ERRATUM Scottish Birds Vol 17.2 : The caption for the winning photograph in the SOC 1993 Photographic Competition should read **Sooty Shearwater** and not Manx Shearwater. Apologies to Mary MacIntyre for this error.

SCOTTISH BIRDS

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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 0930 to 1630). 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

D.B.A. THOMPSON AND D.P. WHITFIELD

Research on mountain birds and their habitats

This report summarises some of the progress to date on SNH-funded research on montane (high mountain) ecology, notably on the population ecology and conservation of Dotterel *Charadrius morinellus*.

Montane habitat in the UK

Whilst Ratcliffe (1977) provides a good working definition of the two major upland zones in the UK – montane (above the former tree-line) and sub-montane (below the tree-line down to the upper limits of enclosed farmland) – Ratcliffe & Thompson (1988) first described their international significance. The montane zone characteristically begins at 700m, but at as low as 300-400m in north-west Scotland. It is marked by the dwarf-shrub heaths, notably heather *Calluna vulgaris*, becoming prostrate with exposure, and by increasing prevalence of small herbs, mosses and lichens (Thompson & Brown 1992). The sub-montane areas were predominantly tree-clad until perhaps only 200-400 years ago in some regions but the montane zone has not held trees for at least seven thousand years and so is much more natural. The distinction between these two zones is important. Whereas the complex montane ecological inter-relationships are in many respects natural, fragile and sensitive to environmental change, those in the more recently created sub-montane zone are founded on semi-natural, arrested successional habitats.

Thompson *et al.* (1987) and Thompson & Brown (1992) described the extent of the montane zone as comprising just over 3% of the GB land surface (12% of Scotland). Thompson & Brown (1992) quantified the habitat variability and plant community diversity throughout montane Britain. One of their findings was that the most extensive montane plant community, the *Racomitrium lanuginosum – Carex bigelowii* mossy dominated heath, is the single most extensive near-natural community on land in the whole of UK.

The assemblage of birds

Twenty-seven bird species use the montane zone in the UK, but only four are confined to it (Snow Bunting *Plectrophenax nivalis*, Ptarmigan *Lagopus mutus*, Dotterel *Charadrius morinellus* and the rare Purple Sandpiper *Calidris maritima*). Nineteen of these species breed in the arctic, and only those with arctic strongholds are restricted in the UK to the mountains (Galbraith *et al.* in press a; Ratcliffe 1990). This assemblage is internationally distinctive not least because the same combination of species is not found elsewhere. Two species have their highest recorded breeding densities in the Scottish Highlands: Dotterel (Galbraith *et al.* in press b, Thompson and Whitfield, in press), and Ptarmigan (Watson 1965). There have been a few breeding records of other arctic birds in Scotland, such as Lapland Bunting *Calcarius lapponicus*, Shorelark *Eremophilia alpestris* and Snowy Owl *Nyctea scandiaca*, but recently such records have been scarce.

Our work on the montane birds forms part of a wider study of montane ecology and aims to examine the reasons underlying differences between mountain tops in the composition of bird communities, and differences in their diet and habitat use.

Habitat preferences

Montane plant communities are complex, and the variables of altitude, exposure, wetness and snowlie contribute substantially to habitat mosaics that vary within mountains as well as between mountain

systems in the UK (eg. Ratcliffe 1977; Thompson & Brown 1992; Brown *et al.* in press), and Table 1 provides a coarse breakdown of the principal habitats used by breeding birds on three central Highland areas studied in detail. Some general rules emerge applying to the breeding birds: a) herbivorous birds prefer dwarf-shrub communities and montane bogs (with variable amounts of *Empetrum* spp.); b) springs, flushes, boulder fields and the exposed *Juncus trifidus* heaths are least preferred, particularly as nesting habitat, by most birds; c) the higher-altitude *Empetrum-Vaccinium* heaths are preferred slightly over the stunted *Calluna* heaths; d) the mossy summit heaths, *Empetrum – Vaccinium* heaths, and the boggy expanses are most preferred, and e) the springs and flushes have high value as brood rearing habitat for some species.

Such information is important for two reasons. First, if particular parts of mountains are at risk of development or change we need to know their importance for the birds, and the importance of their constituent habitats and communities, for the birds. Second, information on habitat-nesting/feeding bird relationships for individuals provides a springboard for a much more detailed assessment of species requirements. Little comparable quantitative information is available on habitat use for the majority of birds breeding in the British uplands (eg. Ratcliffe 1990; Haworth & Thompson 1990).

TABLE 1. Summary of habitat-use by the more regular breeding montane birds in the central Scottish Highlands. The species are ranked roughly in descending order of breeding density.

	Dwarf *Calluna* heaths	*Vaccinium-Empetrium* heaths	Mossy *(Racomitrium)* heaths	Exposed *Juncus trifidus* heaths	*Nardus* snowbed grass-lands	Montane bogs	Springs and flushes	Boulder fields
Ptarmigan (H)	(B)	B++	(B)	—	—	B+	—+	B
Dotterel (I)	(B)	(B)+	B+	B+	—	—	—	—
Meadow Pipit (I)	B	B+	(B)	—	(B)+	B	—	—
Golden Plover (I)	—	(B)+	B+	—	—	B+	—	—
Dunlin (I)	—	—	—+	—	B+	B+	—	—
Wheatear (I)	(B)	B+	(B)+	B+	—	—	—+	—
Skylark (I)	(B)	B+	(B)+	—	(B)+	B	—	—
Red Grouse (H)	B++	B+	—	—	—	(B)+	—	—
Snow Bunting (I)	—	—	—	—+	—	—	—+	B

Notes (H) = mainly herbivorous; (I) = feeds mainly on invertebrates

B = main breeding habitat where available, (B) less preferred breeding habitat, – not often used by breeding birds for nesting;
++ = major feeding habitat, + feeding habitat. NB Many birds feed in mosaics of these vegetation classes.

Source: Galbraith *et al.* (in press, a, c); Ratcliffe (1990); Watson (1965, 1979); Nethersole-Thompson & Nethersole-Thompson (1986); Thompson & Brown (1992); SNH (unpublished).

Population ecology and dynamics of Dotterel
We studied the Dotterel in close detail because, unlike the other regular montane specialists, it is listed on the *EC Directive on the Conservation of Wild Birds* (Directive 79/409/EEC). This obliges the UK government to protect the habitat needed to sustain UK (and therefore EC) populations of Dotterel (and other birds listed in the annexes of the Directive).

There were other reasons for our work, however. The Dotterel is one of the more widespread of the montane specialists and may be an important indicator of the 'health' of mountain environments. It is also one of only two regularly polyandrous species in the UK (female pairs and mates with more than one male), the other being the Dunnock *Prunellus modularis*. We were keen, therefore, to find out what affected the breeding success of each sex under such an unusual mating system. Prior to our project there were only clues as to what influenced breeding success, and there was virtually no information on movements by adults and chicks between mountain tops. There was even less on age of breeding, mate/site fidelity, estimated lifespan, or causes of death and dispersal (notably rates of immigration and emigration). We need to understand all of these factors in order to understand how Dotterel respond to the vagaries of their environment, including changes at the hand of man. Previous work on the species had yielded some important results but had been limited by insufficient time to make prolonged intensive observations as well as low numbers of individually marked birds (Nethersole-Thompson 1973; Nethersole-Thompson and

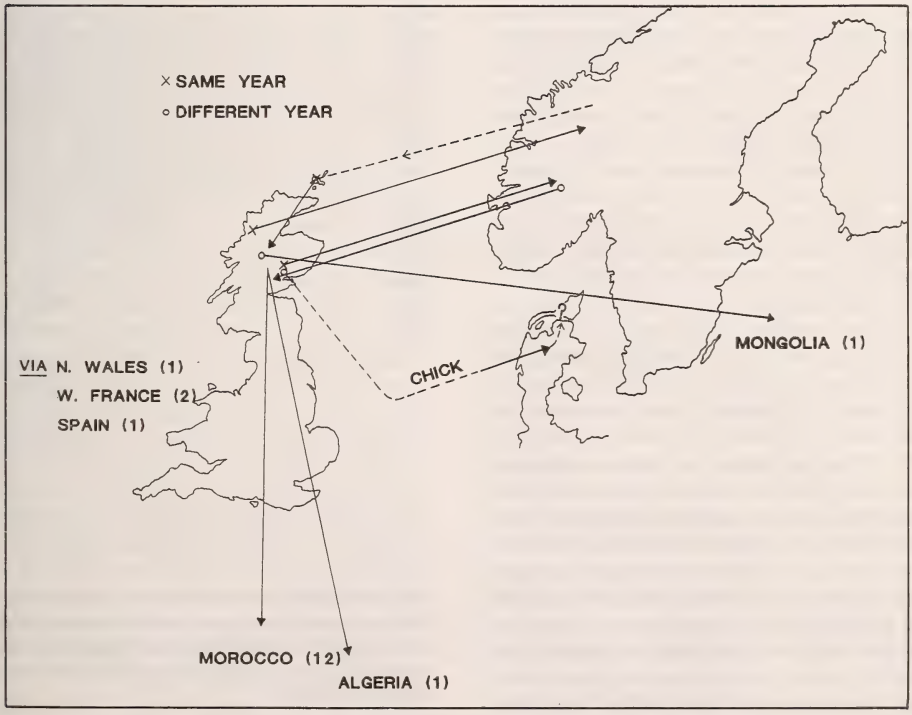

FIGURE 1. Examples of international movements by Dotterel ringed in Scotland.

Nethersole Thompson 1986; Watson 1988, 1989).

We established three intensive study areas, supplemented recently by two more, and several others which we visited less frequently (size range = 2-8km^2). By the early 1990s we had developed working methods. From early May to late August we plotted the arrival, habitat use, nesting distributions, individual fate of nests and broods, and movements of Dotterel (eg. Thomas *et al.* 1989; Galbraith *et al.* in press b, c). Most nesting males were individually colour-ringed, and the chicks were also ringed. We then searched the mountains for colour-ringed birds to build up a picture of movements.

The results show that some adults repeatedly return to the same hill to breed in different years whilst others move large distances between breeding attempts. As Fig. 1 shows, some individuals breed in both Norway and Scotland in different years as well as in the *same* year. There are also highly marked differences in productivity between mountain areas, with some being capable of exporting young birds to other hills as potential breeders whilst others appearing to act as 'sinks' for breeding birds (Fig. 2). On one hill, very few chicks return to breed whereas on others several chicks return, sometimes nesting within 50m of their fathers.

Males alone usually care for the eggs and chicks, and once the first males are incubating, the activities of the females are uncertain. Few females seem to remain on hills where they have laid their eggs and do not seem to return to their wintering grounds in Morocco earlier than the males. Do they fly on farther north-east, to Scandinavia, to breed with males that nest there later? This does seem possible because most observers in Scandinavia comment on the relatively high numbers of females (whilst males are on eggs or caring for chicks). Some females, however, remain to seek out males that have either lost their nests, deserted or arrived late.

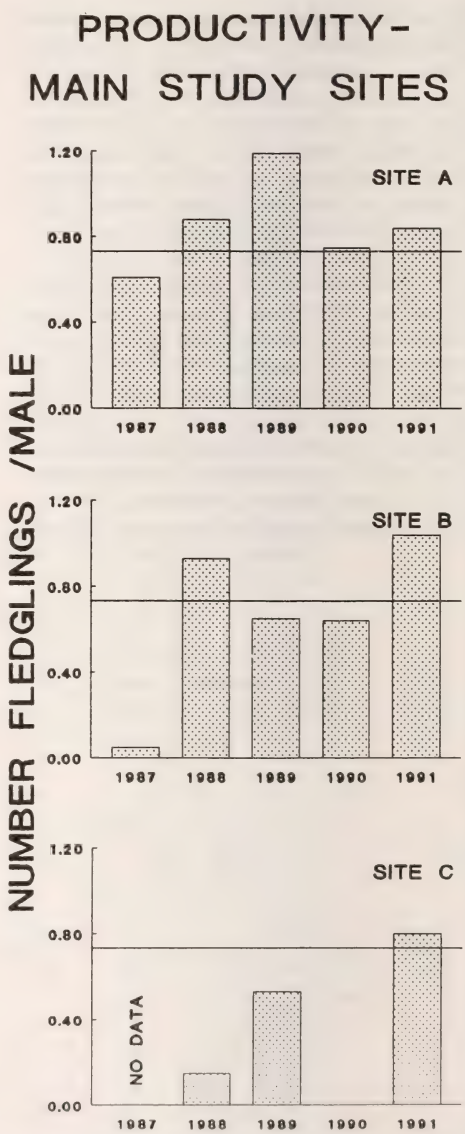

FIGURE 2. Differences in Dotterel productivity (fledged young: adult male ratio) between study areas. The horizontal line gives the productivity required to keep the population stable (calculated across all years).

Breeding success in Scotland has been affected primarily by weather and predation and, on some hills, by trampling of nests by sheep and red deer. At one site significant numbers of crows and gulls were attracted to the plateau. This site has a ski development and it is debateable to what extent the presence of many more people, brought to the tops by a chairlift, attracted birds. By taking Dotterel eggs, these predators have reduced the production of fledglings by almost 20%. At other sites, 20-25% of clutches have been trampled by sheep and/or deer. It was predominantly the later, less productive clutches that were trampled, however, so that there has been only some 10% reduction in the production of fledglings through trampling. Even so, if numbers of predators, sheep and deer were lower, then many more young Dotterel would be produced by the Scottish population.

A three-part paper in preparation by Whitfield *et al.* provides a story of ecological differences between mountains, years, seasons and individual birds (see also Owens 1991). We are also reviewing similarities and contrasts between the Scottish, Norwegian and Finnish situations, and also the links between the breeding birds and their North African wintering grounds.

A major challenge is to model both the dynamics of population change between different mountains and the key factors accounting for variation in productivity and dispersal. The resulting models should help predict future changes in status and distribution. For example, one of the main prey of Dotterel, the cranefly *Tipula montana*, exhibits a bi-annual pattern of emergence so that some plateaux have peaks in the early summer-swarms of craneflies every other year, but nearby plateaux may show peaks in different years. Their life-cycle seems to be tracked by migratory Dotterel, with flocks settling to exploit the large pre-emergence larvae that precede the hatch of adult craneflies every other year. With knowledge of the cranefly life-cycle we can predict which hills will be important each season.

Dotterel population size in the UK

We estimate that the UK population of Dotterel is at least 860 breeding 'pairs', with the vast majority in Scotland where there are about 1.7 pairs km^2 (Galbraith *et al.* in press b; Thompson and Whitfield, in press; Whitfield *et al.* 1991). This is considerably higher than previous estimates (e.g. 100-150 pairs by Nethersole-Thompson & Nethersole-Thompson 1986), but not so different from Watson & Rae's (1987) more accurate assessment of at least 600 pairs. Has the population increased? We believe that in some areas it has, perhaps with more birds destined for Norway stopping off to breed in Scotland *en route* from North Africa. More precipitation in Norway than previously has resulted in greater snowlie there (H.J.B. Birks pers. comm.), perhaps leading to more birds breeding in Scotland. But much more detailed research is needed on climate change and the Scotland-Scandinavia connection. In some areas, more intensive survey effort has simply resulted in more birds being seen.

The last national survey of Dotterel was in 1987-1988 covering just over 55% of all suitable habitat in GB. We plan to repeat this in a later year and to look, in particular, for colour-ringed birds. We need a much more complete picture of movements before the breeding season, and of the use made by roving birds of more than one mountain system both here and abroad.

Environmental changes and impacts

Whilst numbers of Dotterel are higher now than recorded at anytime this century, there is a big difference between the Scottish Highlands and the rest of montane UK. Way back in the mid-19th Century, records suggest a population of at least 50 pairs in north England and Wales (Ratcliffe 1990); now, there are fewer than ten pairs! Work on habitat composition suggests that the moss-dominated heaths preferred by

breeding Dotterel are becoming more grassy, especially in areas south of the Highlands (Thompson *et al.* 1987; Thompson & Baddeley 1991; Thompson & Brown 1992).

This may be due to increasingly severe grazing pressures from sheep, producing habitat conditions that gradually encourage grasses at the expense of mosses, and to rising acidic (notably nitrate) deposition close to industrial centres which may also benefit the grasses and raise soil acidification (see also Baddeley *et al.* in press). These changes will not benefit the food availability and nesting requirements of Dotterel, and may explain low densities in the south of the species' UK range. Pre-breeding flocks pass through north Wales, north England and south Scotland in late spring, but very few settle to breed there.

We are presently developing a new method for monitoring habitat change in montane areas. This method will contrast climate and human-induced changes throughout montane areas in the UK.

Conservation

The study has provided baseline information for three montane Special Protection Areas being proposed under the EC Birds Directive, and a further seven candidate sites are under consideration. A new National Planning Guideline on Skiing has been issued, and this has benefitted from what we have learned about Dotterel and their habitats. We have made numerous representations to the Cairngorms Working Party, which reports to the Secretary of State for Scotland in February 1993. We are pressing hard for reductions in grazing pressures from sheep and deer on the mountains where there have been serious losses of natural habitat diversity over the past 30 years. We also need to have a better understanding of why predators (crows, gulls and foxes) are more active on some hills than on others.

At the strategic level, we need a clear policy for these high mountain areas. This has to be sensitive to the highly individual nature of each mountain, but has to address land-use and management issues lower down the hill which impinge on the higher tops. The Countryside Commission for Scotland (1991) report marked an important start in this new policy making process.

The future

We have also studied Ptarmigan, Snow Bunting and montane invertebrate communities. We are establishing new study sites in the western and northern Highlands and want to see much more research in the montane areas of the southern uplands, north England and north Wales. This new work will focus more on Ptarmigan, and build on the studies of Dotterel and Snow Buntings. Rik Smith and Neil Metcalfe are studying the winter behavioural ecology of Snow Buntings and have found surprising differences between the small stock of birds destined to breed in the Cairngorms and the great majority of birds that breed in more northern countries (e.g. Smith in press).

Much more effort is being devoted to studying pressures from grazing and to the role of grazers, people and predators in affecting the invertebrate biota and breeding success of montane birds. Our work has left us unconvinced that the mounting numbers of hill walkers are having an adverse impact on montane wildlife, but this needs to be monitored. We need to contrast past and contemporary impacts of pollution and climate change on plant species and communities in order to assess what the future holds. Some of the communities are bound to respond rapidly to changes in growing season, snowlie and grazing pressures, not least because of the knife-edge ecological niches occupied. We already see smaller snowbeds and signs of more wind-related erosion. How will the birds and invertebrates react to this?

Over the next five years our success will be marked by how accurately we can predict responses in the montane habitat and its wildlife to environmental change, and the

priority attached by government to these special places.

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D.B.A. Thompson and D.P. Whitfield, Uplands and Peatlands Branch, Research and Advisory Services Directorate, Scottish Natural Heritage, 2 Anderson Place, Edinburgh EH6 5NP.
Contact: Des Thompson (Tel. 031-446 2419; Fax. 031-446 2405).

Research Progress Report

G.S. RIDDLE

A 20 year study of Kestrels in Ayrshire

In the early 1970s, enthusiasts were becoming organised into a group to monitor and protect the population of the Peregrine Falcon, *Falco peregrinus*, in the south-west of Scotland. The Peregrine, along with other raptors, had declined alarmingly in the previous two decades due to the now well documented effects of organochlorine pesticides. As well as taking part in the work on the Peregrine, I decided to study that neglected species, the Kestrel, *Falco tinnunculus*, and over the past 20 years have carried out fieldwork on it every year.

The initial aims were basic: to assess the impact of the pesticide problem on the Kestrel in Ayrshire, confirm its status as common, map its distribution within the county and document current breeding performance. A system of annual monitoring evolved from the early work, sample plots of territories were targetted annually, a ringing programme set up and field techniques developed. The obvious fluctuation in annual output that was found led to an investigation into factors affecting the breeding performance of Kestrels in the area.

The first steps taken were to undertake a comprehensive review of historical literature, launch an appeal for information and contact local naturalists to build up a picture of the previous 20 years. The response exceeded all expectations. Although the data were very mixed in quality, over 50 territories were reported and sufficient data obtained to confirm that, while there had been instances of adult deaths because of chemical poisoning, there was no evidence of clutch depletion or brood size reductions. In fact the Kestrel maintained a high level of production and was confirmed as breeding in all ten kilometre squares in the County.

One of the main benefits of the trawl was the number of productive contacts which were made and the number of traditional territories which were identified. Some of the responses were bizarre, including one from an "oologist of ill repute" as he signed himself, who willingly gave me a number of clutch sizes, apologising profusely that the information did not go beyond the egg stage!

Three main study areas were chosen, each with a distinct habitat type. The Carrick Forest, managed by the Forestry Commission, is a good example of upland hill pasture converted to commercial afforestation. Responding to the increase in vole numbers in the newly planted ground, the Kestrel population increased from 3-4 pairs in the mid 1960s to 15 pairs by the end of that decade, but rapidly returned to the former numbers when the canopy closed. Harvesting is now in progress and the re-stocked areas are once again providing feeding grounds for Kestrels. A nest box scheme begun in 1992 has already attracted nesting Kestrels and numbers should increase in the next ten years. As the forest cycle stabilises and landscaping improves the quality of the habitat, open areas within the forest will become a permanent feature and Kestrels should be ever present.

The Waterhead area is typical upland sheep grazing ground characterised by its open nature and the regular spacing of conifer shelter belts which provided the Kestrels with nesting territories. It is a very stable area compared to the dynamic forest environment. A 45 kilometre section of coastline from Ballantrae to Ayr was chosen as the lowland study area and this was supplemented by individual territories inland which were of interest due to long term occupation. Data from outside the

study areas were always welcomed for comparison and since 1972 information on 440 nesting territories has accummulated.

One of the main thrusts of the work was to monitor the same 40 sample territories annually to achieve full information on breeding from each one. The following six pieces of information were obtained: occupancy, nest site location and time of laying the first egg, clutch size, hatching details, brood survival and fledging details. To obtain these required anything from four to 15 visits per season to each territory depending upon the outcome of the cycle. It is imperative to get into territories in early March in order to make sure that pairs which fail at the pre-laying stage are recorded. Knowing the date on which the first egg is laid is critical from a time management point of view as the rest of the visits can then be planned and disturbance minimised.

From the data collected it was obvious that, although there was annual variation in breeding output (see Fig. 1), no matter which measure is used, over the 20 years the production rate was very high. From 1979 to 1992, during which period the monitoring had reached a very consistent level, the figures were: 4.7 average clutch size; 73% of eggs laid hatched; number of young reared per successful breeding attempt averaged 3.4, with average for all attempts 2.5; brood survival in the nest 87% with 75% of nesting attempts resulting in at least one young reared. This fits in well with the general pattern for middle-sized falcons in which there is a quick turnover of population.

Clutch sizes ranged from 3-8 in size but the majority were 4-6. One interesting finding is that clutch sizes have increased over the past two decades. In the period 1971-80, the average clutch size was 4.55

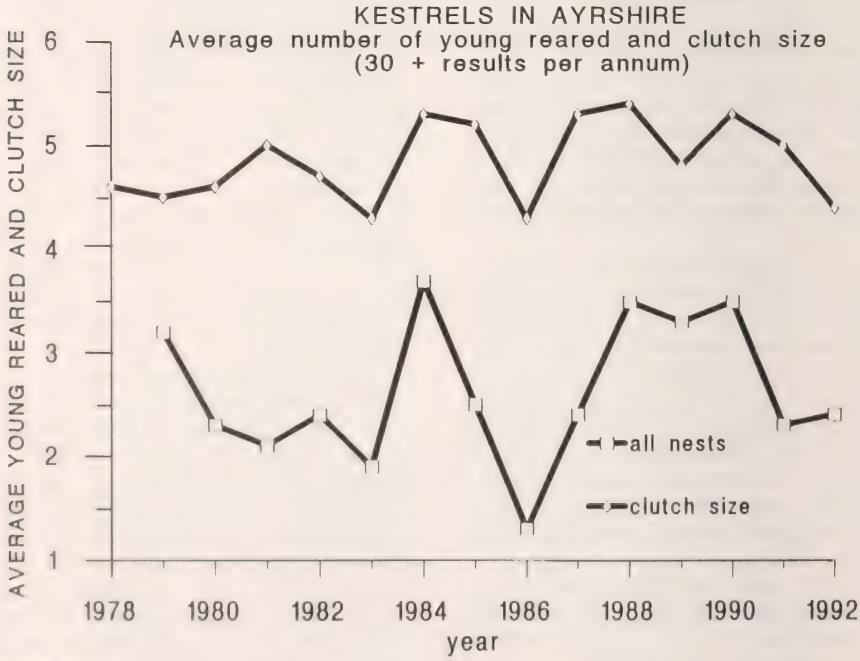


FIGURE 1.

and this had increased to 5.00 for the period 1981-1990. This trend has also been identified by the British Trust for Ornithology from nest record card analysis.

In general, pairs of Kestrels which breed early lay larger clutches and fledge more young per breeding attempt that pairs which start their cycle later. Clutch sizes in Ayrshire averaged 5.3 eggs for hens laying in April as against 4.3 for May. Similarly the number of young reared per breeding attempt was 3.9 for early cycles compared to 2.5 for later cycles. The advantages of having young out of the nest early in the summer are that they will have more time to gain hunting experience and build up resources before the severe winter weather makes survival difficult. Work in Holland by Cavé has also shown that progeny from early breeding pairs have higher survival rates through the first winter.

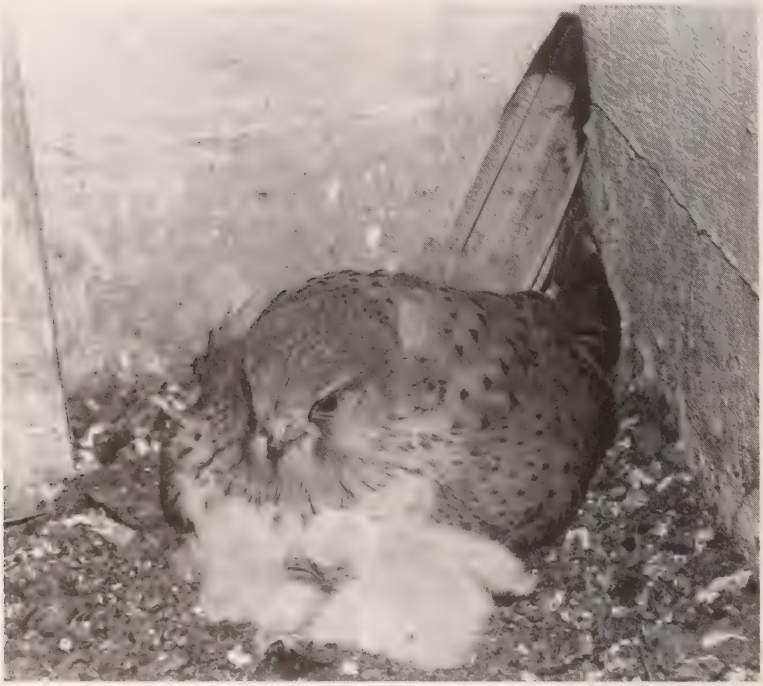
Nearly 90% of breeding failures take place during the pre-laying or clutch stage of the cycle in Ayrshire (failed attempts: pre-laying 26%, clutch 63%, brood 11%). Analysis of failed breeding attempts shows a variety of reasons, ranging from accidents to deliberate human interference. Accidents and the effects of adverse weather conditions, such as washed out sites or desertion due to food shortages, account for nearly a quarter of failed breeding attempts. 29% of failed attempts could definitely be attributed to man's activities whether intentional, such as egg collecting, or unintentional, such as the felling of a nesting tree or maintenance activity in a building. The number of nests robbed by egg collectors or would-be falconers has decreased in the last ten years.

Very few nests were predated (6%) but competition for nest sites with other raptors such as Tawny Owls *Strix aluco*, Barn Owls *Tyto alba*, and Long-Eared Owls *Asio otus* accounted for 14% of failures. Ironically, the recovery of the Peregrine Falcon and their re-colonisation of previously vacated territories caused Kestrels to desert cliff sites into which they had moved as the Peregrines declined. In some cases the adult Kestrels were killed but in one instance the Peregrine pair, which had their nest washed out at the clutch stage, took over a Kestrel brood and reared the two young.

The monitoring data are submitted to the co-ordinator of the South Strathclyde Raptor Study Group each year, then collated with the rest of the raptor work by the RSPB and published in *Scottish Birds News* by the SOC. Any major change in the breeding population of Kestrels would be identified quickly.

Variations in clutch size and in the number of young produced by breeding pairs did occur as a matter of course annually (see Fig. 1). The pattern for clutch size was very regular, with lows in 1979-80, 1983, 1986, 1989 and 1992. However, the number of young reared per breeding pair was much more irregular and made interpretation more difficult. A close examination of possible factors ruled out nest site availability as having great influence. Although there was some competition from other raptors as already mentioned, the number of nest sites available in each territory was high, mainly due to the number of abandoned Carrion Crow *Corvus corone* nests. Most territories had 3-8 potential nest sites available annually. The food supply and consistent spells of good or bad weather were found to be the most important factors in fledging success.

No monitoring of the vole population was carried out but figures from Geoff Shaw's Barn Owl work within the adjacent Galloway Forest Park was used. Interestingly, the poor vole years identified in his area coincided with the years of lowest Kestrel clutch size. The difference was that, whereas the Barn Owl breeding output crashed in those years, the Kestrels merely produced slightly fewer young per breeding pair than normal. Kestrels are not wholly dependent upon field voles and take a considerable number of young passerines (Starlings *Sturnus vulgaris*, Meadow Pipits



A rare instance of a cock Kestrel brooding newly hatched chicks.

Anthus pratensis, and Skylarks *Alauda arvensis*) in June and July and are thus able to switch to other food sources if their primary prey is scarce.

Consistent spells of bad weather in early spring can have a profound effect upon the timing of the cycles and on breeding success. A look at one five yar period 1982-86 illustrates the point well.

1982 – a typical season, mixed weather throughout.

Clutch size 4.7: hatching rate 67% and 2.4 young reared per breeding attempt.

1983 – a cold and wet spring

Clutch size 4.3: hatching rate 70% and 1.9 young reared per breeding attempt.

1984 – warm and dry from beginning to end

Clutch size 5.2: hatching rate 94% and 3.8 young reared per breeding attempt.

1985 – a dry early spring: all pairs started breeding in April: followed by cold wet late spring and early summer.

Clutch size 5.2: 93% hatching rate but only 2.5 young reared per breeding attempt.

1986 – a complete disaster – cold and wet throughout: only 58% of territories occupied and, coincidentally, a poor vole year.

Clutch size 4.3: hatching rate 50% and 1.3 young reared per breeding attempt.

When a poor vole year coincides with a consistent inclement spell of weather in the spring, as in 1986, then the breeding output is badly affected. However, the 1987-88 production rates were well up to normal and recovery from a bad year was swift.

The ringing programme has been a key

part of the study and has shed some light on migration and mortality. Over 1100 young Kestrels have been ringed from the targetted territories since 1975. A recovery rate of 7% has shown a random dispersal of juvenile Kestrels in the late summer in all directions followed by a predominantly south south-easterly migration, birds reaching the south of England and Northern Europe by October. One first year bird reached Northern Spain by 22 December, a flight of 1880 kilometres, but three quarters of recoveries were within 400 kilometres of the natal site. Some birds overwintered in Ireland.

First year birds were most likely to move, only 30% being recovered in Ayrshire compared to 50% for birds aged two years or more. Intriguingly some of the older birds continued to travel abroad or even stayed there: a fourth winter hen was killed in France, a bird in its third breeding season died in Holland and another was killed in its first breeding season in Norway.

Sixty percent of birds recovered had died during their first year, by far the majority between November-March, due mainly to accidents or exhaustion. 18% were second year birds, 12% third year, 6% fourth year and 4% in subsequent years. One bird reached the commendable age of 11 years.

Trapping of adults has also shown a rapid turnover of adults at breeding territories. For example, six different hens nested in one territory over a 13 year period, six in seven years in another and eight in eleven years in a third. There is some evidence of movement of hens within a local area, one bird nesting in three different adjacent territories in a three year period.

In any work on raptors, long term monitoring is important and the continuity of work on the Kestrel in Ayrshire will be maintained for as long as possible.

On a personal note, it is great therapy having such close contact with a fine bird like the Kestrel.

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The status of the Pintail in the Orkney Islands

E.R. MEEK

A survey of all the likely breeding sites of Pintails in Orkney in 1991 revealed a potential breeding population of 22-26 pairs. This is believed to represent over 50% of the British population. Habitat features characterising breeding waters are described. Factors controlling the species' choice of breeding water are discussed as are options for the conservation of these sites.

Introduction

The Pintail *Anas acuta* is a very scarce breeding species in Britain and it is listed as a Red Data Bird by Batten *et al.* (1990). Estimates of the breeding population since the 1960s have suggested a population of about 50 pairs with fluctuations up to 100 but in the years 1974-88 the maximum total was only 32 pairs (Batten *et al.* 1990). For 1989 the Rare Breeding Birds Panel gave a range of 11-39 pairs (Spencer 1991).

The Pintail, like several other duck species, is a relatively recent colonist, first proved to breed in Scotland, in Inverness-shire, in 1869 and in England, in Kent, in 1910. In Orkney, they probably first nested on Sanday, in 1907 or 1908 (Noble 1908; Hale & Aldworth 1910). By the late 1930s Pintails were breeding more or less consistently in Orkney, Shetland, and the Moray, Dee and Forth basins with Loch Leven (Kinross) being the main centre (Berry 1939). Elsewhere in Scotland, as well as in northern England, East Anglia and Kent, nesting was only irregular. By the time of the 'Atlas' survey of 1968-72 (Sharrock 1976), East Anglia and Kent were accounting for about one-third of all breeding occurrences; breeding was no longer annual in any of the north Scottish mainland counties, had apparently become less regular in Orkney and had ceased in Shetland.

More recently, however, Orkney has become the foremost area in Britain for breeding Pintail. In 1989, for example, 17 of the maximum total of 39 pairs in the country were recorded from the islands (Spencer 1991) while in 1990 14 pairs were found (Booth *et al.* 1991).

The present study reports results from a comprehensive survey of Orkney conducted in 1991. It describes the habitats associated with Pintail breeding waters and discusses methods for their effective conservation.

Methods

The accurate censussing of breeding ducks is notoriously difficult, the only entirely reliable method being rigorous nest searching which has the major disadvantage of increasing desertion rates. Such a method would be unacceptable with a species as scarce as the Pintail. It is, however, possible to assess the populations of some species by counting the numbers of males in spring at the start of the nesting season (Bibby *et al.* 1992). In spring 1991 the opportunity arose, during the course of other work, to check all breeding waters throughout Orkney for Pintails in the pre-laying period. This had never been systematically done in previous years, records being dependent on the checking of previously known sites. All waters, other than very acidic moorland lochs which were considered unsuitable and on which Pintail are not known to occur, were checked between late March and early

May. The moorland lochs were checked later in the summer. In Orkney the Pintail is almost solely a summer visitor to its breeding lochs so that confusion with wintering birds was not an important factor. It is just possible that some records may refer to birds on passage, although in the majority of cases the behaviour and length of stay of the birds concerned made this unlikely. The range of numbers given for the population allows for the uncertainty of some of the records.

Data on the occurrence of Pintail in 1991 and characteristics of Orkney lochs from a survey carried out for the then Nature Conservancy Council in 1986 (Charter & van Houten 1989) were assembled for as many lochs as possible. The loch characteristics considered were:

a) trophic (nutrient) status, classified into 10 types as shown in Table 3.
b) area of surface
c) altitude above mean sea level
d) conductivity measured at one or two places
e) pH measured at one or two places.

Where two estimates of conductivity or pH were available, the mean was used in the analysis. For the purposes of analysis, the only lochs considered were those which had been surveyed for Pintail and for which all five of the variables listed above had been measured. This provided a total of 88 lochs of which 12 were recorded as holding Pintail in 1991.

Results

The 1991 survey found a total of 22-26 potential breeding pairs (Table 1). Birds were recorded from 15 sites on seven different islands. The physical characteristics of those lochs on which Pintail were recorded are shown in Table 2 while the occurrence of Pintail in relation to the trophic status of all lochs for which data were available is shown in Table 3.

TABLE 1. Potentially breeding Pintail in Orkney, Spring 1991.

Island	Site	Details
A	1	First noted 27.03 (4m.+3f.); copulation seen 20.04; peak count 4 prs plus 1-2 males 27.04; only young seen was late brood of 2 on 12.08.
	2	First noted 20.03; peak count (2m+1f.) on 28.03; display 08.05; f.+b/5 (large) 03.07.
	3	Pair present 17.04 and subsequently with f. only 28.04.
	4	Pair present on 04 & 08.05.
	5	First noted 30.03; 2 males and 2 alert females possibly with ducklings on 10.05.
B	1	Pair present on 29.04.
	2	Male & 2 females 29.04, female on 30.04.
	3	Male on 29.04 with pair plus a male 30.04.
	4	2 males and 1 female on 30.04.
	5	Pair on 30.04; female possibly nest searching.
C	1	Pair on 29.04 (flew to this site from unsuitable site on island B).
D	1	4 pairs present on 11.04.
E	1	A single female present on 11.05.
F	1	A pair present on two dates in April.
G	1	First noted 27.03; 2 pairs present in late April; single females in late May/early June; single male 07.06.

TABLE 2. Characteristics of Pintail breeding waters in Orkney.

Island/Site	Loch Type	Size	Altitude	Conductivity (*u*mhos)	pH
A1	4	5.7	20	548*	8.05*
A2	4	19.6	12	530*	8.06*
A3	4	96.8	30	458*	8.34*
A4			No data		
A5	8	0.2	<5	720	7.12
B1	6	1.8	<5	5590	9.03
B2	6	7.5	<5	14850	10.30*
B3	7A	19.9	12	510*	10.00*
B4	7A	27.8	<5	720*	9.83*
B5	7A	0.6	40	566*	8.78*
C1	7A	6.0	<5	759	7.06
D1			No data		
E1	6	4.6	<5	21600	8.65
F1	7A	17.3	<5	530	8.53
G1	7A	0.9	<5	No data	

Source: Charter and van Houten, 1989. * = Mean of two readings

TABLE 3. Occurrence of Pintail in relation to trophic status of lochs.

Loch Type	Number of Lochs		
	Without Pintail	With Pintail	Total
1. Dystrophic	7	0	7
2. Oligotrophic (peat substrate)	1	0	1
3a. Oligotrophic (stone substrate)	3	0	3
3b. Oligotrophic (other)	8	0	8
4. Oligotrophic with eutrophic influence	10	3	13
5. Mesotrophic	1	0	1
6. Brackish	5	3	8
7a. Eutrophic	37	4	41
7b. Eutrophic (species poor)	4	1	5
8. Eutrophic (enriched by livestock)	0	1	1
Totals	76	12	88

Ten loch types were identified during the NCC survey but these were grouped into six main categories for further analysis. Type 1 lochs were dystrophic (lacking in nutrients), Types 2 and 3 were oligotrophic (lacking in nutrients but rich in oxygen), Type 5 were mesotrophic (providing moderate amounts of nutrients), Type 6 were brackish and Types 7-10 were eutrophic (over-rich in nutrients); Type 4 lochs showed signs of both oligotrophy and eutrophy.

The sizes of the lochs occupied by Pintails ranged from 0.2-19.92 ha. with the exception of one of 96.8 ha. where the Pintails always used a particular restricted inlet. The altitudes of the lochs ranged from <5-40m., but only two were above 20m. The conductivity of their waters showed a wide range of values from 458-21600 *u*mhos (a measure of the speed at which electricity passes through a unit length of water at 25°c.). However, nine were in the range 458-759 *u*mhos, the much higher figures being from the three waters subject to inundation at high tides. pH values varied from 7.06-10.30.

Lochs with Pintail were of higher pH than lochs without Pintail but there were no other significant differences (Table 4). To check for the possibility that Pintail occurrence might be affected by a combination of two variables, logistic regression models (Aitken *et al.* 1989) were fitted to the data, with the presence or absence of Pintail being the dependent variable and the effect of all pairwise combinations of pH, conductivity, area and altitude being tested. It was found that, although pH had a statistically significant effect on Pintail incidence, there was no significant additional effect of any of the other variables.

It is difficult to assess differences between loch types in the incidence of Pintail because there are many loch types (8) compared with the number of lochs (12). None of the 19 lochs which were dystrophic, oligotrophic or mesotrophic held Pintails but the loch types on which Pintails did occur were disparate and included oligotrophic with eutrophic influence, brackish and eutrophic. The effect of pH on the incidence of Pintail was found to remain statistically significant in a logistic regression model in which the effect of loch type was also included (chi-squared (1) = 4.41, $p < 0.05$). However, on the slim evidence available it is not clear whether Pintail incidence on Orkney lochs is more strongly related to pH, trophic status or possibly other unmeasured factors.

Discussion

The 1991 survey has further emphasised the importance of Orkney for breeding Pintail in a British context. 1991 figures for the rest of the country are not yet to hand but it would appear that the 22-26 pairs breeding in the islands probably represents more than 50% of the national population.

TABLE 4. Medians and ranges of characteristics of lochs with and without Pintail. Values of U from Mann-Whitney tests and associated P values are also given.

Variable	Without Pintail		With Pintail			
	Median	Range	Median	Range	U (12,76)	P
Area (ha)	3.5	0.2-227.0	6.8	0.2-96.8	374.5	0.32
Altitude (m)	10	<5-280	<5	<5-40	346	0.16
Conductivity (*u*mhos)	527	100-22200	643	458-21600	320.5	0.10
pH	7.92	3.58-10.19	8.59	7.06-10.30	296	0.05

TABLE 5. Conservation status of Pintail breeding lochs in Orkney.

Island/Site	Conservation Status
A1	RSPB Reserve; SSSI; Proposed SPA
A2	SSSI
A3	Part RSPB Reserve; part SSSI
A4	Unprotected
A5	Receiving Environmental Management Payments
B1	Unprotected
B2	Receiving Environmental Management Payments
B3	Receiving Environmental Management Payments
B4	Unprotected
B5	Unprotected
C1	Unprotected
D1	Proposed SPA but currently unprotected
E1	SSSI
F1	Unprotected
G1	Unprotected

Islands A and B have held the great majority of Orkney's breeding Pintail for the last 20 years. In 1991 birds were found on all the lochs previously recorded as breeding sites on these two islands while some new sites were also found. Island D has only recently been colonised but has a growing population at the one site. Islands C, E, F and G have not been regularly used in recent years and breeding was not actually proven on them in 1991.

The preference of Orkney Pintails for more eutrophic waters with a high pH is notable. It has been shown that, in more northerly latitudes, eutrophic waters support a more abundant phytoplankton and zoobenthos than do other water bodies (references in Fox *et al.* 1989). Further, Fox & Bell (in press) have shown that in northern Scottish wetlands the most important environmental parameters in determing species richness are pH and conductivity. In some areas, and particularly in spring and summer, animal food, in the form of invertebrates, is known to form a major part of the diet of the Pintail (Cramp & Simmons 1977). Such food is also known to be important to ducklings in the pre-fledging period. A statistical relationship could not be found between Pintail distribution in Orkney and conductivity but the relationship between distribution and trophic status and distribution and pH, might possibly be explained in terms of the richness of the invertebrate fauna in such waters.

What is not explained, however, is the absence of Pintails from numerous other Orkney waters with apparently suitable water characteristics. The NCC survey identified a further 76 waters in the eutrophic categories (together with 12 classed as brackish and 21 as eutrophic/oligotrophic), none of which held breeding Pintails. Other factors must also be controlling site choice, a major one probably being suitable surrounding vegetation for nesting.

Batten *et al.* (1990) discuss the possible threats to the survival of the Pintail as a

breeding bird in Britain. They conclude that there are few threats other than possibly climatic factors and the species' nomadic or opportunistic behaviour. However, in the Orkney context, site safeguard may play an important role in the future. All of the sites holding breeding Pintail in Orkney could potentially be damaged by agricultural drainage. Of the 15 sites listed in Table 1, only one and part of another are RSPB reserves and only they and two others are Sites of Special Scientific Interest (SSSIs). The other 11 sites have no formal protection although four of them are, either wholly or in part, the subject of Environmental Management Payments under the Agricultural Development Programme for Scottish Islands. This Programme ceases to operate in spring 1993, after which payments that have helped to conserve these sites will no longer be made. Attempts are being made to ensure the continuation of such conservation payments under some alternative scheme, designation of the islands as an Environmentally Sensitive Area (ESA) being currently the best option. Although several new Scottish ESAs were announced in spring 1992, Orkney was not amongst them. While further reserve acquisition and SSSI designation is a possibility, an Orkney ESA seems essential for the conservation of the numerous small wetlands on which the Pintail, together with other wildfowl and waders, depends.

Acknowledgements

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E.R. Meek, RSPB Orkney Officer, Smyril, Stenness, Orkney KW16 3JX

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A Survey of Black Grouse leks in Perthshire

M.C. ROBINSON, D. BAINES
AND W. MATTINGLEY

This paper describes a survey of Black Grouse leks in seven 10km grid squares in highland Perthshire in 1990-92. Counts in April and May 1992 at 79 leks produced 697 cocks. An additional 25 cocks were found displaying singly. Leks were generally evenly distributed 1,500m apart within the altitudinal band 230-470m ASL. Densities of displaying cocks in Perthshire were compared with density estimates from other British and European studies.

Introduction

This paper presents results of a survey of Black Grouse *Tetrao tetrix* leks carried out in 1990-92 by the Perthshire Black Grouse Study Group. The group comprised amateur bird-watchers, including members of the Tayside Raptor Study Group, and staff of the RSPB, The Game Conservancy and Forest Enterprise.

Batten *et al.* (1990) list Black Grouse as a species of special concern owing to the recent decline and range retraction in its European populations during the present century, brought about largely by habitat deterioration (reviewed in Cramp & Simmons 1980). Locally, nonetheless, there have been increases due to the colonisation of recently afforested areas in parts of Wales and Scotland (Grove *et al.* 1988; Thom 1986). However, once new forests grow up into the closed canopy post-thicket stage, declines are to be expected, even where there were initial benefits (Cayford 1990).

Highland Perthshire and the Angus glens are a stronghold of the Black Grouse in Britain (Tapper 1992), but land-use changes have recently been far-reaching: the area of commercial forestry in Perth and Kinross District increased by 30% to 73,300ha between 1980 and 1990 (J. Crawford, Tayside Region Planning Dept., pers. comm.). This may affect the distribution and abundance of Black Grouse, and it was to monitor such possible changes that the present study was started.

The study area

This comprised seven 10km grid squares forming a single block in highland Perthshire mainly across the area where the Rivers Garry, Tummel and Tay meet. To the east, it includes the watershed between the Rivers Tummel and Ardle (Fig. 1). This block was chosen as we were already recording other bird species there.

The interface between wooded valley and open hill is particularly well represented in most of the area. Typically the valleys and stream sides have blocks of birch *Betula* spp. wood emerging on to open moorland between 200-300m. This pattern is not followed however where plantations of larch *Larix* spp., spruce *Picea* spp. or Scots Pine *Pinus sylvestris* have been planted along the valley sides. Many of these have been established within the last ten years, although some in the Blair Atholl and Tummel areas are considerably older.

The heather *Calluna* dominant moorland is largely traditional grouse moor managed through rotational burning. Blanket bog covers a comparatively small

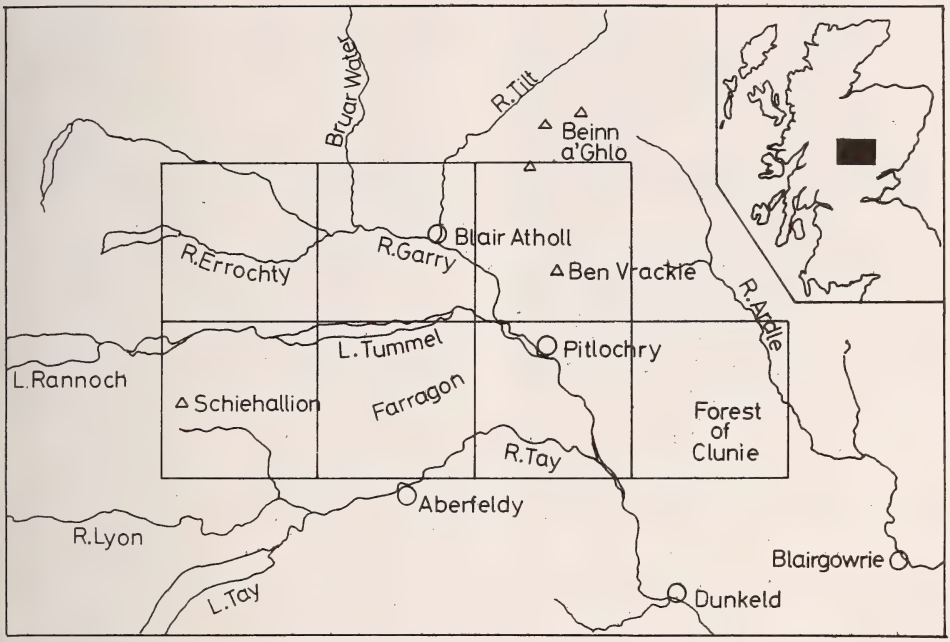

FIGURE 1. The survey area in highland Perthshire.

part of the moorland area, but small flushes and mires are frequent. Grassland communities form mosaics with the heather, especially along stream sides and around lochs. Areas of improved grassland in some places form continuous belts or isolated fields below the moorland edge. The extent of the principal habitats within the study area were roughly estimated from 1:25,000 Ordnance Survey maps and personal knowledge of the area (Table 1).

Methods

Leks are generally considered to be communal displays by the same group of males on a traditional site. To qualify as a lek in this study, two or more males had to be seen displaying at the same place on two or more occasions, thus discounting bouts of display on only one day away from leks and cocks displaying alone. Single displaying cocks were counted separately and added to the total number displaying communally at leks to give an overall number of cocks within each grid square. However, 26 sites were not found until 1992 and were then only counted once. Of these, 17 had two or more displaying birds and were considered to be true leks.

TABLE 1. Estimate of the percentage of the study area covered by the main habitats.

Habitat	% area covered
Unenclosed heather dominant moorland	50%
Conifer plantation (pre-thicket)	10%
Conifer plantation (post-thicket)	15%
Birch woodland	5%
Valley bottoms, inbye fields, towns	18%
Lochs	2%

In Wales, Cayford & Walker (1991) found that peak numbers of cocks occurred at up to 1.5 hours after dawn from mid-April to mid-May. The remoteness of some of the leks and the need to visit several sites on one morning precluded the possibility of visiting all leks during this period. However, 76% of the 208 recording visits were made between 15 April and 15 May, 16% between 5-14 April and 8% between 16-29 May.

The first two years, 1990 and 1991, were spent locating all leks in preparation for a full survey in 1992. The whole of each square, apart from some montane ground, were searched for leks. Leks tended to be conspicuous, with displaying cocks heard from up to 1km away. The location of each lek was recorded using a six-figure grid reference and the date and time of the visit and the number of cocks present noted. Hens were recorded when seen, but as they tended to visit leks in small groups, typically of 2-3, counts at leks gave no reliable estimate of total hen numbers.

In 1992, observers visited 57% of the leks once, 23% twice, 8% three times and the remaining 12% anything up to nine times. When more than one count was made at a lek, the highest number of cocks seen was used. In the case of two leks not visited

TABLE 2. Numbers and density of displaying Blackcock in 1992.

Grid Square No.	No. leks	No. single cocks	Total cocks counted
NN76	12	7	104
NN86	7	3	63
NN96	8	2	85
NN75	11	8	68
NN85	13	1	100
NN95	9	0	85
NO05	19	4	192
Total	79	25	697

TABLE 3. Blackcock population changes at 31 leks counted between 1990-1992.

		No. of cocks counted (% change between years)				
Grid Square No.	No. leks	1990	1991		1992	
NN76	5	68	68	(0)	68	(0)
NN86	5	36	29	(−19)	33	(+14)
NN96	3	29	25	(−14)	23	(−8)
NN75	9	44	45	(+2)	34	(−24)
NN85	2	13	14	(+8)	17	(+21)
NN95	1	9	12	(+33)	8	(−33)
NO05	6	86	94	(+9)	73	(−22)
Total	31	285	287	(+1)	256	(−11)

in 1992, the 1991 count was used. Variations in numbers of cocks between years were assessed from 31 leks counted in all three years.

Results

In 1992, a total of 672 cocks was recorded at 79 leks (Table 2), with numbers of cocks at a lek ranging from 2-30 (median and mode seven cocks). Only 13% of leks had 15 or more cocks (Fig. 2). In addition, 25 single displaying cocks, comprising 4% of the total cock population, were found, giving an overall total of 697 displaying cocks. Numbers of cocks differed three-fold within grid squares, with a maximum of 192 and a minimum of 63 cocks. Data from 31 leks counted in all three years indicated that numbers of cocks attending leks showed virtually no mean change between 1990 and 1991 but declined by 11% between 1991 and 1992 (Table 3). However, changes in some of the squares between 1990 and 1991 were larger than the overall changes between 1991 and 1992.

Displaying cocks were found within a distinct altitudinal band, at 230-470m. (mean 350 + 5 s.e.) in 1990-92 (Fig. 3). The area of land in each square between these altitudes was measured from Ordnance Survey maps. Densities ranged from 0.8-2.3 cocks per km^2 between different squares giving a mean density for the study area of 1.6 cocks per km^2 (Table 4). The seven squares varied considerably in the proportion of land within this altitudinal band, but although there was a weak positive correlation between the area of

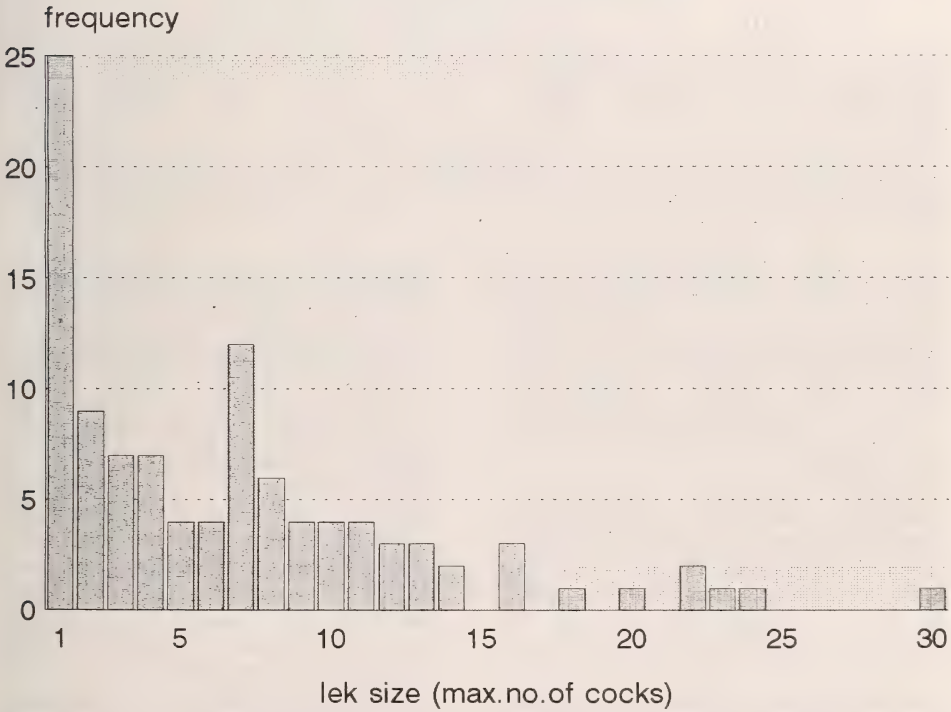

FIGURE 2. Frequency distribution of lek size (max. no. cocks present) from 79 leks and 25 single displaying cocks.

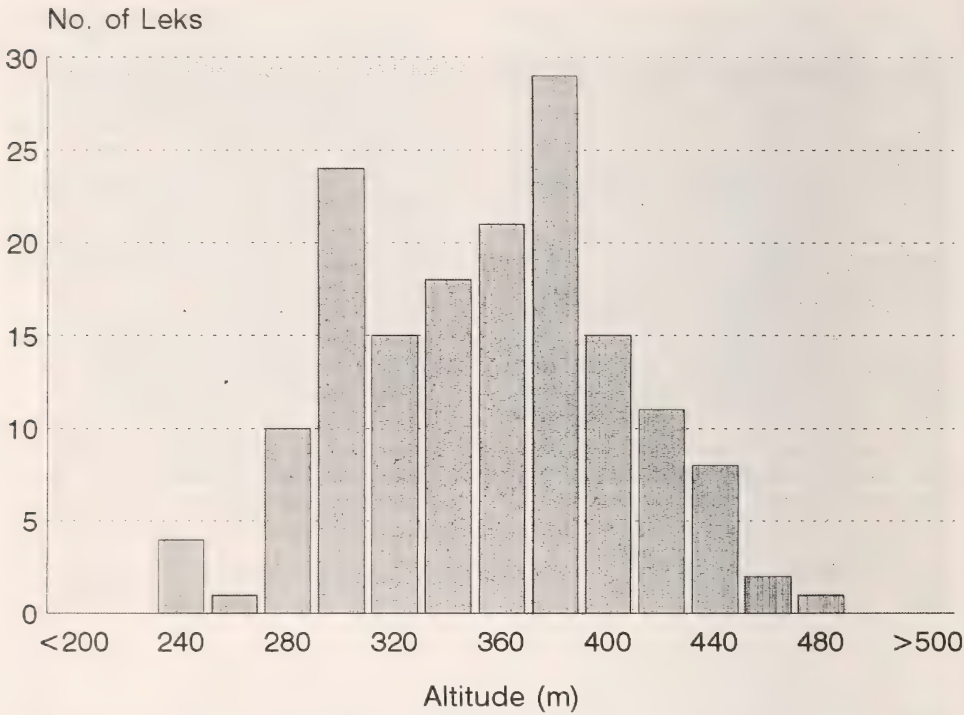

FIGURE 3. Altitudinal distribution of 160 Blackcock display sites including single cocks between 1990 and 1992.

ground between 230-470m and Blackcock numbers, this correlation was not statistically significant (r_5 = 0.53). The mean distance between leks varied two-fold between squares from 1110-2220m. The mean for the whole survey area was 1460m.

Discussion

The mean density of 1.6 cocks per km^2 found by this study is similar to estimates from other British studies, and is within the range of densities found by Baines (1992) but is slightly higher than that found by Picozzi (unpublished) for parts of Deeside (Table 5). Higher densities have been reported by studies in Sweden, the Alps and Estonia, but these studies have either used smaller areas within which birds may be concentrated, or only favourable habitats have been searched.

Black Grouse favour a mosaic of habitats that are transitional in their nature (Cramp & Simmons 1980) or maintained by burning or grazing. In this study, all leks were found at 230-470m which corresponded to a transitional zone between the upper edge of the valley woodland and inbye grasslands and much of the unenclosed moorland. Numbers of cocks varied three-fold between grid squares, but these differences could not be explained solely by variations in the amount of ground lying within the favoured altitudinal zone. Instead, it is possible that differences in the availability and quality of preferred habitat patches within this zone are more important than the absolute amount of ground

available. Such data were not collected during this study, but will form the focus for further analyses.

In our study, only 4% of cocks displayed on their own. This value is low compared to that found in Wales by Grove *et al.* (1988), where 45% of 91 leks were of single birds. Although we do not describe such observations of single birds as leks, there was clearly a higher proportion of singly displaying cocks in the Welsh study. The difference may be due to the Welsh population being scattered and declining whereas there was no evidence that this was the case in Perthshire.

The proportion of single displaying cocks is thought to vary between years in relation to breeding success in the previous year (Angelstam 1983). However we found no evidence of changes in the proportion of single displaying cocks in this study despite between-year differences in breeding

TABLE 4. Densities of Blackcocks and mean inter-lek distances.

Grid Square No.	Area at 230-470m (km^2)	Density (cocks/km^2)	Inter-lek dist. (m) n	mean + se
NN76	85.9	1.2	9	1460 + 175
NN86	74.2	0.9	5	2220 + 365
NN96	48.9	1.7	5	2000 + 310
NN75	52.9	1.3	10	1110 + 90
NN85	52.6	1.9	8	1525 + 300
NN95	44.0	1.9	5	1385 + 340
NO05	84.2	2.3	13	1210 + 150
Total	442.7	1.6 ± 0.2 s.e.	55	1460 + 90

TABLE 5. Densities of displaying Blackcocks in spring in this and other European studies. * densities expressed as number of cocks within the altitudinal band.

Study Area	Area (km^2)	Density (Cocks/km^2)	Author
Perthshire	443 (* 230-470m)	0.9 – 2.3	This study
N. Britain	306 (* 250-500m)	1.2 – 2.3	Baines (1992)
Deeside	34	0.8-1.2	Picozzi (unpubl)
Grimso (Sweden)	90	1.3	Angelstam (1983)
Boda (Sweden)	32	3.7	Angelstam (1983)
Halsen (Sweden)	14	7.2	Angelstam (1983)
French Alps	8	1.5 – 3.7	Ellison *et al.* (1988)
Tessin, Switzerland	Favoured habitat only	4.3 – 6.5	Zbinden (1985)
Estonia	Favoured habitat only	3.9	Viht (1974)

success. Instead, Baines (unpublished) recorded low breeding success in 1990 and 1991, which was correlated with reductions in numbers of cocks attending leks in 1992.

In the next few years, counts will be repeated and changes in Blackcock numbers will be compared with current land use patterns and subsequent changes. For example, new forests under the Native Pinewoods Grant Scheme are being planted in the study area. These developments and their impact on Black Grouse populations will form a focal point for the study group in future years. The Black Grouse has apparently declined in relation to land-use changes and it is hoped that, as understanding of its habitat requirements increases, appropriate management guidelines can be developed and implemented.

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M. Robinson, RSPB, Balrobbie Farm, Killiecrankie, Pitlochry, Perthshire.
D. Baines, The Game Conservancy, Crubenmore Lodge, Newtonmore, Inverness-shire.
W. Mattingley, Cluny House, Aberfeldy, Perthshire.

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Productivity of waterfowl breeding at Airthrey Loch, Stirling

M.V. BELL

Airthrey Loch is a small (9ha) eutrophic lowland loch in central Scotland. The productivity of breeding waterfowl was studied over five summers (1987-1991). The loch supported a large population of common species for its size with between 66-91 pairs of waterfowl breeding annually at a density of 7.3-10.1 pairs/ha or 25-35 pairs/km of shoreline, comprising five pairs of Little Grebe, one pair of Mute Swan, 21-29 pairs of Mallard, 7-8 pairs of Tufted Duck, 20-26 pairs of Coot and 9-18 pairs of Moorhen. Productivity was variable for all species and apparently independent of weather conditions. Predation by mink depressed breeding output by Coot and Moorhen in three seasons and algal blooms were coincident with mortality of downy Tufted Duck and Coot in two summers. The numbers of juveniles observed suggested that the loch produced a surplus of Little Grebe, Mute Swan, Coot and Moorhen.

Introduction

Airthrey Loch is situated in the grounds of the former Airthrey estate on the campus of Stirling University. The loch has a surprisingly large breeding population of common waterfowl which showed marked differences in breeding success between 1987 and 1991. Most of these birds, especially Mute Swan *Cygnus olor*, Mallard *Anas platyrhynchos* and Coot *Fulica atra*, are very tolerant of humans and sometimes aggressive in defence of territories or young. Even though many nests of Coot and Moorhen *Gallinula chloropus* were within two metres of the path round the loch and extremely obvious early in the season, there were very few losses attributed to humans. There is some fly-fishing for trout from boats and from the shore that sometimes led to the loss of lines and hooks on the lochside trees which then presented a hazard to the birds. There was also occasional dinghy sailing on the west bay and canoeing as far as the marker (see Fig. 1). The area round the island is designated as a sanctuary area, though this is not always respected by canoeists and dingy sailors.

Airthrey Loch was formed in the early 19th century by constructing an embankment across a small burn at the west end and diverting the flow to a new exit stream at the south-east corner. The 9ha loch has an unusual shape (Fig. 1) and a correspondingly long shoreline of 2.62km; of this the small loch is 0.28km and the island an additional 0.18km. An access road and embankment divides the small loch from the main loch, these being connected by a submerged pipe. The loch has a mean depth of 1.5m with a maximum depth of 4.2m in the west bay. Water levels are controlled by a sluice but can still rise by up to 30cm after heavy rain. The loch is eutrophic with a low water turnover, especially in summer when dense algal blooms occur. There is emergent vegetation, mainly yellow iris *Iris pseudacorus* and

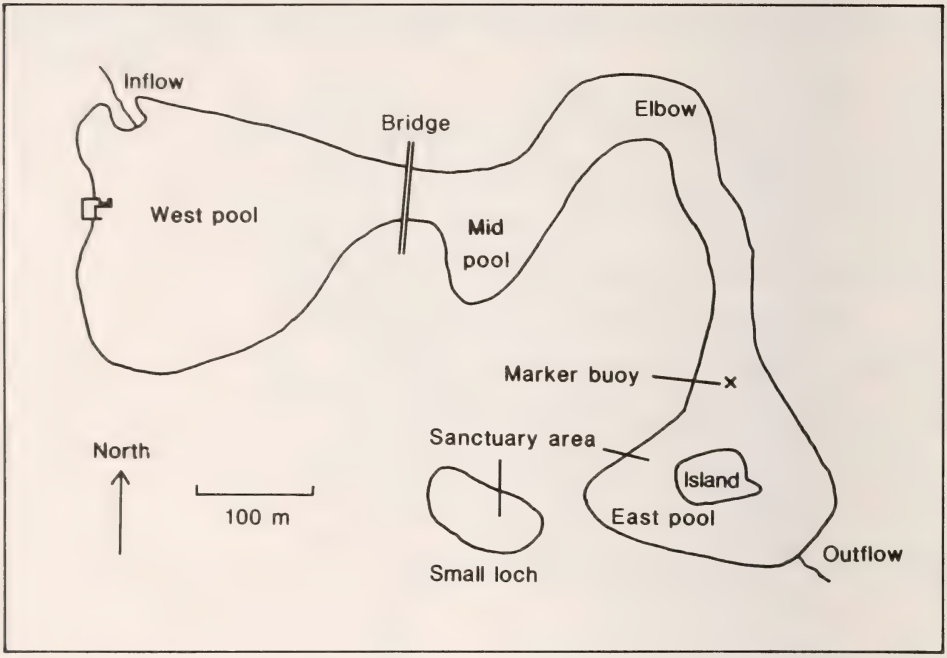

FIGURE 1. Map of Airthrey Loch.

bulrush *Typha latifolia*, along much of the shore east of the bridge which provided nesting cover for Little Grebes *Tachybaptus ruficollis*, Coot and Moorhen while many over-hanging willows *Salix sp.* around the entire shoreline also provided nest sites for Coot. Mature trees with cavities in the surrounding parkland provided some nest sites for Mallard.

Methods

In the first four summers of this study the loch was visited 2-4 times a week from early April to late August with less frequent visits before and after this period. In 1991 the loch was visited only weekly. It was most convenient to walk round the loch between 0615 and 0730 hrs GMT as the loch was least disturbed at that time. However, on cold mornings downy young were often brooded and therefore not visible; this was particularly a problem in late April and May. In these circumstances the loch was checked between 1145 and 1300 hrs also, and very occasionally between 1615 and 1730 hrs but the birds were found to be rather inactive and therefore not very visible in late afternoon and evening. Visits every few days allowed newly hatched broods to be followed from hatching to fledging. Nests and territories of Little Grebe, Moorhen and Coot were marked on a map of the site; Coot territories were a useful reference point for broods of ducklings. No attempt was made to find nests not visible from the perimeter path. The island was not visited.

Individual territory sizes were not determined in this study. Average territory sizes were obtained by dividing the water area by the number of pairs of the particular species. Each year some birds appeared not to nest. Non-breeding pairs were identified

by the following criteria: for Coot and Moorhen, territorial pairs seen regularly (i.e. both adults) through part or all of the nesting season with no signs of egg-laying or incubation of a clutch. Some pairs built rudimentary nests. Pairs of Tufted Duck which were regularly seen on the water (i.e. female not incubating) throughout the summer were taken to be non-breeders. It is possible that some of these pairs may have failed within a few days of starting to nest.

Results

Nesting territories of Little Grebe, Coot and Moorhen were easily located. Almost all Coot nests and most nests of Little Grebe were visible from the shore. Sometimes newly hatched chicks were the first indication of nesting by Moorhens. Providing losses were low, it was possible to follow the success of individual broods of Mallard and Tufted Duck. In 1991, with less frequent visits, this was not possible and there may have been total losses of broods within the first few days which were not noted. Laying and hatching dates were also less accurately known.

Little Grebe

Five pairs of Little Grebe nested each year (Table 1). Most nested east of the bridge (Fig. 1) with single pairs in the west bay in 1988, 1989, 1990 and 1991. The maximum density was 1.1 pair/ha when all five pairs were on the east part of the loch. From late May onwards it was usually impossible to see nests among bulrush, but later nests in floating beds of amphibious bistort *Polygonum amphibium* and yellow water lily *Nuphar lutea* were very obvious and sometimes as much as 10m from the shore. In spite of appearing vulnerable to predators and wind, only two out of twelve such nests were lost; adults usually remained incubating as the wash from canoes rocked their nests.

Newly hatched young often remained hidden in cover and occasionally were not seen until about two weeks old; the number of young hatched was therefore not known. Post-hatching losses appeared to be low with some young fledged from every clutch: only 11 young were lost from 79 hatched in 32 broods. One brood of five was recorded. Broods usually remained within the nesting territory until dispersing about four weeks after fledging but in 1990, a pair moved their newly hatched brood some 200-300m from the mid pool to the west pool from where the young fledged. In 1987, most of the young from the first broods left the loch several weeks after dispersing. The mean size of successful broods was 2.0 (8 of 1, 16 of 2, 5 of 3, 2 of 4 and 1 of 5) over the five summers, and the average productivity varied from 2.0 to 4.0 young/pair.

TABLE 1. Little Grebes breeding at Airthrey Loch 1987-1991.

	1987	1988	1989	1990	1991
no. of pairs	5	5	5	5	5
median hatch date (first clutches)	28 May	21 May	5 Jun	2 Jul	18 Jul
broods hatched	9	6	6	5	6
single broods	2	4	4	3	2
double broods	2	1	1	1	2
triple broods	1	0	0	0	0
young fledged	20	11	12	10	15
young fledged/pair	4.0	2.2	2.4	2.0	3.0

In 1987, there were three pairs at the start of the summer with a fourth arriving in the last week of June and a fifth in the last week of July. This then became the most successful of the five years, with two pairs double-brooded and a third triple-brooded (Table 1). This latter pair fledged two, two and four young from clutches which hatched on approximately 20 May, 13 July and 30 August. Two other pairs also fledged two and three young from late nests which hatched on 20 and 29 August. In 1988, 1989 and 1990 only one pair was double-brooded, with two pairs in 1991. In 1990 and 1991, single pairs failed to rear any young. 1990 was the least successful season. Although all five pairs were present by early May they made no attempt to nest for 4-5 weeks and every nest was then built in amphibious bistort and yellow water lilies well out from the shore. Laying was also delayed until late May or early June in 1991. In 1988, 1989 and 1990 single non-territorial adults were present all summer.

Mute Swan

A pair of Mute Swans nested successfully on the island each year. Eight, seven, seven, seven and nine cygnets were hatched on 7 May, 1 June, 28 May, 27 May and 28 May in 1987-1991 respectively and of these seven, five, four, five and seven fledged. (In 1986, all nine young fledged at Airthrey). In 1988 and 1990, single young were lost soon after hatching while in 1989, all three losses occurred at or just after fledging. In 1988, a fledged juvenile died of ingested lead poisoning.

Mallard

Over twenty broods of Mallard were seen each summer but counts of drakes in April and May underestimated the breeding population by a large margin in every spring except 1991 (Table 2). Numbers of Mallard increased in June, as birds arrived from elsewhere to moult, and large numbers were present in late summer each year with 609 in August 1990.

Mallard nested in the lochside vegetation and in the campus shrubberies up to at least 400m from the water. Four nests were found 3-4m above ground in holes in lochside oaks, and in 1990 one such site was occupied consecutively by different females, both of which hatched their clutches.

Broods appeared from the second week of April to the first week of July, with most appearing in the last week of April and the first two weeks of May, median hatch dates were between 2-18 May in 1987-1990 (Table 2). Fledging success varied between 29-70% of those ducklings first seen: 1987 was the best season with the largest number fledged (110) and the highest number of young fledged/brood (5.0) (Table 2). Four

TABLE 2. Mallard breeding at Airthrey Loch 1987-1991.

	1987	1988	1989	1990	1991
av. no. of drakes April-May	9	9	12	14	21
no. of broods	22	21	23	28	34[a]
median hatch date	15 May	18 May	2 May	6 May	29 May
no. of ducklings first seen	158	127	158	202[b]	210
ducklings fledged (6 weeks)	110	41	54	79	60
total brood failures	4	7	11	7	20
young fledged/brood seen	5.0	2.0	2.3	3.3	1.8

[a] five broods were probably replacements.
[b] four broods totalling 32 ducklings left the site within a few days of hatching.

aberrant pale females fledged from one brood in 1988 and these ducks could be identified individually over the following three summers. In 1990, one of these ducks was double-brooded. She abandoned three ducklings of c.20 days old in the first week of May and ten days later these had joined a brood of seven ducklings of similar age also with a pale duck; all ten ducklings subsequently fledged. On 20 June (45 days later), she appeared with nine newly hatched ducklings of which five fledged. In 1987 and to a lesser extent in 1990, broods older than about three weeks wandered extensively from the loch to feed (up to at least 400m) and several ducks and young were killed on the adjacent roads. In 1990, four broods were thought to have left the loch shortly after hatching, possibly for the river.

Tufted Duck

Between 7-12 pairs of Tufted Duck *Aythya fuligula* were present each summer. Several pairs remained on the water throughout the period and did not appear to attempt to breed. The number of broods seen varied between 2-8 (Table 3). Four nests were found during the study and all were in rank grass on the banks of the loch within 1m of the water. Most broods started to break up after four weeks though some remained cohesive for up to six weeks.

Fledging success was very variable in the four years (Table 3). In 1987, the best year, 43 ducklings out of 57 fledged from seven broods, discounting one brood abandoned at hatching. The duck was found sick and all the ducklings disappeared within two days, most being taken by Carrion Crows *Corvus corone*. In 1988, there was a synchronous failure in good weather with six ducks appearing without broods on 24 June; the first two broods to hatch were very successful, fledging 16 out of 17. In 1990, all but one brood were abandoned between a few days and two weeks after hatching; these broods then fragmented making it very difficult to follow broods and ducklings. Many ducklings grew very slowly, taking up to two weeks longer to fledge than usual. This also occurred in 1991 with the first brood which hatched in the last week of June, fledging all nine ducklings and the subsequent seven broods hatching from mid-July showing brood desertion, slow growth and large losses.

Coot

Between 20-26 pairs of Coot nested each year with up to five additional territorial pairs present (Table 4). The smallest average territory size was 0.22 ha/pair for the two pairs on the small loch in 1991, but the 11

TABLE 3. Tufted Duck breeding at Airthrey Loch 1987-1991.

	1987	1988	1989	1990	1991
no. of pairs	9	8-10	7-11	10-12	8-14
no. of broods	8	2	5	8	8
median hatch date	11 Jul	17 Jun	7 Jul	15 Jul	18 Jul
ducklings first seen (four weeks)	64	17	37	53	54
ducklings fledged	43	16	21	17	19
total failures	1	0	1	2	?
broods abandoned	1	0	1*	7	7
young fledged/pair	4.8	2.0	3.0	1.7	1.7

* duck died

TABLE 4. Coot breeding at Airthrey Loch 1987-1991.

	1987	1988	1989	1990	1991
territorial pairs	20	27	29	25	25
pairs laying	20	26	24	23	24
clutches laid	23	35	39	31(+)	28
replacement clutches	3	7	11	8	4
second clutches	0	2	4	0	1
median hatch date (first clutches)	15 May	14 May	11 May	10 May	1 May
no. of clutches hatched	22	29	26	18	22
no. from which young fledged	17	24	17	9	19
no. of young fledged	42	61	36	19	49
pairs double-brooded	0	1	2	0	1
young fledged/pair	2.1	2.3	1.5	0.8	2.0

pairs on the east loch in 1991 only averaged 0.26 ha/pair. The overall density varied between 2.2 and 2.8 ha/pair in the five summers. The average length of shoreline available varied from 101 to 131 m/pair with the smallest average of 78 m/pair in the west bay in 1989. The boundaries of Coot territories were indicated by frequent territorial interactions. Territory size changed during the season depending on the stage and fortunes of neighbouring pairs, thus pairs with young frequently took over parts of the territories of adjacent pairs that had failed.

First clutches became progressively earlier during this study with egg laying from mid-March in 1990. The median hatch date of first clutches was very constant between 10-15 May in the first four summers but was almost a fortnight earlier (1 May) in 1991 (Table 4). High spring water levels may have prevented even earlier nesting in each of the years. Annual productivity varied between 0.8 and 2.3 young fledged/nesting pair over the five summers.

Nests were rarely unattended and no attempts were made to determine clutch size but opportunist observations of 11 first clutches or replacement clutches gave an average of 6.9 eggs (4 of 5, 1 of 6, 2 of 7, 1 of 8, 2 of 9 and 1 of 10). The four largest clutches may have contained dumped eggs since 11 eggs were left unhatched in these four nests. More detailed observation of nests would have been necessary to determine the extent of egg dumping for both Coot and Moorhen. Newly hatched young were often brooded and not visible for several days post-hatching, but where the brood size was known, 26 first broods averaged 6.0 chicks (1 of 2, 4 of 5, 13 of 6, 7 of 7 & 1 of 8) and seven replacement broods averaged 4.4 chicks (1 of 3, 3 of 5, 2 of 5, 1 of 6). On only one occasion were eggs noted in the water at the edge of the nest but it is likely that other eggs were knocked out of the nest by the adults during skirmishes with rival pairs of Coot or Moorhen. Most losses occurred at the stage of newly hatched young, with brood reduction occurring during the first week, probably due to starvation of the weakest chicks following neglect by the adults. Three instances of predation by Lesser Black-backed Gulls *Larus fuscus* were seen, on chicks about seven, nine and ten days old. Over the five years, of the successful pairs, 21 fledged one young, 24 pairs two young, 17 pairs three young, 16 pairs four young, 4 pairs five young and 1 pair six young

(from two broods of three). There were seven attempts at second broods over the four seasons and only four were successful. In 1988, a very late attempt at a second brood (hatching on 9 September), following a replacement first brood, failed when the last chick which had grown very slowly disappeared between 29 September and 3 October. Small territories caused frequent disputes between adults but young were allowed to cross territorial boundaries. In 1988, young from two adjacent pairs frequently interchanged, while another pair lost control of a brood of five 15-day old chicks which were adopted by a pair with two young 11 days older. All seven fledged.

There was very little interference with nests by humans, though in 1990 it was thought that the failure of three adjacent and obvious nests over the same weekend was caused by human disturbance. In 1988, three pairs failed on 2 May just before or at hatching, following heavy rain and strong easterly winds. Two of these pairs quickly relaid in the same nests. In the summer of 1989, a mink *Mustela vison* was seen at the east end of the loch on two occasions and the agitated behaviour of some birds indicated its presence on several other dates. There was a marked difference in the success of pairs at the east and west ends of the lochs (Table 5). A mink was also present on the same part of the loch in 1990 and 1991. Most of these nests failed at or shortly after hatching and the mink was probably attracted by the calls of the chicks. In 1989, one pair failed four times from clutches started before 12 April, on 28 April, 2 May and 20 June, the last hatching but the young disappearing within a week. In 1990, breeding success was poor round the whole loch though it was still poorer at the east end. Several nests here failed early in incubation after a dilatory start to the season and the birds did not relay. At the west end, five broods were abandoned between 16 days and five weeks after hatching, and the young eventually died though two chicks from different broods, abandoned at 17 days and five weeks, eventually fledged. Other chicks were very slow to grow, taking 2-3 weeks longer to fledge than normal; one died after ten weeks when it was much smaller than normal (c. 3-4 weeks retarded). In 1991, all the first broods of Coot had fledged before the algal bloom occurred.

Moorhen

The number of pairs of Moorhen increased steadily over the five years (Table 6), mainly at the west end of the loch (Table 5). Average Moorhen territory size varied from 0.52 to 1.03ha water area/pair over the five years with the three pairs on the small loch in 1990 and 1991 having only 0.15 ha/pair.

TABLE 5. Breeding success of Coots and Moorhens at the east and west* ends of the loch.

	Coot (nesting pairs)				Moorhen (territorial pairs)			
	West end		East end		West end		East end	
	prs	young	prs	young	prs	young	prs	young
1987	12	22	8	20	4	12	5	18
1988	16	38	10	23	8	12	4	9
1989	16	39	8	1	9	21	5	6
1990	15	15	8	4	13	45	5	6
1991	13	35	11	14	12	47	7	5

* The west end includes the small loch.

TABLE 6. Moorhens breeding at Airthrey Loch 1987-1991.

	1987	1988	1989	1990	1991
territorial pairs	9	12	14	17	19
no. of pairs nesting	9	11	12	15	18
no. of double broods	4	1	1	4	8
no. of triple broods	0	0	0	1	0
median hatch date (first clutches)	12 May	13 May	24 May	14 May	10 May
no. of broods hatched	17	12	15	24	27
no. from which young fledged	12	10	10	18	22
no. of young fledged (5 weeks)	30	21	27	49	52
young fledged/nesting pair	3.3	1.9	2.3	3.3	2.9

Length of shoreline, which may be a more important factor for Moorhen, varied from an average of 175-291 m/pair, with extremes of 390 m/pair in the west bay in 1987 and 93 m/pair on the small loch in 1990 and 1991.

Over the five summers, a total of 65 pairs of Moorhens nested. There was a minimum of 111 nesting attempts of which at least 15 failed before hatching, and a further 24 failed to fledge any young. Of the 65 pairs, 12 fledged no young, 8 pairs one young, 13 pairs two young, 11 pairs three young, 8 pairs four young, 5 pairs five young, 3 pairs six young, 3 pairs seven young and 2 pairs eight young.

There were very frequent disputes between Moorhens and Coots, especially early in the season when little cover was available to hide Moorhens. Every Moorhen territory overlapped with at least one Coot territory, and on one occasion an early Moorhen nest was taken over by Coots. Early nests were often in the base of willows up to a metre above the water since there was little other cover available at this time. A Norway spruce *Picea excelsa* with branches at this height overhanging the water was also used in three seasons. Such sites were not accessible to Coots but could not be used as brood nests, since chicks were unable to climb back to them. In 1989, a brood of five newly hatched young from such a nest were thought to have been killed by Coots, whose nest was only five metres away.

As with Coot, first hatching dates became progressively earlier during the study though the median hatch date of first clutches was little changed (Table 6). The best years were 1987, 1990 and 1991 with about three young fledged/territorial pair. In 1987 and 1990 four pairs were double-brooded, and in 1991 there were eight double-broods. All three pairs on the small loch in 1991 were double-brooded, fledging seven, eight and eight young; the two pairs of Coot fledged three and five young so this site was extremely productive that year. In 1990 there was also a triple-brooded pair which fledged one, two & two young from clutches hatching on about 8 April, 28 May and 17 July. Breeding was less successful at the east end of the loch than at the west end in 1989, 1990 and 1991 (Table 5), especially in the last two years. This was thought to be because of disturbance and/or predation from mink. Moorhen nests were vulnerable to predation by Grey Squirrel *Scuirus carolinensis*, Carrion Crow and Magpie *Pica pica*, while chicks were also vulnerable to cats which were known to have taken several juveniles. Adults from territories adjacent to roads were vulnerable to traffic and in

1987 three of the 18 breeding adults were killed on the roads during the summer.

In 1990, a pair incubated an infertile clutch from at least 28 May to 14 August (79 days), leaving two eggs on eventual desertion. Another territory in 1990 held three birds. After an early failure a bird was incubating a new clutch on 11 April. On 25 April two adults were incubating side by side (head to head) with a third in close attendance. The following day, they were both incubating again and the nest was inspected to reveal at least nine eggs, one of which was chipping. One adult was extremely aggressive, leaving the nest only when the observer was less than a metre away. On the following three days, one bird was incubating/brooding with the other two adults in attendance. On 7 May, the nest had been interferred with by humans and the adults and an indeterminate number of young were hidden in a bed of iris. The full family of three adults and seven young was not seen until 23 May, when three young were clearly larger than the other four and were estimated to be about a week older. All seven fledged. It was thought that a second clutch was attempted by one bird but that this failed before hatching.

Discussion

There have been many studies of the breeding biology of waterfowl but rather few of these have examined breeding productivity. Fledging success is frequently difficult to determine because of the wariness of waterfowl and the extensive cover at breeding sites. The population of waterfowl at Airthrey Loch was particularly amenable to study because the birds were conditioned to the presence of humans and all parts of the loch were easily visible.

The average fledging success of Little Grebe varied between 2.0-4.0 young/pair over the five seasons. A Danish study found clutches of 4-6 usual with a mean brood size of 4.6 at hatching and 1.8 on fledging (Ahlen 1966; cited in Cramp 1977) with two broods normal and possibly three occasionally. During this study there were 15 single broods, seven double broods and one triple brood. In 1987, the most successful year, two pairs were double brooded and one triple brooded, with extreme hatching dates of 18 May and 2 September. This was the first recorded pair of triple-brooded Little Grebe in Britain. Another was recorded at Aylesbury sewage works in 1988 (Glue 1990).

Over 20 broods of Mallard were seen each summer but counts of drakes in April-May consistently underestimated the population of breeding females by 40-60%. Breeding success varied between 2.0-5.0 young fledged/ ♀ or 2.9-6.1 young/ successful ♀ .. The annual productivity varied from 1.9-5.5 young fledged/pair at a gravel pit in Kent over ten summers (Harrison 1972). Other studies reported 3.5 young/successful ♀ (Iceland), 4.7 (SW England), 5.0-7.5 (Denmark) and 7.0 (Finland) (in Cramp 1977) so the productivity at Airthrey Loch was comparable.

At Loch Leven, the most important site in Britain for breeding duck, c.1150 pairs of duck, mainly Mallard and Tufted Duck, nested each year between 1966-1971. Hatching success averaged 55% and 57% respectively for these two species over the six summers but productivity was poor with estimates of only about one young fledged/pair for Mallard and probably better for Tufted Duck (Newton & Campbell 1975), many ducklings being taken by gulls. The breeding duck were re-surveyed here in 1980-1984, when the population was found to be slightly larger at c.1200 pairs. Though relatively few broods were again noted, the number of ducklings per brood surviving beyond two weeks of age was 4.3 for Mallard and 3.6 for Tufted Duck (Wright 1986).

A study of Tufted Duck in Finland found 78% hatching success but only 11.4% fledged with a survival of 0.5, 1.0 and 2.2 young/pair in different years (Hilden 1964).

At Lake Myvatn, Iceland, 1.9-3.3 full-grown young/ ♀ were produced over six summers (Bengtson 1972). At Airthrey hatching success and fledging success were broadly similar to those found in these studies.

An earlier study of Coot at Airthrey Loch was carried out in 1971, when 16 territories were present (Downie 1972). There were fewer waterside willows available to provide nest sites in 1971 than during this study, and recent mild winters may also have elevated the populations of Coot (and Moorhen). Territory size varied between 0.14-1.06ha but measurements of territory quality were so variable that the results did not allow any conclusion. No attempts were made in this study to relate productivity of Coots or Moorhens to territory quality. In 1971, egg laying occurred between 20 April and 6 June, mean clutch size was 5.6 (range 3-8), but only 40.6% of eggs hatched and only 19 young fledged (Downie 1972). Individual territory sizes were not determined in the present study but some pairs were much closer than the average values given in the results, e.g. three pairs in the mid pool in 1988, four pairs at the 'elbow' of the loch in 1988, 1989 & 1990, with three on the outer curve and one on the apex, and three nests within 40m at the southern end of the loch in 1991. One of these nests probably failed because of fighting but the middle territory supported the only double-brooded pair in 1991. In St. James Park, London, Coot territories varied between 0.12-0.44ha, mean 0.36ha (Cramp 1947). Studies in Holland have shown that the size and quality of a Coot territory is related to the age of the male tenant and its neighbours, older males having bigger and better territories (Cave *et al.* 1989).

The nesting season was much more protracted at Airthrey during this study than in 1971, and limited observations also suggested that the clutch size was larger. Hatching success in 1987 and 1988 was also much better than in the earlier study (Downie 1972), but fell in 1989, 1990 and 1991 because of predation by mink. However, there were large losses of chicks in the first two weeks post-hatching in most broods and overall fledging success was similar to that found by Downie (1972). In the earlier study, several Coots used nest boxes that attracted interference from humans which depressed hatching success. A study of brood reduction and brood division in Coots in Oxfordshire found that all chicks surviving the first week subsequently fledged and that the earlier hatched chicks within broods had better survival (Horsfall 1984a,b). Brood reduction is a means of matching the number of young to the food supply through the establishment of a feeding hierarchy, leading to the starvation of the smallest and weakest later hatching chicks. Occasionally, chicks are killed by the parents (Horsfall 1984b).

Violent bouts of 'tousling' of chicks by the parents were noted during the present study but it is not known whether these resulted directly in the death of the chick. At Airthrey, brood reduction occurred over a longer period. In 1987 and 1988, from 48 clutches hatched where the disappearance of chicks was accurately known, 58 disappeared in week one post-hatch, 20 in week two, 11 in week three, four in week four, two in week five and one in week six. Although some of these larger chicks may have been predated, in most cases the circumstances (visibly slow growth, neglect by parents) suggested starvation, poor condition or disease. The small size of some territories at Airthrey and thus food shortage may have accounted for the number of total brood failures or broods from which only one chick fledged. In 1987 and 1988, from 48 nesting attempts which hatched, nine failed to raise any young and eight fledged one young. Only four out of 117 pairs of Coot were double-brooded in 1987-1991. This was surprising, since there seemed to be sufficient time for second broods given the early start to nesting; in

1991, 17 pairs had young which were independent by the end of June, yet only one pair attempted a second clutch (and was successful). A study in Somerset (Alley & Boyd 1947) also recorded poor hatching success but better fledging success than the current study at Airthrey. Alley & Boyd (1947) observed Coots killing chicks from neighbouring pairs which wandered into their territory. Although there were frequent territorial disputes at Airthrey, such aggresion was never seen directed towards chicks. On the contrary, in one instance in 1988 young of similar age from broods of four and five wandered between adjacent territories at will and were possibly fed by the other pair. In another case a pair with two young drove off the parents of an adjacent brood and adopted their chicks. It is possible that in these instances of unusual behaviour the adults were related. Lesser Black-backed Gulls were seen cruising over the loch frequently in late May and June and may have been major predators of small Coot chicks. Three successful attacks were witnessed during this study, and three by Downie (1972), who also observed a Lesser Black-backed Gull attack a Coot nest.

Downie (1972) found 11 territorial pairs of Moorhen at Airthrey in 1971. Hatching success was only 43.5% with humans the main cause of failure. Hatching success was not determined in the present study but is thought to have been better, even though most nests were not found, but fledging success was also low with 1.9-3.3 young fledged/pair even though most pairs attempted two broods.

Over the five seasons, 65 pairs of Moorhens nested and 18 of these were double-brooded with only one triple brood. This is in accord with the study of Wood (1974), who found double broods unusual, while Relton (1972) found more than a third of her pairs double-brooded. However, a study in Aberdeenshire under semi-artificial conditions with an abundant food supply and few predators found three broods to be normal with experienced adults (Anderson 1965). In the Avon valley, Hampshire, 1.6 and 2.6 young fledged/pair in two different years (Wood 1974). Hatching success was poor (13.6% and 25.8%) with only 11 out of 53 nests hatching but fledging success was then very good (Wood 1974). This was not the case at Airthrey where hatching success was much better but fledging success poor. The high density of Moorhens encouraged juveniles to remain on the natal territory, and juveniles from first broods often helped feed the chicks of second broods. A study in Cambridgeshire found that pairs of Moorhen with helpers reared more chicks per nesting attempt than pairs rearing chicks at the same time without helpers (Gibbons 1987), but insufficient data were available in this study to show whether this was true at Airthrey.

Mink was believed to be the major cause of failure of Coots and Moorhens in 1989, 1990 and 1991. Signs of mink were seen only at the east end of the loch, where the lacustrine vegetation was most dense, and this coincided with the failure of most pairs nesting in this area. Mink take a wide range of prey items in proportion to their availability (Akande 1972). They are therefore particularly damaging to birds which nest at high density such as gulls and terns on offshore islands (Craik 1990; Lloyd *et al.* 1991) and localised concentrations of wildfowl which may be found along rivers, streams and loch margins. Lesser Black-backed Gulls may also have been significant predators of young Coot which, being unable to dive, are very vulnerable to attack when out of cover. The other potential predators, Carrion Crows, Magpies and Grey Squirrels, spent most of the time scavenging and largely ignored nests and chicks. In June and July 1990, a bloom of toxic algae appeared to kill many young Tufted Duck and Coot. Adults lost interest in and abandoned chicks, which grew very slowly with many dying. Mallard and Moorhen which mainly fed out of the water had a good season. In 1991, the first brood of Tufted Duck fledged all nine ducklings

but the remaining seven broods, which hatched three to four weeks later during a bad algal bloom, fledged only ten out of 45 ducklings.

Despite its relatively small size, Airthrey Loch is the most important freshwater site in Central Region at the present time for breeding waterfowl in terms of density and number of pairs. The numbers of young fledged were likely to exceed adult mortality, certainly for Little Grebe, Mute Swan, Coot and Moorhen. Survival of full-grown Little Grebe, Mute Swan, Coot and Moorhen was good, and most young Coot and Moorhen appeared to remain on site through the winter, with numbers falling only from February onwards as territories were established. Many Coot remained on territory throughout the year. On only one occasion in five winters was there snow cover and the loch frozen at the same time, forcing most birds to leave. The 1985/86 winter was more severe at Airthrey than any of the subsequent five, and the steady increase in the population of Moorhen suggests they were recovering from a low point. The population of the other five species remained stable during this period.

Breeding productivity was variable for all species over the five seasons, but different species were more or less successful in different years. Success appeared to be independent of temperature and precipitation. A ranking of breeding success for each species with mean temperature, monthly precipitation and the number of days with over 5mm rain measured at the University weather station in each month from April to July showed no relationship. However, these are particularly crude measures and a factor which integrates precipitation and wind chill over time would be much more meaningful since it is well established that a combination of rain, wind and low temperatures is particularly damaging to small downy young. The detailed study at Lake Myvatn found that the weather in the week after hatching was the main factor determining duckling survival (Bengtson 1972), and Harrison (1972) also found cold, wet weather to be very damaging to ducklings of Mallard and Tufted Duck. At Airthrey, the birds fared better in the poor summers of 1987 and 1990 than in the good summers of 1988 and 1989. The reasons for this are unclear but at a neighbouring site in south-west Perthshire, duck bred very well in 1988 and 1989 and badly in 1987, 1990 and 1991 (pers. obs.). At Airthrey, the very short grass around much of the loch may have allowed young Mallard, Coot and Moorhen to feed without becoming soaked and chilled during wet weather. A relatively asynchronous and prolonged breeding season may also have meant that some cold wet periods in June of 1987, 1990 and 1991 were not as damaging as would have been the case in a more synchronous population. Therefore, bad weather may not have had as much effect as expected at Airthrey. It is less clear why success was relatively poor in the two good summers. The loch shore is much more disturbed by walkers and sunbathers in good weather but this disturbance only occurs for a few hours, mainly around mid-day. Food shortage may have been a factor though there was no direct evidence to support this.

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M.V. Bell, 48 Newton Crescent, Dunblane, Perthshire FK15 0DZ

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Breeding numbers and breeding success of the Peregrine in Shetland, 1961-1991

P.M. ELLIS AND J.D. OKILL

The British Trust for Ornithology (BTO) Peregrine Enquiry in 1962 was the first attempt to survey breeding Peregrines in Shetland (Ratcliffe 1963). Of the 19 known traditional nesting sites visited, 11 were occupied and at least three pairs nested. By 1991, the number of occupied sites had fallen to five with no breeding pairs located, making Shetland the only Scottish county without breeding Peregrines. Available data on breeding Peregrines in Shetland between 1961 and 1991 are presented and compared to the situation in Orkney. Possible reasons why Shetland's Peregrine population remains so small are discussed.

Historical background

The Peregrine *Falco peregrinus* has a long history in Shetland, with bones found in excavations of ninth and tenth century Viking dwellings at Jarlshof (Venables & Venables 1955). Dunn (1837) considered it to be "pretty numerous" and Saxby (1874) stated that "within the last five years the number has increased". Evans and Buckley (1899) noted about 14 occupied sites. In 1951-52, P.W. Sandeman reported ten pairs nesting in Shetland (D.A. Ratcliffe in litt.) and Venables & Venables (1955) stated that Shetland "is, and apparently always has been, one of the strongholds in Britain for this species".

Methods

In national enquiries, organised by the BTO in 1961, 1971, 1981 and 1991 and also in 1986, an attempt was made to visit all known nesting sites at least once in April or early May. In the intervening years, from 1978 to 1991, all known nesting sites which had been occupied since 1974 were checked for signs of occupation at least once in April and May. Sites with one or more birds present and active nests were visited subsequently to record breeding success. All prey items found during visits were recorded and removed. A nesting area was considered to be occupied if a nest was located or if one or more Peregrines were seen in suitable habitat. The high sea cliffs made it difficult to locate the kills and in no cases were definite Peregrine kills found without one or more Peregrines also being seen. Since 1984, visits to most sites each year included both searching from the top of the cliff and searching from a boat. The high cliff nesting habitat, together with the large numbers of Fulmars *Fulmarus glacialis* which inhabit it, increased the difficulty of detecting Peregrines, particularly non-breeding birds which, when an observer approaches, may fly directly away from a cliff without calling and without returning (pers. obs.).

Results

Site descriptions

All known sites and all sites occupied since 1978 were on sea cliffs 50-140m high. All nests located since 1984 were on cliff ledges,

except for one which was in the old nest of a Raven *Corvus corax* and another nest which was in the centre of the flat grassy top of a sea stack.

Population size

Table 1 shows the results of each of the five surveys of known Peregrine breeding sites in Shetland. Over the years, a small number of previously unrecorded sites have been discovered. The rate of occupation of the sites visited declined from 58% in 1962 to 13% in 1991, when only five single birds occupied sites. Since 1962, when eight pairs were located, only a small number of pairs were recorded, with one in 1971, five in 1981, four in 1986 and naught in 1991. Breeding attempts were only recorded in 1962, 1981 and 1986, when respectively at least three pairs, four pairs (80% of pairs holding territory) and three pairs (75%) nested. Not all sites were visited each year, and data gathered during intervening years were incomplete, but the maximum number of occupied sites found in any year since 1961 was 14 in 1985, of which only half were apparently occupied by pairs (tables 2-5). By 1991, the number of occupied sites had fallen to only five, and all occupied by single birds. The number of known breeding pairs in any one year since 1961 has never exceeded four.

Breeding success and productivity

In 30 years since 1961, the largest number of successful nests recorded in any year was three, and in total only about 69 young are known to have been produced (an average of only about 2.2 young fledging per year). During the years when all sites were visited, the proportion of pairs breeding successfully varied between 25% in 1981 and 67% in 1986, with no known nesting attempts in 1991. Although up to four pairs nested in individual years, only one or two were successful, although overall 11 out of 15 (73%) were successful. Only in 1987 did all known pairs nest. Usually three to five pairs were located and about half (56%) of these nested. We did not climb to nests until the

TABLE 1. Peregrine breeding data for the BTO National Peregrine Enquiry years and 1986, when all known sites in Shetland were visited.

	1962	1971	1981	1986	1991
Sites checked	19	25	35	36	38
(%) of known sites	(68)	(89)	(100)	(100)	(100)
Sites occupied	11	5	11	8	5
(%) of sites checked	(58)	(20)	(31)	(22)	(13)
Sites occupied by single birds	3	4	6	4	5
Sites occupied by pairs	8	1	5	4	0
Nesting pairs	3+	0	4	3	0
Successful pairs	3+	0	1	2	0
Young fledged	5+	0	3	6	0
Young fledged per nest	?	0	0.75	2.0	0
Young fledged per successful nest	?	0	3	3	0
Productivity (young fledged per pair)	?	0	0.6	1.5	0

In 1962, it was not known whether three of the pairs nested.
Data for 1962 and 1971 from D.A. Ratcliffe (in litt.).

TABLE 2. Data for Peregrines breeding in Shetland in 1961-1970.

	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Sites checked	8	19	11	18	9	10	2	12	5	4
(%) of known sites	(22)	(68)	(31)	(50)	(25)	(28)	(6)	(33)	(14)	(11)
Sites occupied	6	11	8	6	2	3	1	9	5	4
Sites occupied by single birds	1	3	1	2	0	2	0	2	2	1
Sites occupied by pairs	5	8	7	4	2	1	1	7	3	3
Nesting pairs	4+	3+	2+	4	1	1	1	1	2	2
Successful pairs	2+	3+	2+	4	0	0	1	1	2	0-1
Young fledged	3+	5+	3+	7	0	0	2	1	4	?

Data from D.A. Ratcliffe (in Litt.) and Fair Isle Bird Observatory Trust (FIBOT).

TABLE 3. Data for Peregrine breeding in Shetland in 1971-1977.

	1971	1972	1973	1974	1975	1976	1977
Sites checked	25	?	?	?	?	7	10
(%) of known sites	(89)	(?)	(?)	(?)	(?)	(19)	(28)
Sites occupied	5	4	4	6	8	9	?
Sites occupied by single birds	4	0	0	1	0	?	?
Sites occupied by pairs	1	4	2	5	8	?	?
Nesting pairs	0	2	0	4	2+	?	?
Successful pairs	0	2	0	2+	2+	1	0
Young fledged	0	4	0	2+	2+	1+	0
Young fledged per nest	0	2	0	0.25+	1+	?	0
Young fledged per successful nest	0	2	0	1+	1+	?	0
Productivity (young fledged per pair)	0	1	0	0.4+	0.25+	?	0

Data from D.A. Ratcliffe (in litt.) (1971), *Shetland Bird Reports* 1972-1977, Shetland Bird Club, Lerwick, and FIBOT.

TABLE 4. Data for Peregrines breeding in Shetland in 1978-1983.

	1978	1979	1980	1981	1982	1983
Sites checked	21	21	19	36	28	27
(%)	(58)	(58)	(53)	(100)	(78)	(75)
Sites occupied	7	6	6	11	5	4
(%) of sites checked	(33)	(29)	(32)	(31)	(18)	(15)
Sites occupied by single birds	4	3	2	6	1	1
Sites occupied by pairs	3	3	4	5	4	3
Nesting pairs	2	2	4	4	0	2
Successful pairs	0	0	2	1	0	2
Young fledged	0	0	2	3	0	3
Young fledged per nest	0	0	0.5	0.75	0	1.5
Young fledged per successful nest	0	0	1.0	3	0	1.5
Productivity (young fledged per pair)	0	0	0.5	0.6	0	1.0

Data from J.D. Okill and FIBOT.

TABLE 5. Data for Peregrines breeding in Shetland in 1984-1991.

	1984	1985	1986	1987	1988	1989	1990	1991
Sites checked	25	30	36	27	28	31	29	38
(% of known sites)	(69)	(83)	(100)	(75)	(78)	(86)	(81)	(100)
Sites occupied	7	14	9	8	5	4	6	5
(%) of sites checked	(28)	(47)	(25)	(30)	(18)	(14)	(21)	(13)
Sites occupied by single birds	2	7	5	5	1	2	4	5
Sites occupied by pairs	5	7	4	3	4	2	2	0
Nesting pairs	3	2	3	3	2	1	1	0
Successful pairs	2	2	2	1	2	1	1	0
Young fledged	4	6	6	3	4	1	3	0
Young fledged per nest	1.3	3.0	2.0	1.0	2.0	1.0	3.0	0
Young fledged per successful nest	2	3	3	3	2	1	3	0
Productivity (young fledged per pair)	0.8	0.9	1.5	1.0	1.0	0.5	1.5	0

Data from P.M. Ellis, J.D. Okill and FIBOT.

young were at lest 10 days old so there are only three records of clutch size between 1984 and 1991. Brood size at fledging varied from 1-3 with a mean of 2.5 from a total of 11 fledged broods. The maximum number of young fledged in Shetland in any year since 1984 was six in 1986 and in 1987, and a total of only 27 young were known to have fledged between 1984-1991, averaging only 3.25 young fledging in the islands each year. Since 1984, productivity has varied from 0-1.5 young fledged per pair with a mean over the eight years of 0.9. Of the four nests known to have failed since 1984, one clutch was addled, one clutch being incubated by a female heavily contaminated with Fulmar *Fulmarus glacialis* oil disappeared (what was presumed to be the same female was later found not far from the nest site unable to fly), one nest failed with small chicks and another at the egg stage, both for unknown reasons. Despite the incompleteness of the data, it is clear that since 1969 few Peregrines have nested in Shetland and very few young have been reared.

Organochlorine, PCB and mercury contamination

Between 1981 and 1991, unhatched eggs from three clutches were analysed at the Institute of Terrestrial Ecology's Experimental Station at Monks Wood (Table 6). The egg with the thinnest shell, collected in 1986, had been incubated for considerably longer than the normal incubation period, and so may have lost more calcium carbonate than eggs which had not been incubated for so long (Ratcliffe 1980). The sample was small, but the levels of DDE (the main metabolic breakdown product of DDT) and HEOD (the main metabolic breakdown product of aldrin and dieldrin) are unremarkabe for British Peregrines (Newton, Bogan & Haas 1989). In contrast, the level of PCB in a 1988 egg of 1218.18 ppm in lipid (64.33 ppm wet wt.) and the level of mercury in a 1986 egg of 4.62 ppm dry wt. are high.

Prey taken during the breeding season

Saxby (1874) mentions that the Kittiwake *Rissa tridactyla* was a favourite prey on

TABLE 6. Eggshell indices, organochlorine and mercury levels in unhatched (addled) Peregrine eggs, Shetland 1981-88.

	Nest successful = s failed = f	Eggshell index	% shell thinning	HEOD	DDE	PCB	Mercury
1981	f	1.65	9	–	47 (2.9)	280 (17.0)	–
	f	1.52	16	–	–	–	–
1986	f	1.44	21	5.38 (0.28)	67.74 (3.48)	238.44 (12.24)	4.62
1988	s	1.48	19	–	–	1218.18 (64.33)	2.45

HEOD, DDE and PCB units are parts per million (ppm) in lipid (fats), with ppm wet weight values in brackets below. Mercury units are ppm dry weight.

% shell thinning is calculated using pre DDT mean shell index of 1.82. – indicates not analysed.

Eggshell index is calculated by dividing the dry weight of a blown eggshell by its volume.

Unst and in addition mentions 13 species of wild birds, domestic chicken *Gallus gallus* and rabbit *Oryctolagus cuniculus* as prey species taken during the breeding season. In 1962, one pair appeared to be living almost entirely on Fulmars (Ratcliffe 1963).

Table 7 gives details of the 141 prey items recorded in Shetland during 1984-1991. By both number and weight, about half the prey were seabirds, mainly terns and Puffins *Fratercula arctica*. Waders (mostly Redshanks *Tringa totanus* were also

TABLE 7. Prey recorded as taken by Peregrines during the breeding season in Shetland 1984-1991.

Species	Total	% by number	% by weight
Storm Petrel *Hydrobates pelagicus*	1	0.7	0.1
Red Grouse *Lagopus lagopus*	1	0.7	2.6
Oystercatcher *Haematopus ostralegus*	4	2.8	8.5
Ringed Plover *Charadrius hiaticula*	2	1.4	0.7
Golden Plover *Pluvialis apricaria*	5	3.5	3.9
Lapwing *Vanellus vanellus*	3	2.1	2.6
Dunlin *Calidris alpina*	1	0.7	0.2
Snipe *Gallinago gallinago*	2	1.4	0.9
Curlew *Numenius arquata*	1	0.7	2.9
Redshank *Tringa totanus*	7	5.0	4.3
Turnstone *Arenaria interpres*	3	2.1	1.2
Common Tern *Sterna hirundo*	3	2.1	1.5
Arctic Tern *Sterna paradisaea*	35	24.8	17.4
Commic Tern *Sterna spp.*	8	5.7	4.0
Black Guillemot *Cepphus grylle*	1	0.7	1.6
Puffin *Fratercula arctica*	21	14.9	32.1
Rock Dove/Feral Pigeon *Columba livia*	4	2.8	5.9
Collared Dove *Streptopelia decaocto*	1	0.7	0.8
Skylark *Alauda arvensis*	7	5.0	1.1
Meadow Pipit *Anthus pratensis*	2	1.4	0.2
Rock Pipit *Anthus petrosus*	4	2.8	0.4
Wheatear *Oenanthe oenanthe*	1	0.7	0.1
Blackbird *Turdus merula*	2	1.4	0.7
Starling *Sturnus vulgaris*	19	13.5	6.0
Chaffinch *Fringilla coelebs*	1	0.7	0.1
Common Crossbill *Loxia curvirostra*	1	0.7	0.1
Field Mouse *Apodemus sylvaticus*	1	0.7	0.1
Total number items	141		

Commic Terns are Arctic or Common Terns which could not be specifically identified.

Bird weights from Ratcliffe (1980).

Field Mouse weight from Berry & Johnston (1980).

taken frequently, as were Starlings *Starnus vulgaris*.

Contamination by Fulmar oil
Fulmars have a very effective anti-predator defence mechanism. If they are approached by a potential predator, both adults and larger chicks spit oil at the intruder. In 1976, two fledged juvenile Peregrines were found alive but unable to fly properly and covered in Fulmar oil. Another heavily oiled (by Fulmars) juvenile Peregrine was found dead in 1983. In 1987, an adult female was found alive, but unable to fly, not far from a recently failed nest site where the incubating female had been seen to be coated with Fulmar oil. In the same year a contaminated juvenile bird was seen in flight.

Movements
At least some adult Peregrines appear to be resident because some are seen at Shetland breeding sites during the winter (pers. obs.). Although only 29 nestling Peregrines have been ringed in Shetland, a total of six have been recovered. Five were recovered within Shetland, two in their second calendar year in March and April, one in its third calendar year in June, one in its fifth calendar year in October and one in its tenth calendar year in February. One chick was recovered in Orkney 190km from its natal site in its second calendar year in January. No Peregrines ringed outside Shetland have ever been recovered within the islands.

Discussion

Population and breeding success
Ratcliffe (1963) stated that, "the status of the Shetland Peregrine population was not clear, but it may have experienced the same slow decline since 1925 as populations in the Western Highlands of Scotland". The data presented here show that the population has declined further since then, with only five single birds recorded in 1991. The decline of the Shetland Peregrine population may not have been entirely due to contamination by organochlorines as occurred elsewhere (Ratcliffe 1963). By 1971, the BTO Peregrine Enquiry showed that a marked recovery in numbers had taken place throughout most of Britain (Ratcliffe 1972). The 1981 enquiry found that, although numbers were continuing to increase in many inland areas, Peregrines were not recolonising many coastal districts, particularly in the south-east of England and north and west of Scotland (Ratcliffe 1984), and this has been particularly the case in Shetland, the only Scottish county in which Peregrines did not breed in 1991 (T.D. Dick pers. comm.).

The production of young in Shetland has also been low since at least 1962, and the remnant population is distant from the expanding Peregrine population of the Scottish mainland. There is thus little opportunity for the Shetland population to increase through immigration or local production. Several factors including poor weather, persistent pollutants, poor food supplies and contamination with Fulmar oil might be responsible for poor breeding success. Possible causes include the following:

i) Weather
Peregrine breeding success in southern Scotland was depressed by wet, cold weather during hatching (Mearns & Newton 1988). Meteorological records from Lerwick Observatory suggest that weather conditions during the breeding seasons 1976-1991 (particularly rainfall and temperature in April and May) were unexceptional and are unlikely to have directly reduced breeding success in that period.

ii) Organochlorine, PCB and mercury contamination
Only four addled eggs from three clutches have been analysed since 1981, but an effect of chemical residues in depressing breeding success cannot be ruled out, and the chemical analysis of further eggs would be worthwhile. Seabirds and waders, which

together constitute 68% by number and 82% by weight of the breeding season prey found since 1984, are known to carry heavy burdens of PCBs and mercury (Newton *et al.* 1989). The pattern of breeding season data in Shetland with a high proportion of unoccupied territories, unpaired adults, non-breeding pairs and nest failures but with a few pairs rearing young, is similar to that found in populations elsewhere in Britain which were depressed by the effects of organochlorine pesticides during the 1950s and 1960s but which have now recovered (Ratcliffe 1980). It seems likely that Peregrines in Shetland are contaminated with these chemicals via their breeding season prey.

iii) Poor food supply

Although breeding season prey populations, particularly seabirds, have fluctuated in Shetland since 1969 (Lloyd *et al.* 1991), there is no evidence that prey availability during the breeding season is limiting breeding success or adult survival. At least some adult Peregrines are probably at their Shetland breeding sites during the winter but their prey (and its availability) outside the breeding season remains unknown.

iv) Contamination by Fulmar oil

Mearns (1983) showed that of four oiled Peregrines caught at the nest in south-west Scotland, none was retrapped in subsequent years. In his study, one third of trapped females were oiled in an area with relatively few Fulmars compared with Shetland. Fulmars first nested in Shetland in 1878, and their numbers increased rapidly to c.236,000 pairs by 1985-87 (41% of the British and Irish population) (Lloyd *et al.* 1991). All the traditional Peregrine nest sites in Shetland hold large numbers of breeding Fulmars and at times Fulmars try to nest on ledges used by Peregrines (pers. obs.). Contamination by Fulmar oil has claimed a small number of Peregrines in Shetland, but with such a small Peregrine population this could be critical.

Reasons for the low population level of the Peregrine in Shetland

The Shetland Peregrine population may have been declining since 1925, but was probably further reduced as a result of organochlorine contamination after 1955, when Peregrine numbers plummeted in most parts of Britain (Ratcliffe 1963). Peregrines in Shetland, as in many coastal areas, have not recovered to the same degree as those at inland localities (Ratcliffe 1980). The few addled eggs from Shetland which have ben analysed are contaminated with levels of PCBs and mercury that could be sufficient to depress breeding success. In addition, a small number of Peregrines have been found debilitated by Fulmar oil contamination. This could reduce the survival of both fledged juveniles and adults and in an extremely small population this could be critical.

A comparison with the situation in Orkney

All Orkney data are from E.R. Meek (pers. comm.). The Orkney Islands hold approximtely 35 known sites, a similar number to Shetland. The Peregrine population in these islands has also had poor breeding success since at least the 1960s. However, the population in 1991 was larger than in Shetland with 25 occupied sites, 16 occupied by pairs of which 6-11 nested. However, in 1991 breeding success was poor with only 3-9 pairs rearing young.

Of a total of 327 prey items examined in Orkney in the breeding season between 1981 and 1992, seabirds and waders made up 40% by number and 53% by weight, as opposed to 68% by number and 82% by weight in Shetland. However, Rock Doves *Columba livia* and Feral Pigeons were considerably more important in Orkney (20% by number and 26% by weight), compared to only 3% by number and 6% by weight in Shetland in this study. Waders and seabirds are more heavily contaminated

with organochlorines and heavy metals than are Rock Doves and Feral Pigeons (Newton *et al.* 1989). A higher proportion of seabirds and waders in the diet of Shetland Peregrines could be one of the main reasons why the Shetland Peregrine population has declined more than that of Orkney. But there are no data on prey taken in Orkney outside the breeding season.

In addition, the Orkney Peregrine population may have experienced a higher degree of immigration than is the case in Shetland. Some evidence for this comes from three recoveries of Peregrines on Mainland Orkney where the birds were ringed as nestlings elsewhere in Scotland.

A further contributory factor could be that Orkney has less than half the number of Fulmars found in Shetland (82,000 pairs in 1985-87) (Lloyd *et al.* 1991), and as the Peregrine population there has never reached such a low level as in Shetland it may be less affected if a few Peregrines become oiled.

Conclusion

Probably more than one factor is involved in preventing the recovery of the Shetland Peregrine population. More information is needed before the most important factors can be determined. There are indications that chemical contamination caused the main decline and may be the most important factor preventing the population from recovering in numbers.

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Spring Passage of Pomarine Skuas off Shetland in May 1992

H.R. HARROP, M. MELLOR
AND D. SUDDABY

Between 8-17 May 1992 an unprecedented passage of 2709 Pomarine Skuas were recorded off the west coast of mainland Shetland, 2093 of which passed Watsness on 9 May alone, representing the highest known count of this species past one location in Western Europe. The passage and associated weather, their behaviour, suggested theory of arrival and their displaced movement along the west coast of mainland Shetland are discussed.

Introduction

During May 1992, an unprecedented northerly passage of Pomarine Skuas *Stercorarius pomarinus* was recorded from the west coast of mainland Shetland. Observations from Watsness and Eshaness between 7-17 May recorded a total of at least 2709 birds, including 2563 off Watsness on 8 and 9 May. Watsness was manned on five days (see Table 1) and Eshaness on three days during the above period when weather conditions were thought suitable for observing passage.

Spring occurrence in Britain and Ireland

Passage of Pomarine Skuas in spring generally occurs from late April until early June, usually peaking during the first three weeks of May (Davenport 1992). Skua passage is perhaps best known to occur off the Western Isles (e.g. Davenport 1979, 1984, 1987, 1991), but annual movements off the western and southern coasts of Britain and Ireland, most notably off Slyne Head (County Galway), Carnsore Point (County Wexford) and smaller numbers in the English Channel at Beachy Head (East Sussex) and Dungeness (Kent) (Davenport 1981). Since the mid-1980s, irregular spring seawatching off Watsness and Eshaness have recorded small numbers, the most notable year being 1991, when 105 birds were recorded between 14-25 May (*Shetland Bird Report* 1991).

May 1992 records off Shetland

Pomarine Skuas were recorded on all days that Watsness was visited and the results are outlined in Table 1. Observations from Eshaness and other localities are discussed later (see below).

Passage and associated weather

On 7 May, weak frontal systems moving south-eastwards across the British Isles, introduced north-westerly force 6-7 winds with intermittent rain showers to Shetland (see Fig. 1). These conditions prompted a two hour seawatch off Eshaness, during which two Long-tailed Skuas *S. longicaudus* were seen. On 8 May, the trough of low pressure was still tracking south-eastwards over the British Isles continuing the north-westerly airflow over Shetland, with the wind decreasing to force 3-4, gusting five during more frequent showers (see Fig. 2). Another two-hour seawatch off Eshaness between 1100-1300 hrs BST recorded just

TABLE 1. Pomarine Skua passage off Watsness, 8-17 May 1992.

Date	Time (BST)	Wind	Total	Range (flock size)	Mean (flock size)	Birds/hour
08/5	1030-1430 & 1900-2100	NW3-4	470	1-123	24.7 (n = 19)	78.3
09/5	0600-2100	NNW5-7	2093	1-300	37.4 (n = 56)	161.0
10/5	0800-1230	NW4-5	58	1-20	7.3 (n = 8)	12.9
16/5	0900-1200	W4	86	—	not recorded	28.7
17/5	0815-1100	WSW3	2	—	—	0.73

n = number of flocks.

two Arctic Skuas *S. parasiticus*, whilst a total of six hours seawatching off Watsness produced a single flock of 44 Long-tailed Skuas and 470 Pomarines, 359 between 1030-1230 hrs. On 9 May, a deepening low pressure system reached south-west Ireland and had moved across central Britain by early evening; the northern flank of the low gave Shetland a north-north-westerly airstream of force 4-5, gusting 6-7 during the frequent showers of rain, snow and hail (see Fig. 3). A multi-observer seawatch off Watsness from 0600-1700 and 1800-2100 hrs recorded a total of 2093 Pomarine and three Long-tailed Skuas. Passage started at 0645 hrs and continued throughout the day, with the majority of flocks seen soon after showers. There were two pronounced waves of passage: between 0900-1100 hrs and 1445-1700 hrs, with totals of 472 and 1350 Pomarines respectively. Both waves coincided with periods of frequent showers, which presumably drove the birds close inshore. On the same day, 147 Pomarines were recorded off Eshaness between 1015-1145 hrs, exactly the same number recorded off Watsness between the same times suggesting that some flocks were coasting north. Although weather conditions in Shetland were similar on 10 May (see Fig. 4), only 58 birds were recorded off Watsness between 0800-1230 hrs. Off Watsness on 16 May, a west-north-west wind force four produced 86 Pomarines between 0900-1200 hrs with two recorded there the following day between 0815-1100 hrs, the wind having backed to the west-south-west and decreased to force three.

Other west coast localities in Shetland, namely Fair Isle, Garth's Ness, Fora Ness and Belmont were watched to a lesser extent on 9 and 10 May, but failed to produce any Pomarine or Long-tailed Skuas.

Behaviour

The majority of flocks of Pomarine Skuas observed flew low over the sea, and comprised a nucleus of approximately two-thirds bunched at the front, with the remainder following in single file. In advance of approaching showers all but one flock ceased moving and rested on the sea until conditions improved, the exception being a flock of 72 which, on sighting a shower, rose up from sea level and proceeded to climb at a 70° angle until they flew over the shower. Once the showers had passed over the flock, a nucleus of birds would start to climb high and circle until the stragglers or another smaller flock following behind had caught up with them, after which the flock descended to sea level again and continued in a northerly direction. This behaviour was noted also in fine weather

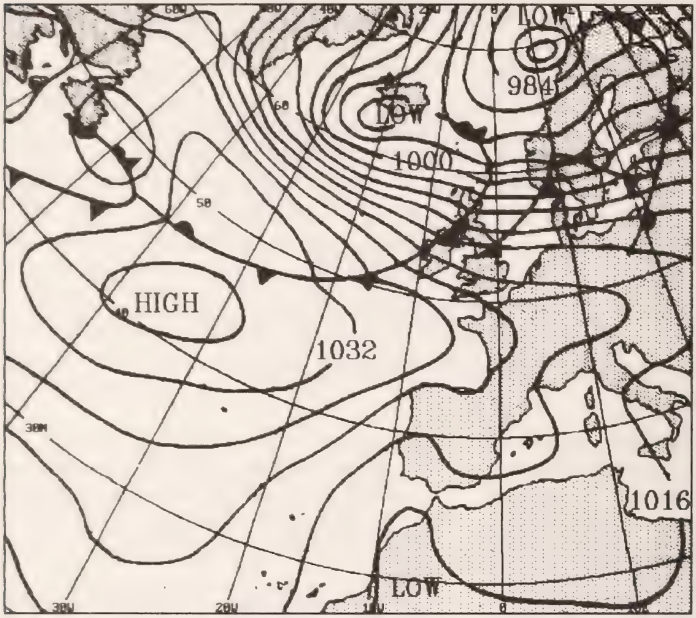

FIGURE 1. 1200 GMT 7 May 1992

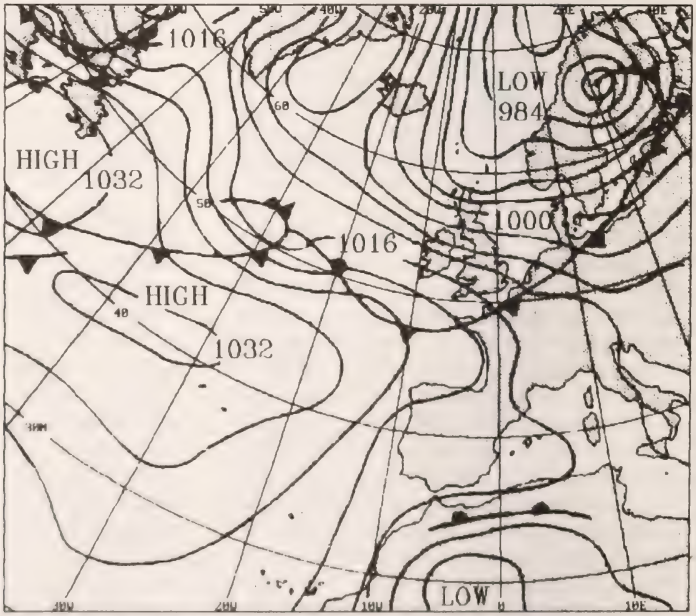

FIGURE 2. 1200 GMT 8 May 1992

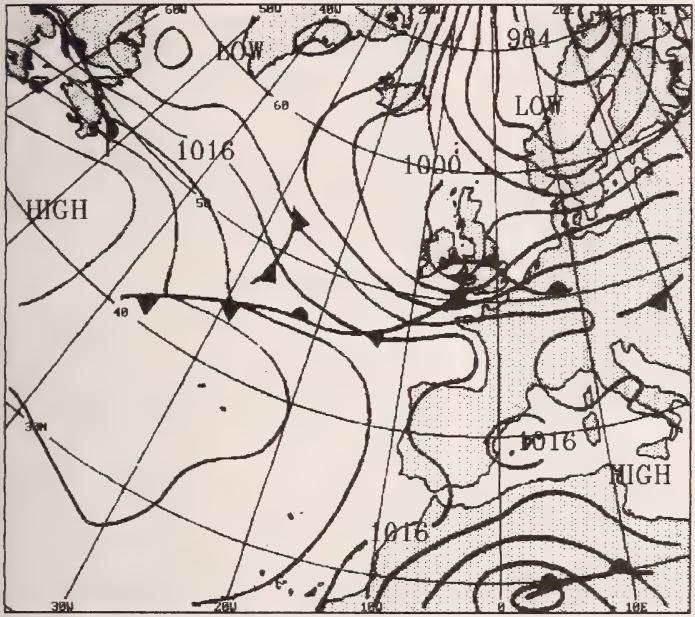

FIGURE 3. 1200 GMT 9 May 1992

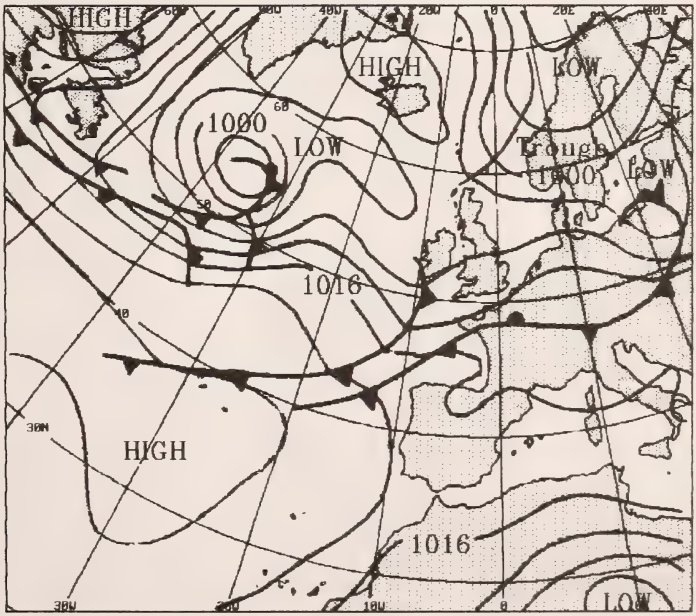

FIGURE 4. 1200 GMT 10 May 1992

with occasional 'coasting' flocks. A likely explanation for this behaviour is that the nucleus of the flock were sighting their continuing route past Watsness.

Discussion

Passage off Shetland seems to occur after several days of strong to gale force west to north-westerly winds, therefore displacing those birds which are thought to follow the continental shelf on northward spring migration (Furness 1987). This assumption is reinforced by the fact that skua passage off the west coast of mainland Shetland has been recorded only after the conditions outlined above. These certainly applied in May 1992, with strong to gale force west to north-westerly winds over the Northern Isles from 4-7 May resulting in large scale northerly movements on 8 and 9 May. However, it must be stressed that those conditions found suitable for observing skua passage off the Western Isles (Davenport 1992) have not, to date, been sufficiently investigated off the west coast of Shetland.

Although no accurate recording of colour phase or age was undertaken during periods of seawatching, a conservative estimation of dark phase birds and sub-adult birds on 9 May, resulted in figures of 5-8% and 15-20% respectively.

Observations at other sites in 1992

Pomarine Skuas were generally noted earlier than usual in spring 1992. In April, birds were recorded from several western localities from 18 April onwards, peak counts being 290 off Bowness-on-Solway (Cumbria) between 19-30 April and 22 off Carnsore Point (County Wexford) on 25 April (Anon. 1992a). In May, records from the Western Isles, predominantly off Balranald and Ardivachar Point included 1289 Pomarines and 835 Long-taileds between 1-16 May. Unfortunately, there was no coverage at Balranald on 7-8 May (to correspond with the coverage at Watsness on 8-9 May) and by 9 May the weather there was unsuitable for skua passage, with light variable winds (D. Davenport pers. comms.). Off Bowness-on-Solway, another 303 Pomarines were recorded between 1-15 May. Many other records came from the west, but good numbers were also recorded from English Channel and North Sea coasts (Anon. 1992b; D. Davenport in litt.).

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Hugh R. Harrop. Fairview, Scatness, Virkie, Shetland ZE3 9JW.
Mick Mellor, Fairview, Quendale, Dunrossness, Shetland ZE2 9JB.
Dave Suddaby, 92 Sandveien, Lerwick, Shetland ZE1 0RU.

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Short Notes

Kestrels feeding on road casualties

Recently we saw Kestrels *Falco tinnunculus* feeding on rabbit road casualties on a relatively quiet moorland road in west Galloway. On 16 December 1991, 7 February 1992, 2 April 1992 and 11 February 1993 we saw a male Kestrel feed on rabbit carrion (twice in the early morning and twice in the late evening) and on 22 October 1992, we disturbed in our car a female or juvenile Kestrel feeding on the old remains of a rabbit carcase at dusk. All five records occurred in the same area within a 400-600m stretch of road. On 15 February 1993, we saw a male Kestrel feed on the remains of a cock Pheasant *Phasianus colchicus* on another road nearby.

Such behaviour may be unusual because Village (1990. *The Kestrel*. London) states that Kestrels are predominently predators of small mammals. Carrion is probably not commonly eaten, but Cramp & Simmons (1980. *The Birds of the Western Palearctic*. Oxford. Vol.2.) state that Kestrels may scavenge at carrion. Village's only record of a Kestrel eating a road casualty was of a common toad in Eskdalemuir while *BWP* gave no records. Similarly Hope-Jones (1980. Bird scavengers on Orkney roads. *Brit. Birds* 73:561-568) makes no mention of Kestrels feeding on road casualties but Hodson (1966. Some notes on the habits of roadside carrion feeders. *Bird Study* 13:272-273) surmised that Kestrels were responsible for eating dead birds that he had placed along a stretch of road but gave no direct observation of this behaviour.

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

Hunting times by Merlins in winter

Casual or anecdotal observations of Merlins *Falco columbarius* in their wintering habitats suggest that they are either active or inactive during much of a short winter day. There are, however, few published records of how Merlins spend their day and, in particular, on the times they hunt. Because little attention has been paid to this, I timed and noted every individual hunting foray, whether successful or not, by 'brown' and 'blue' Merlins from November to February 1966-92 in west Galloway (Fig. 1).

There was a late morning peak of activity at 1030-1200 hrs both by brown and blue Merlins and a similar peak in the afternoon at 1430-1600 hrs by brown and blue Merlins respectively with a lull in activity at midday.

Hunting forays were also plotted between August and March (longer daylight) and a similar pattern emerged (Fig. 2), with a further minor secondary peak of activity by brown birds around 1830 hrs.

Peak activities in the mornings occurred some 2-3 hours after the Merlins had left their roosts. Unexpectedly, there was no indication that Merlins tried quickly to replenish energy stores lost overnight. A need to replenish energy stores to last them during a long winter night is, however, suggested by the greater pattern of activity during the late afternoon. Some Merlins hunted until it was nearly dark but no hunts at their roosts are included.

These finding broadly agree with Warkentin & Oliphant (1990. Habitat use and foraging behaviour of urban Merlin in winter. *J. Zool. Lond.* 221:539-563) who found that nine radio-tagged Merlins in urban Saskatoon, Canada, were relatively

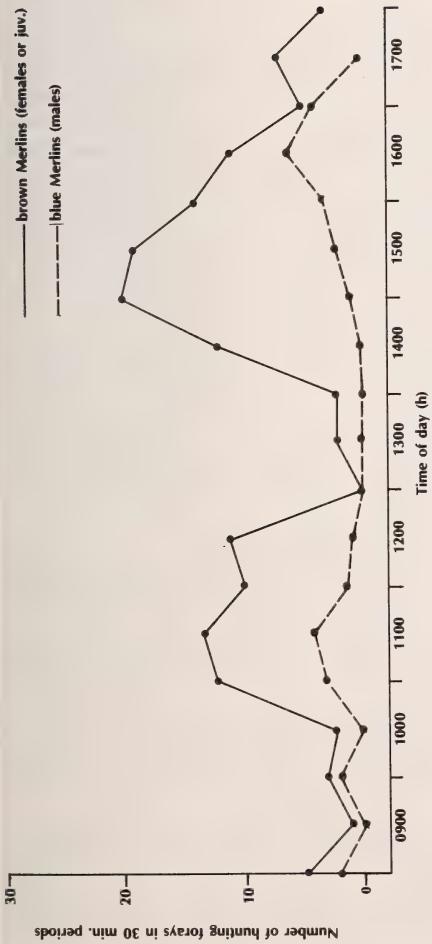

FIGURE 1. Hunting times of Merlins in west Galloway, November – February 1967-92.

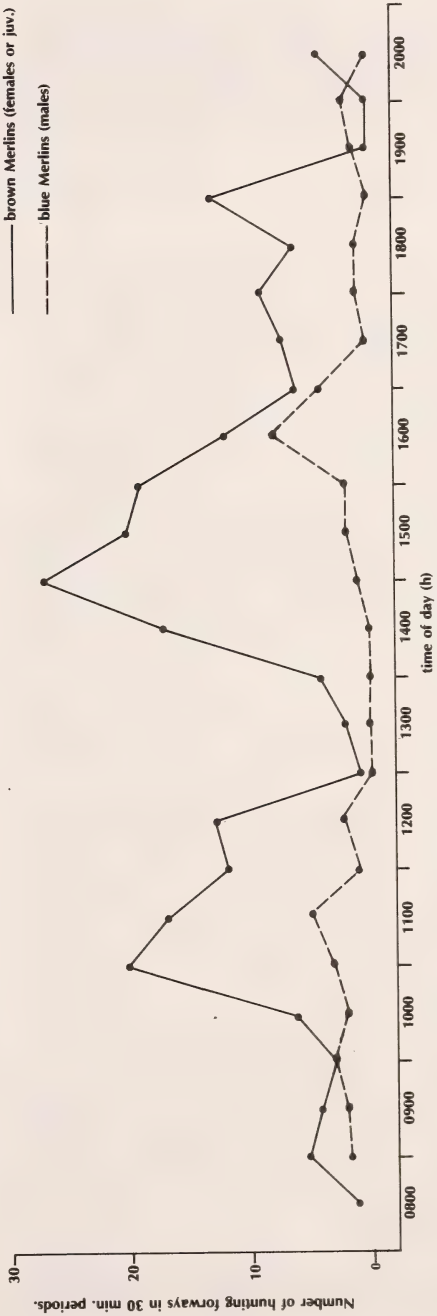

FIGURE 2. Hunting times of Merlins in west Galloway, August – March 1966-92.

inactive for large parts of the day with activity in the early morning, a midday lull and a second activity peak in late afternoon. Newton (1986. *The Sparrowhawk*. Calton) gave a similar pattern of hunting times in radio-tagged Sparrowhawks *Acciper misus*. First-winter birds, however, were more active than adults and had an afternoon peak in activity which was absent in adults.

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

Hunting associations between Merlins and Hen Harriers in winter

Hunting associations between Merlins *Falco columbarius* and Hen Harriers *Circus cyaneus* have previously been described and documented (*Brit. Birds* 77:72-73, 481-482, 79:430; *Ibis* 102:136; *BWP* Vol.2; Watson 1977. *The Hen Harrier*. Berkhamstead). This could be a common hunting strategy, but in west Galloway, during a study of Merlins' hunting activities between 1965-92, it only occurred in 18 out of 270 hunts (6.6%). In winter in west Galloway, Merlins occur in the same open habitats as Hen Harriers and other birds of prey often hunting the same food supply in the same areas at different times and intensity. When the hunting areas of Merlins and Hen Harriers overlapped, Merlins seemed deliberately to take advantage of hunting harriers (and vice versa) but Merlins were usually already at a hunting place before harriers appeared. When a harrier arrived and hunted the same ground, the Merlin would instantly follow and attack prey flushed by the harrier, flying above, behind or ahead and overtaking the hunting harrier as prey was flushed. Both raptors then exploited the prey in the confusion and alarm caused. As long as the harrier was present, the Merlin would continue to hunt with it, but as soon as the harrier left, the falcon continued hunting on its own or flew away. However, I saw only one successful capture by a Merlin in this way, a Lapwing *Vanellus vanellus*; all the rest were unsuccessful.

Nonetheless the confusion to the prey is probably advantageous to both species of raptor (see Watson 1977; *Brit. Birds* 79:430; 81:269-274) and has an element of commensalism about it, since both raptors chased the same prey. Merlins chased Skylarks *Aluada arvensis* nine times, Meadow Pipits *Anthus prentensis* twice, Linnets *Carduelis cannabina* four times and a Pied Wagtail *Motacilla alba* once, while harriers chased the same Skylarks six times, Meadow Pipits once, Linnets three times and a Pied Wagtail once. Merlins hunted with male Hen Harriers on 11 occasions and with 'ringtails' on seven. Calls by Merlins were heard once on 29 December 1991, when a male harrier twisted after some Skylarks, swooped up and met a female or juvenile Merlin head-on which uttered a call; the Merlin then chased the Skylark. During these hunting associations, interactions between Merlins and harriers only occurred four times: twice when a Merlin swooped on a harrier, once when a harrier displaced a Merlin from a perch, and once when a harrier chased a Merlin.

In addition, Merlins also associated with Sparrowhawks *Accipiter nisus* on three occasions. Again the Merlin was always present before a Sparrowhawk arrived and both chased Chaffinches *Fringilla coelebs* and a Linnet flushed by Sparrowhawks beating low across root crops and stubble. Raines (1972. Hunting association of two birds of prey. *Cheshire Bird Report* 1972:20) has also noted similar behaviour.

As well as hunting with other raptors, Merlins will apparently exploit prey species flushed by others, since it has also been reported that they have chased prey flushed by people (Brennecke 1951. Zug Jagdweise

des Merlin-Falken. *Vogelwelt* 72: 82-84; Brown 1974. *Lakeland Birdlife 1920-70.* Carlisle; Dekker 1988. Peregrine Falcon and Merlin predation on small shore birds and passerines in Alberta. *Can.J.Zool.* 66: 925-928); by motor vehicles and Kestrels *Falco tinnunculus* (*Brit. Birds* 79:431) and by a moving train (Kenyon 1942. Hunting strategy of pigeon hawks. *Auk* 59:443-444).

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

Behaviour of Herring Gulls feeding on turnips

In a study of damage to turnips by brown hares *Lepus europaeus*, Hewson (1977) found that gulls *Larus* spp. fed only on turnips from which the hard peel had been removed first by hares (Food selection by brown hares *(Lepus capensis)* on cereal and turnip crops. *J. appl. Ecol.* 14: 779-785). However, in March 1989 Herring Gulls *Larus argentatus* were feeding on turnips in a 2.7 ha field at Eriboll, north-west Sutherland, where there were no rabbits *Oryctolagus cuniculus* or hares to break into the turnips. By 12 March, the gulls had damaged 3.6% of the 36,000 turnips by pecking out a hole big enough for water to collect in, causing rotting or frost damage, and destroyed 6.9% leaving only an empty shell. A month later, and before sheep were folded on the remaining 18,000 turnips, (the rest had been removed to feed cattle and sheep), 7.5% had been damaged and 13.7% destroyed by Herring Gulls. While feeding, gulls pecked in a desultory manner at several turnips before they found one which had

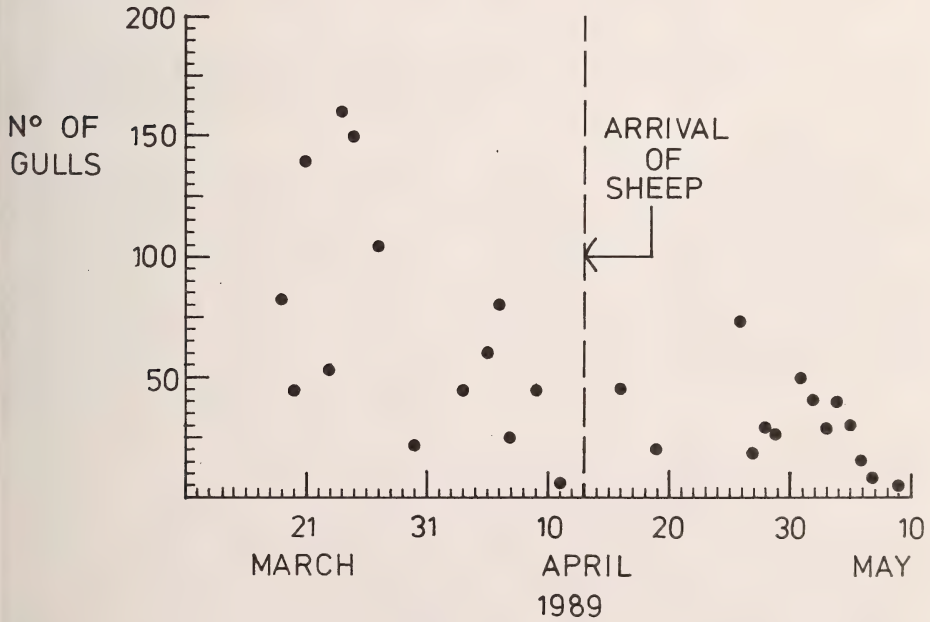

FIGURE 1. The decline in the numbers of Herring Gulls feeding on turnips at Eriboll following the arrival of sheep in April 1989.

been opened up, as if only a proportion of the gulls were adept at breaking into turnips.

Before the sheep arrived, gulls fed in a tight flock over about 10% of the field. They moved away from feeding sheep, which by opening turnips made it easier for the gulls to feed. Gulls then fed over more than 50% of the field in a loose flock, but fewer gulls continued to forage (Fig. 1). Sub-adult Herring Gulls reacted more strongly than adults to the presence of sheep as juvenile Ravens *Corvus corax* do in an unfamiliar situation (Heinrich, B. 1990. *Ravens in winter*. London. Barrie & Jenkins), and the proportion of sub-adults in the flock declined (Fig. 2).

In 1990, red deer *Cervus elaphus* fed widely in the same field from January onwards; consequently many turnips were made available to Herring Gulls. Sheep arrived on 8 January and there were usually about 80, often foraging all over the field. Gulls started feeding in late January and ranged widely in loose flocks. There was no falling-off in numbers as in 1989; indeed there were more gulls in late April than earlier (Fig. 3).

Herring Gulls did not feed on turnips only when bad weather restricted their normal coastal foraging areas. There was no significant difference in the numbers of gulls in the turnip field in winds up to and including force five on the Beaufort scale and in stronger winds.

By contrast, in March 1989 there were no Herring Gulls feeding in 23 turnip fields in north-east Scotland, 11 of them along the coast, although sheep were folded in five

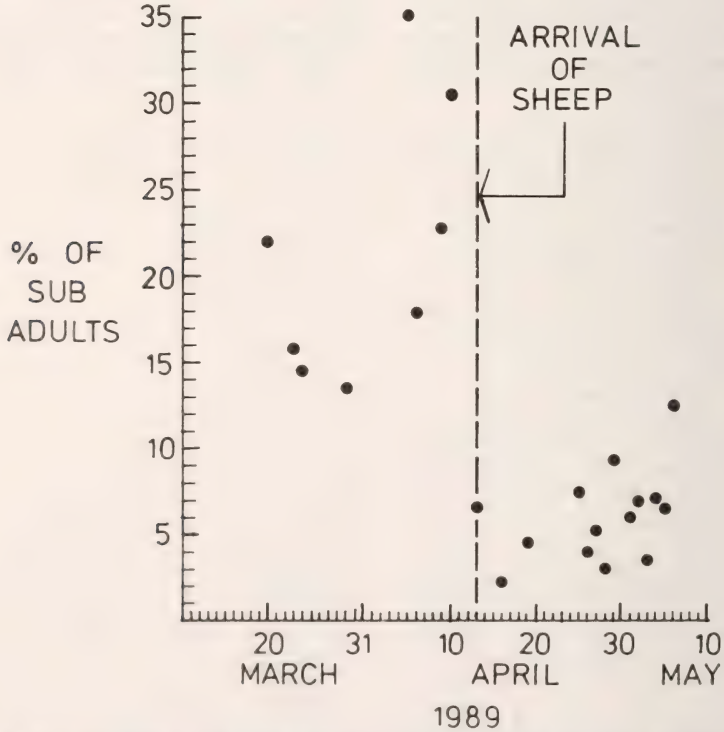

FIGURE 2. The proportion of sub-adult Herring Gulls in the flock following the arrival of sheep.

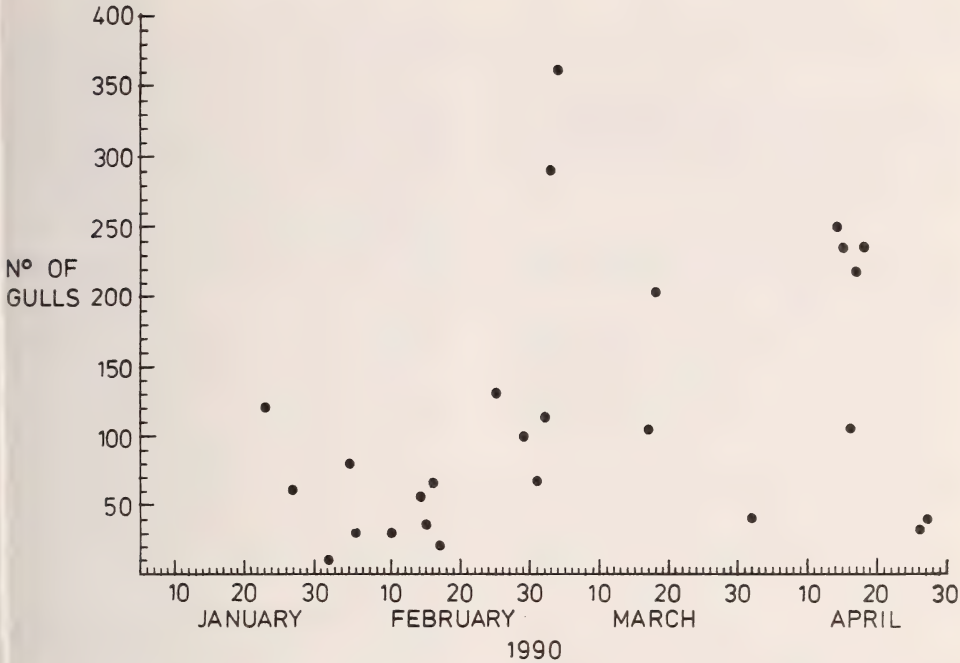

FIGURE 3. Herring Gulls feeding on turnips at Eriboll in 1990, when sheep were present from January though more widely dispersed than in 1989, and Red deer were feeding on turnips in early January, making them more easily available to Herring Gulls.

fields and had been folded earlier in others, and in four fields turnips had been damaged, probably by rabbits.

The extent of the damage at Eriboll was unusually severe when compared with damage to turnips by brown hares, followed by minor damage by birds, in north-east Scotland where 2.8% and 6.0% of turnips on two study areas had suffered minor damage. Of seven varieties involved there, Doon Major, the variety grown also at Eriboll, was the most widely damaged, perhaps because it is a soft-skinned turnip (MacFarlane Smith, pers. comm.). Proximity to the long shoreline of Loch Eriboll may have accounted for the high concentration of gulls on the study area. The nearest other turnip crops were 21km north-west and 20km east.

R. Hewson, Department of Zoology, University of Aberdeen, Tillydrone Avenue, Aberdeen AB9 2TN.

Rare Migrants

(It has been decided by the Editorial Committee that full descriptions will appear in *Scottish Birds* only of species which are new, or at most second records, for Scotland.

Ed)

Solitary Sandpiper on Fair Isle: a third Scottish record

After several days of September gales, mostly from a westerly quarter, the atmosphere at the Fair Isle Bird Observatory was somewhat strained, and visitors to the observatory a little desperate. It was therefore with some relief that Sunday 13 September dawned bright and sunny, with only light to moderate south south-west winds. The wind direction was not esepcially promising, but at least it might now be possible to see what birds there were.

The morning census produced little of real note, although a good fall of Meadow Pipits *Anthus pratensis* (360) and a thin scattering of common warblers were logged. At 1215 hrs I headed up the drive towards Field Croft in search of a first-winter Grey-headed Wagtail *Motacilla flava thunbergi*, which had been reported earlier. As I rounded the corner of the cow byre, I flushed a small brownish wader. The immediate impression was of a brown Green Sandpiper *Tringa ochropus*, with a dark rump and central tail. It did not call and flew only a few yards before alighting. When the bird was at rest, I was struck by its slim, attenuated and 'leggy' appearance, while the bold white eye-ring was much more striking than the indistinct pale loral stripe. I knew instantly that it just had to be a Solitary Sandpiper *Tringa solitaria*. Almost immediately the bird flushed again, this time flying to a tiny pool by the main island road. I hastened to the croft to phone the observatory. Jane Wheeler listened to my garbled request for the telephone with a calm no doubt borne of several years' experience of Fair Isle assistant wardens.

Solitary Sandpiper on Fair Isle

There was no response from the observatory but, seeing the minibus heading back for lunch, I ran out to try and flag it down. It did, however, lurch to a stop before I reached it, and warden Paul Harvey and his two small daughters, Holly and Bryony, were already grilling the bird as I galloped up. Paul's face registered a classic mixture of emotions: delight at the discovery of the superb rarity and the realisation that I had found it first.

The sandpiper flew back to the cow byre as other birders were summoned. Here it remained until the evening of 15 September. It was a particularly confiding individual and provided stunning views to locals and visiting birders during its short stay. A full description may be obtained from the author.

The Solitary Sandpiper breeds over most of Alaska and Canada, wintering in Central America, South America and The West Indies. It is a vagrant to Britain and Ireland, the Fair Isle individual being the 29th documented record. Previous records have all been in the period July-October, with a marked bias to south-west counties of Britain, particularly Scilly. This is the third Scottish record and the first for Shetland. Previous Scottish records are: one shot, Lanark, before 1870; and a juvenile, Maleclete, North Uist, 20 October 1990.

Roger Riddington, Fair Isle Bird Observatory, Shetland ZE2 9JU

Kumlien's Gull in Shetland – the fourth Scottish record

On 15 January 1993, MM was conducting a Beached Bird Survey along the pebble beach at Scatness, Shetland, when he noticed a 'white-winged gull' *Larus glaucoides/hyperboreus* roosting on the fringes of some inland freshwater pools. His initial impression, based on head and wing structure, was that of an Iceland Gull *L. glaucoides*. However, on obtaining closer views, he noticed grey in the outer primaries, characteristic of the subspecies *L. glaucoides kumlieni*, also known as Kumlien's Gull. It soon became apparent that the bird was in an exhausted condition and it was taken into care but, unfortunately, it died soon afterwards. It was thoroughly examined by HRH and MM to eliminate the possibility of it being a Thayer's Gull *L. thayeri*, or a Thayer's x Kumlien's intergrade (which freely interbreed, see e.g. Snell 1989). Reference to Grant (1986) made the eventual identification straight-forward by virtue of the almost textbook pattern exhibited by the outer five primaries. A detailed description was taken and may be found in *Birding World* 6: 105.

Kumlien's Gull breeds on Baffin Island and on the north-west sector of the Ungave Peninsula in north-east Canada. It winters along the Atlantic coasts south to Long Island, USA (Harrison 1987; Lewington *et al.* 1991), and is a vagrant to Europe.

Excluding the Faeroes, where there were at least 38 in January 1983 (Fjeldsa & Jensen 1985), most of the records originate from Britain and Ireland, where a total of 11 individuals have been recorded up to the end of 1991 (Lewington *et al.* 1991; Rogers *et al.* 1992). In addition, and subject to acceptance by British Birds Rarities Committee (BBRC), a further six individuals were recorded in Britain during 1992 (Anon. 1992), including an adult in Highland, bringing the Scottish total to three. These are: Lerwick Harbour, Shetland, adult, 4-8 February 1983 (*Shetland Bird Report* 1983); Banff Bay, Grampian, adult, first seen on 17 March

Kumlien's Gull in Shetland

1985, returning sporadically during winter months until at least February 1992 (Anon. 1992, A Murray pers. comm.); Inverness, Highland, adult 1 January 1992 (Anon. 1992, A Murray pers. comm.).

The Scatness individual, probably a fourth winter bird due to the tail band and primary covert pattern will, upon acceptance by BBRC, constitute the fourth record for Scotland. The skin is now held at the Royal Museum of Scotland.

Acknowledgements

We are grateful to Kevin Osborn for commenting on and improving the manuscript and Angus Murray for providing information on previous Scottish records.

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Hugh R. Harrop, Fairview, Scatness, Virkie, Shetland ZE3 9JW.
Mick Mellor, Fairview, Quendale, Dunrossness, Shetland ZE2 9JB.

Obituary

Dr William Serle O.B.E. (1912-1992)

William Serle died in Edinburgh on 7 October 1992 following a short period of declining health. He was born in Duddingston Manse, Edinburgh on 29 July 1912 and attended George Watson's Boys' College before studying for a degree in medicine at Edinburgh University.

His enthusiasm for ornithology was fired largely by his father's own activity in the subject. The Revered William Serle collated extensive field notes and built up a comprehensive (worldwide) collection of birds' eggs. As a boy, William Serle accompanied his father on many excursions from which he produced his own meticulous notes. He travelled widely throughout the Lothian and Border counties by bicycle and made longer journeys to the north and to Orkney. The first of a long series of ornithological publications was a note on Mergansers *Mergus serrator* in *Scottish Naturalist*, written while he was still in his teens.

With ready access to current bird literature in his father's library, William Serle recognised the potential for increased ornithological research in West Africa. Following his graduation in 1936, the year in which he was elected to the British Ornithologists' Union, he joined the Colonial Medical Service and he sailed for Lagos in 1937.

For the next 20 years William Serle made extensive and valuable collections in Nigeria, Sierra Leone, British Cameroon (as then known) and parts of East Africa. This research yielded some 60 publications from his pen covering aspects of status, distribution, breeding and taxonomy. A number of these papers were classics of their period and it must be remembered that his ornithological work was accomplished very much as a sideline to his professional duties as a doctor. Not unexpectedly, in view of his medical background, William Serle maintained detailed and comprehensive field notes which bore the stamp of a methodical mind; his publications fully reflect this clarity of thought and expression. Despite the fashion of these years for 'splitting', William Serle pushed a conservative line in taxonomic problems, in many cases suggesting that their resolution should be dependent on the availability of a larger series of specimens. Nevertheless, he is credited with the descriptions of 18 new avian taxa, including the Kupe Mountain Bush-Strike *Malaconotus kupeensis*, a bird with a very restricted range and always considered rare.

During the war he was called up to serve with the West African Field Ambulance Corps and he saw active service in India and Burma. He was awarded the O.B.E. in 1946 for his outstanding army service.

He married in 1956, and after a further short period in Africa, he felt called to train for the ministry in Scotland. In 1959, he was ordained and inducted to Drumoak in Kincardineshire where he remained until his retiral in 1987. Following his return to Scotland, he continued research and publication on personal material, much of which had been presented to the British Museum (Nat. Hist.). In 1977, he co-authored Collins' *A Field Guide to the Birds of West Africa* – a work familiar to many. A lower profile, yet significant, role was his position as a referee for the *Birds of Africa* series for which his knowledge and expertise proved invaluable.

In 1987, Dr Serle donated his scientific collection of West African birds' eggs to the

National Museums of Scotland, where it joined material previously donated by him as early as 1932. The bulk of his skin collections are in the Natural History Museum at Tring, though he also sent material to major natural history museums in Africa, Europe and North America. The NMS has c.500 of these skins.

Following his death, field notes and other early notebooks joined his zoological material in collections of the NMS. His collections and published works are a lasting reminder to a very full and varied life. William Serle is survived by his wife Sheila, five daughters and a son. To them all we express our deepest sympathy.

R.Y. McGowan, Department of Natural History, Royal Museum of Scotland, Chambers, Street, Edinburgh EH1 1JF.

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

Further aberrant plumage in Peregrine

I read with considerable interest G. Bates's article in *Scott. Birds* 16: 219 concerning aberrant plumage in a pair of Peregrines *Falco peregrinus* in north Scotland. Just a few days earlier I had come across a Peregrine with aberrant plumage, albeit of an entirely different nature. On 15 June 1992 I visited a location in Central Region where a fortnight earlier two birdwatchers had reported a pair of Peregrines. There had been no breeding records from this site before but it was certainly a very promising location. After searching around, I found a nest and received a shock when I saw the sitting female. She was facing me and, at a distance of no more than 70m, the bird showed a bright salmon-pink breast. The rest of the bird was more normal, with a very black head and moustachial streak, a blue-grey back, a greyish bill with yellow at the base, a dark iris and a yellow eye-ring. After a while the bird took off and flew close overhead. The underparts were heavily barred but I could clearly see that the salmon-pink colour extended to all areas of the underparts that are usually white or off-white. The tail was noticeably very short and was tipped with the same salmon-pink colour. The bird's alarm call and general flight pattern were that of a typical Peregrine. However, when I looked at the nest site, I received another surprise. It contained two tiny chicks, no more than a couple of days old, but instead of having the usual white coloured down, both young were bright salmon-pink all over.

Two days later I visited the site again, this time in the company of Roger Broad. The female Peregrine was present again, but sadly one of the two chicks was now dead, lying with its feet in the air in the nest scrape. On my third and final visit on 11 July the scrape was empty and there was no sign of any birds. On none of these occasions did I see the male Peregrine, but according to Patrick Stirling-Aird, who visited the site once, this was a normal plumaged bird. All site visits were carried out under licence from the Scottish Natural Heritage as part of a national monitoring exercise.

On looking through the literature, there is very little reference to salmon-pink colouring in the nominate race *peregrinus*. Derek Ratcliffe in his book *The Peregrine Falcon* wrote that "the underparts are white or cream, though the actual shade is variable, the chest usually tending to a warm buff or even salmon-pink or pale rufous tint, especially in the female, whereas the males are whiter". However, there is considerable geographical variation in the Peregrine population and *BWP* gives two races that show traces of pink – *F.p. brookei* (Mediterranean basin to Caucasus) is described as "more rufous below", while *F.p. madens* (Cape Verde Islands) has "underparts suffused with dull pink-buff". Both these races seem unlikely to occur in Scotland by their own efforts as neither is known for its migratory movements. In plumage characters, *madens* approaches the

Barbary Falcon *P. pelegrinoides* (which the Scottish bird clearly was not), and *brookei* that I have seen in Algeria were very different from this Scottish individual. The possibility of an escape from captivity cannot be entirely ruled out, although this bird did not have any jesses. *Brookei* and *brookei* x *peregrinus* and other crosses are kept in some numbers in this country. Nevertheless, perhaps this is another case of aberrant plumage in Scottish Peregrines. Like the author of the previous article, I would be very interested to see the results of successful breeding if the bird returns to the site next year.

Mike Trubridge, Garrison Cottage, Inversnaid, Stirling FK8 3TU.

Fulmar oiling of Peregrines

I noted with interest W.R.P. Bourne's letter (*Scott. Birds* 16: 290) suggesting that the aberrant plumage of a pair of Peregrines *Falco peregrinus* in Sutherland (*Scott. Birds* 16: 219) was due to oiling by Fulmars *Fulmarus glacialis*.

I agree with him that Fulmar oiling is a problem for Peregrines and this is definitely the case in Orkney, where there is also competition with Fulmars for nesting ledges. Typically, oiled plumage is stained dark brown and appears to be wet or shiny as though the bird had just been bathing. There is often impairment of flight, the bird only moving a short distance before alighting again.

The incidence of Fulmar oiling of birds appears to have increased in Orkney in recent years (Booth, C.J. & Reynolds, P. 1987. Fulmar oil contamination of birds in Orkney. *Orkney Bird Report* 1986: 70-75). Ravens *Corvus corax*, particularly newly fledged juveniles, and Peregrines were found to be most often affected, but altogether 16 species were recorded with Fulmar oil contamination. From 1971 to the end of 1992, there have been 21 cases of Fulmar oiled Peregrines, 11 of which were either found dead or dying and three others were taken into care for cleaning and then released.

Chemical pollutants also continue to pose a threat to Orkney Peregrines and at two sites that I monitored in 1992 both clutches failed to hatch, the females continuing to sit for longer than the normal incubation period. It would seem that, with only a small number of pairs in Orkney successfully rearing young and with the combination of pollutants and Fulmar oiling, the Peregrine population in the county will have difficulty in making a recovery similar to that seen in other parts of Britain.

C.J. Booth, Ronas, 34 High Street, Kirkwall, Orkney.

Attacks by Great Skuas on an Eider and a Mute Swan

Further to Martin Heubeck's note on Great Skuas *Stercorarius skua* attacking a flock of moulting Eiders *Somateria mollissima* (*Scott. Birds* 16: 284) I would like to add two interesting sightings here on Stronsay in 1992 concerning Great Skuas.

i. At approximately 1100 hrs on 6 May, Tony Hulls and I were watching a small flock of adult Eiders (two drakes, four ducks) swimming 50 yards off-shore at Bomasty Bay. The birds suddenly became agitated and we noticed a Great Skua wheel

round above the Eiders and suddenly dive down at the flock. The Eiders dived, but the Skua seemed to have singled out one individual and after a chase of some 20 minutes, during which time the Eider dived several times, the Skua eventually killed and ate the bird. The rest of the flock had come out of the water and watched the episode from the rocky shore. The singled out Eider escaped from the Skua several times but each time the Skua followed it, as it was swimming underwater, by a series of flapping 'lunges'. The Eider had been held by the wing and nape and finally again by the nape and seemed to be dead after about 20 minutes.

ii. At approximately 1500 hrs on 17 September, I noticed a Great Skua flying low over a pair of Mute Swans *Cygnus olor* with two almost full-grown cygnets, which were swimming in the sea at Whitehall Stronsay. The Skua suddenly wheeled round and attempted to grab one of the cynets by the nape. The parents lunged at the Skua and it was driven off a few yards, where it landed on the sea. The Skua made several further attempts to grab the same cygnet, both from the water and from the air, but each time the parent Swans drove it off. After ten minutes, the Skua gave up and flew off.

John Holloway, 'Castle', Stronsay, Orkney.

The Fair Isle Baillon's Crake and other corpses

Unlike a number of other recent Shetland rarities, now in museums, the Fair Isle Baillon's Crake referred to by McGowan & Kitchener (*Scott. Birds* 16: 289) is in a glass case in my home in Shetland (address below). Anyone who wishes to see it is welcome to call. Suitable provision for posterity has been made in my will, but until that comes into effect I intend to keep the specimen!

Incidentally, a number of other corpses of birds found dead in Shetland in recent years have been sent to museums in Britain, including the following to the Royal Museum of Scotland: Two-barred Crossbill (2), Radde's Warbler, Icterine Warbler, Honey Buzzard, Kumlien's Gull, Spoonbill, Barn Swallow and American Redstart, the latter two being mummified corpses found onboard oil tankers arriving at Sullom Voe from the Americans.

Dave Suddaby, 92 Sandveien, Lerwick, Shetland ZE1 0RU.

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 September 1992 to February 1993. The librarian would be glad to learn of anything that has been missed, and to receive reprints or copies of papers on any aspect of ornithology or natural history.

Bird reports marked with an asterisk are available from the SOC at the prices quoted, but please add 50p per order for postage and packing.

Scientific papers

Belaoussoff, S. 1993. Northern Gannet and Common Guillemot nesting on Rockall. *Brit. Birds* 86: 16.

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Colonsay and Oronsay 1992 Natural History. J. & P.M. Clarke (eds) 1993. 9 pp. An unpublished report in a long-running series.

Fife Bird Report for 1991. D.D. Dickson (ed) 1992. 74 pp. Includes a 46 pp systematic list, short papers on recent decisions on more birds in Fife, Weather, The Fife Bird Atlas, Coastal Birdwatching and four rarities reports. * £3.30.

Forth Area Bird Report for 1991. C.J. Henty (ed) 1992. Pp 27-53 of *Forth Naturalist and Historian* vol. 15.

Grampian Ringing Group Report no. 7 for 1989-91. M. Marquiss (ed) 1992. 86 pp. Includes a 45-page ringing record, and short reports on Teal, Oystercatchers, Dunlins, Meadow Pipits, Robins and Crossbills.

Highland Region (South) Bird Report for 1989 and 1990. J. Carruthers, R. Dennis, D. Galloway & A. McNee (eds) 1992. 40 pp.

Isle of May Bird Observatory Report for 1991. Ian Darling (ed) 1992. 48 pp. * £3.25.

Lothian Bird Report for 1991. P. Speak (ed) 1992. 125 pp. Includes a 71 pp systematic list, and 40 pp of censuses of Mute Swans, Geese and Herons. Also short articles on Oystercatchers, Blue Tits, Long-tailed Skua passage, and four rarity reports. * £4.25.

North Sea Bird Club Report for 1991. P. Doyle (ed) 1992. 75 pp. Includes a 35 pp systematic list, and a short article on migratory movements of Starlings through the North Sea.

North-East Scotland Bird Report for 1991. A. Webb (ed) 1992. 72 pp. * £4.50. Includes four full-page colour plates, a 50-page systematic list, and papers on Peregrines, Merlins, Shearwaters, and rare birds.

Orkney Ringing Group Report no. 5 for 1989-90. C.J. Corse & E.R. Meek (eds) 1992. 54 pp. Includes short papers on Curlew, Purple Sandpipers, Black Guillemots and Swallows, and a 34-page ringing record.

Perth and Kinross Bird Report for 1991. W. Mattingley & R. Youngman (eds) 1992. 40 pp. * £2.90.

Scottish Bird Report for 1990. R. Murray (ed) 1993. 72 pp. Includes a paper by David Jardine on the Crossbill invasion of 1990/91, and a 60-page species list. * £4.00.

West Lothian Bird Report for 1991. West Lothian Bird Club (comp.) 1992. 9 pp. This is their first report and is a commendable effort. It does not pretend to cover the whole of West Lothian, but consists of site descriptions and bird lists for five sites which are watched regularly.

Multi-paper reports

RSPB Conservation Review no. 6. C.J. Cadbury (ed) 1992. 96 pp. £7.00 post free from RSPB, The Lodge, Sandy, Bedfordshire SG19 2DL.

Proc. Seabird Group Conference. European Seabirds. M.L. Tasker (ed) 1992. Held at Glasgow University, March 1992. (Summaries only) 26 pp.

William G. Harper

European journals in the Waterston Library

The following selection of articles appeared in European journals received in the Waterston Library between September 1992 and March 1993, and thus follows on the list published in Vol 16 No 4. 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:	*Der Ornithologische Beobachter*
Belgium:	*Aves, Mergus*
Germany:	*Seevögel, Journal für Ornithologie, Ökologie der Vögel, Corax, Die Vogelwelt, Limicola*
Austria:	*Egretta*
Poland:	*Acta Ornithologica*
Italy:	*Avocetta*
Sweden:	*Vår Fågelvärld, Ornis Svecica*
Norway:	*Vår Fuglefauna, Fauna Norvegica*
Denmark:	*Dansk Ornitologisk Forenings Tidskrift*
Finland:	*Lintumies, Ornis Fennica*
Iceland:	*Náttúrufræðingurinn*

General:

Flade, M. (ed) *et al.* Special issue on methods of monitoring bird populations – some articles in English, majority in German – *Vogelwelt* 4-5/92.

Gatter, W. [Timing and pattern of Autumn migration: the influence of the greenhouse effect] – *Jour. für Orn.* 4/92.

Hilgerloh, G. et al. Are the Pyranees and the Western Mediterranean barriers for trans-Saharan migrants in Spring? – *Ardea* 3/92.

Deceuninck, B. & Baguette, B. [Breeding birds in Spruce plantations of successive ages on the Plateau des Tailles] – *Aves* 4/91.

Jonkers, D.A. [Population trends of breeding birds in the Netherlands 1969-85] – *Limosa* 3/92.

Beintema, A.J. [Mayfield, a necessity: methods of calculating nesting success] – *Limosa* 4/92.

Divers to Ducks:

Keller, V. [The importance of continuous nest-building during incubation by Great Crested Grebe] – *Orn. Beob.* 3/92.

Minguez, E. et al. [Status, distribution, population size and reproductive phenology of the European Storm Petrel in the Basque country of Spain] – *L'Oiseau* 3/92.

Netherlands/Belgium Goose Working Group. [Goose counts in the Netherlands and Belgium 1989/90] – *Limosa* 4/92.

Nilsson, L. & Persson, H. Feeding areas and local movement patterns of post-breeding Greylag Geese in S Sweden – *Orn. Svec.* 2/92.

Follestad, A. [Shooting pressure on Greylag Geese] – *Var Fuglefauna* 3/92.

Étienne, P. et al. [Updating of status of Bean Geese in the Somme estuary] – *Alauda* 2/92.

Devos, K. [The Tufted Duck as a breeding bird in the Belgian coastal polders] – *Mergus* 2/92.

Birds of Prey:

Pielowski, Z. [Population and breeding success of raptors on farmland near Czempin, W Poland] – *Acta Ornith.* 2/91.

Nielsen, O.K. & Björnsson, H. [Rare and vagrant birds in Iceland, Report No 8: Raptors] *Náttúrufraedingurinn* 3-4/92.

Bertel, B. Ageing of Marsh Harrier – *Dansk Orn. For. Tidss.* 3-4/92.

Kostrzewa, R. [On the population ecology of the Kestrel] – *Ök. der Vög.* 2/91.
Tishechkin, A.K. & Ivanovsky, V.V. Status and breeding performance of Osprey in N Byelorussia – *Orn. Fenn.* 3/92.

Grouse to Cranes:

Spidso, T.K. Egg size in relation to renesting in Capercaillie – *Fauna Norveg* 5/92.

Waders to Auks

Piersma, T. & van de Sant, S. Pattern and predictability of potential wind assistance for waders and geese emigrating from W Africa and the Wadden Sea to Siberia – *Orn. Svec.* 2/92.
Gudmundsson, G.A. & Linström, A. Spring migration of Sanderlings through S W Iceland: where from and where to ? – *Ardea* 3/92.
Trolliet, B. [Ruff wintering in the Senegal delta] – *Alauda* 3/92.
Wuorinen, P. Do Arctic Skuas exploit and follow terns during Autumn migration? – *Orn. Fenn.* 4/92.
Willemyns, F. [Long-tailed Skua influx on Belgian coast Autumn 1991] – *Mergus* 6/92.
Hoogendoorn, W. et al. Spring head-moult in Mediterranean Gull in N W France – *Dutch Birding* 6/92.
Schramm, A. [Mass migration of Kittiwakes in Arctic waters in July] – *Seevögel* 3/92.

Pigeons to Woodpeckers:

Ólafsson, E. [Rare and vagrant birds in Iceland. Report No. 7: Nightjars and Swifts] – *Náttúrufræðingurinn* 2/92.

Passerines:

Kouki, J. Habitat associations of passerines breeding in peatland in Eastern Finland – *Orn. Fenn.* 3/92.
Géroudet, P. [The Rock Pipit] – *Alauda* 2/92.
Sachslehner, L.M. [Breeding density of Spotted, Collared and Red-breasted Flycatchers in Viennese woods related to tree die-back and selective cutting] – *Egretta* 2/92.
Thingstad, P.G. Applicability of Pied Flycatcher's clutch size and breeding success as an environmental indicator – *Fauna Norveg.* 5/92.
Nikander, P.J. [Identification of small pipits – Part I] – *Lintumies* 4/92.
Grajetzki, B. [Diet and breeding behaviour of female robins in hedgerow habitat in Schleswig-Holstein] – *Vogelwelt* 6/92.
Hansen, R.E. [Barred Warbler breeding records at Molen and in outer Oslofjord] – *Var Fuglefauna* 1/93.
Möckel, R. [Effects of pollution damage to forests on population dynamics of Coal and Crested Tits in western Erzgebirge] – *Ök. der Vög.* 1/92.
Mäck, U. [First results of a study of the Magpie in Ulm] – *Ök. der Vög.* 2/91.
Henriksen, K. [Communal roosting in suburban Magpies] – *Dansk Orn For Tidsskr.* 3-4/92.
Ellenberg, H. and Dreifke, R. [Ravens acting as protection for other species against Goshawk predation] – *Corax* 1/92.
Barthel, P.H. et al. [Mongolian Trumpeter Finch in the Western Palearctic] – *Limicola* 6/92.
Cordero, P.J. & Summers-Smith, J.D. Hybridisation between House and Tree Sparrow – *Jour. für Orn.* 1/93.

M.H. Murphy

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Moult flock surveys indicate a continued decline in the Shetland Eider population, 1984-92

M. HEUBECK

The number of Eiders in Shetland in late summer 1992 was estimated to be c.7200 birds, based on surveys of moulting areas. This compared with previous estimates of c.10,000 blrds in 1989, c.11,800 in 1984 and at least 16,500 in 1977. In the absence of contrary evidence, it is assumed the Shetland Eider population is largely sedentary. Possible reasons for a continued decline in Eider numbers in Shetland between 1984 and 1992 are discussed but remain unclear, although mortality from oil pollution is unlikely to have been a significant factor.

Introduction

Surveys of flocks of moulting Eiders *Somateria mollissima* began in Shetland in the mid-1970s and counts made in 1977 were used to derive a late summer population estimate (including juveniles) of c.15,500 birds (Jones & Kinnear 1979), a figure subsequently considered too low by at least c.1000 birds (Heubeck 1987). Annual surveys during 1980-84 led to a further estimate of 11,500-12,000 birds in 1984, 25-30% lower than the revised 1977 figure (Heubeck 1987). This paper presents the results of further surveys of moult flocks carried out annually during 1988-92.

Methods

These have been described previously (Heubeck 1987). All known moulting areas were surveyed at least once between mid-August and early September from either the land, 10-15m hard-hulled boats or a small helicopter. Birds were either counted singly, estimated in blocks of five or ten depending on flock size and structure, or counted later from photographs. Moult flocks move locally in response to wind and sea conditions and while the geographic coverage of the 1988-92 surveys focussed on where flocks had been found previously, the length of coastline surveyed gradually increased as boundaries of known moulting areas were extended, to check that birds were not being missed. Additional, largely negative, information came from boat journeys between known moulting areas and, in 1990-92, from observations during separate surveys of harbour porpoises *Phocaena phocaena*. The extent of the coastline surveyed in 1992 and the location of moulting areas is shown in Fig.1.

Results

Counts of Eiders in each moulting area in 1988-92 are compared with the 1977 and 1980-84 results (Table 1). All known moulting sites should be covered in each year's survey as the number of birds moulting in a given area can vary considerably between years, while observations of marked birds have shown that males do not necessarily moult close to where they winter or breed. Of 63 male Eiders caught and wing-tagged in north-east Yell in November 1984, three were later seen in moult flocks : one at North Fetlar (Area 14) in July 1985, one at Scatness (Area 1) in August 1985 and a different bird at Noness (Area 22) in August 1988.

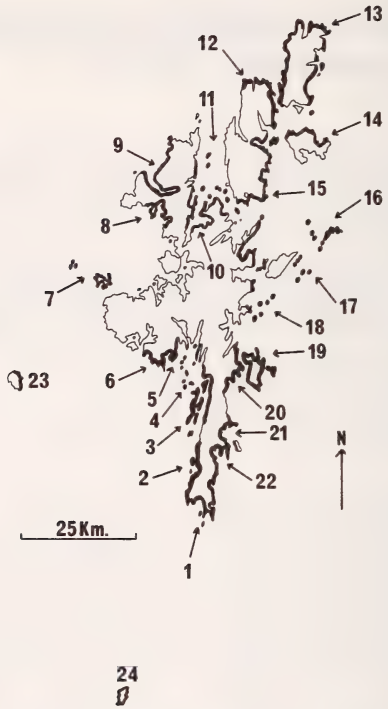

FIGURE 1. ***Map of Shetland showing the coastline surveyed in 1992 and moulting areas identified in Table 1.***

Coverage in 1991 and 1992 was the most extensive to date and helped resolve questions over how regularly some sites are used. Papa Stour and the remote Ve Skerries, difficult to survey by boat, may have long been regular moulting areas (on 11 June 1890 Harvie-Brown found Eiders at the Ve Skerries "abundant, though mostly drakes" (Evans & Buckley 1899)) and it is possible that flocks were overlooked there during fixed-wing aerial surveys in 1980-82. Surveys by helicopter in 1991 and 1992 proved extremely effective, both in terms of coverage, accuracy of counts and quality of photographs taken. The Fitful/St Ninian's Isle area has probably not been used regularly by significant numbers of moulting Eiders and it is now thought that the larger flocks of birds sometimes found there in the 1980s had probably moved north from the Sumburgh area during the moulting period in response to adverse weather. Despite the better coverage and knowledge of local movements of flocks, the total number of Eiders found in 1992 was 40% lower than in 1984, the most thorough of the 1980-84 surveys, and 56% lower than in 1977 when at least seven moulting areas were not covered.

In using these survey results to derive late-summer population estimates, one must take into account known moulting areas not covered by the surveys (including Foula and Fair Isle) and unsurveyed coasts holding scattered birds (mostly females with juveniles) which have not joined moulting concentrations. Jones & Kinnear (1979) cited a figure of c.300 for Foula in deriving

TABLE 1. ***Counts of moulting Eiders in Shetland, 1977 - 1992. Areas are as shown in Figure 1. Counts in brackets indicate incomplete coverage of the moulting area by 1991/92 standards, those marked with an asterisk indicate coverage of the area by fixed wing aircraft only, the method by which flocks were most likely to have been overlooked. Underlined minimum population estimates are those derived from the most thorough surveys.***

AREA	1977	1980	1981	1982	1983	1984	1988	1989	1990	1991	1992
1. Sumburgh	2000	1551	1108	1771	2559	1484	1468	1880	1856	1421	1310
2. Fitful/St Ninian's				(273)	0*	418	333	21	138	47	78
3. Burra/Trondra	(250)	594	172	195	294	235	130	32	115	26	125
4. Scalloway Islands		196	129		70*	(155)	(133)	(91)	35	215	34
5. Reawick									111	21	0
6. Westerwick/Skeld	1800	1345	943	1120	990	1400	565	545	173	310	292
7. Papa Stour/Ve Skerries		(45)*	0*	0*			(345)*	396	(205)	270	436
8. Hillswick Ness	794	946	566	540*	927	650	472	400	224	180	203
9. Ronas/Hevdadale	1400	128	125*	537*	447*	1315	1275	963	427	566	395
10. Sullom Voe				220	170	192	123	91	43	44	165
11. Yell Sound	220	108	185	207	136	15	17	7	76	11	1
12. Gloup Holm, N. Yell	90			(230)	92	130	45*	70	1	11	7
13. North & east Unst		(208)	126*	175*	125*	75	187*	179	247	141	161
14. North Fetlar	243		30	0*	137	28*	4*	46	31	13	27
15. South-east Yell	702	200	465	0*	65	0	0	0	0	0	1
16. Out Skerries	320	823	(476)	742	695*	965	348	489	615	433	398
17. Whalsay Skerries	3336	993	670	654	80*	316	250	420	160	122	10
18. South Nesting Skerries	(310)	430	653	548	308*	475	86	97	180	66	45
19. Bressay/Noss	1630	(433)	1350	(1624)	(1021)	(1415)	(760)	1516	1171	1264	1741
20. Gulberwick	475	500	694	495	747	428	546	506	710	394	245
21. Mail/Leebitton	251	170	323	201	97	59	70	11	12	6	27
22. Noness/Levenwick		(246)	111	186	221	373	527	179	253	279	350
SURVEY TOTAL	13821	8916	8126	9718	8880	10128	7684	8272	6783	5840	6051
22. Foula, mid-July					300			375	c.400	336	356
23. Fair Isle late Aug.			1018	690	680	565	1000	795	551	294	280
KNOWN TOTAL					9860	10693	8684	9447	7833	6470	6687
MININUM POPULATION EST.	16500+				10610	11800	9534	10000	8500	7000	7200

their 1977 population estimate, between 3-400 birds have been recorded in mid-July in most recent years along the east coast of the island by Glasgow University staff and a figure of 350 was used in deriving the 1984 and 1988 population estimates (Table 1).

The situation has been less clear at Fair Isle, which lies 43km from both the southern tip of the Shetland Mainland and North Ronaldsay in Orkney. Counts nearest to 31 August, but not always from complete surveys of the island, are given in Table 1 although higher numbers have tended to be recorded in autumn after the moult period. It has been suggested that this increase may be due to Orkney breeding birds stopping at Fair Isle after moulting in Shetland (Jones & Kinnear 1979) and Davis (1965) thought some birds left the island in late autumn. However, hardly any have been seen at any time of year from the ferry crossing to the Shetland Mainland (Dymond 1992) and a lack of sightings during seawatches at the southern tip of Shetland Mainland, Fair Isle or North Ronaldsay gives no indication whether Eiders move to Fair Isle from Shetland or Orkney, but suggests that interchange between the two island groups is minimal. In calculating a 1977 population figure, Jones & Kinnear (1979) estimated a scatter of c.1000 Eiders away from known moulting areas. In view of the overall decline in numbers, this figure has been reduced to c.750 in 1984 and (a probably over-generous) c.500 in 1989-92. The estimate of 7200 Eiders in Shetland in late summer of 1992 was therefore 39% lower than the 1984 population estimate and 56% lower than that of 1977.

Discussion

In the absence of contrary evidence, it is assumed that the Shetland Eider population is sedentary with little or no immigration from surrounding populations. Extensive studies at sea during the mid-1980s found no evidence of regular movement of Eiders between Shetland and Scandinavia (Tasker *et al* 1987) although a few birds of unknown origin have occasionally been seen from oil installations between Shetland and Norway, especially in October and November (Anderson 1990). There has been just one recovery in Shetland (on Fair Isle) and one in Orkney from the many Eiders ringed in the long-term study at the Ythan Estuary in Aberdeenshire (Buckland *et al.* 1990, Mead & Clark 1990). That Shetland Eiders are significantly smaller than those in north-east Scotland (Table 2) also suggests little inter-mingling with birds from the Scottish mainland, and it has been proposed the north isles Eiders are best included in the Faeroese race *S. m. faeroensis* rather than the nominate race *S. m. mollissima* (Cramp & Simmons 1977).

There can be little doubt that the decline in Eider numbers in moult flocks reflects a decline in the (resident) Shetland population. While no systematic counts have been made, there is anecdotal evidence from throughout Shetland of a decline in numbers of nests and of females with broods. Counts of Eiders in winter also indicated a decline in numbers between the mid-1970s and the mid-1980s, with a further decline by 1991 (Suddaby 1991). Elsewhere, one Orkney source considered there had been "no obvious change in status" there up to 1982 (Booth *et al.* 1984), although another considered Eiders to have "decreased over a longish period" (Meek in Berry 1985). The recent situation is also unclear, with surveys showing numbers of Eiders wintering in Scapa Flow to have declined substantially between 1977/78 and 1988/89 (Christer 1989), but to have increased in the area of Wyre, Rousay and Gairsay Sounds over the same period (Ribbands 1990). Nationally, there has been no suggestion of recent regional declines on the scale observed in Shetland (Marchant *et al.* 1990), although it is questionable whether counts of birds in some regions would have been comprehensive enough to detect anything but gross changes in numbers.

TABLE 2. ***Measurements (mm) and weights of Eiders caught in winter at the Ythan Estuary, Aberdeenshire and in Shetland. The Ythan birds were caught between October and March 1976/77 and 1977/78, no attempt was made to exclude repeated measurements of retrapped birds and most measurements were taken by S.R. Baillie. The Shetland birds were cannon-netted on 23 November 1984 on the island of Linga off north-east Yell and were measured by R.W. Furness. First-year birds were excluded from all samples.***

	YTHAN ESTUARY			SHETLAND				
MALES	Mean	S.D.	n	Mean	S.D.	n	t	Signif.
Wing	303.8	6.9	152	291.3	5.4	61	14.04	p<0.001
Bill	55.7	2.8	151	51.9	2.0	61	11.11	p<0.001
Head	129.2	2.7	41	123.9	2.5	61	10.15	p<0.001
Tarsus	54.5	2.2	151	52.7	1.4	61	6.93	p<0.001
Sternum	125.5	5.0	41	123.3	3.1	61	2.50	p<0.05
Weight	2307.2	191.5	181	1983.8	141.2	61	14.06	p<0.001
FEMALES								
Wing	293.3	9.9	129	284.3	7.1	52	6.87	p<0.001
Bill	55.7	2.7	129	48.1	2.4	52	8.00	p<0.001
Head	121.5	3.2	33	117.9	2.7	52	5.47	p<0.001
Tarsus	53 .1	2.3	128	50.5	1.4	52	9.14	p<0.001
Sternum	118.3	3.4	32	116.8	3.3	52	2.01	pc0.05
Weight	2042.6	219.4	158	1820.6	107.3	52	9.68	p<0.001

The decrease in the Shetland population between 1977–1984 was attributed to a combination of mortality due to oil pollution in the winter of 1978/79 and an unexplained (but not oil-related) heavy mortality in winter 1979/80 in north-east Shetland (Heubeck 1987), similar in many respects to the unexplained mortality in southern Norway the following winter (Wrånes 1988).

Although oil pollution killed many Eiders in Shetland in 1979 (Heubeck & Richardson 1980), few oiled corpses have been found on systematic beached birds surveys since then (Fig. 2). Of 368 corpses found between January 1980 and December 1992, only 30 were definitely oiled (8.1%) and 10 of those were found on just two of the 156 surveys, April 1986 and March 1991. This incidence of oiling was low compared to the 27% recorded on beached bird surveys elsewhere in the British Isles during the 1970s (Stowe 1982) and values between 45-67% recorded by different schemes on south-eastern North Sea coasts in the late 1970s and throughout the 1980s (Averbeck *et al.* 1992) .

Since early 1980, the only instance of abnormally high, unexplained mortality of Eiders was in March-May 1986 when 21 dead birds were found (0.12/km. surveyed), 13 on beaches close to the Sullom Voe Oil Terminal. Although apparently not oiled, plumage samples from three of the Sullom Voe birds were examined by gas chromatography; two showed distinct petroleum-based hydrocarbon residues, the third possible petroleum residues. On 26 March 1986 there had been a suspected discharge into the voe of contaminated ballast water from the tanker *Ariel 5,* which was treated with dispersant. Oily scum spread across the voe and although none of the 318 eiders counted in Sullom Voe that day were clearly oiled, 30-40 were seen preening and splashing and had probably become contaminated by this scum. As well as the three corpses whose plumage was analysed, it is likely that the deaths of some of the 10 others found in Sullom Voe that spring were oil-related. A similar situation occurred near the Flotta Oil Terminal in

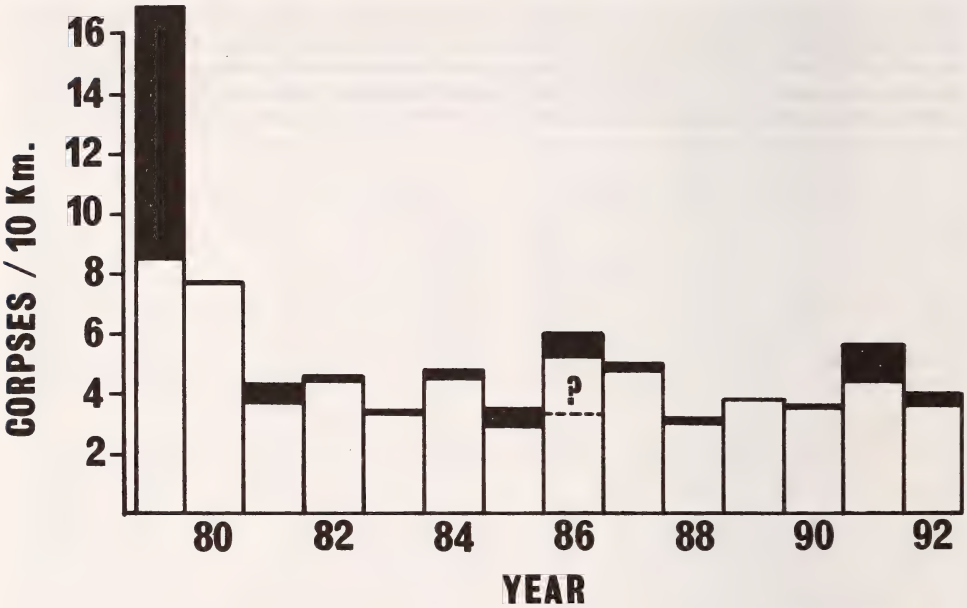

FIGURE 2. ***The number of Eider corpses found per 10km. surveyed on Shetland beached bird surveys, 1979-1992. Solid areas = oiled corpses (n = 451, 15.5% oiled). ? indicates birds found in Sullom Voe in 1986 which may have been slightly oiled but which were recorded as unoiled. A period of unexplained, abnormally high mortality between December 1979 and June 1980 led to the relatively high values for unoiled birds in those years. There was no significant trend in the number of unoiled corpses found between 1981 and 1992 (Spearman Rank Test, rho = - 0.084, df = 10). N.B. 1979 = March to December only.***

Orkney when abnormal numbers of dead Eiders were found several weeks after a small spillage of crude oil from the tanker *Fanny* on 11 February 1984, most having only lightly or barely noticeably stained plumage (Meek 1985). In this incident, 80% of the corpses found were adult males (as were seven of the eight found in Sullom Voe in April 1986) although in late February there should have been little separation of the sexes as most adult Eiders would have paired. Spring would appear to be a time of relatively higher mortality for male than female Eiders (Table 3). At this time of year males expend greater energy than normal in sexual display and mate-defence while females, feeding at twice the rate of males, accumulate fat deposits prior to egg laying (Gorman & Milne 1971). Under such circumstances, drakes may succumb more easily than females to slight contamination of their plumage.

With oil pollution apparently having made only a minor contribution and no unexplained mass deaths having occurred, one can only speculate as to the cause(s) of the decline in Eider numbers between 1984 and 1992. Many people in Shetland believe that predation of Eider ducklings by skuas and gulls has increased in recent years but there is no quantitative evidence for this, although predation of other seabirds by Great Skuas *Catharacta skua* increased in the late 1980s (Hamer *et al.* 1991). In Sweden it has been shown that increased disturbance of broods of Eider ducklings by

TABLE 3. ***Monthly occurrence of unoiled Eiders (corpses/100km surveyed) found dead on Shetland beached bird surveys, March 1979 to December 1992. Birds were reported as either 'male', 'female', 'immature male', 'juvenile/pullus' or unsexed and unaged. Data from December 1979 to June 1980, a period of high, unexplained mortality, are excluded.***

	Km.	Male	Female	Imm. male	Juv.	?Sex ?Age	Total
January	631.7	1.90	1.27	0.47			3.64
February	647.2	1.85	1.39	0.15		0.46	3.86
March	685.2	1.90	1.02			0.44	3.36
April	684.0	3.95	1.02			0.58	5.55
May	647.0	2.94	0.93			0.46	4.33
June	638.4	3.76	2.98	0.16	0.31		7.20
July	718.6	1.81	2.50		0.97	0.83	6.12
August	712.1	0.84	1.54		0.56	0.28	3.23
September	628.0	0.64	1.91		0.32	0.48	3.34
October	690.6	0.14	1.59			0.43	2.17
November	710.1	1.13	0.70				1.83
December	615.4	0.65	1.30	0.16		0.16	2.27
Total		143	121	6	15	28	313

boats led to increased predation rates of ducklings by gulls (Åhlund & Götmark 1989). The development of salmon farming in the 1980s certainly led to increased inshore traffic of small boats in many parts of Shetland but again, any effect this may have had on survival of Eider ducklings remains conjecture.

Great Skuas in Shetland occasionally kill adult female Eiders, either when incubating or when flushed from the nest by humans. Between 1969-76 it was estimated that Great Skuas annually killed 4% of adult female Eiders nesting on Foula, based on annual averages of six predated corpses found in the breeding areas and 160 nesting females (Furness 1981). The respective figures for 1989-92 were averages of 7.5 corpses from 117 nesting females, an increase in the percentage taken to 6% (R.W. Furness *in litt.*). Another possible predator of nesting female Eiders are feral ferrets *Mustela vison*, the population of which has increased and spread considerably on the Shetland Mainland in the past 2-3 years. Although they frequently attack domestic poultry, the extent to which ferrets predate wild birds in Shetland is unknown, apart from one instance in 1992 of a family group killing Puffins *Fratercula arctica* (C . Donald *pers. comm.).* One should be cautious about extrapolating from the Foula example and remember that the cause(s) of the decline in the Shetland Eider population remain speculative. However, for long-lived species such as Eiders which have high annual survival rates (Coulson 1984), a relatively small increase in adult mortality coupled with decreased recruitment to the breeding population could soon lead to substantial population decline.

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Martin Heubeck, Department of Zoology, University of Aberdeen, Tillydrone Avenue, Aberdeen AB9 2TN.

Population fluctuations and mortality of Mute Swans on an Orkney loch system in relation to a Canadian Pondweed growth cycle.

E.R.MEEK

Canadian Pondweed was first noted in the Loch of Harray in 1982. By 1987 it was the most widely distributed plant species in the loch, being especially dense in the northern bays. From early in 1991 there were signs that the amount of pondweed was declining. Breeding numbers of Mute Swans on the Harray/Stenness loch system increased from 36 nests in 1983 to 115 nests in 1990 but dropped sharply to only 13 nests in 1992. A marked mortality of Mute Swans, involving some 250 birds, almost all in their first year, occurred during 1991. Post mortems revealed emaciation and heavy burdens of an internal parasite, Polymorphus minutus. Wintering numbers of grazing wildfowl (Mute Swan, Whooper Swan and Wigeon) increased markedly while pondweed growth was at its height but crashed in subsequent years. Numbers of diving ducks (Pochard and Tufted Duck) remained unaffected.

Introduction

Mute Swans *Cygnus olor* have long been a feature of the Harray and Stenness lochs, a loch system of some 1930ha in the southern part of Orkney's West Mainland (Fig.1). The loch system shows a gradation from a salinity close to that of sea-water in Stenness to eutrophic freshwater in Harray, a situation unique in Britain (Ratcliffe 1977). In the early 1980s the lochs were known to hold some 50% of Orkney's population of 65 breeding pairs. Both breeding and wintering numbers increased in the late 1980s. The peak breeding numbers were reached in 1990 and wintering numbers in 1990/91. Small mortality incidents had occurred in spring in earlier years (eg. Macdonald *et al.* 1978) but in 1991, dead Mute Swans began to be found around the loch shores in late March and mortality continued throughout the rest of that year. A marked decline in wintering birds was apparent by 1991/92 and in breeding birds in 1992. Public awareness of dead and dying swans during 1991 prompted monitoring of the mortality and veterinary assistance was called upon in an attempt to determine cause of death.

Canadian Pondweed *Elodea canadensis*, an alien water-weed, was first noticed in the northern part of the Loch of Harray in 1982. By 1985 concern began to be expressed for the future well-being of the loch and, as a result, in 1988, Orkney Islands Council commissioned a study of the Loch of Harray by the Aberdeen Centre for Land Use. Their report (Sinclair *et al.* 1992) concluded that the loch was 'mildly enriched' and recommended a number of measures for reducing nutrient input.

The circumstantial evidence for a connection between the Mute Swan population fluctuations and the *Elodea* growth cycle is strong.

FIGURE 1. ***Location of the Lochs of Harray and Stromness, Orkney.***

Methods

Counts of breeding Mute Swans were carried out from a canoe in 1983 (Reynolds 1985) and on foot in 1990 (Corse 1991). A full count was not possible in 1991 but an assessment of breeding success was undertaken. In 1992 and 1993 further full surveys were carried out on foot followed by further assessments of breeding success.

Wintering numbers of Mute Swans and other wildfowl on both lochs were available from the National Wildfowl Counts organised by the Wildfowl and Wetlands Trust.

Assessment of the numbers of Mute Swans which died during 1991 proved difficult because of the great length of loch shore and because some corpses were removed by members of the public. A complete count of corpses was carried out on 5 July and again between 15-18 August 1991 and an incomplete one in November 1991.

Post-mortems were carried out on four Mute Swans collected in July, one in November and two in December 1991 with another in January 1992.

Measurements of the abundance of the pondweed were made only in 1987 (Robson 1987) but accounts of its distribution at other times were available from fishermen.

Results

Mute Swan - summer numbers

The numbers of Mute Swans on the Harray/Stenness loch system in the summers of 1983, 1990 and 1992 are detailed in Table 1. The 1983 figures are believed to represent the 'normal' population, numbers having changed little since a previous survey in 1978 (Reynolds 1985). The enormous increase to 115 pairs by 1990 resulted in a breakdown in territoriality on part of the Loch of Harray, the swans nesting colonially on a series of small islands known as the Ling Holms. Fifty-eight nests were found on these four islands, 44 (38 with contents) being concentrated on the largest which was still less than 1ha in area. By 1992 breeding pairs had fallen to just 13 but the number of territorial pairs without nests was high at 33. However, the total population of 318 represented a 54% decrease on the 1990 figure. By 1993 breeding numbers were beginning to show some signs of recovery (22 pairs) but the total population had fallen further to 275.

Breeding success has been monitored since 1991. In that year only two broods (of b/3 and b/6) were found. Similar searches in 1992 revealed only a single brood (of b/2) on Stenness and none on Harray. There was some improvement in 1993 with four broods (b/1, b/2, b/2 and b/3) on Harray and four (b/2, b/3, b/3 and b/5) on Stenness.

Mute Swan - winter numbers

Peak winter counts of Mute Swans on the Harray and Stenness Lochs are shown in Fig.2. A spectacular increase occurred on the Loch of Harray from 1986/87 with a peak of 1205 in 1990/91 followed by a marked reduction in the two subsequent winters. The Loch of Stenness showed no comparable pattern.

Other wildfowl - wintering numbers

Other grazing wildfowl showed similar patterns in their numbers on the Loch of Harray. Fig.3 shows the maximum counts of Whooper Swans *Cygnus cygnus* on both Harray and Stenness. The peak count on Harray was 1010 in December 1988 with 927 present in 1990/91.

TABLE 1. ***Mute Swan numbers on the Lochs of Harray And Stenness, Orkney in the summers of 1983, 1990, 1992 and 1993.***

		Harray	Stenness	Totals	Overall Population
1983	Breeding pairs	14	22	36	
	Non-breeders		88	88	160
1990	Breeding pairs	85	30	115	
	Territorial pairs (without nests)	9	–	9	
	Non-breeders	400	40	440	688
1992	Breeding pairs	6	7	13	
	Territorial pairs (without nests)	24	9	33	
	Non-breeders	190	36	226	318
1993	Breeding pairs	11	11	22	
	Territorial pairs (without nests)	18	–	18	
	Non-breeders	148	47	195	275

Wigeon *Anas penelope*, too, show a similar pattern (Fig.4). As with Mute Swan, their peak was in 1990/91, with a count of 9200.

In contrast to the grazing wildfowl, the two diving ducks, Tufted Duck *Aythya fuligula* and Pochard *Aythya ferina*, for which the loch system has long been nationally important (Cranswick *et al.* 1992), showed no such clear pattern of increase in the late 1980s (Figs. 5 & 6).

Mute Swan mortality

Dead and dying Mute Swans were first reported in April 1991. Mortality reached a peak during that summer and again in November/December. In all, some 250 Mute Swans are believed to have died during the course of the incident.

All except one of the 50 or so corpses which were critically examined were of birds in their first summer/second winter, i.e. birds which had been reared in the boom season of 1990.

Post-mortems were carried out on eight Mute Swans found dead or dying on the Loch of Harray during the course of the incident (Kirkwood & Cunningham 1991, J.Kirkwood pers.comm., J.D.Walker pers. comm.). The findings did not point to bacterial or viral disease but the birds were emaciated, anaemic and had heavy parasite burdens. In some of the birds the intestinal parasite was identified as *Polymorphus minutus*, an Acanthocephalan worm.

The spread and subsequent decline of Canadian Pondweed

Canadian Pondweed was first noted in the northern part of the Harray Loch in 1982. However, its subsequent dramatic spread meant that by the time the loch was fully surveyed in 1987 (Robson 1987) it was the most widely distributed plant species in the loch, being particularly well-established in the northern bays where it was growing in extremely dense mono-specific stands.

In the winters of 1988/89, 1989/90 and 1990/91, the main concentrations of the pondweed in the northern bays of the Harray Loch were obvious from the concentrations of Mute Swans, Whooper Swans and Wigeon feeding there. During this period, in contrast to previous winters, Whooper Swans were rarely seen off the loch itself, the weed seemingly providing all the

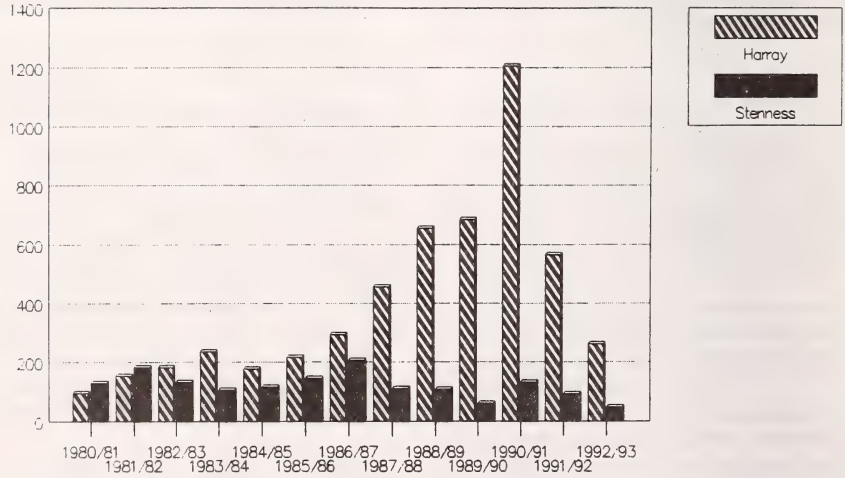

FIGURE 2. *Peak winter counts of Mute Swans on Lochs of Harray and Stenness.*

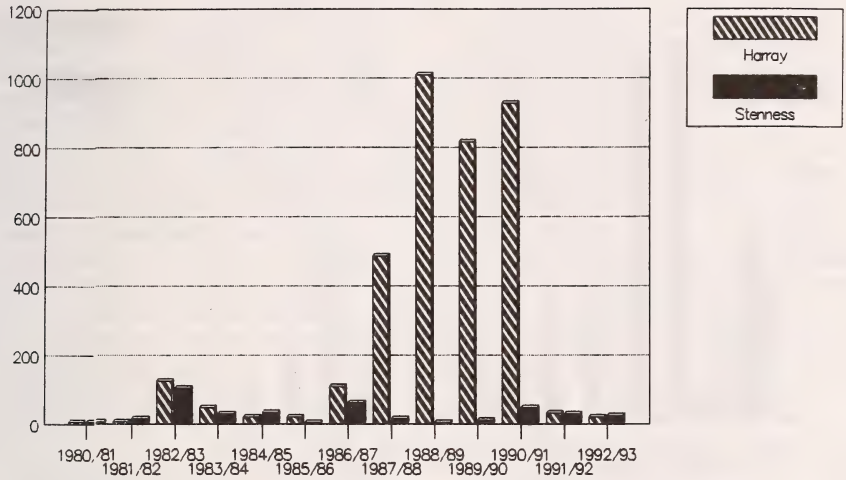

FIGURE 3. ***Peak winter counts of Whooper Swans on Lochs of Harray and Stenness.***

nourishment required without recourse to surrounding fields. In the early spring of 1991, however, Whoopers began leaving the loch to feed in fields near its north-western extremity (pers. obs.), a first indication that perhaps the pondweed was becoming less abundant, an indication confirmed by fishermen later in the spring.

Discussion

It would appear that the breeding and wintering populations of Mute Swans on the loch system closely followed the growth cycle of the Canadian Pondweed as did the wintering populations of the other two main grazing wildfowl at the site, Wigeon and Whooper Swan. The inflated number of

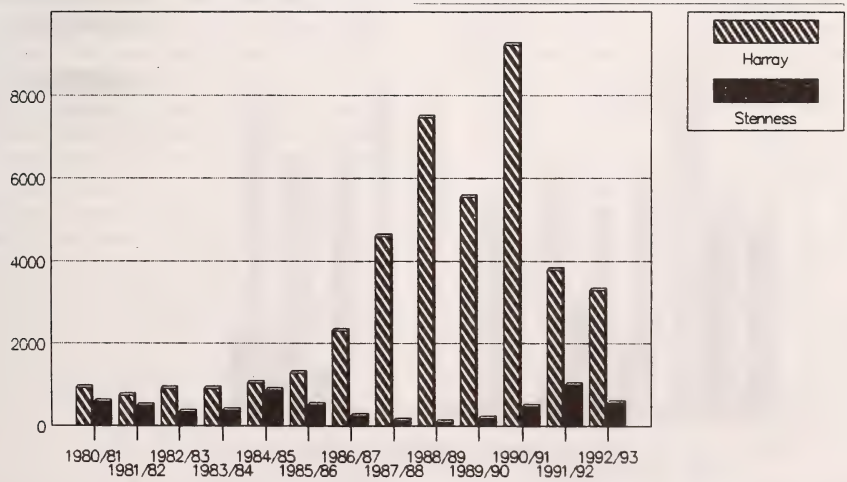

FIGURE 4. ***Peak winter counts of Wigeon on Lochs of Harray and Stenness.***

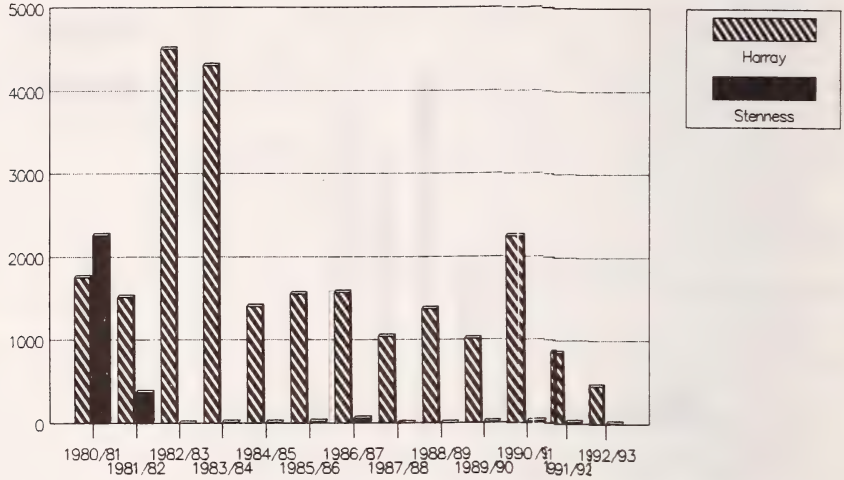

FIGURE 5. ***Peak winter counts of Pochard on Lochs of Harray and Stenness.***

breeding Mute Swan pairs in 1990 and the colonial nesting on the Ling Holms in that season both suggest a super-abundance of food. Colonial nesting is known also from England (Abbotsbury), Denmark and Poland. In the first two of these, the swan families spread out after hatching to feed on abundant inter-tidal vegetation (Kear 1972), a situation analogous to that on the Harray Loch.

Outside the breeding season, greatly increased Mute Swan numbers as a result of increased availability of *Elodea* is known from elsewhere in Britain (Giles 1992). Direct observations of all three grazing

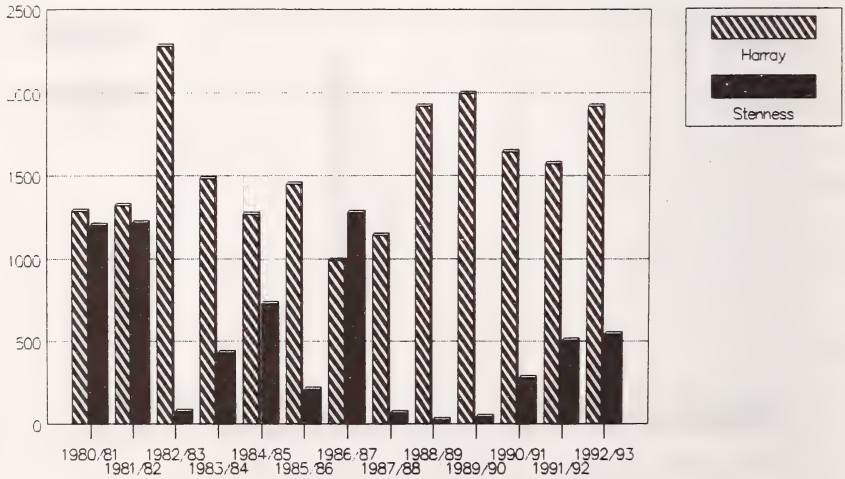

FIGURE 6. ***Peak winter counts of Tufted Ducks on Lochs of Harray and Stenness.***

species in winter on the Harray Loch confirmed their dependence on this pondweed (pers.obs.) During the early 1980s Whooper Swans fed on barley stubbles during the autumn prior to leaving Orkney in mid-winter. With the advent of the pondweed, stubbles were ignored, the Whoopers feeding on the loch throughout the winter. Wigeon behaviour was also of interest. Rather than leaving the loch to graze as normal on surrounding fields, packs of Wigeon could be watched following both Mute and Whooper Swans. As the larger species fed by uprooting pondweed, the Wigeon dabbled in their wake, apparently utilising scraps of weed discarded by the swans.

The decline in wintering numbers of all three grazing wildfowl and the crash in the Mute Swan breeding population coincided closely with observed declines in pondweed abundance.

The large number of deaths amongst the Mute Swan population is a more complex issue. It was initially believed that the birds may simply be dying of starvation. Mute Swans in their first summer are driven out of their natal area by the territorial male (Cramp & Simmons 1977). It is possible that the large numbers of young present in spring 1991 may have been prevented from feeding effectively on what was by then a declining food source by territorial birds.

The question remains as to why, in such a situation, more birds did not leave the area to feed elsewhere. Some birds obviously did; the peak winter count in 1991/92 shows a decline of some 650 birds compared to 1990/91 yet only some 250 corpses were located. The 'missing' 400 birds were not located during National Wildfowl Counts elsewhere within Orkney and must therefore have moved out of the islands presumably to the Scottish mainland although there is no direct evidence of this. It may be that the 250 which remained, only to subsequently die, were never fit enough to move away, pressure on the food resource being too great even in the latter part of 1990.

It is unclear whether the poor condition of the birds allowed the large build up of parasites or vice verca. Mute Swans are known to be among those waterfowl which act as the final host in the complex life cycle of *Polymorphus minutus*, the intermediate host being freshwater shrimps of the genus *Gammarus* (references in Macdonald *et al.* 1978, Sanford 1978). It is perhaps possible that *Gammurus* was particularly numerous in the Loch of Harray in 1991, perhaps as a result of the decomposition of much of the pondweed. Young Mute Swans, already in poor condition, may have ingested large quantities of *Gammurus* and thus become heavily infested with the parasite.

Also germane to this discussion are the factors which allowed the rapid expansion of the Canadian Pondweed. The species is known to thrive in nutrient-enriched (eutrophic) waters. Fears concerning the eutrophication of the Loch of Harray have been expressed since the mid-1960s when phytoplankton blooms began to be reported, in some cases in association with fish mortality. Eutrophication is believed to have been caused by agricultural pollution (fertiliser run-off, slurry and silage effluent) and by sewage from the village of Dounby entering the northern part of the loch. Continuing worries over the impact of agriculture on the loch's condition led to a study by the Aberdeeen Centre for Land Use (Sinclair *et al.* 1992). Their report concluded that the Loch of Harray was currently 'mildly enriched' but that if this enrichment continued the potential for algal blooms would also increase with severe consequences for the loch's ecology. The abundant growth of Canadian Pondweed was believed to have been merely due to the plant having found itself a suitable location but concern was expressed that if current dieback of *Elodea* proves to be permanent the nutrients previously assimilated by it would be available to other macrophytes or phytoplankton.

The findings of the report have been met with some scepticism by loch users and

demands have been made for further monitoring. Continuing winter wildfowl counts and surveys of the breeding Mute Swan population are an essential part of such monitoring and will continue.

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E.R.Meek, RSPB, Smyril, Stenness, Orkney KW16 3JX

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The Scottish Mute Swan census 1990

A.W. AND L.M. BROWN

The 1990 Mute Swan census recorded 4856 birds in Scotland. This represents an increase of 65% since the 1983 census and is the highest total ever recorded. 58% of the population were non-territorial compared with 50.5% in 1983. Populations based on the old Scottish counties are presented, as are data on habitat preferences and on changes since 1983. It is considered that the increase is due to the population's own productivity combined wilh a series of relatively mild winters.

Introduction

The 1990 Mute Swan, *Cygnus olor,* census was a repeat of the complete census which took place in 1983 (Ogilvie 1986) and this paper presents the results for Scotland. A full and detailed assessment of the British population will be published separately (Delany & Greenwood in prep.) but the aim of this paper is to provide an analysis of the Scottish results and a comparison with the 1983 census (Brown & Brown 1985).

The stimulus for another British census of the Mute Swan was the need to determine whether or not the decline in the population, which had apparently been halted by 1983 (Ogilvie 1986), was subsequently followed by a population increase. The decline had been attributed, at least in some areas of England, to lead poisoning as a result of birds swallowing discarded anglers' lead weights (Goode 1981). The sale of lead fishing weights in England and Wales was banned in 1987 and it was considered opportune by the then Nature Conservancy Council for a national census to be undertaken in 1990 to determine whether the apparent success of the ban in some areas, as indicated by marked increases in the population in 1988 and 1989 (Delany *et al.* 1992), was reflected at the national level. Lead poisoning of Mute Swans in Scotland as a result of ingested anglers' weights was not considered to be a problem (Brown & Brown 1985) but in 1983 the population was found to be 10% less than that in 1955/56 when the last full census had occurred (Rawcliffe 1958; Brown & Brown 1985). However, later studies in Ayrshire (Leach 1988), and especially Lothian (Brown & Brown 1984, 1981-89), indicated that the populations were expanding in these areas and a national census provided the opportunity to assess any wider manifestation of this trend.

The objectives of the 1990 survey therefore were to:

a) Estimate population changes since the 1983 census and describe their geographical pattern, particularly in relation to the ban on the use of lead weights by anglers.
b) estimate the current sizes of local and national populations, and
c) Provide a baseline for future monitoring of this species.

The census was carried out, as in 1983, jointly by the Wildfowl and Wetlands Trust, the British Trust for Ornithology and the SOC.

Methods

Using the 10km square of the National Grid as the census unit, the aim was to achieve coverage of as many squares as possible.

The fieldwork techniques were the same as those for the 1978 and 1983 surveys (Ogilvie 1981 & 1986; Brown & Brown 1985) comprising separate censuses of *territorial breeding* and *non-territorial* Mute Swans between 1 April and 31 May. If pairs did not proceed to breed, by building a nest, then they were considered as 'territorial-only.'

As in 1983, regional organisers, based on the BTO regions, were circulated with a list of 10km squares in their region together with instruction sheets and recording forms for their fieldworkers. Whilst some flexibility in recording data was permitted for territorial/breeding pairs, observers were encouraged as before to try and count all non-territorial birds in April, preferably around the middle of the month, to reduce problems of movement and thus double-counting. Observations therefore have been used from as near as possible to mid-April, and all counts in early March and after 15 May have been discounted. The change in numbers which occurs during this period was clearly shown in the returns for sites with a series of counts, thus emphasising the need for attempting non-territorial count co-ordination as far as was practicable.

Whilst full coverage of all 10km squares was the aim it was recognised that in more remote areas and areas with no suitable habitat this might not be possible. In such circumstances it was agreed that observers and regional organisers could provide estimates for squares or part squares. To facilitate population assessment in areas where complete coverage was not possible regional organisers were sent a list of the 10km squares in their region in random order with instructions to cover them in that order. This list acted also as a summary sheet for the actual and estimated counts for each area. This paper concentrates on the actual observations and estimates made by the observers and regional organisers: any further extrapolation of the data for areas not covered will be discussed by Delany & Greenwood (in prep.).

Results

Coverage

A detailed assessment of coverage will be published separately (Delany & Greenwood in prep.) but for most areas of Scotland coverage is considered to have been thorough (see Appendix) and many regions obtained complete coverage. This resulted in little need for estimates to be made. Problems did arise in some areas, however, with poor coverage or none in the Outer Hebrides (Benbecula and the Uists), Aberdeen, Banff, Kincardine and Argyll, while lack of observers and the nature of the terrain may have resulted in some birds being overlooked in Caithness, Sutherland, Ross and Cromarty and Inverness.

As the data were collected according to the BTO Regions and related District Council boundaries, the data returns have been amended to locate sites within the old counties of Scotland to facilitate ease of comparison with all of the earlier surveys, in particular those for 1955/56 (Rawcliffe 1958) and 1983 (Brown & Brown 1985) when full coverage was attempted. Surveys in 1961 (Eltringham 1963) and 1978 (Ogilvie 1981) were sample surveys with insufficient Scottish data to make meaningful comparisons.

The number of breeding birds, territorial-only birds and non-territorial birds and the population total for each of the former Scottish counties are presented in Table 1, together with the corresponding total figure for each county in 1983 and the percentage change between the censuses. Estimates for additional territorial and non-territorial birds, where supplied by regional organisers, are also shown in Table 1. The data for the Outer Hebrides are based on a 1992 census undertaken by C.J. Spray (pers. comm.) while that for Aberdeen/Banff is an estimate assuming a repeat of the 1983 data. This is examined further in the discussion.

Breeding and territorial-only birds

The totals of 1570 breeding birds and 476 territorial - only birds (Table 1) represent 32.3% and 9.8% respectively of the total population counted (Table 2). These figures indicate a potential breeding population of 1023 pairs which represents a 40.3% increase on the 1983 figure (729 pairs).

Table 3 shows the distribution of breeding and territorial-only birds according to habitat and compares percentages with 1983. Aberdeen/Banff is excluded from these data in the absence of actual count data but the 1992 Outer Hebrides counts have been included.

Freshwater lochs and ponds and sealochs, coastal and brackish water held 86% of breeding birds, in line with the 1983 figure (84.8%). Rivers held only a small percentage (6.5%) of breeding birds, probably reflecting the unsuitability of this habitat in much of Scotland. In Britain in 1983 Ogilvie (1986) showed that rivers and streams held 35.5% of the hreeding population, comparable to the 1961 and 1978 surveys, indicating the greater significance of this habitat in England.

The national figures mask regional differences relating to habitat suitability and availability. For example, no breeding pairs occurred on rivers in Sutherland, Caithness and Ross and Cromarty and only 3% in Perthshire compared to 17.8% in Lothian, 25.8% in Kirkcudbright and 42% in the Border counties. Similarly, while 76.7%, 57.5% and 39.5% of breeding birds in Argyll, the Outer Hebrides and Ross and Cromarty respectively nested on sealochs, brackish or coastal waters few pairs occupied such habitats in Eastern and Southern Scotland. In these areas most pairs nested on freshwater lochs and ponds e.g. 60% in Stirling/Clackmannan, 74% in Fife, 60% in Lothian, 91.2% in Ayr, 86.4% in Dumfries and 100% in Wigtown. This is comparable to the situation in 1983 (Brown & Brown 1985). Use of canals was only in Lothian (15.6%) and Dunbarton, Renfrew and Lanark (17.6%) where the expanding populations are re-occupying this habitat, while there was little use of reservoirs throughout Scotland owing, probably, to the generally high altitude of such sites and the limited feeding due to fluctuating water levels (pers. obs. in Lothian).

Non-territorial birds

The count of 2810 non-territorial birds (Table 1) represents 57.9% of the total population (Table 2) compared with 1488 representing 50.5% in 1983. If territorial only birds are added to this figure then 67.7% of the Mute Swan population in Scotland did not breed (61.7% in 1983).

The distribution of non-breeding birds (excluding territorial-only ones) according to habitat is shown in Table 3 and can be compared to the situation in 1983. Although 77.2% of the population is found on freshwater lochs/ponds and sea lochs, coastal and brackish waters, compared to 84.9% in 1983, the proportion using freshwater lochs has increased and sea lochs declined. Rivers and streams have increased in importance to 20.9% (14.2% in 1983).

As with the breeding population the overall figures mask important regional variations related to the availability and suitability of habitat types. Thus, the proportion of non-territorial birds found on brackish/sea loch habitat was 94.5% in the Outer Hebrides, 72.3% in Ross and Cromarty, 83.8% in Inverness, 90.2% in Angus and 90.0% in Argyll. In contrast freshwater lochs/ponds accounted for 78.5% in Orkney, 97.9% in Caithness, 37% in Lothian, 58.1% in Dunbarton, Renfrew and Lanark and 66.7% in Kirkcudbright. Rivers were of importance in Perth (70.3%), Ayrshire (46.2%), the Border counties (88.0%), Dumfries (83.5%) and Wigtown (46.2%).

Table 4 lists all sites (20) holding flocks of 30 birds and over. These 20 sites held 61.4% of the non-territorial population of the Mute Swan in Scotland (excluding Aberdeen) compared with 36.6% in six flocks of this size in 1983 (Brown & Brown 1985).

TABLE 1 ***Number of breeding, territorial and non-breeding Mute Swans and population totals for each Scottish county in 1990 and total population in 1983 with % change.***

	1990							1983	
County	Breeding Birds	Addit.[1] Estim.	Territorial Only Birds	Non Breeders	Addit. Estim.	Total Counted	Total Estim.	Total Counted	%[6] Change 83-90
SHETLAND	0	0	0	1	0	1	1	0	–
ORKNEY	326	0	30	454	0	810	810	323	+151
OUTER HEBRIDES	160	0	86	583	0	829	829	692	+20
CAITHNESS	46	6	18	94	5	158	169	20	+690
SUTHERLAND	8	4	0	0	4	8	16	25	–68
ROSS & CROMARTY	76	0	30	159	2	265	267	96	+176
INVERNESS	22	4	24	37	4	83	91	67	+24
NAIRN	8	0	4	0	0	12	12	2	+500
MORAY	22	0	2	17	23	41	64	22	+86
ABERDEEN[5]	118	0	62	144	0	324	324	324	–
BANFF	6	0	2	4	0	12	12	12	–
KINCARDINE[4]	8	0	0	0	0	8	8	12	–33
ANGUS	46	2	4	113	0	163	165	178	–8
PERTH	66	0	8	165	0	239	239	106	+125
STIRLING	32	0	6	5	0	43	43	34	+26
CLACKMANNAN	8	0	2	0	0	10	10	8	+25
KINROSS	32	0	0	16	0	48	48	16	+200
FIFE	30	0	18	58	0	106	106	61	+74
WEST LOTHIAN	30	0	0	42	0	72	72	9	+700
MID LOTHIAN	24	0	4	50	0	78	78	24	+225
EAST LOTHIAN	36	0	16	73	0	125	125	107	+17
AYR	72	0	8	85	0	165	165	82	+101
ARRAN & BUTE	0	0	0	8	0	8	8	10	–20
PEEBLES	4	2	4	0	0	8	10	16	–50
SELKIRK	16	0	4	25	0	45	45	21	+114
ROXBURGH	36	2	20	139	0	195	197	54	+261
BERWICK	44	14	26	27	0	97	111	49	+98
ARGYLL[5]	60	46	30	80	12	170	228	142	+20
DUMBARTON	30	0	10	58	0	98	98	13	+654
RENFREW	26	0	6	9	0	41	41	35	+17
LANARK	46	6	18	112	0	176	182	68	+159
DUMFRIES	44	0	10	85	0	139	139	73	+90
KIRKCUDBRIGHT	62	0	12	141	0	215	215	197	+9
WIGTOWN	26	0	12	26	0	64	64	46	+39
TOTALS	1570	86	476	2810	50	4856	4992	2944	+65

1. Estimates of additional birds from regional organisers
2. **1992** data - no coordinated survey in 1990 (see text for explanation)
3. **1983** data - no coordinated survey in 1990 (see text for explanation)
4. No coordinated survey in 1990 but data obtained from coverage by Angus organiser
5. Poor coverage has resulted in estimate including birds recorded in **1983** in squares not covered in 1990
6. Based on actual counts.

TABLE 2 Percentage of non-territorial, territorial-only and breeding Mute Swans in the total counted population in Scotland 1983 and 1990.

	NUMBER OF BIRDS					
YEAR	NON.-TERR.	%	TERR.-ONLY	%	BREEDING	%
1983	1488	50.5	328	11.2	1128	38.3
1990	2810	57.9	476	9.8	1570	32.3

TABLE 3 ***Distribution of Mute Swan in Scotland in 1990 according to habitat type and comparison with percentage in 1983[1].***

HABITAT	Breeding Birds	%	1983 %	Territorial Only	%	1983 %	Non-terr. Birds	%	1983 %
Freshwater Lochs, ponds	960	66.4	58.0	212	51.5	48.8	978	36.7	30.5
Reservoirs, Flooded pits	66	4.6	3.7	22	5.3	4.2	32	1.2	0.9
River, Streams[2]	94	6.5	10.4	60	14.6	24.4	555	20.9	14.2
Canals, Ditches	42	2.9	1.1	6	1.5	0	18	0.7	0
Sea lochs, Coastal, brackish[2]	284	19.6	26.8	112	27.1	22.6	1079	40.5	54.4
TOTAL	1446			412			2662		

1 Data refer to actual counts and excludes Aberdeen and Banff which were not covered in the 1990 survey.
2. Includes birds counted in fields adjoining river or estuary.

TABLE 4 ***Flocks of more than 30 non-breeding Mute Swans recorded in April 1990[1].***

LOCATION	HABITAT	NUMBER	DATE[2]
West Loch Bee, Uists	Brackish loch	412	April (1992)
Loch of Harray, Orkney	Freshwater loch	382[3]	April
Montrose Basin, Angus	Estuary	74	5 April
R. Teviot, Near Kelso, Roxburgh	River	74[3]	19 April
Milton Loch, Kirkcudbright	Freshwater loch	71	30 April
Easter Rhynd, Perthshire	River	68	19 April
R. Tyne/Estuary, East Lothian	River, estuary, fields	67[3]	14 April
Hogganfield Loch, Glasgow, Lanark	Freshwater loch	64	16 April
R. Annan, Roberthill to Copewood, Dumfriesshire	River, fields	58[3]	12/13 April
Loch Scarmslate, Caithness	Freshwater loch	54	29 April
Loch an Strumore, Uists	Brackish loch	47	April (1992)
R. Leven, Dunbarton	River	45	29 April
R. Tweed, Near Kelso, Roxburgh	River	45[3]	23 April
Loch Eye, Ross-shire	Freshwater loch	43	11 April
R. Ayr, Ayr	River	43	5 April
R. Dee, west of Castle Douglas, Kirkcudbright	River	42[3]	30 April
Linlithgow Loch, West Lothian	Freshwater loch	36	7 April
Pollo, Ross-shire	Estuary	36	14 April
Loch Watten, Caithness	Freshwater loch	33	8 April
R. Forth, west of Stirling, Perthshire	River	31	16 April

1. Aberdeen data not available.
2. Counts nearest the recommended dates of 16/17 April have been taken where more than one count was submitted for a site. Some sites not shown had counts above 30 birds at other dates in April.
3. Cumulative total.

Discussion

It has been stated previously that the results of the 1955/56 complete census of the Mute Swan should be treated with caution (Brown & Brown 1985) owing to differences in coverage and data collection methods. The 1983 census however was the first complete census to use standardised fieldwork techniques and this provides a valuable baseline on which to assess subsequent surveys. The excellent coverage obtained in 1990 (see Appendix) provides a sound basis on which to examine the change in numbers and distribution which have occurred between 1983 and 1990.

The most striking result of the 1990 census is the remarkable 65% increase since 1983 in the total population counted; the figures represent also an increase of 59% over the 1955/56 census. It would appear therefore that the Scottish Mute Swan population now stands at its highest recorded level.

Some of the changes which have occurred within counties are considerable, even for those counties already with large numbers of birds in 1983. The Orkney population increased by 151% between 1983 and 1990 due apparently to excellent feeding (the presence of Canadian Pondweed, *Elodea canadensis)* at the Loch of Harray which resulted in semi-colonial breeding taking place. This increase has now been dramatically reversed with the collapse of the food supply (E. Meek and pers. comm. 1993). The huge increase in Caithness (690%) may be the result of movement of birds from Orkney, but this has not been established. Certainly the results for north Scotland represent a continuation of the expansion of the population there identified in 1983 (Brown & Brown 1985).

It is unfortunate that poor coverage or none was obtained for the Outer Hebrides and Aberdeen/Banff as these two areas held 35% of the total Scottish population in 1983. Fortunately a complete survey of the Outer Hebrides in 1992 by C. J. Spray has shown changes which mirrored the population trend recorded elsewhere and, although numbers can fluctuate annually, it does not seem unreasonable to include the 1992 figures in the census results. Similarly, given the substantial increases found elsewhere in east Scotland, there is no reason to think that the Aberdeen population might have dropped, although a decline may have occurred at some locations (P. Doyle pers. comm. and see Appendix), so the 1983 figures are considered the best estimate for inclusion. Although mainland Argyll was poorly covered compared to 1983 the birds actually recorded still showed an increase and it seemed most appropriate to include those birds recorded in 1983 in squares not covered in 1990.

The decline in numbers in Central Scotland identified in 1983 (Brown & Brown 1985) has now been completely reversed with Fife up by 74%, Ayr 101%, Lanark 159% and Lothian 96%. The Border counties have shown a 146% increase, while the possible re-distribution of birds between Dumfries and Kirkcudbright in 1983 has now been replaced by increases in both counties, most noticeably by 90% in Dumfries.

Ogilvie (1986) concluded from the 1983 census that the Mute Swan population had the potential to increase but that this varied between parts of the country and that recovery in some areas would be dependent upon the long-term impact of the lead poisoning factor. Given that lead poisoning seems not to have been a serious problem in Scotland for the Mute Swan (Spray & Milne 1988), the increase which has occurred must reflect improved cygnet production and survival or immigration.

Although there has been extensive colour ringing in Northern England, very few English-ringed Mute Swans have been recorded in territory in Scotland. However, non-territorial flocks in Lothian in April invariably include a few birds ringed in

north-east England, while Lothian ringed cygnets have been found to be very mobile (pers. obs.) and have been recorded at sites ranging from Berwick to Middlesborough (A. Bramhall and J. Coleman pers. comm.). This implies a potential mixing of populations between south-east Scotland and north-east England but does not suggest any significant immigration into Scotland, birds moving from one area to the other probably balancing each other out.

Comparison of the percentage of territorial-only and breeding birds with the non-breeding population (Table 2) has shown that all have increased in numbers between 1983 and 1990. However, as a proportion of the total population the breeding plus territorial-only birds have declined from 49.5% to 42.1% while the non-territorial population has increased from 50.5% to 57.9%. Because there is virtually no immigration into the British population (Ogilvie 1986) this adds to the evidence that the overall increase is due to the population's own productivity. It suggests also that the breeding population may be attaining a maximum capacity as a high population is likely to result in fewer vacant breeding sites; thus non-territorial birds will encounter more difficulty in finding a territory and therefore will remain in the non-breeding population for longer. This will contribute to the increase in the number of non-territorial birds in the total population. This is the situation which appears to be occurring in Lothian where the non-territorial population is now increasing faster than the territorial/ breeding population (Brown & Brown in prep.).

That winter weather can have a significant effect on Mute Swan numbers has been shown previously (Boyd & Ogilvie 1964; Ogilvie 1967). The period 1983 to 1990 did not see any winter comparable in long term severity to that of 1962/63 and this series of mild winters will have had a considerahle impact upon Mute Swan survival. In addition, as populations have increased, winter flocks have expanded with many benefitting from enhanced public feeding e.g. at Linlithgow Loch, St Margaret's Loch and Cramond in Edinburgh (pers. obs.) and Hogganfield Loch in Glasgow (B. Zonfrillo pers. comm.). This is likely to have contributed to survival, while other birds may have made use of winter sown cereals (Delany et *al.* 1992).

Brown & Brown (1984), when assessing the status of the Lothian population of the Mute Swan up to 1982, suggested that the population was unlikely to return to the level attained in the late 1950s and early 1960s, and Leach (1988) came to the same conclusion for Ayrshire, with human disturbance and interference being considered a key factor in this. Changes since then in Lothian (Brown & Brown 1984-91), and the results of this census, show this view to have been very pessimistic. These local studies highlight the value of and need for detailed on-going studies of Mute Swan populations elsewhere in Scotland supported by colour-ringing schemes; these would help to clarify the dynamics of local populations, their possible interrelationships, the differences in productivity between areas, whether one area supported another through movement of surplus birds and what the effect is should a severe winter occur.

The Scottish Mute Swan population is now at its highest ever level with 4856 birds counted in 1990 and 4992 estimated. The previous peak in the British population was considered to have occurred in 1959 (Eltringham 1963) followed by a decline at least in part due to a severe winter (Boyd & Ogilvie 1964). It would seem best that a further national census should take place in the year 2000, supported by continuing local studies in the interim, to determine if the present trend has continued or if the population has declined from a peak.

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Allan W. and Lyndesay M. Brown,
61, Watt's Gardens, Cupar, Fife, KY15 4UG.

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FIFE NATURE BIOLOGICAL RECORDS CENTRE

FIFE NATURE

Since 1992, a local Biological Records Centre "Fife Nature" has been established in Fife. Through special surveys and a network of official local recorders, the centre collects, analyses and monitors information on as many biological groups as possible, as well as on habitats and sites of natural history interest within the region. Information is stored electronically and is available for purposes of conservation, planning, research, education and general interest.

A "Survey Pack" is available free by request from "Fife Nature", and the centre also produces provisional atlases, which will eventually lead to a series of fully illustrated books. Available at present are

The Dragonflies of Fife: A Provisional Atlas £2 (incl. p.+p.)
The Butterflies of Fife: A Provisional Atlas (Dec 1993 - Price on inquiry)
The Mammals of Fife: A Provisional Atlas (April 1994 - price on inquiry)
Others planned are A Fife Flora, a Bumble Bee Atlas and an Amphibian/Reptile Atlas.

The centre is also involved with the Fife Ornithological Atlas Group, which is currently (1991-95) carrying out surveys leading to a Fife Breeding Bird Atlas and Monthly Distribution Atlas of Birds in Fife.

Further information is available from Anne Marie Smout, Fife Nature, Department of Economic Develoipment and Planning, Fife House, Glenrothes, Fife KY7 5LT.

FIFE

SCOTTISH NATURAL HERITAGE

WINNING PHOTOGRAPH OF THE SOC PHOTOGRAPHIC COMPETITION 1993

Manx Shearwater Puffinus puffinus (Argyll)

Mary MacIntyre,
Priormuir, St. Andrews, Fife

Reed Warbler Acrocephalus scirpaceus Wormiston, Fife
2 Oct. 1993

Gerry Owens

A Verditers Flycatcher Muscicapa thalassima appeared at Crail with lots of unusual migrants on 3 Oct. 1993. Where did it come from? *Brian Little*

Red-breasted Flycatcher Ficedula parva at Fife Ness 3 Oct. 1993 *D. E. Dickson*

Colour separations by PAR GRAPHICS

THE COLOUR SECTION HAS BEEN SPONSORED BY FIFE REGIONAL COUNCIL.

FIFE
CHARTER FOR THE ENVIRONMENT

CHARTER FOR THE ENVIRONMENT

Fife's Environmental Charter highlights the Regional Council's approach to tackling environmental issues and sets out the basis for the Regional Council's existing and future environmental policies. The Charter is now accompanied by the third action programme which outlines projects the Regional Council is in undertaking itself or in partnership with others: a **Nature Conservation Fund**, *a* **Community Planting Scheme**, *and a* **Community Environmental Improvement Fund** *have been established, and a four monthly* **Environmental Events Diary** *is produced.*

Through the Charter, the Council has made a commitment to publish further items in the Fife Heritage Series as a means of raising awareness of the rich natural and historic environment. Titles currently available from the Dept. of Economic Development and Planning are:
Fife's Early Archaeological Heritage - A Guide £2.50
Castles of Fife - A Heritage Guide £4.00

Topics to be published early in 1994 include:- Landforms, Townscapes, Abbeys and Churches and a Heritage Guide to Inverkeithing.

For further information about the Fife Environmental Charter, please contact Grace MacDonald or Andy Hills on 0592 754411 extension 6337

FIFE ARCHAEOLOGICAL SERVICE

FIFE ARCHAEOLOGICAL SERVICE

Fife contains a wealth of archaeological sites ranging in date from prehistoric settlements and forts dating back some 8,000 years, to industrial and military remains of more recent times. Environmental archaeology has become a key concern of the Regional Council as it can provide information about how the natural environment has been altered by our ancestors. The Archaeological Service is currently working with Scottish Natural Heritage to study and interpret the settlement remains on the Isle of May National Nature Reserve.

The Regional Council are keen to promote the conservation of this rich heritage and have published guides to sites which have been studied. These include:-

Balfarg - The Prehistoric Ceremonial Complex £3.00
St Monans Saltpans and the Lost Industrial Complex £1.00

The Regional Council has an Archaeological Service based in the Department of Economic Development and Planning, and is pleased to offer advice on all aspects of the conservation of the historic environment. To receive advice please contact Peter Yeoman or Sarah Govan on 0592 754411 Ext. 6153.

Appendix

Assessment of coverage in each county Regional organisers were encouraged to obtain whenever possible full coverage of all 10km squares within their area. If this was not possible then partial coverage was permissible with the observer and/or organiser making an estimate of the number of birds likely to have been overlooked. In addition squares could be categorised as 'probable blanks' based on lack of habitat and / or knowledge of the lack of swans in the square from past experience. Birds actually counted and the numbers estimated for each county are shown in Table 1. No estimates have been made apart from those provided by the regional organisers. Regional organisers were asked for comment on the coverage obtained and any trends they were aware of for the Mute Swan population in their area. Where they were given these comments have been noted in the observations below for each county, but for comparison with the 1983 survey (Brown & Brown 1985) coverage has been assessed as good, moderate or poor, with additional comments where appropriate.

Shetland Good. There is no evidence of Mute Swans making any attempt to colonise Shetland, the regional organiser remarking that "you will not be surprised to hear that the Mute Swan survey throughout Shetland came up with nil breeding pairs".

Orkney Good. Full coverage was obtained, the regional organiser remarking on the large increase in the population since 1983 in particular at the Loch of Harray and "indeed on one isle the Mute Swans have given up holding territory and are now nesting in a colony". The organiser attributed this increase to the presence of Canadian pondweed.

Outer Hebrides Good. Poor coverage obtained in 1990 (other than for Lewis and Harris) with the regional organiser able only to provide his own observations in the Uists and Benbecula. However, a complete survey including aerial counts was undertaken in 1992 by C. J. Spray on behalf of the Wildfowl and Wetlands Trust and these data have been used in this paper.

Caithness Moderate.

Sutherland Moderate. Regional organiser commented that "most of the county is not suitable."

Ross and Cromarty Moderate. Although full coverage was not obtained other than in Easter Ross, the regional organiser was able to make estimates for the western part of the county based on recent breeding atlas data.

Inverness Moderate Full coverage was obtained in east Inverness-shire but not west Inverness-shire, although the regional organiser commented on much of this area being unsuitable for Mute Swans and inaccessible; the estimate was however considered to be "quite accurate" .

Nairn and Moray Good. Regional organiser considered it "highly unlikely that we missed any pairs" and the non-breeding estimate was considered to be reasonably accurate.

Aberdeen and Banff Poor. No co-ordinated survey was undertaken and the 1983 data have been used in the analysis (see text). However P. Doyle (pers. comm.) did consider that by 1991 the number of breeding pairs were well down on past years owing to increased disturbance at many sites (shooting and water sports), parasites (nematode infestation at several sites resulting in death of swans) and lead poisoning.

Angus and Kincardine Moderate. Regional organiser considered coverage of Angus was

not as extensive as he had hoped. Additional data were subsequently obtained from N. K. Atkinson and R. Goater. A co-ordinated survey was not undertaken in Kincardine but data from other observers suggests that most sites were checked.

Perth Good. Regional organiser considered that all known breeding waters and non-breeding areas were covered. It was stated also that Mute Swans were "certainly increasing again in Perthshire with breeding at 'new' sites in several recent years but productivity is rather poor."

Stirling and Clackmannan Moderate to Good. Most breeding pairs probably located but some non-territorial flocks may have been overlooked. Late organisation of this area resulted in excellent work by D. Matthews in obtaining satisfactory coverage.

Fife and Kinross Good. Full coverage was obtained.

West, Mid and East Lothian Good. Full coverage was obtained as part of a census commenced in 1978 which has shown a steadily increasing breeding and non-breeding population.

Ayr Good. Full coverage was obtained.

Arran and Bute Moderate.

Peebles, Selkirk, Roxburgh and Berwick Moderate to Good.

Argyll Poor. Other than Islay, Jura and Colonsay (which were organised separately), the organiser for mainland Argyll considered that the census was a disaster and he obtained additional information from the 1990 Argyll bird report. Further data were obtained from D. Trigg. On this basis it was considered appropriate to use 1983 data for those squares not covered in 1990 (see text).

Dunbarton, Renfrew and Lanark Good. Full coverage was obtained, and the small estimate for Lanark is considered to be accurate.

Dumfries Good. Regional organiser considered that coverage was very good and that "all areas that were likely to hold swans were visited". Reference was made to the considerable increase since 1983 but the organiser did not know what had influenced this increase in numbers . It was concluded that "most of the suitable breeding areas now have at least one pair breeding, and all potential breeding sites may now be occupied."

Kirkcudbright Good. Full coverage was obtained.

Wigtown Good. Regional organiser considered that all squares "received reasonable coverage" and that the number of breeding pairs seemed "about right given the unsuitable habitat over a lot of the area".

Short Notes

Unusual behaviour of Black-necked Grebes

I have regularly observed Black-necked Grebes *Podiceps nigricollis* on a loch in Scotland for a number of years, and in June 1993 I witnessed an unusual behaviour between a pair, which I believe has never been recorded and is not mentioned in Cramp & Simmons (1977. *The Birds of the Western Palearctic.* Oxford, Vol. 1) or in del Hoyo, Elliot & Sargatal (1992. *Handbook of the Birds of the World.* Lynx. Vol. 1).

On 3 June 1993 at 1900 BST, I was half way through a three hour observation by the loch side when a pair of Black-necked Grebes appeared on the east side of the loch. The sun had just broken through after a cloudy day and the wind was light and from the south-east. The water surface was calm and visibility was excellent.

The pair made for a dead alder *Alnus glutinosa* which lay partly submerged in shallow water in front of the reed bed where some Swallows *Hirundo rustica* were roosting in the higher branches and a few Tufted Ducks *Aythya fuligula* were roosting on thicker branches above the water level. The pair of grebes found a niche near the collapsed trunk of the alder and thereafter followed approximately five minutes of personal preening. The female then jumped on to the trunk, walked unsteadily for a short distance up a gently incline before lying down on her belly and also resting her head on the trunk. She may have been sunbathing, as del Hoyo *et al.* mention that this is common behaviour amongst grebes living in cold parts. Alternatively she may have been using the trunk as a breeding platform and attempting to induce her mate to copulate. The male was close by on the water and began preening his mate on the trunk and also appeared to extract oil from her oil gland which he used on his own feathers. This behaviour went on for eight minutes without copulation attempts before the female slipped back into the water to join her mate. At this point the male chased off a drake Pochard *Aythya ferina* which was trying to secure a roosting spot on the trunk. After successfully evicting the Pochard, the male jumped out of the water onto the trunk and adopted the same posture as his mate had done earlier. The female was close by and began preening her mate for around five minutes before he came back on to the water to join her. The pair stayed in that area for another ten minutes, mainly preening themselves but also performing a brief head shaking courtship ceremony before disappearing into the reed bed close by.

I made these observations through a telescope at a distance of 120 yards.

A. C. Ramage, 158 Wellesley Road, Buckhaven, Leven, Fife KY8 IHX

Eider Ducks eating flatfish

On 6 March 1993, we watched a small group of male and female Eider Duck *Somateria mollissima* in the harbour at Eyemouth. They were with several Cormorants *Phalacrocorax carbo* and diving close to moored fishing vessels. Some of the male Eiders surfaced with flat fish, probably flounders *Platichtlhys flesus* in their bills. The fish were held head first, banged vigorously several times on the surface of the water and, after much head-shaking and neck-stretching, swallowed. One male appeared with a fish about 13cm wide, which it attempted to swallow. The fish was dropped several times into the water and was then dived for by the Eider. Finally the duck gave up all attempts to eat it. Female Eiders, diving close to the males, did not catch any fish during the 50 minutes we watched the group.

The food of Eiders has been recorded many times at different seasons and habitats. Mussels *Mytilus edulis* form the major part of their varied diet which includes crustaceans, echinoderms, cuttlefish, sea anemones and fish (Cramp & Simmons 1977. *The Birds of the Western Paleartic.* Oxford. Vol. 1.). The identity of fish species is seldom recorded, probably because their remains in Eider stomachs are fragmentary, However, the short-spined scorpion-fish *Myoxocephalus scorpius,* the three-spined stickleback *Gasterotus aculeatus* and the caplin *Mallotus villosa* have been identified in their diet (Salomonsen, F. 1950. *Grønlands Fugle.* Copenhagen pp 121-130; Madsen, F.J. 1954. *Dan.Rev.Game Bird Biol.* 2:157-266; Bardarson, H.R.1986. *Birds of Iceland.* Reykjavik ppl08-110). We have not found any reference to flatfish being eaten by Eiders.

B. M. Hobson and E. M. Hobson, Flat 7, Castle Terrace, Edinburgh EH1 2EL

Hen Harriers systematically testing flocks of Ring-necked Pheasants

On 1 January 1983 a 'ringtail' Hen Harrier *Circus cyaneus* was hunting a large area of rushes in west Galloway. It stooped at a cock Pheasant *Phasianus colchicus* on the ground, flushed and chased it for over 100m but did not catch it. The harrier then returned to the same area and systematically flushed and chased individuals one by one from the rest of the flock of two further males and four females. None was killed although after chasing one of the cocks, the harrier hovered above it and flopped on top of it with lowered talons but was shaken off.

On 6 October 1987 in the same area I watched a male Hen Harrier flush three cock Pheasants, once again systematically chasing each in turn.

Hen Harriers frequently chase individual Pheasants in west Galloway but of 91 observed attacks on them, I have no records of them killing any, nor have prey remains been found in pellets at their communal roosts *(Scott.Birds* 7:24-49; Watson, D. 1977. *The Hen Harrier.* Poyser, Berkhamstead; unpubl. data). Ash (1960. Birds of prey numbers in a Hampshire game preserve. *Brit.Birds* 53:285-300), however, recorded them as carrion prey in winter.

R.C. Dickson, Lismore, New Luce, Newton Stewart DG8 OAJ

Buzzards copulating just before roosting

On 26 March 1993 I saw a female Buzzard *Buteo buteo,* 49 minutes before sunset, sitting on the top of a hawthorn bush on low ground in west Galloway. Six minutes after sunset, the Buzzard stretched her wings and flew east for about 500-600 metres where she met an approaching male Buzzard; both Buzzards circled each other and then flew a short distance west. The female landed on a sloping pasture field and the male circled just above before dropping to mount the female, apparently copulating, slowly flapping his wings for about 10-15 seconds. He flew east and was mobbed by two Carrion Crows *Corvus corone;* meanwhile the female had flown to a large, solitary, deciduous tree nearby. The male returned and swooped up to land beside her; both birds then roosted together in the same tree.

Although it is not unusual for Buzzards to copulate in March, I can find no mention in the literature of Buzzards copulating just before roosting. *BWP* (Vol. 2) states that copulation normally occurs on the nest, and Tubbs (1974. *The Buzzard.* David & Charles, Newton Abbot) noted, on the comparatively few occasions that he witnessed it, that it had taken place on regularly used perches in their territories. Kestrels *Falco tinnunculus* have been noted copulating before roosting *(Scott.Birds* 14·215) and I have also seen Merlins *Falco columbarius* copulating about an hour before roosting in April 1975 and 1978 on their breeding grounds in Galloway. This behaviour might occur more often in some birds of prey than has been recorded, although some authors state that copulation in some species occurs more often in the mornings (Newton 1986. *The Sparrowhawk.* Poyser, Calton; Village 1990. *The Kestrel.* Poyser, London). In other Buteonine hawks, however, Johnsgard (1990. *Hawks, Eagles and Falcons of North America.* Smithsonian Institution Press, London) mentions that Swainson's hawk *Buteo swainsoni* copulate mainly during morning and evening.

R.C. Dickson, Lismore, New Luce, Newton Stewart DG8 OAJ

Comment and Reply

What is the scale of seabird movement across central Scotland?

C.J.HENTY

Large numbers of Kittiwakes move westward into the inner Forth and this has been held to indicate that considerable cross country flights occur. It is argued here that unequivocal evidence only exists for occasional inland movements and there is strong negative evidence against regular flights. Observations are reviewed that suggest a similar picture for other marine Laridae.

In an editorial comment, R.D.Murray (1992, p38) asserted that there was a large passage of Kittiwakes *Rissa tridactyla* between Forth and Clyde with the implication that such movements were quite frequent. This is certainly a departure from the standard published view in both Baxter and Rintoul (1953) and Thom (1986), where inland Kittiwakes are stated to be unusual and usually storm driven. Murray is clearly correct that this view is inadequate: he quotes a 1990 record of 38 Kittiwakes flying high to the east over the Erskine Bridge whilst W.R.Brackenridge noted flocks flying west over Carron Valley Reservoir in October 1985 and 1987 and in December 1984. There are, however, very few such unequivocally inland records and Murray presumably relies on evidence of large and regular movements into the inner Forth off Hound Point (e.g. *Lothian Bird Reports* 1984-91). I wish to argue that the interpretation of such movements is not straightforward and there is in fact a wide range of possible interpretations depending on what assumptions are made on seabird behaviour and the weighting of negative evidence.

The problem is that west of Hound Point there are some 100 square kilometres of wide estuary before the Forth narrows markedly above Kincardine Bridge; thus there is ample space for Hound Point birds to feed. In recent years flocks of up to 500 Kittiwakes have not been unusual in this area and in fact large feeding flocks have been known for a long time - around December 1872 great numbers were in the upper Forth feeding on enormous shoals of *Clupea sprattus* (Harvie-Brown 1906). Such birds could, conceivably, drift back eastwards to the North Sea in a diffuse movement some time later; a night return is possible since Myres (1963) found that departure from breeding colonies continued after dark. The most convincing observations for inland flights were made by G.L.Sandeman (1974, 1975) in October and November: he detected large westerly movements off Edinburgh and followed them to see (a) in 1974, large flocks circling high over the Queensferry bridges and heading west and (b) in 1973, flocks gaining height and heading west over Skinflats. If the latter flight direction was persistent then the birds must have departed inland. Although flocks of Kittiwakes in this locality are often hesitant and not actually seen to depart (D.M.Bryant, W.R. Brackenridge pers. comm.) there can be little doubt that Sandeman's observations support the inland observations that Kittiwakes fly overland in flocks at least occasionally. Several versions of Murray's more generous interpretation might be distinguished: (1) overland flights occur regularly but only involve a small proportion of birds entering the inner Forth.

(2) a significant (say >10%) of such birds leave overland or (3) the majority of them do so.

There are three sets of observational evidence against regular overland flights. First, since Sandeman's notes there has been intensive observation around Grangemouth but no large and unequivocal departures have been recorded. Second, between 1978-1988 a group led by A.D.Wood made frequent and thorough observations at Carron Valley Reservoir but did not report anything to add to the observations already mentioned. Third, in the last 20 years I have made many observations in autumn specifically to look for visible migration on the north and the south sides of the Gargunnock Hills and have many records of passerine and goose movement but with no sign at all of seabirds. Admittedly, Kittiwakes over land are often likely to be flying high but the visible migration watches specifically involved scanning the sky; thus for any regular passage to be completely overlooked it would be necessary to assume that almost all of the birds occur at above about 2000m. Such an assumption is certainly conceivable but in my view would need some independent support to carry any conviction. I have in fact had no difficulty in detecting large gulls, probably *Larus fuscus,* with x8 binoculars against well-lit cloud at a range of 5000m. It is worth noting that non-systematic observation by local observers in autumn quite regularly pick up small numbers of Gannets *Sula bassana,* usually juveniles, either flying overland or departing inland. Radar observations made by Evans (1968) of overland departures by waders from the Forth might also have been expected to detect any regular movement of Kittiwakes but no such evidence was obtained, although Professor Evans tells me that high flying flocks would have been within range of his radar. Bourne (1963), reviewing bird migration in north-west Europe, also mentioned Kittiwake movements only at sea. Professor Coulson tells me that the ringing evidence gives no support to a theory of large scale interchange overland between the west and east coasts.

Occasional inland movements have been noted for other species. In autumn, parties of Common Terns *Sterna hirundo* have twice left to S or W from Grangemouth and a steady movement up river occurred above Alloa on 13 September 1970. The last was accompanied by two Little Gulls *Larus minutus* and one of this species flew inland at Skinflats on 22 August 1991. Sandwich Terns *Sterna sandvicensis* have been noted flying W over Gargunnock. However this species illustrates the risks of interpreting isolated observations - twice in August 1991 above Alloa large parties were seen to fly off W gaining height, only to return with loud calling some minutes later. The numbers of skuas *Stercorarius sp.* seen around Grangemouth are only a small percentage of those seen passing W at Hound Point - it is worth noting that a notable proportion also fly E at this site, records from the *Lothian Bird Reports* 1987-1991 show 27% E for Pomarine *S.pomarinus,* 22% for Arctic *S.parasiticus,* 8.5% for Long-tailed *S.longicaudus* and 17.4% for Great Skuas *S.skua.* These facts suggest that most of the skuas eventually return to the North Sea. However, Arctic Skuas have been seen to leave inland from Skinflats at least once. More surprisingly, a party of 18 arrived from the WSW (apparently from inland) on 18 September 1976.

All these records suggest that inland passage through Scotland occurs occasionally in most primarily coastal *Laridae* but there is no strong reason to conclude that it is frequent. A more generous conclusion in the case of the Kittiwake would depend on dismissing the negative evidence detailed above; there are certainly reasons why any of the types of negative evidence might be misleading, but when all are in agreement I assert that to conclude that inland passage is regular or on a large scale would be to go far beyond the existing evidence. Thus I can find no support for any of the three regular

movement options mentioned earlier, although I would agree that the option involving a small part of inner Forth birds should be kept in mind as a possibility. It would be very useful if observations of movement at Hound Point could be relayed immediately to observers who watch in the Grangemouth area so that specific and simultaneous checks for inland departure could be made.

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C.J. Henty, University of Stirling, Stirling FK9 4LA

Reply to Henty

The fate of the seabirds that travel westwards up the Forth at Hound Point in the autumn has interested me ever since the scale of the Hound Point passage first became apparent, in relation to skua movements, in the late 1980s. In the four years between 1988-91 some 2133 skuas were counted moving through Hound Point. Of these 1593 (75%) travelled west while the remaining 540 were seen moving east. Another 100 birds were reported moving in an indeterminate manner, usually circling round in the area immediately east of Hound Point. Even deducting the 540 eastward travellers, as moving west and then returning, this still leaves over 1000 skuas passing through westwards.

Observers at Hound Point have absolutely no doubt that these birds are cross-country travellers from their behaviour as they approach the main observation area. They are reluctant to pass under the Forth Bridges and they typically begin to tower as they approach Hound Point. They spiral upwards and when they reach their preferred altitude, they move off west and south-westwards parallel to the southern shore of the Forth, passing directly above South Queensferry. This behaviour is typical of bright aftemoons when the wind is between south-west and north. The eastwards movements, which Henty suggests are birds returning out of the upper Forth, only occur in dull conditions and easterly winds according to M. Griffin and I.J. Andrews, two of the principal Hound Point devotees. Their interpretation of this behaviour is that, if the birds are unable to see their way clearly westwards in the area where the land narrows at the bridges, they will turn back eastwards down the Forth, presumably to search out another route west to the Atlantic. It is only in clear conditions, perhaps when the towering birds can actually see the Atlantic, that they head westwards. It is noticeable in this regard that most movements occur in the afternoon when it is more likely that the birds will see the sun shining off the ocean surface.

I personally witnessed just such a situation in September 1992 at the summit of Broad Law (834m) in the virtual centre of

southern Scotland. Whilst conducting botanical fieldwork, our party came upon a juvenile Arctic Skua *Stercorarius parasiticus* feeding off emerging crane flies *Tipulidae*. After an hour the bird flew off, spiralled upwards for several hundred metres before flying off westwards towards the point where the sun was reflecting off the Atlantic to the south of Goat Fell on Arran. I have little doubt that this is what occurs at Hound Point. Perhaps people who use Edinburgh Airport and fly above the Forth Bridges in the afternoon might confirm this.

There are remarkably few reports of any skuas from points west of Queensferry, and none of the flocks of skuas, which pass Hound Point on some days. Yet it is known that skuas routinely fly overland across Eurasia south of their breeding range, cross-country to the Caspian Sea and along the flyway between the Baltic Sea and the Gulf of Murmansk. In our case, I suspect the skuas travel across Scotland unseen at high levels, spreading out from the bottleneck at the Forth Bridges, reducing the likelihood of being spotted by observers. Certainly, the Carron Valley and the Gargunnock Hills seem too far north to be on the flightlines of birds seen at Hound Point.

It seems unlikely that the Hound Point movements are anything new. They were overlooked despite vast numbers of birdwatchers in the area. The spring passage of skuas off the Western and Northern Isles is certainly not a novel phenomenon, but this was also overlooked until recently. What else is waiting to be discovered?

The near certainty that skua movements at Hound Point must have gone on for years before the passage was reported tends to reduce the impact of Henty's negative evidence for Kittiwake *Rissa tridactyla* movements. The Hound Point observers regularly see Kittiwake flocks, often several hundred birds strong, towering like the skuas and passing off westwards. Sandeman's evidence seems to tie in well with the apparent westwards passage seen more recently at Hound Point. The fact that they are not seen over the areas indicated in Henty's note may simply suggest that they move over parts of Central Scotland which are as yet undiscovered.

The suggestion in the 1990 *Scottish Bird Report* was simply that such movements across Scotland do occur, as hinted at by the quoted 38 Kittiwakes moving east high above the Erskine Bridge in March 1990, while 1600 moved west past Hound Point on 18 October that year. Even a casual glance at the bird reports for Lothian and the Clyde area in recent years shows that these observations are not unique. Respectable numbers of Kittiwakes travelling westwards pass Hound Point each October and small numbers are seen in the Clyde area apparently moving east each March. The movements may well be regular.

The 1991 *SBR* documented Long-tailed Skuas *S. longicaudus* moving inland up the Eden Estuary and the River Dee during the large movement of September. Similarly, numbers of Kittiwake were again seen in Glasgow during March, some passing eastwards. A paper on the regular passage of Little Gulls *Larus minutus* across the Pennines between the Irish Sea and the North Sea (Messenger, D. 1993. Spring passage of Little Gulls across Northern England. *Brit. Birds* 86: 397-06), records a movement that would have been considered fantastic 20 years ago.

When preparing the species accounts for *SBR*, information in local bird reports often makes it possible to see trends or features which are not readily apparent from reading just one or two bird reports. My attempts to draw together the huge amounts of data and present these in a way that will both interest and enlighten the reader, lead me to hint at points which become apparent to me, in the hope that someone will notice and actually prove them. A letter challenging my opinion means at least that someone reads *SBR*.

R.D. Murray, 4 Bellfield Crescent, Eddleston, Peebles EH45 8RQ

Research Index

The following is an index of fieldwork and research presently undertaken with specific Scottish interest. The index is updated every year and researchers are either listed alphabetically by the institute where the research is based, or in two cases (SNH & RSPB) by the topics and species researched. If you are doing research in the area and are 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 in Kielder, Northumberland. (PhD study).

Doyle, P. Factors associated with the persistence of sub-colonies of the Fulmar on Eynhallow, Orkney. (PhD study).

Dayawansa, N.P. Distribution and feeding ecology of waders and waterfowl on the Ythan estuary, Grampian in relation to algal growth on mudflats. (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, M. 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 Scotland.

Gorman, M.L. & Langsdale, A. 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. & 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.

Edinburgh University

Carter, A. Feeding behaviour and micro-habitat distribution of waders on rocky shores, especially in East Lothian (MPhil study)

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

Deag, J. Studies on communication and social organisation in tits, with field work mainly at Ormiston, East Lothian. (PhD study).

Hanna, L. Barn Owl populations genetics. (PhD study).

Lunny, C. Behaviour and ecology of Dippers. (PhD study).

McAfferty, D. Ecological energetics of Barn Owls. (PhD study).

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

Taylor, I. 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.

Vickery, J. Behaviour and ecology of Dippers and waders of farmland.

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. Seabirds and their food supply.

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.

Henny, V. Reproductive strategy in Common Terns.

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: an 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).

Ramsay, S. Nutritional factors in egg production in tits.

Ratcliffe, N. Reproductive effort of Great Skuas of known ages from 4-30 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).

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 the 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 commercial 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.

Tasker, M.L. Head of Seabird Team.

Walsh, P. 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: A. Webb (leader), C. Stone (marine biologist), D. Halley (ornithologist).

The Royal Society for the Protection of Birds

The RSPB undertakes extensive research into all aspects of birdlife: their ecology, distribution, status and conservation. The following projects are of particular Scottish interest and names of the RSPB research staff involved are given in brackets. Further details are available from Ian Bainbridge at RSPB SHQ. In addition to this list, regular bird monitoring is undertaken on almost all the RSPB's reserves in Scotland. There are also numerous projects on many aspects of the ecology and management of the reserves, including ornithological, botanical, hydrological and entomological projects, which are too numerous to list here.

Species research

Factors affecting breeding success of Black-throated Divers. Studies of lochs, fish, invertebrates and diver productivity. (1992-95, D. Jackson, M. Hancock, R. Summers).

Individual bird calls. With University of Nottingham. Investigation of individual bird identification using calls; including Black-throated Diver, Corncrake, Bittern. (1990-93, G. Gilbert and P. MacGregor Nottingham University, K. Smith).

Factors affecting breeding success of Slavonian Grebes. Studies of lochs, fish, invertebrates and grebe productivity. (1992-94, R. Summers, R. Mavor).

Surveying methods for Storm and Leach's Petrels. Development of methods for surveying and monitoring these species, using transects, endoscopy etc., on Shetland and elsewhere. (1990-95, D. Suddaby, P. Ellis, J. Sears).

Barnacle Goose feeding ecology. With Durham University. Investigation of reseeding, grazing and fertiliser management on grassland use by Barnacle Geese at Loch Gruinart. (1992-95, J. Welstead & P. Evans Durham University, S. Percival Sunderland University, I. Bainbridge, D. Beaumont, Loch Gruinart Reserve staff).

Goose grazing management experiments. With Aberdeen University. Studies on the effects of grazing, mowing and fertiliser regimes on grey goose use of Loch of Strathbeg. (1991-95, R. Fuchs & I.J. Patterson Aberdeen University, D. Beaumont, I. Bainbridge, Strathbeg Reserve staff).

Moray Firth seaduck and wader studies. Regular surveys of Moray Firth seaduck populations, and co-ordination of BoEE counts, 1985 onward. (1977-95, R. Evans, J. Stenning).

Sea Eagle population studies. With SNH and JNCC. Monitoring and demographic modelling of Sea Eagle populations. (1984 ongoing, RSPB Regional staff, R. Green).

Golden Eagle home range use. Investigation of use of habitat by radio-tagged eagles; relating breeding success and habitat to prey abundance, land use and topography. (1991-95, M. McGrady, J. Grant, I. Bainbridge).

Golden Eagle project, Galloway. With SNH, Forest Enterprise and Dumfries & Galloway RSG. Studies of the home ranges, prey and carrion densities and habitat use of eagles in Dumfries and Galloway. (1992-94, C. Park, C. Rollie).

Red Kite monitoring. Joint project, with JNCC managing English re-introduction. Monitoring of breeding success and dispersal of the Scottish Red Kite population. (1989, ongoing, D. Orr-Ewing, R. Evans).

Effect of forestry on Hen Harriers. Contract to Glasgow University. Studies of breeding and feeding use of forestry and other land by harriers. (1991-94, M. Madders & D. Houston Glasgow University, I. Bainbridge).

Hen Harrier ecology. Studies on the population biology and dispersal of Hen Harriers. (1990-95, B. Etheridge, J. Craig, R. Summers).

Merlin survey. Repeat of 1983-84 national Merlin survey to give population size, trends and baseline for future studies. (1993-94, G. Rebecca, I. Bainbridge).

Relationships between raptor and grouse populations. Joint project with ITE, GC, SNH, JNCC. Relationships between harriers, Peregrines and grouse populations. (1991-97?, ITE and GC staff, I. Bainbridge).

Black Grouse and land use. Analysis of Perthshire Black Grouse survey to investigate relationships between grouse density and distribution with land use. (1993-94, R. Green).

Breeding success and habitat selection in Capercaillie. Work on Abernethy reserve, examining the effects of habitat, predators and other factors on Capercaillie productivity and survival. (1991-95, R. Summers, R. Proctor, Abernethy Reserve staff).

Survey and monitoring of Capercaillie populations. Joint project with ITE, GC,

SNH, FC. Estimation of population size and habitat use. (1991-94, R. Summers, I Bainbridge).

Corncrake ecology. Studies of Corncrake breeding biology to assist in land management for Corncrake conservation. (1992-95, G. Tyler, R. Green, C. Self, E. Brindley).

Corncrake survey. Joint project with IWC. Repeat of 1988 national survey, 1991 part survey to give population size, trends and habitat changes. (1993, R. Green).

Corncrake tape-luring. Experimental tape-luring to attract Corncrakes to suitable habitat, Loch Gruinart. (1991-94, M. Peacock, G. Hirons).

Red-necked Phalarope ecology. Identification of habitat and management requirements. (1992-95, M. O'Brien, I. Bainbridge).

Montane bird monitoring, Abernethy. Collaborating with SNH. Development of monitoring methods for breeding Dotterel and Snow Buntings. (1992-95, A. Amplett, I. Bainbridge, D. Beaumont).

Lowlands breeding waders in Scotland. Joint project with SOC. To determine the numbers and distribution of lowland breeding waders in Scotland, set up a baseline for future studies, identify key sites for waders. (1992-94, M. O'Brien, I. Bainbridge).

Low tide counts. Contract to BTO. Low tide counts of distribution of waterfowl wintering on estuaries. (1992 ongoing, J. Evans BTO, J. Sears).

Roseate Tern. A study to monitor the breeding range and productivity of the east Atlantic population, identify its wintering range, and determine threats to the species. (1988-94, A.del Nevo).

Seabird monitoring. Monitoring of seabirds at RSPB reserves and other sites; particularly tern monitoring. Contribution to joint seabird monitoring project with JNCC and SOTEAG. (ongoing, J. Sears).

Seabird monitoring, east Caithness. Census plot counts and productivity studies at five colonies in east Caithness. (1980-93, R. Evans).

Orkney and Shetland seabird studies. Monitoring numbers, breeding success and body condition of Arctic Terns and skuas in relation to food availability. (1990 ongoing, D. Suddaby, C. Orsman, P. Ellis, E. Meek, J. Sears).

Winter pinewoods bird survey. Crested Tit, Crossbill and Capercaillie population distribution and habitat studies. (1992-95, R. Summers, A. Maclennan, G. Rebecca).

Scottish Crossbill identification. With Dundee Institute of Technology. Studies on Crossbill DNA to determine species distinction and aid future field identification. (1992-94, R. Summers).

Habitat and legislative research.

Estuaries inventory. Development of a database on the 57 most important estuaries in the UK, identifying land use, developments, bird numbers and areas used. Includes Solway, Clyde, Forth and Moray Firth. (1990-95, K. Peck, J. Sears).

Reedbed inventory. Development of a full national inventory of reedbeds, with vegetation surveys, monitoring of reedbed condition. (1993-94, K. Smith, M. Painter).

Upland futures. Review of the likely effects of upland land use change on birds. (1992-93, R. Green, N. Harding).

Review of licensed bird killing. Examination of the level of killing of birds under licence in the UK, how the licensing system operates. Concentrating on sawbills, Cormorants and geese. (1993-94, S. Murray, P. Newbery).

nshore fisheries study. Review of inshore (net) fisheries in Scotland and Northern Ireland and the effects of incidental bird kills in them. (1992-93, S. Murray, N. Harrison).

Shetland sandeels survey. Contribution to SOAFD survey of sandeels numbers and distribution around Shetland, in connection with the Braer incident. (1993-95, SOAFD staff, J. Sears).

Beached Bird Survey. Organisation and analysis of annual beached bird survey. (1991 ongoing, RSPB Regional staff, I. Sim, J. Sears).

St Andrews University

Gil, D. Field studies of Treecreeper song. (PhD study 1993-96: topic to be decided).

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

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

Scottish Association for Marine Science (formerly Scottish Marine Biological Association), Dunstaffnage Marine Laboratory, PO Box 3, Oban, Argyll PA34 4AD

Craik, J.C.A. Factors affecting breeding success of Common Terns and Arctic Terns in western Scotland, especially predation by mink and otter. Effects of such predation on smaller gull species (Common and Black-headed) are also receiving study.

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 appropriate 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) at 2/5 Anderson Place, Edinburgh, EH6 5NP. Tel 031 554 9797. Other contact persons are also at this address, unless otherwise specified.

International site designations: survey, review and assessment of bird numbers and distributions with respect to Special Protection Areas and Ramsar sites. JNCC. (G.P. Mudge, D.P. Whitfield, C. Galbraith JNCC).

Services in ornithology. Including the Birds of the Estuaries Enquiry (WEBS); 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. (G.P. Mudge, C. Galbraith JNCC).

Monitoring of rare British breeding birds. JNCC/Rare Breeding Birds Panel. (G.P. Mudge, D. 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. (C. Galbraith JNCC).

Services in wildfowl research, including the National Waterfowl Count scheme (WEBS). JNCC/Wildfowl and Wetlands Trust. (G.P.Mudge, D. Stroud JNCC).

Conservation plans for migratory waterfowl under the Bonn Convention and Ramsar Convention. JNCC/International Waterfowl and Wetland Research Bureau. (D. Stroud JNCC).

Effect of commercial dredging on wintering birds on the Solway. British Trust for Ornithology. (M. Hughes, SNH Dalbeattie).

Meteorological Office reports related to statutory shootings bans on waterfowl during severe winter weather. JNCC/Meteorological Office. (D. Stroud JNCC).

Moorland bird surveys; techniques and ecology. (D.P. Whitfield, A. Brown English Nature).

Moorland changes and influences on birds in the Northern Isles. (A. MacDonald, D.B.A. Thompson).

Population ecology and conservation of montane birds, notably Dotterel, Ptarmigan and Snow Bunting. (D.P. Whitfield, D.B.A. Thompson, with R. Smith & S. Rae).

Review of bird-habitat relationship and consequence of habitat loss. (J.B. Reid, D.B.A. Thompson).

Atlas study of central Highland breeding birds. (J.B. Reid).

Seabirds at sea programme, phase 4. JNCC (A. Webb JNCC).

Seabird colony register. Maintenance of a database of counts of seabird colonies. JNCC/Seabird Group. (M . L. Tasker JNCC).

Seabird monitoring programme, Annual monitoring of breeding success at seabird colonies. JNCC/RSPB/SOTEAG (M.L. Tasker JNCC).

Survey of breeding seabirds of Sanda and associated islands. (D. Hunt SNH Kilmory).

Seabird studies, Hermaness. Contract to Dr. T. Martin. (P. Harvey SNH Shetland).

Sule Skerry - collation of bird data. (P. Harvey SNH Shetland).

Slavonian Grebe biology. Contribution to RSPB study. (N. Buxton SNH Inverness).

Grey geese - movements and habitat usage of wintering grey geese in the Moray Firth area. (N. Buxton SNH Inverness).

Grey geese - monitoring of numbers, distributions and habitat usage in Scotland. Wildfowl and Wetlands Trust. (G.P. Mudge).

Greenland White-fronted Geese on Islay. An investigation of flock structure, field usage and roost occupancy. Wildfowl and Wetlands Trust. (R. MacDonald SNH Islay).

Barnacle Geese - an investigation of the seasonal patterns of distribution and effectiveness of appropriate grazing and scaring techniques. (M. Hughes SNH Dalbeattie).

Eider survey, Sands of Forvie. Aberdeen University. (P. Harvey SNH Shetland).

Wildfowl and wader counts on the Ythan Estuary. Aberdeen University. (M. Ferguson SNH Aberdeen).

Comparative feeding ecology of predatory birds. Glasgow University. (D.B.A. Thompson, C. Galbraith JNCC).

Re-introduction of Sea Eagles. Release of chicks from Norway and monitoring of the re-introduced population. Joint project with RSPB. (G.P. Mudge).

National survey of Golden Eagles. To write up the results of the 1992-93 survey. Joint project with RSPB and the Scottish Raptor Study Groups. (D.P. Whitfield).

Golden Eagle - assessment of potential prey in Dumfries and Galloway, in conjunction with RSPB and Forestry Commission. (M. Hughs SNH Dalbeattie).

Red Kite re-introduction: national and international co-ordination. JNCC/ RSPB. (G.P. Mudge, C. Galbraith JNCC).

Effects of predators on Red Grouse and moorland waders in southern Scotland. Institute of Terrestrial Ecology. (P. Reynolds).

Past ecology of Ptarmigan in south Scotland. (D.P. Whitfield).

Capercaillie - status and habitat needs. Joint contract with RSPB to the Institute of Terrestrial Ecology. (G.P. Mudge).

Peatland waders - habitat use, feeding ecology and movements. Durham University. (D.P. Whitfield, D.B.A. Thompson).

The impact of afforestation on moorland breeding birds, Glen Dye. Institute of Terrestrial Ecology. (D. Bale SNH Aberdeen).

Survey of breeding waders on Oronsay. (R. MacDonald SNH Islay).

Philopatry, fidelity, mating/social systems and conservation in waders. (D.P. Whitfield, D.B.A. Thompson).

Effect of weed mats on the distribution and feeding ecology of waders at the Ythan Estuary. Aberdeen University. (M. Ferguson SNH Aberdeen).

Long term study of Greenshanks in north-west Scotland. (D.B.A. Thompson).

Population trends of gulls and other seabirds on the Isle of May. Institute of Terrestrial Ecology. (G.P. Mudge).

Co-existence of 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. (D.B.A. Thompson).

A review of Chough data in parts of south-west Scotland. (I. Langford SNH Dalbeattie).

Ecology and conservation of Pied Flycatchers in north-west England. NERC/SNH Studentship. Leicester University. (D.B.A. Thompson).

Ecology of Corn Buntings on the Outer Isles. Leicester University. (D.B.A. Thompson).

Stirling University

Alves, M-A. Behavioural ecology of Sand Martins. (PhD study).

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

Bryan, S. Energetics of laying in birds. (PhD study).

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

Calladine, J. Breeding ecology of Larus gulls on the Isle of May (with ITE Banchory - PhD study).

Jalil, S.A. Effects of land use changes on waterfowl populations. A study based on freshwater lochs in central Scotland. (PhD study).

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

Hashim, R. Ecology and energy requirements of Great Tits in summer and winter. (PhD study).

Logie, J. Population ecology of Dippers in central Scotland. (PhD study).

Wernham, C. 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-September 1993. The librarian would be glad to learn of anything that has been missed, and to receive reprints or copies of papers on any aspect of ornithology or natural history. Bird reports marked with an asterisk are available from the SOC at the prices quoted, but please add 50p per order for postage and packing.

Scientific papers.

Aebischer, N.J. 1993. Immediate and delayed effects of a gale in late spring on the breeding of the Shag. *Ibis* 135: 225-232.

Andrew, D.G. 1993. House Martins taking over Barn Swallow's nest. *Brit. Birds* 86: 184-185. An occurrence in East Lothian.

Ap Rheinallt, T. 1993. Notes on some little-known Arran birds. *Arran Naturalist* 16: 3-10.

Aspinall, S. 1993. Avoiding double-counting in a Gull colony. *Seabird Group Newsletter*. 64: 4-5.

Avery, M.I., Burges, D., Dymond, N.J., Mellor, M. & Ellis, P.M. 1993. The status of Arctic Terns in Orkney and Shetland in 1989. *Seabird* 15: 17-23.

Bailey, R.S., Furness, R.W., Gauld, J.A. & Kunzlik, P.A. 1991. Recent changes in the population of the Sandeel *Ammodytes marinus* at Shetland in relation to estimates of seabird predation. *Int. Counc. Explor. Sea Mar. Sci. Symp.* 193: 209-216.

Belaoussoff, S. 1993. Northern Gannet and Common Guillemot nesting in Rockall. *Brit. Birds* 86: 321.

Bibby, C.J. & Etheridge, B. 1993. Status of the Hen Harrier in Scotland in 1988-89. *Bird Study* 40: 1-11.

Bourne, W.R.P. 1993. The story of the Great Auk *Pinguinis impennis*. *Archives of Nat. Hist.* 20: 257-278.

Brown, A.F. & Stillman, R.A. 1993. Bird-habitat associations in the eastern Highlands of Scotland. *J. Appl. Ecol.* 20: 31-42.

Cairngorms Working Party. 1992. Common sense and sustainability- a partnership for the Cairngorms. 180pp + 7 maps. A report to the Secretary of State for Scotland.

Carss, D.N. 1993. Cormorants at cage fish farms in Argyll, western Scotland. *Seabird*. 15: 60-67.

Craik, J.C.A. 1992. Exceptional mortality of Auks, Terns, and Kittiwakes in western Scotland in July 1985. *Sula* 6: 125-138.

Cranswick, P.A. 1992. Distribution of Pink-footed and Greylag Geese in south-east Scotland, especially in relation to disturbance. A report by Wildfowl and Wetlands Trust, Slimbridge to NCC Scotland. 116pp.

Cranswick, P.A., Kirby, J.S. & Waters, R.J. 1993. *Wildfowl and Wader Counts* 1991-92: 109pp.

Donnelly, P.J. 1993. Yellow-browed Bunting in Orkney. *Brit. Birds* 86: 411-414.

Dougall, T.W. Breeding passerine communities of five duneland habitats in northeast Fife. *Scot. Nat.* 102: 1990: 53-67. Reprint recently received.

Dowie, M.I. 1993. Blackpoll Warbler in Shetland. *Brit. Birds* 86: 206-209. An occurrence on Fair Isle.

Forrest, G.J. 1993. Wintering Chiffchaff feeding on peanuts. *Brit. Birds* 86: 186187.

Fox, A.D. & Meek, E.R. 1993. History of the Northern Pintail breeding in Britain and Ireland. *Brit. Birds* 86: 151-162. The main Scottish sites are in Orkney and Tiree.

Furness, R.W. 1992. Implications of changes in net mesh size, fishing effort and minimum landing size regulations in the North Sea for seabird populations. Joint Nature Conserv. Comm. Report No 133: 75pp.

Galbraith, H., Murray, S., Duncan, K., Smith, R., Whitfield, D.P. & Thompson D.B.A. 1993. Diet and habitat use of the Dotterel *Charadrius morinellus* in Scotland. *Ibis* 135: 148-155.

Gilburn, A.S. & Kirby, J.S. (1992). Regional patterns of wildfowl distribution on British wetlands. Part 1. Scotland and northern England. Joint Nature Conserv. Counc. Report No 138: 57pp. A report from the Wildfowl and Wetlands Trust to the JNCC, Peterborough.

Greenstreet, S.P.R., Morgan, R.I.G., Barnett, S. & Redhead, I. 1993. Variation in numbers of Shags *Phalacrocorax aristotelis* and Common Seals *Phoca vitulina* near the mouth of an Atlantic salmon river at the time of the smolt run. *J. Anim. Ecol.* 62: 565-576. A study in south Kintyre.

Halley, D.J. 1993. Population changes and territorial distribution of Common Buzzards in the Central Highlands, Scotland. *Bird Study* 40: 24-30.

Halley, D.J. & Harris, M.P. 1993. Intercolony movement and behaviour of immature Guillemots *Uria aalge. Ibis* 135: 264-270.

Hamer, K.C. & Furness, R.W. 1993. Parental investment and brood defence by male and female Great Skuas: the influence of food supply, laying date, body size and body condition. *J. Zool., Lond.* 230: 7-18.

Hamer, K.C., Monaghan, P., Uttley, J.D., Walton, P. & Burns, M.D. 1993. The influence of food supply on the breeding ecology of Kittiwakes *Rissa tridactyla* in Shetland. *Ibis* 135: 255-263.

Harris, M.P. & Calladine, J. 1993. A check on the efficiency of finding colour-ringed Kittiwakes. *Ringing & Migration* 14:113-116.

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Ayrshire Bird Report for 1992. Angus Hogg (ed) 1993. 56pp. *£2.75. Includes a 40- page systematic list and four short articles.

Borders Bird Report No 13 for 1991. R.D. Murray (ed) 1993. *£3.50.

Canna Report No 15 for 1991 and 1992. R.L. Swann (ed) 1993. 19pp. Another in the long series of long-term ornithological studies on Canna.

Clyde Bird Report for 1990. Iain P. Gibson (ed) 1992. 75pp. *£3.25.

Fair Isle Bird Observatory Report for 1992. Paul Harvey & David Parkin (eds) 1993. 84pp *. Includes a 26 page systematic list and short articles on many aspects of life and natural history on the island.

Fife Bird Report for 1992. D.E. Dickson (ed) 1993. *£3.50. Includes a 46 page systematic list, reports on a Mute Swan census, and on work on the Fife Bird Atlas. Also three rarity reports.

Isle of May Bird Observatory Report for 1992. Ian Darling (ed) 1993 / 56pp. *£3.00. Includes "Memories of Isle of May characters" by J.H.B. Munro.

Moray & Nairn Bird Report for 1992. Martin Cook (ed) 1993. 64pp. *£2.75. Mainly a 47 page systematic list, but with short notes on Pomarine Skuas and Mute Swans.

Orkney Bird Report for 1992. C. Booth, M. Cuthbert & E. Meek (eds) 1993. 70pp. *£3.00. Includes a systematic list, and short reports on the Skua populations of Orkney, a rarity report, a North Ronaldsay Bird Observatory Report, and cetacean records.

Perthshire (Central/Southwest) Peregrines and Ravens in 1992. P. Stirling-Aird 1993. 3pp. An unpublished report in a long-running series.

Scottish Bird Report for 1991. R.D. Murray (ed) 1993. 76pp. *£5.00

Shetland Bird Report for 1992. K. Osborn (ed) 1993. 120pp. This is an exceptional bird report from this fascinating part of Scotland. It has 8 pages of colour plates of rarities, 38 pages of special reports, and a 65-page systematic list.

St. Abbs Head NNR Seabird Report for 1992. K.I. Rideout, R.R. Elliott & W. Hepburn 1993. 18pp. An unpublished report in a long-running series.

William G. Harper.

European Journals in the Waterston Library

The following selection of articles appeared in European journals received in the Waterston Library between April and August 1993, thus following on the list published in Vol. 17 No. 1. 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 its year of publication. Journals quoted are as follows:

Netherlands:	Ardea, Limosa, Dutch Birding.
France:	L'Oiseau
Switzerland:	Der Ornithologische Beobachter, Nos Oiseaux, Ornis
Belgium:	Aves, Mergus, Le Gerfaut
Germany:	Limicola, Vogelwelt, Vogelwarte, Ökologie der Vögel, Seevögel, Corax, Ornithologischer Anzeiger
Italy:	Rivista Italiana di Ornitologia
Spain:	Butlleti del Grup Català d'Anellament (in Catalan)
Iceland:	Bliki
Norway:	Cinclus, Vår Fuglefauna
Sweden:	Vår Fågelvärld
Finland:	Suomen Riista, Linnut (formerly Lintumies), Ornis Fennica

General

Väisänen, R.A. & Hildén, O. [Bird feeding stations have led to increase in seed-eating birds in Finland]. *Linnut* 3/93.

Gaßmann, H. & Glück, E. [Nest-site selection and breeding success of hedgerow birds]. *Vogelwelt* 4/93.

Divers to Ducks

Anker-Nilssen, T. & Anker-Nilssen, P.G. Breeding of Leach's Petrel in the Røst archipelago, N Norway. *Cinclus* 2/93.

Schneider, U. [Second pair of Gannets attempt breeding on Heligoland]. *Seevögel* 2193.

Brugière, D. & Duval, J. [Wintering of Cormorant in the Allier and Central Loire valleys]. *Nos Oiseaux* 431/93.

Jakobsen, J. [Premature autumn migration of wildfowl caused by shooting pressure ?]. *Vår Fuglefauna* supplement 1/93.

Mooij, J.H. Development and management of wintering geese in the Lower Rhine area of N Rhine-Westphalia. *Vogelwarte* 1/93.

Vangeluwe, D. & Stassin, P. [Wintering of Red-breasted Goose in the Western Dobruja and a review of the status of the species in winter]. *Le Gerfaut* 1-2/91.

Birds of Prey

Helbig, J. *et al.* [High density of wintering Hen Harriers and Buzzards in area of Dummer Lake]. *Vogelwarte* 3/92.

Seys, J. [Hen Harrier roost counts in winters of 1990-1 and 1991-2]. *Mergus* 4/92.

Sachteleben, J. [Hunting strategy and use of habitat by Buzzard and Kestrel: the avoidance of competition]. *Orn. Anzeiger* 1/93.

Sommani, E. [Variations in hunting technique by Peregrines]. *Riv. It. di Orn.* 1-2/92.

Grouse to Cranes

Milonoff, M. *et al.* [Large size a risk factor for Capercaillie chicks]. *Suomen Riista* 39/93.

van den Berg, A.B. *et al.* [Sandhill Crane at Paesens-Moddergat Sep 91] (i.e. the Shetland bird). *Dutch Birding* 1/93.

Waders to Auks

Meltofte, H. [Wader migration through Denmark]. (special 180pp issue covering all migratory waders in Denmark). *Dansk Orn. For. Tidsskr.* 1-2/93.

Klemp, S. [Population trends of Lapwing in Schleswig-Holstein]. *Corax* 2/93.

Pulliainen, E. & Saari, L. [Breeding biology of Golden Plover in E. Finnish Lapland]. *Orn. Fenn* 1/93.

Jacob, J-P. & Fouarge, J-P. [Development of population and habitats of Little Ringed Plover in Wallonia and Brussels region]. *Aves* 3-4/92.

Schmidt, C. & Barthel, P.H. [Plumages of Little Stint and their variations]. *Limicola* 3/93.

Peterson, Æ. [Kittiwake colonies on Snæfellsnes peninsula]. *Bliki* 13/93.

Mlody, B. & Becker, P.H. [The development of body mass and mortality in Common Tern chicks under unfavourable environmental conditions]. *Vogelwarte* 2/91.

Noordhuis, R. *et al.* [Food shortage for Common Terns at Zeewolde in 1991?]. *Limosa* 2/93.

Lyngs, P. Colony interchange in Baltic Guillemots. *Dansk Orn. For. Tidsskr.* 3-4/93.

Pigeons to Woodpeckers

Schlapfer, A. [The immigrant from the East: the Collared Dove]. *Ornis* 4/93.

Chantler, P. Identification of W Palearctic Swift. *Dutch Birding* 3/93*.

Laine, T. [Hybridisation of Great Spotted and White-backed Woodpeckers]. *Linnut* 2/93.

Nilsson, S.G. *et al.* [Lesser Spotted Woodpecker: why it is disappearing from Sweden?]. *Vår Fågelvärld* 3/93.

Passerines

Serra, L. Ageing criteria and moult conditions in Yellow Wagtail during spring migration. *Riv. It. di Orn.* 3-4/91.

Weber, S & Hegelbach, J. [Differences in use of habitat by breeding Grey and White Wagtails]. *Orn. Beob.* 1/93.

Dubois, P.J. & Yésou, P. [Review of the status of the British race of Pied Wagtail in Western France]. *L'Oiseau* 1/93.

Paulsen, B.E. [Breeding distribution and biology of the British race of Yellow Wagtail in SW Norway]. *Cinclus* 2/93.

Järvinen, A. Redstart and Pied Flycatcher nesting in same box. *Orn. Fenn.* 2/93.

Busche, J. [Migration of Ring Ouzel in Schleswig-Holstein - a contribution to loop migration theory]. *Vogelwarte* 1/93.

Bradshaw, C. & Dowdall, J. Identification of Catharus thrushes. *Dutch Birding* 2/93.

Slagsvold, T. Sex recognition and breast-stripe size in Great Tits. *Ardea* 1/93.

Kooiker, G. [Nest-sites of Magpies and Rooks on electricity pylons]. *Ök. der Vög.* 2/92.

Motis, A. Mixed breeding pairs of European and Spotless Starling in NE Spain. *But. del Grup Català* 9/92.

Gatter, W. [Exploratory behaviour, migration and the evolution of migratory habits in the Common Crossbill]. *Vogelwelt* 2/93.

Biber, O. [Availability and use of hedges and shrubs as nest sites by Yellowhammers in an intensively farmed area of Switzerland]. *Orn. Beob.* 2/93.

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

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

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

NEOTROPICAL BIRD CLUB

Neotropical bird club launched

A club has been launched to promote the study and conservation of the birds of the Neotropics (South America, Central America and the Caribbean). It is currently seeking founder members to help reach the launch budget of £2000, which is required to get the club running and to publish the two first issues of its intended journal 'Continga'. Founder members will be asked to pay a minimum of £25, and will be formally acknowledged in the first issue of 'Continga', planned for January 1994. 'Continga' will provide a colourful and much needed forum for exchange of information on the avifauna of this extremely rich and diverse area, and will contain papers and features on the birds and their conservation as well as news of recent observations and discoveries (at present, new species are still being discovered at the rate of more than two a year). It is hoped that in due course the club will be able to provide direct funding and support for practical conservation programmes.

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

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Scottish Birds, the official journal of the Scottish Ornithologists' Club, publishes original material relating to ornithology in Scotland. Papers and notes should be sent to The Editor, *Scottish Birds*, 21 Regent Terrace, Edinburgh EH7 5BT.

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). (But please phone beforehand). A comprehensive stock of Scottish local bird reports is held at headquarters and may be purchased by mail order.

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Research Progress Report

I.J. PATTERSON & J.G. OLLASON

The density and species diversity of songbird populations in northern upland spruce plantations

The Forestry Authority (FA) has a statutory duty to promote a reasonable balance between timber production and nature conservation. The FA financed the research described here because of its desire to diversify upland conifer forests as wildlife habitats, and to safeguard rare and sensitive species.

There have been several studies of bird populations in conifer forests in Britain, but most were based on small samples in restricted areas with few in the north. Most studies have also concentrated on first generation crops in extensive new afforestation. There was thus a need for study of second generation crops and of mosaics of different aged patches of forest as bird habitat because these were relatively neglected. There was also a need for study of winter bird populations, which may be important in determining subsequent breeding numbers and which may also have an important influence on the abundance of invertebrate pests of conifers.

The aim of this study was to measure the bird density and species diversity in upland spruce forests in relation to forest habitat variables, and to develop a computer model to predict how the bird populations were likely to change under different forest management regimes.

In each of two study areas, at Cowal, Argyll and Kielder, Northumberland, 88 study plots were selected randomly from 24 combinations of tree age (0-8, 9-15, 16-25 and over 25 years), plot size (1-2, 2.1-5 and over 5 ha) and altitude (above or below 250m). Both pure sitka spruce and mixed conifers were included, as were first and second rotation crops.

Point counts, at up to five per plot, were used to estimate bird populations, and in larger plots additional edge points allowed the comparison of plot centres and edges. At each point, a five-minute settling-down period was followed by a five-minute count period. Birds were detected by both sight and sound, up to a limit of 60m. Counts were made from 1990 - 1992 in winter (mid-November to mid-March), early spring (mid-April to mid-May) and late spring (mid-May to mid-June). Each plot was visited once in each period. The counting method was found to give consistent results both within and between days at the same count points.

There was strong and significant variation in bird numbers and diversity with tree age, both being highest in older trees in winter and in 9-25 year old trees in spring. All of the common species (Chaffinch *Fringilla coelebs*, Coal Tit *Parus ater*, Crossbill *Loxia curvirostra*,

Dunnock *Prunella modularis*, Goldcrest *Regulus regulus*, Meadow Pipit *Anthus pratensis*, Robin *Erithacus rubecula*, Redpoll *Acanthis flammea*, Siskin *Carduelis spinus*, Song Thrush *Turdus philomelos*, Tree Pipit *Anthus trivialis*, Wren *Troglodytes troglodytes* and Willow Warbler *Phylloscopus trochilus*) showed significant variation in their abundance between tree age categories, with all except Meadow Pipit occurring at their lowest density in the youngest trees and at their highest densities in 9-25 year old trees.

The number of individual birds detected was consistently higher at the edges than in the centres of the same plots, particularly in the first ten metres from the edge, but the type of habitat outside the plot had little effect on this. There was little detectable effect of plot size, altitude, admixture of other conifer species or planting generation on either bird numbers or species diversity.

Spring numbers of most of those common species, which were resident also in winter, were significantly correlated with their winter numbers, but the correlations were weak (particularly in 1992) and had little predictive value.

The two study areas and the two years were very similar in the way in which bird numbers and diversity varied with forest characteristics, suggesting that the conclusions may be of wide relevance. Bird numbers tended to be higher in 1991 than in 1992, due mainly to there being more Crossbills and Siskins in 1991, when there was a very high cone crop.

A computer model has been developed to predict how bird populations would be expected to change as such forests are managed to change the size and age distributions of the plots of trees.

The study clearly identified tree age and closeness to the forest edge as the two main factors affecting the number and diversity of songbirds in upland spruce plantations. This suggests that the greatest number and diversity of songbirds could be encouraged by creating mosaics of small patches (i.e. with a high ratio of edge habitat), with a mixture of tree ages, including a large proportion of 9-25 year old trees.

I.J. Patterson and J.G. Ollason
Zoology Department, University of Aberdeen.

Research Progress Report

R. MOSS

Research on Capercaillie and their habitat

Capercaillie *Tetrao urogallus* are now scarce in Scotland. The number shot for sport in Scotland declined roughly fourfold in the late 1970s and fell still further in the 1980s (Baines, Goddard & Hudson 1991). Bag records are a fair reflection of the number of birds on the ground where shooting is done (Moss, Weir & Jones 1979) and so this was a reliable indication of a widespread decline. At one estate on Speyside, where birds were counted each year from 1975-85, densities fell from about 20 birds km^2 in winter 1979-80 to 8 km^2 in 1984-85 (Moss & Weir 1987). This was particularly worrying as the forests of Speyside are one of the Capercaillie's main Highland strongholds.

Concern about falling Capercaillie numbers has given rise to a big increase in the amount of research on them. This report summarises what is being done.

Numbers and breeding success

The present distribution of Capercaillie in Scotland is being mapped and numbers estimated in a three-year project, due to end in 1994. This is being conducted, financed or supported jointly by the Institute of Terrestrial Ecology, the Forestry Commission, the Game Conservancy, the Royal Society for the Protection of Birds, the Scottish Landowners Federation, Scottish Natural Heritage and the Scottish Office. The project is also comparing the breeding performance of Capercaillie in a number of different forests, where factors such as forest type and the numbers of gamekeepers vary. The intention of this survey is to relate habitat and the level of predator control to the success of hens in rearing chicks.

Predator control is an emotive issue. Despite anecdotal evidence suggesting that active control of predators by gamekeepers is associated with better breeding performance by Capercaillie, better information is required before conservation bodies and landowners can reach rational conclusions on the topic. As well as participating in the above survey, the RSPB has begun an experimental programme at their Abernethy reserve to determine the importance of predation by different predators on Capercaillie populations, and the effects on these populations of predator control.

Throughout the study (1991-93), breeding has been poor so the outlook has not improved. I have been monitoring breeding performance and numbers since 1975 at one estate in Deeside, and there the last year of good breeding was 1989.

Habitat and diet

Capercaillie are usually thought of as birds of

old forest where they rely largely on pine needles for their winter diet. However, Rolstad & Wegge (1987) concluded that old forest seems favourable 'simply because it offers the necessary physical structure and key food elements' and not because it is old. A comparison of the winter diets of different populations of Capercaillie throughout their range in the western Palaearctic with the proportion of different native trees species in the habitat shows that they prefer eating pine (such as Scots or arolla pine) to fir (such as white fir), and fir to Norway spruce. However, they subsist on fir in the absence of pine, and spruce in the absence of fir and pine.

The inference that the structure of a forest is more important than its age or tree species composition has important implications. Young forests of, for example, sitka spruce might support Capercaillie if they are of the right structure, if sitka spruce is an adequate winter food, and if the forest floor supports enough blaeberry or other ground vegetation to provide the chicks with food and cover. Research by ITE, funded in part by the Forestry Commission, the Scottish Forestry Trust, Eagle Star and Horsens Folkeblad (a Danish company with forestry interests in Scotland) is looking at the question of whether plantation forests can be managed to support Capercaillie. Results so far confirm that Capercaillie do live in some sitka-dominated forests where in winter they eat sitka spruce as readily as Scots pine. Whether such forests can also provide good brood habitat is still an open question. Management guidelines for Capercaillie will be summarised in a Forestry Commission Bulletin, written by Robert Moss and Nick Picozzi, due to be published in 1994.

The concept of forest structure has hitherto been fairly vague and embodied in terms such as pre-thicket, thicket, pole stage, high-canopy (mature) and semi-natural forest. These terms bring an image to the mind of somebody who has been shown examples on the ground, but are not quantitative. To assess the association between forest structure and Capercaillie numbers more rigorously, ITE developed a new measure of forest structure (Picozzi, Catt & Moss 1992). These authors confirmed an association between Capercaillie numbers and old forest, and suggested that this is largely because the open structure of such forests allows enough light to reach the ground to support heather and especially blaeberry, which is an important chick food. The RSPB are using this measure of forest structure in a detailed study of habitat preferences at their Abernethy reserve (R.W. Summers & R. Proctor, in progress).

Blaeberry leaves and berries are important chick foods, and blaeberry also supports many of the arthropods upon which the chicks feed in their first weeks. Most plantations which support good populations of Capercaillie also have much blaeberry. Work in Norway (Kastdalen & Wegge 1985) indicated that in their first month about half the food of chicks (by volume) comprised arthropods and about half vegetation. The vegetation in their study was mainly blaeberry leaves, and many of the arthropods caterpillars of geometrid moths such as the winter moth (they also eat spiders and harvestmen). The Game Conservancy is conducting extensive sampling of larval abundance in relation to such factors as longitude and the level of grazing by large herbivores, and the RSPB is measuring larval abundance in relation to Capercaillie breeding performance on the Abernethy reserve, as is ITE at one of their intensive study areas in Deeside.

There is, however, very little information on

what Scottish Capercaillie chicks actually eat. A particularly important question is whether other foods can substitute for blaeberry and geometrid larvae and, if so, what. ITE and the Forestry Commission began to study this topic in 1993. The answer will be relevant to future forest management. If alternative foods, such as low-growing willow and birch scrub, for example, can support chicks, then encouraging these plants might become a valuable management procedure.

Fences

A radio-tracking study by ITE confirmed earlier work (Moss 1987) showing that collisions with forest fences are an important cause of Capercaillie mortality. Concerned about this, the RSPB began monitoring fence lines in Abernethy, verified that woodland grouse frequently hit fences (Catt *et al.* 1994), and then removed most of their deer fences. This work also suggested that fence strikes occurred more frequently along some stretches of fence than along others. The characteristics of such 'hot spots' are currently being investigated by continued co-operative work between the Forestry Commission, the Game Conservancy, ITE, RSPB and SNH. This has confirmed that deaths of grouse and Capercaillie from hitting fences are widespread as well as frequent in some places.

In one forest, such deaths continued even after the hot spots along a deer fence were marked with a broad band of brightly coloured plastic. It is possible that the strike rate was reduced by the plastic, but the data were not sufficient to test this possibility. In principle, steps should now be taken to do experimental work on how to reduce bird strikes by re-siting and marking fences. In practice, the scale upon which this work would need to be done may make a rigorous scientific study expensive. Sensible measures meantime include removing fences as soon as they have served their purpose; identifying hot spots and re-siting fences along less dangerous lines; and, if re-siting is impracticable, marking hot spots to make them obvious to the birds.

Scale

Capercaillie are big birds with large home ranges and can disperse long distances. In Scotland (Picozzi *et al.* 1992), as elsewhere (Wegge & Rolstad 1986), leks are spaced at approximately 2 km intervals in continuous forest, indicating that a lekking population of cocks occupies an area of 3-4 km^2. But current radio-tracking studies by ITE with the Forestry Commission are showing that adult cocks may visit more than one lek and one hen visited at least five different leks in one spring. ITE with RSPB are studying natal dispersal in Capercaillie by means of radio-tracking. Samples so far are fairly small but 3 of 22 hens tagged as poults in Deeside have moved more than 20 km before settling. One hen tagged as a poult at Abernethy was later recovered near Braemar, presumably having flown over the Cairngorms.

All this means that forest management for Capercaillie needs to be strategically planned on a large scale, such as entire catchments, rather than on a local forest or estate level. A reasonable guess is that it would take a minimum of 1000 ha of good habitat (3-4 leks) to support a population of breeding Capercaillie. Good habitat need not be continuous but must provide for both adults and chicks.

Population ecology

It may be presumed that chick production is

the key to Capercaillie numbers and that a reduction in breeding success is the root cause of the present low numbers. In turn, one may speculate that wetter summers, heavier predation and overgrazing of forest vegetation by deer have contributed to this decline. However, the evidence from two continuing long-term ITE population studies which started in 1975 is not obviously consistent with these suggestions.

At an estate in Deeside, there was a big decline in shooting bags between 1970 and 1974. Shooting ended in 1982 but counts in summer and autumn showed no long-term trend in density of hens between 1975 and 1993. For most of this period chick production generally exceeded the number needed to replace adult mortality and the population seemed to have been regulated by density-dependent dispersal of young birds (Moss & Oswald 1985). This meant that the more birds there were present, the bigger the proportion that left the area: so the density of breeding hens remained at about 5.5 km^2. More recently, breeding has been poor but adult numbers have still not declined further.

Shooting bags at an estate in Speyside also declined in the early 1970s, and a further decline in numbers there in the early 1980s was associated with a decrease in the recruitment of young birds to the population. However, this failure of recruitment was apparently not due to an absolute shortage of young birds. Breeding remained good during the decline and the evidence suggests that there was net dispersal of young birds away from this Speyside population (Moss & Weir 1987), as at the Deeside estate.

The observations are consistent with a core/sink model in which the best 'core' habitats produce an excess of young which move to the poorer 'sink' habitats where breeding is poor and mortality high. When conditions worsen in the sink habitats, density there may drop and more birds may disperse out of the core habitats into sink habitats, resulting in a decline in both core and sink habitats.

The model is speculative but implies an important danger. It is correct, the still wide distribution of the Capercaillie may give a false idea of its security as the entire Scottish population might depend upon a relatively small area of core habitat. It the core habitat is destroyed or allowed to deteriorate, then the birds in the sink habitats might go too. Thus, a sensible conservation strategy for Capercaillie would be to safeguard their core habitats - pinewoods with blaeberry - while improving the quality of sink habitats, such as other coniferous plantations.

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Robert Moss, Institute of Terrestrial Ecology (N),
Hill of Brathens, Banchory,
Kincardineshire AB31 4BY.

Prey remains at Osprey nests in Tayside and Grampian, 1987-1993

D.N. Carss & K. Brockie

Prey remains were collected from twenty Osprey nests in Tayside and three in Grampian during 1987-1993. All remains were from fishes and included scales, pieces of skin and fins, and cranial keybones. Methods were devised to identify these keybones to species and to determine the original sizes of prey. Overall, 104 prey records were collected, the most numerous being brown and rainbow trout (37%), followed by roach (21%), perch (18%), grayling (13%), pike (11%) and flounder (1%), but proportions varied throughout the study. The mean length of all measurable fishes (n - 113) was 34cm and the corresponding weight 480g, but mean size varied with species. We could find no previous record of grayling as Osprey prey anywhere, and roach has apparently not previously been recorded as prey of Ospreys in Scotland. The diet of Ospreys in Tayside and Grampian is discussed in relation to other studies, the Scottish fish fauna and current fishery practices.

Introduction

The decline and subsequent recovery of the Osprey *Pandion haliaetus* population in Scotland is well documented. The species ceased to breed about 1916 and although nesting attempts were recorded in the 1950s, breeding was not successful until 1954. Thereafter, the population increased gradually to 13 pairs in 1972, 25 pairs in 1981, 50 pairs in 1986 and 76 pairs in 1992; there were 86 breeding pairs in 1993 (Osprey Study Group pers. comm.). Despite this rapid recolonisation there has been relatively little published on diet in Scotland (Poole 1989). Throughout its range the Osprey is primarily piscivorous, taking a wide variety of fishes near the surface depending on their relative availability (Cramp & Simmons 1980). However, apart from an intensive study at a single nest site in Speyside (Green 1976) and observations of foraging birds and their prey remains in an area of north-east Scotland (McLeod & Duncan 1984), little is published on the diet of the species elsewhere in Scotland.

Most Ospreys return to the same nest and forage in the same habitats for many consecutive years (Postupalsky 1989). Such nesting and foraging site fidelity could mean that samples of prey from the same few nests spanning several years are less representative of the general diet of a population than samples from a larger number of nests. This paper reports on the analysis of prey remains collected from 23 Osprey nests in Tayside and Grampian Regions of Scotland between 1987 and 1993.

TABLE 1. ***Numbers of nest samples taken each year from 23 Osprey nest sites in Tayside and Grampian, 1987-93. Each asterisk indicates at least one visit between May-August in any one year.***

Region and site number	Year 1987	1988	1989	1990	1991	1992	1993
Tayside							
1	*			*	*		
2	*			*	*	*	
3	*			*			
4	*	*	*	*			
5	*	*	*	*		*	*
6	*	*		*	*	*	*
7		*					
8			*	*		*	*
9				*	*		
10				*	*		
11				*		*	*
12						*	
13		*					
14						*	
15						*	*
16						*	
17							*
18							*
19							*
20							*
Grampian							
21				*		*	*
22				*	*	*	*
23							*
Total no. samples	6	5	3	12	6	11	12

Study area and methods

Nest material

Twenty nests in Tayside and three in Grampian were visited during the study period (Table 1). These solitary nests were usually visited once or twice, but occasionally more often, during the breeding season (May-August) to record nest contents and to count and ring nestlings. During these visits a handful of material was scraped from the lining of the nest and any uneaten food in, and under, the nest was collected. In cases where more than one collection was made from the same nest in one season, samples were combined for analysis. Nest 'scrapes' were dried at room temperature for 24-48 hours and all prey remains extracted for examination.

Prey identification and measurement

Prey remains were analysed in two way: (1) the presence of all identifiable material (skin, fins, scales and bones) was recorded and identified using keys (Maitland 1972, Steinmetz & Muller 1992) and a reference collection, and (2) 'keybones', which could be assigned to individual fish, were counted, identified and measured (Fig. 1). These included salmonid first (atlas) vertebrae and cleithra (paired bones on either side of the head supporting the gill arches), lower jaws (pike *Esox lucius*, perch *Perca fluviatilis*, and salmonids), opercular and preopercular bones (perch and roach *Rutilus rutilus*). These bones were also used to determine the original sizes of fishes using a series of regression equations derived from intact specimens (see Table 3). Flounder *Platichthys flesus* was

TABLE 2. ***Length:weight relationships for five fish species, Wt = wet weight (g), L = fork length (cm).***

Species	Relationship	Source
Perch	$Wt = 0.0135\ L^{3.0}$	Craig (1974)
Pike	$Wt = 0.005248\ L^{3.09}$	Frost & Kipling (1967)
Roach	$Wt = 0.009303\ L^{3.1513}$	Mills (1969)
Brown trout	$Wt = 0.0195\ L^{2.822}$	Clelland (1979)
Rainbow trout	$Wt = 0.0101\ L^{3.05}$	Carss (1993b)
Flounder	$Wt = 0.01481\ L^{2.925}$	Summers (1979)

identified from a single bone and the original fish size estimated from a reference collection.

Intact fish were collected and measured from the snout to the fork of the tail (fork length, mm) and their heads were removed and digested in a saturated solution of biological washing powder for 4-5 days. The resulting bones were rinsed and dried and the various keybones extracted and measured (mm) (Fig. 1). These measurements were regressed against original fork lengths to produce a series of conversion equations. In the case of roach opercular bones, a published equation (Mann 1973) was used. The original size of broken bones was estimated by comparison with reference material. Prey lengths were converted to weights by a series of regression equations (Table 2).

Figure 1. Keybones and the position of the measurements used to determine the original length of fishes. Lower jaws: pike (a), perch (b), salmonid (c); opercular bones: perch (d), roach (e); perch preoperculum (f), salmonid cleithrum (g) and atlas vertebra (h).

FIGURE 1

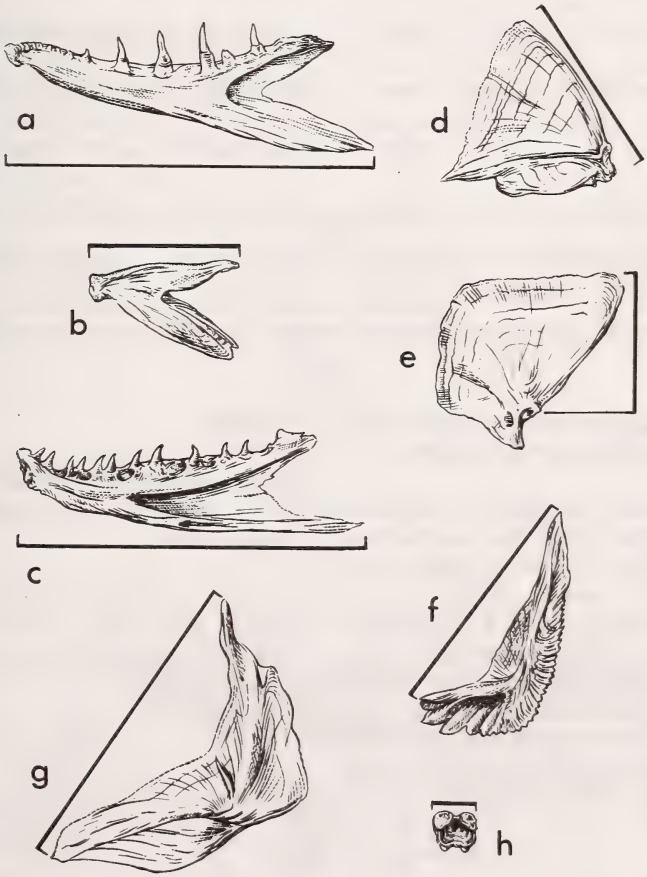


TABLE 3. ***Regression equations for various pike, perch, brown and rainbow trout keybone measurements (mm) against fork length (FL, cm).***

Keybone	N	Range (cm)	r^2	Relationship
Pike lower jaw	31	11-53	0.99	Log FL = -0.192 + 1.01 Log J
Perch lower jaw	17	9-36	0.99	Log FL = 0.0684 + 1.01 Log J
Perch preoperculum	17	9-36	0.97	Log FL = 0.0014 + 0.955 Log P
Perch operculum	17	9-36	0.98	Log FL = 0.207 + 0.873 Log Op
Salmonid lower jaw	103	10-56	0.97	Log FL = 0.0664 + 0.982 Log J
Salmonid atlas	100	10-56	0.98	Log FL = 0.761 + 1.08 Log At
Brown trout cleithra	60	10-56	0.98	Log FL = -0.0475 + 1.04 Log Cl
Rainbow trout cleithra	40	10-55	0.94	Fog FL = 0.0298 + 0.96 Log Cl

Distinguishing salmonids and estimating the accuracy of diagnostic features

Pike, perch, roach and salmonid keybones were very different from one another but brown trout *Salmo trutta* and rainbow trout *Oncorhynchus mykiss* could not be distinguished easily. Thus a method was devised to separate these species by closer examination of their keybones. This was later tested by one experienced and two inexperienced observers examining a mixed sample of brown and rainbow trout lower jaws, cleithra and atlas vertebrae (n = 40 of each).

Results

Distinguishing brown and rainbow trout and estimating the accuracy of their identification

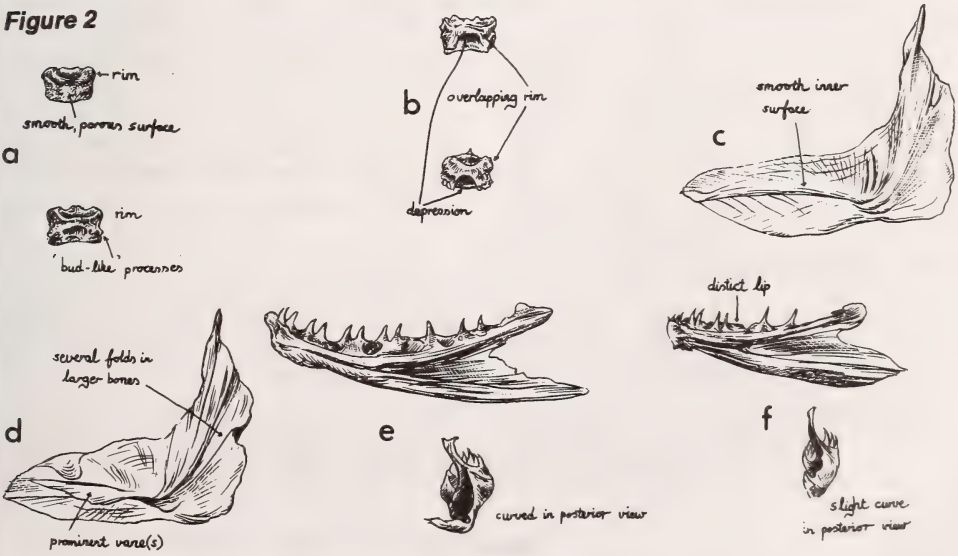
Brown and rainbow trout atlas vertebrae, cleithra and lower jaws could each be distinguished using only a small number of characteristics:

(a) The dorsal surface of the brown trout atlas appears separated from the anterior surface by a distinct rim. It is porous and relatively smooth, sometimes having a pair of small 'bud-like' processes emerging from it. These processes are not connected to the rim of the vertebra (Fig. 2a). The dorsal surface of the rainbow trout atlas is often grossly overlapped by the rim separating it from the anterior surface. Large, smooth processes originate from this rim and often extend posteriorly beyond the body of the atlas. Below this the dorsal surface is smooth, usually leading to a deep depression between, and below, the processes (Fig. 2b).

(b) The inner surface of the brown trout cleithrum is relatively smooth (Fig. 2c) whilst that of rainbow trout has one, and occasionally two, prominent antero-posterior vanes whilst the posterior portion of bones from larger fish also have several folds (Fig. 2d).

(c) Viewed from the inner side, brown trout lower jaws appear relatively deep compared to the length of the narrow surface from which the teeth emerge. There is also no 'lip' of bone on the outer edge of the teeth. Viewed posteriorly the jaw is sharply curved, its lower plane is almost perpendicular to the tooth-bearing axis(Fig. 2e). Viewed from the inner side, rainbow trout lower jaws appear relatively shallow compared to the length occupied by the teeth. The teeth emerge from a broad surface and there is a distinct 'lip' of bone on their outer edge which is clearly visible between them. Viewed posteriorly, the jaw is only slightly curved (Fig. 2f). The shape, number and exact position of the teeth, and holes marking the position of broken teeth, varied greatly between individuals and no consistent patterns were observed within, or between, species.

Figure 2. Characteristic features used to distinguish brown and rainbow trout keybones: dorsal surfaces of the two types of brown (a) and rainbow trout (b) atlas vertebrae; inner surfaces of brown (c) and rainbow trout (d) cleithra; lower jaws of brown (e) and rainbow trout (f) with posterior profiles.



These characters could be used to distinguish brown and rainbow trout in 83% (atlas), 95% (cleithrum) and 93% (lower jaw) of cases by an experienced observer. Corresponding figures for two inexperienced observers were 80%, 92%, 78% and 70%, 92%, 88%, respectively, with observers consistently making more correct identifications based on cleithra than the other two keybones.

Keybone regression equations

The relationships of keybone measurements to original fish length were linear, those for the lower jaws and atlas vertebrae of brown and rainbow trout ('salmonid') could each be described by a single equation (Table 3).

Species and sizes of fish from Osprey nests

Seven fish species, roach, perch, pike, grayling *Thymallus thymallus*, brown trout, rainbow trout, and flounder were identified from nest samples (Table 4). The three Grampian nests yielded remains of brown trout, rainbow trout, pike and perch. Site and seasonal variation in prey remains were investigated in the Tayside samples.

For Tayside, cumulative records showed that six of the seven fish species were recorded after nine of the 20 sites had been sampled, the single flounder being recorded in 1993 after 17 nests had been sampled (Fig. 3).

Figure 3. The cumulative number of nest sites sampled during the study and the number of fish species recorded.

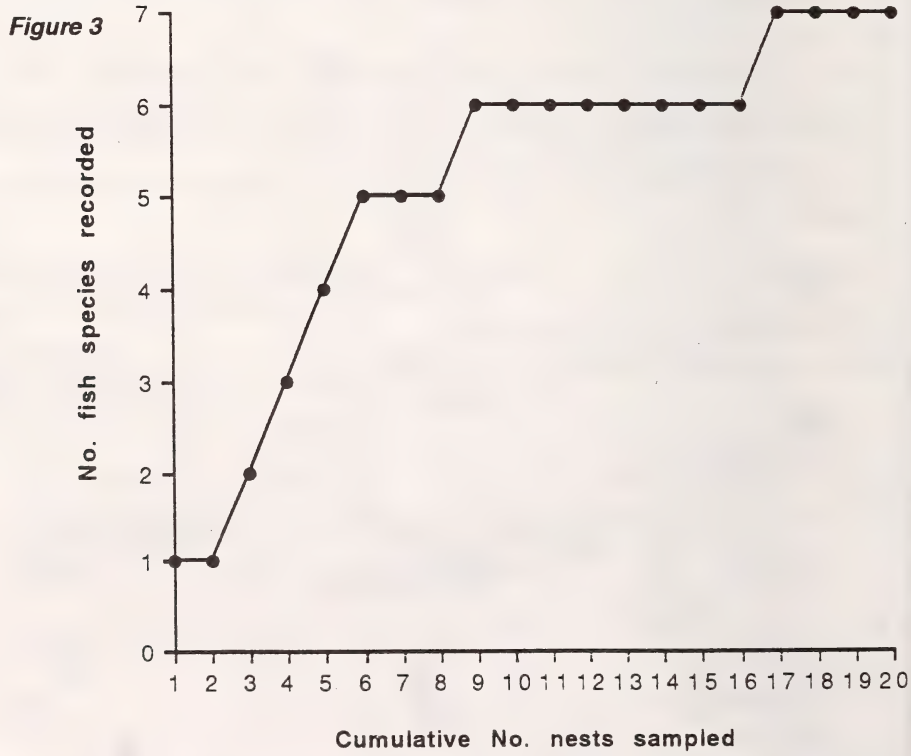


TABLE 4. ***The fish species recorded at each nest site during the study period. Numbers refer to specific nests, as given in Table 1.***

Prey	1987	1988	1989	Year 1990	1991	1992	1993
Roach	1,2,3,4,5	4,5	4,5,8	1,3,4,5,8 9,10,11	1,12	16	11
Perch	4,5,6	None	4,5	2,9,10	2,6	2,8,14 15,21	8,15,17,18 21
Pike	5	7	5	6,21	18	5,8,15,21	15,18,20,21
Salmonids	3,4,6	4,6,13	4,5,8	1,4,5,6,8 9,10,11 22	2,6,12 22	2,6,8,11 12,14,15 16,21,22	5,6,8,11 15,17,18 20,22,23
Grayling	None	None	4	8,11	2,9	2,5,11,12	5,11,19,20
Flounder	None	None	None	None	None	None	20
No. records	12	6	10	24	11	24	25
No. sites	6	5	3	12	6	11	12

Overall, 104 prey records were collected; the most numerous were salmonids (37%), followed by roach (21%), perch (18%), grayling (13%), pike (11%) and flounder (1%). Proportions of salmonid, roach and 'other fishes' remains were similar in 1987-89 and 1990-93, but within the 'other fishes' category, proportions of grayling increased throughout the study (Table 5).

Most (69.8%) of the salmonids identified from keybones (n =63) were brown trout, the remainder (30.2%) being rainbow trout. Proportions of rainbow trout varied annually and in years when at least ten measurable salmonids were recorded, proportions were 40.0% (1987, n = 10 salmonids), 71.4% (1990, n = 14) and 7.4% (1992, n = 27).

The mean length of all measurable fishes (n = 113) was 34cm and the corresponding weight was 475g. However, mean sizes varied with species (Table 6). Ignoring the single flounder (ca. 27cm, 288g), there were significant differences in mean fish lengths ($F_{4,107}$ = 13.92, P<0.001) with the 'long-bodied' fishes, salmonids and pike, being significantly longer (mean = 36cm, SE = 0.8) than the 'deep-bodied' fishes perch and roach (mean = 26cm, SE = 1.0) (t = 6.64, df = 110, P<0.001). Mean fish weights were also significantly different ($F_{4,107}$ = 8.42, P<0.001) with the salmonids being significantly heavier (mean = 630g, SE = 47.3) than the other fishes (mean = 301g, SE =27.9) (t = 5.62, df = 110, P<0.001).

Discussion

Methodology

Assessments of Osprey diet have been obtained by several methods, for example collecting uneaten remains from nests and feeding perches (e.g. Hakkinen 1978), observing foraging birds (e.g. Edwards 1988), and recording fish delivered to the nest (eg. Jamieson *et al.* 1982, Mclean & Byrd 1991). The latter method has the disadvantage that it is labour intensive and may often be restricted to a small number of nests. Moreover, as with observations of foraging birds, identifications are likely to be biased in favour of distinctively shaped or coloured fishes and, as a result, considerable proportions of prey may be unidentified. For example, 68% of all Bald Eagle *Haliaetus leucocephalus* open-water captures could not be identified by Mersmann *et al.* (1992).

The remains of prey taken extremely rarely may not be found. We have for instance a reliable field record of an Osprey carrying an eel *Anguilla anguilla* to a nest in Tayside but found no remains of this species in over 45 samples. Prey remains could be lost to scavengers such as foxes *Vulpes vulpes*, Crows *Corvus corone* and Magpies *Pica pica.*, but this would result in bias (i.e. an incorrect representation of the true proportions) only if they removed an unrepresentative sample of items. Two types of bias can occur: (1) in species, because fishes whose scales are relatively large and easily lost during manipulation, or large bony species, may be over-represented in samples and (2) in size, because small scales and pieces of fish skin may decompose faster than larger diagnostic bones, particularly over time. This is particularly relevant if samples are collected infrequently.

TABLE 5. ***Top: the number of records of roach, salmonids and 'other fishes', these were similar in 1989 and 1990-93 (X^2 = 4.39, df = 2, NS). Bottom: the number of nests where Grayling were either present or absent in each year. There was a significant increase in grayling records throughout the study period (Snedecor & Cochran's test for a linear trend in proportions, z = 2.54, P = 0.011).***

	Year						
Prey recorded	1987	1988	1989	1990	1991	1992	1993
Roach	5	2	3	8	2	1	1
Salmonids	3	3	3	8	3	8	8
'Other fishes'	4	1	4	6	4	11	12
Total no. records	12	6	10	22	9	20	21
Grayling absent	6	5	2	8	3	5	5
Grayling present	0	0	1	2	2	4	4
Total no. nests	6	5	3	10	5	9	9

In the present study of prey remains, there was thus probably some bias but the method had the advantage that it required little effort per nest and so several nests could be sampled each season. Nevertheless sample sizes were rather small: only nine out of 23 nests were visited in more than three years and only two visited in six years. Fourteen (more than half of the nests) were visited only in one or two years and possibly only once. Furthermore, as few remains (bones and skin) were collected at each visit, it was not possible to determine such things as the variation in diet at particular nests or the quality of the fish delivered. However, despite the potential for bias it was thought data were sufficient to determine diet and size of prey in general terms.

General diet

Ospreys are presumed to feed on the most abundant and available fish species in any particular area (Poole 1989) and data from the present study were not inconsistent with this view. Seven fish species were recorded but it was not possible to infer the foraging habitat of Ospreys as all the fishes taken are known to inhabit both running and standing freshwaters (Maitland & Campbell 1992). However, the species recorded were as expected from the status and distribution of Scottish freshwater fishes.

The Scottish freshwater fish fauna is impoverished compared with that of continental Europe (Maitland & Campbell 1992) and is dominated by the salmonids. These are northern hemisphere fishes, well-adapted to cold waters (Wheeler 1978) and include the indigenous Atlantic salmon *S. salar* and brown trout and the rainbow trout introduced from North America. The two trout species formed the largest proportion of measurable remains collected (54.9%), of which over two-thirds were brown trout. The remains of the four largest salmonids appeared from skin colouration and keybone features to be those of brown trout but it was possible that they came from the closely-related salmon. Returning adult salmon, which may be as small as 50cm (D. Hay, SOAFD, pers. comm.), enter freshwater throughout the year although spawning does not take place until the autumn. Furthermore, there are two lochs in Tayside which are stocked with a few hundred salmon (1.4-2.7kg) each year for angling purposes. Ospreys have been seen scavenging moribund salmon here on at least one occasion (C. Langton pers. comm.).

The cyprinid family is the largest group of freshwater fishes in Europe (Wheeler 1978) and in continental Europe Osprey diet includes at least 11 species (Cramp & Simmons 1980). Furthermore, species such as bream *Abramis brama*, silver bream *Blicca bjoerkna*, and roach often comprise the largest single dietary component. However, cyprinids are scarce in Scotland, particularly north of the Forth-Clyde Canal (Mills 1969, Maitland 1972). Apart from the minnow *Phoxinus phoxinus* roach is the most widely distributed cyprinid in Scotland and it was the only one recorded in the present study. Cyprinids have not been recorded previously in studies of Osprey diet in Scotland (Green 1976, McLeod & Duncan 1984), presumably because of their relative scarcity and patchy distribution.

Piscivorous fishes are thought to be swifter and harder to capture than enthic-feeding or non piscivorous limnetic fishes (Swenson 1979), and are relatively scarce in Osprey dietary studies. For example perch and pike have been found to comprise no more than

16% and 37%, respectively, of the prey items examined in European studies (Cramp & Simmons 1980). Similarly, corresponding figures for the present study were low (18% and 11%, respectively).

TABLE 6. ***Length and weight details of fishes caught by Ospreys.***

		Length (cm)			Weight (g)		
Prey	N	Mean	SE	Range	Mean	SE	Range
Perch	16	25	0.9	18-30	213	22.0	79-365
Pike	25	33	1.2	24-44	326	40.4	110-966
Roach	9	28	2.3	18-38	388	91.4	84-885
Brown trout	44	38	1.3	23-60	636	59.1	136-2032
Rainbow trout	18	36	1.4	29-48	614	78.1	262-1355
Salmonids, pike	87	36	0.8	23-60	-	-	-
Perch, roach	25	26	1.0	18-38	-	-	-
Salmonids	6	-	-	-	630	473	136-2032
Perch, roach, pike	50	-	-	-	301	27.9	79-996
All fishes	113	34	0.8	18-60	481	32.6	79-2032

We could find no previous record of grayling in the diet of European Ospreys (Cramp & Simmons 1980, McLeod & Duncan 1984, Eriksson 1986). The Grayling was introduced to Scotland in the nineteenth century and has a limited distribution. North of the Forth-Clyde Canal, the only Grayling populations are currently in the River Tay system: the rivers Tummel, Isla and Earn and at least two Tayside lochs (Gardiner 1992). The increase in grayling occurrences in remains could be a reflection of the increase in Osprey numbers, and their spread throughout Tayside, with birds visiting more of the available freshwaters and possibly foraging more on rivers than previously. An alternative, but not mutually exclusive, explanation is that grayling abundance has increased in recent years. There is known to be year to year variation in grayling numbers leading to dominant year classes, and catches on the R. Tummel have allegedly increased over the 1970s and 1980s (R. Gardiner pers. comm.). As there have been no further fish introductions there in recent years, the overall distribution of grayling in the area is unlikely to have changed (R. Gardiner SOAFD pers. comm.).

Size of prey

The perch and roach recorded in the present study were smaller than the other fishes but all the fishes taken were similar in size and weight to those reported for the same species in other studies (Cramp & Simmons 1980, Poole 1989). The two salmonids had different length distributions, possibly associated with the size structure of their populations in the wild. Brown trout exhibited a natural, multi-modal frequency distribution which was positively skewed towards larger (>40cm) fish but also included smaller (<30cm) individuals. The rainbow trout length distribution, although positively skewed, lacked any of these smaller fish and was typical of stocked fish populations. Most rainbow trout sport fisheries are maintained by regular introductions of hatchery-reared fish which are grown-on before release, until large enough to be caught by anglers. Most of these fish are about 35cm on release and only a few are less than 30cm long. This was certainly the case at one fishery known to be visited by Osprey from at least four of the nests in the present study. The largest fish recorded, a 60cm/2032g brown trout, was possibly scavenged as carrion, a rare, but not unrecorded, phenomenon (Dunstan 1974).

Although piscivorous fish are relatively scarce prey items for Ospreys, pike and perch do dominate the diet of birds in one area of north-east Scotland where there are few, if any, trout (McLeod & Duncan 1984, Carss 1993a). Here, perch (n = 173) and pike (n = 239) of between 13-41cm and 18-48cm, respectively, have been recorded taken by Ospreys (Carss 1993a). These size ranges are strikingly similar to those taken by Ospreys in Tayside in the present study (18-30cm and 22-44cm, respectively) which were obviously taken by birds foraging in a number of different sites.

The future

As Ospreys increase in Scotland, they may come into conflict with man. As present the species is recorded visiting a few pond trout farms each year but such predation can be prevented by placing nets over small ponds (NCC 1990). However, in 1993 there were several reports of birds feeding regularly at small lochs stocked with rainbow trout and in such circumstances the birds may be competing directly with anglers for fish (Carss & Marquiss 1992). As a result, in one area, the RSPB, SNH and other conservation bodies

were approached by a fisheries manager requesting financial compensation for losses to Ospreys (I. Francis pers. comm.). As conflicts are extremely difficult to resolve, and compensation payments are highly unlikely, it seems inevitable that such complaints will increase. Protecting the relatively large areas of water involved is impractical, whilst the birds themselves receive legal protection. In some cases, predation of stocked trout could possibly be reduced by altering the timing of stocking to allowing introduced fish time to acclimatise before Ospreys arrive or by increasing cover by providing floating islands and encouraging bankside vegetation (R. Dennis pers. comm.).

So far, breeding Ospreys have been carefully guarded in Scotland and this has discouraged intensive research (Poole 1989) because of the risk to a small and vulnerable population. However the continued increase in Osprey numbers means that the small risks involved become increasingly acceptable, enabling the species to be studied in greater detail. Such studies could include further work on diet, foraging energetics in different habitats (e.g. natural and stocked lochs, seashores and estuaries, and associated river systems), and post-fledging dispersal.

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D.N. Carss, Institute of Terrestrial Ecology, Hill of Brathens, Glassel, Banchory, Kincardineshire, AB31 4BY.
K. Brockie, Iolaire, Dron Farm, by Invergowrie, Dundee, DD2 5LH.

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Scottish List

Several attempts have been made in the past by various people to produce a list of Scottish Birds, but none of these lists have been updated on a regular basis. It became obvious to many people that a need existed for a formal Scottish List and that an organisation (not an individual) was required to take responsibility for such a list.

At its annual meeting held in November 1991 the Scottish Birds Records Committee (a sub-committee of the SOCs Council) agreed to commence work on the preparation of a draft for such a list. Ken Shaw volunteered to prepare an initial draft which was circulated around all SBRC members for comment, following which a second draft was prepared and further amendments made. A third draft was then circulated around all Local Recorders for their comments during the first few months of 1993.

At an SOC Council meeting in July 1993, it was agreed to adopt a fourth draft as forming the basis of an official SOC produced Scottish List and the Club accepted responsibility for its continued maintenance. It was further agreed to delegate to SBRC responsibility for maintaining the list and publishing regular amendments. This list which has been further updated is now published for the first time. It is the intention of SBRC to publish amendments on a regular basis and from time to time to publish revised versions of the list.

Each species has been categorised, depending on the criteria for its admission to the Scottish List and the category (A, B or C) appears before the English name. Species in category D do not form part of the main list and are listed separately at the end. The categories are defined as follows:

Category A. Species which have been recorded in an apparently wild state in Scotland at least once since 1958.

Category B. Species which were recorded in an apparently wild state in Scotland at least once up to 31 December 1957, but have not been recorded subsequently.

Category C. Species which, although originally introduced by man, have now established a regular feral breeding stock which apparently maintains itself without necessary recourse to further introduction.

Category D. Species which would otherwise appear in Category A or B except that :

(D1) there is a reasonable doubt that they have ever occurred in a wild state, or

(D2) they have certainly arrived with a combination of ship or human assistance, including provision of food and shelter, or

(D3) they have only ever been found dead, or

(D4) species that would otherwise appear in category C except that the feral population may or may not be self-supporting.

We have used several principles in establishing the list:-

1. We have used identical categories (A,B,C and D) to the British Ornithologists' Union who are responsible for maintaining the official list of birds recorded in Britain and Ireland.

2. We have in no instance given a bird on our list a higher category than the BOU (e.g. if a species appears in Category B on their list it cannot appear as Category A on our list) and have not included any species which do not appear on the British List.

3. We have used the same systematics as the BOU (e.g. we have not given species status to Yellow-legged Gull as the BOU have not yet done so).

4. We have only accepted a species in Category A if either :-

i) It appears on the British Birds Rarities List and the British Birds Rarities Committee have accepted at least one Scottish Record (they were formed in 1958 and the BOU have therefore for that reason decided that a bird must have occurred in Britain or Ireland since 1 January 1958 to be in Category A of their list).

ii) It does not appear on the British Birds Rarities List and we are satisfied that it has occurred in a wild state in Scotland since 1958.

A few species are assigned more than one category. With the exception of Capercaillie, these are all either dual A and C or dual A and D4 to reflect the situation where records of genuinely wild birds are supplemented by birds from stock originally introduced by man. In the case of Capercaillie (dual B and C) a natural population became extinct in the 18th century, with the present feral population being introduced during the 19th century.

The choice of English bird names used in the list should in no way be taken as reflecting a particular view. The SOC do not wish at this stage to become involved in the present debate on English names and have decided to continue with existing names at least for the time being. We have therefore on the whole stuck to conventional English bird names.

All species appearing on the main British and Irish List (i.e. Categories A, B and C) which have not been admitted to the Scottish List (Categories A, B and C), appear on the BBRC List and would therefore require to be accepted by them prior to being admitted to the Scottish List, with the exception of Egyptian Goose, Lady Amherst's Pheasant and Rose-ringed Parakeet.

The Scottish List stands at 469 species (there are now 550 species on the British and Irish List). The 12 species which are in category D only, do not form part of the main List.

Category A	450
Category B	13
Category C	6
	469
Category D	12
	481

The list will require regular revision and at any one time there is likely to be more than one record held pending which if accepted would affect the list. Among other decisions awaited at present are those by the BOU which could add Brown Flycatcher to the Scottish List and change the category for Pallid Harrier.

The Scottish Birds Records Committee which is responsible for maintaining the Scottish List, now consists of Bernard Zonfrillo (Chairman), Pete Gordon, Angus Hogg, Ken Shaw, Eric Meek, Kevin Osborn and Ron Forrester (Secretary).

Ken Shaw was responsible for a large part of the work associated with producing this list and the Committee wish to thank all those who commented on the early drafts. Bernie Zonfrillo has commenced work on the production of a list of all sub-species recorded in Scotland, which when complete, is expected to supplement this present list.

Ronald W. Forrester
Secretary
Scottish Birds Records Committee.

Systematic List

A	Red-throated Diver	*Gavia stellata*
A	Black-throated Diver	*Gavia arctica*
A	Great Northern Diver	*Gavia immer*
A	White-billed Diver	*Gavia adamsii*
A	Pied-billed Grebe	*Podilymbus podiceps*
A	Little Grebe	*Tachybaptus ruficollis*
A	Great Crested Grebe	*Podiceps cristatus*
A	Red-necked Grebe	*Podiceps grisegena*
A	Slavonian Grebe	*Podiceps auritus*
A	Black-necked Grebe	*Podiceps nigricollis*
A	Black-browed Albatross	*Diomedea melanophris*
A	Fulmar	*Fulmarus glacialis*
A	Cory's Shearwater	*Calonectris diomedea*
A	Great Shearwater	*Puffinus gravis*
A	Sooty Shearwater	*Puffinus griseus*
A	Manx Shearwater	*Puffinus puffinus*
A	Mediterranean Shearwater	*Puffinus yelkouan*
A	Little Shearwater	*Puffinus assimilis*
A	Wilson's Petrel	*Oceanites oceanicus*
B	White-faced (Frigate) Petrel	*Pelagodroma marina*
A	Storm Petrel	*Hydrobates pelagicus*
A	Leach's Petrel	*Oceanodroma leucorhoa*
A	Gannet	*Morus bassanus*

A	Cormorant	*Phalacrocorax carbo*
A	Shag	*Phalacrocorax aristotelis*
B	Magnificent Frigatebird	*Fregata magnificens*
A	Bittern	*Botaurus stellaris*
A	American Bittern	*Botaurus lentiginosus*
A	Little Bittern	*Ixobrychus minutus*
A	Night Heron	*Nycticorax nycticorax*
B	Squacco Heron	*Ardeola ralloides*
A	Cattle Egret	*Bubulcus ibis*
A	Little Egret	*Egretta garzetta*
A	Great White Egret	*Egretta alba*
A	Grey Heron	*Ardea cinerea*
A	Purple Heron	*Ardea purpurea*
A	Black Stork	*Ciconia nigra*
A	White Stork	*Ciconia ciconia*
A	Glossy Ibis	*Plegadis falcinellus*
A	Spoonbill	*Platalea leucorodia*
A,C	Mute Swan	*Cygnus olor*
A	Bewick's Swan	*Cygnus columbianus*
A	Whooper Swan	*Cygnus cygnus*
A	Bean Goose	*Anser fabalis*
A,D4	Pink-footed Goose	*Anser brachyrhynchus*
A	White-fronted Goose	*Anser albifrons*
A	Lesser White-fronted Goose	*Anser erythropus*
A,C	Greylag Goose	*Anser anser*
A,D4	Snow Goose	*Anser caerulescens*
A,C	Canada Goose	*Branta canadensis*
A,D4	Barnacle Goose	*Branta leucopsis*
A	Brent Goose	*Branta bernicla*
A	Red-breasted Goose	*Branta ruficollis*
B	Ruddy Shelduck	*Tadorna ferruginea*
A	Shelduck	*Tadorna tadorna*
C	Mandarin	*Aix galericulata*
A	Wigeon	*Anas penelope*
A	American Wigeon	*Anas americana*
A,C	Gadwall	*Anas strepera*
A	Teal	*Anas crecca*
A,C	Mallard	*Anas platyrhynchos*
A	Black Duck	*Anas rubripes*
A	Pintail	*Anas acuta*
A	Garganey	*Anas querquedula*
A	Blue-winged Teal	*Anas discors*
A	Shoveler	*Anas clypeata*
A,D4	Red-crested Pochard	*Netta rufina*

A	Pochard	*Aythya ferina*
A	Ring-necked Duck	*Aythya collaris*
A	Ferruginous Duck	*Aythya nyroca*
A	Tufted Duck	*Aythya fuligula*
A	Scaup	*Aythya marila*
A	Eider	*Somateria mollissima*
A	King Eider	*Somateria spectabilis*
A	Steller's Eider	*Polysticta stelleri*
A	Harlequin Duck	*Histrionicus histrionicus*
A	Long-tailed Duck	*Clangula hyemalis*
A	Common Scoter	*Melanitta nigra*
A	Surf Scoter	*Melanitta perspicillata*
A	Velvet Scoter	*Melanitta fusca*
A	Bufflehead	*Bucephala albeola*
A	Barrow's Goldeneye	*Bucephala islandica*
A	Goldeneye	*Bucephala clangula*
A	Smew	*Mergus albellus*
A	Red-breasted Merganser	*Mergus serrator*
A	Goosander	*Mergus merganser*
C	Ruddy Duck	*Oxyura jamaicensis*
A	Honey Buzzard	*Pernis apivorus*
A	Black Kite	*Milvus migrans*
A,D4	Red Kite	*Milvus milvus*
A,D4	White-tailed Eagle	*Haliaeetus albicilla*
A	Marsh Harrier	*Circus aeruginosus*
A	Hen Harrier	*Circus cyaneus*
B	Pallid Harrier	*Circus macrourus*
A	Montagu's Harrier	*Circus pygargus*
A,C	Goshawk	*Accipiter gentilis*
A	Sparrowhawk	*Accipiter nisus*
A	Buzzard	*Buteo buteo*
A	Rough-legged Buzzard	*Buteo lagopus*
A	Golden Eagle	*Aquila chrysaetos*
A	Osprey	*Pandion haliaetus*
A	Lesser Kestrel	*Falco naumanni*
A	Kestrel	*Falco tinnunculus*
A	American Kestrel	*Falco sparverius*
A	Red-footed Falcon	*Falco vespertinus*
A	Merlin	*Falco columbarius*
A	Hobby	*Falco subbuteo*
A	Eleonora's Falcon	*Falco eleonorae*
A	Gyr Falcon	*Falco rusticolus*
A	Peregrine	*Falco peregrinus*
A	Red Grouse	*Lagopus lagopus*

A	Ptarmigan	*Lagopus mutus*
A	Black Grouse	*Tetrao tetrix*
B,C	Capercaillie	*Tetrao urogallus*
C	Red-legged Partridge	*Alectoris rufa*
A,C	Grey Partridge	*Perdix perdix*
A	Quail	*Coturnix coturnix*
C	Pheasant	*Phasianus colchicus*
C	Golden Pheasant	*Chrysolophus pictus*
A	Water Rail	*Rallus aquaticus*
A	Spotted Crake	*Porzana porzana*
A	Sora	*Porzana carolina*
A	Little Crake	*Porzana parva*
A	Baillon's Crake	*Porzana pusilla*
A	Corncrake	*Crex crex*
A	Moorhen	*Gallinula chloropus*
A	Coot	*Fulica atra*
A	Crane	*Grus grus*
A	Sandhill Crane	*Grus canadensis*
A	Little Bustard	*Tetrax tetrax*
B	Houbara Bustard	*Chlamydotis undulata*
A	Great Bustard	*Otis tarda*
A	Oystercatcher	*Haematopus ostralegus*
A	Black-winged Stilt	*Himantopus himantopus*
A	Avocet	*Recurvirostra avosetta*
A	Stone-curlew	*Burhinus oedicnemus*
A	Cream-coloured Courser	*Cursorius cursor*
A	Collared Pratincole	*Glareola pratincola*
A	Black-winged Pratincole	*Glareola nordmanni*
A	Little Ringed Plover	*Charadrius dubius*
A	Ringed Plover	*Charadrius hiaticula*
A	Killdeer	*Charadrius vociferus*
A	Kentish Plover	*Charadrius alexandrinus*
A	Greater Sand Plover	*Charadrius leschenaultii*
A	Caspian Plover	*Charadrius asiaticus*
A	Dotterel	*Charadrius morinellus*
A	American Golden Plover	*Pluvialis dominica*
A	Pacific Golden Plover	*Pluvialis fulva*
A	Golden Plover	*Pluvialis apricaria*
A	Grey Plover	*Pluvialis squatarola*
A	Sociable Plover	*Chettusia gregaria*
A	Lapwing	*Vanellus vanellus*
A	Great Knot	*Calidris tenuirostris*
A	Knot	*Calidris canutus*
A	Sanderling	*Calidris alba*

A	Semipalmated Sandpiper	*Calidris pusilla*
A	Western Sandpiper	*Calidris mauri*
A	Little Stint	*Calidris minuta*
A	Temminck's Stint	*Calidris temminckii*
A	Least Sandpiper	*Calidris minutilla*
A	White-rumped Sandpiper	*Calidris fuscicollis*
A	Baird's Sandpiper	*Calidris bairdii*
A	Pectoral Sandpiper	*Calidris melanotos*
A	Sharp-tailed Sandpiper	*Calidris acuminata*
A	Curlew Sandpiper	*Calidris ferruginea*
A	Purple Sandpiper	*Calidris maritima*
A	Dunlin	*Calidris alpina*
A	Broad-billed Sandpiper	*Limicola falcinellus*
A	Stilt Sandpiper	*Micropalama himantopus*
A	Buff-breasted Sandpiper	*Tryngites subruficollis*
A	Ruff	*Philomachus pugnax*
A	Jack Snipe	*Lymnocryptes minimus*
A	Snipe	*Gallinago gallinago*
A	Great Snipe	*Gallinago media*
A	Long-billed Dowitcher	*Limnodromus scolopaceus*
A	Woodcock	*Scolopax rusticola*
A	Black-tailed Godwit	*Limosa limosa*
A	Bar-tailed Godwit	*Limosa lapponica*
B	Eskimo Curlew	*Numenius borealis*
A	Whimbrel	*Numenius phaeopus*
A	Curlew	*Numenius arquata*
A	Upland Sandpiper	*Bartramia longicauda*
A	Spotted Redshank	*Tringa erythropus*
A	Redshank	*Tringa totanus*
A	Marsh Sandpiper	*Tringa stagnatilis*
A	Greenshank	*Tringa nebularia*
A	Greater Yellowlegs	*Tringa melanoleuca*
A	Lesser Yellowlegs	*Tringa flavipes*
A	Solitary Sandpiper	*Tringa solitaria*
A	Green Sandpiper	*Tringa ochropus*
A	Wood Sandpiper	*Tringa glareola*
A	Terek Sandpiper	*Xenus cinereus*
A	Common Sandpiper	*Actitis hypoleucos*
A	Spotted Sandpiper	*Actitis macularia*
A	Turnstone	*Arenaria interpres*
A	Wilson's Phalarope	*Phalaropus tricolor*
A	Red-necked Phalarope	*Phalaropus lobatus*
A	Grey Phalarope	*Phalaropus fulicarius*
A	Pomarine Skua	*Stercorarius pomarinus*

A	Arctic Skua	*Stercorarius parasiticus*
A	Long-tailed Skua	*Stercorarius longicaudus*
A	Great Skua	*Stercorarius skua*
A	Mediterranean Gull	*Larus melanocephalus*
A	Laughing Gull	*Larus atricilla*
A	Franklin's Gull	*Larus pipixcan*
A	Little Gull	*Larus minutus*
A	Sabine's Gull	*Larus sabini*
A	Bonaparte's Gull	*Larus philadelphia*
A	Black-headed Gull	*Larus ridibundus*
A	Ring-billed Gull	*Larus delawarensis*
A	Common Gull	*Larus canus*
A	Lesser Black-backed Gull	*Larus fuscus*
A	Herring Gull	*Larus argentatus*
A	Iceland Gull	*Larus glaucoides*
A	Glaucous Gull	*Larus hyperboreus*
A	Great Black-backed Gull	*Larus marinus*
A	Ross's Gull	*Rhodostethia rosea*
A	Kittiwake	*Rissa tridactyla*
A	Ivory Gull	*Pagophila eburnea*
A	Gull-billed Tern	*Gelochelidon nilotica*
A	Caspian Tern	*Sterna caspia*
A	Lesser Crested Tern	*Sterna bengalensis*
A	Sandwich Tern	*Sterna sandvicensis*
A	Roseate Tern	*Sterna dougallii*
A	Common Tern	*Sterna hirundo*
A	Arctic Tern	*Sterna paradisaea*
A	Forster's Tern	*Sterna forsteri*
A	Bridled Tern	*Sterna anaethetus*
B	Sooty Tern	*Sterna fuscata*
A	Little Tern	*Sterna albifrons*
B	Whiskered Tern	*Chlidonias hybridus*
A	Black Tern	*Chlidonias niger*
A	White-winged Black Tern	*Chlidonias leucopterus*
A	Guillemot	*Uria aalge*
A	Brünnich's Guillemot	*Uria lomvia*
A	Razorbill	*Alca torda*
B	Great Auk	*Pinguinus impennis*
A	Black Guillemot	*Cepphus grylle*
A	Little Auk	*Alle alle*
A	Puffin	*Fratercula arctica*
A	Pallas's Sandgrouse	*Syrrhaptes paradoxus*
A,C	Rock Dove	*Columba livia*
A	Stock Dove	*Columba oenas*

A	Wood Pigeon	*Columba palumbus*
A	Collared Dove	*Streptopelia decaocto*
A	Turtle Dove	*Streptopelia turtur*
A	Rufous Turtle Dove	*Streptopelia orientalis*
A	Great Spotted Cuckoo	*Clamator glandarius*
A	Cuckoo	*Cuculus canorus*
B	Black-billed Cuckoo	*Coccyzus erythrophthalmus*
A	Yellow-billed Cuckoo	*Coccyzus americanus*
A	Barn Owl	*Tyto alba*
A	Scops Owl	*Otus scops*
B	Eagle Owl	*Bubo bubo*
A	Snowy Owl	*Nyctea scandiaca*
A	Hawk Owl	*Surnia ulula*
C	Little Owl	*Athene noctua*
A	Tawny Owl	*Strix aluco*
A	Long-eared Owl	*Asio otus*
A	Short-eared Owl	*Asio flammeus*
A	Tengmalm's Owl	*Aegolius funereus*
A	Nightjar	*Caprimulgus europaeus*
A	Common Nighthawk	*Chordeiles minor*
A	Chimney Swift	*Chaetura pelagica*
A	Needle-tailed Swift	*Hirundapus caudacutus*
A	Swift	*Apus apus*
A	Alpine Swift	*Apus melba*
A	Little Swift	*Apus affinis*
A	Kingfisher	*Alcedo atthis*
A	Bee-eater	*Merops apiaster*
A	Roller	*Coracias garrulus*
A	Hoopoe	*Upupa epops*
A	Wryneck	*Jynx torquilla*
A	Green Woodpecker	*Picus viridis*
A	Great Spotted Woodpecker	*Dendrocopos major*
A	Lesser Spotted Woodpecker	*Dendrocopos minor*
A	Calandra Lark	*Melanocorypha calandra*
A	Bimaculated Lark	*Melanocorypha bimaculata*
A	Short-toed Lark	*Calandrella brachydactyla*
A	Crested Lark	*Galerida cristata*
A	Woodlark	*Lullula arborea*
A	Skylark	*Alauda arvensis*
A	Shore Lark	*Eremophila alpestris*
A	Sand Martin	*Riparia riparia*
A	Swallow	*Hirundo rustica*
A	Red-rumped Swallow	*Hirundo daurica*
A	House Martin	*Delichon urbica*

A	Richard's Pipit	*Anthus novaeseelandiae*
A	Tawny Pipit	*Anthus campestris*
A	Olive-backed Pipit	*Anthus hodgsoni*
A	Tree Pipit	*Anthus trivialis*
A	Pechora Pipit	*Anthus gustavi*
A	Meadow Pipit	*Anthus pratensis*
A	Red-throated Pipit	*Anthus cervinus*
A	Rock Pipit	*Anthus petrosus*
A	Water Pipit	*Anthus spinoletta*
A	Buff-bellied Pipit	*Anthus rubescens*
A	Yellow Wagtail	*Motacilla flava*
A	Citrine Wagtail	*Motacilla citreola*
A	Grey Wagtail	*Motacilla cinerea*
A	Pied Wagtail	*Motacilla alba*
A	Waxwing	*Bombycilla garrulus*
A	Dipper	*Cinclus cinclus*
A	Wren	*Troglodytes troglodytes*
A	Dunnock	*Prunella modularis*
A	Alpine Accentor	*Prunella collaris*
A	Robin	*Erithacus rubecula*
A	Thrush Nightingale	*Luscinia luscinia*
A	Nightingale	*Luscinia megarhynchos*
A	Siberian Rubythroat	*Luscinia calliope*
A	Bluethroat	*Luscinia svecica*
A	Red-flanked Bluetail	*Tarsiger cyanurus*
A	Black Redstart	*Phoenicurus ochruros*
A	Redstart	*Phoenicurus phoenicurus*
A	Whinchat	*Saxicola rubetra*
A	Stonechat	*Saxicola torquata*
A	Isabelline Wheatear	*Oenanthe isabellina*
A	Wheatear	*Oenanthe oenanthe*
A	Pied Wheatear	*Oenanthe pleschanka*
A	Black-eared Wheatear	*Oenanthe hispanica*
A	Desert Wheatear	*Oenanthe deserti*
A	Rock Thrush	*Monticola saxatilis*
A	Blue Rock Thrush	*Monticola solitarius*
A	White's Thrush	*Zoothera dauma*
A	Siberian Thrush	*Zoothera sibirica*
A	Hermit Thrush	*Catharus guttatus*
A	Swainson's Thrush	*Catharus ustulatus*
A	Grey-cheeked Thrush	*Catharus minimus*
A	Ring Ouzel	*Turdus torquatus*
A	Blackbird	*Turdus merula*
A	Eye-browed Thrush	*Turdus obscurus*

A	Dusky Thrush	*Turdus naumanni*
A	Black-throated Thrush	*Turdus ruficollis*
A	Fieldfare	*Turdus pilaris*
A	Song Thrush	*Turdus philomelos*
A	Redwing	*Turdus iliacus*
A	Mistle Thrush	*Turdus viscivorus*
A	American Robin	*Turdus migratorius*
A	Cetti's Warbler	*Cettia cetti*
A	Pallas's Grasshopper Warbler	*Locustella certhiola*
A	Lanceolated Warbler	*Locustella lanceolata*
A	Grasshopper Warbler	*Locustella naevia*
A	River Warbler	*Locustella fluviatilis*
A	Savi's Warbler	*Locustella luscinioides*
A	Aquatic Warbler	*Acrocephalus paludicola*
A	Sedge Warbler	*Acrocephalus schoenobaenus*
A	Paddyfield Warbler	*Acrocephalus agricola*
A	Blyth's Reed Warbler	*Acrocephalus dumetorum*
A	Marsh Warbler	*Acrocephalus palustris*
A	Reed Warbler	*Acrocephalus scirpaceus*
A	Great Reed Warbler	*Acrocephalus arundinaceus*
A	Thick-billed Warbler	*Acrocephalus aedon*
A	Olivaceous Warbler	*Hippolais pallida*
A	Booted Warbler	*Hippolais caligata*
A	Icterine Warbler	*Hippolais icterina*
A	Melodious Warbler	*Hippolais polyglotta*
A	Dartford Warbler	*Sylvia undata*
A	Subalpine Warbler	*Sylvia cantillans*
A	Sardinian Warbler	*Sylvia melanocephala*
A	Rüppell's Warbler	*Sylvia rueppelli*
A	Orphean Warbler	*Sylvia hortensis*
A	Barred Warbler	*Sylvia nisoria*
A	Lesser Whitethroat	*Sylvia curruca*
A	Whitethroat	*Sylvia communis*
A	Garden Warbler	*Sylvia borin*
A	Blackcap	*Sylvia atricapilla*
A	Greenish Warbler	*Phylloscopus trochiloides*
A	Arctic Warbler	*Phylloscopus borealis*
A	Pallas's Warbler	*Phylloscopus proregulus*
A	Yellow-browed Warbler	*Phylloscopus inornatus*
A	Radde's Warbler	*Phylloscopus schwarzi*
A	Dusky Warbler	*Phylloscopus fuscatus*
A	Bonelli's Warbler	*Phylloscopus bonelli*
A	Wood Warbler	*Phylloscopus sibilatrix*
A	Chiffchaff	*Phylloscopus collybita*

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FIFE NATURE BIOLOGICAL RECORDS CENTRE

FIFE NATURE

Since 1992, a local Biological Records Centre "Fife Nature" has been established in Fife. Through special surveys and a network of official local recorders, the centre collects, analyses and monitors information on as many biological groups as possible, as well as on habitats and sites of natural history interest within the region. Information is stored electronically and is available for purposes of conservation, planning, research, education and general interest.

A "Survey Pack" is available free by request from "Fife Nature", and the centre also produces provisional atlases, which will eventually lead to a series of fully illustrated books. Available at present are

The Dragonflies of Fife: A Provisional Atlas £2 (incl. p.+p.)
The Butterflies of Fife: A Provisional Atlas £2.50
The Mammals of Fife: A Provisional Atlas (June 1994 - price on inquiry)
Others planned are A Fife Flora, a Bumble Bee Atlas and an Amphibian/Reptile Atlas.

The centre is also involved with the Fife Ornithological Atlas Group, which is currently (1991-95) carrying out surveys leading to a Fife Breeding Bird Atlas and Monthly Distribution Atlas of Birds in Fife.

Further information is available from Anne Marie Smout, Fife Nature, Department of Economic Develoipment and Planning, Fife House, Glenrothes, Fife KY7 5LT. Tel 0592 754411 ext 3793.

FIFE

SCOTTISH NATURAL HERITAGE

Female Mandarin Aix galericulata First breeding record in Scotland

Steve Petty

Semi-palmated Sandpiper Calidris pusilla On Stronsay 7th June 1993

Painting by John Holloway

Joe Eggeling on his last visit to the Isle of May in June 1989 *Keith Brockie*

Pallid Harrier Circus macrourus
15th September 1993 Shetland

Dennis Coutts

Colour separations by PAR GRAPHICS

THE COLOUR SECTION HAS BEEN SPONSORED BY FIFE REGIONAL COUNCIL.

CHARTER FOR THE ENVIRONMENT

Fife's Environmental Charter highlights the Regional Council's approach to tackling environmental issues and sets out the basis for the Regional Council's existing and future environmental policies. The Charter is now accompanied by the third action programme which outlines projects the Regional Council is in undertaking itself or in partnership with others: a **Nature Conservation Fund**, *a* **Community Planting Scheme**, *and a* **Community Environmental Improvement Fund** and a **Schools Environmental Awards Scheme** *have been established, and a four monthly* **Environmental Events Diary** *is produced.*

Through the Charter, the Council has made a commitment to publish further items in the Fife Heritage Series as a means of raising awareness of the rich natural and historic environment. Titles currently available from the Dept. of Economic Development and Planning are:
Fife's Early Archaeological Heritage - A Guide £2.50
Castles of Fife - A Heritage Guide £4.00

Topics to be published early in 1994 include:- Landforms, Townscapes, Abbeys and Churches and a Heritage Guide to Inverkeithing.

For further information about the Fife Environmental Charter, please contact Grace MacDonald or Andy Hills on 0592 754411 extension 6337

FIFE ARCHAEOLOGICAL SERVICE

Fife contains a wealth of archaeological sites ranging in date from prehistoric settlements and forts dating back some 8,000 years, to industrial and military remains of more recent times. Environmental archaeology has become a key concern of the Regional Council as it can provide information about how the natural environment has been altered by our ancestors. The Archaeological Service is currently working with Scottish Natural Heritage to study and interpret the settlement remains on the Isle of May National Nature Reserve.

The Regional Council are keen to promote the conservation of this rich heritage and have published guides to sites which have been studied. These include:-

Balfarg - The Prehistoric Ceremonial Complex £3.00
St Monans Saltpans and the Lost Industrial Landscape £1.00
The Capital in the Kingdom: The Archaeology of Medieval Dunfermline £3.00

The Regional Council has an Archaeological Service based in the Department of Economic Development and Planning, and is pleased to offer advice on all aspects of the conservation of the historic environment. To receive advice please contact Peter Yeoman or Sarah Govan on 0592 754411 Ext. 6153.

A	Willow Warbler	*Phylloscopus trochilus*
A	Goldcrest	*Regulus regulus*
A	Firecrest	*Regulus ignicapillus*
A	Spotted Flycatcher	*Muscicapa striata*
A	Red-breasted Flycatcher	*Ficedula parva*
A	Collared Flycatcher	*Ficedula albicollis*
A	Pied Flycatcher	*Ficedula hypoleuca*
A	Bearded Tit	*Panurus biarmicus*
A	Long-tailed Tit	*Aegithalos caudatus*
A	Marsh Tit	*Parus palustris*
A	Willow Tit	*Parus montanus*
A	Crested Tit	*Parus cristatus*
A	Coal Tit	*Parus ater*
A	Blue Tit	*Parus caeruleus*
A	Great Tit	*Parus major*
A	Nuthatch	*Sitta europaea*
A	Treecreeper	*Certhia familiaris*
A	Golden Oriole	*Oriolus oriolus*
A	Brown Shrike	*Lanius cristatus*
A	Isabelline Shrike	*Lanius isabellinus*
A	Red-backed Shrike	*Lanius collurio*
A	Lesser Grey Shrike	*Lanius minor*
A	Great Grey Shrike	*Lanius excubitor*
A	Woodchat Shrike	*Lanius senator*
A	Jay	*Garrulus glandarius*
A	Magpie	*Pica pica*
A	Nutcracker	*Nucifraga caryocatactes*
A	Chough	*Pyrrhocorax pyrrhocorax*
A	Jackdaw	*Corvus monedula*
A	Rook	*Corvus frugilegus*
A	Carrion/Hooded Crow	*Corvus corone*
A	Raven	*Corvus corax*
A	Daurian Starling	*Sturnus sturninus*
A	Starling	*Sturnus vulgaris*
A	Rose-coloured Starling	*Sturnus roseus*
A	House Sparrow	*Passer domesticus*
A	Tree Sparrow	*Passer montanus*
A	Red-eyed Vireo	*Vireo olivaceus*
A	Chaffinch	*Fringilla coelebs*
A	Brambling	*Fringilla montifringilla*
A	Serin	*Serinus serinus*
A	Greenfinch	*Carduelis chloris*
A	Goldfinch	*Carduelis carduelis*
A	Siskin	*Carduelis spinus*

A	Linnet	*Carduelis cannabina*
A	Twite	*Carduelis flavirostris*
A	Redpoll	*Carduelis flammea*
A	Arctic Redpoll	*Carduelis hornemanni*
A	Two-barred Crossbill	*Loxia leucoptera*
A	Common Crossbill	*Loxia curvirostra*
A	Scottish Crossbill	*Loxia scotica*
A	Parrot Crossbill	*Loxia pytyopsittacus*
A	Trumpeter Finch	*Bucanetes githagineus*
A	Scarlet Rosefinch	*Carpodacus erythrinus*
A	Pine Grosbeak	*Pinicola enucleator*
A	Bullfinch	*Pyrrhula pyrrhula*
A	Hawfinch	*Coccothraustes coccothraustes*
A	Evening Grosbeak	*Hesperiphona vespertina*
B	Black-and-white Warbler	*Mniotilta varia*
A	Tennessee Warbler	*Vermivora peregrina*
A	Yellow Warbler	*Dendroica petechia*
A	Chestnut-sided Warbler	*Dendroica pensylvanica*
A	Blackburnian Warbler	*Dendroica fusca*
A	Cape May Warbler	*Dendroica tigrina*
A	Yellow-rumped Warbler	*Dendroica coronata*
A	Blackpoll Warbler	*Dendroica striata*
A	American Redstart	*Setophaga ruticilla*
A	Ovenbird	*Seiurus aurocapillus*
A	Common Yellowthroat	*Geothlypis trichas*
A	Hooded Warbler	*Wilsonia citrina*
A	Savannah Sparrow	*Ammodramus sandwichensis*
A	Song Sparrow	*Zonotrichia melodia*
A	White-crowned Sparrow	*Zonotrichia leucophrys*
A	White-throated Sparrow	*Zonotrichia albicollis*
A	Dark-eyed Junco	*Junco hyemalis*
A	Lapland Longspur	*Calcarius lapponicus*
A	Snow Bunting	*Plectrophenax nivalis*
A	Pine Bunting	*Emberiza leucocephalos*
A	Yellowhammer	*Emberiza citrinella*
A	Cirl Bunting	*Emberiza cirlus*
A	Ortolan Bunting	*Emberiza hortulana*
A	Cretzschmar's Bunting	*Emberiza caesia*
A	Yellow-browed Bunting	*Emberiza chrysophrys*
A	Rustic Bunting	*Emberiza rustica*
A	Little Bunting	*Emberiza pusilla*
A	Yellow-breasted Bunting	*Emberiza aureola*
A	Reed Bunting	*Emberiza schoeniclus*
A	Pallas's Reed Bunting	*Emberiza pallasi*

A	Black-headed Bunting	*Emberiza melanocephala*
A	Corn Bunting	*Miliaria calandra*
A	Rose-breasted Grosbeak	*Pheucticus ludovicianus*
A	Bobolink	*Dolichonyx oryzivorus*
A	Brown-headed Cowbird	*Molothrus ater*
A	Northern Oriole	*Icterus galbula*

Category D

D1	White Pelican	*Pelecanus onocrotalus*
D1	Greater Flamingo	*Phoenicopterus ruber*
D1	Egyptian Goose	*Alopochen aegyptiacus*
D1	Baikal Teal	*Anas formosa*
D1	Saker Falcon	*Falco cherrug*
D2	Northern Flicker	*Colaptes auratus*
D1	Cedar Waxwing	*Bombycilla cedrorum*
D1	Chestnut Bunting	*Emberiza rutila*
D1	Red-headed Bunting	*Emberiza bruniceps*
D1	Blue Grosbeak	*Guiraca caerulea*
D1	Indigo Bunting	*Passerina cyanea*
D1	Painted Bunting	*Passerina ciris*

Typescript received 25 January 1994

Short Notes

Mating times of Merlins

There are few British data on the mating times of Merlins *Falco columbarius*. In the North American subspecies, however, Laing (1985. Food habits and breeding biology of Merlins in Alaska. *Raptor Research* 19:42-51) observed Merlins copulating 11 times during 16.3 hours of observations (0.67 copulations/hour) in Alaska. Sodhi (1991. Pair copulation, extra pair copulation and intraspecific nest intrusions in Merlins. *Condor* 93:433-437) also noted 41 copulations in 679 hours of observations (0.06 copulations/hour) in a rather atypical urban population in Canada. Because so little had been published on this subject, I timed and logged the number of copulations seen in three breeding areas in upland Galloway in 1973-74 and 1977-78.

In Galloway, observed matings usually occurred on boulders or on the ground near nest sites but not on the nest itself. No elaborate rituals preceded matings but either sex would initiate copulations by calling and sometimes bowing beforehand. Males mounted females from behind, usually dropping down slowly from a higher perch with wings held in a 'V' position, and with tail spread and legs lowered. Females responded by crouching with wings held slightly down and tail fanned. Copulations usually lasted 10-15 seconds, the males slowly flapping their wings. The first copulations occurred some 30 days before egg laying (the fertile period: pre-laying and egg laying) but none was recorded after clutches were completed (the non-fertile period: incubation, nestling and fledging).

The total number of matings recorded overall was 22 copulations during 80 hours observations (0.28 copulations/hour) lower than Laing's records but similar to Sodhi's findings in the fertile period (Table 1). Fifteen copulations (68%) occurred during 34 hours observations in the mornings (0730-1200 hours), five (23%) in 39.3 hours in the afternoon (1200-1700 hours) and two (9%) in 6.3 hours in the evening (1700 hours to sunset). It would seem that copulation times during the day do differ significantly in Galloway, with more than expected occurring in the morning and less in the afternoon/evenings ($X^2 = 5.85$, 1 df, $p<0.02$) (Siegel, S. 1956. *Nonparametric statistics for the behavioural sciences.* McGraw-Hill, New York). Twelve copulations in 56.3 hours observations (0.21 copulations/hour) were recorded during the early stages of pair formation (pre-laying 1 - 23 April) and ten copulations in 23.3 hours (0.43 copulations/hour) were recorded just prior to egg laying (27 April - 1 May). Thus Merlins appear to copulate at a high frequency a day or two before the first eggs are laid and nearly twice as much as in the pre-laying period.

Sodhi thought it was unlikely that females traded copulations for food in Canada and the same conclusion seemed to be the case in Galloway: of 22 copulations, only three (13.6%) occurred after males brought prey to females. However, copulations seemed to be associated with nest selection because ten (45.4%) occurred before and after visits to

Table 1. ***Number of copulations per hour during non-fertile (incubation, nestling and fledging) and fertile (pre-laying and laying) periods in the Merlin in various localities.***

Locality	No. of Copulations/hour	No. of Copulations/hour Non-fertile periods	No. of Copulation/hour Fertile periods	Source
Denali National Park Alaska	0.67	-	0.67	Laing 1985
Saskatoon Canada (urban)	0.06	0.03	0.20	Sodhi 1991
Upland Galloway	0.28	NIL	0.28	This study

nests by either sex. There was no evidence of extra-pair copulations nor was there any interference during copulations; the only evidence of an extra bird present was when a strange male flew over a resident male on 1 April 1973, and when a male and female chased a second female in another year outwith this study. Most copulations occurred before noon. This agrees with the times recorded in other falcons e.g. Kestrel *Falco tinnunculus* (Village, A. 1990. *The Kestrel.* Poyser, London) and the Peregrine Falcon *Falco peregrinus* (Ratcliffe, D. 1980, 1993. *The Peregrine Falcon.* Poyser, Calton and London). I would like to thank Dr. Jim Reid for kindly carrying out the statistical analysis.

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

Merlin chick killed by adder

Merlins *Falco columbarius* may suffer higher rates of egg and brood predation from ground nests than in tree nests (Little, B. & Davison, M. 1990. *Bird Study* 39: 13-16). Predation accounted for 43% of 104 nest failures in a Grampian study (Rebecca, G.W. *et al.* 1992. *Scot. Birds* 16: 165-183), where four species of mammal predators were identified. On drier moors, adders *Vipera berus* share the habitat with Merlins, and are potential predators: MacIntyre (1936. *Wildlife in the Highlands.* Batchworth, London) found Merlin eggs inside an adder which he killed at a nest. Predation by adders may be under-recorded, since no evidence is left at the nest. This note reports that losses to adders can continue into the later nestling stages.

On 30 June 1993, in the Galloway Forest Park area of south-west Scotland, I visited a Merlin nest immediately following a prey delivery. The nest comprised a roughly circular platform of thin heather twigs, tramped flat, in tall heather. An adult male adder was basking in the centre of the platform, sheltered from the wind while two c. 3-week old Merlin chicks were at the edge, about 10cm from the adder, which moved off when I stood at the nest, revealing an addled egg. One of the two chicks was freshly dead and still warm with no visible injury other than a small amount of fresh blood on its crown. It was in good condition, weighing 152g with outer primaries 20-25mm emerged. A *post mortem* examination at a later date confirmed that the chick had 'suffered acute death', consistent with an adder bite.

Burgess *et al.* (1990. *RSPB Cons. Review* 4: 32-35) found that small areas of bare ground, cleared on heathland to provide nest sites for Nightjars *Caprimulgus caprimulgus,* were used as basking sites by adders. In the Galloway Forest Park R.C. Dickson (*pers. comm.*). also disturbed an adder from a Merlin nest (from which small young had previously disappeared), in 1977. In the present instance, it seems likely that the reptile was making use of the nest platform as a sheltered basking site in the deep heather. Intentional predation was improbable, since the adder was incapable of swallowing a prey item as large as the Merlin chick, and may have struck at it in a defensive response.

I am grateful to Neil A. Forbes, of the Clock House Veterinary Hospital at Stroud, for *post mortem* examination of the carcase, and to G.W. Rebecca and R.C. Dickson for helpful comments on an earlier draft.

Geoff Shaw, Forest Enterprise,
South Scotland Region,
55-57 Moffat Road, Dumfries. DG1 1NP.

Site fidelity of Jack Snipe on migration?

Freshwater Haven, one mile north-east of Gullane, is a typical East Lothian bay, backed by a double line of sand dunes stabilised by marram grass. The deep trough between the two dune-lines is normally totally dry, and was so on 7 August 1991 when I flushed a Jack Snipe *Lymnocryptes minimus* there. It was there again on almost every one of the next 11 days until 18 August.

This record on its own is mildly noteworthy for two reasons:- the habitat was totally atypical (though something similar was recorded almost 100 years ago at the St. Andrews links - *Zoologist* 1901: 108), and the date was unusually early. One sees few Jack Snipe in this country before October. Indeed a bird seen at an undisclosed locality in Britain between 13-23 August 1977 was included in the annual report 'Rare breeding birds in the United Kingdom in 1978' (*Brit. Birds* 73:19). There was no reason to suspect breeding in the present case, but there is a curious twist to the story.

At the east end of the trough between the two dune-lines there is in some years a small pool of water which accumulates by underground seepage from the spring, 50 yards further inland, which gives the bay its name. There had been such a pool in the spring of 1991 when on 11 April I flushed the first Jack Snipe that I had ever recorded in this area. It was from this same, now totally dry, hollow that I first flushed the August bird, although on all subsequent occasions I found it resting a few yards away, higher up on the dune slopes.

These records raise interesting speculations. At the simplest level, it is surprising that the August bird should choose to day-roost (for there can be no question of its feeding there) for 12 days at precisely the same spot where it was so regularly disturbed. More intriguing is the possibility that (as seems highly likely in view of the unsuitability of the habitat) the same individual was involved in both the April and the August records. *BWP* (3: 403-409) has nothing to say about the site fidelity of Jack Snipe either on their breeding grounds or in their wintering quarters, although evidence of the latter is provided by the recoveries of 'two ringed in Wigtown and Shetland and recovered in the same areas, in November and March, one and three years later', quoted in *Birds in Scotland* : 189. Perhaps these East Lothian records provide the first tentative evidence that this site fidelity may also extend to stopping places on migration?

Dougal G. Andrew
Muirfield Gate
Gullane
East Lothian EH31 2EG

First breeding records of the Mandarin in Argyll

The Mandarin *Aix galericulata* occurs naturally in north-east Asia and Japan (Cramp & Simmons 1977. *The Birds of the Western Palearctic,* Vol.1 Oxford). The population in Britain originates mainly from introductions earlier the century (Lever 1977. *Naturalised animals of the British Isles.* Hutchinson). Their present breeding range is expanding and concentrated in south-east England (Davies 1998. *Bird Study* 35: 203-208). Davies (*Loc. cit.*) estimated their population at just under 7000 birds. The breeding population in Scotland is much smaller and centred on the River Tay, but with sporadic records elsewhere (Thom 1986. *Birds in Scotland.* Poyser). Observations of birds on Loch Lomond in the 1970s were the closest to Argyll and thought to have come from a local collection (Thom *Loc. cit.*).

In each of the years 1991-93 one pair of Mandarins successfully bred at Loch Eck, in Cowal, south Argyll (Table 1). All breeding attempts were in Tawny Owl *Strix aluco* nestboxes (Petty 1987. *Quarterly Journal of Forestry* 81: 103-109). They used two boxes 20m apart, that were fixed to oak trees facing out over the loch. The first breeding attempt in 1991 occurred after the box was last checked on 11 April. When the box was checked for the first time in 1992, four old unhatched eggs in a down nest were discovered. The presence of egg fragments and membranes indicated than an unknown number of eggs had hatched in 1991. The number of eggs hatching in 1992 and 1993 was ten and five respectively (Table 1).

Table 1. Details of three breeding records by the Mandarin at Loch Eck in Argyll.

Parameter	1991	1992	1993
Nest box number	T261B	T261A	T261A
Clutch size	-	14	13
Unhatched eggs	4	4	8
Hatched eggs	-	10	5
Laying date *	-	18 April	-
Egg length cm (SE)	5.26(0.03)	5.23(0.04)	5.25(0.04)
Egg width cm (SE)	4.00(0.01)	3.91(0.04)	3.95(0.01)

* date when the first egg was laid, based on an interval of one day between laying (Cramp & Simmons 1977).
The egg measurements in 1991 were from the unhatched eggs only.

The low hatching success in 1993 appears to have been influenced by a Goosander *Mergus merganser* that laid one egg in the box part-way though the laying period of the Mandarin. Two Mandarin eggs were found to be cracked after the appearance of the Goosander egg, suggesting that the Goosander may have been responsible. Goosander eggs are much bigger than Mandarin eggs, and because of this size difference, the Mandarin may have been less able to incubate the clutch, resulting in the low hatch-rate. The Goosander egg did not hatch.

The female Mandarin was hand-caught in the nest box towards the end of incubation in 1992 and 1993. She was ringed when first caught in 1992, and the same bird was recaptured in 1993. (Plate no. 1). There were no other marks on the duck to indicate her origin. Nor have we been able to locate wildfowl collections in south and mid-Argyll that admit to losing Mandarins, thus the origin of this pair is unknown.

The nestboxes used for breeding had been in place since 1988, and many other boxes suitable for Mandarins had been available since 1983 and checked annually (Petty 1992. *Ecology of the Tawny Owl* Strix aluco *in the spruce forests of Northumberland and Argyll.* Ph.D. Thesis, The Open University). Therefore, we consider these breeding attempts at Loch Eck to be a recent phenomenon, rather than one that had been under-recorded in the past.

However, it should be noted that Mandarins are difficult to detect, even in an area with a high breeding density, and particularly when breeding in natural tree cavities (Davies 1985. *BTO News* 136:12). Away from the nest we have only seen Mandarins three times in three years, in an area where we undertake much fieldwork on other species. It will be interesting to see if these successful breeding attempts result in the colonisation of suitable habitat elsewhere in Argyll.

S.J. Petty and D.I.K. Anderson, Wildlife Ecology Branch, Forestry Authority, Ardentinny, Dunoon, Argyll PA23 8TS.

Discovery of the first British clutch of Slavonian Grebe eggs in a museum collection

Major William Stirling of Fairburn (1859-1914) gained a reputation for his ability to find the nests of such secretive species as Siskin *Carduelis spinus*, Scottish Crossbill *Loxia scotica*, and Greenshank *Tringa nebularia*. He collected the eggs of these and other species on his estate in Easter Ross (Highland Region) and neighbouring districts between 1895 and 1910, both for his own collection and to be exchanged with other collectors of the eggs of foreign species. Sir Roderick Stirling, William Stirling's grandson, donated the substantial collection and uncompleted catalogue to Inverness Museum and Art Gallery in 1983.

Since August 1992 I have sorted out all the clutches and catalogued the entire collection during the course of which work I discovered a clutch of three heavily stained grebe eggs, with fragments of nest material still attached, which were not listed in the original catalogue. Although three eggs would form an unusually small clutch for any grebe, incubation was well advanced to judge from the degree of staining of the eggs from nest vegetation, and the clutch must have been completed. The damaged state of one of the eggs could indicate that the clutch had been larger but some eggs had been broken. One of the eggs bears the following mark in William Stirling's hand:

Pod. auritus
Loch Laite
Inverness
W.S
17.V.09

which implies that the eggs are those of the Slavonian Grebe *Podiceps auritus*, and were collected by William Stirling (W.S) at Loch Laite, on 17 May 1909. The other two eggs, one of which is cracked, bear the 'set mark' *17.V.1909*. The measurements of the eggs (45.25 x 30.10, 45.80 x 30.20, ? x 30.70, to the nearest 0.05mm) agree well with those published for Slavonian Grebe eggs (Cramp & Simmons 1977. *The Birds of the Western Palaearctic.* Oxford. Vol 1). There is no Loch Laite in Inverness-shire, but there is a Loch Laide (pronounced 'Latch') with an adjacent settlement called Lochlait, which would appear to be the locality from which the eggs were collected.

The original reference regarding early breeding attempts by Slavonian Grebe (Ogilvie-Grant, W.R. 1910. *Bull. Br. Orn. Club.* 25: 75-76) state that a bird with a nest but no eggs was shot and stuffed in 1908, after being seen in June of the same year by a Mr. H.M. Warrand. The locality given was "a small reedy sheet of water in the hills of Inverness-shire", a description which applies to Loch Laide as well now as it surely would have done in 1908 (it should be noted that this description does not readily apply to Loch Ruthven, which is traditionally regarded as the Slavonian Grebe's centre of distribution in Scotland).

Ogilvie-Grant, still quoting Warrand, writes:

"I was cheered, however, to learn the following year(1909) that one or two pairs had appeared at the same loch, but soon afterwards heard that the nests had been ruthlessly robbed by a private collector'.

Given that no other Slavonian Grebe breeding territories were known in 1909, it would appear that the 'private collector' was William Stirling. None of the other breeding attempts prior to 1909 had produced eggs (Barra 1898 and Arisaig 1907 in Inverness-shire; see Ogilvie-Grant 1910) and the reported breeding near Gairloch (Wester Ross, Highland Region) in the 1880s and early 1890s supposedly referred to the Little Grebe *Tachybaptus ruficollis* (Evans, A.H. 1892. *Ann. Scot. Nat. Hist.* 192: 171-172), although I suggest this reidentification is open to some doubt given that the birds were seen by the great H.E. Dresser. Stirling's clutch of three eggs therefore represents the first proven egg laying event (or at least the second, if there were indeed two pairs in 1909) for the Slavonian Grebe in Britain.

The acknowledged 1908 date for first breeding, cited in *BWP*, would appear to be based on the presence of a single bird with a nest which was never seen to have a mate or to lay eggs; this date should not be accepted.

Acknowledgements

I must thank the following for their help: Stephen Moran (Assistant Curator, Natural Sciences) of Inverness Museum for encouraging my work on the collection; the librarian at the George Waterston Library for sending me a copy of Ogilvie-Grant's paper, Malcolm Harvey and Roy Dennis for their comments. Sir Roderick Stirling, who generously donated the collection, read a draft of this paper.

Henry A. McGhie,
Nurse's House
West Road
Muir-of-Ord
Ross-shire IV6 7TD.

Rook flight-line across Firth of Forth

In winter, Rooks *Corvus frugilegus* feed in dispersed flocks by day and fly to large communal roosts for the night, often via intermediate points where flocks may join others before going to the final roost. Usually, each roost is large, comprising birds from a number of rookeries in the surrounding area (Munro, 1971. Scottish winter Rook roost survey - southern Scotland. *Scott. Birds* 6: 438-443; Coombs, 1978. The Crows, *a study of the corvids of Europe.* Batsford, London; Goodwin, 1986. *Crows of the world.* British Museum (Natural History), London.).

There appears to be a regular winter flight-line across the Firth of Forth. In late afternoons, I have seen Rooks arrive at the Lothian coast from somewhere south of Dalmeny House. Then from the shore at NT174777 near Long Green, usually after descending temporarily into trees, they set out over the water keeping a straight n.n.e. direction over Inchcolm island and on to the Fife mainland. This flight crosses 7.5km of water. The following observations were made after doing shore-bird counts; I made no attempt to watch Rooks over constant time periods or at particular times of day.

Date	Time	numbers of Rooks
13.10.91	Before dusk.	some.
10.11.91	Near dusk.	some.
8.12.91	Near dusk and during darkness.	400 in groups, plus more continuing while getting dark.
19.1.92	Late afternoon.	some.
14.11.92	Near dusk.	groups of 5-15.
12.12.92	Before dusk.	none.
30.1.93	Near dusk (4-4.30pm).	280 in groups of 12-100.

Rooks were not seen crossing the Forth earlier during the day on these dates or on other days. The observations should not be taken to indicate the numbers of Rooks which may be involved, as birds could have passed before or after, but they do suggest that a regular movement was occurring.

Jackdaws *Corvus monedula* accompanied the Rooks crossing the Forth in October, November and December 1991, including about 100 Jackdaws on 8 December 1991. No Carrion Crows *Corvus corone* were seen with these flights, although not infrequently single or pairs of Carrion Crows do cross the Forth by day.

Rook winter roosts for all of Lothian were surveyed and mapped by Munro (1948. Rook roosts in the Lothians, winter 1946-47. *Scott. Nat.* 60: 20-9) who showed that Rooks from Cramond then roosted near West Calder and Rooks from South Queensferry near Bathgate. Neither he nor Smout (1986. *The Birds of Fife.* Donald, Edinburgh) mention Rooks crossing the Firth of Forth.

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

The diet of nestling Corn Buntings on North Uist - insects not grain.

Watson states that the diet of nestling Corn Buntings, *Miliaria calandra*, is not well known but that he has observed adults provisioning their young with unripe grain on numerous occasions (Watson 1992. *Scott. Birds* 16: 287). The nestling diet for this species has also been described vaguely as small beetles (Walpole-Bond 1938. *A History of Sussex Birds* Vol.1), green caterpillars, craneflies and an 'unidentified whitish substance' (MacDonald 1965. *Scott. Birds* 3: 235-246), and grasshoppers, grubs and caterpillars (Ryves & Ryves 1934. *Brit. Birds* 28: 2-26 & 154-164). The only real attempt to quantify the diet of nestlings comes from work in Germany by Schmidt and Gliemann (in Gliemann 1972. *Die Grauammer*) who, in two separate studies, used neck collars on a total of four broods of chicks to assess food intake. The major food items found in their studies were caterpillars (Lepidoptera larvae) (30.2% of items), grasshoppers (Orthoptera) (13.6%), Lepidoptera pupae (11.3%), beetles (Coleoptera) (9.9%), earwigs (Dermaptera) (8.5%) and wheat seeds (16.1%).

In the summer of 1989 we carried out a study of nestling diet in Corn Buntings at Balranald, North Uist. We quantified the diet using faecal sample analyses from nestlings and also six gizzard samples taken from chicks which died naturally in the nest. Sixty-two faecal samples were collected from 23 nests. The overall proportions of food types were similar in both the gizzard and faecal samples, so we can assume that the results of faecal sample analysis closely reflect the diet of the nestlings.

We found that the diet consisted of harvestmen (Opiliones; found in 67.7% of samples), craneflies (Tipulidae; 61.3%), plant material (61.3%), hoverflies (Syrphidae; 51.6%), adult beetles (Coleoptera; 56.5%), adult moths (Lepidoptera; 29.0%), other flies (Diptera; 25.8%), caterpillars (Lepidoptera; 25.8%), grasshoppers (Acrididae; 24.2%), pupae (Lepidoptera: 17.7%) and small numbers of sawflies (Hymenoptera), earwigs (Dermaptera), beetle larvae (Coleoptera), spiders (Aranaea), terrestrial snails (Gastropoda) and plant hoppers (Homoptera). Nearly all the harvestmen (Opiliones) were *Mitopus morio* (F.) and most of the hoverflies (Syrphidae) were *Helophilus* sp. or *Rhingia campestris.* The beetles were represented by members of the families Scarabeidae and Curculionidae. Much of the plant material was pollen, mainly from grasses, and was recorded in 29 samples (46.8%), usually in only small amounts. Seeds of any kind were rare and most often absent.

The results show that Corn Bunting nestlings on North Uist are fed a range of invertebrates, mainly harvestmen, craneflies, hoverflies and beetles. It is perhaps surprising to find hoverflies playing so large a role in the diet as these tend to be fast flying and highly manoeuvrable insects, as are grasshoppers and plant hoppers. A possible explanation is that hoverflies are taken early in the day before they are warm enough to fly, and this may also apply to the craneflies. The high incidence of harvestmen is also of interest because these animals are generally considered to be distasteful due to the secretion of noxious chemicals from their coxal glands.

Watson found that unripe grain was more often provided on cold days or when insects were not abundant, and the point of this note is to show that, under different conditions, Corn Buntings will prefer to select invertebrate food when provisioning their nestlings. On North Uist the agricultural regime tends to be non-intensive and pesticide sprays are less commonly use than on the mainland, so invertebrates may be more available than at Watson's study site. Cereal crops were available to forage from if the parents had preferred to provide seeds to their nestlings. Perhaps these observations provide a partial explanation for the decline of the Corn Bunting over most of Britain. If young elsewhere are generally being reared on suboptimal food then we would expect to see a decline in chick survival and recruitment in comparison with the North Uist population, where chick starvation is a relatively rare form of nest failure (Hartley & Shepherd 1994 *Ardea* in press).

Ian R. Hartley, Department of Zoology, University of Cambridge, Downing Street, Cambridge CB2 3EJ.

Donald L.J. Quicke, Department of Biology, Imperial College at Silwood Park, Ascot, Berkshire SL5 7PY.

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**)

Pink and polluted Peregrines

Since I am possibly the only person around who has seen both the Mediterranean and Cape Verde Peregrine *Falco peregrinus brookei* and *F.p. madens* and their ally the Barbary Falcon *Falco pelegrinoides*, may I comment on Mike Trubridge's report of a potentially similar pink Peregrine and chicks seen in Central Scotland (*Scott. Birds* 17: 68-69)? While these birds are normally rufous or cinnamon around the head and flanks, the colour did not appear either 'bright salmon pink' or concentrated on the underparts, and in *brookei* at least the chicks are not noticeably pink either. Therefore, as in the case of the birds potentially oiled by Fulmars *Fulmarus glacialis* (*Scott. Birds* 16: 290, 46-48, 17: 69), could this also be due to contamination by some red substance, possibly sheep-marker or paint, left in the nest or some place frequented by Peregrines, or used in some misguided marking experiment or practical joke, and transferred to the chicks when they were brooded?

While so far I have failed to detect any oiled Peregrines along the north-east Scottish coast, one plucking-station on a projecting bank is regularly littered with not only the remains of gulls and auks but also Fulmars in varying states of decay, so that it would appear the Peregrines must be quite capable of catching Fulmars safely, and any pollution with their oil may arise through squabbling over nest-sites. It is noticeable that, while there are a limited number of huge, old-established, but sharply-localised Fulmar colonies within the breeding range of the Peregrine around Arctic North America, the two species have only recently started to come into wide contact during the breeding season in Europe, so that any extensive interaction between them must be a very new development.

W.R.P. Bourne, Department of Zoology, Aberdeen University, Tillydrone Avenue, Aberdeen AB9 2TN.

Spring passage of Skuas in Outer Hebrides

R.D. Murray is not altogether correct in saying (*Scott. Birds* 17:110) that the spring passage of skuas off the Western Isles was overlooked until recently. Harvie-Brown & Buckley (*A Vertebrate Fauna of the Outer Hebrides.* 1888. p. 151) include the following in their account of the Pomarine Skua *Stercorarius pomarinus*: 'There cannot be any doubt as to its frequent, if not regular, summer visits to the coasts of these islands, and the seas to the west of Lewis, most of such birds proving to be old birds in most perfect plumage. It frequents the harbour of Carloway on the west of Lewis, and the seas over the great cod-banks between that and the Flannan Islands, as also still further to the westward, where we have shot them from the deck of our yacht'. Harvie-Brown later added the further comment that 'These birds appear to frequent the ocean and seas of the Outer Hebrides in some numbers every summer of late years. The line of their migration towards the north appears to be further west than the shores of the Outer Hebrides' (*Annals of Scot. Nat. Hist.* 1903: 17).

Dougal G. Andrew, Muirfield Gate, Gullane, East Lothian EH31 2EG

Rare Migrants

(It has been decided by the Editorial Committee that full descriptions will appear in *Scottish Birds* only of species which are new, or at most second records, for Scotland. Eds)

Semi-palmated Sandpiper on Stronsay; second Scottish record

Whilst filming seals during the afternoon of 7 June 1993, Mike and Lynn Johnson noticed a small party of waders flying towards them. Fortunately the birds settled in the 'frame' and Mike continued filming the group as they fed along the shoreline.

Three were obviously adult Dunlin *Calidris alpina* but the fourth bird was considerably smaller and, not being sure of the identification, Mike and Lynn returned to the Stronsay Bird Reserve where they were staying and showed the film to myself and Joyce Maples who was also staying on the reserve. The bird looked very interesting to say the least, lacking any of the bright rufous found in summer Little Stint *Calidris minuta* and we decided to have a hasty tea and return to the site.

The bird was relocated at approx 2030hrs and watched until 2200hrs during which time we managed to obtain excellent views down to 20ft for prolonged periods. It was obviously very small with an attenuated rear-end and knowing some of the problems of stint and peep identification we collected as much detail as we could before poor light forced us to return to 'Castle', where my wife Sue had been searching all available literature to assist with the identification.

After much searching, we came to the conclusion that our bird was a Semi-palmated Sandpiper *Calidris pusilla* and the following day Mike Johnson obtained excellent views of the webbing between the toes which eliminated all others except Western Sandpiper *Calidris mauri*. Western had already been eliminated on bill shape and length and lack of any rufous to the upperparts. Although the bird was present up until mid-afternoon on 8 June, it could not be located later that day and was not seen again.

Description

Small calidris wader similar in size to Little Stint but 'rear-end' more attenuated, wing-tips level with tip of tail.

General appearance rather greyish-fawn with no rufous in plumage. Some warm brown in cheeks and sides of crown and tertial edges rather brighter-edged than rest of wing feathers. One row of scapulars very dark-centred, contrasting with rest of upperparts and one row of lower scapulars with distinct anchor-shaped marks. Underparts white with fine dark streaking to breast and breast-sides and a few dark marks onto flanks. The mantle was rather plain with streaks, lacking the bright pale braces of Little Stint. There was a large dark spot immediately before the eye. The tertials covered all but the very tips of the primaries.

In flight the bird showed a rather indistinct pale wing-bar, less obvious that that of Little Stint.

The legs appeared black but when seen at very close range were in fact an extremely dark green. (This seems to contradict the generally held view that this species is one of the black-legged stints, but e.g. Hollom. 1960 *The Popular Handbook of Rarer British Birds* states : 'legs very dark green, appearing black'.)

The bill was very distinct when viewed head-on. It was very broad-based and had a spatulate tip. Viewed from the side it appeared deep-based and ended in a 'droop-tip'.

The feeding action was quite distinct, being generally rather plover-like, slower and more deliberate that Little Stint.

The call was heard on several occasions when the bird took to the wing. It was a rather dry 'drrrp', completely different to the normal 'chit' of Little Stint, rather husky and flat.

The record was accepted by the BBRC and constitutes the first occurrence of the species in Orkney and only the second for Scotland. The usual range of the species is North America. It is interesting to note that Semi-palmated Sandpipers were recorded in East Anglia (May '93) and Spitzbergen (late June '93). Perhaps the same bird?

John Holloway,
'Castle', Stronsay,
Orkney.

Pallid Harrier in Shetland; second Scottish record

On 15 September 1993 at Exnaboe, Shetland, Dennis and John Coutts found a 'ringtail' Harrier *Circus sp.* flying over the main road at Toab, South Mainland, Shetland. Their attention was immediately drawn to the bird's relatively small size, bright rusty-orange underparts and almost wholly dark secondaries and inner primaries. Their initial thought was that the bird was perhaps a juvenile Montagu's Harrier *C. pygargus*. They followed the bird until it perched on a fence post in nearby Exnaboe where they watched it for 15 minutes, noting the well marked facial pattern, consisting of a black loral line continuing through the eye and joining a broad patch at the ear coverts which connected the lores, with a whitish patch below the eye and unmarked rusty-orange underparts. They informed me of their discovery, and we were able to relocate the bird, which, from their description, I suspected might be a juvenile Pallid Harrier, *C. macrourus.* I noted the unstreaked underparts and a brief glimpse of the head pattern showed both the broadness and the paleness of the collar which encircled the head. As it flew around the field, I scribbled down some notes and mentally compared it to all the juvenile Montagu's I had seen when I was involved in protection work on that species in Norfolk in 1986. The flight of this bird was slightly heavier and less buoyant than that of a Montagu's, with a fairly broad wing base that lacked the raised hand associated with Montagu's, the hand itself appearing relatively short and the scapular and covert fringes and tips on our bird looking tan-buff, not rufous as on Montagu's. We saw the bird briefly on two other occasions we did not, however at this stage note dark semi-collar that borders the pale collar, which was the most important feature. When John Clifton arrived with a visiting birder John Miller, the bird was flushed again in poor light. Overnight, I read the literature (see references) associated with the Hen Harrier of the North American race *C.c. hudsonius* and with the rare rufous morph

juvenile *cyaneus* and checked and re-checked my field notes against descriptions of harriers I had built up over the years. The bird was found shortly after dawn the following morning, distantly perched side on. I noted the extent of the dark semi-collar indicating that it was a Pallid, but we really needed to see it in more favourable light. Unfortunately, I had work commitments and left the scene. Eventually however, Mick Mellor and Nick Dymond had superb views as it flew over the road exhibiting all the features described, including the semi-collar. At 1600hrs it was last seen drifting north.

Description

General Size and Structure: a lightly built harrier with slim tail and absolutely no bulk to underbody. Similar in size and shape to Montagu's Harrier, although direct comparison was only made with a perched Hooded Crow *Corvus corone cornix*, with which it appeared to be about the same size, but obviously much longer winged. The flight was light, but not as buoyant as Montagu's, probably due to the shorter wings making it look more 'compact'. The usual flight consisted of gliding on slightly raised wings but also sometimes almost level wings.

Head: well defined facial pattern consisting of blackish lores extending through eye to form eye-stripe which joined a broad blackish patch on the rear ear-covert region which also continued to meet the lores, forming a complete ear-covert surround. Thus surround was at it,s broadest on the outer and lower edge. A white patch below the eye gave a strong contrast with this surround. A narrow creamy-white, but distinctive supercilium extended from the creamy-white lower forehead to the upper rear of the dark ear covert surround, where it joined an obvious and broad whitish collar, which bordered the lower edge of the ear-coverts and extended beneath the lores and also extended around the back of the head, where it formed a slight inverted 'V'. A uniform dark brown broad band from the nape extended around the sides of the neck, forming a semi-collar, which contrasted strongly with the pale collar.

Upperparts: mantle dark brown with thin but distinct warm buff tips and fringes to feathers. Back dark brown with traces of buff fringes and tips to feathers. Obvious white rump patch, appearing as broad as Hen Harrier. Long thin tail, with at least four thin dark tail-bars contrasting with greyish brown bars. A broader dark brownish-black subterminal band was bordered on the posterior edge by creamy-white tip.

Underparts: throat, breast, belly, flanks, ventral region and undertail coverts unmarked bright orange-rufous.

Upperwing: scapulars, lesser, median, greater and primary coverts dark brown with distinct warm buff tips, although the scapulars were both fringed and tipped warm buff, and because of the relative small size these feathers formed a striking upperwing panel in flight. The greater coverts were noticeable darker than the other coverts, appearing almost black. Dark brown tertials with warm buff fringes and tips. Secondaries appeared wholly blackish on the closed wing, but in flight exhibited thin buff tips forming a trailing edge. Thin whitish tips to blackish primaries. Three, sometimes four prominent primaries were exposed on the open wing in flight.

Underwing: underwing coverts bright rusty orange contrasting strongly with almost wholly black secondaries. Silver-white primaries with dark transverse barring across whole width except at base where they appeared unmarked forming a distinct place area which contrasted with dark tips to the primary coverts. Tips to the three or four 'exposed' primaries were blackish.

Bare parts: views attained could not allow much bill detail to be noted although it appeared to be small harrier-type bill with yellow on upper mandible and greyish on lower mandible contrasting with darker tip. Legs and feet dark yellow. Eye appeared dark.

Range and Status

Pallid Harrier breeds in dry temperate steppe zones in a belt that extends from eastern Europe across the USSR to central Asia and winters chiefly in Africa and southern Asia. It is a rare, but increasingly regular vagrant to western Europe, particularly Scandinavia and the low countries. If accepted by The British Birds Rarities Committee, this bird will constitute the second record for Scotland and the fourth record for Britain and Ireland. The three previous accepted British records are as follows (Dymond *et al.* 1989):
Shetland: Fair Isle, male, from about 24 April to 8 May 1931 (shot).
Dorset: Studland, male, 11 April 1938.
Yorkshire: Hutton Cranswick, immature male, shot on 2 October 1952.

Summary

A juvenile Pallid Harrier *Circus macronus* was present in the Sumburgh and Dunrossness area of Shetland from 15-16 September 1993. Upon acceptance by BBRC, this bird will constitute the second record for Scotland and the fourth for Britain and Ireland.

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Hugh Harrop, Fairview, Scatness, Virkie, Shetland ZE3 9JW.

Cetti's Warbler in Edinburgh: a new bird for Scotland

On 5 October 1993 Mike Shepherd was handed a freshly dead bird that had been found beneath a window of the Scottish Natural Heritage offices at 2 Anderson Place in Leith, Edinburgh. Incredibly the bird turned out to be a Cetti's Warbler *Cettia cetti* that had presumably flown into a window the night before and even more remarkably bore a French ring. It was later found to have been ringed as a first-year bird at Wissant, between Cap Gris-Nez and Calais, on 24 August 1993 (P. Rauvel & C. Duponcheel pers. comm.).

The bird was taken to the Royal Museum of Scotland, Edinburgh where it is now preserved as skin number NMSZ 1993.181. Here the

specimen was compared with several text books and a number of other skins in the collection from Spain, Italy and Turkey. The bird was clearly a small individual with all measurements at the low end of the published range and was less bright rufous than all other specimens in the collection. The bill was also finer and narrower than other specimens.

Description

Upperparts: uniform rufous brown, becoming darker brown on the upper tail coverts and crown and greyer on the sides of the breast.

Underparts: under tail coverts brown and broadly tipped off white. Vent, flanks and sides of breast brownish grey, becoming greyer on the breast. Centre of belly off white, greyer across the breast. Throat white.

Head: whitish supercilium from bill to behind eye, where it was broader and more prominent. Also white feathering on lower eye lid. Dark line through the eye to above the ear coverts.

Wings: darker brown than mantle, with a more rufous panel on the closed wing. The wings were short with a length of 56mm.

Tail: dark brown, as wings. There were 10 tail feathers, that were slightly worn. The tail measured 57m.

Eye colour: darkest brown.

Bill: fine and rather narrow at base compared with other skins. Dark brown above with purplish pink base to lower mandible. Measured as 13mm from bill tip to skull and 9mm from tip of feathering.

Tarsus: transparent flesh/pink in colour and measured as 19.3mm.

Ankle and feet: transparent purplish pink.

Weight: 10.8g, but it may have lost about 1g before weighing. Stomach empty, but in good condition with good amount of subcutaneous and deposited fat (3 on a score of 1 to 3).

Age/sex: on dissection the bird was found to be a male and the skull was fully ossified, indicating it was an adult.

Note that measurements and the colour of the bare parts were noted by the taxidermist when the bird was fresh.

For Scotland's first Cetti's Warbler to turn up as a corpse beneath a window in Edinburgh was unexpected, to say the least. It is the longest distance travelled by a Cetti's Warbler ringed at the Wissant site, and also now the furthest north record in the UK after one at Hornsea (North Humberside) on 2-3 November 1972. The date of its arrival is certainly typical of migrant Cetti's Warblers arriving in southern England from the continent, but why it should have ended up in Leith can only be guessed at. The site is only 1.5km from the coast and although adjacent to the Water of Leith there is no suitable habitat nearby. Central Edinburgh also hosted a Hoopoe *Upupa epops* on 21 October and a Firecrest *Regulus ignicapillus* on 28 November - perhaps the East Lothian coast is not the best place to look for migrants after all!

Acknowledgement

I am grateful to Mike Shepherd for allowing me, as Local Recorder, to write up the occurrence and Bob McGowan at the Royal Museum of Scotland for supplying information on the bird's soft-part colouration and measurements.

Ian J. Andrews, 39 Clayknowes Drive, Musselburgh, Midlothian EH21 6UW.

Obituary

Dr W.J. Eggeling CBE FRSE

Joe Eggeling, who died in February 1994, was one of the most outstanding figures in Scottish conservation and ornithology. Born the son of a GP in Fife in 1909, he progressed to distinguished careers as a student of forestry at the Universities of Edinburgh and Oxford and then as a practitioner of it in Africa, joining the Colonial Forestry Service in 1931. Both in Uganda where he became Conservator in 1946 and in Tanganyika to which he moved in 1950 and where he rose to be Chief Conservator, he made an exceptional contribution to the survey and management of these countries' natural resources.

Retiring from forestry at the age of 45 in 1954 he returned to Scotland and cast about for a new career. He recalled an incident years before when he was wildfowling at Cameron Reservoir in Fife and had shot a goose with a private ringing scheme ring on its leg. He returned the ring with a note saying 'I shot a curious Canada-type goose with your ring on it. Sorry.' It was indeed a curious goose, a 'Barnada': a cross between a Barnacle gander and a Canada goose, part of the wildfowl collection at Tayport.

Now he wrote again to the owner of the goose, Dr John Berry, then Director in Scotland of the Nature Conservancy: 'You may remember me as the man who shot your goose. If there are any posts going in the Nature Conservancy I hope you will consider me.' He was considered. He was enthusiastically appointed to a post as a Scientific Officer; 'just the man for the job - it was made for Joe', but Civil Service regulations blocked the appointment. A Scientific Officer had to be a scientist and 'Dr Eggeling is not a scientist but a forester'. The late Sir Arthur Duncan, then Chairman of the Nature Conservancy (and first Chairman of the SOC in 1937) was determined to have him on board and swept away the objections by the inspired expedient of inventing a new type of post to which a forester *could* be appointed: Conservation Officer. Thus Joe Eggeling was launched on his distinguished conservation career in Scotland.

The Nature Conservancy in the 1950s and 60s was a much smaller organisation than its modern counterpart but in a pioneering way it grappled with major issues like the setting up of the first National Nature Reserves in the Cairngorms, in Torridon and Rhum, designating the first Sites of Special Scientific Interest and generally bringing a more orderly approach to the welfare of wildlife. Joe Eggeling relished the challenge which this presented both in terms of directing practical conservation work on the ground and also the more humdrum and long drawn-out bureaucratic processes which lay behind it.

In all this he could be quite firm with everyone concerned; he possessed the formidable armoury of toughness combined with a sense of humour. One landowner who telephone the Nature Conservancy with a complaint and who scathingly said that its staff knew nothing of ecology compared to his own experience of Africa found himself being addressed by Joe Eggeling in trenchant Swahili. He succeeded Dr Berry at Director in Scotland in 1968 until his retirement from the Conservancy in 1970. He was made CBE in 1971.

He also applied his energy to the SOC, being elected to Council in 1955 and serving as Vice President in the years 1963-66 and as

President in 1966-69. During this long service he played a prominent part in all the Club's decisions including, for example, the founding of *Scottish Birds* in 1958. In the late 1950s *The Scottish Naturalist*, in which the Club published material, was down to a circulation of 250 with only 90 Club members subscribing. It took a steady nerve to start a new journal from that base. Accommodation was another problem and Joe Eggeling served on the committee which, thanks to the generosity of a donor's gift of £3000, was able to oversee the purchase of 21 Regent Terrace as the Scottish Centre of Ornithology and Bird Protection.

He also chaired the committee which, for nerve, was the biggest Club undertaking of those years: the Bird Islands Cruise of 1966. This entailed chartering the passenger liner Devonia and setting up the whole organisation for a tour for 420 foreign delegate to the International Ornithological Congress, plus resident members, on a journey round the top of Scotland to islands not always blessed with fine weather.

On this occasion they were. Warm sunshine and calm seas contributed to the outstanding success of the trip and at the end of the first day Joe Eggeling was able to put some months of anxiety behind him with a beaming grin and the words 'It will be all right now'. Members who were on the cruise will remember his genial presiding presence and his excellent commentaries from the bridge as the ship sidled past island birds cliffs.

Of all these islands it was the May which was closest to his heart. Familiar with its shape on the horizon since childhood, it was a haven for him for many years. On 25 October 1952 he wrote in the Bird Observatory log: 'I would like to record the extreme pleasure I have obtained from my visits to the island this summer and autumn. I have laid up many lovely memories to bring out of store and linger over in Africa. That country is too large, as even are its component parts, for one to get to know any piece of it intimately, and that is one of the great attractions of the May. You can get to know every blade of grass, every stone, and every nest'.

Never one to stay on the side-lines he soon found himself elected as Honorary Secretary of the Bird Observatory on his return to Scotland. He threw himself into running it, keeping the most meticulous records in tiny handwriting famously at odds with his bulky frame, and completely re-organising the records system. In his professional role he was instrumental in bringing about the National Nature Reserve on the May through negotiations with the Northern Lighthouse Board, and also with the Bird Observatory which was entrusted as managed of the reserve on the Nature Conservancy's behalf.

Not that it was all book work. A good deal of physical effort was required to keep the Observatory building, the Low Light, and all the traps in good order. In the 1950s one hazard was the lightkeepers goats which made a habit of climbing onto the roofs of the Heligoland traps to nibble emerging tree tops, and crashing through the wire netting.

Often accompanied by his wife Jessie and their children he was a frequent resident of the Low Light, refurbishing it, repairing goat and gale damage elsewhere, trapping and ringing, botanising, but above all enjoying the place with its migrant excitements and its teeming sea-birds in summer. He took a particular interest in the small Fulmar population; one long-resident pair was dubbed Joe and Jessie.

But some of the work was a slog, a fact not always appreciated by others who benefited from it. On a lone visit in March 1958, he wrote in the log: 'It has been a day of toil and my fingers are so chapped and hacked and wire torn that I can scarcely hold the pen'. Three days later the situation had not improved. 'Already I am six days overdue and the emergency shelf now houses only one tin of sardines, curry powder, mixed herbs and white pepper'. It was to be yet another six days before the weather calmed down enough for a boat to take him off; he had been kept going by the lightkeepers hospitality and a plentiful supply of rabbits.

1960 saw the publication of his book *The Isle of May* in which he chronicled the whole story of the island with its lighthouses and its wildlife and the Bird Observatory. This was just prior to the dramatic changes in the sea-bird populations. In a log entry in July 1949 he had written: 'The morning was spent looking for Puffins. Two pairs were seen to enter cracks in the Mill Door'. By 1960 they were breeding 'in small numbers' before taking off to the present population of over 40,000. Herring Gulls increased from about 6000 in 1960 to 30,000 ten years later, leading to the culls carried out in the 1970s by the NCC at the request of the Observatory committee.

Following retirement Joe Eggeling suffered a stroke in 1973 but continued his active interest in conservation as a Commissioner of the Countryside Commission for Scotland and a Vice President of the Scottish Wildlife Trust. On his last visit to the May in 1989 he had the pleasure of seeing the ownership of the island being formally handed over to the NCC, securing its conservation for the future. He himself had played a major part in advancing that conservation, not only on the May but throughout the whole of Scotland. He will be remembered with respect for that achievement, but he will also be remembered with affection for his generosity of spirit, his thoughtfulness towards others and for his good company. He was not just a big man; he was a towering presence.

John Arnott

Items of Scottish Interest

Most of the following papers and reports on birds in Scotland are available in the Waterston Library at 21 Regent Terrace for reference, and include all that have come to notice in the period October 1993 to February 1994. The librarian would be glad to learn of anything that has been missed, and to receive reprints or copies of papers on any aspect of ornithology or natural history. Bird reports marked with an asterisk are available from the SOC at the prices quoted, but please add 50p per order for postage and packing.

Scientific papers.

Bones, M. 1993. The garefowl or Great Auk *Pinguinis impennis. Hebridean Nat.*11: 15-24.

Bryant, D.M. 1993. Bird communities in oak and Norway spruce woodlands on Loch Lomondside: a long-term study. *Forth Nat. & Hist.* 16: 59-70.

Buckland, S.T. & Elston, D.A. 1993. Empirical models for the spatial distribution of wildlife. *J. appl. Ecol.* 30: 478-495. Includes case studies of the Redstart and the Green Woodpecker in Scotland.

Cadbury, J. 1993. Grazing and other management of upland vegetation for birds in the United Kingdom. *RSPB Conserv. Rev.* 7: 12-21.

Canham, M. 1992. Nestboxes for Kestrels. *Forestry Comm. Res. Inf. Note* 215.

Craib, J. 1994. Why do Common Cuckoos resemble raptors? *Brit. Birds* 87: 78-79. A study in northern Scotland.

Cresswell, W. 1993. Escape response by Redshanks *Tringa totanus* on attack by avian predators. *Anim. Behav.* 46: 609-611.

Crockford, N.J. 1993. Action for Merlins. *RSPB Conserv. Rev.* 7: 22-26.

Delany, S. 1993. Introduced and escaped geese in Britain in summer 1991. *Brit. Birds* 86: 591-599.

Dougall, T.W. 1993. Post-juvenile moult and dispersal in the Meadow Pipit *Anthus pratensis. Ringing and Migration* 14: 137-142. A study in southern Scotland.

Duncan, K. & Marquiss, M. 1993. The sex/age ratio, diving behaviour and habitat use of Goldeneye *Bucephala clangula* wintering in north-east Scotland. *Wildfowl* 44: 111-120.

Elliott, M.M. 1993. Greylag Goose counts in the Uists from 1986 to 1991. *Hebridean Nat.* 11: 56-60.

Ellis, P. & Dawson, J. 1994. Ageing and sexing of King Eiders. *Brit. Birds* 87:36-40. Based on observations in Shetland and in captivity.

Fairlamb, D. 1993. The year of the flood. *Perth & Kinross Bird Report* for 1992: 42-44. Describes the creation of an artificial wetland at Vane Farm RSPB Reserve.

Furness, R.M. 1994. The impact of the BRAER oil spill on Shetland's breeding seabirds. *Seabird Group Newsletter* 67: 3-6.

Gibson, J.A. 1992. The 1988 census of Gannets on Ailsa Craig. *Scot. Nat.* 104: 115-121.

Gitay, H., Fox, A.D. & Boyd, H. 1990. Analysis of historical Pink-footed Goose ringing recovery data. *Ring* 13: 103-112. A study covering Ireland, England and Scotland (only recently received).

Graves, J., Ortega Ruano J. & Slater, P.J.B. 1993. Sex ratio of chicks in the Shag *Phalacrocorax aristotelis* determined by a female-specific band in DNA fingerprinting. *Ibis* 135: 470-472.

Green, R.E. & Stowe, T.J. 1993. The decline of the Corncrake *Crex crex* in Britain and Ireland in relation to habitat change. *J. appl. Ecol.* 30: 689-695.

Harrison, N. & Sears, J. 1993. Towards a marine conservation programme. *RSPB Conserv. Rev.* 7: 35-41. Concerned with

seabirds, pollution and overfishing.
Hartley, I.R., Shepherd, M., Robson, T. & Burke, T. 1993. Reproductive success of polygynous male Corn Buntings as confirmed by DNA fingerprinting. *Behav. Ecol.* 4: 310-317.
Hill, D., Rushton, S.P., Clark, N., Green, P. & Prys-Jones, R. 1993. Shorebird communities on British estuaries: factors affecting community composition. *J. appl. Ecol.* 30: 220-234.
Hirst, P. 1993. RAFOS Expedition to St Kilda 28 May - 15 June 1988. *Royal Air Force Orn. Soc. J.* 22: 1-18.
Hume, R.A. 1993. Brown Shrike *Lanius cristatus* in Shetland: new to Britain and Ireland. *Brit. Birds.* 86: 600-604.
Johnston, R.D. 1993. The effect of direct feeding of nestlings on weight loss in female Great Tits *Parus major. Ibis* 135: 311-314. A study near Stirling.
Kenney, D. 1993. Common Buzzard taking Common Teal in flight. *Brit. Birds* 86: 625.
McCracken, D.I., Foster, G.N., Bignal, E.M. & Bignal, S. 1992. An assessment of Chough *Pyrrhocorax pyrrhocorax* diet using multivariate analysis techniques. *Avocetta* 16: 19-29.
Mitchell, J. 1993. The Heronry at Gartcairn Wood, Loch Lomondside: an update. *Forth Nat. & Hist.* 16: 58.
Moss, R., Watson, A., Parr, R.A., Trenholm, I.B. & Marquiss, M. 1993. Growth rate, condition and survival of Red Grouse chicks. *Orn. Scand.* 24: 303-310.
Newton, I. 1993. Age and site fidelity in female Sparrowhawks *Accipiter nisus. Anim.Behav.* 46: 161-168.
Peach, W.J., Thompson, P.S. & Coulson, J.C. 1994. Annual and long-term variation in the survival rates of British Lapwings. *J. Anim. Ecol.* 63: 60-70.
Percival, S.M. 1993. The effects of reseeding, fertiliser application and disturbance on the use of grasslands by Barnacle Geese, and the implications for refuge management. *J. appl. Ecol.* 30: 437-443. A study on Islay.
Redfern, C. 1993. Song Thrushes feeding on Periwinkles. *Brit. Birds* 86:630. An occurrence in the Outer Hebrides.
Riddiford, N. & Potts, P. 1993. Exceptional claw-wear of Great Reed Warbler. *Brit. Birds* 86: 572. Found in a vagrant on Fair Isle.
Sankey, S. 1993. Our birds: a conservationist's view. *Forth Nat. & Hist.* 16: 53-57.
Watson, A., Moss, R., Parr, R., Mountford, M.D. & Rothery, P. 1994. Kin landownership, differential aggression between kin and non-kin, and population fluctuations in Red Grouse *Lagopus l. scoticus. J. Anim. Ecol.* 63: 39-50.
Watson, J., Leitch, A.F. & Rae, S.R. 1993. The diet of Golden Eagles *Aquila chrysaetos* in Scotland. *Ibis* 135: 387-393.
Williams, G. & Green, R. 1993. Towards an upland habitat action plan. *RSPB Conserv. Rev.* 7: 5-11.
Young, S.C. 1993. The Shetland oil disaster. *Envir. Politics* 2: 333-339.
Zonfrillo, B. & Brockie, K. 1993. Daurian Redstart in Scotland. *Brit. Birds* 86: 629. Vagrant on the Isle of May.

Bird Reports

Argyll Bird Report for 1992. J.C.A. Craik (ed.) 1993. 56pp. *£3.50

Colonsay and Oronsay, Natural History of., for 1993. J. Clarke & P.M. Clarke (eds) 11pp. This series is now in its 12th year under the same editors.

Dumfries & Galloway Bird Report for 1992. Paul Collin & Ken Bruce (eds) 1993. *£2.20

Forth Area Bird Report for 1992. C.J. Henty (ed.) 1993. In *Forth Nat. & Hist.* 16: 25-52. Covers the Districts of Falkirk, Clackmannan and those parts of Stirling District that drain into the River Forth.

Highland Bird Report for 1991. Colin Crooke (ed.) 1993. 31pp *£2.50

Lothian Bird Report for 1992. Paul Speak (ed.) 1993. 122pp. *£3.95. Includes ten short articles on special surveys, rarity reports, atlas work and ringing, plus a 67-page systematic list.

North Sea Bird Club Annual Report for 1992. 84pp. Includes a 43-page systematic list and a checklist of birds seen at offshore oil installations and vessels from 1979-92.

North-East Scotland Bird Report for 1992. Andy Webb (ed.) 1993. 76pp. *£3.50. Includes articles on wintering waterfowl at the Loch of Skene, on Skua movements off Peterhead, and on Quail in north-east Scotland.

Perth & Kinross Bird Report for 1992. Wendy Mattingley (ed.) 1993. 48pp. *£3.50. Includes a 38-page systematic list, a short report on ringing, and an article on the Vane Farm RSPB reserve (see Fairlamb above).

W.G. Harper.

European Journals in the Waterston Library

The following selection of articles appeared in the European journals received in the Waterston Library between September 1993 and February 1994 inclusive, thus following on the list published in Vol 17 No 2. 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 its year of publication. Journals quoted are as follows :

Belgium: *Mergus*
Netherlands: *Dutch Birding, Limosa, Ardea*
France: *Alauda, Le Passer*
Switzerland: *Der Ornithologische Beobachter*
Germany: *Limicola, Vogelwelt, Corax, Die Vogelwarte, Seevögel*
Poland: *The Ring*
Spain: *Ardeola*
Ireland: *Irish Birds*
Denmark: *Ornis Scandinavica* (with effect from 1994 renamed *'Journal of Avian Biology'), Dansk Ornitologisk Forenings Tidsskrift*
Norway: *Vår Fuglefauna,* Stavanger Museum occasional publications
Sweden: *Vår Fågelvärld, Ornis Svecica*
Finland: *Linnut, Ornis Fennica*

General:

Helmich, J. [The impact of pesticides on birds; a case study on Great Bustard]. *Ardeola 2/92* (This is a special issue of *Ardeola.* It contains seminar papers on conservation in Spain which are too numerous to enumerate here, but cover a wide field of subjects on this overall theme).

Divers to Ducks:

Wink, M. *et al.* Genetic evidence for speciation of Manx Shearwater and Mediterranean Shearwater. *Vogelwelt 6/93.*
Ullman, M. [Field identification of Storm Petrels]. *Vår Fågelvärld 7/93.*
Anfinnsen, M.T. [The Great Crested Grebe at Jæren in the 1950's] (includes a brief history of Great Crested Grebe in Norway since 1774). Stavanger Museum occasional publication 1992.
Rösner, H-U. [Monitoring of Barnacle and Brent Geese in Schleswig Holstein Wadden Sea 1991-2]. *Corax 3/93.*
Clausen, P. & Fischer, K. [Identification of age and race of Brent Geese]. *Dansk Orn. For. Tidsskr. 1/94.*
Gélinaud, G. *et al.* [Wintering of Shelduck in France]. *Alauda 4/92.*
Schricke, V. [Mont St Michel Bay, the major moulting area in France for Common Scoter]. *Alauda 1/93.*
Durinck, J. *et al.* Diet of Common and Velvet Scoters wintering in the North Sea. *Ornis Fenn. 4/93.*

Birds of Prey:

Solonen, T. Spacing of raptor territories in southern Finland. *Ornis Fenn. 3/93.*
Kjellén, N. [Raptor migration at Falsterbo]. *Vår Fågelvärld 5/93.*
Wirdheim, A. [The Honey Buzzard]. *Vår Fågelvärld 5/93.*
Solonen, T. *et al.* [Where do Buzzards nest? a review of nest sites in Finland]. *Linnut 4/93.*
Fernandez, C. [Selection of breeding site cliffs by Golden Eagle]. *Alauda 2/93.*

Fernandez, C. & Azkona, P. [Influence of breeding success on reuse of nests by Golden Eagle]. *Ardeola 1/93.*
Forsman, D. [Ageing of Golden Eagle]. *Linnut 6/93.*
Selås, V. [How does illegal shooting of Goshawks affect the breeding population?]. *Vår Fuglefauna 3/93.*
Steen, O.F. [Status of Peregrine Falcon in SE Norway 1993]. *Vår Fuglefauna 4/93.*

Grouse to Cranes:

Martin, K. & Horn, A.G. Clutch defence by male and female Ptarmigan. *Ornis Scand. 4/93.*

Waders to Auks:

Mahéo, R. [International importance of French coasts for wintering waders]. *Alauda 4/92.*
De Putter, G. *et al.* [Numbers and distribution of waders on Flemish coast July 1989 - June 1990]. *Mergus 1/93.*
Ens, B.J. *et al.* [Distribution of overwintering waders in the Dutch Wadden Sea]. *Limosa 4/93.*
Berg, A. Habitat selection by monogamous and polygamous Lapwings on farmland - the importance of foraging habitats and suitable nest sites. *Ardea 2/93.*
Boschert, M. & Rupp, J. [Breeding biology of Curlew at a site in the southern Upper Rhine valley]. *Vogelwelt 5/93.*
Hülsmann, H. [The Redshank in Schleswig-Holstein] *Seevögel 4/93.*
Leuzinger, H. & Jenni, L. [Migration of Wood Sandpipers at Ägelsee, Switzerland]. *Orn. Beob. 3/93.*
Le Maréchal, P. [Development of gull (Larus and Rissa) populations in Ile-de-France 1976-92]. *Le Passer 1-2/93.*
Kompanje, J.O. & Post, J.N.J. [Russian race of Common Gull in Netherlands]. *Dutch Birding 6/93.*
Bartel, P. & Königstedt, D.G.W. [Identification of Slender-billed Gull]. *Limicola 4/93.*

Pigeons to Woodpeckers:

Fredriksson, R. [Identification of juvenile owls after leaving nest]. *Limicola 6/93.*
Giraudoux, P. & Michelat, D. [Prey-predator-habitat relationship of Barn Owl during breeding season]. *Alauda 2/93.*
Stegen, C. [Prey composition of Barn Owl in an area of Schleswig-Holstein]. *Seevögel 3/93.*
Lind, H. Differing ecology of male and female wintering Snowy Owls. *Ornis Svec. 3-4/93.*

Passerines:

Sjöberg, K. *et al.* Differences in bird habitat quality between plantations of Scots and Lodgepole Pine measured in terms of Pied Flycatcher breeding success. *Ornis. Svec. 2/93.*
Mild, K. [Identification of European black-and-white flycatchers]. *Limicola 5/93.*
Busse, P. Migratory behaviour of Blackcaps wintering in Britain and Ireland : contradictory hypotheses. *The Ring 1-2/92.*
Fransson, T. & Stolt, B.-O. Is there an autumn migration of continental Blackcaps into Northern Europe? *Vogelwarte 2/93.*
Hogstad, O. & Kroglund, R.T. The throat badge as a status signal in juvenile male Willow Tits *Jour. für Orn. 4/93.*
Berrow, S.D. *et al.* 2nd International Chough Survey in Ireland 1992. *Irish Birds 1/93.*
Olsen, K.M. [Field identification of Crossbill species]. *Vår Fågelvärld 8/93.*

M.H. 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 in italics should follow the first text reference to each species and should follow Voous 'List of Recent Holarctic Bird Species' as given in the *The British Birds' List of Birds of the Western Palearctic (1984).* Only single quotation marks should be used throughout and numbers one to ten should be written out whereas 11 and above should be written as numerals. Dates should be written:.....on 5 August 1991.....but on the 5th (if the name of the month does not follow). Please note that papers shorter than 700 words will be treated as Short Notes where all references should be incorporated into the text, and not listed at the end, as in full articles.

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

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

Errata

Scott. Birds 17(2) Colour plates. The caption to the winning photograph in the SOC 1993 Photographic competition should read 'Sooty Shearwater' *Puffinus griseus* and not Manx Shearwater. The plate opposite should read 'Verditer Flycather', not 'Verditers'. Apologies to the photographers.

Scott. Birds 17: 104. Paragraph 3. line 3 should read '61 attacks' not '91'. Apologies to the author.

[Eds].

NEOTROPICAL BIRD CLUB

Neotropical bird club launched

A club has been launched to promote the study and conservation of the birds of the Neotropics (South America, Central America and the Caribbean). It is currently seeking founder members to help reach the launch budget of £2000, which is required to get the club running and to publish the two first issues of its intended journal 'Continga'. Founder members will be asked to pay a minimum of £25, and will be formally acknowledged in the first issue of 'Continga', planned for January 1994. 'Continga' will provide a colourful and much needed forum for exchange of information on the avifauna of this extremely rich and diverse area, and will contain papers and features on the birds and their conservation as well as news of recent observations and discoveries (at present, new species are still being discovered at the rate of more than two a year). It is hoped that in due course the club will be able to provide direct funding and support for practical conservation programmes.

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

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Scottish Birds, the official journal of the Scottish Ornithologists' Club, publishes original material relating to ornithology in Scotland. Papers and notes should be sent to The Editor, *Scottish Birds*, 21 Regent Terrace, Edinburgh EH7 5BT.

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). (But please phone beforehand). A comprehensive stock of Scottish local bird reports is held at headquarters and may be purchased by mail order.

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Research Progress Report

G. SHAW

A ten year study of Barn Owl conservation in conifer forests

Twenty -five years ago, when I first became enthralled by this beautiful bird, Barn Owls *Tyto alba* were a common sight hunting at dusk over the young conifer plantations of Galloway in south-west Scotland. The afforestation of these upland grasslands, mainly during the 1950s and 1960s, involved the removal of grazing sheep, and this encouraged a rapid increase in the populations of field voles *Microtus agrestis* in the unchecked grass growth. Owls, and other vole-eating birds of prey, were quick to exploit this temporary glut of food.

Years of pastoral farming had left the Galloway hills treeless, and trees with potential nest-cavities simply did not exist, but the Barn Owls found a ready supply of nesting sites in the remote, and now abandoned, shepherds' cottages. When I first began to study the Barn Owls in Glentrool Forest in the early 1970s, I located ten breeding pairs, using 12 nesting sites, all in former dwellings. From the outset, it was clear that the affairs of man and owl were closely linked.

Lacking maintenance, the abandoned cottages had a limited life; slates blew off, rain rotted the roof timbers, and decay set in. The Barn Owl study became a sorry tale of diminishing numbers as nest sites were lost. At first this hardly mattered, since the conifers were growing up, shading out the grass and with it the voles. Many former territories became unviable anyway. By the mid-1980s only four buildings remained usable as nest sites.

Around this time the pendulum began to swing back to favour the owls; the earliest plantings had become productive timber. Clear-felling and re-stocking commenced; large areas within the forest were opened up, and were quickly re-colonised, first by grasses and then by voles. Now the opportunity was there for the owls also to re-colonise, and the loss of the derelict buildings had become an acute problem. The diminishing area of newly-afforested land provided no solutions; by the 1970s there had developed a ready sale for second homes and quiet country retreats, and any former tied houses entered the housing market.

With this background, in 1984 the Forestry Commission in Newton Stewart Forest District initiated a Barn Owl Conservation Project; the proposition was simple - a food supply (field voles) existed, but nest sites were lacking. If artificial nest sites could be provided and accepted, there was the potential to increase the owl population many times over. A project team of Andrew Dowell and myself, aided and advised by Iain Taylor of Edinburgh University, and by Steve Petty from FC Research branch, set about designing and erecting a range of tree-mounted nestboxes throughout the Forest District.

Several nestbox designs were employed; the common feature was a large cavity space that could be fixed onto a tree. At the time the increasing interest in Barn Owl conservation, motivated by the realisation of a serious national decline, was at the stage of providing static nestboxes in suitable farm buildings.

Our aim was to go a step further, by taking the nest site out to where the prey was. Boxes were erected in pairs, to avoid competition from the earlier-nesting Tawny Owl *Strix aluco*. By the spring of 1985, 33 sites were in place and this was gradually increased to 89 by 1989, after which the number was kept constant.

Small numbers of Barn Owls began to use the nestboxes from the spring of 1985 onwards, with a huge increase in 1988 from nine to 31 pairs (Fig. 1). Since then the number has fluctuated between 26 and 37 pairs; the original study area in Glentrool Forest (now a part of Newton Stewart Forest District) has regularly held 15-16 pairs in 'new' territories, in addition to the four sites remaining in old buildings.

The first conclusion from the project was that nestboxes do work, and that in the right place - where there is an abundant food supply of small mammals - it is feasible to create 'designer' owl territories, simply by providing a suitable nest site. A Forestry Commission Bulletin was published, describing the methodology, and encouraging many other Forest Districts in all six national FC Regions to develop similar conservation schemes. But within the original project we realised that in monitoring an annual sample of 30+ nests, there was an opportunity to develop a research programme to answer some of the questions that inevitably arose.

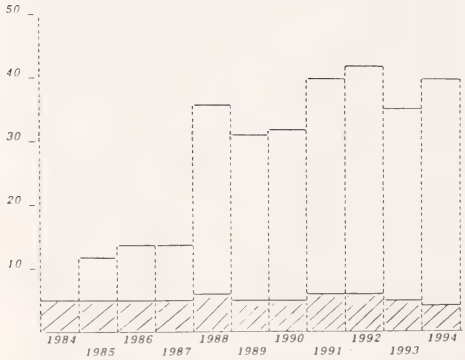

FIGURE 1. ***Number of Barn Owl pairs nesting in Newton Stewart Forest District, 1984-1994. Hatched part of column shows nests in old buildings, rest of column shows nestbox pairs.***

Where do they come from?

The spectacular increase in the nest box owl population immediately makes one ask where they have all come from. If established pairs of owls had been persuaded to quit their territories to exploit voles in the forest, then the project might be counter-productive. We tackled this problem in two ways; firstly, all existing nest sites in the forest were monitored each year. The number of owls using these old buildings remained stable in the ten years from 1985 (Fig. 1). Secondly, in association with workers from the Hawk & Owl Trust, as many owl chicks as possible were ringed at established nest sites in a 50km radius surrounding the forest.

From 1986 we began to trap the breeding owls at their nestboxes, beginning with a small number and monitoring the degree of disturbance caused. Fortunately, no adverse effect could be detected, and by 1988 most female owls were routinely trapped each year. Males were more difficult, since they spent only a limited time at the nestbox, and the annual sample has always been small. However, we were able to show that 82% of females trapped in 1988 were first-time breeders, and that most had been hatched in farmland and forest nests the previous year. The remaining, older females had bred in the

nestboxes in earlier years. At ten newly-occupied nestboxes where the male was trapped, all were yearling birds. There was no evidence that older birds, which may have previously been breeding outside the forest, had switched nest sites. Surveys conducted in the surrounding farmland showed a stable occupancy throughout.

How far do they come?

The same ringing/recapture programme showed that in 1988, 18 first-year females had moved an average of 9.7km from their natal site to breed in a nestbox; seven marked males had dispersed an average of 6.1km. Many subsequent handlings over the years have not significantly altered these figures; the furthest movement for a female has been 22km, and half this distance for a male. Given the spread of the chick-ringing operations, it would have been possible to detect movements of 50km+, if any had occurred.

Once settled, the breeding owls were extremely site-faithful. During the period 1985-94, only a single established male changed nestboxes, and then merely to the nearest adjacent territory. Females were slightly more mobile; in 70 cases where a female was trapped in two successive years, 50 (71%) were at the same site and 20 (29%) had moved boxes. None had moved more than three territories from their earlier breeding site, and most were on the adjacent territory.

The sedentary nature of Barn Owls has important implications for their conservation. Young owls disperse over short distances, and adults move hardly at all; once an owl population enters a decline, or is lost, it may be difficult to recover unless there is a source population close by. Nestbox schemes should work outwards from the source population, rather than in isolation.

What do they eat?

The forest habitats provided abundant field voles, and examination of owl pellets and prey caches at nests showed that the owls greatly favoured this one prey item. However in northern temperate latitudes, grassland voles exhibit cycles of abundance over a 3-4 year period. By sampling, using a vole sign index, we were able to define a roughly 3-year cycle in the Galloway forests; a year with high vole populations was followed by a low year, and then by a year with increasing numbers (Table 1). In low vole years, the owls brought

TABLE 1. ***Some aspects of breeding performance by Barn Owls using nestboxes in Newton Stewart Forest District, through two complete vole cycles 1989-94. Columns are totals over two years.***

Vole numbers	LOW 1989+1992	INCREASE 1990+1993	HIGH 1991+1994
Occupied nestboxes	63	57	70
Pairs laying eggs	39 (62%)	44(77%)	68(97%)
Pairs rearing young	19(30%)	36(63%)	59(84%)
Average laying date	23 May	30 April	10 April
Young reared	33	103	189
Average Adult survival to next season	54%	64%	38%*

*adult survival after high vole years based on 1988/89+1991/92

some voles to their nests, but also shrews and a variety of small woodland birds. These items seemed either small and unprofitable, or difficult to catch. In such years it was likely that the breeding owls experienced a shortage of suitable food, since there were no mice or other small rodents to switch to - as there might have been in more traditional farmland habitats.

The low vole years did not necessarily mean that there were fewer Barn Owls in the nestboxes (Table 1). However, what did happen was that in these years fewer birds (44-77%) laid eggs, and only a small part of the breeding population (11-35%) successfully reared young. By contrast when vole numbers were high, virtually all birds laid, and most (68-85%) were successful. In the early stages of the breeding attempt, from March onwards, the female owl was very inactive, and was always found at or in the nestbox. She depended on her mate to bring her food, and by conserving her energy she typically achieved a rapid body weight gain of around 30%, enabling her to produce a clutch of 5-6 eggs. In low vole years, some females showed only minor weight changes, and either produced small clutches (often later abandoned) or none at all. Those birds that did lay took longer to reach laying condition, resulting in a 6-week difference in average laying dates between high and low vole years (Table 1).

Population processes

In good food conditions the Barn Owls laid large clutches and produced many young; a few pairs successfully reared two broods in high vole years. This ability to react quickly to changing conditions meant that the owls could establish a permanent population in the forest, provided that the breeding birds could survive the low food years and be ready to profit when the voles increased. On average, about half of the females survived to the next successive breeding season; because we knew that adult dispersal was limited, most of these that disappeared can be assumed to have died, though few were ever found. When vole numbers crashed, adult survival sometimes dropped as low as 32%, and when vole numbers were increasing it exceeded 80%.

Barn Owls normally began to breed in their first year of life; at the extreme a young bird which became independent at the beginning of November was found sitting on eggs the following April. Each year there was a number of vacancies in the nestboxes, due to losses of adult birds, which could be filled by first-time breeders. However, recruitment of yearlings was not directly related to the opportunities available; 56 out of 78 yearlings arriving in the population had hatched in years when vole numbers were increasing. Only 18 (23%) came from the high vole years, when most chicks were produced, and a mere four (5%) had hatched in low vole years. This result was most likely due to young birds being better able to survive the winter when vole numbers were on an upward trend.

This pattern also meant that it was most profitable for adults to produce young in those years when voles were increasing, since they were more likely to contribute to future generations of owls. In this light, the very poor breeding output every third year was not such a disaster for the owls involved; adult survival in the low vole years (53-55%) was rather better than after a high year (32-44%). Survivors to the next breeding season would gain on two counts; next year's offspring would have the greatest change of entering the future breeding population, and the adult birds themselves would have a high probability of surviving to reproduce again. Taken in isolation, these years of dismal breeding failure might seem worrying, but the more complete picture serves to emphasise the value of long term monitoring.

Future Work

The nestbox scheme was begun as a conservation project, and research developed out of monitoring the project. While the principle has been established, that nestboxes can be used to increase Barn Owl numbers, there remain some conservation objectives that can be met from long term monitoring. Most importantly, we have accumulated data from 89 'manmade' territories, many for a full ten years. Fifty-eight have been used by Barns Owls, some just once and some right through; for the other 31 at least, our idea of a suitable territory failed to match that of the owls. The challenge now is to combine all the habitat features and the breeding records for each territory, so that in the future we can make the best possible use of our nestbox resources, by placing them more precisely in the places that have most of everything that a Barn Owl could need.

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Changes in breeding numbers of Kittiwakes in Shetland, 1981-1994.

M. HEUBECK & R.M. MELLOR

Counts of Kittiwake nests indicate that the Shetland breeding population in 1991-94 was 26% lower than in 1985-87, and 30% lower than in 1975-81. The decline has been far from uniform. There has been only a slight, recent decrease at Fair Isle whereas 60% fewer nests were found in 1991-94 along the south-west and east coasts of Shetland than in 1980/81. This decline is considered to have been due mainly to two factors. Firstly six successive years of low breeding success in the late 1980s, caused by a scarcity of sandeels, resulted in few new recruits to the breeding population. At the same time, predation at Kittiwake colonies by Great Skuas increased considerably and has continued at a high level at many colonies, even though sandeel abundance has increased. Improved breeding success since 1991 may soon lead to a halt to, or a reversal of, the population decline although this may be offset by continued predation pressure, which is also likely to have local effects on nest site selection.

Introduction

When the Shetland Oil Terminal Environmental Advisory Group (SOTEAG) began monitoring seabird populations in 1978, the Kittiwake *Rissa tridactyla* was selected as one species to be studied. The original aim was to count adults and nests in study plots established by the former Nature Conservancy Council (NCC) at four colonies in 1975-77, with the assumption that changes in numbers in these plots would reflect wider population change.

In 1981 the NCC made the first comprehensive census of Kittiwake colonies in Shetland, surveying virtually the entire cliff coastline from the sea (Richardson 1985). Also in 1981, SOTEAG made counts from land of nests in widely scattered colonies to detect changes since the 1969/70 'Operation Seafarer' counts (Cramp *et al.* 1974) and a 1974 survey by the Institute of Terrestrial Ecology (Harris 1976). The SOTEAG study found : a) although counts in SOTEAG study plots had declined, there was no evidence of any overall population decline between 1974-81, b) numbers had increased at some colonies, decreased at others, some colonies had disappeared and some new colonies had formed, c) counts from land (rather than from the sea) underestimated numbers of nests by an average of 36% (Pritchard 1981). When further counts were made from the sea in 1985 for the Seabird Colony Register it became clear that inferring overall population change by extrapolation from counts at study plots within colonies was invalid; instead it was decided to count total numbers of nests from a Zodiac inflatable along entire stretches of coastline at the appropriate time of year (Heubeck *et al.* 1986). This paper presents the results of counts made in this way since the 1981 survey.

Methods

Counts were made from a Zodiac inflatable boat usually crewed by three people, one handling the boat, another counting nests and the third counting adult Kittiwakes on the cliffs. Exceptions were at Sumburgh Head and Eshaness where some colonies were counted from land one or two days after the others had been counted from the sea. A few colonies were counted by landing on and climbing up rocks from which a better view of nests was obtained. All known colonies were visited and suitable cliff habitat was checked during surveys for new colonies. Two factors aided the ease of counting. Firstly, most Kittiwake colonies in Shetland are relatively small (only 11% in 1981 contained more than 250 nests (Richardson 1985)) and any large colonies were counted in sections, according to topographical features of the cliff. Secondly, counts tended to be made by the same observers (using tally counters) who rapidly gained experience, and knowledge of more problematic colonies. Counts were normally made during the first three weeks of June (but some in 1981 and 1985 were in the first few days of July) when the maximum number of nests might be expected.

Sea conditions were critical in determining which coasts could be surveyed each year; counts were made in winds up to Beaufort Force 5, as long as winds were offshore and there was little swell. Coverage was therefore more opportunistic than planned, although we tried to ensure that no more than three years elapsed between surveys of particular coasts. Where possible, nests were differentiated as 'incubating' (a well-built nest with an adult apparently incubating or brooding), 'AON' (a well-built but apparently empty nest, whether or not attended by an adult) and 'trace' (fragments of nest material only) (Harris 1987). The ability to see trace nests varied with viewing distance and sea conditions; here we consider well-built nests only, i.e. 'incubating' and 'AON' combined and referred to hereafter as AONs. Sometimes we encountered colonies with apparent high proportions of early breeding failures (typically, many partially disintegrated nests would be seen). On these occasions it was particularly difficult to categorise nests; those that were essentially substantial were counted as AONs, but the difference between the actual numbers of nests that had been built and that recorded will have been greater than normal. All adult birds ashore were counted, those in well-defined roosts or loafing areas being recorded separately from those in breeding colonies, and the location of all colonies and roosts were recorded on 1:10,000 maps. Counting error was not quantified but was thought to have generally been small since most colonies were relatively small and surveys were usually made in favourable sea conditions. Occasionally, a combination of cliff topography and swell or tidal chop made counts at particular colonies difficult, when the tendency was probably to underestimate numbers, but such errors contributed little to the overall changes recorded.

Kittiwake 'colonies' have been defined variously as aggregations separated by more than 50 yards (Boyd 1960) or 200 yards (Coulson 1963) of cliff free of nests. Our definition, of groups of nests clearly separable on 1:10,000 maps and hence distinguishable by different observers on subsequent visits usually fell between these distances. We use Coulson's (1963) term 'breeding station' to refer to groups of colonies with less than a mile of unoccupied coast between each other or, in the case of islands, separated from the nearest colony by less than a mile of sea.

The large breeding stations on Fair Isle and Noss, counted by Fair Isle Bird Observatory and Scottish Natural Heritage staff respectively, were subdivided into sections of coast according to natural features rather than discrete colonies. Also, the 1992 survey of Foula (previously surveyed only in 1976 by Glasgow University and in 1987 by NCC) was the first occasion that colonies were recorded in the manner we used elsewhere so the history of changes at individual colonies at these major breeding stations could not be determined.

Results

Breeding stations

In addition to Fair Isle and Noss, 57 breeding stations were recorded between 1981 and 1994 (Fig. 1; Table 1). Over Shetland as a whole, the most recent counts of AONs were c.26% lower than in 1985-87 and c.30% lower than in 1975-81 (Table 1). Breeding had ceased by 1991-94 at seven small stations and only one new one was established, at Siggar Ness, where roosting adults but no nests were recorded in 1981. At stations surveyed in 1980/81 (i.e. all except Fair Isle and Foula), the number of AONs had decreased by 51% by 1991-94 while the number of adults decreased by 53% (Table 1).

The total counts of AONs at breeding stations on Foula suggested lesser changes, decreases of 22% between 1975 and 1987, and only 1% between 1987 and 1992. However, these counts may be less comparable than at other breeding stations as some colonies were counted from land in 1976, while the 1992 survey was conducted in perfect sea conditions with absolutely no wind or swell. Less favourable conditions in 1987 and 1976 limited access to some colonies (R.W. Furness & M.G. Richardson pers. comm.).

At Fair Isle, the numbers of AON's increased until at least 1988 but fell by 6% between 1988 and 1992, although some colonies were overlooked in 1988 and the actual decrease was probably c.10% (Harvey *et al.* 1992).

Breeding areas

To examine regional and temporal trends in breeding numbers more critically, we used arbitrary geographical areas within which all breeding stations were counted in the same years (Fig. 1; Table 2).

Area A: At Sumburgh Head and Horse Island the number of AONs declined during the 1980s to a peak rate of -13% p.a. between 1989 and 1991, lessening slightly to -10% p.a. between 1991 and 1993; the number of AONs in 1994 was similar to 1993 and 56% lower than in 1981.
Area B: In the south-west Mainland there was little difference in the totals of AONs in 1981 and 1987, after which numbers fell with the highest rate of decrease (-14% p.a.) again between 1989 and 1991, a further decrease causing the 1993 total to be 46% less than in 1981.
Area C: In the west Mainland the number of AONs fell between 1981 and 1986 but rose again by 1988, after which there was a steep decline with numbers in 1993 being 70% lower than in 1981.
Area D: At Papa Stour and Muckle Roe there was little change in totals of AONs until gradual decreases between 1989, 1992 and 1993, the last count being 18% less than in 1981.
Area E: At Eshaness, after a slight decrease in the early 1980s, numbers of AONs increased by 7% p.a. between 1985 and 1989, but thereafter fell substantially with the 1994 total being 32% lower than in 1981.
Area F: Many abandoned, disintegrated nests were noted on the 1985 survey of north-west Mainland and early breeding failures

FIGURE 1. ***The location of Kittiwake breeding stations in Sheltand, 1981-94, and the areas within which all stations were counted in individual years.***

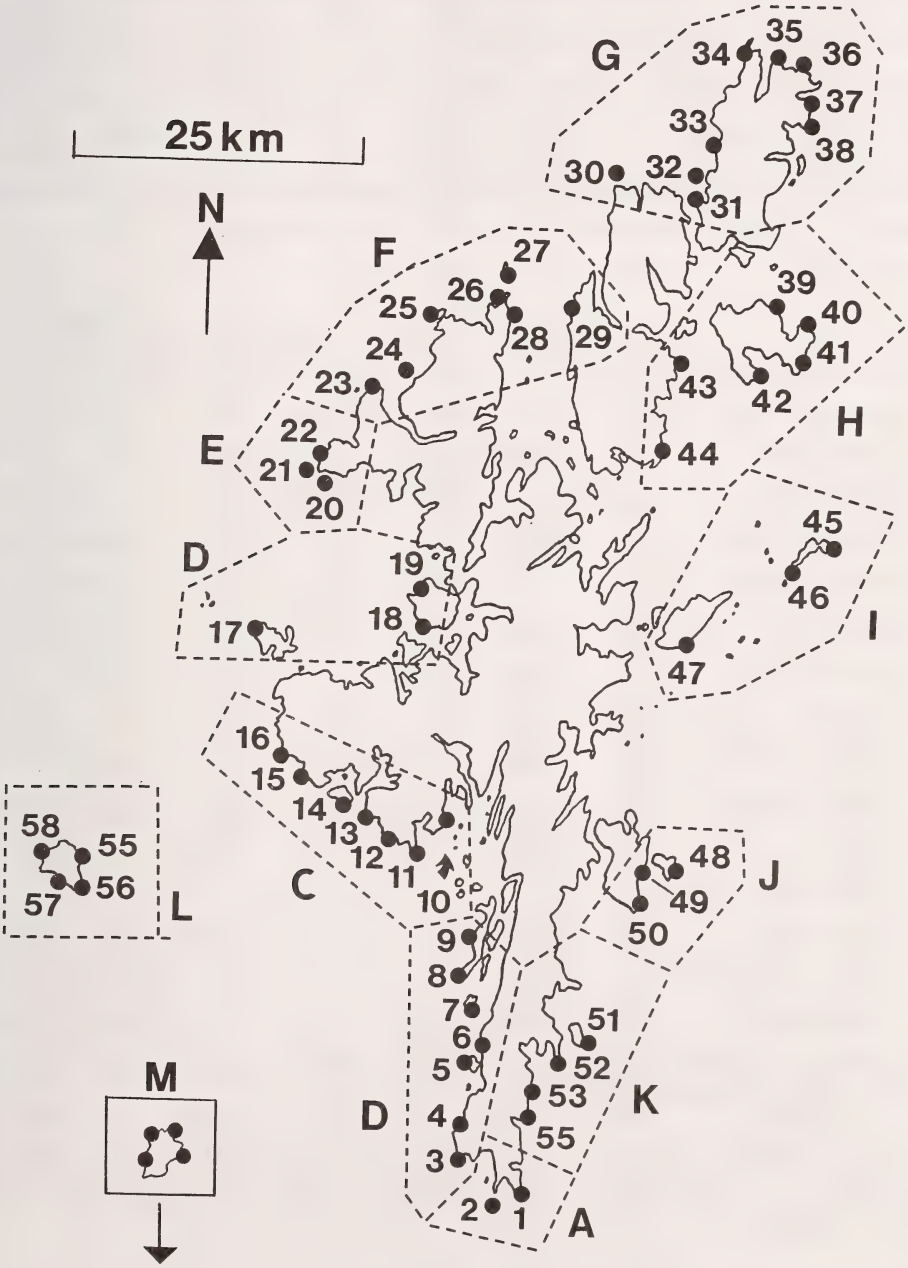

TABLE 1. ***The number of apparently occupied nests (AONs) at Kittiwake breeding stations in Shetland in 1981, 1985-87, and the most recent count (1991-94). Where counts were made in more than one year in 1985-87 both are given, consecutively, and the later count was used to calculate the total. In 1985-87 no count was made at Gruna Stack (No. 24) and those at Braga Ness (No. 15), Watsness (No. 16) and Tingon (No. 23) were made from the land. No counts were made at Fair Isle or Foula in 1981, those given were from 1975 and 1976, respectively. Indicated are the number of colonies known to have existed between 1981 and 1991-94, the number at which numbers of AONs increased or decreased between 1981 and 1991-94, the number of new colonies that formed, the number that disappeared and the number presumed missed by the 1981 survey. * = some colonies formed since 1981 had disappeared by 1991-94.***

Breeding Station	1981 AONs	1985-7 AONs	1991-4 AONs	Cols.	Inc.	Dec.	New	Dis.	Missed 1981
1. Sumburgh Head	2641	2451	1366	25	4	18	0	2	1
2. Horse Island	594	516/327	62	7	0	1	0	6	0
3. Siggar Ness	0	1	102	3	0	0	3	0	0
4. Fitful Head	500	258	177	6	0	4	0	1	1
5. St Ninian's Isle	47	65/77	140	3	2	1	0	0	0
6. Ness of Ireland	203	151	126	3	0	1	1	1	0
7. South Havra	29	9	0	1	0	0	0	1	0
8. Kettla Ness	280	315	48	2	0	2	0	0	0
9. West Burra	615	897	304	8	2	5	0	1	0
10. Reawick	272	197	41	4	0	3	0	1	0
11. Skelda Ness	186	64	58	5	1	2	0	2	0
12. Westerwick	454	284	133	10	0	5	1	4	0
13. Burga Stacks	58	3	17	1	0	1	0	0	0
14. Vaila	255	291	102	14	1	5	3	7*	0
15. Braga Ness	12	27	15	1	1	0	0	0	0
16. Wats Ness	11	0	1	1	0	1	0	0	0
17. Papa Stour	1059	1087	894	17	3	11	0	3	0
18. South Muckle Roe	96	99/69	33	4	0	2	0	2	1*
19. Swabie Stack	56	46/83	60	1	1	0	0	0	0
20. Dore Holm	375	328	197	2	0	2	0	0	0
21. Skerry of Eshaness	1266	1271	756	5	1	4	0	0	0
22. Mainland Eshaness	837	731	718	5	2	1	0	2	0
23. Tingon cliffs	35	21	3	4	0	0	1	3	0
24. Gruna Stack	50	-	81	3	2	0	1	0	0
25. Uyea	731	365	450	9	2	5	0	2	0
26. Fethaland	14	0	0	1	0	0	0	1	0

27. Ramna Stacks	1350	994/1047	598	14	0	12	0	2	0
28. Trumba	2	1/11	16	1	1	0	0	0	0
29. Varnadil	56	10	10	2	0	2	0	0	0
30. Gloup Holm	78	7	81	3	1	1	0	1	0
31. Blue Mull	158	114	87	4	0	2	0	2	0
32. Lang Holm	32	2	0	1	0	0	0	1	0
33. South Holms	121	305	71	3	1	1	0	1	0
34. Hermaness	3872	3497	2280	51	8	25	0	15	3
35. Saxavord	141	186/432	447	13	4	5	2	3*	0
36. Virdik	84	72	23	1	0	1	0	0	0
37. Burgar	217	211	196	2	1	0	0	1	0
38. Mooa Stack	53	92	67	1	1	0	0	0	0
39. Clett Stack	30	26/50	0	1	0	0	0	1	0
40. Strandburgh Ness	273	129/51	49	3	0	1	0	1	1
41. South-east Fetlar	32	0/3	7	6	0	0	2	5*	0
42. Lambhoga	37	66/67	11	2	0	1	1	1*	0
43. Birrier	82	11/43	62	2	1	1	0	0	0
44. Burravoe	392	169/168	109	9	0	3	3	4*	0
45. Grunay	261	148	12	6	0	1	1	5*	0
46. North Benelip	23	24	22	1	0	1	0	0	0
47. Clett Head	25	8	33	2	1	0	0	1	0
48. Noss (1980)	(11050)	9348	4301						
49. Millburn Geo	19	27	0	1	0	0	0	1	0
50. Hole of Bugars	19	0	0	1	0	0	0	1	0
51. Mousa	148	14	0	2	0	0	0	2	0
52. Noness	1627	1489	614	8	0	5	0	3	0
53. Troswick Ness	716	520	187	3	0	3	0	0	0
54. Boddam	256	277	239	6	2	3	0	1	0
Total AONs	31380	27518	15406	295	43	143	19	91	7
Total Adults	47292		22104						
55. Hodden Geo, Foula			19	2					
56. South-east Foula			76	6					
57. The Noup, Foula			523	2					
58. North-west Foula			3688	31					
Foula Total	(5570)	4350	4306	41					
Total AONs	36950	31868	19739	335					
59. Fair Isle	(17000)	19072	18159						
Shetland Total AONs	53950	50940	37898						

undoubtedly contributed to the low total count. Accepting this, the directions of changes recorded were similar to Eshaness although slower, the 1994 total being 48% less than in 1981.

Area G : There was little change in AON totals in Unst and north Yell until a decrease between 1987 and 1991, when 32% fewer were recorded than in 1981. Unfortunately, sea conditions in 1994 prevented counts in the Area.

Area H: The number of AONs on Fetlar and Yell more than halved between 1981 and 1985, with lesser decreases until a further substantial decline between 1989 and 1991. Numbers increased between 1991 and 1993 (mainly at the Yell colonies), when the total of AONs was 69% lower than in 1981.

Area I : The number of AONs fell throughout 1981-92 at colonies on Whalsay and Out Skerries, with the greatest rate of decrease (-20% p.a.) between 1986 and 1989. As on Yell there was a slight increase in 1993, when numbers were 78% lower than in 1981.

Area J : One small colony on Bressay disappeared by 1988, the other by 1993. Numbers of AONs on Ness fell increasingly rapidly throughout, the 1994 count being 61% lower than in 1980.

Area K: After a slight decrease in the early 1980s counts of AONs in south-east Mainland indicated periods of relative stability punctuated by steep declines between 1988-90 (-21% p.a.) and 1992-93 (-30%). As in Area A the 1994 count was similar to 1993 but 62% lower than in 1981.

Breeding colonies

Breeding had ceased by 1991-94 at 91 colonies known to have existed since 1981 (30% of the total) while only 19 new ones were known to have formed, six of which had disappeared by 1991-94. It was commonplace for changes in the number of AONs at nearby colonies to occur both in different directions and at highly variable rates. An example was at Noness, where counts of nests were also made from black and white and colour slide photographs taken from the sea in 1977 (Fig. 2; Table 3). There was some reduction in numbers at most colonies between 1977 and 1981 but by 1988 there had been substantial decreases at colonies 3 and 4, but large increases at colonies 5 and 6. By 1993, colonies 3 and 4 had disappeared completely and breeding was almost entirely confined to the four southern colonies, which in 1977 held only 53% of all AONs at the breeding station.

Some recorded changes in breeding distribution strongly suggested that established, breeding adults were moving from one colony to another. On the headland of Hermaness, the number of AONs in the central colonies between Saito and The Neap fell from 1,275 in 1981 to 694 in 1987 (-45%) and 223 by 1991 (68%). At other colonies on the headland to the north and south the respective decreases were only 2% and 23%, while there was a substantial (150%) increase at the South Holms immediately south of Hermaness between 1981 and 1987 (Table 1), and to the east at Saxavord where one colony (around a large cave entrance) increased from just two AONs in 1981 to 112 in 1985, 337 in 1987 and 361 by 1991. At Papa Stour, where there was little change in AON totals for the breeding station between 1981 and 1989, the numbers at colonies in relatively open situations on the cliffs of Papa Stour itself fell progressively from 27% of the total for the breeding station in 1981 to 17% in 1989 and just 8% in 1993, with corresponding increases in the proportion of the total of AONs occurring on the offshore stack of Fogla and Lyra Skerries, where colonies were mostly in large cave entrances. This tendency

TABLE 2. ***Counts of Kittiwake AONs at colonies in breeding stations in the areas indicated in Figure 1, 1981-1994. Areas L and M were counted in 1976 and 1975, respectively, not 1981. Percentage changes per annum (%p.a.) between sets of counts are indicated.***

AREA	1981	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
A. AONs	3235	2967				2290		1750		1404	1428
%p.a.		- 2%		- 6%			-13%		-10%		+ %
B. AONs	1675			1696		1448		1071		897	
%p.a.		< 1%			-8%		-14%		-8%		
C. AONs	1248		866		1028		613	526		367	
% p.a.		- 7%		+ 9%		-23%		- 14 %	-16%		
D. AONs	1211	1232				1211			1042	987	
%p.a.		< 1%		< 1%			- 5%			- 5%	
E. AONs	2459	2330				3050		2469			1672
% p.a.		- 1%		+ 7%			-10%			-12%	
F. AONs	2224	1468				1722			1651		1157
% p.a.		-10%		+ 4%				- 1%		-10%	
G. AONs	4756			4732				3252			
% p.a.		< 1%				- 9%					
H. AONs	845	401	382		337	333		192		264	
% p.a.		-17%	-5%	- 6%		- 1%	- 24%		+17%		
I. AONs	309		180			91			57	67	
% p.a.		-10%		-20%				-14%		+17%	
J. AONs	11088	9465					7017				4301
% p.a.		- 3 %		- 6 %					- 11 %		
K. AONs	2747	2300			2436		1524	1570	1460	1025	1040
% p.a.		- 4 %	+ 2 %			-21%		+ 3 %	-7%	-30%	+1 %
L. AONs	5570			4350					4306		
% p.a.		- 2%				< 1 %					
M. AONs	17000		19072		19340				18159		
% p.a.		+ 1 %		< 1 %			- 1 %				

Notes. :*Area C* Vaila counted 1985 (291 AONs), not 1986. Reawick Ness 1987 count (197 AONs) used to calculate both 1986 and 1988 totals. Most recent counts at Braga Ness (15 AONs) and Watsness (1 AON) in 1990 were used to calculate 1991 and 1993 totals.
Area F Tingon counted 1986 (21 AONs) not 1985. Gruna Stack not counted 1985, AONs (67) calculated from 1981-89 % change p.a. Trumba counted 1986 (11 AONs), not 1985 and not counted 1992; 1989 count (14 AONs) used to calculate 1992 totals. Varnadil counted 1986 (10 AONs), not 1985 or 1992; 1991 count (10 AONs) used to calculate 1992 totals.
Area J Noss counted 1980 (11,050 AONs), not 1981. Millburn Geo and Hole of Bugars counted in 1986 (27 AONs and 1988 (18 AONs), not 1985 & 1990.
Area K Mousa counted in 1986 (14 AONs), not 1985.

for a greater proportion of AONs at breeding stations to be concentrated in colonies in caves or other sheltered situations was noted elsewhere, e.g. at Boddam where of the six colonies, three in the entrances of deep caves held 41% of the total (256) in 1981 but 70% in 1994 (n=239). A possible explanation for this is given below.

Discussion

Accepting uncertainties over current numbers in Unst and former numbers on Fair Isle and Foula, the breeding population of Kittiwakes in Shetland has declined by at least 30% since 1975-81. The greatest decrease occurred since the Seabird Colony Register counts of 1985-87 (Lloyd *et al.* 1991). This is the largest regional decline known to have occurred recently in Britain and Ireland; the only other significant regional decrease has been at colonies in south-east Ireland although substantial local declines have occurred, e.g. on the Isles of Scilly (Walsh *et al.* 1994). Even in Orkney, whose nearest Kittiwake colonies are only 100km from Mainland Shetland, there has been no evidence of a recent, widespread decline in numbers although there was a 40% decrease between 1969/70 and 1985-87 (Lloyd *et al.* 1991), which mainly occurred between 1980 and 1984 and halted in 1985 (Benn *et al.* 1987). It is also notable that the decline on Fair Isle, mid-way between the two island groups, has been much less and more recent than elsewhere in Shetland. Within Shetland, the greatest proportional decrease occurred at colonies along the south-west and east coasts (Areas A-C and H-K), where the most recent total count of nests (8,364) was 53% lower than in 1985-87 (17,856) and 60% lower than in 1981 (21,147).

Oil pollution around Shetland is unlikely to have contributed much to this decrease since beached bird survey data indicate no significant recent increase in the proportion of birds found that were oiled, which anyway was low compared to other areas of the North Sea (Heubeck *in press a*).

TABLE 3. ***Numbers of Kittiwake AONs at colonies at Noness, 1977 - 1994. Made from a Zodiac inflatable except those in 1977 which were made from photographs taken from the sea. The 1985 count was not plotted accurately enough for colony comparisons.***
Dates : 25/6/77, 15/6/81, 20/6/85, 12/6/88, 15/6/90, 8/6/91, 13/6/92, 6/6/93, 2/6/94.

Colony	1977	1981	1985	1988	1990	1991	1992	1993	1994
1	34	22		30	16	18	19	9	5
2	83	49		26	0	0	0	0	0
3	323	300		27	9	7	2	0	0
4	390	407		105	15	25	14	0	0
5	508	488		661	464	475	444	309	358
6	176	145		269	116	146	139	82	88
7	106	110		136	93	91	99	66	66
8	148	106		163	89	100	102	76	97
Total	1768	1627	1489	1417	806	862	819	544	614

Instead, there are two more likely explanations for the population decline. Firstly, reduced abundance of lesser sandeels *Ammodytes marinus* around Shetland caused Kittiwakes to suffer progressively reduced breeding success from around 1985 onwards, culminating in 1990 when most colonies experienced virtually complete breeding failure (Walsh *et al.* 1992). Although some colonies in other parts of the British Isles also experienced moderate to poor breeding success during this period, in no other region was there such a loss of potential recruits to the breeding population as in Shetland and it is notable that high breeding success was maintained in Orkney in the late 1980s (Walsh *et al.* 1992). Within Shetland, moderate breeding success was maintained during the late 1980s at north-western colonies where proportional decreases in breeding numbers were less. Whether the stress of breeding in such adverse conditions affected adult survival rates is unclear, but brooding adults were significantly lighter in 1990 than in 1991 (Hamer *et al.* 1993), when there was a marked and broadly sustained improvement in breeding success after an increase in the abundance of sandeels spawned that year (Wright & Bailey 1993; Heubeck *et al. in press*).

Kittiwakes first breed when three, but most not until four or five years old (Wooler & Coulson 1977). The greatest effects of reduced recruitment to the breeding population might therefore have been expected at colonies between 1989 and 1994, which indeed corresponds to the years when the greatest proportional reductions in numbers of nests were recorded in most areas. Assuming no unusually low survival rates of immatures or increased dispersal to or from Shetland of potential recruits, it might also be expected that the benefits of improved breeding success in 1991-94 (Heubeck *et al. in press*) will be reflected in nest counts from 1995 onwards. Large roosts of Kittiwakes, including many first-year birds, were noted around colonies in 1993 and 1994 and possibly most of these birds were not yet of breeding age.

The second factor likely to have contributed to population decline has been increased predation pressure. The main predators at Kittiwake colonies in Shetland are Great Skuas *Stercorarius skua*, Ravens *Corvus corax* and Hooded Crows *Corvus corone* (Great Black-backed Gulls *Larus marinus* and Herring Gulls *Larus argentatus* also sometimes take eggs or small chicks). Corvids predate eggs and in our experience their attentions are rather transitory and highly localised (Heubeck & Mellor 1994), with sometimes a large proportion of eggs being taken for a few years at a particular colony and then the predation ceasing, presumably as specialist individual birds die. This behaviour has long been recorded (Saxby 1876) and we have no evidence of a recent increase in corvid predation of Kittiwake eggs.

FIGURE 2. ***The location of Kittiwake colonies at the Noness breeding station (Table III).***

Great Skuas predate eggs, nestlings, recently fledged and adult Kittiwakes, characteristically swooping into colonies and dragging birds from nests or catching them in mid-air, then falling to the sea where they are drowned and eaten. Predation by skuas has been known to occur for many years at some Shetland Kittiwakes colonies, e.g. Noss (Perry 1948) and Hermaness (Lockie 1952), and as the population of Great Skuas increased this century there was debate as to whether or not predation was reducing breeding numbers of Kittiwakes. Some authors believed it was (e.g. Venables & Venables 1955) but offered only anecdotal evidence, while Andersson (1976) believed that predation of nestlings may have reduced breeding success but was unlikely to cause decreases in breeding numbers (Andersson estimated that there were 600 pairs of Kittiwakes in his Hermaness study colony in 1972; the respective 1981, 1987 and 1991 counts were 370, 174 and six).

Furness (1981) reviewed the diet of Great Skuas of Foula in the mid-1970s and warned that any restrictions on the quantity of whitefish discarded from fishing boats or reductions in sandeel abundance close to their colonies could result in Great Skuas turning to predation as a main feeding technique, in which case "all Shetland seabirds would suffer" with the greatest influence on populations of, among other species, Kittiwakes. This proved prophetic, when sandeels became less available to seabirds during the 1980s. In 1983 there was a sudden, sustained increase in the proportion of birdmeat in the diet of non-breeding skuas on Foula, the occurrence of bird remains in regurgitated pellets during 1983-89 being on average five times greater than in 1973-82 (Hamer *et al.* 1991); the incidence of bird remains in pellets regurgitated by skua chicks increased markedly in 1988, when it was four times the average values for 1983-87 and nine times those for 1974-82. Pellet analyses indicated that Great Skuas fed predominantly on seabirds on Fair Isle in 1989, principally Kittiwakes (Harvey *et al.* 1989). These findings accord with widespread but largely unquantified observations of an increase in skua predation at Shetland Kittiwake colonies around 1988 which, despite a marked increase in sandeel abundance from 1991 onwards (Wright & Bailey 1993), seems to have become progressively more widespread rather than abating (Heubeck *et al.* in prep.). Increased predation of adult birds, in particular, could result in a rapid decline in breeding populations.

Since Great Skuas characteristically circle around a colony before swooping in to attack a nest, and prefer to attack nests higher on the cliff, cliff topography is likely to determine which colonies and nests are predated and which are in too sheltered situations or are too low for skuas to manoeuvre effectively. Of 1,020 nests on Papa Stour colonies checked from a Zodiac on 14 July 1988, chicks were seen in only 94, virtually all of which were situated in recesses, under overhangs or in the backs of caves; none was seen in nests on 'open' cliff faces. At Kettlaness breeding success was monitored between 1987 and 1993 at a colony that, it transpired, suffered intense predation by skuas (only three chicks survived to fledging size during 1988-93). As the number of nests decreased (from 261 in 1987 to 42 in 1993) the upper parts of the colony were the first to be abandoned and typically, the chicks that survived longest were those in the lowest nests and under rock overhangs.

If the current levels of predation by Great Skuas are maintained, then the proportion of the Shetland Kittiwake population nesting in cave entrances or other highly sheltered

situations will probably increase, in which case censusing from the sea is essential as such colonies are usually difficult to view from land.

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M. Heubeck, Department of Zoology, University of Aberdeen, Tillydrone Avenue Aberdeen AB9 2TN.
R.M. Mellor, Fairview, Quendale, Shetland ZE2 9JB.

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Densities of breeding Magpies and Carrion Crows in south-east Scotland in 1992-93.

H.E.M. DOTT

Densities of breeding pairs of Magpies and Carrion Crows, based on nests found in 2km X 2km squares, are reported for different habitats in Lothian and Borders Regions in south-east Scotland. Differences in density are discussed in relation to habitat and other factors.

Introduction

The distribution and numbers of Magpies *Pica pica* and Carrion Crows *Corvus corone* in Britain have undergone changes in the past, and recently both species have increased nationally. The increases have not been the same in different parts of Britain or in all habitats (Thom 1986, Marchant *et al.* 1990, Birkhead 1991).

The populations of both Magpies and Carrion Crows have two components: a breeding component comprising pairs of birds holding nesting territories, and a non-breeding component of mainly younger birds which usually form loose groups or flocks and do not hold defined territories (Goodwin 1986, Birkhead 1991). Most population studies have been based on numbers of breeding pairs (e.g. Parslow 1973, Sharrock 1976, Tatner 1982a, Marchant *et al.* 1990, Gibbons *et al.* 1993). In Scotland there are few published records of population densities, particularly for the Magpie. This article reports on the densities of breeding pairs in selected parts of south-east Scotland obtained by an easily repeatable method which will provide a basis for future comparisons.

Methods

Densities were recorded in sample areas of a constant size in 1992 and 1993. The whole of each sample area was surveyed, during February - June. These sample areas were 2km x 2km squares (tetrads) taken from Ordnance Survey maps, in a variety of geographical locations and habitats in south-east Scotland. 'Habitats' sampled in this study are broad ones such as suburban or farmland, rather than components of these such as garden, park, tree line or field. Individual Magpie or Crow territories could span more than one of these components. Tetrads were considered to be a better size than 1km x 1km squares for sampling these broad habitats, as smaller units would be more strongly biased towards particular features such as woodland strip or field within farmland, or housing scheme or school ground within cities.

Within each tetrad, a search was made for all nests of Magpies and Carrion Crows. Searching was done in late winter and spring, as nests are easier to locate before trees are in leaf, and checks were made after this time. Care was taken to distinguish nests from a previous year, and to distinguish those of

Magpies, Carrion Crows, Rooks *Corvus frugilegus*, raptors, squirrels *Sciurus* spp. or other species. Two nests built in the same or neighbouring trees were taken to represent one breeding pair, as pairs are known to build close to old nests or to new, abandoned nests (Picozzi 1975, Hewson & Leitch 1982, Birkhead 1991). Differences in habitat affected the ease of discovering nests, that requiring most time-effort being suburban habitat for Magpies with numerous garden boundaries and thick evergreen trees. The method was kept constant and was done by the same observer in each tetrad, so that the results should be comparable with each other.

Observations outside the tetrads were also made very widely throughout Lothian and Borders Regions in connection with fieldwork for the breeding bird atlas for this area (in prep.), so giving an impression of how similar or otherwise sampled tetrads were to surrounding areas.

Results and Discussion

Magpie

Table 1 shows the numbers of Magpie nests found in each tetrad, and the densities of breeding pairs. The densities ranged from 1.5 to 2.25 per km^2.

City and suburban Magpies tended to nest near the tops of medium sized deciduous trees with thick twig-growth such as hawthorn, silver birch and whitebeam, and evergreen spruce. Wider observations suggested that the Edinburgh and Dalkeith tetrad results were typical of much of the north, west and south of the city and suburbs. The Riccarton tetrad was mainly rural, with University campus (which resembles suburban habitat) filling a quarter of the tetrad. The tetrad near Broxburn was typical of much of West Lothian, with undulating hills and hollows, small farms with stock on pasture, some grain crops, shelter belts, and numerous hedges of hawthorn both trimmed and well-grown. Magpie nests were mainly in lines or patches of hawthorn, with some in taller trees near farm buildings.

In town and country, Magpies showed a distinct preference for nesting in hawthorn. This occurred even in places where hawthorns were very scarce and a range of other suitable tree species was present. Other trees used for nesting were beech, alder, larch, pine, yew, holly and once (at Cramond in 1993) in the top of a monkey puzzle tree; this may be one of the few records of any British wildlife using this introduced species of tree, though J.B.Reid (*in litt.)* has recorded Rooks nesting in a monkey puzzle tree in Fife.

Table 1 ***Annual densities of breeding Magpies in south-east Scotland,1992-93***

Tetrad: map ref. to centre point	Location	Habitat	Number of Nests	Density of breeding pairs per km^2	Higher density within tetrad of nests per km^2 (see text)
NT 230690	Edinburgh	urban	6	1.50	16.00
NT 330670	Dalkeith	suburban	9	2.25	-
NT 170690	Riccarton	rural and suburban	8	2.00	-
NT 070740	nr Broxburn	rural	7	1.75	4.00

The results indicate a higher density in suburban habitat of about 2.25 pairs per km^2, and lower in city and rural habitats of 1.5 to 1.75 pairs per km^2. Interestingly, in the Edinburgh city tetrad some clumping of nests occurred; four of the nests were within one quarter km^2 - a density of 16 nests per km^2 for this group. Part of this tetrad comprised playgrounds and playing fields, but there was much garden and tree-line habitat apparently suitable for Magpie nests but lacking them, and so the clumping could not obviously be explained by habitat variation. A possible explanation was that Magpies may have been avoiding nesting near places with Crows' nests; Crows are known to interfere with Magpie breeding success (Baeyens 1981, Tatner 1982b). In the rural tetrad near Broxburn, five of the Magpie nests were spaced at about 4.0 per km ^{2}, but this did seem to be related to habitat; hawthorn hedges and scrub with small trees were more abundant in this part of the tetrad than in the remainder.

Over Britain as a whole, sample plots in 1972 gave mean densities of 2.3 pairs per km^2 for farmland, and 2.8 for woodland (Sharrock 1976), but these have risen since to over five pairs per km^2 for farmland, and over ten for both woodland and suburban habitat (Gooch *et al.* 1991). In Manchester, Magpies occurred at six to seven pairs per km^2 in the city, but less than this in the surrounding farmland (Tatner 1982a). In Manchester central city parks, Groom (1993) recorded up to 49 pairs per km^2, but suggested that this should be 'compared cautiously' with other studies due to his small sample areas. In Sheffield city densities were about 1.3 pairs per km^2 in 1946, 4.1 in 1976 (Roberts 1977) and up to a maximum of 32 recently, but much lower just outside the city (Birkhead 1991). One published density for Scotland is 0.22 pairs per km^2 for farmland with few hedges in Aberdeenshire (Love & Summers 1973). The wide variation in published densities may result from different size of study areas as well as genuine differences in Magpie densities.

As at Manchester and Sheffield, this study shows Magpie densities in south-east Scotland to be higher in suburban areas than in surrounding rural habitat. These south-east Scotland densities are much lower than the recent ones for English cities, but much higher than rural Aberdeenshire in the 1970s. The New Atlas (Gibbons *et al.* 1993) shows that from the 1970s to the 1990s the main Magpie breeding distribution has changed very little, but that the abundance within this range has continued to increase, and that England, Wales and Ireland have widespread high abundance compared to Scotland. In West Lothian, Magpie density may be lower than it potentially could be due to Carrion Crows, because some Crows there nest in lines of well-grown hawthorn which would otherwise be favoured Magpie habitat.

Throughout Borders Region, East Lothian District, and Midlothian District except for Edinburgh satellite towns, Magpies are still too scarce as a breeding species for density sampling to be meaningful, although records show their range to be increasing in recent years (Borders Bird Reports, Lothian Bird Reports, 1979-1992). Interestingly, Magpies in Borders and perhaps in eastern East Lothian tend to nest in patches of dense conifer plantation, thus differing from those in West Lothian and west of there (pers. obs.). Magpies were present generally through south-east Scotland until the 1840s, and keepering is accepted to be the main reason for their disappearance (Thom 1986). There is no record that Magpies were ever absent

from West Lothian, and round the western parts of Edinburgh they were judged to be more plentiful than in other parts of Scotland in the 1930s (Rintoul & Baxter 1935). In the 1950s they were still very scarce in central and eastern Edinburgh (Edinburgh Bird Bulletins 1950-1958) where they are now widespread. However, there has been no quantitative assessment until now.

The sampling of whole tetrad squares over rural, urban, or other broad habitats should provide a useful method for future comparison. This could be more meaningful for this species than sampling smaller component habitats for example woodland strips, where a 'woodland density' obtained might be based on nests of pairs whose territories were largely in the surrounding habitat.

Magpies have been increasing steadily in Britain as a whole over several decades, and faster in suburban than in rural areas (Parslow 1973, Marchant *et al.* 1990, Birkhead 1991). This increase has included the colonisation of new coniferous plantations and cities (Watson 1948, Prestt 1965, Sharrock 1976). There are signs that the national population may now be stabilising (Stroud & Glue 1991), but locally, as in East Lothian and Borders Region, the spread is continuing.

Carrion Crow

Table 2 shows the numbers of Carrion Crow nests found in each tetrad and the densities of breeding pairs. The highest densities were some ten times greater than the lowest.

In Edinburgh city and its suburbs, Crows nested very conspicuously, mainly choosing sites high in tall deciduous trees such as sycamore, beech, elm, poplar and lime. In farmland preferred nest sites were in high, mature trees, growing singly or in spaced-out lines and, in contrast to Magpies, usually not close to houses. Lower trees were also used, and in West Lothian Crows nested in lines of tall hawthorns (often former railway routes) where, as suggested earlier, they may have been excluding Magpies. No Crow nests were seen on man-made structures, perhaps suggesting that Crows are not under pressure from lack of nest sites in south-east Scotland (see Marchant *et al.* 1990).

The Edinburgh and Dalkeith tetrads showed densities of 2.5 and 1.75 pairs per km^2 , and wider observations suggested that these would be typical of most of Edinburgh and its satellite towns. Such high densities are of interest as urban habitat is one which Carrion Crows have only colonised relatively recently (Prest 1965, Parslow 1973, Sharrock 1976). The other high figure of 2.5 pairs per km^2 was for rural West Lothian where, as described for the Magpie, the farmland is mixed stock and arable with many well-grown hawthorn hedges, scrub, tree-lines and shelter strips. A much lower density averaging 0.21 pairs per km^2 was found for six contiguous tetrads in East Lothian around Elphinstone. This area has a flatter landscape of larger farm fields mainly of grain, fewer hedges usually trimmed very low, and fewer shelter belts, but some boundary lines of tall, spaced trees where most of the Crow nests were situated. In an area overlapping these tetrads, da Parto (1985) obtained a rather higher density of one pair per km^2 for farmland, but his study area probably included more varied habitat.

The hill and moor tetrads south-east of Teviothead were mainly devoid of trees (apart from coniferous plantations), except for a few growing at isolated and mainly derelict farmhouses where Crow nests occurred. Elsewhere in Borders Region single small

Table 2 ***Annual densities of breeding Carrion Crows in south-east Scotland, 1992-93***

Tetrad: map ref. to centre point	Location	Habitat	Number of nests	Density of breeding pairs per km^2	Higher density within tetrad of nests per km^2 (see text)
NT 230690	Edinburgh	urban	10	2.50	-
NT 330670	Dalkeith	suburan	7	1.75	-
NT 170690	Riccarton	rural and suburban	5	1.25	-
NT 070740	nr Broxburn	rural	10	2.50	-
NT 370690	nr Elphinstone	mainly rural	1		
NT 390690	nr Elphinstone	rural	2		
NT 410690	nr Elphinstone	rural and suburban	0	0.21	-
NT 390710	nr Elphinstone	mainly rural	0		
NT 410710	nr Elphinstone	mainly rural	1		
NT 430710	nr Elphinstone	rural	1		
NT 710690	eastern Lammermuir Hills	low hills and valleys	4/6*	1.0 / 1.50*	44.0
NT 430050	s.e. of Teviothead	hill, moor & coniferous plantation	1	0.25	-
NT 450050	s.e. of Teviothead	hill, moor & coniferous plantation	1	0.25	-
NT 450030	s.e. of Teviothead	hill and moor	2	0.50	-

* Four nests were found, but a small part (0.04%) of the tetrad was not surveyed and was likely to have hald 1-2 additional nests.

stunted rowan, birch or willow trees in remote gullies were used for nesting. Certain narrow valleys in treeless hills hold long, narrow thickets of trees such as birch, willow and alder. This was the case in the tetrad surveyed in the eastern Lammermuir Hills, where the four Crow nests found gave a density of 44 nests per km^2 if calculated for the wood alone. However, these Crows would use the area of the surrounding hills so that the tetrad density of 4-6 pairs per km^2 gives a more realistic picture.

Dense or extensive woodland is one habitat in which Carrion Crows do not normally nest (Goodwin 1986), though they have spread into some 'sparsely wooded country' (Parslow 1973), and more recently into some upland conifer plantations (Marchant *et al.* 1990). In south-east Scotland, Crows still do not normally nest in woods larger than narrow shelter strips, nor in coniferous plantations, although on 24 April 1993 a Carrion Crow nest was found in a spruce tree in a 1.5 X 1.5km plantation of 3m tall spruces and pines on a valley slope south-east of Teviothead, 0.25km in from the forest edge.

Published Crow densities do not compare

easily with the present data due to differing study areas and methods. For Britain generally, mean densities for 1972 are stated as 3.2 and 4.7 pairs per km^2 for farmland and woodland respectively (Sharrock 1976). However, the 'woodland' figure must include mainly pairs whose nests were on the edges of woods but whose territories were mainly in surrounding habitats. In East Lothian, da Prato (1985) recorded one pair per km^2 for farmland, and 19 per km^2 for woodland and scrub but these were based on stands of only 27 and 10ha respectively, where again the Crows would use adjacent habitats. In Kincardineshire, Picozzi (1975) recorded Crows at 2.3 - 3.0 pairs per km^2 on farmland and woods not including adjacent moorland which the Crows used. Hewson & Leitch (1982) in Argyll found 26 pairs per km^2 in a coastal strip of wooded habitat which excluded the adjacent moor occupied by the Crows, and Rebecca (1985) found six pairs in 25ha (=24 per km^2) of trees surrounded by farmland in Aberdeenshire. Petty (1985) recorded 0.17 and 0.67 pairs per km^2 in two areas of moor with newly planted conifers in Argyll. Most of the above published densities are not comparable with the tetrad densities here, as they concern nests in confined patches of habitat where the Crows would be largely occupying the surrounding areas as in the right-hand column of Table 2. The tetrad method should be good for sampling general habitats such as urban, mixed farmland, hill-sheep land, or others.

The present results suggest that in south-east Scotland, the highest Carrion Crow densities are found in urban habitats and in West Lothian mixed farmland, and lowest densities are found in arable land and in hill country of East Lothian and Borders Region. To what extent these different densities are due to habitat alone, or to a combination of habitat and human interference, is not known. Persecution of Crows has lessened greatly since the two World Wars and has enabled a national increase in Crows which is still continuing (Prestt 1965, Parslow 1973, Marchant *et al.* 1990, Stroud & Glue 1991). However, shooting and trapping still occur widely on keepered estates and on hill-sheep land, which in south-east Scotland occurs mainly in East Lothian District, Midlothian District, and Borders Region.

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

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The breeding performance of Ravens from a sample of nesting territories in Shetland during 1984-1993

P.M. ELLIS, J.D. OKILL, G.W. PETRIE & D. SUDDABY.

This paper summarises the breeding performance of some Raven territories in Shetland during 1984-93. There were no significant annual differences. Shetland Ravens showed broadly similar breeding performance to that found during previous studies from various areas of Britain, Europe, North and Central America. However breeding success (the percentage of nesting pairs which fledged at least one young) in Shetland was lower than that found in all but three of 18 other studies cited.

Introduction

After a retreat since mediaeval times from much of lowland Britain, particularly during the era of intensive game preservation, the population of the Raven Corvus corax had not declined seriously in many areas until the 1960s (Ratcliffe 1962). However, since then it has declined in south, south-west and central Scotland, mainly as a result of changes in land use (Marquiss *et al.* 1978, Mearns 1983, Mitchell 1981), in Speyside possibly due to human persecution and in particular the illegal use of poisoned baits (Weir 1978) and the English Pennines, also probably due to illegal poisoning (D.A. Ratcliffe pers. comm.). Its status is of sufficient concern for it to have been included in a list of candidate species for inclusion in 'Red data birds in Britain' (Batten *et al.* 1990). However over much of the western Highlands and Islands, Shetland and Orkney the Raven remains widespread (Thom 1986, Booth 1979, Ewins *et al.* 1986).

In Shetland, Ewins *et al.* (1986) carried out a survey of breeding Ravens during 1982-83. He investigated diet by examining pellets and also gathered some data on breeding performance from a sample of c. 60 nesting attempts. This paper presents data on breeding performance gathered at 43 Raven territories from widely distributed localities throughout Shetland which were visited annually and involved 311 nesting attempts during 1984-1993.

Study area

Shetland is an archipelago of over 100 islands lying at the northern end of the North Sea at latitude 60° north. It has a cool maritime climate influenced by the relatively warm waters of the North Atlantic Drift. The rugged 1,450km long coastline has many high seacliffs, with no point in the islands more than 5km from the sea (Flinn 1974). Much of

the land area of 1,468km2 is rough grazing, carrying about 380,000 sheep (Anon. 1993).

This study was carried out during the course of other ornithological work, particularly the annual monitoring of Peregrine Falcons Falco peregrinus and Merlins Falco columbarius. The monitored Raven sites were not chosen randomly, but were chosen to be relatively near to the routes to the monitored falcon breeding sites (so that this work fitted in easily with higher priority raptor monitoring), or were on the islands of Fetlar and Yell where RSPB nature reserve wardens were resident during the summer. Nevertheless, the sample of 43 territories included in this study represents 21% of the known Raven territories in Shetland and there was a deliberate attempt to include sites from a wide area; 11 (26%) were on the island of Fetlar, two (5%) on the island of Yell, six (14%) in the north Mainland, 12 (28%) in the central Mainland, four (9%) in the west Mainland and eight (18%) in the south Mainland.

Methods

Each year, the monitored territories were visited at least once and all suitable nesting habitat within about one kilometre of any past nesting site was searched. During 1984-1986 suitable territories were still being located, but during 1987-1993 the same 43 territories were visited each year. Any sites occupied on the first visit were visited a second time and any active nests were visited subsequently to ring or record any young and to check if young had fledged. Twenty-three (c. 50%) of the nest sites were relatively accessible, but were usually climbed to only in order to ring young when they reached an estimated ten days of age. A territory was recorded as occupied if it contained at least one displaying individual, birds showing alarm, a pair regularly seen in suitable breeding habitat, or a nest which had been built up and lined that season or containing eggs or young. A breeding attempt was recorded if a nest with eggs or young was located or an empty nest that had been built up and lined.

Nest sites

In 34 (79%) of the nesting territories monitored during this study, nests were usually located on seacliffs, although in five of these territories at least one alternative site was not on a seacliff. In the other nine territories (21%) nests were always in inland locations up to 1.7km from the coast. Inland sites varied from the bank of streams (one nest being only 3m above the stream bed), active or disused quarries, roadside cuttings to, in one case, a tree.

Results

Table 1 gives the breeding data for the monitored Raven territories. During 1984-93 there was a significant difference between the percentage of nests which were occupied each year ($X2 = 16.972$, $df = 9$, $p<0.05$). This was because during 1984-86 a small number of occupied, but previously unknown nesting territories, were located and these were subsequently included in the monitoring programme. This resulted in a bias in the percentage of occupied sites during the first three years of the study. Consequently, unless otherwise stated, further discussion refers only to data gathered during 1987-1993.

Annual breeding performance

The average proportion of sites occupied each year was 79.7%, (range 67%-93%) and there was no significant difference between years ($X2 = 10.28$, $df = 6$, $p>0.05$, $n = 43$). The average proportion of territorial pairs which

TABLE 1. ***Breeding data for a sample of Raven territories in Shetland during 1984-1993.***

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Sites checked	26	39	41	43	43	43	43	43	43	43
(%) of known sites	(13)	(19)	(20)	(21)	(21)	(21)	(21)	(21)	(21)	(21)
Sites occupied(all by pairs)	24	34	37	32	40	36	35	33	35	29
(%) of sites checked	(92.3)	(87.1)	(90.2)	(74.4)	(93.0)	(83.7)	(81.4)	(76.7)	(81.4)	(67.4)
Nesting pairs	21	33	36	32	35	34	33	31	30	26
(%) of all pairs	(87.5)	(97.1)	(97.3)	(100)	(87.5)	(94.4)	(94.3)	(93.9)	(85.7)	(89.7)
Successful pairs	13	19	23	20	24	16	18	19	17	14
(%) of nesting pairs	(61.9)	(57.6)	(63.9)	(62.5)	(68.6)	(47.1)	(54.5)	(61.3)	(56.7)	(53.8)
Young fledged	40	56	79	62	73	49	47	63	57	33
Mean brood	4.0	3.11	3.43	3.10	3.17	3.06	2.76	3.32	3.35	2.54
Standard diviation	1.333	1.323	1.441	1.210	1.302	0.854	1.522	1.376	1.618	0.967
number in sample	10	18	23	20	23	16	17	19	17	13
Productivity (young fledged per pair)	1.90	1.70	2.13	1.94	1.87	1.36	1.38	1.91	1.63	1.18
S.d.	2.234	1.845	2.030	1.795	1.866	1.641	1.758	1.958	2.030	1.442

nested was 92.1%, (range 87%-94%) and there was no significant difference between years (X2 = 2.595, df = 2,p>0.05). (The degrees of freedom were reduced because the expected frequency per cell was below the permitted minimum of five, therefore several years were aggregated together; 1987-88, 1989-91 and 1992-93). There was no significant difference in mean brood size between years (Kruskal-Wallis analysis of variance = 5.319, df = 6, p>0.05, mean brood size 3.07, range 1-6, sd = 1.30), nor was there any significant difference over the entire ten years of the study (Kruskal-Wallis analysis of variance = 10.485, df = 9, p>0.05, mean brood size 3.18, sd = 1.33). There was no significant difference in productivity between years (Kruskal-Wallis analysis of variance = 5.555, df = 6, p>0.05, mean productivity 1.62 young fledged per pair, sd = 1.80) and there was also no significant difference in the proportion of successfully nesting pairs between years (X2 = 4.045, df = 6, p>0.05). The mean proportion of successful pairs (nesting pairs which fledged at least one young) was 57.9%, (range 47%-69%).

Clutch size

Table 2 shows the frequency distribution of clutches and mean clutch size for a sample of 43 complete clutches recorded during 1984-1933. The mean clutch size was 4.63, sd = 1.35, range 1-7.

Number of known nesting territories and nesting density

Ewins (1986) documented 196 Raven territories in Shetland. Between 1984 and 1993 an additional ten territories were located, nine of which were in inland locations. This brings the number of known Raven territories in Shetland to 206, giving a density of 14.0 territories/100km2, but with a mean occupation rate during 1987-93 of 80% this would produce a density of 11.2 occupied territories/100km2 and with a mean of 73% of territories holding nesting pairs during 1987-93 give a density of 10.2 nesting pairs/100km2.

Table 2. ***Clutch size data for a sample of clutches from Ravens nesting in Shetland during 1984-1993, all years combined.***

Clutch size	1	2	3	4	5	6	7	Total clutches	Mean size	S.d.
Number of clutches of each size recorded	1	2	6	8	13	12	1	43	4.63	1.35

Human persecution and nesting failures

Definite proof of persecution was recorded on several occasions at five of the 43 sites (12%), and was suspected at several others. All but one of the persecuted territories were inland sites. One nest was shot into, one was dislodged with a length of pipe, one was pushed off a small cliff and two had rocks dropped into them. Of the 127 nest failures recorded during 1984-93 only six (4.7%) definitely occurred after young had hatched, and three of these were due to human persecution. The reason for most nest failures was unknown.

Discussion

Although the sample of Raven territories involved in this study was not chosen randomly, they were from a wide geographical area of Shetland and from both seacliff and inland sites, so were likely to give a reasonably representative indication of the breeding performance of Ravens in Shetland between 1984 and 1993. It appears that, although Shetland Ravens show annual variations in breeding performance, these are relatively small and in this study were not significant.

Comparisons with other areas

Table 3 shows breeding data from this study compared to those found in several other areas of Britain, Europe, North and Central America. Nineteen of these studies showed a range of mean clutch sizes of 4.2-6.0, average 4.9, 27 studies showed a range of mean brood sizes of 2.5-4.0, average 3.1, 19 studies gave a range of mean breeding success of 47.4-89%, average 71% and eight studies gave a range of mean percentage of pairs nesting of 64-95%, average 87%.

Although the mean clutch size, mean brood size and mean percentage of pairs nesting found in this study was similar to those found elsewhere, breeding success was towards the lower end of the range. Lower nesting success than the present study (58%) or that of Ewins et al. (1986) (52%) was reported from only two areas: 57% in Orkney during 1983-85 (Booth 1985) and 47.4% in Utah during 1967-70 (Smith & Murphy 1973). Dorn (1972) found a mean nesting success of 58% (equal to the present study) in Wyoming in 1971.

Possible reasons for the low breeding success of Ravens in Shetland

The use of illegal poisoned baits has never been recorded in Shetland by the RSPB and during 1984-93 no cases of egg collecting involving Ravens was known to the RSPB (PME pers. obs.). The Raven is one of the few species in Shetland which is persecuted by man (pers. obs.). Although definite proof of persecution was recorded at only a few sites, it is possible that the actual amount was substantially higher. However it seems unlikely that this is the main reason for such a high number of nest failures.

Breeding performance may be related to the food supply in spring and early summer (Ewins *et al.* 1986). Ewins *et al.* (1986) described the diet of Shetland Ravens obtained from the examination of 540 pellets. Since there is much sheep carrion, and rabbits and birds apparently available as prey (pers obs.), food shortage would seem to be an unlikely reason for poor breeding success.

Ravens in Shetland nest at relatively high densities: only seven of the 38 studies cited by Skarphedinsson *et al.* (1990) and Nogales

Young Sand Martin Riparia riparia ready to fledge. *Bobby Smith*

Winning Photograph of the SOC Photographic Competition 1994.

Snipe preening, Kinloch, Grampian. *S.M.D. Alexander*

Rose-coloured Starling Sturnus roseus, at Meigle, August, 1994. *Rae Taylor*

Barn Owls Tyto alba at forest nestbox. *Don MaCaskill*

A Long-billed Dowitcher Limnodromus scolopaceus on Fair Isle, September 1990. One was seen at Montrose Basin, September 1994. *Bob McCurley*

Kittiwakes Rissa tridactyla. *A-M. Smout*

TABLE 3. ***A comparison of Raven breeding performance and nesting density in Shetland with previous studies (adapted from Skarphedinsson et al. 1990 and Nogales 1994).***

Location and study period	Mean clutch size	Mean brood size	Mean nest success	Mean % of pairs nesting	Nesting pairs /100km^2	Source
Britain and Ireland						
Shetland 1987-93	4.6	3.1	58	92	10.2	Present study
Shetland 1982-85	4.7	3.2	52		11.2-12.8	Ewins *et al.* 1986
Orkney 1972-77	5.1	3.1			4.0-4.8	Booth 1979.
Orkney 1983-85		2.9	57		5.2	Booth 1985.
Coastal Scotland 1961-62		3.0				Mearns 1983.
Inland Scotland 1981		3.2	74			Mearns 1983.
S. Scotland and Northumberland 1974-76	5.1	2.7				Marquiss *et al.* 1978.
Various areas of Scotland, England and Wales 1945-61		4.6	2.6 c		2.2-5.9	Ratcliffe 1962.
Various areas of Britain	5.2					Holyoak 1967.
Isle of Man 1941		3.2			6.0	Cowin 1941.
Isle of Man 1967-77					5.6	Cullen 1978.
Isle of Man 1982	4.5	2.75	89		4.3	Elliot & Nuttall 1983.
N. Wales 1946-67	5.2	3.3	80			Allin 1968.
N. Wales 1978-81		2.5	65		4.2-10.5	Dare 1986.
C. Wales 1975-79	4.5	2.8	67	89	13.314.2	Netwon *et al.* 1982.
Cambrian Mountains, Wales 1975-79	4.2	2.8	67	88	8.8-20.6	Davis & Davis 1986.
Dublin/Wicklow, Ireland					2.0	Noonan 1971.

Location and study period	Mean clutch size	Mean brood size	Mean nest success	Mean % of pairs nesting	Nesting pairs /100km^2	Source
Europe						
SW. Iceland 1982-84	5.1	3.5	82	95		Skarphedinsson (1990).
NE. Iceland 1981-85	4.5	3.2	77	87		Skarphedinsson (1990).
E. Iceland 1981-85	4.6	3.3	89	90		Skarphedinsson (1990).
Iceland seven areas combined 1981-85					1.5-6.8	Skarphedinsson (1990)
Sweden 1913-76		3.6 a				Strandberg 1980.
Mecklenburg, Germany 1975	4.3	3.1			4.7	Prill 1982.
North Germany 1951-60					1.2-5.5	Looft 1965.
Schleswig, Germany					2.1	Looft 1971.
W. Mecklenburg, Germany					3.2	Looft 1971.
North Germany 1950-80					0.7-2.1	Looft 1983.
SE Holstein					1.9	Warnke 1960.
NE Schleswig-Holstein					4.7	Simson 1966.
Wolgast, Germany					18.7	Sellin 1987.
Bernes, Switzerland 1958-73		2.6			1.7	Blanc 1974.
Jura, Switzerland					1.5	Bohmer 1974.
Switzerland (Wallis) 1977-85					2.9-3.0	Oggier 1986.
Botosani, Rumania 1972					9.6	Andriescu & Corduneau
Tula Forest, URSS					7.5	Likhachev 1951.
Sicily, Italy					3.1	Giudice & Mascara 1985.

Granada, Spain					5.8	Zuniga *et al.* 1982.
Tenerife, Canary Islands					3.4-3.9	Martin 1987.
El Hierro, Canary Islands						
1986-87					34.2-35.6	Nogales 1994.
North America						
Nova Scotia	5.0					Tufts 1961.
Virginia 1972-74		2.5	63			Hooper 1977.
Virginia 1973-74					2.6	Hooper *et al.* 1975.
Jackson Hole, Wyoming 1971		5.4	3.0	58		Dorn 1972.
Jackson Hole, Wyoming 1975					64	Craighead & Mindell 1981.
Utah (Eastern Great Basin)						
1967-70	5.3	2.57	47.4		1.9	Smith & Murphy 1973.
Snake River, Idaho 1974-81	5.0	4.0	72	91		Kochert *et al.* 1980. 1981.
Snake River, Idaho 1984		3.9	88			Kochert 1984.
Snake River, Idaho 1986					72.6	Kochert *pers. comm.* in Nogales 1994.
Snake River, Idaho 1975-78					35-43	US Dept. of Interior 1979.
Snake River, Idaho 1975-78					2.9-3.8	US Dept. of Interior 1979.
Malheur, Oregon 1976-77	6.0	3.9	60		4.0-4.6	Stiehl 1985.
NWT (central acrtic Canada)						
1983-86		3.24	86		0.35-0.6	Poole & Bromley 1988.
Central America						
Los Esesmiles, El Salvador					6.0	Dickey & Van Rossem 1938.

(1994) found higher densities (table 3). The mean nesting density from the 38 studies cited was 9.4 nesting pairs/100km2, range 0.35-72.6. The differences between the densities found in this study and those found by Ewins et al. (1986) may in part be due to that authors use of a lower figure for the area of Shetland and a different method of calculating the proportion of territories occupied by nesting pairs. In addition flocks of failed breeders or non-breeding Ravens occur in Shetland. During 1975-1992 in most years, the largest flocks of Ravens reported were published in the annual Shetland Bird Report (Shetland Bird Club 1975-92). In nine of the 18 years, the largest flocks were recorded during the breeding season. The mean size of these large flocks of failed breeders or non-breeding Ravens was 60, range 19-80. As such a high population density recorded in Shetland, it is possible that density dependent effects on breeding are operating (D.A.Ratcliffe pers. comm.). The reasons for the poor breeding success of Ravens in Shetland are worthy of further investigation.

Population trend

The non-random selection of the sample of sites used in this study precludes any conclusions on population trends. However, casual observations suggest that no major changes have occurred since 1982-83, although a repeat survey would be required to confirm this.

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P.M. Ellis, RSPB, Broonies Taing, Sandwick, Shetland.
J.D. Okill, Heilinabretta, Trondra, Shetland.
G.W. Petrie, 18 Fogralea, Lerwick, Shetland.
& D. Suddaby, 92 Sandveien, Lerwick, Shetland.

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Breeding seasons and nesting success of Snow Buntings in north-east Scotland

R.D.SMITH & M. MARQUISS

The timing and success of breeding Snow Buntings was monitored over a six year period and two montane areas in north-east Scotland. Successful first broods were initiated slightly earlier on the more eastern massif in two of four summers, perhaps as a result of its more continental climate. Successful second broods were found more frequently on the eastern massif, but clutch and brood sizes and nest failure rates were similar. On the western massif, early summer snowfalls appeared to limit the early production of first brood fledglings, and this, in turn, was associated with a reduction in the frequency of successful second broods. Little difference in productivity was noted between summers, except in 1992 when clutch and brood sizes were low. This poor breeding success occurred in a snow-free summer, and followed a particularly mild winter in which losses of breeding adults were unusually high.

Introduction

The Snow Bunting *Plectrophenax nivalis* is one of Britain's rarest breeding birds, existing here on the southern margin of its circumpolar Arctic distribution. It is confined to the Scottish Highlands where it breeds in the high corries and boulder fields. Numbers have increased in the past 20 years, and the estimated total of 50-100 Scottish territories in some recent summers (Watson & Smith 1991, Smith 1993) far exceeds the single figure estimates previous to this (Nethersole-Thompson 1966).

Although Nethersole-Thompson's (1966) Snow Bunting monograph provided many novel observations on the behaviour and distribution of the Scottish population, low numbers of birds at that time (mainly 1930s - 1950s) restricted the collection of data on breeding biology. Also, the behaviour and breeding ecology of Scottish Snow Buntings may have changed in association with, or as a result of, the population increase.

In this paper we describe aspects of the timing and success of breeding in north-east Scottish Snow Buntings during 1987-1993. Higher population levels have also allowed us to look for variation in the timing and success of breeding between summers. Finally we have been able to compare breeding biology on the main Scottish breeding area with that of a small number of pairs on a lower nearby massif.

Methods

The main study area (A) was the central and western parts of the Cairngorms (57ºN, 4ºW), approximately 32km2 of granitic mountain plateaux and corries between 1000 and 1300m in altitude, divided by a deep mountain pass, the Lairig Ghru. Observations began in 1987, but were confined to a census of pairs east of the Lairig Ghru and the monitoring of four nests found by chance. In 1988 we censused the whole area, and attempted to locate all successful breeding attempts east of the Lairig Ghru. Also, six nests were found west of the Lairig Ghru. From 1989 to 1993 we monitored nests and broods throughout the whole study area. Snow Buntings were rarely reported in the 5km band surrounding area A in the breeding season, suggesting that the area chosen held a discrete Snow Bunting population. Nests were also found on a second, smaller area (B) in the south-eastern Grampian mountains (approximately 30km from area A) from 1990 to 1993. In this area Snow Buntings nested mainly in large granitic corries between 900 and 1100m in altitude. Area A held 26-40 pairs of Snow Buntings during 1989 to 1993 and a total of 256 active nests or fledged broods were located. On area B there were 2-5 pairs and 23 nests/broods were found.

Most breeding sites were visited on four or more occasions. Breeding pairs were usually identified within two visits although some could be more elusive. In the first years of our study it was possible to differentiate between pairs on the basis of plumage differences, at least in males. Later, this became less necessary because up to 80% of the breeding birds were individually marked with coloured leg rings.

Before 1992, attempts to find nests were biased towards times when nestlings were expected to be present. This was possible because nesting behaviour was fairly synchronised at the start of the breeding season, or on other occasions after heavy snowfalls had caused widespread nest failure (see Results). Second breeding attempts were begun soon after (and sometimes probably before) the first brood fledged, allowing us to predict the best time to search for second broods. In 1992 and 1993 effort was spread more evenly, so more nests were found during incubation or soon after hatching.

Two hundred and twenty-nine active nests and an additional 50 fledged broods were found during 1987-1993. Thirty-three percent of nests were initially found with eggs, 19% with small young (oldest chick less than five days old), 33% with medium-sized young (5-9 days old), and 14% with large young (10 days or older). We tested for differences in breeding parameters (e.g. clutch or brood size) between these four nest stages where appropriate, to allow for the possibility that eggs or young were removed from (or left) some nests. First egg dates were back-calculated from estimated chick (youngest) or fledgling ages assuming that one egg was laid each day, that incubation lasted for 12 days, the nestling period for 14 days, and that young became independent at two weeks after fledging (Nethersole-Thompson 1966, pers. obs.). Two failed clutches of three eggs were omitted from calculations of clutch-size because they may have been deserted before the clutch was complete.

Criteria used for estimating nestling ages were similar to Maher (1964): size relative to the egg in the first three days after hatching, length of growing primary sheath in days four to seven (when the feather emerged from the sheath), and wing-length/emerged primary

length until fledging. At 16 days old the fledglings were still relatively immobile with very short tails. Chicks of this age often crouched when approached, flights were hesitant, and they retreated under boulders if possible. By 20 days they made short flights in pursuit of their parents, attempted to feed themselves, and often took flight when approached. Over the nest week pursuit of parents became well-developed and families could range over large areas in a short space of time. By the end of the second week after fledging, the wings and tail were of similar length to those of adults (primaries full-grown when about 35 days old - unpubl. data), the chicks spent most of their time feeding themselves (although often in the company of a parent), and the frequency and success of begging behaviour was reduced.

The contents of nests were last counted on the day the nestlings were ringed so as to reduce the likelihood of chicks departing prematurely. The young could be ringed when only four days old, although 6-8 day old young were ideal and most were done at this stage. The number of young alive in the nest when they were ringed is referred to as the brood size at ringing. Subsequently, it was not possible to count the number of chicks accurately without handling them. However, as most nests were revisited after the young had fledged, we could also calculate the fledging brood size by subtracting the number of dead chicks in the nest from the brood size at ringing. This measure will inevitably be an overestimate because, on a few occasions, nestlings known to have died were not found and must have been removed from nests by the parents or by predators.

Of the 229 nests found, 31 definitely failed (contents deserted or disappeared long before fledging could have occurred) while 161 almost certainly fledged chicks. Evidence for successful fledging was considered sufficient if the nestlings were known to be alive in the nest at 12 days old or older (at this stage they could evade a predator by scrambling out of the nest and hiding in cracks within the nest cavity), or if they were seen after fledging. This was aided from 1989 onwards by colour-ring coded broods, or individuals (in 1992 and 1993). A further 37 nests were treated as failures because most of the young, especially the oldest, were found dead in the nest on a follow-up visit after the expected fledging date or because the young appeared emaciated on the final visit. The main reason for the unproven outcome of the remaining 31 nests was too few follow-up visits. They were hence treated as successful because of the advanced age and obvious health of the chicks on the final visit, and the low nest failure rate (see Results).

First and second broods were separated by date (first egg date before or after 1 July respectively) or whether the pair were known to have already successfully produced a fledged brood. Second attempts invariably involved the construction of a new nest, usually within 10-500m of the first. On only one occasion, when a snowfall forced a female to abandon a full first-brood clutch, was a nest re-used within the same summer: the second attempt was started several days later (still, by definition, a first brood) and the new clutch, which later produced fledged young, was laid directly on top of the first.

Results

Laying dates

First egg dates for individual clutches ranged from 21 May to 23 July, apart from one exceptionally early nest on area B (newly fledged young on 6 June, estimated first egg

date 9 May). Peaks of egg-laying occurred in late May/early June and in late June/early July (Fig. 1). The average first egg date of successful first broods was 29 May on area B, but 6 days later on area A. This varied between summers, however: successful first brood nests on area B fledged 12-18 days ahead of those on area A in 1990 and 1991. but fledging dates were similar in both areas in 1992 and 1993.

On area A alone there was considerable annual variation in first egg dates of first broods (one way ANOVA $F_{5,161}=4.62$, $P<0.001$). This was associated with the occurrence and extent of snowfalls during May and early June (Fig. 2) which apparently delayed egg-laying in one year and led to failure of initial nesting attempts in others. In 1988 and 1992, the second half of May and June was mild with little fresh snow. These laying season were synchronised and largely successful with a low proportion of late first clutches. In 1993 there was no snow during the laying season, but a heavy and prolonged period of snow just prior to it (13-17 May). Although some birds initiated breeding attempts on expected dates (before the end of May, as in 1988 and 1992), half of the pairs did not lay until after this, perhaps as a result of energy deficiencies incurred during the snow storm. 1989, 1990 and 1991 all had two peaks in the distribution of first egg dates of first broods, and in each case a snowfall occurred between early and late first nests. In both former years, nests with early first egg dates were successful but the nests themselves were mostly found during the nestling stage. The behaviour of other pairs seen prior to these snowfall (females carrying nest materials, or males resuming singing with no signs of their mates) suggested that other females also initiated early first nests, but were forced to abandon them during the snow. Hence they were never detected. The later mean first egg date of successful first broods in these three years therefore probably represents the second nesting effort of the summer for many pairs, rather than simply a weather-induced delay to the first efforts. In 1991 this was confirmed to some extent: only two out of seven nests located prior to snowfalls on 2-5 June survived. Three of the five females which failed laid the first egg of their next nesting attempts during 9-12 June, the peak of the second wave of nesting attempts in that summer.

FIGURE 1

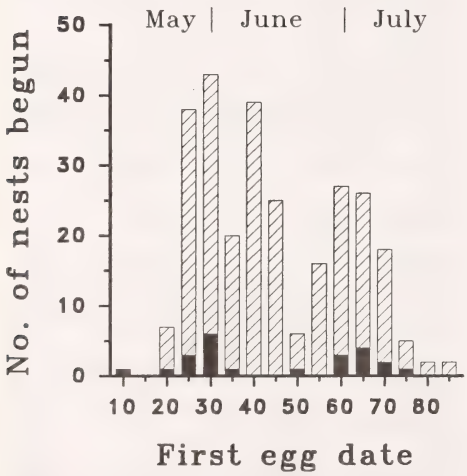
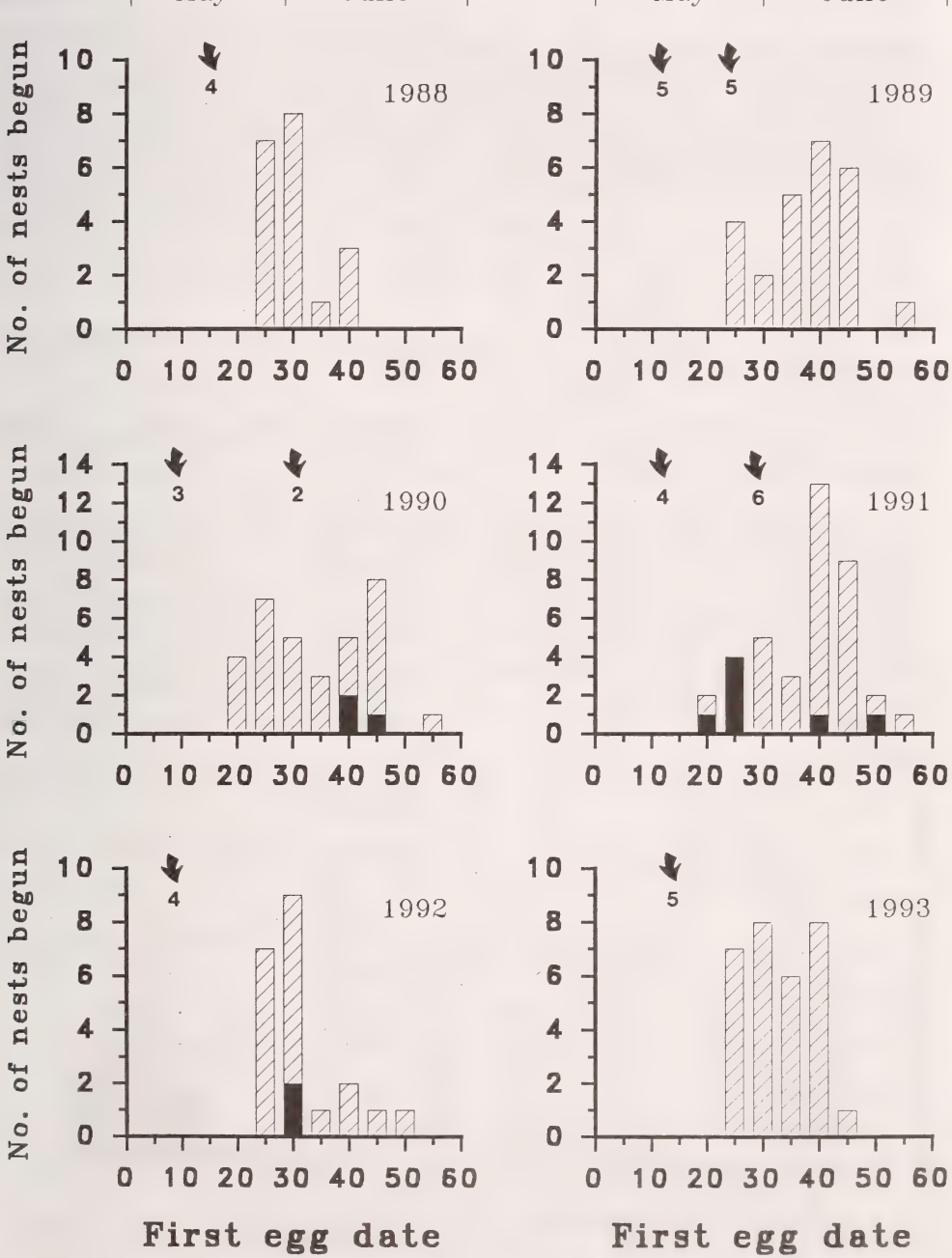


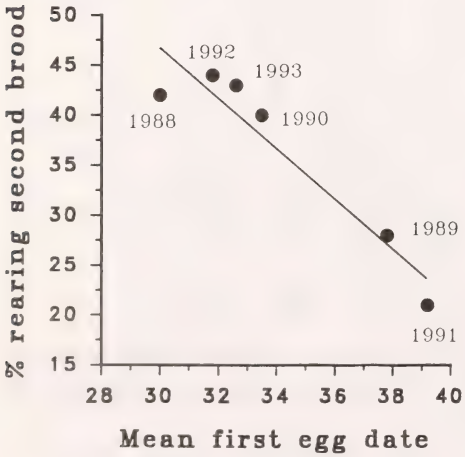
FIGURE 2


May
June
May
June
No. of nests begun
1988
1989
1990
1991
1992
1993
First egg date
First egg date

Number of broods

Snow Buntings on area B successfully reared more broods (1.69 per pair) than did those on area A (1.20 per pair; log-linear model taking into account annual variation, X^2_2=9.36, P<0.01). On area A, an average of 60% of pairs reared one brood each summer, 30% reared two broods and 10% apparently failed completely (n=174). Pairs were more likely to rear two broods successfully if their first successful brood was initiated early in the nesting season (mean 29 May, n=52). Pairs which attempted but failed to rear a second brood initiated their first successful clutches on 2 June (n=18) on average, whilst those in which no second brood was detected were later still (mean 8 June, n=78; ANOVA taking into account annual variation in first egg dates of successful first broods: $F_{2,130}$=35.0, P<0.001). Similarly, amongst females which successfully reared first broods, the proportion which went on to successfully rear a second was higher in years when successful first broods were initiated early in the season (R_S=-0.83, n=6, P<0.05; Fig. 3).

FIGURE 3



The inter-nest interval of a pair, defined as the number of days between laying the last egg of their first successful brood and laying the first egg in a second brood, averaged 30 days (s.d.=6 days, n=81 pairs), although it peaked at 26-29 days, perhaps indicating that long intervals were due to a failure of an intermediate nesting attempt. We noted nest-building by several females which still had young in the nest, enabling a small overlap of broods.

Clutch size, brood size and partial nest losses

The mean number of eggs in 71 nests observed during incubation was 4.83 (s.d.=0.96). The total contents (number of eggs or young) of 44 nests first counted when the oldest chick was no more than four days old was slightly, but not significantly, higher (5.05±0.89eggs+young; ANOVA, $F_{1,92}$=0.99, n.s.). This indicates that losses of contents during incubation and early brood rearing were negligible. The overall mean of 4.91±0.93 eggs or young in these 115 nests is therefore the best estimate of clutch size (Fig. 4).

FIGURE 4

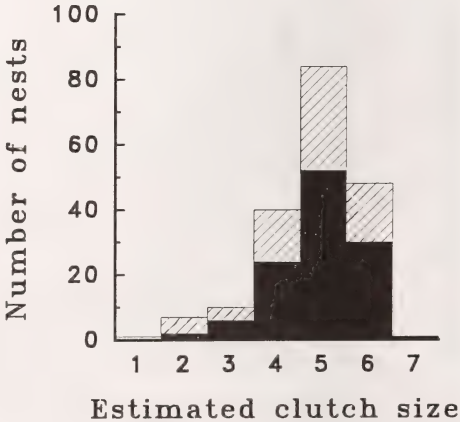


TABLE 1. ***Annual variation in Snow Bunting breeding parameters. Broods fledged per female includes data from Area A only, otherwise data from Areas A and B are combined. Clutch size is calculated from nests containing eggs or small young. Brood size at ringing age excludes nests failing before this. The percentage of nests losing small young, may include cases where unhatched eggs were removed by the parents. Daily nest failure rate in 1991 excludes the five nests lost in a snowstorm at the beginning of the breeding season.***

Parameter	1988	1989	1990	1991	1992	1993	Mean
Broods fledged per female	1.42	1.26	1.22	1.02	1.08	1.39	1.20
(no. of females)	(12)	(27)	(37)	(41)	(26)	(31)	(174)
Clutch size	5.21	5.62	4.71	5.27	4.47	5.00	4.91
(no. of nests)	(14)	(8)	(17)	(15)	(32)	(29)	(115)
% nests with unhatched eggs	65	44	24	25	52	43	39
(no. of nests)	(20)	(25)	(38)	(40)	(33)	(47)	(207)
% nests losing small young	30	14	27	33	38	26	30
(no. of nests)	(10)	(7)	(15)	(9)	(26)	(27)	(94)
First brood size at ringing	3.92	3.69	4.38	4.57	3.68	4.33	4.20
(no. of broods)	(12)	(13)	(24)	(28)	(19)	(27)	(125)
Second brood size at ringing	3.40	3.60	3.27	3.67	2.57	3.26	3.27
(no. of broods)	(5)	(10)	(15)	(12)	(14)	(19)	(77)
Daily nest failure rate (%)	2.3	1.4	1.5	2.2	1.6	1.1	1.7
(no. of days at risk)	(215)	(218)	(324)	(185)	(510)	(454)	(1936)

The total contents of nests with medium-sized young was significantly lower (mean=4.67±1.17, n=76; ANOVA taking into account annual variation, $F_{2,153}$=3.24, P<0.05), while the total contents of nests with large young were smaller still (3.94±1.27, n=32). This was probably due to removal of some addled or infertile eggs, death and removal of some young, increased mobility of young within the nest cavity (scrambling into inaccessible cracks between rocks to avoid being caught, an anti-predator strategy), or early fledging of some brood members (which can occur from 12 days old; Maher 1964).

There was no difference in mean estimated clutch size of first and second broods (ANOVA with nest stage and year: $F_{1,174}$=2.70, n.s.), or between Areas A and B (ANOVA with nest stage and year: $F_{1,157}$=0.05, n.s.). However, there was variation in clutch sizes between summers (Table 1; ANOVA with nest stage and brood category, i.e. first or second brood, effect of year: $F_{5,174}$=3.10, P<0.02). This was mainly a result of low clutch sizes in 1992 (mean=4.47) compared to the other five summers during 1988-1993 (mean=5.08).

In 39% of nests which hatched, one or more eggs were infertile or addled, amounting to 13% of all eggs. On average 1.6 eggs failed to hatch in nests with incomplete hatching. There was no significant difference in hatching rate between areas. Between year, the proportion of nests with unhatched eggs varied substantially, from 24% in 1990 to 65% in 1988 (Table 1).

In 1992 and 1993, in nests with partial hatching success, eggs which failed to hatch were broken to record their stage of development. Twenty nests had eggs with no signs of embryonic development, five had limited signs of development, one embryo was half developed and three were well-developed. Most eggs failing to hatch were therefore infertile or 'died' during the egg-laying or early incubation periods.

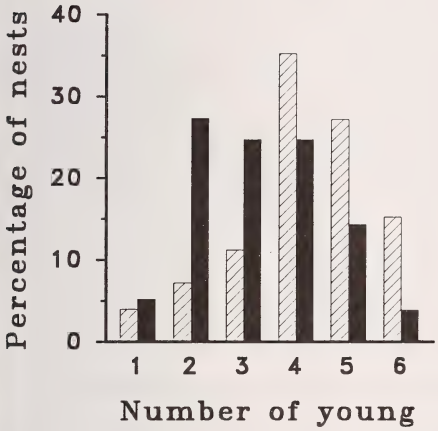
Further losses occurred between incubation and the day when the chicks were ringed. The majority of this appeared to be due to deaths of chicks rather than loss of viable eggs or removal of addled eggs. In some cases dead chicks were left in the nest, but probably most were removed by the parents (inferred in some nests by higher counts of chicks close to hatching than present when the chicks were ringed). Partial predation was suspected on only one occasion, when the nest was virtually destroyed. Losses prior to ringing occurred in 30% of 94 nests found with eggs or small young, and were independent of site, year or nest stage.

The mean brood size at ringing was 3.85 young (s.d.=1.34, n=202). There was no difference between study areas (ANOVA correcting for brood category: $F_{1,198}$=0.23, n.s.) but, as with clutch size, brood-size was smaller in 1992 (Table 1; ANOVA correcting for brood category: $F_{5,186}$=2.43, P<0.05). The most obvious difference, however, was that first broods were larger than second broods by an average of almost one chick per nest (Fig. 5). Dead chicks were found in the nest or nest-cavity on 20% of post-fledging visits to nests where fledging was known or assumed. However, mortality of young post-ringing was probably under-estimated due to removal of bodies by the parents.

Total nest failure

As well as partial losses of nest contents, complete nest failures occurred as a result of the accumulation of partial losses or

FIGURE 5



instantaneously through nest desertion or predation. We quantified the rate of nest mortality (percentage of nests failing per day) using the Mayfield method (Mayfield 1961, Johnson 1979).

Nest mortality rates, although ranging from 1.1% of nests per day for nests with small young to 2.1% nests/day for nests with eggs, did not differ significantly between stages of the nesting cycle (maximum ratio of difference in mortality rates to their standard errors, z=1.21, n.s.). From the daily mortality rate averaged across all stages (1.8% nests/day), we can calculate that typical nests (5 eggs hatching asynchronously over a one-day period) would have a success rate of 60%, i.e. at least one chick fledged in 60% of nesting attempts (95% confidence interval 50-71%). Nest mortality rate was similar between sites (z=1.17, n.s.), and did not vary between years except in 1991 when five nests were lost in an early season snowstorm (Table 2).

Reasons for nest failure are listed in Table 2. Most failures were due to starvation of young (as evidenced by thin or emaciated condition on the penultimate visit, gradual disappearance of the youngest brood members, or all chicks dead in the nest at a variety of ages) and perhaps reflected a poorer food supply toward the end of the season. Several cases where the nest was deserted

TABLE 2. ***Causes of failure of first and second brood Snow Bunting nests.***

Cause of failure	No. occurring in: First Brood	Second Brood
Weather (desertions in snow)	5	0
Desertion (eggs)	3	5
Desertion (young)	1	3
Starvation of young	1	12
Predation	0	1
Unknown	1	2

or the cause of nest mortality was unknown may also have been due to seasonal food shortage.

Five nests were deserted because of a heavy snowfall. These all occurred in 1991, but the double peak of first egg dates of first broods (Fig. 2) in 1989 and 1990 suggested that snowfalls caused widespread desertion of undiscovered clutches in these summers also. This factor is therefore probably underestimated in Table 2, because few nests were found at the egg-laying/incubation stages. Three periods of snow occurred during the brood-rearing periods: on 29 June 1989, 18 June 1991 and 9 July 1993. No fall deposited more than 5cm of snow and all had largely gone within a day. There was little evidence of nest failure during these periods.

Predation was unequivocal on only one occasion; the remains of the female and her young were found dead in the nest hole and were most likely the victims of a stoat or weasel. The contents of two other nests disappeared completely, possibly predated, but removal of starving young by the parents was equally plausible. The other nest which failed in unknown circumstances may have been a result of death or predation of the female. The male continued to visit the partially incubated clutch in her absence.

Survival of adults

Just over half of individually colour-ringed breeding adults returned to the study area to breed the following year. The return rate was similar on areas A and B (means for 1990 to 1993: 50% & 58% respectively, n=136 &12; X^2_1=0.06, n.s.), and also during four of the five years (range 59-64%, n=15-49) but was lower from 1991 to 1992 (37%, n=57; loglinear X^2_4=9.23, P=0.056).

Discussion

Variation between sites

Area A in the Cairngorms is almost certainly the most extensive and most consistently used area of suitable Snow Bunting habitat in Britain. We might therefore have expected that breeding success would be higher there than on area B where 4-5 pairs in 1992 and 1993 represents an all-time high, and which may be devoid of birds in some summers (only single pairs were seen on any eastern Grampians hills during 1970-87, Watson & Smith 1991).

However, egg-laying dates of successful first broods were on average almost six days earlier on area B than on area A. First egg dates of first nesting attempts (rather than first *successful* attempts) may have been similar on both areas because it is believed that many pairs on area A failed at an early stage in 1990 and 1991 due to snowfalls (Fig. 2). These setbacks may account for the lower frequency of double-brooding on area A. The risk of nest failure as a result of early season snowfalls may be lower on area B because, within Britain, montane areas further to the south and east have a warmer and drier summer climate (Thompson & Brown 1992). The differences in altitude between the two sites may be less important: no overall relationship was found between first egg dates of successful first brood nests and altitude *within* area A (Smith & Marquiss, unpubl. data).

Some of the difference in the number of broods reared between areas may, however, have been artificial because broods were more likely to have been missed on the larger site, and follow-up visits to nests on area B, especially to second brood nests, were less

frequent. In conclusion, however, there is certainly no evidence to suggest that area B was any *less* productive than area A. Because return rates of adults and settlement rates of their offspring are similar between the two sites (Smith & Marquiss in prep.), previous low counts of breeding birds on area B may result from periodic extinctions associated with a small population size, although the lack of thorough searching in previous years could not be entirely excluded.

Annual variation

Spring and early summer snowfalls appeared to delay the early fledging of first brood young, hence reducing the chances of rearing two broods successfully. However, snowfalls did not cause all extant nests to fail. The ability of some females to continue incubation in such conditions may have been due to fortuitous nest-site choice rather than depletion of energy reserves during snow, because the duration of 100% snow cover was short. Also the ensuing snow thaw may have provided rich feeding conditions: Snow Buntings were often seen feeding along the edges of melting snow patches, perhaps on invertebrates flushed to the surface. Three of the five females known to lose clutches in 1991 laid the first eggs of replacement clutches within ten days of losing their initial attempts, despite the snow persisting for the first two of these days. Witness also the peak of presumed replacement clutches only 5-10 days after snowfalls (Fig. 2).

Our data on the causes of nest failure in second broods suggest that the end of the breeding season is set by food shortage: 12-14 out of 23 failures could directly be attributed to starvation of the young, while a further eight pairs may have deserted nests because they could not find sufficient food.

Clutch sizes were unusually low in summer 1992, and as there were slightly greater than average losses due to unhatched eggs and the disappearance of small chicks, brood sizes were also smaller (Table 1). Twenty-three percent of the 26 females known to summer on area A were not known to rear even one brood, in 1992: this was the highest rate observed during the six summers despite our greater efforts to find nests and broods in 1992 and 1993. The poor 1992 summer followed upon a year in which the adult return rate was only 60% of that averaged across the rest of the study period, leading to the largest population decrease on area A during the study period, from 40 pairs in 1991 to only 26 in 1992. Recruitment of 1991 chicks was also lower in 1992, although not significantly so. Interestingly, this drop in overwinter return rates and productivity followed a particularly snow-free winter and spring in Scotland (46 snow-free days in the Cairngorm mountains during January to April 1992, compared to a mean of 18 days during the rest of the five winters from 1988 to 1993, R.D. Smith unpubl. data) and much smaller summer snow beds than usual (Adam Watson pers.comm.). Nethersole-Thompson (1966) also noted an association between higher Snow Bunting numbers in the Cairngorms and cold winters/ snowy springs although he attributed this to an increased rate of immigration rather than to enhanced survival/breeding success. If the association between decreased productivity and reduced snow lie is correct, this may reflect adverse effects on the Snow Bunting invertebrate food supply and therefore be of wider conservation and biological significance.

Acknowledgements

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McGowan (Royal Scottish Museum) provided details of the degree of incubation of unhatched eggs. A long list of other observers made useful contributions. Neil Metcalfe and an anonymous referee commented extensively on earlier drafts, while discussion with Adam Watson, Des Thompson, Hector Galbraith and Phil Whitfield also generated enthusiasm, ideas and criticism. Substantial financial assistance was received by RDS from SNH through the Mountain Plateau Ecology Project, HIDB, BOU, ASAB and BES. We are also grateful to Cairngorm Chairlift Company for providing access to the study area via their chairlifts. Thanks are also due to the RSPB and other landowners on whose ground we worked.

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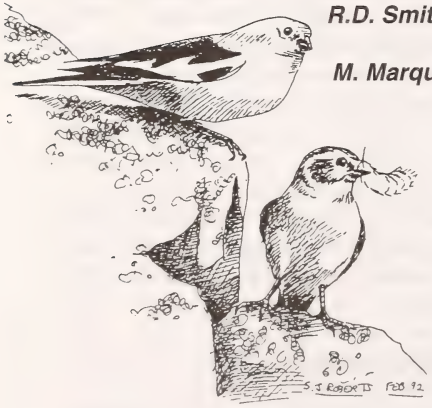

R.D. Smith, Applied Ornithology Unit, Department of Zoology, University of Glasgow, Glasgow. G12 8QQ. U.K.
M. Marquiss, Institute of Terrestrial Ecology, Hill of Brathens, Banchory, Kincardineshire AB31 4BY. U.K.

(Revised typescript received 15 August 1994)

Short Notes

Kestrel predation of Ring Ouzel nestling

On 19 May 1993 during a survey of Ring Ouzels *Turdus torquatus* in Glen Mark, at the head of Glen Esk, I witnessed a male Kestrel *Falco tinnunculus* remove a Ring Ouzel pullus from a nest site. I was trying to count Ring Ouzel pairs present when I saw a male Kestrel flying straight towards a ledge. The Kestrel was about 400m from my position when it landed and momentarily appeared to entangle its wings in the surrounding heather. After a few seconds, it flew off, carrying a nestling in its beak. Just seconds prior to and during the attack, at least 5-6 adult Ring Ouzels mobbed the Kestrel and made frantic efforts to distract it with loud alarm calls. The pullus appeared to be 5-8 days old.

Until the attack the nest was unknown to me, although I had earlier seen a male Ring Ouzel perched on a stunted birch nearby. When I approached the site about an hour later, I found the nest on a rocky ledge about 4m above ground level and apparently undamaged. I could not see whether any pulli remained in the nest, as it was inaccessible. During a visit eight days later, both parents were seen to carry food into the nest site, suggesting that some of the brood had survived.

In several years of observing Ring Ouzels in Glen Esk, the main cause of alarm has been the appearance of a hovering Kestrel, and this kind of predation is probably understated. In Derbyshire, Fox (1900. *Zoologist* 4: 1-10) described how he observed a pair of Ring Ouzels drive a Kestrel from their territory or nest site. Very few instances appear to have been recorded of nestling predation by raptors, and Cramp & Simmons (1980. *BWP* Vol. II) found that raptors seldom preyed on nestlings.

David Arthur, 12 Dundee Street, Carnoustie, Angus DD7 7PD

Interaction between Red Grouse and Osprey

On 6 June 1991, I watched an Osprey *Pandion haeliatus* hunting over a highland loch at 300 metres a.s.l., surrounded by heather moorland. The Osprey caught a large trout and then flew over nearby moorland at a height of about five metres, disturbing a pair of Red Grouse *Lagopus lagopus* which may have had a brood nearby. The male grouse flew up at the Osprey and appeared to strike it, causing the Osprey to drop its prey. The Osprey circled quickly, dropped to the ground and having retrieved its fish flew off in its original direction.

Brood defence interactions between Red Grouse and Hen Harrier *Circus cyaneus* are well documented (S.M. Redpath. 1992. *Ornis Scand.*). In this case, it seems probable that the low-flying Osprey may have been mistaken for a quartering harrier.

Allan Mee, 70 Busby Road, Carmunnock, Glasgow G76 9BL.

Merlin follows prey underground

On 13 August 1993 I was driving along a country road near Cabrach, Banffshire, which passed through rough grazing on the fringe of heather moorland, when an adult male Merlin Falco columbarius flew from a roadside fence post 100 metres ahead of me across the rough grass and landed behind a stonewall. The road at this point turned at right-angles, so I drove round the corner and stopped my car at a point directly adjacent to where I had seen the Merlin land on the ground and cautiously looked over the fence. There was a drop of about one metre to the field below but no sign of the Merlin. However, on closer inspection, to see if there were any signs of a kill, I heard a fluttering noise coming from the entrance of a rabbit burrow at the base of the wall and the Merlin appeared, but on seeing me it immediately flew off across the field, calling in alarm.

A few seconds later, an immature Starling Sturnus vulgaris flew away from the base of the wall in an erratic manner as though impaired in one wing. I climbed over the fence, down into the field, and checked the place from where the Starling had flown, thinking that the Merlin had flushed it from the main rabbit burrow through a 'pophole' or an escape tunnel, in the manner of a ferret. There were holes in the turf-topped wall, but none appeared to go any distance. Getting down on my hand and knees, I looked into the main rabbit burrow to check for other exists and was surprised to see another juvenile Starling at the end of the short tunnel, approximately 45cm long and 10cm in diameter at the entrance. The Starling was standing up on its feet at the far end of the tunnel and there were no other exits from the tunnel. I reached in and removed the now screeching Starling, which appeared perfectly healthy and unharmed and when released, it flew strongly away.

There is no mention of Merlin pursuing prey underground in BWP.

James K Craib, 5 Rashcrook Walk, New Elgin, Elgin, Moray IV30 3EZ

Sparrowhawk exploiting a Sand Martin colony

In 1975, the late Tom Irvine guided me to a Sparrowhawk *Accipiter nisus* nest in coniferous woodland near to the river Tarras at Langholm, Dumfriesshire. The hawks were rearing four young and prey items collected at the nest and from the male's plucking post indicated that at this stage the hawks were significantly exploiting a Sand Martin *Riparia riparia* colony, located some 440m distant.

During the initial visit the remains of 22 adult martins were collected, ten days later a further 13 were retrieved and subsequently four more were found. A feature of the prey at the male's plucking post was that the wings were not plucked out and remained attached to the sternum, while debris at the nest indicated that the female typically took them apart. A watch at the colony showed that only the male hawk attempted to catch martins; of 14 observed passes within 37 hours of observation only three resulted in kills. Usually

the martins avoided capture by twisting in flight and by 'towering', by this time of course the colony had been depleted and fewer martins were available to the hawk. The mode of attack was similar in all cases: a swift low level approach. Although being more visible, the hawk made no attempt to attack the martins while they fed at higher altitudes. I was unable to ascertain if juvenile martins were more vulnerable as, quite dramatically, the whole prey spectrum changed at this stage with the female bringing in larger items to feed the brood and the male hawk reverting to typical woodland species. Juvenile Sand Martins are known to be vulnerable and were seen to be taken by a male Sparrowhawk at Barbush near Dunblane in the early 1980s as they sat at the burrow mouths. (I. MacGowan *pers. comm*).

At the Dumfriesshire site, I estimated from counts of occupied burrows that the hawk killed 58% of the available adult martins. To put this record into perspective, I have not found Sand Martin remains at any of the other 1247 active Sparrowhawk nests I have visited during the past two decades.

John G. Young, SNH, West Lodge, Airlie, by Kirriemuir, Angus.

A successful artificial Sand Martin banking

Sand Martins *Riparia riparia*, conventionally, as the name implies, prefer to excavate breeding tunnels in soft sand or in lighter, loamy soils. Over the years, there has been a proliferation of records where they have been seen to excavate into more difficult or unusual strata. They have, for example, utilised temporary dumps of building materials and compressed heaps of coal spoil, sawdust, manure, as well as exposed peat banks (T. Holden, J.G. Young pers. comm.).

Sand Martins are also known to have exploited man-made or eroded holes in masonry in, for example, harbour walls and especially in the support walls of buildings and railway embankments where clay drainage or 'weep' pipes have been inserted to alleviate a build-up of hydrostatic pressures. At one such site in the centre of Cumnock, Ayrshire, up to 12 pairs have bred intermittently in large clay pipes since at least 1967 (J.G. Young pers. comm.). It has also been noted from trials at Loch Leven and New Cumnock, Ayrshire, that where visual stimuli are induced by forming holes either neatly with a soil auger, or even crudely with a walking stick, Sand Martins will be attracted to breed provided that the exposed strata are conducive to further excavation and that the vital insect food sources are within reasonable flying distances. (A. Allison, T. Holden, J.G. Young pers. comm). I know of no other examples, other than by the deliberate exposure of planes in sandy bankings, where an artificial site has been especially constructed to house Sand Martins.

While developing a small private aquatic nature reserve near Lockerbie in Dumfriesshire, I experimented with a reinforced concrete banking. The mode of construction was simple. On a stable foundation relevant to height, were built some seven courses of high density concrete blocks, on top of which concrete was poured into shutters (see photo). Martin holes were preformed within the shuttering using either removable tubes or by the insertion of clay drainage tiles at the diameter, length, angle

and distribution normally found in a natural site. Behind the concrete were also formed, a compact area of coarse grained, riverside sandy soil was firmly packed to allow the Martins to complete excavation and to form nest chambers. Other apertures of different dimensions to encourage occupation by water shrews, Swifts *Apus apus*, Pied Wagtails *Motacilla alba* and bat species.

The banking was completed in the autumn of 1989. The next season two pairs of Sand Martins bred in it. Sixteen broods were raised successfully in 1991, and in the three season since then, all the available holes have been occupied. At 136 pairs, the size of the colony is higher than the British average (37.6) for natural sites. (*BWP* Vol. V). The concrete banking is stable and not prone to the erosion which destroys many river and lochside sites. Natural sites are known to be suffering increasingly from overgrazing and trampling by farm stock, and from damage by rabbits, which may burrow into soft soils. Because of the tendency to severe, rapid flooding at many sites, natural colonies are continually at risk. An important additional feature of the site is that there is smooth concrete for some two metres below the nest holes, which makes it extremely difficult for ground predators such as rats, stoats, weasels, mink and feral cats to gain entry to the nest chambers, while laterally placed, small mesh netting inhibits vertical burrowing.

During the winter of 1993, the number of nest sites has been doubled with significant modifications to the design. Should these prove successful, a more detailed note on construction currently being prepared will be available from the North Solway Ringing Group. The provision of relatively safe and stable artificial breeding areas, strategically placed for Sand Martins, may well prove significant in the conservation of a species that shows strong site fidelity and is declining markedly in Scotland.

Robert T. Smith, Knowetop, Applegarthtown, Lockerbie, Dumfriesshire.

Correspondence

The influence of the weather on seabird movements across central Scotland.

It is surprising that during their discussion of seabird movements across central Scotland neither C.J.Henty nor R.D.Murray (*Scott. Birds* 17: 107-110) consider whether they may be due to the weather. I have discussed the main features of seabird migration elsewhere (in Cramp, S., Bourne, W.R.P. and Saunders, D., *Seabirds of Britain and Ireland,* Collins, London, 1974: 28-30). In general, birds of the coast and inland waters, such as the pelicans, cormorants, smaller skuas, gulls and terns, may regularly perform long journeys overland, which are liable to be missed because, as in the case of the massive eastward spring migration of the Common Gull *Larus canus* across Scotland, they tend to fly high over land (*Scott. Birds* 2: 3-17); it has since emerged from observations at oil installations that the autumn migration is in turn missed by radar because at that season the birds fly lower over the sea. The more marine species, including the tubenoses, tropicbirds, gannets and boobies, larger skuas, Sooty Tern *Sterna fuscata* and kittiwakes *Rissa* sp., normally avoid the land except when visiting the breeding places or carried there by the wind, as discussed for the north-east coast of Scotland by Bourne (*Ibis* 124: 81-88) and for Islay by Verrall & Bourne (*Scott. Birds* 12: 3-11).

On a number of occasions in the autumn coastal birds have flown south-west from the north-east coast, ascending as they went inland, including small skuas from the Moray Firth, and parties of terns from the Ythan estuary. Further inland I have also seen *Larus* gulls flying south over the Grampian mountains, and traced what from the timing of the movement appeared to be shore and water birds flying south to south-west for long distances with radar. But, as deduced by Henty, there was no reason to suspect that Kittiwakes *Rissa tridactyla* were included. If one examines the daily maps in the journal *Weather* there is usually some meteorological explanation for the appearance of such species offshore or inland. For example, the movements of 500 Kittiwakes per hour west in the Firth of Forth on 16 November 1973 and 1000 per hour west on 28-29 October 1974 described by Sandeman (*Scott. Birds* 8: 77-78, 324-325) both occurred with the cold northerly airstream behind a depression. This is normally associated with massive southward movements of seabirds down both coasts of Britain at this season, and may have led to an accumulation of birds in the Firth of Forth. Similarly, the eastward movement up the Clyde on 11 March 1990 occurred with the west winds during the passage of a depression to the north which were also associated with some of the largest movements past Islay. The accumulation of birds in the Forth on 18 October 1990 occurred with the east winds associated with misty, overcast weather north of an occluded front. Some birds taking part in such movements have been seen to continue overland in such places as the Wash in the past (*Seabird* 5: 18-21), though if watched carefully most eventually appeared to follow the coast back out to sea.

W.R.P. Bourne, Department of Zoology, Aberdeen University, Tillydrone Avenue, Aberdeen AB9 2TN.

Items of Scottish interest

Most of the following papers and report 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 September 1994. The librarian would be glad to learn of anything that has been missed, and to receive reprints or copies of papers on any aspect of ornithology or natural history. Bird reports marked with an asterisk are available from the SOC at the prices quoted, but please add 50p per order for postage and packing.

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Committee. A large proportion of these occurrences have been in Scotland.

Summers, R. 1994. Diurnal and nocturnal activities of a Purple Sandpiper *Calidris maritima*. *Wader Study Gp. Bull.* 72: 33-34. A study on the Isle of May of a radio-tagged bird.

Swann, R.L. (1993). Canna seabird studies 1993. *Joint Nature Conservation Committee Rep.* 181: 9pp.

Swann, R.L., Aiton, D.G., Carruthers, J., Graham, R.J. & Ramsay, A.D.K. 1994. An analysis of Shag *Phalacrocorax aristotelis* ring recovery and breeding success data during a period of population change on the Isle of Canna. *Seabird* 16: 50-56.

Tasker, M. 1994. East coast seabird wreck February 1994. *Seabird Gp. News* 68: 1.

Thomson, D.L. 1994. Growth and development in Dotterel chicks *Charadrius morinellus*. *Bird Study* 41: 61-67. A study in the Cairngorm mountains of Scotland

Uttley, J.D., Walton, P., Monaghan, P. & Austin, G. 1994. The effects of food abundance on breeding performance and adult time budgets of Guillemots *Uria aalge*. *Ibis* 136: 205-213. A study carried out at Sumburgh Head, Shetland.

Walsh, P.M. (1993). Counts of breeding seabirds on the Grampian coast in 1992. *Joint Nature Conservation Committee Rep.* 151: 54pp.

Wells, M.J. 1992. Outer Hebridean Ringed Plovers *Charadrius hiaticula* in winter: feeding rates in territorial and non-territorial individuals. *Wader Study Gp. Bull.* 66: 36. Abstract only.

Withers, B.R. 1994. The Royal Air Force Ornithological Society's expedition to Benbecula, June 1981. *RAFOS J.* 23: 1-18.

Yalden, D.W. & Dougall, T.W. 1994. Habitat, weather and growth rates of Common Sandpiper *Actitis hypoleucos* chicks. *Wader Study Gp. Bull.* 73: 33-35. Growth rates were similar in streams in the Peak District of England and in the Scottish Borders, but varied between years.

Composite report

Davidson, N. & Rothwell, P. (eds). 1993. Disturbance to Waterfowl on Estuaries. *Wader Study Gp. Bull* 68: 106pp. A collection of 15 papers, two of which are listed above. Available from RSPB, Sandy for £15 inc. p&p.

Bird reports

Arran Bird Report for 1993. Audrey Walters (ed) 1994. 24pp. Includes an updated checklist of the island's birds by Tristan ap Rheinallt.

Ayrshire Bird Report for 1993. Angus Hogg & Andrew Stevenson (eds). 68pp. * £2.75. A new addition to this long-running series is an Ayrshire butterfly report.

Clyde Birds (Clyde Bird Report for 1992). Iain P. Gibson (ed) 1994. 78pp. Available from Iain Gibson, 2 Fulton Crescent, Kilbarchan, Renfs. PA10 2EB.

Highland Bird Report for 1992. Colin Crooke (ed) 1993. 40pp.

Islay Bird and Natural History Report for 1993. Malcolm Ogilvie (ed). 32pp. * £1.50. Covers birds, mammals, butterflies, moths, dragonflies and flowering plants.

Livingston Bird Report for 1993. Livingston Countryside Ranger Service (ed). 33pp. Includes a 24-page species list.

Moray and Nairn Bird Report for 1993. Martin Cook (ed). 1994. 87pp. * £3.75. Includes a 60-page systematic list, a ringing report and two short papers.

Orkney Bird Report for 1993. Chris Booth, Mildred Cuthbert & Eric Meek (eds) 1994.

83pp. A 58-page systematic list and several short reports including "Corncrake survey in Orkney in 1993", and a North Ronaldsay Bird Observatory Report. * £3.50.

Perthshire (Central/Southwest) Peregrines and Ravens in 1993. P. Stirling-Aird 1994. 3pp. An unpublished report.

Shetland Bird Report for 1993. Kevin Osborn (ed). 126pp. Includes reports on the Braer Oil Spill, on the 1992 survey of Arctic and Great Skuas in Shetland, and on the rise and fall of the Fulmar in Shetland.

William G. Harper.

European journals in the Waterston Library

The following selection of articles appeared in European journals received in the Waterston Library between March and August 1994 inclusive, thus following on the list published in Vol. 17 No. 3. Articles are arranged in species order; square brackets indicate that the article is in the original language, other articles being in English. Journals quoted are as follows :

Belgium: *Oriolus, Aves*
Netherlands: *Dutch Birding, Limosa*
France: *Ciconia, Le Bievre, L'Oiseau, Alauda, Le Cormoran*
Switzerland: *Der Ornithologische Beobachter, Nos Oiseaux, Ornis*
Germany: *Limicola, ökologie der Vögel, Corax, Vogelwelt, Seevögel*
Poland *Acta Ornithologica, Zprävy MOS*
Croatia: *Larus*
Italy: *Rivista Italiana di Ornithologia, Avocetta*
Spain: *Ardeola, Butlleti del Grup Català d'Anellament* (in Catalan)
Iceland: *Nàttùrufræ ingurinn, Bliki*
Denmark: *Journal of Avian Biology, Dansk Ornitologisk Forenings Tidsskrift*
Norway: *Vår Fuglefauna*
Sweden: *Vår Fågelvärld, Ornis Svecica*
Finland: *Linnut, Ornis Fennica, Suomen Riista*

General

Kjellén, N. Moult in relation to migration in birds - a review. *Orn. Svec.* 4: 1-24.

Hazevoet, C.J. Species concepts and systematics. *Dutch Birding 16: 111-16.*

Kempenaers, B. [Mating behaviour among birds: an overview of the pair system]. *Oriolus* 59: 25-30.

Vansteenwegen, C. *et al.* [A comparison of census methods: quadrant mapping and capture-ringing-recapture]. *Aves* 30: 105-108.

Radovic, D. *et al.* [Results of bird ringing and recoveries of ringed birds in 1991 and 1992]. *Larus* 44/45: 1-32

Vansteenwegen, C. [Geographical variation in sedentary behaviour of partial migrants in France: an analysis of ringing results - Part 1]. *L'Oiseau* 63: 163-177.

Saurola, P. [Trans-Saharan recoveries of Finnish-ringed birds]. *Linnut* 3/94: 8-14

Divers to ducks

Walser, B. & Barthel, P.H. [Plumages of Red-necked Grebe]. *Limicola* 8: 101-120

Lang, B. [Geese in Normandy 1971-1993]. *Le Cormoran* 9: 29-36

Markkola, J. & Peltomäki, J. [The threat ened Lesser White-fronted Goose]. *Linnut* 3/93: 27-30

Aarvak, T. & Øien, I.J. [The Lesser White-fronted Goose : a threatened species. Developments in Norway 1987-93]. *Vår Fuglefauna* 17: 70-80

Leivo, M. *et al.* [Migration of Arctic water fowl in north Baltic , Spring 1993]. *Linnut* 2/94: 12-19

Samwald, O. *et al.* [Pochard x Ferruginous Duck hybrids in Austria]. *Egretta* 37: 28-32

Staav, R. [Arctic Eiders in North Norway]. *Vår Fågelvärld* 2/94: 24-25

Birds of prey

Various. [Papers presented at raptor and Owl conference at Prerov in 1991]. *Zprávy MOS* 50: 7-74

Müller, W. [A European brings it off : the Red Kite on the increase]. *Ornis* 4/94: 35-39

Steen, O.F. [The Hobby in SE Norway 1979-93]. *Vår Fuglefauna* 17:81-90

Grouse to cranes

Valkeajärvi, P. & Ijäs, L. [Comparison between breeding success of artificially fed and unfed Black Grouse in central Finland]. *Suomen Riista* 40: 98-109

Grandjean-Thomsen, A. [Significance of some factors on display activity of Black Grouse in Denmark]. *Dansk Orn. For. Tidss.* 88: 85-90

Parr, R. *et al.* Changes in the numbers and interspecific interactions of Red Grouse and Black Grouse. *Avocetta* 17: 55-59

Schäffer, N. [Methods of ascertaining breeding in Corncrake]. *Vogelwelt* 115: 69-73

Jedraszko-Dabrowska, D. & Debinska, D. Ethological and ecological aspects of adaptation of Coot to breeding in urban conditions. *Acta Ornith.* 28: 91-96

Waders to auks

Pérez-Hurtado, A. *et al.* [Importance of the bay of Cadiz for wintering shorebird populations]. *Ardeola* 40: 133-142

Ullman, M. [field identification of pratincoles in flight]. *Vår Fågelvärld* 4/94: 28-30

Brunner, H. [Juvenile development of Dotterel]. *Limicola* 8: 15-27

Gudmundsson, G.A. Spring migration of Knot over S Scandinavia, as recorded by radar. *J. of Avian Biol.* 25: 15-26

Mouritsen, K.N. Day and night feeding in Dunlin : choice of habitat, foraging technique and prey. *J. of Avian Biol.* 25: 55-62.

Brathel, P.H. [Identification of Great Black-headed Gull]. *Limicola* 8: 64-78

Hario, M. Reproductive performance of nominate Lesser Black-backed Gull under pressure of Herring Gull predation. *Orn. Fenn.* 71: 1-10

Volet, B. [Arctic Terns in the port of Geneva : notes on bill colouring in juvenile plumage]. *Nos Oiseaux* 42: 335-340

Lyngs, P. [The Great Auk : a 150-year

memorial]. *Dansk Orn. For. Tidss.* 88: 49-72

Pigeons to woodpeckers

Various. [Papers on owls presented at Raptor and Owl conference at Prerov in 1991]. *Zprávy MOS* 5: 7-74

Lode, T. [Seasonal variations in Long-eared Owl diet in relation to variations in population densities of small rodents]. *Alauda* 62: 91-100

Sudmann, S.R. *et al.* [Short-eared and Long-eared owls as predators in Common Tern colonies]. *Vogelwelt* 115: 121-126

Passerines

Shirihai, H. Field identification of Dunn's, Bar-tailed Desert and Desert larks. *Dutch Birding* 16: 1-9

Weggler, M. [The Black Redstart]. *Ornis* 2/94: 30-32

Rebstock, H. & Maulbetsch, K-E. [Observations on juvenile development of Whinchat]. *ök. der Vögel* 15: 137-153

Flinks, H. [Ageing of *rubicola* Stonechats by plumage characteristics]. *Limicola* 8: 28-37

Sandberg, R. [Wheaters and the Earth's magnetic field]. *Vår Fågelvärld* 3/94: 18-19

Spaar, R. & Hegelbach, J. [Nest site and breeding biology of the Song Thrust in the Zürich area]. *Orn. Beob.* 91: 31-41

Alström, P. *et al.* [Identification of small *Acrocephalus* warblers from the Far East]. *Limicola* 8: 121-131

Mild, K. [Field identification of 'black and white' flycatchers]. *Vår Fågelvärld* 3/94: 29-36

Kooiker, G. [Influence of Magpie on urban bird populations in Osnabrück, north west Germany]. *Vogelwelt* 115: 39-44

Senar, J.C. *et al.* Wing shape variation between resident and transient wintering Siskins. *J. of Avian Biol.* 25: 50-54

Thorstenson, S. & Peterson, Æ. [Breeding biology of Redpolls in north Iceland]. *Bliki* 14: 1-13

Borras, A. *et al.* Simultaneous capture of several Common Crossbills with whitish wing bars]. *B. del Grup Cat. d'Anellament* 10: 15-17

òlafsson, E. [Vagrants in Iceland part 10 : buntings, vireos and icterids]. *Nàttùrufræ ingurinn* 63: 87-108

Kempenaers, B. [Extra-pair relations and paternity in Blue Tit]. *Aves* 30: 167-172

Alström, P. [Field identification of Pechora Pipit]. *Vår Fågelvärld* 5/94: 29-30

Hillström, L. & Olsson, K. Advantages of hatching synchrony in Pied Flycatcher. *J. of Avian Biol.* 3: 205-214

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 in italics should follow the first text reference to each species and should follow Voous 'List of Recent Holarctic Bird Species' as given in the *The British Birds' List of Birds of the Western Palearctic (1984).* Only single quotation marks should be used throughout and numbers one to ten should be written out whereas 11 and above should be written as numerals. Dates should be written:.....on 5 August 1991.....but on the 5th (if the name of the month does not follow). Please note that papers shorter than 700 words will be treated as Short Notes where all references should be incorporated into the text, and not listed at the end, as in full articles.

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

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

ERRATUM: Caption for colour print of female Mandarin *Aix galericulata* in Summer 94 issue should read first breeding record in Argyll.

Unfortunately space was restricted and the Research Index which normally appears in December issue will now appear in the June issue.

NEOTROPICAL BIRD CLUB

Neotropical bird club launched

A club has been launched to promote the study and conservation of the birds of the Neotropics (South America, Central America and the Caribbean). It is currently seeking founder members to help reach the launch budget of £2000, which is required to get the club running and to publish the two first issues of its intended journal 'Continga'. Founder members will be asked to pay a minimum of £25, and will be formally acknowledged in the first issue of 'Continga', planned for January 1994. 'Continga' will provide a colourful and much needed forum for exchange of information on the avifauna of this extremely rich and diverse area, and will contain papers and features on the birds and their conservation as well as news of recent observations and discoveries (at present, new species are still being discovered at the rate of more than two a year). It is hoped that in due course the club will be able to provide direct funding and support for practical conservation programmes.

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

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