flock on the sea is unknown. Certainly there is no evidence that the increase in numbers or the

TABLE 2. Monthly peak counts of Common Scoters in Loch Indaal, Islay, 1985-1992.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	0	86	0	35	0	0	0	0	0	10	23	12
1986	3	4	100	6	10	0	0	0	92	56	11	9
1987	140	165	0	0	87	59	22	10	2	94	79	54
1988	82	60	88	84	65	45	18	36	76	0	10	59
1989	109	35	62	141	82	125	140	171	111	104	82	49
1990	83	104	37	125	130	96	96	96	87	87	98	68
1991	92	85	85	130	83	82	80	69	105	95	76	109
1992	124	107	232	209	228	68	92	125	160	162		

recent presence of the summering flock has made any difference to the numbers breeding.

Although Common Scoters occur in several places on the east coast of Scotland, including some moulting flocks, they are relatively scarce on the west. The only other known flock in Argyll is in the Sound of Gigha, between Kintyre and that island. Counts in the last few years have revealed a year-round and probably increasing flock here, at its largest in summer, reaching over 300 in 1991. However, there are insufficient earlier counts to show whether summering is a new phenomenon as it appears to be on Islay.

Red-breasted Merganser

Loch Indaal has long been known as a year-round site for this species, with the highest numbers in the summer through the presence of a moulting flock. There are scattered counts of up to 150 in the 1950s and 1960s. Counts since 1969-70 are summarised in Table 1. All the peak counts for the period up to 1977-8 fall in the period June-September. Then the moulting flock seemed to vanish. Counts fell right away, with the single exception of 101 in July 1981. In 1986-7 there was a sudden return that has been maintained and, most recently, significantly improved upon. Table 3 sets out the summer month counts for the last ten years. Only some tens of pairs breed on Islay, so the moulting birds are coming in from elsewhere.

TABLE 3. Monthly counts of summering (moulting) Red-breasted Mergansers on Loch Indaal, Isle of Islay, 1983-1992.

	May	Jun	Jul	Aug	Sept
1983	0	0	0	0	13
1984	0	0	0	0	3
1985	0	0	65	18	4
1986	6	7	64	189	180
1987	3	70	100	76	17
1988	22	120	106	88	80
1989	0	76	90	240	122
1990	15	14	172	102	87
1991	46	46	45	114	350
1992	15	270	360	560	176

There is considerable variation in the timing of the peak, which sometimes occurs in June-July, but in other years not until August-September. The then record count of 350 in September 1991 suggested that these were birds coming in much later, though still presumably to moult. Cramp and Simmons (1976) state that male Red-breasted Mergansers are flightless for about one month in the period mid-July to end-August, while females are about a month later. There is no information on the sex of the moulting birds in Loch Indaal. The sudden surge of numbers in 1992 is so far inexplicable. It certainly indicates substantial numbers of small fish but there is no direct information that would suggest fish stocks have also increased.

The changes in numbers of Red-breasted Mergansers in Loch Indaal over the years probably are not due to variation in counting effort. The moulting flock has always preferred the head of the loch, especially on the north side around Blackrock, and are readily visible from the road. Another moulting flock of up to 100 birds, at Claggan Bay on the east coast of Islay, also dwindled in the 1970s, to no more than 25, but has been back up to about 100 in recent years, including 98 in August 1992.

Red-breasted Mergansers have increased and spread throughout Scotland and northern England in recent decades, though the national index of numbers, based on winter counts, having doubled through the 1970s, has fallen back sharply in the last few years so that by 1990-1 it was back to the level pertaining before the 1970s (Kirby *et al* 1991). Moulting flocks of Red-breasted Mergansers are found quite widely round Scotland, though many are not easy to count regularly. In Argyll, up to 1000 have been counted in the Sound of Gigha, on the west side of the Mull of Kintyre, but not often enough to be able to say whether

variations there can be matched with changes in the Loch Indaal flock. It should be noted that a regular flock of 100 birds qualifies a site for recognition as of national importance for this species.

WADERS

Several species of wader occur regularly on Islay, but it is rare for a flock of any species to reach 1000. The most numerous are Oystercatcher *Haematopus ostralegus* and Curlew *Numenius arquata*, both of which occur in flocks of hundreds in Loch Indaal and Loch Gruinart, as well as breeding widely. Other species, such as Ringed Plover *Charadrius hiaticula*, Sanderling *Calidris alba* and Dunlin *Calidris alpina*, can occur in hundreds but these larger flocks are mainly comprised of migrants in spring and autumn and their occurrence is too irregular to detect any pattern or trend. Just one estuarine species, Bar-tailed Godwit *Limosa lapponica,* has shown some changes in the last 20 years and is examined in detail below, as is the Lapwing *Vanellus vanellus*, purely in its status as a breeding species on the Loch Gruinart reserve.

Bar-tailed Godwit

Islay has regular wintering flocks of this species in both Loch Indaal and Loch Gruinart. Counts were much less complete in the latter site during the 1970s but have been monthly since the early 1980s. The figures for both lochs are set out in Table 4. Allowing for the gaps in the Loch Gruinart data it does appear that numbers at the two lochs change in synchrony. There was a period of high numbers in the first half of the 1970s then a few years with much smaller numbers before a short-lived recovery in the early 1980s. Numbers fell back again but have returned to former levels in the last four years.

Reasons for these fluctuations are unclear but may be linked to food supply on the intertidal flats or to weather elsewhere as Bar-tailed Godwits are known to shift in response to severe conditions. The weather seems an unlikely factor, however, as the numbers summering have varied more or less in line with wintering numbers. Thus during the 1970s, the peak count in June and July, when passage appears to be almost negligible, regularly reached 50-70, occasionally 100, then fell away almost to nil until a slow increase occurred through the 1980s, from under 10 in 1983-1988, to 50-90 in 1989-1992.

TABLE 4. Average maxima and peak annual counts of Bar-tailed Godwits on Loch Indaal and Loch Gruinart, Isle of Islay, 1969-70 to 1991-2.

Season	Loch Indaal		Loch Gruinart	
	Ave max	Peak count	Ave max	Peak count
1969-70	(69)	110	nc	nc
1970-1	131	294	(5)	11
1971-2	222	250	90	175
1972-3	152	280	(60)	100
1973-4	172	329	-	200
1974-5	210	220	nc	nc
1975-6	233	280	nc	nc
1976-7	129	277	nc	nc
1977-8	53	80	nc	nc
1978-9	17	34	nc	nc
1979-80	41	56	nc	nc
1980-1	118	300	nc	nc
1981-2	145	240	76	108
1982-3	129	200	29	64
1983-4	56	91	74	86
1984-5	91	190	50	70
1985-6	86	106	59	62
1986-7	117	161	10	12
1987-8	87	100	68	74
1988-9	134	155	225	323
1989-90	115	119	162	184
1990-1	172	243	129	152
1991-2	248	292	95	120

Notes
Count season runs from July to June
'Ave max' is average of highest three counts in season; if placed in brackets, then only two counts available to average; "-" = only one count in season
'Peak count' is highest count in season

Lapwing
Most farmers and crofters say that the Lapwing is much scarcer than it used to be, though there are no adequate counts to back up this widely-held view. One, in a letter to the local newspaper, went so far as to put the blame on the increasing numbers of geese leaving no room on the fields for the Lapwings to feed or nest.

Contrary to any such changes over the island as a whole has been the great increase in breeding pairs on the RSPB Loch Gruinart reserve. The number of pairs has been censused annually from 1985 when a total of 108 pairs were found. It has increased each year since to no less than 220 pairs in 1992. The area surveyed, of approximately 250 ha (62 acres), has remained the same though the personnel involved have changed and it is likely that the census technique has improved. Nonetheless there is no doubt that the increase is both real and substantial and this despite rotational ploughing and reseeding of approximately 40 hectares each year. Early nests on these latter fields undoubtedly get destroyed by these farming activities, but the pairs involved have ample opportunities for further attempts on neighbouring fields.

BIRDS OF PREY

There have been very encouraging increases in the numbers of all seven breeding species of birds of prey on Islay in recent years. In most cases, these can be attributed to man ceasing his former unrelenting persecution, in particular of Hen Harrier *Circus cyaneus*, Buzzard *Buteo buteo* and Golden Eagle *Aquila chrysaetos*, and to a lesser extent of Sparrowhawk *Accipter nisus* and Peregrine *Falco peregrinus*, while even the Kestrel *Falco tinnunculus* and Merlin *Falco columbarius* have suffered in the past. For obvious reasons it is not possible to publish figures for some species so the following accounts will include statements unsupported by any actual data.

Hen Harrier
The concensus on past status is that this species was more or less exterminated towards the end of the last century. Nesting was attempted from time to time over the next 50 years, followed by a steady recolonisation since about 1960. The nesting of a pair in 1969 was of sufficient interest to be noted in the *Scottish Bird Report* for 1969. Breeding was proved in four 10-km squares during 1968-72.

Since 1988, annual breeding surveys have been carried out. The precise total of nesting birds, which may have just levelled off, is still confidential, but breeding is now taking place in 12 10-km squares, while the number of nests on the RSPB Loch Gruinart reserve has increased from six in 1985 to at least nine in 1992.

As well as the apparent cessation of persecution, there has been an increase in young forestry plantations in parts of the island which seems to have been beneficial, at least in the short term, by providing undisturbed nesting sites and a good supply of food.

Sparrowhawk
Booth (1975) was of the opinion that the status of this species had not changed for the previous 100 years, while Elliott (1989) suggested that during the 1970s and 1980s there were perhaps nine home ranges on Islay. He also considered that the species was increasing as a result of less attention from keepers. This is borne out by the BTO Atlas surveys with positive breeding in just five 10-km squares in 1968-72 but in nine in 1988-91. There has not been a thorough survey of the species on the island but available records suggest the population is currently of the order of 15-20 pairs.

Buzzard
This is another much persecuted species but one which has made a major comeback in the last few years. Breeding was proved in 1968-72 in only two of the 14 10-km squares covering the island. There seems to have

been a slow but steady increase during the 1970s and early 1980s. Elliott (1989) using observations collected between 1975 and 1987 concluded that there were about 20 home ranges on the island. From the first year's returns (for 1988) from the new BTO Breeding Atlas, Jardine (1989) showed that the density of Buzzards on Islay, at 0.31/tetrad, was significantly lower than in other areas of Argyll, where densities of 1.0 (lowland) and 0.69 (upland), were attained. My own best estimate for the present situation, based on observations in 1991 and 1992, is that at least 30 pairs are now breeding in 12 10-km squares.

The cessation of persecution has been a principal factor in the recent increase in numbers. Poisoned Buzzards have been found on the island several times but the last certain occasion was in 1989. Pairs are now nesting freely in areas from which they were formerly excluded and where it would be very easy to deal with them if this was still the policy.

Golden Eagle

Past and present records suggest that there is room for about eight pairs on the island, but it is doubtful whether this number have ever bred, or attempted to breed, in the same year. However, it may not be too long before they do.

The species has been much persecuted for a century or more, with many references to their destruction in 19th century estate game books (see, e.g., Booth (1975)). An unpublished diary, kept by a member of the Oxford Ornithological Society Expedition to the island in June 1936, records that the party glimpsed just one eagle during their ten-day visit and relates how "a keeper said that the birds do not ordinarily nest in Islay. This year, however, there was a nest in an easily accessible place which was preserved because a friend of the laird wanted to photograph it, but the birds deserted". They were also told a slightly unlikely story of another site where the male bird was shot but the female and young left unharmed.

More recently, a retired keeper claimed that 57 had been killed in 12 years in the 1950s and 1960s on one estate; a gin trap (old) was removed from an eyrie about ten years ago; and two birds were found poisoned in 1988.

During the BTO Atlas survey of 1968-72, only two pairs were thought to have bred. There has been a slow increase since then to a maximum of six pairs breeding in 1992. There are two other territories on the island where young pairs have been seen in the last two years.

Kestrel

Ross (1913) was able to write: "the most abundant of the nesting species of hawks. Most keepers now acknowledge that it is comparatively harmless". This did not stop one shooting out a nest as recently as 1987. Nor is it now the most abundant nesting raptor. Elliott (1989) thought that it was common in the 1970s but declined in the 1980s. However, it was recorded in nine 10-km squares in both the 1968-72 and 1988-91 breeding Atlases, suggesting little change. The current population is probably around 10-15 pairs.

Merlin

It always surprises me that the Merlin, whose diet consists largely of small birds supplemented in summer by moths, should be persecuted but as Meiklejohn and Stanford (1954) reported: "it bred on the island in 1954, the nest being destroyed by a keeper".

It is difficult to make a lot of sense of the past records of this species, not least because Icelandic birds are present into April so that spring sightings are not necessarily of potential nesting pairs. Positive breeding only occurred in one 10-km square in 1968-72, plus sightings in five more, yet in 1974 a fairly thorough survey revealed about nine pairs present in eight squares. The late Richard Elliott estimated that there were at least eight and possibly 15 home ranges in 1986 (Elliott

1989), though this seems high and I have been unable to discover on what he based his estimate.

No particular effort has been put into looking for Merlins in recent summers, but pairs have bred or been present in five different locations since 1989. On the other hand, a number of former known Merlin localities seem to have been deserted. The national survey of Merlins due in 1993 will, it is hoped, stimulate sufficient fieldwork to provide a clearer picture. There seems to be plenty of suitable habitat for them, with good heather banks to nest on and an abundance of small birds for food. If there has been a recent decline then perhaps one may hazard that increasing numbers of other birds of prey might be working to the detriment of the Merlins. This thought is reinforced by the drama I saw this summer when a male Merlin, flying in with food to a nest site, had the narrowest of escapes from a Peregrine stooping at him at the very moment the Merlin was passing the food to his female. The Merlin dived to the ground and escaped while the unsuccessful Peregrine disappeared at speed closely pursued by the female.

Peregrine

This species is also increasing and again there have been no recent signs of persecution though only in 1990 a farm owner, recently arrived from the South of England, who claimed that a pair nesting close to his land were taking his lambs (!), had to be discouraged from taking drastic action against the birds. The 1991 census found about 30% more occupied territories than in 1981.

OTHER SPECIES

Detailed evidence and space dictates only two more species accounts, namely Corncrake *Crex crex* and Chough *Pyrrhocorax pyrrhocorax*. There have undoubtedly been status changes in several other species in the last 20-30 years, including such obvious ones as the arrival of the Collared Dove *Streptopelia decaocto*. Red Grouse *Laqopus laqopus* and Black Grouse *Tetrao tetrix* have both declined disastrously, the former almost certainly because of the same adverse conditions pertaining over other grouse moors of western Scotland, namely increased numbers of deer and sheep, and therefore ticks carrying louping ill, as well as decreasing management of the heather. Annual bags of 500-700 Red Grouse on a single estate were commonplace in the 1930s but such a number probably comfortably exceeds today's total island population.

Woodcock *Scolopax rusticola* have always been subject to wide fluctuations in numbers, not least in the size of winter immigrations, but it is over 50 years since influxes of the size that produced a kill of over 1000 in two weeks on one estate in 1937-8 have taken place.

Islay lost its Puffins *Fratercula arctica* many years ago. Meiklejohn and Stanford (1954) found five pairs at Sanaig in the north-west of the island, and breeding was proved there in 1969 but since then only occasional birds have been seen though it is not inconceivable that breeding is attempted in some years. At the turn of the century Puffins were reported as being numerous on the Oa, but had deserted the area by the 1930s or soon after. Introduced land predators such as cats and, more recently, ferrets, may well have been responsible for the species' demise as a nesting bird.

Another disappearance as a breeding bird is the Corn Bunting *Milaria calandra* which last certainly bred in the 1930s and 1940s, as the farming began its steady change from small mixed arable to mainly pasture.

To set against these declines and losses are substantial increases in some woodland birds, particularly those favouring conifer plantations. Thus Coal Tit *Parus ater*, Goldcrest *Regulus regulus* and Siskin *Carduelis spinus* have all benefitted greatly

from the large blocks of forestry planted in the Glen east of Bowmore in the early 1960s and will presumably be further encouraged as the 1980s plantings mature. The forestry, too, has been responsible for a recent gain of a breeding species, Crossbill *Loxia curvirostra*.

Corncrake

The first ever count was by Meiklejohn and Stanford (1954) who in June that year "heard birds calling in thirty-one different fields". Birds were recorded in ten 10-km squares during the BTO Atlas survey of 1968-72. By the time of the national survey in 1978, the total for the island was down to 22-24 (Cadbury 1980). In 1985, another thorough census was carried out by Moore (1985), when a total of 20-29 calling birds was heard. Since then, censuses have been attempted almost every year as follows: 1986 – 23; 1987 – no census; 1988 – 19; 1989 – 12; 1990 – 14; 1991 – 13; 1992 – 11.

The reasons for the decline undoubtedly include the well-documented adverse effect of the change from hay-making to silage. In an attempt to reverse the trend, the RSPB, Scottish Natural Heritage and the Scottish Crofters Union have promoted an initiative to pay small sums of compensation to crofters and farmers willing to delay cutting selected grass fields until 1st August. Four such grants were made on Islay in 1992, at sites with calling birds. It is understood that the prescriptions now being drawn up for the Inner Hebrides Environmentally Sensitive Area, which is due to come into existence on 1st April 1993, will include the opportunity for similar Corncrake-friendly management agreements.

Chough

Islay is the Scottish stronghold of the Chough with c.90% of the population and around 40% of the total British population. Formerly much more widespread in western Scotland, the range has steadily contracted and it has hardly occurred as a regular breeder outside Islay and neighbouring islands this century. In the last century it was reported as common all over Islay and there is mention of wandering flocks as well as pairs (Gray 1871). A little later, Scot-Skirving (1876) was reporting much persecution on account of demand for skins for natural history specimens, but Ross (1913) saw flocks totalling 60 birds on the Oa in July 1907.

There is little information on which to base estimates of numbers until very recently. Rolfe (1966) reported a flock of 47 on the Oa in July 1963 which was thought to be the whole island population, though this seems highly improbable in view of counts of flocks in other parts of the island in years immediately before and since. There is no evidence that the island population has ever gathered together in one locality.

In 1976, a survey of coastal birds produced a total of 135-140 birds (Booth and Taylor, unpub.); adding in known or suspected inland pairs brings their total to 153-158 birds, including 39-41 breeding pairs. A count of 134 in February 1978 is just attributed to "Islay" (*Scottish Bird Report* 1978). In 1981, Warnes (1982) undertook thorough surveys in December 1980 and April 1981, and estimated an island total of 160-180 individuals with 58-61 breeding pairs. She drew attention to the increasing use of buildings inland for nesting as opposed to the previous traditional cliff caves. As Choughs are highly territorial when breeding, this extension of the range inland opened up considerable new areas for them. However, Warnes wrongly stated that the first known inland breeding was in 1977. When Susan Cowdy was gathering information at the time of the 1963 census she was informed of a nest in an old building in that year.

A repeat survey carried out in 1982 found a slight decrease to 141-175 birds including 53-61 breeding pairs (Warnes 1983). However, another survey in 1986 found pairs of Choughs present at no less

than 95 sites, with 62 pairs confirmed breeding, 16 probably breeding and a pair present at the remaining 17 sites. A further 105-140 non-breeding birds were recorded giving an island population of 295-330 (Bignal *et al* 1988).

Unfortunately, Bignal *et al* do not discuss the difference between their results and those of Warnes just four years earlier except to predict that "the population should continue to expand". That, though, it has not done. Recent information suggests a fall in numbers probably linked to a run of years of relatively poor breeding success and low young survival (E. Bignal, pers.comm.). A full survey being conducted in 1992 should reveal more clearly what has happened.

Management agreements with farmers on SSSIs aim to benefit the Chough by controlling cattle grazing in order to produce short swards with plenty of cowpats, both of which provide the Choughs with important food supplies. In addition, grants have been awarded by Scottish Natural Heritage and the Worldwide Fund for Nature to enable Chough 'caves' to be incorporated in the roofs of buildings being renovated. This has been very successful, the birds continuing to nest after the renovations.

DISCUSSION

This personal, and patchy, account of changes in status of some of the birds occurring on Islay, based on reasonably respectable data, has indicated what changes have occurred, but suggested reasons have had to be speculative.

For the Barnacle and Greenland White-fronted Geese, it seems clear that agricultural improvements coupled with low mortality have been the main factors for the substantial increase in numbers. Changes in duck and wader numbers on Loch Indaal, on the other hand, whilst relatively straightforward to monitor, are much harder to explain.

The main inputs to the loch were mentioned earlier. Changes in these could perhaps be described if the relevant data were forthcoming. For example, it seems probable that the increased use of artificial fertiliser in the catchments of the River Sorn and the various burns will have led to an increase in the amount reaching the sea, particularly in this area of relatively high rainfall. Despite an overall decline in the human population on Islay in the last 30-40 years, the number of people living in the villages around Loch Indaal has probably increased, though whether by sufficient to affect the quantities of nutrients in the sewage might be hard to discover.

What this survey does confirm is that few if any bird populations are static and that the continued monitoring of numbers, whether through national schemes such as Wildfowl Counts and Birds of Estuaries Enquiry, or just the assemblage of records for a defined area by one or two people, can provide information of potential value. In these days when more and more birdwatchers seem content merely to find and identify birds, or to chase after rarities, there is a need to ensure that at least some of us realise the worth of noting numbers, too.

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Development of an internationally important Pink-footed Goose roost at West Water Reservoir, Borders Region, 1966-1990

Allan W. & Lyndesay M. Brown

This paper records the development of an internationally important Pink-footed Goose roost at West Water Reservoir, Borders Region, over the 25 years 1966-1990. The pattern of use by the geese throughout the winter is described with peak counts occuring in October/early November when the site regularly holds over 10% of the British population. The lack of disturbance at the site is highlighted as a major factor in maintaining the importance of the roost.

Introduction

The Pink-footed Goose *Anser brachyrhynchus* population which breeds in east Greenland and Iceland and winters in Britain totalled 72,000 in the 1970-71 winter (Ogilvie 1970), increasing to 95,000 in 1980-81 (Ogilvie 1981) followed by a dramatic increase to 194,000 by 1990-91 (Kirby & Cranswick 1991). A distinct and much smaller population, numbering over 30,000 birds in the 1980s (Batten *et al.* 1990), breeds in Spitsbergen and winters from eastern Denmark to Belgium. Together these two populations, totalling about 225,000 birds in 1990-91, comprise the entire world population of Pink-footed Geese.

This paper describes the development over a period of 25 years of a Pink-footed Goose roost at West Water Reservoir, Borders Region, to a site of international importance. The first report of geese using the site was in the 1965-66 winter (W. Brotherston unpub. data). The peak count in winter 1967-68 represented 5% of the British population at that time. Since 1980-81 the reservoir has consistently held over 10% of the British population with a peak count in October 1988 of 40,000 birds, 23% of the British population and 20% of the world population.

West Water has been found to be of particular value from late September to early November and again in springtime, with geese utilising feeding sites a considerable distance from the reservoir, but numbers declining in the area from December through to February. This pattern of use is described in this paper and some reasons for it suggested.

Study Area

West Water Reservoir lies in the south-east corner of the Pentland Hills, Borders Region (Fig. 1) at an altitude of 320 m and covers an area of 42 hectares. It is a water supply reservoir owned by Lothian Regional Council. Construction began in 1962 and was completed by 1967 although it began to fill with water by 1965. Lothian Regional Council shares the fishing rights with the adjoining estate which also owns the shooting rights over and around the reservoir. The surrounding land consists of heather moor, rough pasture and wet peatlands with marshy flushes, and is quite devoid of trees. As the reservoir is not fenced off from the surrounding land sheep and cattle are free to roam to the water's edge but cause little disturbance to roosting

FIGURE 1. *Location of West Water Reservoir, Borders Region.*

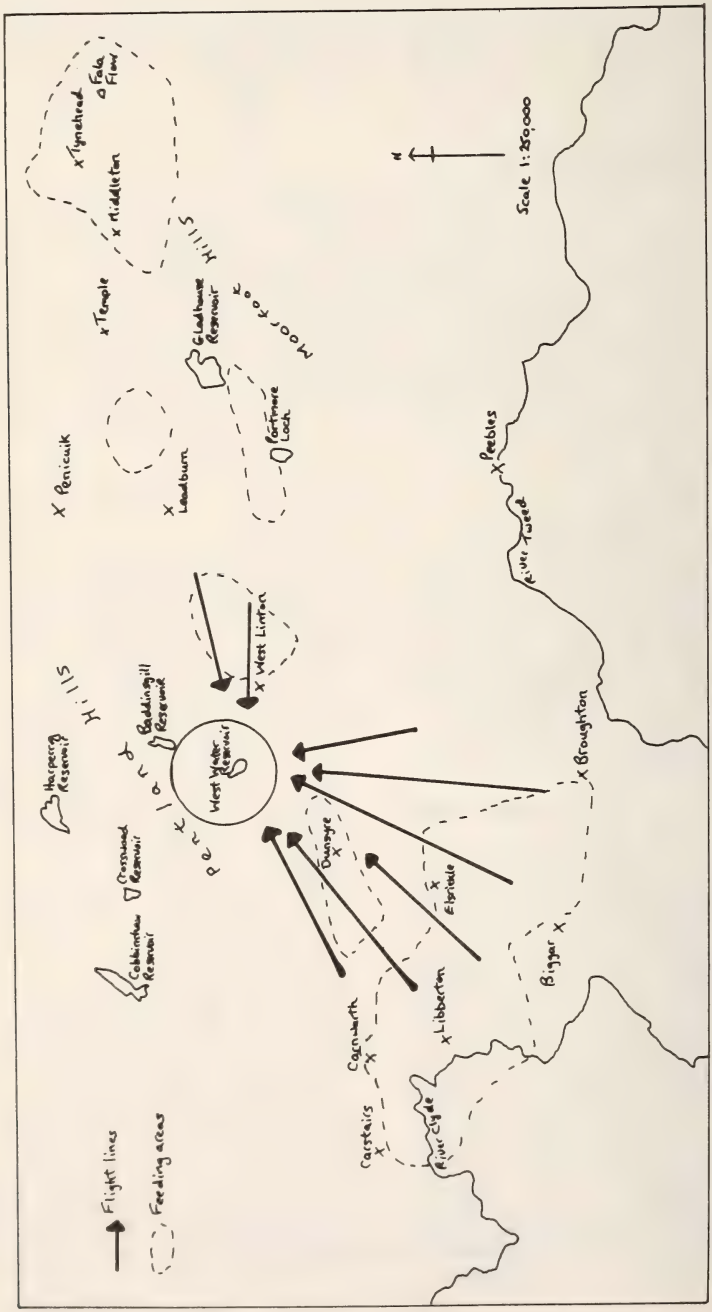


FIGURE 2. *Feeding areas and flight lines utilised by Pink-footed Geese roosting at West Water Reservoir.*

geese. In contrast public access to the reservoir is restricted.

Fishing and shooting are the two principal activities which could disturb the roost. At present two boats are permitted on West Water, one each for the estate and Regional Council, and no bank fishing is allowed. Most fisheries in Lothian and Borders Regions are open from 1 April to 30 September, but in 1990 the fishing at West Water Reservoir was restricted to 1 May to 31 August in recognition of its importance to geese. In practice this affords the early goose arrivals in September a site free from disturbance allowing numbers to build up rapidly; likewise in April prior to spring migration. This may be contrasted with Gladhouse Reservoir (Fig. 2) where up to eight boats could regularly be on the water until one hour after sunset throughout September and April. The shooting season extends from 1 September to 31 January but levels of shooting and associated disturbance fluctuated at West Water during the 1970s and 1980s occasionally causing changes in the roosting pattern of the geese.

Methods

Brotherston (1964) documented the changes in numbers and behaviour of Pink-footed Geese in the Lothians and Berwickshire up to 1963 and described the establishment in 1955 of co-ordinated annual counts in late October and early November at most of the important goose roost sites in the area. The latter count was subsequently incorporated into the National Goose count in 1960-61 (Boyd & Ogilvie 1969) while a National Spring Goose count began in winter 1969-70.

In order to establish the pattern of use of West Water by Pinkfeet and determine peak winter counts, which did not necessarily coincide with the National Goose count dates, we undertook more frequent counts, in addition to the co-ordinated October/November and spring counts, from winter 1976-77 with additional valuable data being supplied by waterkeepers Andy Dewar and Andy Moffat.

Most counts were at dusk of birds flighting into the roost. If undisturbed, especially during the first few weeks of arrival when there was longer daylight for feeding, the geese frequently loafed about the reservoir until mid-morning making dawn counts difficult without disturbing the birds. Day-time feeding areas were found by following geese out from the roost by car and again on their return to the roost.

Results

Annual trends in numbers.

Fig. 3 illustrates the annual maximum counts of wintering Pinkfeet at West Water Reservoir from 1966 to 1990 and shows its development into a major roost site. Geese apparently used the site in winter 1965-66 (W. Brotherston unpub. data) but no counts are available. From 1966-67 to 1977-78, counts only once exceeded 5,000 birds whereas in every subsequent year over 6,000 birds were recorded in each winter and over 10,000 in all but one of the winters 1981-82 to 1990-91. Fig. 3 also shows the annual maximum counts as a percentage of the national population. Since 1967-68 over 1% of the national population has annually used the reservoir, increasing to over 10% annually since 1980-81 and peaking at 22.7% in 1988-89. Thus the increase in the number of geese using West Water was in excess of what would be expected had it merely reflected the increasing population wintering in Britain. Rather, the increasing proportion of the national population roosting on West Water suggested either a greater increase in population locally than elsewhere in Britain, or a shift in roosting behaviour from nearby localities into West Water. There was strong evidence for the latter because prior to 1966 Baddinsgill Reservoir (Fig. 2) was the main goose roost in the south-east Pentlands and was designated a Site of Special Scientific Interest (SSSI) due to the numbers it held.

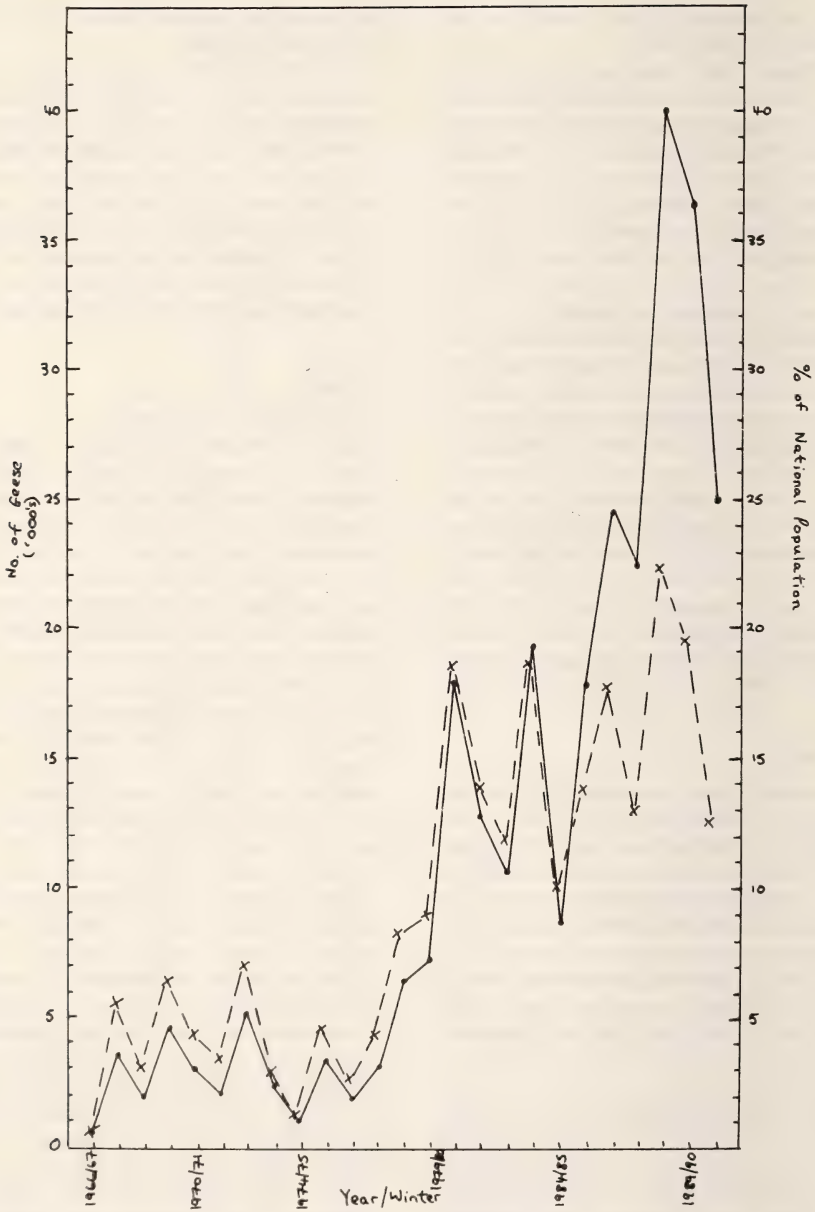
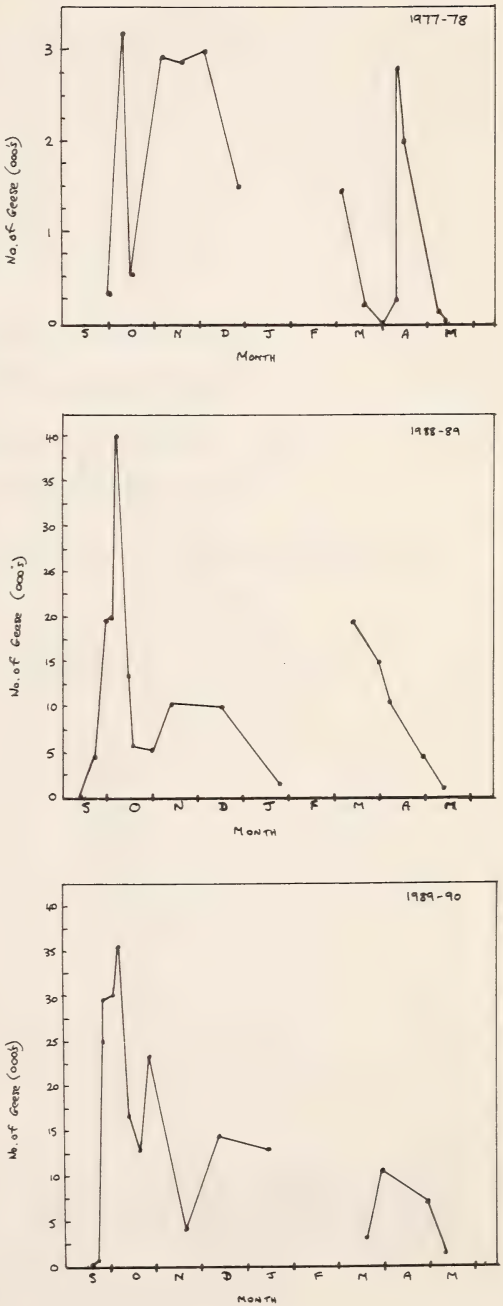


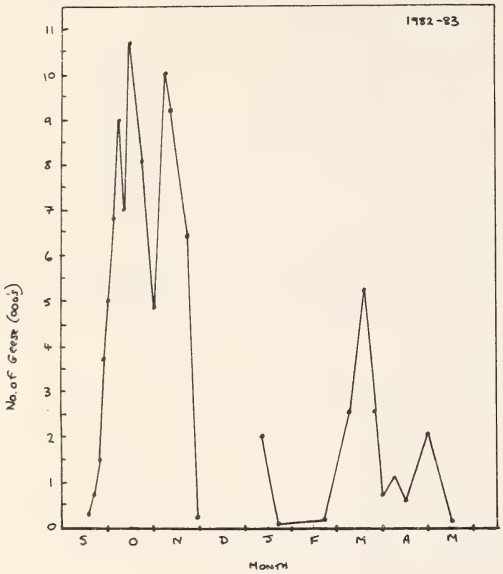
FIGURE 3. *Annual maximum wintering Pink-footed Goose counts and their percentage of the national population at West Water Reservoir, 1966-90. ● = number of geese in 1000's; x = percentage of national population.*

However, by 1978 the geese were favouring West Water, utilising Baddinsgill only when heavily disturbed at West Water. This practice in turn ceased by 1980 (and Baddinsgill was subsequently de-notified as an SSSI) and if heavily disturbed at West Water they tended to delay arrival or 'park out' until well after dark, come into roost from a great height or change their direction of arrival.

Trends in numbers within winters.
The first arrivals appear by mid-September followed by a rapid influx. This is illustrated in Fig. 4 for five winters where more complete counts are available. Some dispersal takes place after the initial mass arrival but the peak count generally occurs in October or early November and by late November numbers decline. Bell *et al*, (1988) described a similar pattern for Pinkfeet roosting at Meikle Loch/Ythan estuary.

In Lancashire in 1977-78 to 1981-82 Forshaw (1983) recorded that numbers of Pinkfeet peaked in late November or in December with high numbers remaining into January followed by a decline in February, most having left by the end of March and the last birds gone by early May. This mirrors the pattern at West Water where declining numbers coincided with an increase in Lancashire by November/December and conversely a decline in numbers in Lancashire in February/March coincided with a return of birds to West Water. Numbers built up at West Water from late February into March with substantial numbers recorded in April, while in 1989 and 1990 some birds lingered into May. Prior to 1977 a roost count in mid-March was the only data available on the use of the roost in spring and thus gave no indication of its value at that time of year. From 1977 we undertook more frequent counts and Fig. 5 illustrates the peak counts in March, April and May from 1977-90. In most years since 1982 the maximum March count exceeded 4,000 birds, reaching 19,334





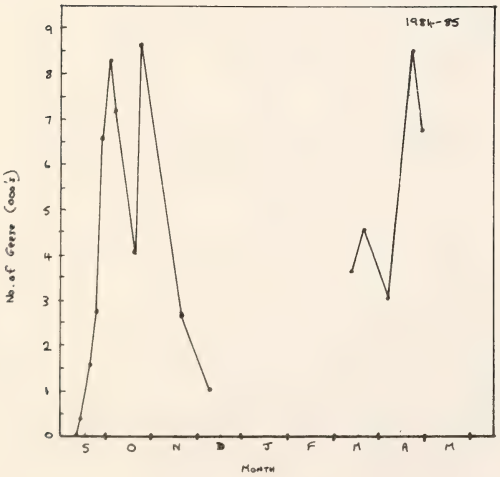


FIGURE 4. *Roost counts of Pink-footed Geese at West Water Reservoir for winters – 1977/78, 1982/83, 1984/85, 1988/89, 1989/90 – for which count data are more complete.*

in 1989 and 11,000 in 1990. Peak annual April counts (Fig. 5) from 1984 regularly exceeded 5,000 birds. The mean of the nine March peak counts 1982-90 was 7,607 while for eight April peak counts (no data for 1987) it was 6,263.

Feeding areas

The reservoir attracts geese from as far as Biggar, Broughton, Carnwath and the upper Clyde valley, up to 20 km distant as the geese fly (Fig. 2). In recent years goose counters at Gladhouse and Portmore Reservoirs have occasionally noted some geese overflying their reservoirs and heading in the direction of West Water. Also counters at West Water have noted that the number of birds flighting in from east/north-east have exceeded the number of birds known to be feeding near West Linton. Perhaps the West Water roost attracted some geese that fed in the Gladhouse area.

Discussion

Over the last 25 years West Water has developed into a major goose roost and has been shown to be of exceptional importance to Pinkfeet when they first arrive in Scotland. Strathearn, Loch of Strathbeg, Hule Moss, Montrose Basin (Newton *et al.* 1990) and Dupplin Loch (Bell & Newton 1991) are of similar importance. The annual peak autumn roost count at West Water Reservoir between 1966 and 1990 increased, we believe, in part due to the increase in the national population and in part to a redistribution of the geese in Lothian and Borders (Brown & Brown in prep.). It held second place in the national table of Pink-footed Goose roosts (Kirby *et al.* 1991), averaging 29,590 birds over the five Octobers 1986-90. The Loch of Strathbeg held the prime position with an averae of 30,030 over the five Novembers 1986-90.

West Water is now recognised as a site of both National and International importance having regularly held 1% of the

We are extremely grateful to

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WINNING SLIDE OF SOC PHOTOGRAPHIC COMPETITION 1992

Wren at nest, Troglodytes troglodytes — *W.E. Middleton*

Semi-palmated Sandpiper, Calidris pusilla, Fair Isle, Shetland, May 1992. Paul Harvey

Dark-eyed Junco, Junco hyemalis, Hamilton, May 1992. J.C. Maxwell
Courtesy of The Herald

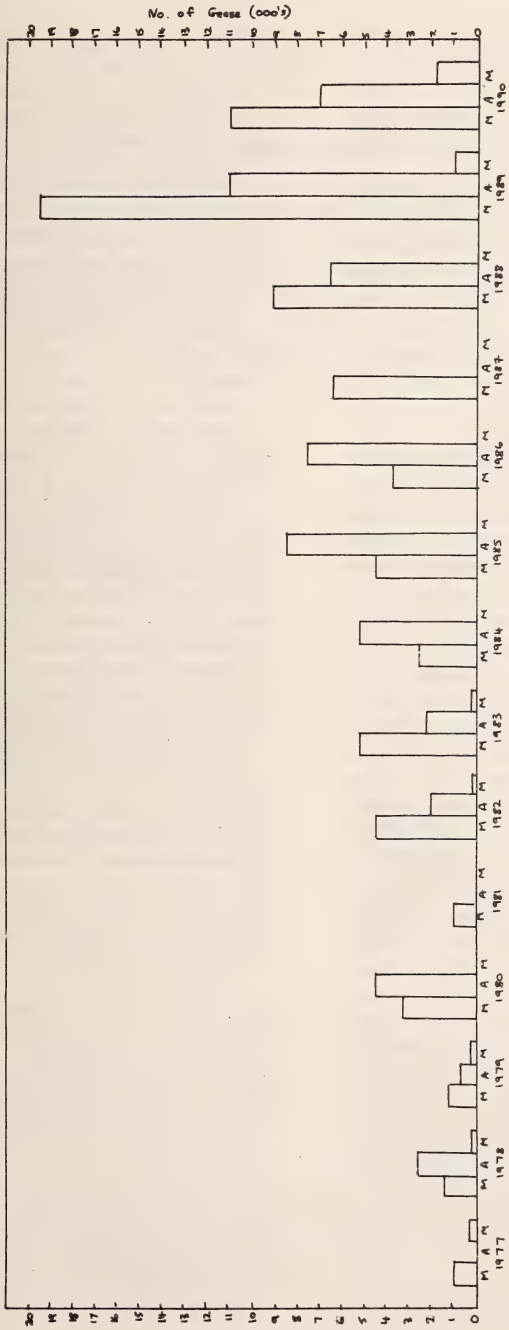

FIGURE 5. *Maximum counts of Pink-footed Geese at West Water Reservoir in March, April and May from 1977 to 1990.*

Pink-footed Goose population. It was designated an SSSI in 1975 and was re-notified in 1986 because of its Pinkfoot roost. It has been identified for designation as a Ramsar Site in addition to a Special Protection Area.

Newton *et al.* (1973) considered that disturbance was a major factor in influencing goose distribution. Perhaps the main reason for the development of such an important goose roost at West Water was the lack of disturbance, especially when the birds first arrive and then prior to spring departure, but also for large parties of birds frequenting the site throughout the day in order to rest, wash and preen.

Having achieved international importance as a goose roost it is to be hoped that West Water continues to holds its position, that disrupting activities continue to be restricted and that perhaps more people may be able to enjoy the spectacle of 30,000 birds flighting into the roost.

Acknowledgements

Data for West Water Reservoir prior to 1976 were obtained from the records of the late William Brotherston who was local goose count organiser for Lothian and Borders until his death in 1981. We are grateful to John H. Ballantyne for extracting the relevant information. We thank Lothian Regional Council for granting us access to West Water, Helen and Ian Chisholm for counting geese when we were otherwise engaged and Andy Moffat for supplying additional data. Dr M. Marquiss and Dr M.A. Ogilvie provided valuable comments on a draft of this paper which was kindly typed for us by Jim Aitken. Andy Dewar, waterkeeper from 1970 to 1984, and Maria his wife were particularly kind and helpful. Not only did they provide additional information, they frequently thawed us out following goose counts in wet freezing conditions with mugs of hot coffee by their warm fireside .... then encouraged us over an alcoholic beverage to return the following weekend to repeat the exercise etc. etc!

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Grey geese and agriculture in north-east Scotland

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This paper aims to stimulate debate on the problem of the economic loss that some farmers suffer as a result of grazing by grey geese, particularly in north-east Scotland. In many areas of Scotland it would be difficult to demonstrate that geese cause any harm. But in a few places farmers have to bear the cost of large numbers of grey geese feeding on their land. Solutions tailored to local circumstances are required, and the situation in north-east Scotland is used by way of illustration.

Background

The increase in the size of the over-wintering populations of grey geese is well documented (Owen *et al* 1986). The population of Pink-foot Geese *Anser brachyrhynchus* has risen from c.30,000 in the 1950s to the current level of c.195,000 and numbers of Greylag Geese *A. anser* from 26,000 in 1960 to the current toal which is in the region of 120,000. Both Pink-footed and Greylag Geese over-winter in many parts of lowland Scotland where they feed on a range of grass, cereal and root crops. In most areas, the farmers are not economically disadvantaged. However in the north-east some evidence suggests that on farms in the immediate vicinity of the large Pinkfeet roosts at Loch of Strathbeg and the Ythan/Meikle Loch the impact of the grazing by geese has economic consequences.

The Law

Most Greylag and all Pink-footed Geese in Scotland are migratory. The management of these populations is therefore an issue of international importance as well as of national and local concern. Both species are afforded some protection by the Bonn Convention on the Conservation of Migratory Species of Wild Animals and the Berne Convention on the Conservation of European Wildlife and Natural Habitats. They are also listed on Annex II of the EC Directive on the Conservation of Wild Birds. Greylag and Pink-footed Geese, along with some other goose species are listed on Schedule 2 part 2 of the Wildlife and Countryside Act 1981. This allows them to be killed during the open season, but requires a licence to kill during the close season. However, a licence can be issued by the Scottish Office Agriculture and Fisheries Department (SOAFD) to allow shooting to prevent serious damage to crops. In the north-east, licences are routinely issued to farmers in the areas where geese regularly concentrate, such as around Loch of Strathbeg. Other species such as Barnacle *Branta leucopsis*, Brent *B. bernicola*, and Greenland White-fronted Geese *Anser albifrons flavirostris* are protected at all times, so for them there is no open season. Nonetheless a few licences have been obtained from SOAFD by farmers on Islay to prevent damage to agricultural crops by Barnacle and Greenland White-fronted Geese. The sale of dead wild geese has been outlawed since 1968.

In addition to the legal protection given to the birds themselves, the sites that the birds use can also be protected as Sites of Special Scientific Interest. Many of the SSSIs notified for the protected species of geese include both roost and feeding grounds but for grey geese often only the

roosts are included. The larger roosts, including those at the Loch of Strathbeg and the Ythan/Meikle Loch also qualify as internationally important and are proposed Special Protection Areas under the EC Birds Directive.

The problem

In line with national trends, the number of geese at the major north-east roost sites has increased. In November 1980, 2200 Pinkfeet were counted at Strathbeg, in November 1990 the number was 37,100. Over the winter the roosts are also important staging areas for the geese on migration to and from Iceland. The spring influx, which in 1992 peaked at 37,950 (J. Dunbar pers. comm.), generates the greatest outcry from the local farmers because it is such an important time in the farming calendar. In late spring the geese feed on winter cereals and newly sown grain and compete with livestock for early bite grass (Keller & Patterson 1990). The autumn influx does not put the same pressure on agricultural crops because the geese generally only stay in the area if there is rich feeding on spilled grain in stubble fields. If this is not available the geese disperse fairly rapidly. Research at Aberdeen University (Patterson 1991) has shown that under severe goose grazing pressure yields of spring grass can be depressed by up to 60%, yields of silage by up to 20% and winter barley by 10-20%. These are extremes, normally losses would not be so high, but as well as reducing yields, grazing by geese can cause other effects such as uneven ripening of crops, delayed harvesting, more weeds in the crop and a delay in the turning out of livestock onto spring grass.

After years of research attempting to measure crop losses, it is generally agreed that it is very difficult to evaluate the economic cost of crop damage to individual farmers because of a variety of complicating factors including weather, soil and crop type.

Management Options

Three main techniques are used to attempt to manage goose numbers and distribution. These are culling, scaring and habitat management.

Culling. Some farmers have advocated that numbers of grey geese should be reduced to a pre-determined level by culling. However other people believe that the setting of arbitrary population levels for geese is neither desirable nor practicable. A cull on either the breeding grounds in Iceland or on the over-wintering grounds in Britain could be both practically and politically difficult to implement.

Scaring. A variety of scaring devices such as gas guns, mobile scarecrows, kites and wires have been used to scare geese, usually with only limited success. Shooting at flocks to scare them and disturbance by people are more effective. But all scaring techniques have a cost. However, scaring only moves geese from one location to another, so it is most valuable when used in conjunction with habitat management.

Habitat Management. For some species of geese such as Barnacle and Brent, feeding grounds have been provided in reserves. Crops are grown specifically to feed the geese. This technique has been used primarily for small, concentrated populations of protected species of geese but it has not been widely adopted in Scotland as a means of managing the large and dispersed populations of grey geese, although at the Loch of Strathbeg on a relatively small scale the RSPB manage some of the grassland in their reserve for grey geese.

Current Management Practices

The schemes currently operating in Scotland mainly concern protected species. On Islay, the farmers in 'goose' SSSIs can be paid through a Management Agreement to

tolerate the grazing geese and a new scheme has just been started to allow for payments to farmers on the island outside SSSIs. On the Solway at Caerlaverock there is a sanctuary system for the Svalbard Barnacle Geese. Here the merse or estuarine grasslands are managed to attract the Barnacles but this also benefits the Greylag Geese in the area. At Loch Leven, the RSPB manage land in their Vane Farm reserve for Pinkfeet. At Montrose Basin the issue of managing the increasing numbers of geese outside the reserve areas is being investigated.

In England, there is a Brent Goose option in the Countryside Premium Scheme whereby farmers in a prescribed area can enter their land into the Ministry of Agriculture, Fisheries and Food's 'Set Aside' Scheme. But if they manage their land in a specified way farmers can qualify for 'top up' payments from the Countryside Commission.

The Dutch government is encouraging the development of regional goose management plans. The policy is to scare geese, in a planned and co-ordinated way, from land susceptible, to damage such as arable crops, onto land less susceptible to damage including pastures, areas of natural habitat and reserves. At present, goose damage is reimbursed from a special fund unless a licence has been issued to scare geese away.

In October 1990 a conference entitled Farmers and Waterfowl: Conflict or Co-existence was held at Lelystad in the Netherlands. It recommended that a management strategy for geese is required at the international, national and regional level. Work has already begun on developing international flyway management plans for some species, notably for Greenland White-fronted Geese, but it is likely to be some time before such plans are finalised for Greylag or Pink-footed Geese. In the interim, a system is required to assist those farmers whose land is intensively grazed by grey geese causing economic loss. The Lelystad conference acknowledged that although wildlife is an integral part of agriculture, it is still a negligible part of agricultural policies. The participants at the conference recommended that "it is of the utmost importance to broaden the scope of agricultural policies to ensure the conservation of our natural heritage".

Farming with Wildlife

Pienkowski & Stroud (1991) have proposed that for large or medium-sized dispersed populations including Greylag and Pink-footed geese an approach similar to the Environmentally Sensitive Areas is required. This would enable farmers to opt in and accept payments and tolerate geese or opt out and bear the losses and costs of preventing them feeding. In a limited area around the largest Pinkfeet roosts in north-east Scotland, such a scheme could be very valuable in reducing tensions between the local farmers and bird protectionists. It may be necessary to operate a scheme only during the close season when the goose grazing competes with livestock grazing or damages growing crops. At other times, farmers can derive some income from the geese by letting the shooting. Rather than trying to compensate farmers for individual losses, the scheme could offer flat rate payments per unit area in a defined area around the roost. Payment would only be made on the fields where significant numbers of geese actually feed. This could be determined by 'dropping counts'. Additional payments could be made to those prepared to grow special crops for the geese. Outside the defined area, licences could be readily available in order to disperse the geese and encourage them to return to the refuge.

The recent reform of the Common Agricultural Policy (CAP) had introduced new opportunities for introducing such a scheme. The new Agri-Environment Programme could be developed to

accommodate farming with geese. This could be integrated with the Set Aside Scheme and, although this has shortcomings in its present form, it could be modified to accommodate management of 'set aside' land for geese. The international lifestyle of the Greylag and Pink-footed Geese seems a suitable case for EC consideration. If the policy makers can be persuaded, the wildlife on some of Scotland's farms could benefit from CAP funding in much the same way as those in Environmentally Sensitive Areas. This would help offset the detrimental effects on wildlife that CAP has caused elsewhere.

Acknowledgements

I would like to thank Professor David Jenkins and Dr Ian Francis for their helpful comments on this paper.

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Some post-war declines in Corn Bunting numbers in north-east Scotland

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Notes based mainly on counts of singing birds along public roads are compared for 1944-48 and 1988-92. In Deeside west of Ballater, Corn Buntings were widespread in 1944-46 but not seen in summer 1947 and since. In the Turriff area, summer adult numbers are as high in a few places as in 1944-48, but in most places lower or absent. Adult numbers in the Turriff area were no lower in summer 1947 following a severe winter than before it. Birds were seen in mid Deeside in 1944-46 and a big flock in mid Donside in January 1947, but none there in 1952-55. Notes from other parts of north-east Scotland show generally fewer birds than in 1944-48.

Introduction and Methods

The decline of Corn Buntings *Miliaria calandra* is well known from the BTO Atlas. However, few observers have compared numbers on an area in widely different years, although this is the best guide to changes in local distribution and numbers. Below, I give some such notes, based mainly on counts of birds singing on fine evenings in May to mid August on wires and other song positions along public roads. Such counts are minima, but current intensive work (Watson, unpublished) shows that in such conditions nearly all cocks are seen. I also give some notes from winter.

Results

West of Ballater. East and west of Bridge of Muick, and Dallyfour to Ardmeanach, a few April 1944, "quite a number" each July 1944-46, and flocks at ricks each winter 1944-47; the foot of the Balintober road was a very favoured spot. Coilacriech, one singing July 1945. Bridge of Gairn to Crathie, quite numerous July 1944-46 and flocks at ricks each winter 1944-47. Abergairn to Prony and Culsh, Strathgirnock to Balhalach, Mains of Abergeldie to Tornauran, and above Crathie at Crathienaird, Newton, Bush and Lawsie, quite numerous July 1946. Balnault and Inver, one each, singing July 1946. North of Braemar by the A93, south similarly, Auchallater, Balintuim, and north-west of Braemar, one each, singing July 1946. Tomintoul croft (420m) at Braemar, two in hay August 1946. I saw none west of Ballater in 1947-51, in 1952-55 when I searched for Goodbody's (1955) Aberdeenshire survey, and in 1988-92. Goodbody saw none there in 1952-55.

Mid Deeside, mid Donside and upper Speyside. Ballater to Tomnakeist, Ballaterach to Deecastle, and Ordie to Tarland, several each, singing July 1944-46, and Loch of Aboyne, one singing July 1946. Craigievar up from Alford, flock of at least 80 on snowfree ground, 5 January 1947. Goodbody (1955) saw none west of Crathes, and above Alford, in 1952-55. Loch Alvie, one June 1947. I saw none in these places in 1988-92.

Turriff area. Decreasing 1940-43, more birds 1944-48. Above Turriff Station, 20 in flock April 1945, and flocks of 8-15 at Bridgend and at Millmoss to Darra in winter 1944-48; in winter 1988-92 I saw none. Forglen kirk, a pair May 1945. Turriff to Deveron Brig railway, one singing June 1945. Aberchirder to Mountblairy, fair numbers June and winter 1944-48; none seen 1988-91 except a flock of 8 at Burreldales March 1990. Greenlaw near Alvah, flock of 50 February 1946, and flocks totalling 60 below Hill of Alvah with 25 in one tree. Craigston to Gamrie kirk, "here and there" May 1946; same comment would apply summer and winter 1988-92. Brunthall south of Turriff, 19 in flock February 1946; 20 in flock February 1990. Turriff Station to Brunthall in deep snow February 1947, flocks of up to 15 here and there, and some birds singing; in winter 1988-92, only one flock seen, in 1990 (above). Burnt Smithy to Fintry (3 km), 4 in full song 14 and 20 August 1946; none seen summer 1990. Fishrie, Troup and Pennan, "a lot" including a flock of 10 and a few still singing 22 August 1946, and "lots" June 1947; fair numbers 1988-92 but fewer than 1944-48, and some gaps with none. Strocherie to Crudie, fairly common June 1947 and summer 1990-91.

In winter 1944-48, nearly all birds were in flocks. Most foraging birds were on grain stubble, many at ricks (especially in snow), some on sown grain, turnips and roadside grass, and a few in pasture. Loafing birds were mostly in trees and sometimes on wires. I saw many cocks singing in flocks from December onwards, and occasionally in November, and often saw lone cocks singing strongly on fine days from 5 January onwards. These habits still prevail, save for the virtual lack of grain ricks now.

The best area found in summer was the Fishrie crofts; on 10 August 1947 "great numbers, a cock was sitting singing on the wires every 200 yards for several miles and a flock of 50 was seen, while odd birds were seen here and there not singing".

Table 1 shows numbers singing along roads in 1944-48 and 1989-92 in the Turriff area. Numbers in a few places are as high as in the 1940s, but in others have declined greatly. The distribution area has retracted.

Elsewhere in north-east Scotland. On a high wire by the A92 north-east of St Cyrus, one December 1945; birds were in this area in

TABLE 1. Numbers of singing Corn Buntings along roads in the Turriff area of Aberdeenshire and Bannfshire in summer 1944-48 and 1989-92 (blanks indicate no records made).

Road	Distance (km)	44	45	46	47	89	90	91	92
Turriff-Brunthall	3	6	4	7	7	7	2	5	7
Birkenhills-Keithen	5½		8	5	8	3	2	3	4
Fishrie (Cook-Overbrae)	5			22	26	2	3	4	4
Mill of Pot to west	1½		7	6	8	1	1	0	
Turriff-Mill of Delgaty	2		3	3	4	0	0	0	
Braefoot-Lenshie	6½		3		4	1	5	3	3
Turriff-Fyvie-Gordonstown	18		6		7	1	2	2	2

Turriff by Colp to Idoch, Idoch to Woodhead of Delgaty, Turriff to Darra, Turriff to Mahon, and Turriff to Burnt Smithy (4, 2½, 2½, 3 and 2½ km) had 4, 4, 2, 3 and 2 birds in 1946, and 0 in 1990. Turriff-Brunthall 7 in 1948.

winter 1988-92. Newburgh to Balmedie, a few May 1946; same comment would apply 1988-92. Both sides of Ythan estuary, a few May and November 1946. Newburgh via Ellon to Old Meldrum, "plenty" June 1947; in 1988-92 I saw none near Old Meldrum. West of Forres, a few October 1946, and Spey Bay, "lots" December 1946; I saw none west of Forres and at Spey Bay on four winter visits and one spring one in 1988-91. Dyce north to Goval, flocks December 1946. Gartly to Lessendrum, a few May 1947. Last three miles from the south-west to Loch of Strathbeg, fairly numerous June 1947; and Strathbeg area, "lots in flocks and many singing" February 1948; such comments on high numbers would not apply in 1988-92.

Discussion

West of Ballater, many were seen in 1944-46, but none in summer 1947 following the severe winter of early 1947, and none in 1952-55. The 1947 winter there was exceptionally cold, snowy and prolonged from January till April, and the 1950-51 winter also severe. These were the two snowiest winters at Braemar in 1939-92, judged by the number of mornings with snow lying (Monthly Weather Report, Meteorological Office, Bracknell). In the Turriff area, however, adult numbers were if anything higher than usual in summer 1947 (Table 1, and Fishrie notes in Results). Although that winter was unusually severe in the Turriff area, it was markedly less long, snowy and frosty on this lowland area than west of Ballater. Interestingly, Corn Buntings on lowland at Freuchie in Fife increased from 12 to 18 pairs between 1946 and 1947 (Dacker 1948).

The question is why numbers have fallen in the Turriff area. Such questions can be answered reliably only by detailed research, which has been lacking. Certainly, farm practices have changed much since 1948. One change is the lack of grain ricks, but this includes places where the number of singers has not fallen, such as Turriff to Brunthall. There, steep uncultivated patches at Brunthall and weedy barley on one farm may help maintain numbers. Birds have declined greatly at the Fishrie crofts, associated with a big drop in the number of worked family farms. Most farms there had oats and turnips, but pasture has replaced these on most of the area. Corn Buntings seldom use pasture in winter, and it is usually too short for nesting.

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Rare Migrants

Little Swift on Fair Isle: the second Scottish record

The 1st November 1991 was preceded by six days of South easterly airflow on Fair Isle, Shetland. These classic fall conditions brought a significant arrival of migrants, which amongst others, included a Desert Wheatear *Oenanthe deserti*, 3 Siberian Stonechats *Saxicola torquata maura/stegnegeri*, a Yellow browed Warbler *Phylloscopus inornatus*, a Spotted Crake *Porzana porzana* and several thousand Thrushes *Turdus sp.* Conditions on the 31st October, a force 9 gale and heavy rain, made viewing very difficult, so with better conditions the following day, C.J. Orsman, A. Prior and myself decided to cover the island. A good assortment of migrants were present in the south of the isle, including an Olive backed Pipit *Anthus hodgsoni*. At around 1600 hrs, we were walking along the cliff tops at Bergaroo, when I saw what appeared to be a Hirundine flying away from me at the base of the cliffs. From the brief views that I obtained, I was amazed to see Swift *Apus sp.* like wings and a vivid square cut white rump. It rapidly flew out of sight into Easter Lother. At that stage, CJO and AP had not seen it. From what I saw, the bird was obviously a species of Swift and I suggested that it may be a Little Swift *Apus affinus*! Excited, we hurried to Easter Lother and relocated the bird, where it remained for the next twenty minutes. Looking down on it from the high cliffs, we were able to confirm my initial impressions: fairly long sickle-like wings and an obvious square cut white rump; the tail was also square cut, lacking the appendage appearance of Common Swift *Apus apus*. The colour of the underparts was noted when it made an upward glide, just metres away, showing a white throat patch contrasting with what were otherwise sooty-brown underparts. We were then joined by S. Thomson Jnr., before the bird was lost from view, presumably going to roost. At this stage I was almost certain that the bird was a Little Swift, but I could not remember whether the species showed a white throat patch. On returning to the Observatory, I telephoned Paul V. Harvey and Pete Ellis in Shetland, describing the features we had seen. After much discussion and checking the relevant literature, we concluded that the bird was, indeed, a Little Swift. The description was submitted to the British Birds Rarities Committee and was accepted on first circulation.

Description

SIZE AND SHAPE. No direct size comparison was made, but appeared smaller than Common Swift, about the size of a large hirundine. Sickle shaped wings, fairly broad based. Tail square ended, lacking the forked effect of Common Swift.

PLUMAGE. All upperparts blackish except for slightly paler remiges and a vivid white rump, square cut on leading edge. The head showed a greenish tone and a slight glossy

green sheen to the mantle was also noted. A white throat patch and white sides to the rear flanks, formed by the downward extension of the white rump feathers, contrasted with sooty-brown underparts.

FLIGHT. The bird spent most of the duration gliding effortlessly, fluttering only when banking, reminiscent of a Bat *Chiroptera*.

Range

The Little Swift breeds throughout Africa and Southern Asia east to Southern China, Formosa, the Philippines and Borneo, north to Morocco, Syria, South Transcaspia and Kashmir between 40 N and 35 S. The species is mainly resident but *A.a.galilejensis* (which breeds from Morocco east to Kashmir and south to the central Sahara and Arabia), winters to just south of the breeding range (British Ornithologists' Union 1971).

Little Swift is a vagrant to Britain and Ireland. There have been 9 previous records, which include a single at St. Andrews, Fife, on 29th May 1985 (Dymond *et al* 1989; Rogers *et al* 1989).

Summary

A Little Swift was present on Fair Isle, Shetland on 1st November 1991. This was the second record for Scotland and the 10th for Britain and Ireland.

Acknowledgements

I am grateful to Kevin Osborn and Pete Ellis for commenting on the manuscript.

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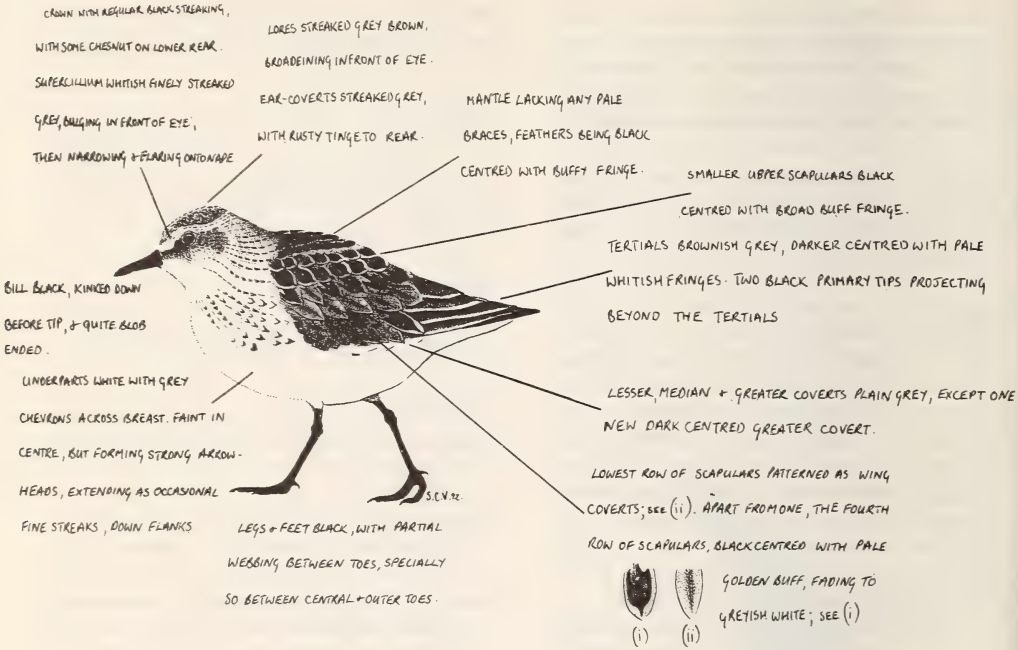
Semi-palmated Sandpiper on Fair Isle: a first record for Scotland

May 13th dawned with light south to south-easterly winds and as a direct result there was a sprinkling of commoner spring migrants on Fair Isle. At around 1500 hrs I was checking the open fields between Bull's Park and Field when I noticed a small wader *Calidris sp.* feeding along the edge of a shallow pool. I was immediately struck by the bird's small size: it was obviously a stint and, as I continued to watch the bird, the lack of any obvious rufous tones to the plumage and lack of pale mantle braces (both features commonly associated with Little Stint *C. minuta*) was striking. Over the following ten minutes the bird continued to feed, quite unconcerned by my presence, whilst I scribbled some hasty notes. At this point I considered the possibility that the bird was a Semi-palmated Sandpiper *C. pusilla*.

Following a phonecall to the Observatory, Paul Harvey arrived with a telescope and a copy of *Shorebirds*, and the next 20 minutes were spent grilling the bird; with the previous experience of PH and with reference to the available literature we were able to confirm the bird as Scotland's first Semi-palmated Sandpiper.

The bird remained on the same pool for the remainder of the day; the following day it moved to a flooded 'tattie' patch at Field croft, where it remained until 15 May, feeding alongside a Dunlin *C. alpina*.



Description

SIZE AND STRUCTURE. Generally appeared very similar to Little Stint, although perhaps a little more chunky and with a slightly more attenuated rear-end. Short primary projection with only two tips visible beyond the tertials. Bill quite heavy, and straight except for an obvious downward kink just before the swollen tip.

HEAD. Crown heavily streaked blackish on greyish-brown ground colour. Sides of rear crown with a distinct chestnut tinge, although this was only visible at certain angles. Nape whitish with fine grey streaking, contrasting with the crown to give a slight 'capped' appearance.

Supercilium white, finely streaked grey, prominent in front of eye and broadening just above the eye, before narrowing and finally flaring as it faded into the nape. There was no sign of any 'split' in the supercilium.

Lores streaked dark grey, narrowest at the base of the bill, broadening in front of the eye. Ear coverts finely streaked grey, streaking most intense along the upper edge of the ear-coverts, forming a distinct dark eye-stripe behind the eye. In certain lights the ear-coverts showed a slight chestnut tone.

UPPERPARTS. Mantle feathers greyish- or golden-buff, with distinct black centres, contrasting with the plain nape. The bird lacked any pale 'braces' or 'tram-lines'.

Upper three rows of scapulars black-centred with obvious broad golden/buff fringes. The fourth row of scapulars with black centres, pointed at the tip, and with pale area within the black at the base of the feathers. The pale fringing to these feathers was chestnut-golden at the base, fading to whitish grey at the tip.

A single feather on each side of the fourth row and the entire fifth row of scapulars uniform grey, with darker central streak (these feathers possibly retained from winter plumage).

UNDERPARTS. Chin and throat white, contrasting quite markedly with grey breast streaking. Streaks finest and narrowest in the

centre, becoming heavier on the sides of the breast forming distinct chevrons, which extended slightly onto the upper flanks. The rest of the underparts white, except for occasional fine streaks on the rear flanks and undertail coverts.

WINGS. Tertials plain greyish-brown with narrow white fringes. Lesser, median and greater wing coverts uniform grey, except for slightly darker central streak. There was at least one differently patterned (new?) greater covert on each wing, these being longer and with a distinctly black centre. The primaries and secondaries were dark (blackish).

In flight showed a narrow whitish wing-bar.

BARE PARTS. Bill black. Legs and feet black, with partial webbing clearly visible between toes, although more prominent between the central and the outer toes. Surprisingly obvious when at close range, or when seen through a telescope. They were also noted when footprints were examined in the mud.

CALL. The call was heard several times in flight, being similar to Little Stint, but distinctly fuller and more rolling; transcribed as 'drrrup' or 'trrrrp'.

Range

Semi-palmated Sandpipers breed from Alaska and central, through to eastern, Canada. They winter largely in coastal parts of north-eastern South America, but also further north to the West Indies and the Pacific coast of Central America.

It is occurring with increasing regularity in Western Europe, probably as a result of increased observer awareness. Up to the end of 1991 there have been a total of 63 British and Irish records, all but two of which have been in autumn. There have been a further 19 Western Palearctic records, 10 of which have been on the Azores, with the others spread liberally around western Europe.

The route that the Fair Isle bird took is debatable, as with many of the vagrants to Britain, but a likely explanation is that it was on its northward spring migration, having arrived in Europe the previous autumn.

Summary

An adult summer-plumaged Semi-palmated Sandpiper *Calidris pusilla* was present on Fair Isle, Shetland, 13-15 May 1992. This constitutes the first record for Scotland, subject to acceptance by the relevant rarities committees.

Acknowledgements

I would like to thank Paul Harvey for his assistance and the accompanying photograph. And also Roger Riddington and Wendy Christie for their invaluable help.

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Stephen C Votier, c/o Fair Isle Bird Observatory, Shetland ZE2 9JU.

Dark-eyed Junco in Hamilton

On Sunday 3 May I had been out chasing rarities since dawn and, arriving home in Hamilton just before 7 p.m., I was taken aback when my wife, Joan, insisted that an unusual bird had been feeding regularly in our back garden from 8 a.m. She had taken notes on the bird and had eliminated all the likely garden birds.

At first I was at a loss to think what it was but then I realized it could be a Dark-eyed Junco, and when I showed my wife illustrations in several field guides, she was confident that this was indeed what she had seen. Within minutes the bird appeared on a plum tree in the corner of the garden, and the first impression confirmed that it was indeed a Dark-eyed Junco *Junco hymelis*. It moved confidently around the garden, returning repeatedly to feed on a tray of seed on the ground beside a wall and chasing off a Chaffinch *Fringilla coelebs*, the only other bird in the garden.

The bill was noticeably pale pink and of typical bunting shape. The head, breast and upperparts appeared uniformly dark grey and contrasted sharply with the white belly and undertail coverts. The area around the eyes looked particularly dark, appearing almost black from certain angles. The white on the outer tail feathers looked particularly noticeable and extensive as it flitted around on the ground. In certain poses the bird did look somewhat plump, although its tail did not appear particularly long. It was roughly the same size as the Chaffinch that it had chased from the garden, providing a suitable touchstone for comparison. All in all it presented itself as a neat, strikingly unusual bunting, and the incontrovertible conclusion was that it was an adult male Dark-eyed Junco in pristine plumage.

I was in a state of shock and incredulity for several minutes, and could only speculate on why this bird had turned up in a suburban garden in Hamilton when it should have been in North America. A quick check in *The Rare Birds of Britain & Europe* and *Rare Birds in Britain and Ireland* indicated that this was the 16th record of Dark-eyed Junco in Britain and only the 5th for Scotland, and also that 11 birds out of 16 had appeared in Britain in May.

When a small measure of calm returned, I contacted my colleague, Campbell Lindsay, and suggested that he should get to my house as soon as possible to try to photograph the bird. However, the Junco appeared to go to roost just after 8 p.m., shortly before C.L. arrived.

The weather was overcast with light drizzle and we reckoned that, given the bird's feeding behaviour throughout Sunday and the distinct possibility that it was a genuine vagrant, there was a good chance that it would remain overnight.

I was, however, hesitant about 'releasing' the news for various reasons. I anticipated problems of parking and access. If a large number of people wanted to see the Junco without disturbing it or nearby residents, they would have to view it from the back windows of my house! After discussion with Angus Murray of Birdline Scotland, I decided to hope for the best and let the news be released.

The first expectant birders arrived just after 5 a.m., and at 5.55 a.m. the Dark-eyed Junco appeared in the garden to feed for about five minutes. It then flew off but returned within the hour, a pattern it was to follow all day. By 8 a.m. a constant stream of birders began to appear, trudging up the stairs and coming back down smiling. The bird appeared either on the garage roof, where I had thrown seeds, or on the tray of seed on the ground. By 10 a.m. the number of birders had increased considerably and bemused neighbours looked out of windows, wondering what was happening. Shortly afterwards, the advance guard for a procession of press reporters and photographers appeared, and the 'twitch' took on the air of a street party or a community celebration. Despite several fraught moments in the course of the day,

the Junco appeared regularly in the garden until 7.30 p.m. By this time over 300 people from all over Britain, and many neighbours too, had had excellent views of this rarity for Scotland and indeed for Britain. Monday night was clear and bright and Tuesday morning was warm and sunny. The Junco was looked for from 6 a.m. but it was not seen again. It had probably moved on during the night or early morning.

However, the publicity and interest generated by the Dark-eyed Junco's two-day stay in our garden was nothing short of staggering, ranging from interviews on the radio, mentions on national radio and television, coverage in nearly all the national and Scottish dailies with perhaps the ultimate coverage being front page articles in *The Scotsman* and *The Times*, and an interview on 'McGregor's Gathering' on Radio Scotland.

Finally, however, we were hugely gratified by the impeccable behaviour of and genuine warmth and gratitude expressed by the 300 or so visitors for allowing them into our house to see the bird. Donations amounting to £110 were collected for Hessilhead Wildlife Rescue Trust and a donation of £20 to Lega Italiana Protezione Uccelli (LIPU) was also made.

Summary

A male Dark-eyed Junco *Junco hymelis* spent 3-4 May 1992 in the garden of 37 Laburnum Lea, Hamilton, Lanarkshire. It was seen by more than 300 people and was also well photographed. Although no problems are anticipated, it has still to be considered by the British Birds Rarities Committee, and if accepted this will constitute the 16th record for Great Britain and the 5th record for Scotland.

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Ian Shedden, 37 Laburnum Lea, Hamilton ML3 7LY.

The Dark-eyed Junco, also called the Slate-coloured Junco, enjoys a wide distribution in North America, where it breeds in the north-eastern USA and in parts of Canada (while other forms breed further west). It winters over much of USA and Southern Canada.

Eds.

Short Notes

Merlins' hunting effectiveness

In Britain the prey of Merlins *Falco columbarius* ranges from day-flying insects to relatively large birds such as pigeons *Columba spp.* and Lapwings *Vanellus vanellus*, in both breeding season and in winter (see e.g. Newton, I., Meek, E.R. & Little, B. 1984. Breeding season foods of Merlin in Northumbria. *Bird Study* 31: 49-56; Dickson, R.C. 1988. Habitat preference and prey of Merlins in winter. *Brit. Birds* 81: 269-274). Hunting success and techniques may vary according to methods and defences adopted by their prey species to elude capture. Other variables include the difference between experienced adults and inexperienced juveniles, differences in hunting efficiency between individual birds, the number of inexperienced prey species available, whether the species are tired migrants or resident winter flocks and so on. These variables are difficult to assess but this paper estimates hunting success rate as the percentage of individual forays that result in prey capture (Johnsgard, P.A. 1990. *Hawks, Eagles and Falcons of North America.* Smithsonian Institute Press, Washington and London).

Apparently, few statistics have been documented on the hunting success rates of Merlins in the breeding season. Most statistics have been on the analysis of prey remains at nest sites. However, Bengtson (1975. Jaktbeteende och bytesval hos en islandsk population av stenfalk. *Fauna och Flora, Upps.* 70: 8-12) found that 11.4% of 61 hunts in Iceland were successful (9.8% by hunting pairs). In addition, there are a few published estimates on hunting forays in winter, often associated with large concentrations of prey. Rudebeck (1951. The choice of prey and modes of hunting of predatory birds with special reference to their selective effect. *Oikos* 3: 200-231) recorded 139 hunts by migrating Merlins in Sweden of which seven were successful giving a success rate of 5%. Meinertzhagen (1959. *Pirates and Predators.* London) observed 100 hunts in Iceland, Scandinavia, Britain, Egypt and Germany of which 15 (15%) were successful. Page & Whitacre (1975. Raptor predation and wintering shorebirds. *Condor* 77: 73-83) recorded 343 hunts on wintering wader flocks by one of the North American subspecies of *Falco columbarius* in California, and in this case

Table 1. Hunting success rates of Merlins.

No. of hunts	Prey	% success	Source
61	Breeding season birds	11.4	Bengtson 1975
139	Autumn migrants	5.0	Rudebeck 1951
100	Various species	15.0	Meinertzhagen 1959
343	Wintering waders	12.8	Page & Whitacre 1975
111	Wintering Dunlins	22.5	Buchanan *et al.* 1988
270	Wintering waders and passerines	10.0	Original observation
19	Passerines at roost	21.0	Original observation

Table 2. Number and success of attacks on prey species by Merlins in west Galloway in autumn and winter 1965-92.

Species attacked	Attacks (n)		Successful attacks (n)	
	blue	brown	blue	brown
Waders (1)	-	12	-	2
Thrushes (2)	1	5	1	1
Starling	2	19	-	4
Skylark	8	92	1	6
Finches (3)	23	47	2	5
Meadow Pipit	1	23	-	3
Others (4)	2	8	-	1
Unidentified small passerines	5	22	1	-
Totals	42	228	5	22

Blue = probably cock Merlin; Brown = juvenile or female

1. Includes Turnstone, Dunlin, Ringed Plover, Lapwing, Redshank and Curlew
2. Includes Redwing, Blackbird and Fieldfare
3. Includes Greenfinch, Redpoll, Linnet, Twite and Chaffinch
4. Includes Pied Wagtail, House Sparrow, Woodpigeon and rabbit

Table 3. Number and success of attacks on prey species by Merlins at one of their winter roosts in west Galloway, 1970-91.

Species attacked	No. of attacks		Successful attacks	
	blue	brown	blue	brown
Meadow Pipit	1	6	-	1
Redpoll	-	2	-	-
Skylark	-	1	-	1
Fieldfare	-	1	-	-
Starling	-	1	-	-
Unidentified small passerines	3	4	-	2
Totals	4	15	-	4

Blue = probably cock Merlin; Brown = juvenile or female.

12.8% were successful. Buchanan *et al.* (1988. Merlin predation of wintering Dunlin: hunting success and escape tactics. *Wilson Bull.* 100: 108-118) studied the success rates of Merlins hunting Dunlin *Calidris aplina* flocks in western Washington State and found a success rate of 22.5% from 111 observed hunts (Table 1).

In a study of the prey of Merlins in winter in west Galloway between 1965 and 1985 Dickson (1988; Dickson, R.C. 1989. Restricted winter range of a Merlin in west Galloway. *Scot. Birds* 15: 131-132) recorded 163 hunts of which 9.2% were successful. Further observations to March 1992 add another 107 hunts, giving a total of 270 of which 27 (10%) were successful (Table 2). The monthly differences in success rates in winter, however, ranged from 4.4 – 20% (August/September 20%, N = 3; October 5.7%, N = 3; November 17.5%, N = 7; December 13.8%, N = 4; January 11.1%, N = 5; February 4.4%, N = 3; March 10%, N = 2).

In west Galloway most hunting in winter is by day but occasionally at roosts where a higher success rate was recorded from a small sample. Of 19 hunts recorded at roosts, four or 21% were successful (Table 3). Sys (1982. Waarnemingen op een gemeenschappelijke slaapplaats van Smellekens *Falco columbarius. Wielewall* 48: 360-367) also stated that Merlins had a greater hunt success at a roost in Belgium but gave no details. This higher rate might be because of the victims' lack of awareness of the presence of the falcon in the half-light, or because of the falcons' greater need to feed before roosting and hence greater vigour, or because of the Merlins' greater visual acuity than their prey.

These examples suggest that Merlins hunting birds have a low success rate in autumn and winter (5-22.5%, average 14%).

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

Great Skuas attacking a flock of moulting Eiders

On 17 August 1992 I saw two loose flocks of c.110 and c.360 moulting drake Eiders *Somateria mollissima* sleeping on the sea to the west of Sumburgh Head, Shetland. A few minutes later I noticed that the birds in the larger flock were alert and had gathered together in a tight formation typical of moulting Eiders when disturbed. The source of the disturbance became obvious when a circling Great Skua *Catharacta skua* suddenly plunge-dived into the middle of the flock, causing the nearest Eiders to dive and the birds on the edge of the flock to splash away from the skua in panic. A second skua soon joined in and the two repeatedly attacked the Eiders which kept diving, splitting into smaller flocks and regrouping. Typically the skuas simply crash-landed in the middle of a flock and tried to catch an Eider before they dived too deep, mostly only submerging their head and neck in the attempt although occasionally all but the wingtips were underwater. Having failed at this, the skuas would then lunge a few times at the birds on the surface before taking off and circling over the flock again. In about 40 'plunge-attacks', I only once saw an Eider caught but the skua was almost completely underwater by that time and the Eider escaped. After 15 minutes of fairly continuous attack, the skuas remained sitting on the sea while the Eiders swam off around the southern tip of Sumburgh Head.

The increased predation of seabirds by Great Skuas in Shetland in recent years (Hamer, K.C., Furness, R.W. & Caldow, R.W.G. 1991. *J. Zool. Lond.* 223: 175-188) has led to some unusual observations,

including the killing of adult Gannets *Sula bassana* (D. Suddaby, pers. comm.), Great Black-backed Gulls *Larus marinus* (M. Mellor, pers. comm.), and even other adult Great Skuas (pers. obs.), while aerial chases of waders and smaller gulls are now not uncommon sights. However, this was the first time I had seen determined attacks on a flock of moulting, flightless Eiders.

Martin Heubeck, Department of Zoology, University of Aberdeen, Tillydrone Avenue, Aberdeen AB9 2TN.

Predation of birds' eggs and chicks by herbivorous mammals

Furness (1989. The predation of Tern chicks by sheep. *Bird Study* 35: 199-202) described predation by sheep of chicks of Arctic Terns *Sterna paradisaea* and Arctic Skuas *Stercorarius parasiticus* on Foula, Shetland. He could find no similar instances in the literature except his own observations of predation of Manx Shearwaters *Puffinus puffinus* by red deer on Rhum (Furness, R.W. 1988. Predation of ground-nesting seabirds by island populations of red deer *Cervus elaphus* and sheep *Ovis. J. Zool., Lond.* 216: 565-573). However, MacDougall (MacDougall, P. 1992. Lesser Black-backed Gull corpse scavenged by sheep. *Brit. Birds* 85: 313.) pointed out that the habit of chewing the legs of tideline bird corpses is common amongst the native sheep on North Ronaldsay, Orkney. This habit was also recorded by Lockley (1938. *I know an Island*. London). Other observations show that predation by herbivorous mammals is widespread in the Northern Isles.

North Ronaldsay sheep remove the legs and frequently the bills of almost all tideline corpses on the island. They also eat Arctic Tern chicks (pers. obs.), and have been recorded eating the eggs of Ringed Plovers *Charadrius hiaticula* (Walker, K. 1966. The birds of the island. In: Scott, M. *Island Saga*. Aberdeen). This may be why many Ringed Plovers on the island nest in covered sites (Pennington 1992, Ringed Plovers nesting in covered sites. *Brit. Birds* 85: 498-499). Sheep may also take the eggs of other birds on North Ronaldsay, including Arctic Skua and Arctic Tern.

In Shetland, live and dead chicks of Arctic Terns and Arctic Skuas mutilated in the way described by Furness (1988, 1989) have been found many times over the past 15 years in a number of different localities, including Papa Stour and Whalsay (J.D. Okill pers. comm.). In an Arctic Tern colony on Unst, dead chicks found in 1991 were believed to be the victims of Shetland ponies (pers. obs.) while, during hide watches on Papa Stour in 1989, not only were sheep seen taking Arctic Tern chicks but on one occasion a rabbit dragged a chick down its burrow! (G.M. Scanlon pers. comm.). In 1990, on Hermaness, Unst, two small Guillemot *Uria aalge* colonies containing a total of over 600 individuals were completely abandoned by early June after predation by a trapped, hungry sheep. Many predated eggs were found, crushed and punctured in a fashion consistent with the sheep's dentition.

These casual observations suggest that predation of birds' eggs and chicks by sheep and other herbivorous mammals is not unusual, at least in conditions where mineral deficiencies in the herbivores' diet are likely. Such deficiencies were suggested by Furness (1988, 1989) as the origins of such behaviour.

M.G. Pennington, 9 Daisy Park, Baltasound, Unst, Shetland ZE2 9EA.

Unusual Buzzard nest sites in Glen Roy

In 1985 I was shown the nest of a Buzzard *Buteo buteo* in Glen Roy. It was located amongst deciduous trees in a conifer plantation, but its position was unusual in that it was at ground level at the bottom of a bank overhanging a burn at the base of alder trees *Alnus glutinosa*. The bank extended for c.10 metres at a slope of about 45 with bracken *Pteridium aquilinum,* short purple moor grass *Molina caerulea* and various moss species growing on it. The nest was supported, cradle-like, principally by the alder trees (see diagram below). Although very occasionally nests are known to occur on steeply sloping ground (Cramp, S. & Simmons, R.E.L. (eds). 1980. *The Birds of the Western Palearctic*. Oxford. Vol. 2), and in the Uists they have been recorded on flatter ground also (Newton, I. 1979. *Population Ecology of Raptors.* Poyser, London), such sites are clearly rare.

The trees around the Glen Roy site, although mature, did not contain suitable typical nesting places. In the years 1985-87, a total of three young fledged from the seven eggs laid in this nest. Only two eggs were lost to predation, both in 1986.

In 1988, a new nest was built on the opposite side of the burn but close to the first. This one was in a small birch *Betula pendula* about 2 metres above ground level. This is lower than the three metres normal minimum for tree nests (*BWP* Vol 2) though similar heights have been recorded in

Speyside (Brown, L. 1976. *British Birds of Prey*. Collins. London). A total of five young were fledged from this new nest in 1988 and 1990. Neither nest was used in 1991, nor in 1992.

In spite of the abundance of trees, a lack of suitable nest sites exists in this area, but this has clearly not prevented Buzzards from breeding successfully in these unusual places.

Dominic Sargent, 'Cruach Innse', Roy Bridge, Inverness-shire PH31 4AJ

Unripe grain, a major food for young finch-like birds

D. Macdonald (1965, *Scott. Birds* 3: 235-246)) wrote that the most frequent food items brought to nestling Corn Buntings *Miliaria calandra* in Sutherland were "green caterpillars and an unidentified whitish substance which was carried in large billfulls". While watching north-east Scottish nests in 1989 I noted that hens often fed their nestlings on a pale green or off-white paste. In Angus in 1990 I identified it. A hen with fledged young was feeding them mainly on grain. After taking a grain from the plant, she rolled it round inside her open bill, using her tongue to do so, whereupon the husks fell off, torn from the grain by hard ridges inside the bird's bill. I had often seen various bunting, finch and sparrow species do this while feeding on grain; each grain takes several seconds of bill-rolling, except for threshed wheat, which lacks husks. The hen Corn Bunting did this, grain by grain, until she had enough to feed to a chick, and then returned to the grain field to repeat the process. She often speeded up the act by taking several unhusked grains in her mouth, flying to a nearby tarmac road, and striking each grain against the road, whereupon the husks quickly fell off. While doing this she dropped some green bits but then picked them up before flying to the young. She often came to the road to husk grains, but once husked them by striking them against hard compacted earth at a field edge. A Linnet *Carduelis cannabina* repeatedly took grain paste from the tarmac road by the grain field to feed young in a nest in gorse 400 metres away. Later I saw Corn Buntings striking greenish grains against the tops of posts, wire, stones and drystone walls, before feeding the paste to their young. Since then I have often seen Tree Sparrows, House Sparrows, Chaffinches, Greenfinches and Yellowhammers (*Passer montanus, P. domesticus, Fringilla coelebs, Carduelis chloris* and *Emberiza citrinella*) flying with grain paste to feed nestlings, and feeding fledged young on it at the edge of grain fields. It is one of the main foods taken by Corn Buntings to young in and out of the nest, often even from the day of hatching. It is particularly predominant in cold wet weather when insects are less available, but is less frequent in areas with very abundant insects.

Barley, wheat and oats are all used. Adult Corn Buntings prefer ripe grain for feeding themselves, but for their young they prefer grain with a slightly greenish tinge. Bright green, completely unripe grain, at a stage with a high liquid content, is not used. The material used has a higher protein and lower starch content than ripe grain, and so approximates more to the high-protein food available in insects. In north-east Scotland, winter barley provides this food in late May-mid July, winter wheat in mid June-mid September, and spring barley and spring oats in late June-September. Hence the season when this food is available starts much earlier if winter grain is present.

Adam Watson, c/o Institute of Terrestrial Ecology, Banchory, Kincardineshire AB31 4BY.

Heron attacked by Osprey

On 25 August 1990, we watched two Ospreys *Pandion haliaetus* sitting in a dead Scots pine on the far side of a lochan in Perthshire. This tree was about 500 metres from another pine in which their nest was situated. A Grey Heron *Ardea cinerea* was fishing on the edge of the lochan using the 'wade or walk slowly method' (Voisin, C. 1991. *The Herons of Europe*. Poyser, London). We watched until it disappeared behind a low rocky heather-covered promontory. Some time later we heard and saw a juvenile Osprey in the heather close to the nest tree. The young bird called persistently. An adult flew towards it and made rapid dives towards the water behind the promontory. These rapidly repeated dives were unlike the normal fishing behaviour which we have observed on many occasions. The Heron came swimming from behind the promontory with the Osprey diving towards it. The Heron reacted to the diving Osprey by retracting its head and neck and continued swimming for the nearest shore from which it flew away from the lochan. It was not pursued by the Osprey which flew to a tree close to the young bird.

Grey Herons have been observed swallowing Mallard *Anas platyrhynchos* ducklings (*Scot. Birds* 16: 44), catching, killing and swallowing Hoopoe *Upupa epops* and eating birds as large as Redshank *Tringa totanus* and Ruff *Philomachus pugnax* (*Brit. Birds* 84: 57-68). However, whether the Osprey attacked the Heron because it was a competitor for food or a threat to its young we cannot say.

Bruce M. Hobson and Elizabeth M. Hobson, Flat 7, 27 Castle Terrace, Edinburgh EH1 2EL

Correction

In the Short Note by Duncan, Cooper & Leitch (*Scot. Bird* 16: 22) on natal philopatry in female wigeons, the editors added a reference to the important article by Greenwood (*Anim. Behav.* 28, 1140-1167), but unfortunately the word 'female' dropped out in the printing process, thus inadvertently implying that natal philopatry is rare amongst birds generally, whereas the intention was to indicate that female birds are less philopatric than male ones. Amongst birds males usually nest closer to their site of hatching than do females but, as stated in the note, a variety of duck species have been found to be an exception to this rule. As Greenwood showed, the situation is the opposite in mammals, where, in most species, females breed closer to their site of birth than do males. We apologise to the authors for this slip and thank Cliff Henty for pointing it out to us. Eds.

Correspondence

(The Editor welcomes correspondence on suitable topics in *Scottish Birds*. It is essential, however, that all letters are addressed to the Editor and that personal or libellous comments should be avoided.

Eds.)

Letters

Baillon's Crake at Fair Isle

We read with interest the article by Suddaby and Harvey in *Scottish Birds* 16(3): 211-214 about the occurrence last autumn of a juvenile Baillon's Crake *Porzana pusilla* at Fair Isle. The bird was found dead on 2 October and rumour has it that the specimen was prepared privately as a mount. This raises a general concern as to the fate of dead rarities over the recent past.

It was not long ago that it was the (almost) universal practice for Scottish rarities to be deposited at the Royal Museum of Scotland for incorporation into the national collection (for example see countless articles in *Annals of Scottish Natural History/Scottish Naturalist*, and various species accounts in Baxter and Rintoul (1953) *The Birds of Scotland* and Thom (1986) *Birds in Scotland*), which means that the material is freely accessible to any *bona fide* ornithologist, and easily compared with other series of skins. As mounted birds generally have a limited life and are difficult to store, most material is prepared as cabinet skins which store well and which are also convenient for posting locally and internationally. This widens their availability.

Skins in the museum are maintained in light-proof and insect-proof cabinets and remain in good condition indefinitely. Some specimens here are 200 years old yet remain in as good condition now as the day they were prepared. Furthermore, the significance of particular specimens is not always recognised until later generations. Incidentally, the 1929 Fair Isle specimen, referred to by Suddaby and Harvey was deposited in the Museum by George Stout (Reg. no. NMSZ 1929.70).

There is no indication of the current location of the 1991 crake or, indeed, whether it is still in Scotland. If it has been mounted, will the possessor be willing to send it to others for examination and comparison? Is it free of light damage and pest attack? (Specimens exposed even to low levels of sunlight can be bleached within a year or two.) Where will the specimen be in 10, 50 or indeed 100 years time?.

We believe that the aims of ornithology are better served if rarities are deposited in permanent reference collections where they are freely available to interested parties. There have been several instances in the last few years where rarities have been retained by individuals. We suspect that, however well-intentioned this is, it is almost certain that these specimens will be lost to science in a few decades (or in any case after the death of the owner).

This letter has been written as a reminder that the Bird Section has a continuing need for new specimens, whether rare or common, for reference purposes. Perhaps the lack of public awareness of this reflects our own failure to make this requirement more widely known.

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Discoloured Peregrines in the north of Scotland

The account by G.G. Bates of a pair of dark Peregrines *Falco peregrinus* in north Sutherland (*Scott. Birds* 16: 219) seems reminiscent of a number of similar reports eventually attributed to oiling by Fulmars *Fulmarus glacialis* in the early 1970s. They are discussed by Andrew Clarke (*J. Zool., Lond.* 181: 11-20), who was able to quote nine incidents all in the north of Scotland. Where details were supplied all were adults affected in the summer, and some of the birds died. Clarke speculated that the Peregrines may have become oiled either when they tried to prey upon the increasing population of Fulmars, or because of consequent disputes between the two species over nest-sites.

The present incident seems increasingly serious because not only may both members of a pair of Peregrines have been affected, but they nested late and the eggs apparently failed to hatch, perhaps because if eggshells become oiled the embryo may suffocate. This might therefore provide one explanation for the decline of northern and western Peregrines reported in *Scottish Bird News* 26. Perhaps it is time for further investigation of the problem, and the early discouragement of any Fulmars settling near possible future Peregrine nest-sites before the falcons occupy them?

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Pied Wheatear in Shetland

In our last issue under the heading 'Rare Migrants' (*Scottish Birds* 16: 214-216) it was stated that a Pied Wheatear *Oenanthe pieschanka* in Shetland on 9 October 1991 was the fifth record for Scotland. Several people have since written in to say that this bird was in fact the sixth record, and that a first winter female on Stronsay 16-20 October 1988 had been omited from the list at the end of the note. The bird was found by Dennis Garrett, was accepted by the British Birds Rarities Committee and became the second record for Orkney. The record is mentioned by M.J. Rogers and the Rarities Committee (1989) in 'Report on rare birds in Great Britain in 1988' (*British Birds* 82: 505-563). Our thanks to everyone who wrote in to put us right.

Eds.

Research Index

The following is an index of fieldwork and research presently undertaken with specific Scottish interest. This index is updated every year and researchers are either listed alphabetically by the institutes where the research is based, or in two cases (SNH & RSPB) by the topics and species researched. If you are doing research in this area and not listed here, or know of someone who is, please put us right by sending details to the editor.

Aberdeen University:

Cosgrove, P. The importance of conservation zones for bird populations in upland spruce forest, concentration on broadleaf strip, unplanted stream edges, marshes, etc, in otherwise unbroken conifer. Based at Kielder, Northumberland (PhD study).

Dunnet, G.M. The Fulmar on Eynhallow in Orkney (since 1950) concerned primarily with population dynamics, longevity and, recently, recruitment.

Dunnet, G.M. & Heubeck, Martin. Monitoring programme (since 1978) in breeding seabird populations in Shetland, as well as changes in seabird and waterfowl wintering populations in two areas: Yell Sound and Sullom Voe and the Bluemull/Colgrave Sounds area of north-east Shetland.

Gorman, Martyn L. & Reynolds, Peter. Feeding ecology of raptors (Short-eared Owl, Hen Harrier and Kestrel) in Orkney, particularly concerned with the effects of changes in land-use.

Patterson, I.J. & Fuchs, R.M.E. Management of grassland to provide reserves for wild geese; experiments with different mowing, grazing and fertiliser regimes at the RSPB reserve at the Loch of Strathbeg, Grampian.

Patterson, I.J. & Ollason, J.G. Bird population density and species diversity in upland spruce plantations, in relation to different management regimes especially changes in compartment size; based at Kielder, Northumberland and Cowal, Argyll.

Patterson, I.J. & Laing, R. Monitoring of wildfowl and wader numbers on the Ythan estuary, Grampian. Twice-monthly counts throughout the year, with special emphasis on the Eider Duck in the breeding season.

Rae, S. Habitat use by Ptarmigan, especially in the breeding season, in relation to vegetation type and reproductivity, cover and other environmental factors (with SNH/Des Thompson, PhD study).

Edinburgh University:

Carter, Adrian. Feeding behaviour and micro-habitat distribution of waders on rocky shores, especially in East Lothian (MPhil study).

Cresswell, Will. Behaviour and ecology of a predator-prey system: Sparrowhawks and Redshanks, concentrated on Tynninghame, East Lothian (PhD study).

Deag, John. Studies on communication and social organization in tits, with field work mainly at Ormiston, East Lothian (PhD study).

Hanna, Laurel. Barn Owl population genetics (PhD study).

McAfferty, Dominic. Ecological energetics of Barn Owl (PhD study).

Scott, Graham. Social behaviour and communication in Blue Tits (PhD study).

Taylor, Iain. Long-term study (started 1978) of Barn Owl ecology and conservation. Has been monitoring, since 1980, changes in Lapwing breeding density in relation to agriculture.

Glasgow University

Askew, C. Survival rates and ecology of Great Skuas on Handa: comparison of a small and expanding population with the large decreasing one on Foula.

Austin, G. The ecology of Buzzards in Argyll in relation to land use (PhD study).

Barber, I. Breeding performance of seabirds on Handa in relation to industrial fishing development (MSc study).

Bolton, M. Energetic costs of breeding in Storm Petrels.

Calvo, B. Effects of agricultural land use on the breeding ecology of waders (PhD study).

Calvo, B. & Furness, R.W. Endosteal lamellae in bird bones as a means of estimating the age of dead adult birds.

Cohen, B.L., Wildon, R.H., Furness, R.W. & Willcox, S. Molecular studies of skua DNA to assess the evolutionary history of skuas.

Crompton, D.W.T. & Huntingford, F.A. Profilicollis botulus: an Eider Duck parasite in the Clyde Estuary.

Ensor, K. Breeding season diets of Great Skuas and gulls in relation to the activities of the whitefish fisheries around Scotland.

Furness, R.W. Seabird interactions with fish stocks and fisheries, birds as monitors of environmental change, long term monitoring of seabird ecology on Foula, Shetland (since 1971), seabird energetics, body composition and moult.

Furness, R.W, Hamer, K.C., Klomp, N.I. & Ratcliffe, N. Ecology of Great Skuas on Foula, Shetland: long term studies begun in 1960s.

Hansell, M.H. A comparative study of nest building behaviour in birds.

Horn, W. Diet selection and foraging economics in breeding terns (PhD study).

Houston, D.C. Food quality and breeding performance in Blue Tits.

Klomp, N.I. & Furness, R.W. Recruitment of immature Great Skuas into breeding colonies (comparative work with Professor E.C. Young, University of Auckland, in southern hemisphere skuas).

Macedo, E. Effects of fisheries on seabird numbers: and assessment of net mortality and fishery-induced changes in food availability (MSc study).

Madders, M. Hen Harrier ecology, especially their use of forestry plantations (PhD study).

Metcalfe, N.B. Social behaviour and ecology of flocking birds: reproductive ecology of Pied Flycatchers.

Monaghan, P. Population ecology of gulls.

Monaghan, P., Burns, M. & Walton, P. Reproductive strategies in Black Guillemots.

Monaghan, P., Burns, M., Uttley, J.D., Walton, P. & Austin, G. Effect of prey availability on reproductive and foraging strategies in Shetland seabirds.

Monteiro, L. Heavy metal accumulation by petrels and shearwaters (PhD study).

Muda, F. Nest material stealing in Shags (PhD study).

Phillips, R. Population ecology of Arctic Skuas in relation to climate and variations in numbers and reproductive success of the species they rob of fish (PhD study).

Purton, M.D. & Solomon, E.E. Eggshell formation in cage birds.

Ratcliffe, N. Reproductive effort of Great Skuas of known ages from 4 to 30 years old: a test of predictions of life history theory (PhD study).

Selman, R. The role of female body condition on egg production in birds (PhD study).

Smith, R.D. Dispersal and behaviour of over-wintering Snow Buntings (PhD study).

Solomon, S.E. Comparative study of the ultrastructure of eggshell formation in birds.

Stewart, R.M. Uptake, storage and excretion of cadmium and lead by birds and an assessment of birds as monitors of cadmium and lead pollution (PhD study).

Thomas, C. The ecology of Ravens in relation to land use (PhD study).

Thomson, D.L. Energetics and ecology of Kittiwakes (PhD study).

Thompson, D.R. & Furness, R.W. Analysis of stable isotope ratios of nitrogen, carbon and other elements in feathers of seabirds as a means of assessing their trophic relationships in marine ecosystems and changes in diet of the last 150 years.

Walsh, P.M. Feeding ecology and mercury burdens of Gannets (PhD study).

Williams, J. Birds as possible carriers of Lyme disease (PhD study).

Zonfrillo, B. Breeding ecology of seabirds on Ailsa Craig (PhD study).

Institute of Terrestrial Ecology, Banchory:

Bacon, P.J. & Palmer, S.C.F. (Oxford). Investigation and modelling of habitat utilisation by Red Grouse.

Harris, M.P. & Nuttall, P. The importance of tick-borne diseases on seabird populations.

Harris, M.P., Halley, D. (St Andrews) & Wernham, C. (Stirling). Long-term studies of numbers, survival, productivity and for some species, recruitment and body condition, of seabirds on the Isle of May in relation to food availability and environmental conditions.

Marquiss, M., Carss, D. & Alexander, G. Does Goosander and Red-breasted Merganser predation have an impact on salmon populations.

Moss, R., Parr, R., & Trenholm, I. Population regulation in Red Grouse. Roles of behaviour, dispersal and predation in determining population size.

Moss, R., Picozzi, N. & Catt, D.C. Studies of habitat requirements, dispersal, numbers and distribution of Capercaillie; particularly the use made by Capercaillie of commerical woodland.

Parr, R. A study of population size and productivity of moorland waders and Red Grouse in relation to afforestation.

Wanless, S., Harris, M.P. & Hector, J.A.L. Reproductive and foraging energetics of Shags with particular emphasis on the influence of food availability and feeding habitat.

Joint Nature Conservation Committee: Seabirds Team, Aberdeen

Mark Tasker, head of Seabird Team.

Paul Walsh, Seabirds Colony Register - collates counts of seabirds at colonies throughout the U.K.

JNCC Seabirds at Sea Team (SAST). Studies the distribution of seabirds in the offshore waters around Britain throughout the year. Staff: Andy Webb (leader), Carolyn Stone (marine biologist), James Williams (data manager), Tim Barton and Ian Gordon (ornithologists).

Ian Carter, North Sea Database - compiling database of seabirds in the North Sea using data from seven countries bordering the North Sea.

The Royal Society for the Protection of Birds:

The RSPB undertakes extensive research into all aspects of birdlife. The following projects with particular Scottish interest are listed in order of topics and species involved. Staff and researchers involved are given in brackets. Further details may be had from the RSPB HQ, who produce an annual Project Register, which also gives details of projects on reserves ecology, too numerous to list here.

Fisheries statistics. Review of fisheries statistics, for countries fishing in EC waters (1992-93 J. Sears, S. Curran).

Changes of Distribution of breeding birds (with BTO), using data gathered by the BTO atlas projects (1991-94 K.W. Smith, D. Gibbons BTO).

Individual distinct bird calls. Investigation into the effectiveness of using call and song. Species include Bittern, Black-throated Diver and Corncrake (K.W. Smith, P. McGregor, G. Gilbert University of Nottingham PhD study 1990-93).

Orkney and Shetland seabirds. Monitoring numbers, breeding success and body condition to contribute to the debate on the future of sandeel fishing and RSPB marine policy (1992-93 J. Sears, D. Suddaby, I. Sim).

The effect of loch quality on the breeding productivity of Black-throated Divers and Slavonian Grebes (1992-95 R.W. Summers, D. Jackson).

Loch Gruinart: Goose counting, reseeding and goose usuage experiments (M. Peacock, J. Fleming, I. Bainbridge, G. Hirons, C. Evans, J. Welstead, S. Percival Durham University PhD Study 1992-95).

Osprey population dynamics (1992-93 R.W. Summers/R.H. Dennis consultant).

Causes of poor breeding success in White-tailed Eagle with JNCC. (1992 R.E. Green, K.W. Smith, A. Hughes).

Golden Eagle home range use. Investigation of use of habitat by radio-tagged Golden Eagles; relating habitat use to prey abundance, cover and topography (1991-95 R.E. Green, M.J. Mcgrady, J. Grant).

Merlins and land cover. Relating spacing, occupancy and breeding success at known Merlin sites to surrounding vegetation and topography through airphoto interpretation (1992-93 R.E. Green, R.W. Summers, G. Rebecca).

Breeding success and habitat selection of Capercaillie, especially at the Abernethy reserve (1991-93 R.W. Summers/R. Proctor).

Survey and monitoring of Capercaillie populations (with ITE, Game Conservancy, SNH and Forestry Commission) (1991-94 R.E. Green).

Impact of mowing on Corncrake survival and productivity (with Irish Wildbird Council Project to estimate the effect of mowing at different times of year, at different mowing speeds and patterns (1992-95 R.E. Green, G.A. Tylor).

Lowland breeding waders in Scotland and Northern Ireland. A joint project with SOC. Designed to be repeatable (1992-94 R.E. Green, K.W. Smith, M. O'Brian).

Red-necked Phalarope ecology. Identification of habitat requirements, particularly those susceptible to management (1992-95 R.E. Green, M. O'Brian).

Orkney and Shetland skua survey to assess Arctic and Great Skua population changes since previous surveys (1992-93 J. Sears, P. Ellis, E. Meek, D. Suddaby, I. Sim, H. Harrop, A. Williams, D. Steel, C. Whyte, R. Ribbands, RSPB and SNH wardens).

Roseate Terns. A study to monitor the breeding range of the eastern Atlantic population, to identify its wintering range, and to study threats to the species. (1988-1994 A.J. del Nevo).

Nightjar survey (1991-92), using amateur and professional fieldworkers, to count and map all Nightjars breeding in the UK, and to assess their requirements by detailed habitat measurements.

Numbers of Crested Tits, Crossbills and Capercaillie in Highland pine woods to determine relative abundance, densities and tree preference (1992-95 R.W. Summers, G. Rebecca).

Second international Chough survey (with Irish Wildbird Council, JNCC, Manx Chough Project and others). To estimate 1992 population in Ireland and Britain by a full survey (R.E. Green).

St Andrews University

Adhikerana, A.S. Singing behaviour in Coal Tits (PhD study 1988-92).

Graves, J.A. & Ortega-Ruano, J. Mating and reproductive success in Shags on the Isle of May.

Halley, D. A study of recruitment in Guillemots on the Isle of May (PhD study 1988-92).

Povey, Fiona & Jones, Alex. Aspects of song development in Zebra Finches in the laboratory (PhD studies).

Slater, P.J.B. Field and laboratory studies on the development and organisation of bird vocalisations.

Scottish Natural Heritage:

SNH is involved in a wide range of work on birds. Much of this is currently contracted out to other organisations, and some is managed on its behalf by the Joint Nature Conservation Committee (JNCC). Names of individual workers are not attached to the following list, although the key organisations involved are given, as is the apporopriate contact person in SNH or JNCC. The first contact points for further information on these projects and other aspects of SNH's work on birds are Greg Mudge (agricultural/lowland birds) and Philip Whitfield (upland/peatland birds). Topics are given in order of the species involved.

International site designations: review and assessment of bird numbers and distributions with respect to Special Protection Areas and Ramsar sites. JNCC. (Greg Mudge/Philip Whitfield/Colin Galbraith, JNCC).

Services in ornithology. Including the Birds of Estuaries Enquiry; national bird ringing scheme; integrated population monitoring; monitoring birds of prey; monitoring of wetland birds; special surveys; habitat management research. JNCC/British Trust for Ornithology. (Greg Mudge/Colin Galbraith, JNCC).

Monitoring of rare British breeding birds. JNCC/Rare Breeding Birds Panel. (Greg Mudge/David Stroud, JNCC).

Conservation of vulnerable and dispersed species. Measures to protect birds outside protected areas in line with UK responsibilities under the EC Birds Directive. JNCC. (Colin Galbraith, JNCC).

Services in wildfowl research, including the National Waterfowl Count scheme. JNCC/Wildfowl and Wetlands Trust. (Greg Mudge/David Stroud, JNCC).

Conservation plans for migratory wildfowl under the Bonn Convention and Ramsar Convention. JNCC/International Wildfowl and Wetland Research Bureau. (David Stroud, JNCC).

Moorland bird surveys; techniques and ecology. (Des Thompson/Andy Brown, English Nature).

Moorland changes and influences on birds in the Northern Isles. (Angus MacDonald/Des Thompson).

Population ecology and conservation of montane birds, notably Dotterel, Ptarmigan and Snow Bunting. Philip Whitfield/Des Thompson).

Seabird colony register, Maintenance of a database of counts of seabird colonies. JNCC/Seabird Group. (Mark Tasker, JNCC).

Seabird monitoring programme. Annual monitoring of breeding success at seabird colonies. JNCC/RSPB/SOTEAG. (Mark TAsker, JNCC).

Seabirds at sea programme, phase 4. JNCC. (Andrew Webb, JNCC).

Monitoring of Black-throated Divers. With RSPB. (Greg Mudge).

Goose monitoring on Islay, Long-term monitoring of the numbers and feeding distribution of Greenland White-fronted and Barnacle Geese. With the Wildfowl and Wetland Trust. (Greg Mudge/David Stroud, JNCC).

Comparative feeding ecology of predatory birds. Glasgow University. (Des Thompson/Colin Galbraith, JNCC).

Re-introduction of Sea Eagles. Monitoring of the re-introduction population. With RSPB and JNCC. (Greg Mudge/Mike Pienkowski, JNCC).

National survey of Golden Eagles. To update the results of the previous survey carried out in 1982-83. Joint project with RSPB and the Scottish Raptor Study Groups. (Philip Whitfield).

Red Kite re-introduction: national and international co-ordination. JNCC/RSPB. (Greg Mudge/Colin Galbraith, JNCC).

Effects of predators on Red Grouse and moorland waders in southern Scotland. Institute of Terrestrial Ecology. (Philip Whitfield).

Past ecology of Ptarmigan in south Scotland. (Philip Whitfield).

Capercaillie: status and habitat needs. Joint contract with RSPB to the Institute of Terrestrial Ecology. (Greg Mudge).

Philopatry, fidelity, mating/social systems and conservation in waders (Philip Whitfield/Des Thompson).

Long term study of Greenshanks in NW Scotland. (Des Thompson).

Population trends of gulls and other seabirds on the Isle of May. Institute of Terrestrial Ecology. (Mark Tasker, JNCC).

Co-existence on moorland passerines. A study of the effects of heather/bracken patchiness on the inter-relationship of breeding Meadow Pipits, Skylarks and Whinchats. University of York. (Des Thompson).

Ecology and conservation of Pied Fly-catchers in NW England. Leicester University. (Des Thompson).

Ecology of Corn Buntings on the Outer Isles. Leicester University. (Des Thompson).

Stirling University:

Alves, Marie-Alice. Behavioural ecology of Sand Martins (PhD study).

Bell, Mike. Wildfowl counts. Breeding wader surveys. Raptor monitoring.

Bryant, David. Energy requirements of wild birds. Populations and ecology of estuarine birds (especially Forth). Hirundine and Dipper breeding ecology.

Jalil, Sari A. Effects of land use changes on waterfowl populations. A study based on freshwater lochs in central Scotland (PhD study).

Johnstone, Ian. Territorial behaviour in Robins and Dippers (PhD study).

Hashim, Rosli. Ecology and energy requirements of Great Tits in summer and winter (PhD study).

Ward, Sally. Egg laying and incubation behaviour in Swallows and Dippers (PhD study).

Wernham, Christine. Breeding ecology of Puffins (with ITE Banchory – PhD study).

Items of Scottish Interest

Most of the following papers and reports on birds in Scotland are available in the Waterston Library at 21 Regent Terrace for reference, and include all that have come to notice in the period March to August 1992 (the most recent list of items of Scottish interest was in SB 16(3): 226-228). We would be glad to learn of anything that has been missed, and to receive reprints or copies of papers on any aspect of ornithology or natural history.

Bird reports marked with an asterisk are available from the SOC at the prices quoted, but please add 50p for postage and packing.

Scientific papers

Aebischer, N.J. & Wanless, J. 1992. Relationships between colony size, adult non-breeding and environmental conditions for Shags on the Isle of May, Scotland. *Bird Study* 39: 43-52.

Baines, D. & Aebischer, N.J. 1992. Black Grouse: the effects of predator control and vegetation cover. *Game Conservancy Review* of 1991: 98-101.

Booth, C.J. & Reynolds, R. 1992. Crossbill eating slug. *British Birds* 85: 245-246. Strange Orkney habits.

Cobley, N. & Moss, R. 1992. Numbers and breeding success of Capercaillie in 1991. *Game Conservancy Review* of 1991: 102-103.

Corse, C. 1992. Wader studies in Orkney. *Wader Study Group Bulletin* 64: 37-39.

Craik, J.C.A. & Becker, P.H. 1992. Temporal and spatial variations in body-weights of Common Terns and Arctic Terns. *Seabird* 14: 43-47.

Danchin, E. 1992. Food shortage as a factor in the 1988 Kittiwake breeding failure in Shetland. *Ardea* 80: 93-98.

Danchin, E. 1992. The incidence of the tick parasite *Ixodes uriae* in Kittiwake colonies in relation to the age of the colony, and a mechanism for infecting new colonies. *Ibis* 134: 134-141. Based on studies in three breeding areas including the Isle of May.

Dickson, R.C. 1992. Feeding groups of Common Scoter containing other species. *British Birds* 85(1): 35-36.

Dowell, A. & Shaw, G. 1992. Barn Owls and Tawny Owls nesting close together. *British Birds* 85(7): 379. An unusual occurrence in southwest Scotland.

Elkins, N. 1992. Herring Gull using wind shear over land. *British Birds* 85(1): 36-37. Unusual means of progression over Fife airfield.

Ewins, P.J. 1992. Growth of Black Guillemot chicks in Shetland in 1983-84. *Seabird* 14: 3-14.

Furness, R.W. & Aitken, A. 1992. Breeding success of seabirds on Handa Island, Sutherland in 1991. *Joint Nature Conservation Committee Report* no. 48, 6 pp.

Furness, R.W., Ensor, K. & Hudson, A.V. 1992. The use of fishery waste by gull populations around the British Isles. *Ardea* 80: 105-114. A study mainly in Scottish waters.

Grant, M.C. 1992. The effects of re-seeding heathland on breeding Whimbrel in Shetland. Pt. 1. *J. Appl. Ecol.* 29: 501-508.

Grant, M.C., Chambers, R.E. & Evans, P.R. 1992. The effects of re-seeding heathland on breeding Whimbrel in Shetland. Pts. 2 & 3. *J. Appl. Ecol.* 29: 509-523.

Harris, M.P. 1991. Isle of May seabird studies in 1991. *Joint Nature Conservation Committee Report* no. 18, 21 pp.

Harris, M.P. & Bailey, R.S. 1992. Mortality rates of Puffin and Guillemot and fish abundance in the North Sea. *Biol. Conserv.* 60: 39-46. A study on the Isle of May.

Harvey, P.V. & Orsman, C.J. 1991. Fair Isle seabird monitoring scheme: report to JNCC of sixth season's work in 1991. *Joint Nature Conservation Committee Report* no. 22, 64 pp.

Hudson, P. 1992. Upland ecology. *Game Conservancy Review* of 1991: 92-97. A short survey of the Conservancy's work on Red Grouse in 1991.

Klomp, N.I. & Furness, R.W. 1992. Non-breeders as a buffer against environmental stress, declines in numbers of Great Skuas on Foula, Shetland, and prediction of future recruitment. *J. Appl. Ecol.* 29: 341-348.

Livingstone, I. & Morton, R. 1992. Recoveries

of Sanda Guillemots and Razorbills. *Seabird Group Newsletter* 62: 11-12.

Marquiss, M. & Feltham, M.J. 1991. Predation of juvenile salmon by Red-breasted Mergansers. *Inst. Terrestrial Ecol. Ann. Rep.* for 1990-91.: 44-46.

Monaghan, P., Uttley, J.D. & Burns, M.D. 1992. Effect of changes in food availability in reproductive effort in Arctic Terns. *Ardea* 80: 71-81. A study in Shetland.

Okill, J.D. 1992. Natal dispersal and breeding site fidelity of Red-throated Divers in Shetland. *Ringing and Migration* 13: 57-58.

Okill, J.D., Fowler, J.A., Ellis, P.M. & Petrie, G.W. 1992. The diet of Cormorant chicks in Shetland in 1989. *Seabird* 14: 21-26.

Orchel, J. & Shawyer, C. 1992. Barn Owl conservation in southwest Scotland in 1990. *Raptor* 19: 17-18.

Parr, R. 1992. The decline to extinction of a population of Golden Plovers in north-east Scotland. *Orn. Scand.* 23: 152-158.

Percival, S.M. & Houston, D.C. 1992. The effect of winter grazing by Barnacle Geese on grassland yields on Islay. *J. Appl. Ecol.* 29: 35-40.

Redpath, S.M. 1992. Behavioural interactions between Hen Harriers and their moorland prey. *Orn. Scand.* 23: 73-80. Study areas were Speyside and Perthshire moorlands.

Riley, S.J. 1992. Purple Sandpipers feeding inland outside breeding season. *British Birds* 85(5): 241. Seen on South Uist.

Smith, R.D. 1992. Age determination, wing-feather colour and wing-length changes in Snow Buntings. *Ringing and Migration* 13: 43-51. A study at five inland sites in northeast Scotland.

Spray, C.J. 1991. Population dynamics of Mute Swans in the Outer Hebrides, Scotland. *Wildfowl Supplement* no.1: 143. (Abstract only).

Swann, R.L. 1991. Canna seabird studies in 1991. *Joint Nature Conservation Committee Report* no.19, 9 pp.

Uttley, J.D. 1991. Food supply and allocation of parental effort in Arctic Terns. *Ardea* 80: 83-91. A study in Shetland and Orkney.

Wanless, S. 1992. Effects of tail-mounted devices on the attendance behaviour of Kittiwakes during chick rearing. *J. Field Orn.* 63: 169-176.

Wilson, J.D. 1992. A probable case of sexually selected infanticide by a male Dipper. *Ibis* 134: 188-190. A detailed study of a case of egg destruction.

Wyllie, I. & Newton, I. 1991. Demography of an increasing population of Sparrowhawks. *J. Anim. Ecol.* 60: 749-766. Compares the recent recolonisation in east-central England with the stable or decreasing populations in southern Scotland, and discusses causes.

Bird Reports

Argyll Bird Report no. 8 for 1991. S.J. Petty (ed) 1992. 67 pp. A 49 pp systematic list and short papers on Barn Owls on Islay, Buzzard eyries on Colonsay, and Greylag Geese on Coll and Tiree. * £3.50.

Arran Birds in 1991. M.H. Dunn & T. ap Rheinallt (eds) 1992. 21 pp. This is the 12th bird report published for the Isle of Arran Natural History Society. It includes a special report on the Lesser Whitethroat in Arran. Available from Tristan ap Rheinallt, Ashgrove, Pirnmill, Isle of Arran KA27 8HP. £1.50.

Ayrshire Bird Report for 1991. Angus Hogg (ed) 1992. 57 pp. A systematic list, and special articles on Garnock Estuary shorebirds, the Black-throated Diver in Ayrshire, Kestrels, waders and wildfowl. * £2.75.

Dumfries and Galloway Region Bird Report for 1991. Paul Collin (ed) 1992. 34 pp. * £2.00.

Fair Isle Bird Observatory Report for 1991. P. Harvey & V. Thom (eds) 1992. 76 pp. Includes a 25 pp systematic list and several short articles. * £3.50.

Islay Bird and Natural History Report for 1991. M. Ogilvie (ed) 1992. * £1.50.

Isle of May Bird Observatory Report for 1990. Ian Darling (ed) 1992. 48 pp. Includes a migration summary and a ringing report. * £3.00.

Moray and Nairn Bird Report for 1991. Martin Cook (ed) 1992. 69 pp. * £2.75.

Orkney Bird Report for 1991. C. Booth, M. Cuthbert & E. Meek (eds) 1992. 78 pp. Includes a short report from the North Ronaldsay Bird Observatory, and four short articles. * £2.50.

Outer Hebrides Bird Report for 1991. T. Dix & P. Cunningham (eds) 1992. 88 pp. This is the second bird report in a new detailed format, published by the Outer Hebrides Ornithologists' Group. The 67 pp

systematic list includes bird records from St Kilda, and there is a special report on the spring passage of Skuas off Balranald. * £4.00.

Perthshire (Central and Southwest) Peregrines and Ravens in 1991. P. Stirling-Aird 1992. a 3 pp unpublished report in a long-running series.

Shetland Bird Report for 1991. K. Osborn (ed) for the Shetland Bird Club 1992. 104 pp. Includes six special articles and four pages of colour photographs.

William G. Harper
Librarian, Waterston Library

European journals in the Waterston Library

The following selection of articles appeared in European journals received in the Waterston Library between April and September 1992, and thus follows on the list published in Vol 16 No 3. Articles are arranged in species order; square brackets indicate that the article is in the original language, other articles being in English. The reference, abbreviated for reasons of space, indicates merely the journal, its number and year of publication. Journals quoted are as follows:

Netherlands:	*Ardea, Limosa, Dutch Birding*
France:	*Alauda, L'Oiseau*
Switzerland:	*Nos Oiseaux, Der Ornithologische Beobachter*
Belgium:	*Aves, Mergus*
Germany:	*Die Vogelwelt, Limicola, Corax, Journal für Ornithologie, Seevögel*
Austria:	*Egretta*
Italy:	*Rivista Italiana di Ornitologia*
Spain:	*Ardeola*
Sweden:	*Vår Fågelvärld, Ornis Svecica*
Norway:	*Vår Fuglefauna, Cinclus*
Denmark:	*Ornis Scandinavica, Dansk Ornitologisk Forenings Tidsskrift*
Finland:	*Ornis Fennica, Lintumies*

Divers to Ducks:

Iborra, O. *et al.* [Wintering of Black-necked Grebe on the Étang de Berre, S.E. France] – *Alauda* 4/91.

Debout, G. [Use of resting places and roosts by Cormorants in the non-breeding period] – *L'Oiseau* 1/92.

Frederikson, M. [Breeding population of Grey Heron in Denmark 1991] - *Dansk Orn. For. Tidsskr.* 1-2/92.

Struwe, B. & Nehls H-W. [Results of the International Waterfowl Count on the Baltic coast of Germany January 1990] – *Seevögel* 2/92.

Follestad, E. [Census of Greylag Geese in Norway Autumn 1991] - *Vår Fuglefauna* 2/92.

Persson, H. [Impact of shooting on breeding populations of Greylag Geese] - *Limosa* 2/92.

Gauter, B. [Numbers and distribution of Barnacle Geese on North Sea coast of Germany] - *Corax* 1/92.

Ebbinge, B.S. Regulation of numbers of Dark-bellied Brent Geese on Spring staging sites - *Ardea* 2/92.

Grussu, M. & Meloni, R. [The Ruddy Duck in Europe and its first occurrence in Italy] - *Riv. It: di Orn.* 1-2/91.

Birds of Prey:

Bavoux, C. *et al.* [Variations in juvenile plumage in Marsh Harriers in Charente Maritime] – *Alauda* 4/91.

Forsman, D. [Ageing and sexing of Rough-Legged Buzzards] - *Lintumies* 1/92.

Jenny, D. [Reproduction and regulation of density in an Alpine population of Golden Eagles] - *Orn. Beob.* 1/92.

Steen, O.F. [The Peregrine in S.E. Norway 1990/91] - *Vår Fuglefauna* 1/92.

Kéry, M. [Resistance of Peregrine eggs and chicks to prolonged absence of adults] - *Nos Oiseaux* 5/92.

Grouse to Cranes:

Renard, F. [The behaviour of Black Grouse attacked by Hen Harriers on lekking areas] - *Aves* 2-3/91.

Willebrand, T. Breeding and age in female Black Grouse - *Orn. Scand.* 1/92.

Waders to Auks

Girard, O. [Migration of waders in Continental France] - *Alauda* 1/92.

Barbosa, A. [Identification key to European waders on the basis of cranial morphology] - *Ardeola* 2/91.

Pulliainen, E. & Saari, L. Breeding biology of the Dotterel in Eastern Lapland - *Orn. Fenn.* 2/92.

Gebauer, E. & Nadler, T. [Behaviour and voice of Lesser Sand Plover] - *Limicola* 3/92.

OAG Münster & OAG Schleswig-Holstein [Numbers of Ruff on migration in Germany 1990] - *Vogelwelt* 3/92.

Achtermann, S. [Identification of Lesser and Greater Yellowlegs] - *Limicola* 2/92.

Blokpoel, H. *et al.* Population dynamics of Lari in relation to food resources (Proceedings of an international workshop) - special issue of *Ardea* 1/92.

Mierauskas, P. & Greimas, E. Taxonomic status of yellow-legged Herring Gulls in the Eastern Baltic - *Dutch Birding* 3/92.

Kilpi, M. *et al.* Change in clutch size in the Arctic Tern in the Northern Baltic - *Orn. Fenn.* 2/92.

Skov, H. *et al.* [Distribution and numbers of Guillemots in the Skagerrak in late summer] - *Dansk Orn. For. Tidsskr.* 1-2/92.

Lust, P. [Influx of Little Auks on coast of Flanders 1990-91] – *Mergus* 4/91.

Pigeons to Woodpeckers:

Schulze-Hagen, K. [Parasitism and egg losses due to Cuckoo in Reed and Marsh Warblers in Central and Western Europe] - *Jour. für Orn.* 3/92.

Michelat, D. & Giraudoux, P. [Nocturnal activity of Barn Owl and hunting strategy at nest site] - *Alauda* 1/92.

Schaden, G. [Influence of early experience on choice of nest site by Barn Owl] - *Egretta* 1/92 (special edition devoted to owls and diurnal raptors)

van Manen, W. [Selection of territory and nest site by Long-eared Owls] - *Limosa* 1/92.

Hansson, L. Requirements of Great Spotted Woodpecker for a suburban life - *Orn. Svec.* 1/92.

Virkkala, R. [Distribution of White-backed Woodpecker in Finland 1990-91] - *Lintumies* 3/92.

Passerines:

Ullman, M. [The Shore Lark] - *Vår Fågelvärld* 3/92.

Mild, K. [The Thrush Nightingale and Nightingale] - *Vår Fågelvärld* 4/92.

Königstedt, D.G.W. *et al.* [Field identification of Isabelline Wheatear] - *Limicola* 1/92.

Königstedt, D.G.W. & Robel, I.D. [The Isabelline Wheatear in the Balkans] - *Limicola* 1/92.

Schulze-Hagen, K. *et al.* [Reed and Marsh Warblers in the same habitat: laying time, clutch size and breeding success] - *Vogelwelt* 2/92.

Folvik, A. Norwegian records of Yellow-browed Warbler - *Cinclus* 2/92.

Järvinen, A. Spatial pattern of nest-box occupancy by the Pied Flycatcher in mountain birch forest - *Orn. Fenn.* 1/92.

Grimsby, A. & Roer, J.E. [Colonisation of Norway by Lesser Redpoll 1962-91] - *Cinclus* 2/92.

de Souza, J.A. [The Snow Bunting in the Iberian Peninsula] - *Ardeola* 2/91.

Jukema, J. & Fokkema, J. [Origin of Snow Buntings wintering in the Netherlands] - *Limosa* 2/92.

Michael Murphy

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Reference should be made to recent issues of *Scottish Birds* for guidance on style of presentation, use of capitals, form of references, etc. **Papers should be typed on one side of the paper only, double-spaced and with wide margins; two copies are required and the author should also retain one.** Headings should NOT be underlined, nor typed entirely in capitals. Scientific names in italics should follow the first text reference to each species and should follow Voous' 'List of Recent Holarctic Bird Species' as given in *The British Birds' List of Birds of the Western Palearctic* (1984).

Only single quotation marks should be used, and numbers one to ten should be written out whereas 11 and above should be written as numerals. Dates should be written: ..... on 5 August 1991 ..... but on the 5th (if the name of the month does not follow). Please note that papers shorter than 700 words will be treated as Short Notes where all references should be incorporated into the text, and not listed at the end, as in full articles.

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

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

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