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Observations at a winter Rook and Jackdaw roost in Aberdeenshire

I S FRANCIS

A large corvid roost near Alford, Aberdeenshire was counted during winter 1994-95. Up to 18,500 birds used the roost from early September to late March, with peak counts in late November. Around 68% of the birds were Rooks, the remainder Jackdaws. The roost was utilised by birds from perhaps as far as 20 km distant. Arrival times and behaviour are described. The roost is important in a national context, and reflects the very high densities of Rooks in Aberdeenshire.

Introduction

Large winter roosts of Rooks *Corvus frugilegus* and other corvids, including Jackdaws *Corvus monedula*, have been described from numerous parts of Scotland, particularly during an SOC inquiry from 1969-1975 (Munro 1975), when 164 such roosts were noted. During the winter of 1994-95, I visited a mixed corvid roost from September to March, estimated numbers of roosting birds and made some observations of arrival times and behaviour.

Site description

Meiklemoss Wood, near Alford, Aberdeenshire (NJ 602161; 145 asl) is a mixed Scots Pine - Birch *(Pinus sylvestris - Betula* spp.) woodland of cl0 ha, on level ground with a thicker Birch fringe and a few scattered spruces *(Picea sitchensis & P abies)*. Canopy height is around 10-14 m. The understory is mostly grassy and dominated by the grasses *Holcus mollis* and *Deschampsia caespitosa*. There are some open areas with Heather *Calluna vulgaris* and Broom *Cytisus scoparius*. Within the roost area there are some dead trees, possibly killed by the birds' droppings , beneath which lie dense patches of Chickweed *Stellaria media* with Nettles *Urtica dioica*. Feathers and pellets are scattered over an area of around 100 x 200 m, indicating the approximate extent of the roost. In general, the impact of a large number of roosting corvids on the woodland appears minimal, though the Chickweed and Nettle patches are clear evidence of a fertilising effect. The introduction of *Stellaria media* to a rookery has been recorded elsewhere (Rieley and Shah 1984), though Meiklemoss Wood is not a breeding rookery. This corvid roost appears to have arisen in the last 15 years or so (J Latham *pers comm*); in 1971, Munro (1975) could find no Rooks in Strathdon in winter, the nearest roost being 5 km to the south west at Muir of Fowlis.

Methods

The roost area was visited 21 times, around 7-9 days apart, initially by car but later viewed from one vantage point, and estimates made of numbers of birds entering the roost. On most occasions, it was necessary to estimate in 5-10 minutes large numbers of incoming

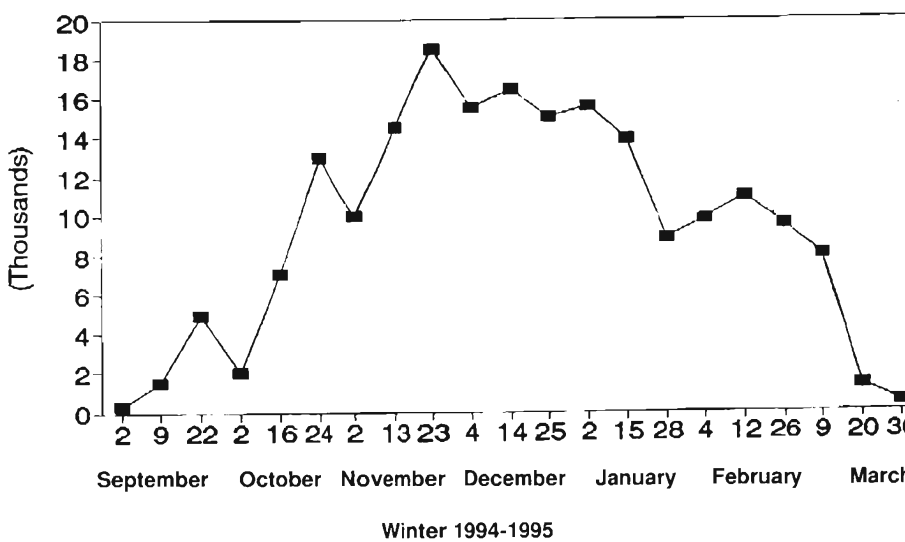
birds, which were counted in blocks of 50 or 100. This inevitably led to inaccuracies. In order to assess the extent of this on one occasion, 3 independent observers estimated numbers which varied from 8,000 to 9,500. This indicates the probable degree of error, but also shows that the numbers recorded were probably not more than 20% under or overestimated. The proportions of Rooks and Jackdaws were usually extremely difficult to determine under count conditions. Therefore, on 5 different dates, 30 counts of large pre roosting aggregations were made by 3 observers. Proportions of Jackdaws varied from 25% to 38%, with no apparent trend, but most lay in the range 28-36%. A figure of 32% Jackdaws was used in all flock counts to estimate numbers of that species. However, much of the account below relates to total corvids. Carrion Crows *Corvus corone* were noted only very rarely.

Results

Total numbers of birds and changes through the winter

The roost peaked at 18,500 on 23 November 1994, comprising around 13,900 Rooks and 4,600 Jackdaws. Rook numbers rose from around 300 in early September to over 5,000 by mid October. Numbers were over 10,000 from mid November to early January, dropping to 2,800 by mid March then very rapidly to under 300 by the end of March. There was no indication that the proportion of Jackdaws changed greatly through the winter, and the roost held over 3,000 from late October to mid January. Figure 1 illustrates the trend in numbers for total corvids. There was no significant roost before early September or after the end of March, though in late summer, at least one other area nearby (Breda Wood,

Figure 1 ***Combined numbers of Rooks and Jackdaws roosting at Meiklemoss Wood.***



5 km to the west) was used for roosting, prior to utilisation of Meiklemoss Wood.

Roosting times

On all occasions, arrival in the roost proper occurred shortly before almost total darkness and well after sunset. Weather conditions did not influence this. Arrival times in the roost proper, therefore, changed systematically, linked to time of darkness, through the winter, from 1930 GMT in early September to 1624 GMT in late December and 1938 GMT in late March. However, arrival in the pre roost gathering areas was much more variable, with the first birds usually arriving to feed in favoured fields up to 55 minutes before roosting, though 25-30 minutes was more usual.

Pattern of arrival and catchment area

Birds usually arrived in pulses of several hundred, presumably feeding flocks, separated by periods with few arrivals, from several consistently favoured directions, mostly to the south and west. They usually dropped into fields (both grass and stubble) to the south of the wood and the A944, where they fed and undertook occasional pre roost flights. Birds were observed flying to the roost from over 5 km to the west and over 10 km to the south west. Other observations of flightlines also suggested that the roost was holding birds which fed much further west up Strathdon, perhaps 20 km distant. However, most birds appeared to come from the Alford to Tarland area.

Behaviour

Birds arrived in pre roost flocks in nearby fields, sometimes in nearby small woods and trees, and most fed, though many spent time sitting quietly on fences. Periodically groups would fly up in short display flights in tight flocks, before settling again. The flights involved circling over the wood with sudden dives by tight flocks, followed by rising higher again. Sometimes these flights would extend over the roost wood, some 500 m distant, and arriving birds would often tumble and undertake short display flights before landing in the fields. Occasionally, birds would fly over and look at, or tumble into the roost woodland on arrival, then fly out again to join birds in the fields. On 2 occasions, shortly before the actual roosting flight began, the entire flock flew up over the roost wood and performed complex flights, before returning to the fields (once) or dropping into the roost. However, the usual behaviour immediately before roosting was for some small flocks to take off and carry out display flights over the wood. This then seemed to prompt the rest of the birds to fly to the wood in large waves, usually dropping in fairly quickly. Once birds landed in the roost it was rare for them to take off again.

Discussion

Communal roosting in Rooks and Jackdaws has often been described, though there have been few recent detailed accounts of individual roosts, particularly in Scotland. Early work by McWilliam (1924) and Munro (1948) was later succeeded by studies in the Ythan valley (Patterson *et al* 1971; Feare *et al* 1974), which concentrated on wider issues of Rook ecology, though Feare *et al* (1971) considered roosting behaviour in detail. North east Scotland seems notable for the number and size of corvid (particularly Rook) roosts. Munro (1975) described 11 known Rook roosts in Aberdeenshire and at least another 3 possible sites (see also Watson 1967; Dunnet and Patterson 1968). Estimated numbers of birds

ranged from 2,000 to 10,000 at several roosts, 21,500 at Ellon, 49,000 at Straloch and 65,000 at Hatton Castle, the largest known in Scotland. Roosts quite close to Meiklemoss Wood were Dunnideer Hill, Insch ('thousands') and Inver Fowlis (Muir of Fowlis, 7-10,000). At least 6 were known from Banffshire (numbering up to 30,000), one from Kincardineshire (5-10,000) and 3 from Morayshire (numbering up to 20,000). In all these estimates, Jackdaws were not counted separately. Earlier in the century, and elsewhere in Scotland, McWilliam (1924) considered Jackdaws were very much a minority in a roost of 12,000 corvids on Bute.

I also visited Meiklemoss Wood during the winter of 1995-96, on 3 December 1995, when 19,500 corvids were estimated, and during winter 1996-97, on 13 December 1996, when c13,000 corvids entered the roost. It was also counted in 1992, when a much larger figure of 37,000 Rooks was recorded (R J and S J Aspinall, NE Scotland Bird Report 1992); there were also up to 12,000 Jackdaws. Clearly, the roost can hold larger numbers than those recorded in 1994-96. However, using population and mortality figures given in Lack (1986) and Gibbons *et al* (1993), the Meiklemoss Wood roost may have held, in 1994-95, around 0.5% of Britain's winter population of Rooks. Rook breeding densities in Aberdeenshire are the highest recorded for Britain, with the largest rookeries (Dunnet and Patterson 1968; Thom 1986) and Feare *et al* (1974) considered this to be attributable to small scale field patterns, abundant winter stubble, late harvests and later spring sowings. These high densities are clearly reflected in winter, and make Aberdeenshire in general, and roosts such as Meiklemoss Wood in particular, of great significance for this species in national, and probably also European, terms.

Rooks will travel up to about 50km (30 miles) to communal roosts in the winter, with similar movements for Jackdaws (Holyoak 1971). The roosts are linked to the rookeries, even in winter, with birds flying from roost to rookery in the morning (Dunnet and Patterson 1968). In Aberdeenshire, maximum distances to roost in the Ythan valley were nearer 10-19 km (Patterson *et al* 1971). Buckland *et al* (1990) note that in the years prior to 1990, a large roost was present at Muir of Fowlis, which served upper Deeside and Donside. This roost is not now present, following felling of many trees at the site around 1989, and may have been replaced by Meiklemoss Wood, 5 km to the north east. Birds observed flying to roost at Meiklemoss Wood at up to 10 km away would accord with observations from elsewhere.

Feare *et al* (1974) found that for most of the year the times of entering and leaving the roost were related to sunrise and sunset, this relationship being affected to only a small extent by the weather. This was clearly so at Meiklemoss Wood. Munro (1948) and Feare *et al* (1974) also described pre roosting and roosting behaviour which was seen in this study too. The latter authors concluded that the main function of roosting lay in the post roost behaviour. Assembling after roost, and the dispersal from such assemblies, enables Rooks to locate food in unfamiliar surroundings when conditions prevent them from using their usual feeding grounds; each individual has access, through the flock, to a larger store of knowledge of potential food resources. The erratic display flights before roosting were considered to be anti predator behaviour.

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The diet and foraging behaviour of the Red Kite in northern Scotland

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Red Kites have recently been successfully reintroduced to northern Scotland to an area with a presumed rich food supply. This study showed that the diet was composed mainly of Rabbits, both in winter and summer. Other important components of the diet were voles and terrestrial invertebrates in winter, and birds, particularly Corvids, in summer. The kites also scavenged on sheep and deer carrion, household refuse and fish. Red Kites foraged over pasture, stubble, woods, the foreshore and village gardens. They employed different foraging techniques: pouncing from the air, hawking insects, scavenging and kleptoparasitism. The scavenging of Rabbits killed on the road makes the kites vulnerable to collisions with traffic, whilst feeding on shot Rabbits makes them susceptible to lead poisoning

Introduction

Ninety three juvenile Red Kites *Milvus milvus*, translocated as nestlings from Sweden, were released in northern Scotland between 1989 and 1993 as part of a scheme to reintroduce Red Kites to Scotland, after a period of extinction of about 100 years (McGrady *et al* 1994). Successful breeding was first recorded in 1992 and there has been a steady growth in the population subsequently, reflecting the success of the scheme (Evans *et al* in press). The release sites were selected in areas of lowland farmland and woodland similar to Sweden where there are sufficient feeding and nesting habitats. Now that a breeding population is becoming established, their use of the habitat can be assessed. This paper describes the diet and foraging behaviour of the Red Kites both in winter and summer.

Methods

Many of the Scottish kites roost communally in woodland throughout the winter and early spring. The main communal roost was visited during January to April 1994 and 10 fresh pellets were sub sampled from a large number collected each month. The pellets were broken up for examination and larger items removed from the general matrix (Yalden 1977). The matrix was scanned under a microscope for earthworm chaetae and insect remains (eg chitinous jaws of caterpillars). Mammal hair identification was initially based on shape, size, texture and pigmentation. If identification was not achieved, microscopic analysis was then used. Casts of guard hairs were made on a film of 5% gelatin solution on a microscope slide. After the gelatin hardened, the hairs were removed and the imprint of the cuticular scale pattern was used for identification.

Finally, confirmation of identification was based on the pattern of medullary cells, viewed at a magnification of x400, of hairs mounted in 70% ethanol (Day 1966). Bird identification was based on the lower barbs of feathers which were mounted in 70% ethanol, allowing the characteristics of the barbules to be seen at magnifications of x200 to x400 (Day 1966).

During the breeding seasons of 1994 and 1995, 8 and 14 nests were visited respectively and prey remains within and below the nests were identified and counted. If prey was dismembered, the numbers of limbs, wings and other identifiable parts were taken into account when counting items and minimum numbers estimated.

Results

Diet

In winter, the most frequently identified prey in pellets was the Rabbit, followed by sheep, voles, worms and insects (Table 1). Identified insects included caterpillars and beetles. Passerines included thrushes and Robins *Erithacus rubecula*.

In summer, the most abundant and frequently found prey item was again the Rabbit (Table 2). Corvids were the next most important prey. Three Chaffinch nests were found at Red Kite nests. It seems likely that the kites had plucked the entire nest from its site and eaten the contents.

Table 1 ***The percentage occurrence of prey items in 40 pellets of Red Kites in winter and early spring in northern Scotland. See Table 2 for scientific names.***

	January	February	March	April	All months
Sheep	40	30	30	20	30
Rabbit	90	80	50	60	70
Rat	0	10	10	0	5
Voles	20	30	30	40	30
Mice	0	0	20	0	5
Mole	20	30	0	20	18
Shrews	0	0	10	0	3
Ducks	0	10	0	0	3
Galliformes	0	20	20	20	15
Gulls	10	10	20	30	18
Pigeons	30	0	10	0	10
Corvids	10	10	10	30	15
Other Passerines	20	40	10	20	23
Worms	10	20	40	50	30
Insects	30	30	30	30	30
No of pellets	10	10	10	10	40

Table 2 ***The diet of breeding Red Kites in summer in northern Scotland in 1994 and 1995 from items identified at or near the nest.***

PREY ITEMS		1994 Percent by number	1994 Percent occurrence	1995 Percent by number	1995 Percent occurrence	Both years Percent by number	Both years Percent occurrence
Rabbit	*Oryctolagus cuniculus*	51.5	100	59.2	93	55.2	95
Brown Hare	*Lepus capensis*	-	-	0.8	7	0.4	5
Voles		3.7	38	0.8	7	2.3	18
Mole	*Talpa europaea*	0.8	13	-	-	0.4	5
Brown Rat	*Rattus norvegicus*	0.8	13	1.6	14	1.2	14
Sheep/lambs	*Ovis aries*	1.5	25	2.4	14	1.9	18
Hedgehog	*Erinaceus europaeus*	0.8	13	2.4	21	1.5	18
Roe Deer	*Capreolus capreolus*	0.8	13	-	-	0.4	5
Mussel	*Mytilus edulis*	0.8	13	-	-	0.4	5
Crab		-	-	0.8	7	0.4	5
Flounder	*Platichthys flesus*	1.5	25	0.8	7	1.2	14
Lumpsucker	*Cyclopterus lumpus*	-	-	0.8	7	0.4	5
Invertebrates		4.5	13	-	-	2.3	5
Piece of lard		0.8	13	-	-	0.4	5
Piece of roast meat		-	-	0.8	7	0.4	5
Shag	*Phalacrocorax aristotelis*	0.8	13	-	-	0.4	5
Domestic hen	*Gallus gallus*	-	-	0.8	7	0.4	5

Table 2 contd ***The diet of breeding Red Kites in summer in northern Scotland in 1994 and 1995 from items identified at or near the nest.***

PREY ITEMS		1994 Percent by number	1994 Percent occurrence	1995 Percent by number	1995 Percent occurrence	Both years Percent by number	Both years Percent occurrence
Pheasant	*Phasianus colchicus*	-	-	4.0	21	1.9	14
Waders		0.8	13	-	-	0.4	5
Herring Gull	*Larus argentatus*	1.5	13	0.8	7	1.2	9
Gulls		4.5	25	-	-	2.3	9
Feral Pigeon	*Columba livia*	1.5	25	0.8	7	1.2	14
Woodpigeon	*Columba palumbus*	6.0	38	8.0	36	7.0	36
Swallow	*Hirundo rustica*	-	-	0.8	7	0.4	5
Song Thrush	*Turdus philomelos*	-	-	0.8	7	0.4	5
Chaffinch	*Fringilla coelebs*	0.8	13	-	-	0.4	5
Chaffinch nest		1.5	25	0.8	7	1.2	14
Corvids		15.7	100	12.8	57	14.3	73
Number of items		134		125		259	

As well as preying and scavenging on small mammals and birds, the Red Kites also scavenged on larger mammals (sheep and deer) and on household refuse (pieces of lard and roast meat). The kites also visited the seashore to obtain marine invertebrates, fish and dead seabirds (auks and gulls).

Foraging behaviour

Red Kites foraged in a variety of habitats and employed a number of feeding methods. A commonly observed hunting method was a slow flight 3-5 m above the ground before pouncing on small mammals in fields of pasture and stubble. Food became unavailable on pastures when the grass became long but when silage was cut in May small mammals became available again. A harvested pea field attracted many birds of prey with a maximum count of 18 Red Kites plus 22 Buzzards *Buteo buteo.* In spring, Red Kites were seen on freshly ploughed land along with gulls and Buzzards, feeding on worms and, presumably, other invertebrates.

Away from farmland, a Red Kite was seen swooping down from a perch in a Beech *Fagus sylvatica* wood to catch a small mammal and kites were seen taking moths from Heather *Calluna vulgaris.* Red Kites are very manoeuvrable in flight and were seen hawking large insects, perhaps crane flies *Tipulidae.* They also visited rookeries during the breeding season in search of young Rooks *Corvus frugilegus,* despite being persistently mobbed by adult Rooks.

Kleptoparasitism was observed against a Kestrel *Falco tinnunculus,* robbing it on the ground of a rat, and a Sparrowhawk *Accipiter nisus,* robbing it in flight of a Blackbird *Turdus merula.* An immature Red Kite was also seen snatching a broken Mussel *Mytilus edulis* which a Hooded Crow *Corvus corone* had just dropped on the foreshore and was about to retrieve (B Etheridge *pers comm).* Mussel shells were regularly found below roosting trees during the winters 1994-1996 suggesting that the kites obtain many Mussels.

Rabbits and Pheasants *Phasianus colchicus* which had been killed on the road were observed being scavenged. This hazardous behaviour has led to at least 3 Red Kites being struck by cars. Red Kites also scavenged Rabbits that had been shot and left in fields by farmers. Scavenging in villages was also observed. At least 4 households left out food for Red Kites in gardens or on bird tables. The food provided included Rabbits, mice, birds and fish protein pellets. Other food not specifically put out for Red Kites was also taken. This included lard, cooked meat, bread and kitchen slops.

Discussion

Prey from the 2 seasons was identified using different methods, both of which have inherent and different biases. Pellet analysis revealed that the Red Kites were eating earthworms, even in winter. None were, however, found as prey remains at nests. Such small items are probably eaten entirely and any remains quickly disintegrate. It is likely, in the pellet analysis, that prey containing little indigestible material would be less likely to be found than prey with a high amount of indigestible material. Remains of smaller animals are also more likely to be overlooked than those of larger animals.

The diet of Red Kites in northern Scotland showed some similarities and contrasts to elsewhere. In Sweden, the country of origin of the birds released in Scotland, Red Kites primarily take road kills and waste from farms and rubbish dumps in winter (Kjellén 1996).

During the breeding season, however, their diet is broader and based mainly on birds (76% of items), particularly young Corvids, but also Pheasants, gulls, pigeons and Starlings *Sturnus vulgaris*. Rabbits and small rodents make up most of the mammal prey. Those nesting close to lakes take many fish (Kjellén 1996). The main contrast with Sweden is, therefore, the differing percentages of Rabbits: 55% by number in Scotland compared to 5% in Sweden.

The main contrast with the diet of the native Red Kite population in Wales is in the relative use of sheep carrion (Davies & Davis 1973). This is a major food source the year round and appears to be peculiar to the sheepwalks of Wales. Elsewhere in the range of the Red Kite, sheep carrion is of minor importance (Cramp & Simmons 1980). The recent development of a new roost in northern Scotland in an area of sheep walk will, however, probably result in a greater use of sheep carrion.

In the southern part of their range in Europe, Red Kites take many reptiles (Garzón 1974, Manzi & Pellegrini 1992) which are absent from the diet in Scotland.

If Red Kites continue to use Rabbits as a major food source, there is a concern that the current spread of Rabbit Haemorrhagic Disease may severely reduce the Rabbit population as did Myxomatosis when it first appeared. This may have a detrimental effect on the Red Kite population as it continues to establish itself in Scotland. Of more immediate concern is that by scavenging on Rabbits killed on the road, the kites themselves become vulnerable to being killed by cars. Their habit of scavenging shot Rabbits also means that they are likely to ingest lead shot which can result in lead poisoning (Pain *et al* 1993).

It is likely that the success of the reintroduction, in terms of good breeding performance and population growth (Evans *et al* in press), is in part due to the plentiful supply of Rabbits which forms much of the diet. The area where most Red Kites are nesting also has a high density of Buzzards which also prey on Rabbits (Swann & Etheridge 1995). At present, there is no overt indication that the 2 species are competing, suggesting that prey is super abundant.

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The late Lorna Wildman

Breeding biology of Swallows in Easter Ross

D P BUTTERFIELD & A D K RAMSAY

During the 1980s the Swallow population steadily declined, especially in south and east England, and the species is now considered to be of conservation concern. This study monitored the number of Swallows breeding in an area of Easter Ross, Highland, over a 3 year period and examined their breeding success. Results are compared with other studies and possible causes of decline in the numbers of breeding Swallows discussed.

Methods

We decided to study the numbers and breeding success of Swallows *Hirundo rustica* breeding in Easter Ross to compare this population with breeding Swallows studied elsewhere in the UK. During the summers of 1992-1994 regular visits were made to an area of Easter Ross to record the contents of every accessible Swallow nest and to ring the nestlings. Each nest was visited once every 7 to 10 days between mid May and mid September by which time the last young birds had left the nest.

The study area consists of a series of derelict wartime buildings on a disused airfield at Fearn and Loans of Tullich. Less than 10m asl, the site covers approximately 4sq km of mainly arable farmland, with some improved grassland grazed by sheep and cattle. A variety of nest sites are available, ranging from low concrete air raid bunkers less than 2m high, to tall brick towers over 5m high. The outbuildings of a disused croft are also utilised. Human disturbance is considered to be minimal, although some buildings are used on a casual basis by sheltering livestock.

Each room in a building which contained an active or old Swallow nest was numbered to avoid any confusion when recording contents. Because of the large number of nest sites available, each room generally held only one pair of Swallows. Occasionally a large room, or a long corridor within a building, held 2 pairs at opposite ends. These nests were generally out of sight of each other, although they sometimes shared a common entrance. It was assumed that, after a successful nesting attempt, a further nesting attempt in the same room was initiated by the same pair. There was no evidence to suggest that pairs moved to a different building, or room, after a successful first brood. Occasionally, however, after a failed first attempt a new nest was started in an adjacent unoccupied room within the same building. This was assumed to be the same pair relocating. In 1992 a small number of nests were not accessible but it was still possible to include these in the total number of breeding pairs and to determine their success or failure.

First egg dates were calculated assuming an incubation period of 15 days. This was based on observations of nests where the date of laying of the final egg and the date of hatching were both known. This assumes that incubation began with the laying of the final

egg and that eggs were laid at one day intervals. This period also closely follows Adams (1957) who found a mean incubation period of 15.25 days from an analysis of national nest record card data.

During the autumns of 1992-1994 regular visits were made to the reed bed roost at Loch Achnacloich, near Ardross in Easter Ross. Here we tape lured and trapped Swallows for ringing between mid July and mid September. All birds caught were aged as adults or juveniles according to Svensson (1992).

Results

Breeding numbers

Although full data were not collected during the 1991 breeding season, the study site was visited on a regular basis to ring the nestlings. At this time the population stood at 90-95 pairs. Numbers were lower at 69 pairs in 1992, 50 pairs in 1993, and 38 pairs in 1994, the population having fallen by 45% between 1992 and 1994. Further visits were made in 1995 and 1996 to ring nestlings and count the total number of pairs. The population in 1995 was found to have further declined to 30 pairs but had stabilised at 30-31 pairs in 1996.

Timing of breeding

Generally the first eggs were laid around the middle of May, however the peak laying period varied, with median dates for first eggs being 24 May (n=56) in 1992, 26 May (n=38) in 1993 and 29 May (n=31) in 1994. Most clutches were begun by 10 June. In each of the 3 years less than 10% were begun between then and the latest recorded date of 25 June in 1992. After successfully rearing a first brood there was a delay of between 2 and 25 days before a second clutch was started. The average delay was 11.9 days (n=78, sd =4.04). Additionally 2 pairs are known to have started a second clutch in an adjacent nest in the same room 2 days before their first brood had fledged. There was no evidence of any attempts to rear a third brood following 2 successful attempts. Only one pair managed to successfully rear 2 broods after their first nesting attempt had failed at an early stage. There were no records of any pairs starting a third nesting attempt when their second attempt had failed after a successful first attempt. Most fledgling swallows had left the nest by the end of the first week in September with the latest recorded date being 17 September 1992.

Clutch size

In the study area the clutch size ranged from 3 to 6 eggs, with one exceptional clutch of 7 which fledged 7 young. The average clutch size varied little between years, being 4.81 (n=96, sd=0.68) in 1992, 4.82 (n=72, sd=0.63) in 1993 and 4.81 (n=57, sd=0.63) in 1994. The average size of clutches begun in each month showed a steady decline from 5.05 in May (n=89, sd=0.62) to 4.73 in June (n=41, sd=0.70) and 4.61 in July (n=92, sd=0.59). June clutches were significantly smaller than May ones ($t = 4.051$, $p < 0.01$). July clutches were not, however, significantly smaller than June ones ($t = 1.622$, ns). The only clutch started in August contained 4 eggs. The average first clutch size was 4.96 (n=124, sd=0.68) and the average replacement clutch of 4.92 (n=14, sd=0.46) was not significantly different. The average second clutch size of 4.61 (n=80, sd=0.58) was, however, significantly smaller ($t = 5.833$, $p < 0.01$) than the first clutch. During the 3 years of our study 4.3% of the 1078 eggs laid were found to be addled.

Breeding success

In the 3 year study period, one nest was deliberately destroyed by humans and one nest was predated, probably by a feral cat. The average number of young fledged per nest was 3.34 (n=103, sd=1.94) in 1992, 3.40 (n=85, sd=2.08) in 1993 and 4.00 (n=60, sd=156) in 1994, showing no significant variation between years. The average for the 3 year study period was 3.52 (n=248, s.d.=1 .93). The number of pairs successfully rearing 2 broods was 43.5% (n=62) in 1992, 44% (n=50) in 1993 and 52.6% (n=38) in 1994. There was no significant variation between years (x^2 = 0.78, ns). The number of young fledged per pair varied from none to 13, the average being 5,55 (n=62) in 1992, 5.78 (n=50) in 1993 and 6.45 (n=38) in 1994. This again showed no significant variation between years and overall averaged 5.85.

Another way of measuring breeding success is to calculate the number of young fledged as a percentage of the total number of eggs laid in nests of known outcome. This showed a steady increase from 74.46% (n=462) in 1992, to 83.29% (n=347) in 1993 and 87.59% (n=274) in 1994. This gives a 17.6% increase in breeding success between 1992 and 1994, which was highly significant (x^2 = 26.705, $p < 0.001$). This was partly due to very few pairs, 3 out of 38 (7.8%) failing to rear any chicks at all in 1994, compared with 15 out of 112 (13.4%) in 1992-93.

Autumn trapping

The percentage of juvenile Swallows trapped at Loch Achnacloich in autumn remained stable at 88.5% (n=1052) in 1992, 88.21% (n=653) in 1993 and 88.36% (n=524) in 1994. However the total numbers of birds trapped mirrored the decline in population levels in the study area, the trapping effort being fairly constant. Ringing recoveries of birds trapped at this site indicate that they are predominantly of local origin with only a very small number of birds from further north being trapped on passage.

Discussion

The average clutch size of 4.81 is slightly higher than the average of 4.66 found by McGinn and Clark (1978) in Lothian, and the 4.01 to 4.09 found by Boyd (1936) in a sample biased towards southern Britain. This lends further support to the findings of Boyd (1936) who states that average clutch size should increase with latitude. This suggests that there is an association between the longer hours of daylight in the northern summer and, therefore, more time to gather food for the nestlings, and larger broods. Average clutch size declined from May to July, confirming the findings of McGinn and Clark (1978) who found a decline from an average of 5.06 in May to only 4.08 in August, and Adams (1957) who found an average of 4.7 in April decreasing to 4.3 in July. The 4.3% of eggs addled is a much lower figure than the 7.2% given by McGinn and Clark (1978) and the 10% quoted by Boyd (1936).

The number of young birds fledged as a percentage of the number of eggs laid suggests a possible density dependent effect where breeding success increased as the number of pairs decreased. The figures of 74.5% in 1992 rising to 87.6% in 1994 show that the population enjoyed better breeding success in 1993 and 1994 than the populations studied by McGinn and Clark (1978) and Adams (1957), who give figures of 76.3% and 71.9% respectively.

Between 1992 and 1994 the number of Swallows breeding in the study area fell by 45%, and, despite the apparent increase in breeding success, continued to decline in 1995. There is no evidence to suggest that this was due to emigration from the study area to other parts of Easter Ross. During the period 1991 to 1994 visits were made to many other sites in Easter Ross to find Swallow nests and ring the nestlings. Many pairs nesting in isolated farm buildings and old croft houses are known to have also disappeared at this time. Evidence suggests that the number of pairs breeding near Nigg, some 6km south of the study site, fell by more than 60% during the study period (*pers obs*). Swallows are known to be very site faithful (Turner 1994), with adult birds frequently returning to breed at exactly the same site each year. Juveniles are also known to return to breed close to their natal area. The habitat in the study area appeared to remain stable throughout and the lack of change in breeding success suggests that local environmental effects had no part to play in the decline.

According to Turner (1994), first year mortality of juvenile Swallows ranges between 70% and 90%, and annual mortality of adults between 43% and 73%. If we take the middle value of these ranges (ie 80% mortality for juveniles and 58% for adults), then it is possible to calculate that an average of 5.8 young fledged per pair per year should be sufficient to sustain the population. Based on these figures, the Easter Ross population appears to be producing enough young each year to maintain itself at a stable level, the annual production of young birds ranging from 5.55 to 6.45 young fledged per pair. This suggests that the reason for the decline lies elsewhere, either during the non breeding season in southern Africa, or on passage to or from this area.

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A survey of Storm Petrels on the Treshnish Isles in 1996

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A survey of Storm Petrels in all accessible habitat on the Treshnish Isles was undertaken during 9-29 July 1996. The survey method used was diurnal playback of the male's 'purr' song. To estimate the population of Storm Petrels, it was necessary to determine the probability that a bird would respond to playback. To estimate this, playback was repeated over 8 successive days at stone wall and boulder beach sample plots. On the assumption that all occupied burrows were located over the 8 successive visits, it was possible to calculate that any single playback visit elicited responses from 36% of occupied burrows. Using this response probability the total population of breeding pairs of Storm Petrels on the Treshnish Isles in 1996 was estimated to be 5,040. The majority of Storm Petrels 3,120, were present on the island of Fladda which was largely surrounded by suitable boulder beach habitat. Most colonies were in boulder beach, or scree, or rubble mixed with soil with some short ground vegetation. There was a higher density of birds in this type of habitat when the boulders had a covering of tall vegetation.

Introduction

The Storm Petrel *Hydrobates pelagicus* is the smallest of the Atlantic petrels with a breeding distribution limited to the western Mediterranean and coasts of the eastern north Atlantic. Storm Petrels have amber listed status (Gibbons *et al* 1996) with breeding populations localised in the UK, virtually endemic to Europe and threatened by the possible introduction of mammalian predators. In the UK the majority of colonies occur on offshore islands along the west coast. The Treshnish Isles are a string of small islands west of Mull which were designated a Special Protection Area in 1994 under the EC Wild Birds Directive (Fig 1). The only surveys of the breeding birds on the Treshnish Isles over the last 20 years have been by the Treshnish Isles Auk Ringing Group (Walker and Cooper 1996). They estimated that 2,000 pairs of Storm Petrel bred in the large boulder beach on Lunga. This number was estimated by measuring the area of the beach and assuming one pair of Storm Petrels was present in each square metre. The apparently high density was confirmed by the large numbers of birds seen and caught in mist nets at night. Walker and Cooper (1996) also found Storm Petrels on the island of Fladda and thought it likely that they would occur on all of the larger islands in the Treshnish group.

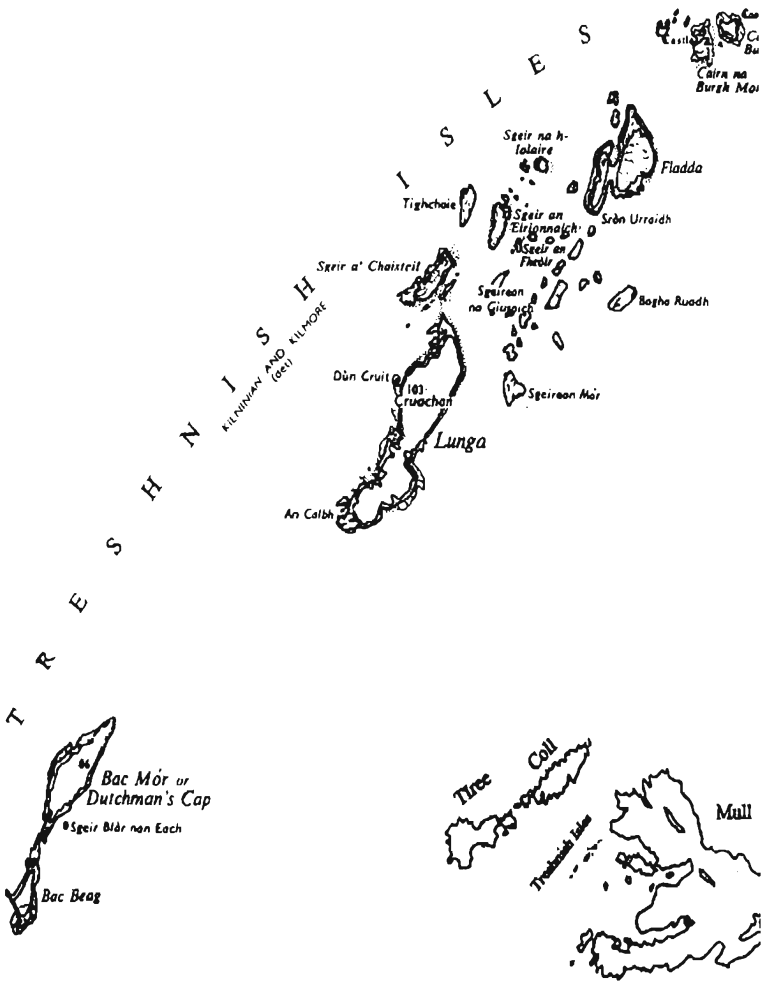

Figure 1 ***The Treshnish Isles.***

Timing

Fieldwork was carried out between 9 July 1996 and 29 July 1996 in order to coincide with the peak of the incubation period, when the largest numbers of birds are on eggs. It was assumed that peak incubation would be between the known peak dates for Skokholm (approximately 10 July) and Mousa (approximately 2 August) (Ratcliffe *et al* 1996).

Sample survey plots

It was necessary to estimate a mean response probability using sample survey plots of representative habitat types. Plots of wall habitat and boulder beach habitat were chosen on the island of Lunga as sites where playback was repeated during the day for 8 days (10 July 1996 to 17 July 1996). The time of day of playback was varied. A total of 260m of wall was sampled in 8 separate sample lengths in various parts of the island. Five areas of boulder beach were selected in the area of the landing beach at Lunga where previous observers had noted large numbers of birds. Each boulder beach sample plot was 25 m^2, (5x5 m). The tape (a good quality recording of a purring male from Mousa) was played back at the base of each wall at 1m intervals and from the same positions every day. The 5 boulder beach quadrats were each marked into 25 x lm squares using white matt removable spray paint. The tape was played back in the centre of the 25 squares on each visit. Playback lasted 10 seconds, each response, and its type, was noted and the burrow entrance numbered. Numbers were written with waterproof markers onto strong adhesive tape which was stuck to the entrances. This proved very effective; none of the tape was washed off during the survey, but it was all quickly removed at the end. In an attempt to control for any effect of site and plot, the boulder beach plots were on different aspects of the boulder beach. This resulted in the plots having different mixes of boulder size, different amounts of vegetation cover and different mixtures of boulder and soil. The wall sample plots were of different lengths, heights and thickness. They faced the sea in north, south, east and westerly directions.

Calculating response probability

The data on detection probability (response/ no response) were analysed using logistic regression. It was assumed that each site in each habitat was detectable over the 8 days of repeated sampling. Habitat (wall or boulder beach) and visit number (1-8) were included in the regression model as categorical variables. A forward stepwise method was used with a likelihood ratio probability of 0.05 as the maximum criteria for inclusion in the model. This analysis would detect any overall effect of the habitat type (wall vs boulder beach) on the likelihood of getting a response, or an effect from the different visits themselves, as well as providing a figure for the probability of detection.

Whole islands survey

All potential Storm Petrel breeding habitat was surveyed once during daylight hours using the same method of song playback as for the sample plots. The same tape and playback equipment were used as for the sample plots. The type of response was noted. If faint or unrecognisable calls were heard the playing of the tape was repeated to elicit further response. This was also sometimes necessary to clarify the situation for areas in which several birds responded simultaneously.

At wall sites the tape was played at the base

Study Site

The Treshnish Isles consist of 7 larger islands, Lunga, Fladda, Dutchman's Cap (Bac Mór), Little Dutchman (Bac Beag), Sgeir a' Chaisteil, Cairn na Burgh More and Cairn na Burgh Beg), 3 small vegetated islets (Sgeir an Eirionnaich, Sgeir an Fheòir and Sgeir na Giusaich) and a large number of skerries. All of the larger islands are surrounded to some extent by sheer cliffs, with gullies and boulder scree, but the extent to which the boulder scree is covered by the high water mark varies between islands. The larger islands have very distinctive terraced outlines caused by weathering of Tertiary basalt (Walker and Cooper 1996). The islands have been uninhabited since about 1860, but the remains of walls, houses, churches, garrisons and other buildings are present on all the larger islands.

Methods

There is no standardised method of counting breeding Storm Petrels and, therefore, there has been no accurate monitoring of the breeding population. The world population of Storm Petrels has been estimated at between 135,000 and 380,000 pairs with an estimated British population of between 20,000 and 150,000 pairs Lloyd *et al* 1991). Recent studies (Mainwood *et al* 1997; Ratcliffe *et al* 1996; Vaughan and Gibbons *in press)* discuss census methods such as nocturnal mark and recapture studies using mist netting data and nocturnal counts of vocalisations. However, they suggest that diurnal playback of the male's song is the best method currently available. Diurnal playback is preferable to nocturnal surveys, as surveying in daylight is less hazardous, allows more accurate mapping and enhances visual detection of suitable habitat. There is also an unknown proportion of burrows occupied by non breeding birds which is larger at night than during the day (Mainwood *et al* 1997*)*.

Response probabilities

Diurnal playback will not detect every pair of breeding birds in a single visit and to calculate the total population it is necessary to obtain a correction factor based on response probabilities. A tape played back at a burrow entrance may fail to elicit a response either because there is no adult in the burrow or the adult may fail to respond. These 2 factors combine to give an overall response probability. Almost every survey which has used the diurnal playback method has come up with a different correction factor and therefore a different way to calculate the overall population. Mainwood *et al* 1997 use the mean figure from 2 studies, giving a correction factor of 74%. These studies (on Skokholm and Mousa) used an equation from James and Robertson (1985) to derive response probabilities for nest sites where the presence of birds was known. The overall response probability was estimated in the present study by repeatedly sampling occupied habitat types which initially contained unknown numbers of Storm Petrels and without the use of James and Robertson's (1985) equation. Using a similar procedure Vaughan and Gibbons *(in press)* found a 34% response probability.

The aims of this project were to investigate the probability of diurnal detection of Storm Petrels on the Treshnish Isles in order to estimate the size of the breeding population.

Additional data on playback response types were also collected to allow a population estimate to be calculated using other published methods.

of one side of the wall at 1m intervals, and for higher walls again at 1m intervals at a height of 1m. Boulder beaches were surveyed by 2 people using playback in 1m parallel transects. In areas where the boulder scree was half buried in the soil and widely distributed on island tops, any gaps under boulders and potential burrows were surveyed. Thick bracken, caves and accessible cracks in cliffs and rocks were also surveyed. Areas where individuals were separated by more than 10m were considered to be different groups. Each group was plotted on a map of the island being surveyed and the number and type of responses were recorded.

On several occasions the locations of small discrete groups of Storm Petrels were initially discovered by listening at night. With complicated shorelines and cliffs of various heights, it was also found that use of a boat was extremely helpful. The only areas that were not surveyed were those such as cliff faces that were inaccessible.

We compared the estimated populations of Storm Petrels on each island calculated from our own repeated sampling with those calculated from an equation formulated by James and Robertson (1985) in their playback studies.

Habitat

The type of habitat was noted for each group and where possible an estimate of the area of the habitat occupied by Storm Petrels was made in the field and from maps. The length and height of walls was estimated to allow area comparisons with other non-linear habitats. The habitat occupied by Storm Petrels on Treshnish could be split into 8 basic categories:

1 Boulder beach, not mixed into a composite with soil, with no vegetation cover

2 Boulder beach, or scree, or rubble and soil composite with some short ground vegetation, but no tall vegetation cover

3 Boulder beach, or scree, or rubble and soil composite with some short ground vegetation, but also with tall vegetation cover

4 Walls still relatively intact with tall vegetation cover

5 Walls still relatively intact with no tall vegetation cover

6 Caves

7 Cracks in cliffs

8 Burrows in soil

Tall vegetation cover was either Bracken *Pteridium aquilinum*, Bramble *Rubus fruticosus*, Bramble and Honeysuckle *Lonicera periclymenum*, or Nettles *Urtica dioica*. Short ground vegetation was mostly grasses.

Results

Over the 8 daily visits a total of 57 occupied Storm Petrel sites were detected in the boulder quadrats and 83 in the wall plots. Logistic regression analysis revealed no overall effect of habitat type ($P = 0.212$; $df = 1$; $G^2 = 1.56$) or visits ($P = 0.062$; $df = 7$; $G^2 = 13.45$) on response rates. The probability of getting a response to playback from any site on any day was 0.36.

Table I ***Number of groups, number of responses to playback recorded and population estimates based on the 36% response rate found in the present study from repeated playback at sample plots and on James and Robertson's (1985) equation.***

Island	No of groups	Total No of responses	Number of "purr" responses	Number of "terr-chick" responses	Population est based on James & Robertson's (1985) equation	Population est based on 36% response rate
Lunga	50	332	91	241	515	922
Sgeir a' Chaisteil	3	31	7	24	52	86
Dutchman's Cap Bac Mór	11	70	27	43	90	194
Dutchman's Cap Bac Beag	3	19	7	12	25	53
Fladda	27	1,123	300	823	1,762	3,119
Cairn na Burgh Beg	5	8	4	4	8	22
Cairn na Burgh More	12	232	63	169	362	644
Treshnish Isles Total	111	1,815	499	1,316	2,814	5,040

The playback response probability of 0.36 was applied as a correction factor to the playback responses recorded in the whole islands survey. Table 1 gives island by island population estimates using both our own 0.36 correction factor and James and Robertson's (1985) equation.

Most of the groups (87%) were recorded in habitat types 1 to 5 with habitat 2 hosting the most groups (47%). The density of each Storm Petrel group was measured as total responses per 10 m^2. Table 2 shows the mean density for each of the 5 important habitats. There was a significant difference in the density of Storm Petrels amongst the 5 habitat types (Kruskal-Wallis one way analysis of variance; H = 27.1; df = 4; P=0.0001), with walls holding the highest densities. Of the boulder/scree habitats (1-3) there was a higher density of Storm Petrels amongst boulders which had some tall vegetation cover (habitat 3) (Mann Whitney U test; U = 204; 2- tailed P = 0.042; n_1 = 10, n_2 = 68).

Discussion

This was the first comprehensive survey of Storm Petrels on the Treshnish Isles. The total breeding population was estimated to be 5,040. Using James and Robertson's (1985) equation the population was estimated to be

Table 2 ***The mean density of Storm Petrels in 5 different habitat types, where density is measured as the number of pairs per 10 m2 in each group. The Storm Petrel groups are from all of the Treshnish Isles and the habitat types (1-5) are explained in the text.***

Habitat Type	No. of Groups	Mean Group Density (Pairs/10m²)	Standard Error
1	16	0.098	0.018
2	52	0.345	0.099
3	10	0.606	0.332
4	3	0.642	0.216
5	16	1.36	0.338
Total	97		

2,814. Our correction factor of 36% calculated to assess the probability of a Storm Petrel responding to playback was similar to the 34% calculated by Vaughan and Gibbons *(in press)*. We believe that the application of the 36% response rate found on site gives a better representation of the actual population than that of an unrelated response rate (eg Mainwood *et al* 1997; James and Robertson 1985).

The figure of 2,000 breeding pairs estimated by Walker and Cooper (1996) for the landing beach at Lunga is considerably higher than our estimate of about 350 pairs for the same area. Walker and Cooper's (1996) estimate was made at night when birds move around and additional non breeding birds come in to land, inflating the apparent population size. Also, this boulder beach faces nearby Fladda where by far the most Storm Petrels were found during the present survey. Therefore, the differences in estimates for the landing beach at Lunga are probably due to an initial overestimate rather than representing a decline in numbers between the 2 dates. It is also true, however, that without Walker and Cooper's (1996) observations of the large numbers of Storm Petrels in this area, the present survey may not have been initiated. The population estimate of 5,040 breeding pairs of Storm Petrels on the Treshnish Isles may include some non breeding birds. However the proportion of non breeding birds within colonies is highest during the night and is thought to be less significant during the day (Mainwood *et al* 1997). It is impossible to say how many Storm Petrels were missed by not surveying inaccessible places.

The diurnal playback method used to carry out the survey was straightforward and practical. The playback equipment was light and could be used with one hand. Much of the terrain surveyed was quite dangerous and it was important to have one hand free. One of the main advantages of the survey was the flexibility of being able to work at any time of

the day. Some caves, gullies and islands could only be visited when tide conditions allowed and much of the terrain could not have been covered if a night time survey had been used. The method is also repeatable which allows for future monitoring of part or all of the Treshnish Isles. Results from playback experiments on Mousa show that the time of day does not significantly affect the response rate (Ratcliffe *et al* 1996), although the repeat playback carried out when responses were weak or confused may have occasionally located new birds and slightly increased the number of responses noted.

Although the method was as standardised as possible it is still unclear why the response rate is so low. There are many factors which may influence the probability of a bird responding for example: the stage of the season; the number of days a bird has been incubating (Mainwood *et al* 1997); the volume of the speakers; the particular male song used for playback and the strength and direction of the wind. Variation in these factors between surveys and between sites could lead to differences in response rates.

Mainwood *et al* 1997 found most Storm Petrels in peat burrow systems and in peat cracks under heather. On the Treshnish Isles the densest groups were found in walls and boulder/scree particularly when covered by tall vegetation. There may be some advantage to Storm Petrels to breed amongst boulder piles covered by vegetation, rather than bare boulder piles. They must be at their most vulnerable to predation as they land and a cover of thick vegetation may offer some protection from predators, such as Great Black-backed Gulls *Larus marinus*.

Storm Petrel *Andrew Stevenson*

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The status of Storm Petrels on Mousa, Shetland

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The population status of Storm Petrels on Mousa was estimated from a diurnal playback census during the incubation period. Sample sections of drystone wall and transects in all occupied natural sites (boulder beaches and rock scree) were surveyed using playback of male purr calls and responses of birds in Apparently Occupied Sites (AOSs) were counted. Boot strapped means of AOS density were calculated within walls and natural sites and extrapolated to the entire area of these habitats. Observations of response rates at a sample of accessible nest sites suggested that only 25% of occupied nests respond to playback, so the estimates were multiplied by a correction factor. The population was thus estimated at 6,800 ± 2,000 Apparently Occupied Sites, with 56% occurring in the islands drystone walls and the rest in areas of boulder beach and rock scree. This estimate is higher than that found in 1992 for this island but the interpretation of the trends requires caution since the census methods differed between years.

Introduction

Storm Petrels *Hydrobates pelagicus* are difficult to census with any degree of accuracy due to their nocturnality, the presence and behaviour of large numbers of non breeders and the remoteness of their colonies (Lloyd *et al* 1991). The nesting habitats include cracks in rock or peat, burrows in soil and in cavities among boulder scree, boulder beaches and in dry stone walls. In the latter 3 cases there are no apparent entrances to the nest to count, and so this further complicates census work.

The estimates of Storm Petrels status presented in Lloyd *et al* (1991) are little more than guesses at the abundance on known breeding islands. These figures suggest that the Storm Petrels in Britain and Ireland represent 51-65% of the world population, the other main population being in the Faroes (Lloyd *et al* 1991). This species is thus of major conservation concern in Britain and Ireland on the basis of its international importance, so it is essential to develop methods to monitor their populations. Mousa is thought to support an important Storm Petrel colony and Lloyd *et al* (1991) estimated the population of the island to be between 1,000 and 10,000 pairs. Mapping the location of calling birds at night has subsequently been used to estimate the population there more accurately (Suddaby 1992), giving an estimate of 4,500-5,000 calling birds. James and Robertson (1985) advocated the use of diurnal playback of conspecific calls to elicit

vocal responses from incubating birds as a method for censusing petrels, and this has been applied to several British Storm Petrel colonies. During July, when birds are incubating, the burrow occupancy for Storm Petrels is high (Davis 1957, Scott 1970, Bolton 1996) and playback of the male purr call (James 1984) will elicit a proportion of the birds present to reply. In order to calculate the population status, the attendance and response probability must be known and a correction factor based on these data applied to the initial estimate (James and Robertson 1985). Estimates of diurnal response rate for Storm Petrels have varied between 0.25-0.75 (for review see Ratcliffe *et al* 1997a).

This report presents data from a sample census of Mousa using diurnal playback methods in 1996. During this year detailed studies of response probabilities and attendance were carried out at known nest sites (Ratcliffe *et al* 1997a), thus allowing accurate correction factors to be generated for Mousa in the same year as the census.

Study site and methods

Mousa is a small, low lying island situated off the coast of south west Shetland. It has 15 visually distinct, natural areas of loose rocks and boulders in which Storm Petrels can be found. All of these, except the Broch boulder beach, are well above and set back from the intertidal zone. They range in type from very rounded boulder beach through to piles of flat sandstone slabs with varying amounts of vegetation and earth among the stones. The drystone walls on the island are less than 1m thick and are in varying states of repair, with many sections containing both intact and ruined lengths.

The whole island was surveyed for sub colonies at night by listening for purr calls during May when males are most vocally active (Scott 1970, Ratcliffe *et al* 1996) and their locations were plotted on a large scale map. The census work was carried out between the 26 July and the 9 August when most breeding birds were thought to be incubating eggs or young chicks (Bolton unpublished data). Breeding in 1996 seemed to be earlier than in 1992, with the peak of nest attendance being highest in mid July (Ratcliffe *et al* 1997a), resulting in the latter part of the census being marginally late.

A recording of a male Storm Petrel purr call (James 1984) that was recorded on Mousa was used for the playback survey. The sound equipment was a personal stereo with amplified speakers. In all habitats, the playback volume was 80dB and this was played for 10 seconds duration. Any responses elicited during a 30 second period following the playback were noted. The walls on the island were divided into 100m lengths and 10 of these sections were selected at random for survey. The tape was played along the base of the walls because Storm Petrels only nest at ground level on Mousa. The tape was played at 1m intervals along one side of the walls because a recording played 1m from a nest produced similar response rates to those played right next to it (Ratcliffe *et al* 1997a).

All of the 15 separate areas of natural habitat were sampled using 1m wide parallel transect lines spaced at 5m intervals. Transects started and finished at the first and last section of suitable habitat and so were variable in length. The tape was played every 1m along the middle of each transect if the point was over apparently suitable nesting habitat (ie scree with cavities that would be large enough to

accommodate a Storm Petrel nest). The Broch boulder beach was sampled using 4 randomly selected 25m^2 quadrats. The tape was played at the intersections of a 5 x 5 m grid plotted within the quadrant.

The number of responses from adult birds for each sample was summed and divided by the length of wall or the area of natural sites to give an estimate of the density of AOSs (Apparently Occupied Sites). Calls from chicks were not included in final census estimates as the correction factor used to estimate the numbers of birds missed during playback census is based on adult response only.

The total length of walls on the island were measured directly using a 100m tape measure. The total area of natural habitat was estimated by multiplying the length of the habitat by its mean width, the latter derived from measures of width along the transect lines. Not all of the habitat within a sub colony is suitable as nesting habitat for Storm Petrels and so at 1 m intervals along each transect the habitat was scored as suitable or not suitable. This measure was used to calculate the percentage of nesting habitat in each sub colony and the total area within the perimeter boundary was corrected using this percentage to give an estimate of the total area of nesting habitat.

Estimation of the population

The densities of AOSs in the 100m stretches of walls and in transects within natural habitat were calculated. Analyses were conducted within these habitat types as the units of measure differed (walls: AOS/m, natural habitats: AOS/m^2). Inspection of the frequency distribution of AOS's revealed that the data were strongly skewed towards low values, suggesting that AOS distribution was clumped, so the arithmetic calculation of means and confidence intervals was inappropriate as this assumes a normal distribution. Instead, a bootstrapping procedure was used to resample the density data and produce a frequency distribution of possible mean values for which the arithmetic mean and CIs could be calculated (Westfall and Young 1993). The bootstrapped mean AOS density and upper and lower 95% confidence intervals (CIs) were then extrapolated to the total length of wall or area of natural habitat.

A correction factor was applied to estimate the number of birds that were breeding but did not respond to the playback. Studies of response rates in known Storm Petrel nest sites (Ratcliffe *et al* 1997a) showed that the probability of a bird responding was 0.25 (Lower 95% CI = 0.23, Upper 95% CI = 0.27) giving a correction factor of 4 (Lower 95% CI = 3.7, Upper 95% CI = 4.3). These figures were multiplied by the estimates of detected AOSs to give an estimate of the population status and the confidence limits around this estimate. The figures for natural habitats and walls were finally summed to give an estimate of the total island population on Mousa.

Results

The census of the 10m sections of wall habitats found that the sample mean AOSs detected per metre of wall was 0.15, although the bootstrapped mean was 0.19. This difference was due to bias of the sample mean, since it is based on a small sample and the variance is quite large. The total length of walls on Mousa was 4,923m and the mean number of AOS's per metre was extrapolated by the bootstrapped mean to give an estimate of 950 detected AOS's (Table 1). Correction

factors were applied to this figure to estimate the number of birds that were present but did not respond to playback. This produced an estimate of 3,800 AOSs in wall habitats (Lower 95% CI = 2,823, Upper 95% CI = 4,592, Table 1).

In natural habitats, the sample mean density of AOSs was 0.08, which was exactly the same as the bootstrapped mean. The estimated total area of the apparently suitable natural habitat was 9,596m^2. The extrapolation of the mean detected density by the total area gave an estimate of 738 AOSs. Correcting this figure to allow for the number of sites that were undetected gives an estimated total of 2,956 AOSs in natural habitats (Lower 95% CI = 1,987, Upper 95% CI = 4,167, Table 2). These estimates of AOS abundance within habitat types can be summed to give an population estimate on Mousa of 6,759 AOSs (Lower 95% CI = 4,810, Upper 95% CI = 8,759). Rounding these figures to the nearest 100 AOSs to give a reasonable level of precision gives a final estimate of 6,800 AOSs (Lower 95% CI = 4,800, Upper 95% CI = 8,800). Further details of the locations of the habitats surveyed, the

Table 1 ***Calculation of population estimate for wall habitats.***

Parameter	Mean	Lower 95%CI	Upper 95% CI
Detected AOS density[1]	0.19	0.16	0.22
Extrapolated AOS Estimate[2]	950	763	1068
Estimated population [3]	3800	2823	4592

[1] Mean and 95% confidence intervals calulated from bootstrap estimates.
[2] Detected AOS density multiplied by the length of wall (4,923m).
[3] Estimated population after correcting for birds present but not detected. Correction factors are: Mean (^{2} x 4), Lower 95% CI (^{2} x 3.7), Upper 95% CI (^{2} x 4.3).

Table 2 ***Calculation of population estimate for natural habitats.***

Parameter	Mean	Lower 95%CI	Upper 95% CI
Detected AOS density[1]	0.08	0.06	0.10
Extrapolated AOS Estimate [2]	738	537	969
Estimated population [3]	2,956	1,987	4,167

[1] Mean and 95% confidence intervals calculated from bootstrap estimates.
[2] Detected AOS density multiplied by the total area of natural habitat (9,596m^2)
[3] Estimated population after correcting for birds present but not detected. Correction factors are: Mean (^{2} x 4), Lower 95% CI (^{2} x 3.7), Upper 95% CI (^{2} x 4.3).

raw count data and calculations of population status can be found in Ratcliffe *et al* (1997b).

In addition to the AOSs detected in the survey of the main habitats, a small number of AOSs (approximately 20) were found in the sparse outcrops of stone on the North Isle and adjacent to the Underlee sub colony. The Broch also contains a small number of birds but the exclusion of these 3 areas is unlikely to affect the population significantly given the size of the confidence intervals around it.

Discussion

The estimated 6,800 AOSs means that Mousa is of considerable national importance for breeding Storm Petrels and based on Lloyd *et al* (1991) could represent between 4% and 32% of the UK population. However, the low accuracy of the population estimates for Storm Petrels (Lloyd *et al* 1991) means the national importance of the colony at Mousa is actually difficult to interpret. A playback survey of all the colonies in Britain and Ireland would be required to fully appreciate the relative importance of Mousa, although it is undoubtedly an important breeding site for this species.

The population estimate of 4,500-5,000 AOSs from Suddaby (1992) approximates to the lower 95% confidence interval (4, 800) from this survey and this perhaps suggests that the population is stable or increasing. However, the distribution within Mousa may have changed substantially. The 1992 estimate for the Broch boulder beach was higher than the 1996 estimate (1992 = 1,300, 1996 = 300) but that for the walls was lower than 1996 (1992 = 2,300, 1996 = 3,800). Suddaby only surveyed the walls and the Broch boulder beach as nocturnal visits and located 'very few' calling birds in other areas of natural habitat, so there may have been a decline in numbers in the Broch boulder beach and an increase in the walls and other natural sites.

These possible trends should be treated with caution as the methods used differed greatly between the surveys. In 1992, Suddaby used nocturnal visits to map densities of calling birds without playback. The Broch boulder beach and lengths of wall were surveyed for purring males from early July through to late August. A correction factor of 2.65 was used to estimate the number of sites missed due to them not containing a calling male and extrapolations to total wall length and beach area were made. However, the survey was timed when most birds on Mousa would be incubating eggs or have chicks (Bolton unpublished data, Ratcliffe *et al* 1997a). Breeding males purr primarily during the pre egg stage (Scott 1970) and purring decreases greatly after eggs are laid (Scott 1970, Ratcliffe *et al* 1996). Non breeding birds appear in colonies during July and August at night in large numbers and males regularly purr from potential nest sites (Scott 1970). It is therefore possible that many of the birds detected during the 1992 census were in fact non breeders.

Non breeding birds are unlikely to cause a significant bias in the 1996 census results. Data on diurnal attendance and response rates of non breeding Storm Petrels at Mousa in 1996 suggest that the probability of detecting a non breeding bird during a single survey is less than 0.005 (Ratcliffe *et al* 1997a) and so will not comprise a significant proportion of the sites detected.

It is important that further surveys are conducted on Mousa to estimate the population trends for this important population. There are few data on the trends of Storm

Petrels due to the difficulty in obtaining comparable estimates. An improved understanding of the status and trends of populations at Mousa and other main colonies in the UK is essential for the implementation of appropriate conservation action to conserve this species.

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Fish prey in the diet of Great Skuas at St Kilda

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Fish prey in the diet of Great Skuas at St Kilda was investigated during the 1994-1996 breeding seasons through the analysis of sagittal otoliths collected from regurgitated pellets. A total of 1054 otoliths was collected from breeding territories, the vast majority being Poor Cod/Norway Pout with fewer Whiting and Haddock. The diet of non breeding skuas was assessed by collection of otoliths from the one club site. Of 1224 otoliths, most were from Poor Cod/Norway Pout and Whiting. Fish were probably scavenged from fishing boats. There were few Sandeels in the diet and these never exceeded 2% of otoliths collected from any site or year. Several species of fish recorded in this study can be described as meso or bathypelagic and have not previously been recorded in the diet of Great Skuas.

Introduction

The Great Skua *Catharacta skua* colony at St Kilda was founded in 1963 when a single pair was confirmed breeding on the main island of Hirta (Pollock 1963). Since then, the colony has grown to 213 occupied territories in 1996 (see Phillips *et al* 1997a). A recent study, based on regurgitated pellet analysis, revealed that the diet of Great Skuas at St Kilda consisted mainly of other seabirds, with Goose Barnacle *Lepas anatifera* and fish of lesser importance (Phillips *et al* 1997b). Furthermore and perhaps surprisingly, of fish species found in the diet in that study, Sandeel *Ammodytes sp*, was rarely recorded at St Kilda (Phillips *et al* 1997b). However, Sandeel is thought to be an important prey species for Great Skuas at some of its other breeding sites in Scotland (for example, Furness & Hislop 1981, Hamer et *al* 1991). In this paper we present a comprehensive summary of the fish species recorded in the diet of Great Skuas at Hirta, St Kilda during the breeding seasons of 1994-96.

Methods

The St Kilda archipelago (57°49'N 08°35'W) consists of 4 main islands (Hirta, Dun, Soay and Boreray) with numerous sea stacs. The work for this study was carried out on Hirta during the 1994, 1995 and 1996 breeding seasons. Great Skuas regurgitate the indigestible remains of food in the form of a pellet. In the vast majority of cases, pellets contained the remains of only one prey type (bird, fish, Goose Barnacle, other crustacean or Squid). Those derived from fish (containing vertebrae and other bone fragments) were examined for the presence of sagittal otoliths ('ear bones') which were collected and later

identified to species wherever possible, using comparative reference material and Härkönen (1986). Pellets were collected from breeding territories and the only club site (a well defined area frequented primarily by non breeding Great Skuas throughout the breeding season (Klomp & Furness 1990)) between late May and early August 1994-96, with the majority collected during chick rearing. Pellets found at the club site were produced mainly by non breeders, but not exclusively so, as breeding adults regularly bathed in the nearby lochan and used the adjacent club site for preening. Fresh pellets only were collected.

Results and discussion

Use of otoliths from pellets

Many studies have analysed prey remains in regurgitated pellets to assess seabird diet (for example, Barrett & Furness 1990, Hamer *et al* 1991, Harris & Wanless 1991, Mund & Miller 1995). In the case of Great Skuas, this approach has notable advantages; it is non invasive and a large amount of dietary information can be gathered relatively easily. In contrast, direct observations of prey regurgitated by adult males for their partners or by adults for their chicks at the territory can be difficult; it is often impossible to identify prey to species level when observed from distance, and the amount of dietary information obtained (number of birds studied, number of prey identified) is likely to be less.

However, pellet analysis has inherent drawbacks and limitations. For example, pellets will persist for differing time periods after production depending on their composition (Furness & Hislop 1981), potentially adding bias towards more resilient pellets. Perhaps most importantly, studies of captive Shags *Phalacrocorax aristotelis* have shown that otolith recovery in regurgitated pellets depends upon the species of fish and the size of otoliths consumed (Johnstone et *al* 1990). In that study, smaller, more delicate otoliths (from Sandeel and Sprat *Sprattus sprattus)* were recovered to a lesser extent than larger, more robust otoliths (from Cod *Gadus morhua).* Furthermore, due to acid digestion smaller otoliths were found to be eroded to a greater extent than larger otoliths, making calculations of fish size based on regurgitated otolith size prone to error (Johnstone *et al* 1990). This finding agreed with acid digestion trials using extracted otoliths, in which Herring *Clupea harengus* otoliths dissolved at a faster rate than those from Haddock *Melanogrammus aeglefinus* (Jobling & Breiby 1986). It is clear therefore, that otoliths from small fish species or juvenile fish may be underestimated in pellet collections, at least in Shags, and that calculations of fish size based on regurgitated otoliths can be inaccurate.

In the present assessment and for the reasons outlined above, we have not attempted to calculate fish size from regurgitated otoliths but we did detect otoliths of small or juvenile fish, most notably of Whiting *Merlangius merlangus* and Blue Whiting *Micromesistius poutassou.* Other studies of Great Skua diet have found pellets containing otoliths from small fish species, predominantly Sandeel, often at high frequencies (for example, Furness 1979, Furness & Hislop 1981, Baber 1992). It is unlikely, therefore, that small or juvenile fish would be completely overlooked in regurgitated pellets, but it is possible that their relative abundance in Great Skua diet assessed through otoliths, would be underestimated. Despite this potential drawback, analysis of regurgitated pellets is the most efficient method of gaining an overview of fish in the diet of Great Skuas.

Species recorded

Fish species recorded in Great Skua pellets from breeding territories are presented in Table 1. Of 1054 otoliths recovered over the 3 breeding seasons, the vast majority (56-86%) were of Poor Cod *Trisopterus minutus* or Norway Pout *T. esmarki*. Whilst for relatively intact and large otoliths of Poor Cod and Norway Pout separation to species is possible, this becomes extremely difficult using worn, fragmented and small otoliths. For this reason we have combined these 2 species into a single group. Of the other species recorded, only Whiting and Haddock represented more than 10% of otoliths (Table 1). These species have been recorded frequently in the diet of Great Skuas at other Scottish sites (Furness 1979, Furness & Hislop 1981, Hamer *et al* 1991). Similarly, otoliths recorded at the club site showed a predominance of poor Cod/ Norway Pout (52-85%) and Whiting (up to 15%; Table 2). All other species were relatively infrequent. Included in this last category was Sandeel, which represented less than 2% of otoliths collected and which was absent from all collections in 1996.

By comparison with other sites in Scotland, the paucity of Sandeel recorded in the present study (Tables 1 & 2) is striking. Other seabird species (notably auks) at St Kilda are known

Table 1 ***Numbers and percentages of otoliths of different fish species from pellets regurgitated by Great Skuas from breeding territories at Hirta, St Kilda.***

Fish species	1994		1995		1996	
Poor Cod *Trisopterus minutus*/ Norway Pout *T. esmarki*	318	85.5%	250	81.2%	211	56.1%
Bib *T. luscus*	8	2.2%	12	3.9%	2	0.5%
Whiting *Merlangius merlangus*	14	3.8%	28	9.1%	83	22.1%
Haddock *Melanogrammus aeglefinus*	10	2.7%	-	-	46	12.2%
Saithe *Pollachius virens*	2	0.5%	-	-	12	3.2%
Sandeel *Ammodytes* sp.	6	1.6%	4	1.3%	-	-
Scad *Trachurus trachurus*	7	1.9%	-	-	-	-
Blue Whiting *Micromesistius poutassou*	-	-	-	-	9	2.4%
Unidentified gadids	3	0.8%	2	0.6%	9	2.4%
Herring *Clupea harengus*	2	0.5%	4	1.3%	-	-
Silvery Pout *Gadiculus argenteus*	-	-	-	-	1	0.3%
Argentine *Argentina sphyraena*	-	-	4	1.3%	-	-
Lepidion eques	-	-	-	-	1	0.3%
Tadpole fish *Raniceps raninus*	-	-	2	0.6%	-	-
Forkbeard *Phycis blennoides*	2	0.5%	-	-	2	0.5%

Table 2 ***Numbers and percentages of otoliths of different fish species from pellets regurgitated by Great Skuas from the club site at Hirta, St Kilda.***

Fish species	1994		1995		1996	
Poor Cod *Trisopterus minutus*/ Norway Pout *T. esmarki*	453	84.5%	457	80.5%	66	51.6%
Bib *T. luscus*	17	3.2%	12	2.1%	-	-
Whiting *Merlangius merlangus*	28	5.2%	60	10.6%	19	14.8%
Haddock *Melanogrammus aeglefinus*	5	0.9%	9	1.6%	2	1.6%
Saithe *Pollachius virens*	4	0.7%	17	3.0%	9	7.0%
Sandeel *Ammodytes* sp.	8	1.5%	-	-	-	-
Scad *Trachurus trachurus*	1	0.2%	4	0.7%	-	-
Blue Whiting *Micromesistius poutassou*	-	-	-	-	12	9.4%
Unidentified gadids	3	0.6%	-	-	3	2.3%
Silvery Pout *Gadiculus argenteus*	6	1.1%	-	-	16	12.5%
Argentine *Argentina sphyraena*	6	1.1%	1	0.2%	-	-
Lepidion eques	2	0.4%	2	0.4%	-	-
Tadpole fish *Raniceps raninus*	1	0.2%	-	-	-	-
Blackspot Grenadier *Coelorhynchus coelorhynchus*	-	-	-	-	1	0.8%

to feed on Sandeels (Harris 1984, Leaper *et al* 1988), but it may well be that they are unavailable to Great Skuas except through kleptoparasitism. Furthermore, regurgitations by Great Skua chicks did not contain any Sandeel in 1996 (Phillips et al 1997b), nor were Sandeel recorded in either adult or chick regurgitated food in 1997 (S Bearhop *pers comm*). This lack is particularly interesting given the dramatic effect the reduction of Sandeel availability at Shetland had upon the breeding success of Great Skuas at Foula (Hamer *et al* 1991). Furness & Hislop (1981) noted that Sandeels were fed to Great Skua chicks at Foula in preference to whitefish or other foods. Furthermore, Hamer *et al* (1991) described poor chick growth, a decrease in the attendance of adults at the colony and poor breeding success in Great Skuas at Foula in association with a reduction in the availability of Sandeels. In response to this adult skuas fed to an increased extent upon seabirds and spent more time foraging (Hamer *et al* 991). That the Great Skuas at St Kilda appear to breed as successfully as at sites where Sandeel is thought to be an important prey (Phillips *et al* 1997b) is particularly noteworthy.

The majority of the fish species recorded are likely to be derived from commercial fishing operations near to St Kilda. Trawling and long line fishing activity have been noted over the continental shelf edge, to the west of St Kilda (Leaper *et al* 1988, *pers obs*). With few exceptions, these fish can be considered mid water or bottom dwelling species (Whitehead *et al* 1989), and, therefore, most likely made available to skuas through discarding. Noteworthy in this category are Silvery Pout *Gadiculus argenteus, Lepidion eques* and Blackspot Grenadier *Coelorhynchus coelorhynchus* which are either bathypelagic or benthopelagic, occurring at depths generally greater than 200m and often in excess of 1000m (Whitehead *et al* 1989). Deep water fish have been recorded in the diet of seabirds previously (for example, Imber 1973, Hamer *et al* 1994, Thompson *et al* 1995), but to our knowledge this is the first time that meso and bathy pelagic fish have featured in the diet of Great Skuas.

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Acknowledgements

We thank John Love and Nigel Buxton (SNH) and Movement Control (Benbecula) for help and support with fieldwork. For expert help with otolith identification we thank Werner Schwarzhans and for help with collection of pellets in 1994 and 1995 we thank Jim Vaughan and Paul Tyler.

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Great Skua chasing tern *Barry Larking*

SHORT NOTES

Common Buzzards cartwheeling during a food pass

Aerial activity in early spring between Buzzards *Buteo buteo* usually consists of soaring and diving displays between pairs but contact between birds is rare beyond touching of wings (Cramp & Simmons 1980, *Birds of the Western Palearctic*, Vol 2, Oxford). Buzzards will turn over and present talons in courtship and an extension of this behaviour occurred on 27 March 1996 when 2 Buzzards circled each other over moorland near Newton Stewart, Wigtownshire. The male had a reptile, either an Adder *Vipera berus* or a Slow Worm *Anguis fragilis* dangling from his talons above the female. The female tried to collect the prey by a food pass and 3 times turned over on her back trying to take the prey, talon to talon, uttering calls. On the fourth attempt they locked talons and cartwheeled several times. The reptile dropped, the female unlocked her talons and deftly caught the prey. She glided down to some trees followed by the male.

The only other documented records of talon locking appear to be of a Red-shouldered Hawk *Buteo lineatus* which engaged in talon locking and cartwheeling when it attacked a conspecific in its breeding area in North America (Johnsgard 1990, *Hawks, Eagles and Falcons of North America*, London).

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Buzzard *Jim Young*

Cannibalism in a Merlin brood

Relations among siblings in broods of falcons are usually peaceful and deliberate fratricide is unknown (Cade 1982, *The Falcons of the World*, London). As there is no apparent aggression among Merlin *Falco columbarius* siblings, cannibalism is also rare and evidence of it hard to obtain.

The only direct evidence of cannibalism obtained during long term studies in Galloway was on 18 July 1976 when I made a routine visit to a Merlin's nest on a heathery ledge deep in dense conifer plantations. The nest contained 2 fully feathered young about 23-25 days old and one dead young which was lying on its back. It was obvious that I had just disturbed the 2 live siblings eating their dead sibling because they were standing over it with their beaks freshly blooded and the breast freshly plucked. The dead sibling could have died naturally as there was no visible injuries, but Adder *Vipera berus* predation could not be ruled out as an Adder was lying sunning just below the nest site (see also Shaw 1994, *Scottish Birds* 17:162). Fresh prey remains at the nest site included a Skylark *Alauda arvensis*, 2 Meadow Pipits *Anthus pratensis*, and 2 Chaffinches *Fringella coelebs*. The 2 young eventually fledged.

The only other evidence of cannibalism in a Merlin brood is that given by Brown (1976, *British Birds of Prey*, London), who gave details from ringing returns of 3 dead young in a nest where one had apparently been eaten by its nest mates. Cade considered it likely that in severely food stressed broods of falcons a chick that dies will be eaten by its siblings, although starvation did not seem to be the cause at the nest in Galloway.

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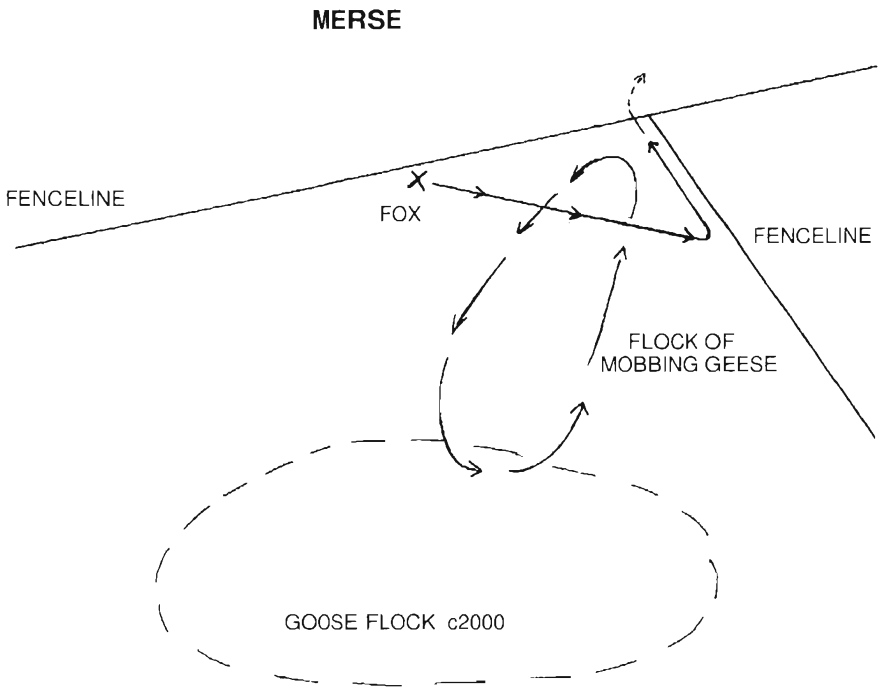
Merlin *Andrew Stevenson*

Mobbing behaviour by Barnacle Geese on a ground predator

On 19 March 1996 at Caerlaverock WWT Reserve, Dumfries & Galloway, I was observing a flock of around 2000 Barnacle Geese *Branta leucopsis* which were feeding on improved pasture. Suddenly, all the birds appeared very alert and uneasy. After about 5 minutes of vigilance by the goose flock a single Red Fox *Vulpes vulpes* appeared from the corner of the field and began walking very slowly towards the fence line bordering the neighbouring field (see diagram).

About 300 geese immediately took flight from the main flock and flew directly over the fox at a height of about 20m from the ground. These birds were continually calling. The flying geese then circled back over the remaining flock on the ground but did not land to rejoin them. Instead, they flew back over the fox at the same height, calling constantly. Some birds even tried to hover over the mammal. This mobbing behaviour, which lasted a total of 3 minutes, was repeated 5 times in succession over the fox. It only stopped when the creature had reached the fence line of the neighbouring field. During



the mobbing some of the birds returned to the vigilant flock on the ground and at the last (fifth) mobbing attempt there were only around 200 birds left in the air. When the flying geese were mobbing the fox, the remaining geese on the ground were vigilant and calling constantly.

I have been working on Barnacle Geese for 3 years at Caerlaverock and this is the first time that I have witnessed geese taking any attacking action against a ground predator. The usual behavioural action taken by Barnacle Geese towards a fox at Caerlaverock is simply the alert posture, although sometimes birds will walk towards and almost follow a fox until it is out of sight. This observation of geese acting as a flock when mobbing, and also defending, compares with other observations on Barnacle Geese seen at Caerlaverock in response to the presence of a Peregrine Falcon *Falco peregrinus*. (Patterson, *Scottish Birds* 18:101-102). However I can find no reference to Barnacle Geese mobbing a ground predator.

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Barnacle Geese *Rodney Dawson*

Marsh Warblers breeding in Orkney in 1993: a first for Scotland

On 14 July 1993, one of us (RGA) visited an area of reed swamp *Phragmites australis* in order to clear rides for mist netting As the work progressed, a single net was erected and an *Acrocephalus* warbler was caught. It was identified as a Marsh Warbler *A. palustris* on the basis of its general colouration and wing formula (Svensson L 1992, *Identification guide to European Passerines, 4th edition* Stockholm). The bird was judged to be an adult and, as June is the normal month for the spring passage of this species in the northern isles, it was presumed to be a lingering migrant. However, on 20 July, a second adult bird was trapped by RGA while the first was retrapped. The second bird was also identified as an adult Marsh Warbler although the wing formula was not as clear cut as on the first bird.

On 22 July one of these birds was watched by RGA on 6 occasions as it carried large beakfulls of food and also called in a very agitated manner; a second bird was seen very briefly. RGA contacted ERM who visited the reed bed shortly afterwards. He too saw one, probably 2, birds one of which was seen with food, called repeatedly and sang frequently. This bird only gave brief views but appeared to be a Marsh Warbler with olive toned upperparts, distinctly pale tipped inner primaries and a song with an outstanding amount of mimicry. The activities of the birds were centred on an area of the *Phragmites* bed about 30m from its boundary with improved grassland and 80m from the open water of the nearby loch. At this point, running through the reeds, was a small ditch edged with Meadow Sweet *Filipendula ulmaris,* Marsh Marigold *Caltha palustris,* Forget-me-not *Myosotis sp* and Water Mint *Mentha aquatica.* Also close to the ditch is a substantial Willow *Salix sp* bush from which the bird did most of its vocalising. On 24 July one of the ringed birds was again glimpsed by RGA and also heard and seen briefly by T R Dean who also considered it to be a Marsh Warbler.

Thereafter, windier weather conditions made watching in the reed bed very difficult so that no further observations were made. On 11 August, RGA was mist netting for Sedge Warblers *Acrocephalus schoenobaenus* when he caught 2 unstreaked *Acrocephalus* warblers. The freshness of the plumage indicated that these were both immature birds while the lack of rufous in the upper parts and the length of the 2nd primary notch strongly suggested that they were Marsh rather than Reed Warblers *A.scirpaceus* (Svensson 1992). On 16 August, a third immature bird was caught and ringed by RGA and similarly considered to show characters of Marsh rather than Reed. None of the 5 birds was seen again after this date. The whole scenario suggested that a pair of Marsh Warblers had successfully fledged 3 young.

In an attempt to verify the records ERM and Martin Gray independently examined the wing formula data for the 5 birds. The data were graphed using the methods described in (Walinder G, Karlsson L & Persson K 1988 A new method for separating Marsh Warblers from Reed Warblers *Ringing & Migration* 9:55-62.). Using these methods the first adult was conclusively identified as Marsh Warbler but the second adult fell in the Marsh/ Reed overlap zone (Adam & Meek, 1994). The 3 immature birds were considered next. Using one of Walinder's graphing methods (wing length v notch length) all 3 fell just within the range of Marsh. However, using his other method (wing length v notch position)

produced a different picture with 2 birds falling within the range of Reed and the other falling close to the overlap zone. One explanation of these discrepancies between the 2 methods was, of course, that the immature birds, especially those measured on 11 August, did not have fully developed wings when trapped. Notch length is fixed once the feather has emerged from pin but its position in relation to the other primaries is not set until the feather has completed growth.

Because of the discrepancies we felt that it was not possible to claim, as certain, a first breeding record for Scotland although the evidence did strongly suggest this to be the case. A paper in the *Orkney Bird Report* 1993: 73-76, Did Marsh Warblers *Acrocephalus palustris* breed in Orkney in 1993? Adam R G & Meek E R 1994, reported this situation and the details were repeated in the report on *Rare breeding birds in the United Kingdom in 1993, British Birds* 89:2:87.

Subsequently ERM and RGA were contacted by JH of Westphalia, Germany who has been working on the Marsh Warbler population of that area and who had developed an interest in the birds of Orkney on holiday in the islands in 1992. He confirmed that the description of the breeding territory fitted perfectly with the habitat utilised in Westphalia. Turning to the morphometric data, rather than the Walinder method, he applied the methods described in H Dorsch (1983 Bewertung verschiedener Merkmale zur sicheren Unterscheidung von Teichund Sumpfrohrsanger *(Acrocephalus scirpaceus, A.palustris)* mit einer praktischen Bestimmungshilfe *Ber. Vogelwarte Hiddensee* H.4: 111-120.) to the published data in the *Orkney Bird Report*. Using this method, the first adult and all 3 of the immature birds were clearly Marsh Warblers; only the second adult could not be certainly identified as Marsh. However, because the second adult was also identified as Marsh on general colouration and because the Walinder method placed it in the overlap zone and not in the Reed Warbler zone (see graphs in Adam & Meek, 1994), we are now confident that a pair of Marsh Warblers did indeed breed successfully in Orkney in 1993 and that this represents the first breeding record of the species in Scotland (Thom V M 1986 *Birds in Scotland* Poyser, Calton). The birds did not return to the site ialthough a pair did breed successfully at a site 15km to the south in 1997.

Acknowledgements

We are especially grateful to Jörg Hadasch for his interest in this record and for his efforts in helping us to establish its validity. We also thank Martin Gray for his independent examination of the wing formula data.

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An unusually open Wigeon nest

At 0800 on 23 June 1996 near Ballater, Deeside we noticed a female Wigeon *Anas penelope* lying very flat and still in short grass approximately 10m from a small roadside pool. She was still in this position when we left 10 minutes later. In the evening we were surprised to see the female Wigeon still in the same place, again lying very low and still. SF began to walk towards the sitting bird 30metres away. She quickly flushed and flew away. To our amazement she had been sitting on a nest which contained 5 eggs.

The grass was no longer than a couple of centimetres with grazing cattle present in the field. The pool, which was approximately 20x8m and drying out fast, was in the centre of the field and 30m from any cover. Although the Wigeon had made her nest in a slight hollow, the surrounding grass was so short that even when lying flat the top half of her body was visible. Wigeon nests are normally well hidden in vegetation. Of 16 nests found during a Wigeon study at another site in Deeside, all were fairly well hidden amongst Heather *Calluna vulgaris*, Rushes *Juncus* sp or rank grass.

The Ballater nest was visited again on 29 June when it was found to contain 4 eggs. The female was still sitting on 9 July but there was no sign of her on 14 July when the nest contained 3 eggshells, from which chicks appeared to have successfully hatched, and an infertile egg. The laying date, when calculated back from the approximate date of hatching, and the clutch size suggested this was probably a repeat clutch.

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Drake Wigeon *David Mitchell*

Song Thrush apparently nesting on the ground

On 12 April 1997, a member of the Royal Dornoch Golf Club informed me that on 2 recent occasions he had flushed a Song Thrush *Turdus philomelos* from 2 eggs on a bare patch on the ground below Gorse *Ulex europaeus* bordering one of the golf course fairways. Visiting the site later that day, I found that it had been predated and all that remained were several pieces of Song Thrush eggshells, which lay on a piece of bare ground below the overhanging Gorse. An inspection of the cover overhead failed to reveal any sign of a nest from which the eggs might have fallen out. *BWP* Vol 5:998 describes various Song Thrush nest sites ending with the words. 'and on the ground among thick vegetation' which, I assume, refers to a normally constructed nest.

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Song Thrush *Andrew Dowell*

Hunting times of Sparrowhawks in the non breeding season

During studies of the hunting times of Merlins *Falco columbarius* and Hen Harriers *Circus cyaneus* (*Scottish Birds* 17:56-58, 18:182-183) in winter in west Galloway, I also saw Sparrowhawks *Accipiter nisus* (adults and juveniles) hunting regularly in the same open country habitats between August and February 1970-97. Each year all hunts were timed in open country only, where I spent an equal amount of time at different hours of the day (see Dickson 1992, *The Birds in Wigtownshire*, Wigtown for details of sightings in various habitats).

Two hundred and fifteen hunts were recorded by both classes: 131 by adults, 84 by juveniles (first years). Sixty nine percent of adult hunts

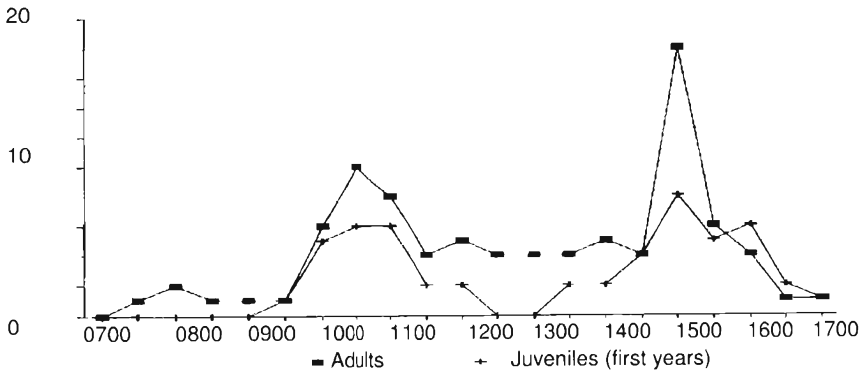

Figure 1 ***Hunting times of Sparrowhawks in west Galloway, November - February 1970-97***

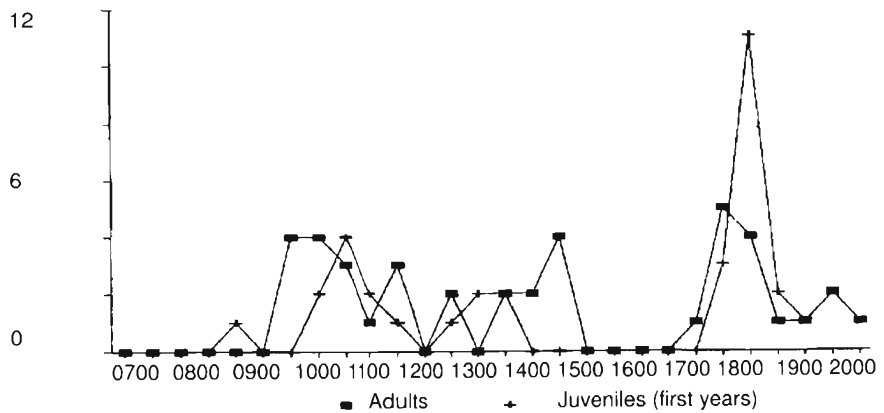

Figure 2 ***Hunting times of Sparrowhawks in west Galloway, August - October 1970-97***

occurred in the period November-February (Fig 1) and 31% in August-October (Fig 2); 62% of juvenile hunts were in November-February (Fig 1) and 38% in August-October (Fig 2). Both classes showed pronounced peaks of activity at 1030 and 1500 hours in the period November-February. In the period August-October there was no pronounced peak of activity during the day by both classes but there was a definite peak by juveniles at 1830 hours (BST).

The findings in this study of major peaks of activity in mornings and afternoons with lulls in activity around midday agree with the findings on the hunting times of other raptors in winter. The main peaks in Figure 1 by juveniles coincide with the winter peaks described by Newton (1986, *The Sparrowhawk*, Calton), but the more pronounced peak of activity in the afternoon shown by adults in Figure 1 was not recorded by Newton.

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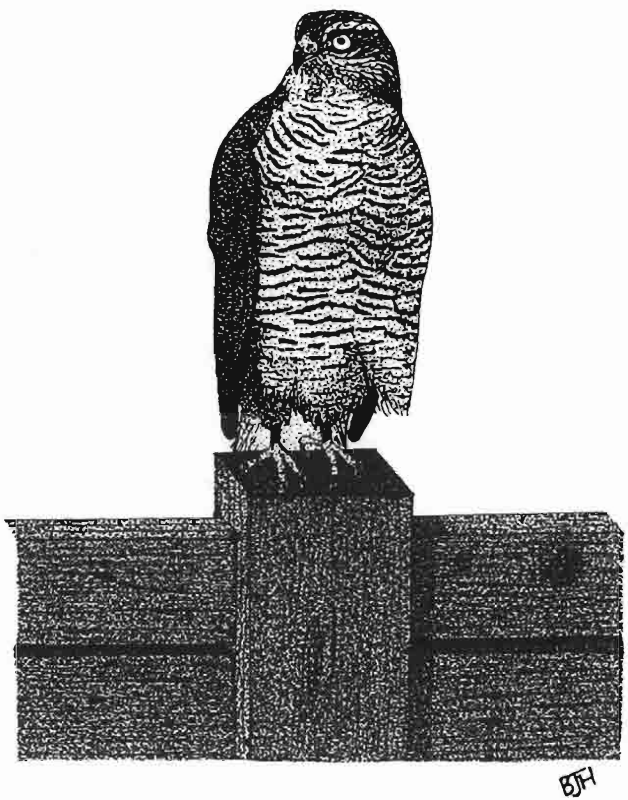

Sparrowhawk *Brent Hurley*

Merlin's sunning behaviour in winter

Sunning behaviour by Merlins *Falco columbarius* in winter has rarely been observed in the wild. In a list of species recorded sunning, Merlins were not mentioned (Kennedy 1969, *British Birds* 62:249-258) although sunning was subsequently recorded (in summer?) in the North American subspecies (Cade 1982, *The Falcons of the World*, London). Informaton on sunning behaviour by wild Merlins in winter in Britain is thus generally lacking and probably under recorded.

On 19 January 1997 at 1105 GMT, a relatively mild, cloudless day (9°C) with warm sun and very light winds, I watched a female or juvenile Merlin preening vigorously on a fence post on low ground in Wigtownshire. After preening it stood, back to the sun, with its wings held partly down and extended in the typical ' loose spread sun basking posture' (see Simmons 1986, *The Sunning Behaviour of Birds*, Bristol). Eleven minutes later it stood with only its right wing partly extended sun basking before flying 5-7m to another fence post. Here it stood for the next 4 minutes sun basking in the loose spread posture before flying away.

Feather care used by Merlins in winter include preening, shaking and wing stretching. Cade considered that this loose spread posture is the typical sunning posture of falcons and likely to be shown by all species, although not previously documented in the wild by Merlins in mid winter.

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Hen Merlin *Arthur Gilpin*

Territory sizes of Crested Tits at Abernethy Forest, Strathspey

The Scottish Crested Tit *Parus cristatus scoticus* is confined to the Highlands of Scotland where it inhabits native pinewoods and old plantations, composed largely of Scots Pine *Pinus sylvestris* (Cook 1982, Breeding status of the Crested Tit. *Scottish Birds* 12:97-106). It is an amber rated species in the list of species of conservation concern in the United Kingdom (Gibbons *et al* 1996. Bird species of conservation concern in the United Kingdom, Channel Islands and the Isle of Man: revising the Red Data List. *RSPB Conservation Review* 10:7-18). Elsewhere in its range, the Crested Tit has been the subject of detailed studies of individual birds (eg Ekman 1979. Coherence, composition and territories of winter social groups of the Willow Tit and Crested Tit. *Ornis Scandinavica* 10:56-68) but there has been little work in Scotland where the Crested Tit is generally regarded as being sedentary (Cramp & Perrins 1993, *Birds of the Western Palearctic*, Vol 7. Oxford). However, there have been few direct observations made of individual birds to confirm this. This note provides some detailed observations on a small group of birds.

The study was carried out around Forest Lodge (57°14'N, 3°37'W) in Abernethy Forest where 6 adult Crested Tits were colour ringed with unique combinations. The study area comprised *c*.300ha of native pinewood and Scots Pine plantation, and set routes were

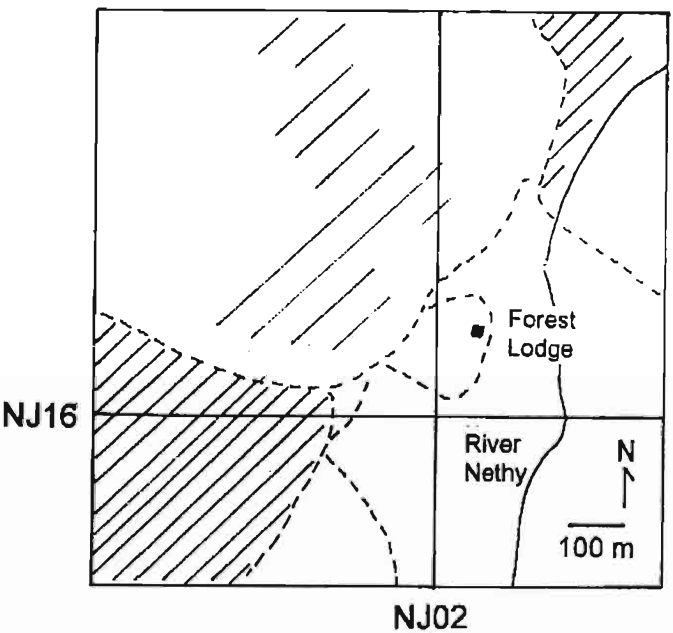

Figure 1 ***The study area at Forest Lodge. The habitat is native pinewood apart from young (heavy shading) and old plantations (light shading). Dashed lines are roads. Grid reference numbers are shown.***

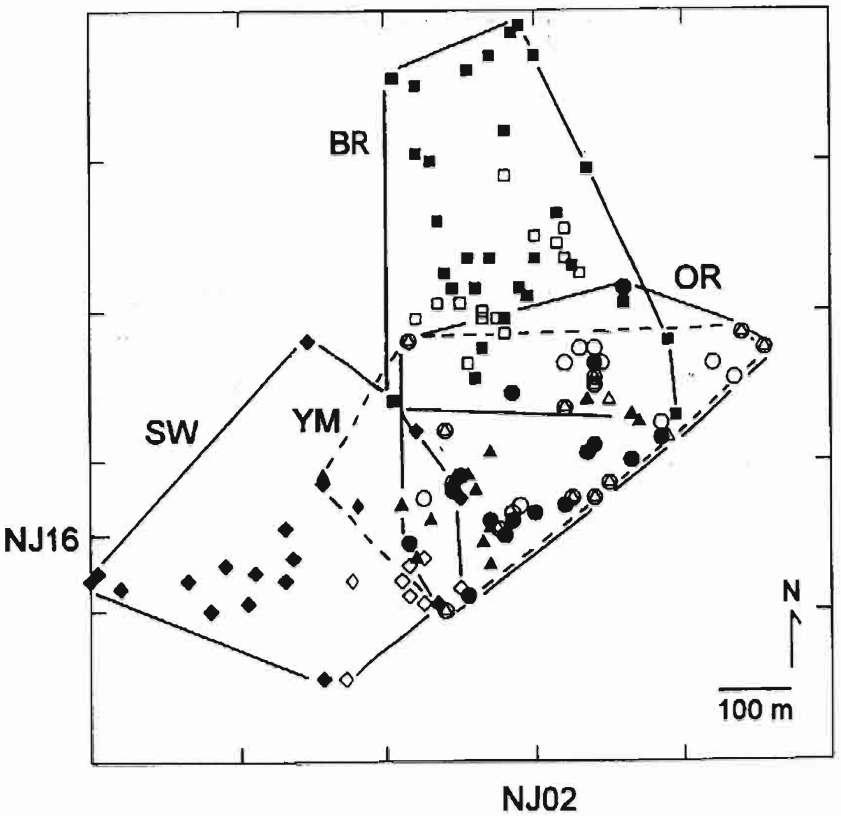

Figure 2 ***The locations of 4 Crested Tits in summer (open symbols) and winter (filled symbols). OR and YM were paired.***

walked during summer (24 May 1994-11 July 1994) and the following winter (2 November 1994-9 February 1995) to search for the marked birds (Fig 1). Once located, their positions were mapped to the nearest 10m. Observations one day apart were treated as independent of others and territories measured by joining the outermost points and measuring the size of the enclosed area (minimum area method; Mohr in Southwood 1966. *Ecological Methods*, Methuen). Because one requires a minimum of about 25 plots to estimate territory size, data for the 2 seasons had to be combined and, even then, this provided sufficient data for only 4 birds. Their territory sizes were (12.5, 13.1, 14.0 and 15.1ha (mean = 13.7ha). Birds OR and YM were a pair and had similar sized (12.5 and 13.1ha) and overlapping ranges (Fig 2). The territories of 2 neighbouring birds of this pair overlapped considerably, showing that territories were not mutually exclusive.

There appeared to be changes in the sizes of territories between summer and winter but the results were not consistent, and insufficient observations were made of most birds to give realistic estimates of territories in each season. The pair (OR and YM), had smaller ranges in winter (7.1ha, n=17 and 6.8ha, n=18) compared with summer (10.4ha, n=24 and 10.3ha, n=16). In contrast, birds BR and SW had smaller ranges in summer (3.3ha, n=15 and 1.6ha, n=9) than in winter (15.1ha, n=30 and 12.6 ha, n=17).

In order to find out if there were shifts in territories between summer and winter, the centre of each territory of all 6 birds was determined for the 2 seasons separately and the distances apart were measured. These shifts in centres were only 146m apart on average (range 81-256m). These distances were small in relation to overall territory size, indicating that these Crested Tits had fixed territories. The results of this limited study confirm that Crested Tits are sedentary, at least in a native pinewood in Scotland.

Territory sizes of Crested Tits in other situations are likely to be different. The average size of 21 group territories in Swedish forests of Norway Spruce *Picea abies*, and Birch *Betula* spp. was 20ha (Ekman 1979). Other tit species tend to have smaller territories, though there is much variation depending on habitat and breeding density. For example, Great Tits *Parus major* have territories which range in size from 0.2 to 4ha (Gosler 1993, *The Great Tit*. Hamlyn).

The birds were trapped and ringed by R Proctor and observations were made by M Adams, P Benstead, R Denny and C Jeffs. Territories were calculated by Dr M McGrady. The draft was commented on by Drs M I Avery and I P Bainbridge.

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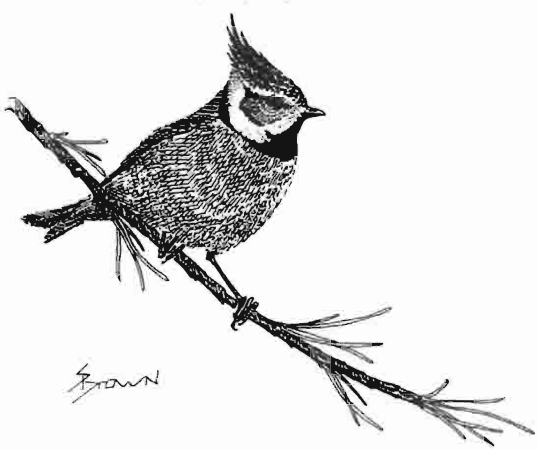

Crested Tit *Steven Brown*

Baby Stoat in Peregrine nest

On 8 June 1997 whilst ringing 2 small Peregrine *Falco peregrinus* chicks in an old Raven's *Corvus corax* nest in Strathcarron, Sutherland I was surprised to find a freshly dead Stoat *Mustela erminea* lying uneaten in the nest. It may have just been brought in by one of the adults as I had flushed the female from the nest as I approached. The Stoat was about 11cm in length from nose to tail with very short pink fur and looked as though it was still blind. It had obviously still been totally dependent on its parents. There were no other prey remains in the nest, apart from some feathers from a Grouse *Lagopus* sp and a Starling *Sturnus vulgaris*. Although this bird had laid 4 eggs there were only 2 chicks, one noticeably smaller than the other. Both also had empty crops indicating that prey may have been scarce.

Ratcliffe *(The Peregrine Falcon* 1980) states that small mammals are very occasionally taken by Peregrines as is carrion. There is also a record of a Peregrine stealing a vole (species unknown) from a Kestrel *Falco tinnunculus*. One can only speculate whether the Peregrine obtained the Stoat from an adult Stoat carrying its youngster, from another raptor or by finding it freshly dead Presumably, if avian prey is scarce, the adults will resort to more unusual prey in order to feed their hungry young.

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Peregrine at nest *Jim Young*

Oystercatcher incubating Lapwing clutch

In 1995 at Colquhar, Leithen Water, Borders, a pair of Oystercatchers *Haematopus ostralegus* hatched a clutch of Lapwing *Vanellus vanellus* eggs, which produced 3 chicks, at least one of which survived for over 12 days (Dougall 1996, *Scottish Birds* 18:184). In 1996 at the same site a pair of Lapwings reared 3 chicks unaffected by Oystercatchers which were also present.

In 1997, at the same site, I again found an Oystercatcher incubating a clutch of 3 Lapwing eggs on 3 May. On 21 April I had noted 2 Oystercatchers and 2 Lapwings on site, none of which was incubating. On 26 April an Oystercatcher was seen sitting on a nest with a Lapwing standing close by. The nest was visited on 3 May, when there was no danger of trampling by sheep. On 10 May the Oystercatcher was again sitting, with its mate and one Lapwing nearby. On 18 May there were no birds on the site and the nest was not relocated, having failed for an unknown reason. It seems probable that the same (infertile?) Oystercatcher was involved in both the 1995 and 1997 events.

Oystercatchers were not seen again in 1997, but, on 31 May, 2 Lapwings were back in the area, although they were not seen to incubate on that or later dates. A single Lapwing with a brood of 2 was seen adjacent to the site on 10 and 15 June, but it is thought that this family had moved into the area from nearby.

Again, I am grateful to Mr Templeton, the Colquhar shepherd, for his tolerance of my activities.

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Accepted August 1997

Oystercatcher *A D Johnson*

Song Thrush predation on marine gastropods

Shell fragments belonging to 4 gastropod species were collected from an 'anvil' used by a Song Thrush *Turdus philomelos* on a rocky shore in south Harris during April 1997. Of 275 shells recovered, 244 were of the Edible Periwinkle *Littorina littorea*, 28 of the Flat Periwinkle *Littorina obtusata*, 2 of the Dog Welk *Nucella lapillus* and there was a single *Littorina saxatilis*. Observations of a Song Thrush breaking shells and examination of the discarded shell fragments revealed that the gastropods were held in the beak with the spire pointing to the left and struck

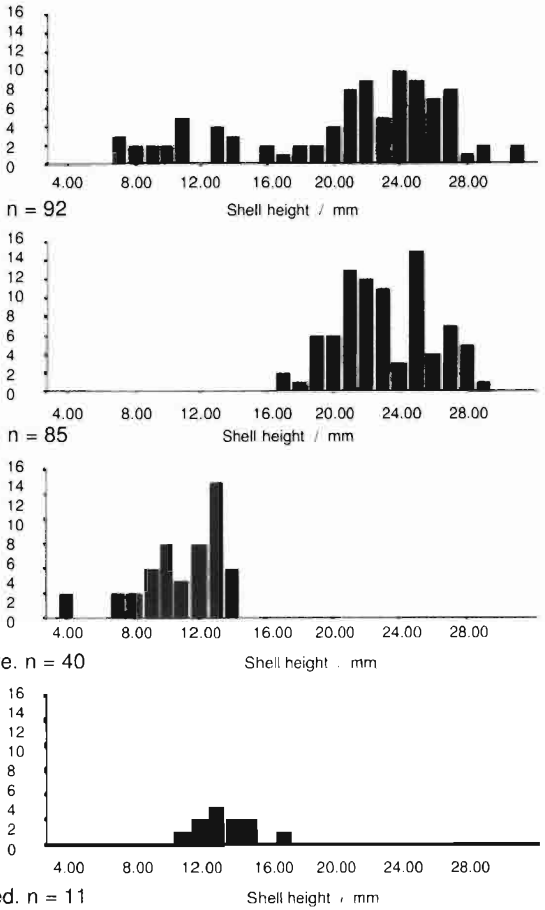

Figure 1 ***The shell heights of periwinkles*** **Littorina littorea** ***and*** **Littorina obtusata** ***found around the 'anvil' of Song Thrush and available on the shore.***

usually 3 to 4 times. The effect of this is either to break a hole in the side of the shell or to break the shell in half. Previous records suggested that such predation is largely associated with harsh weather conditions (Feare, C J 1966. *British Birds 60:412-414).* However, the quantities of shells to be found around anvils, and the regularity with which Song Thrushes were seen to behave in this way, suggests that this may not be the case in south Harris.

Maximum height was measured for the predated shells of 85 *L. littorea* and 11 *L. obtusata* that were either holed or could be pieced together from broken fragments. These were compared with the maximum shell height of 92 L. *littorea* and 40 *L. obtusata* collected from the same shore at low tide (Fig 1).

Selection of gastropods by Song Thrushes was both species and size specific. *L. obtusata* was the most numerous gastropod on the shore and *N. lapillus* was particularly conspicuous, being found on exposed rocks, yet many more *L. littorea* were taken than either of these species. The size of *L. littorea* taken in Harris corresponded to the size range of *L. littorea* in Wales that represent the adult cohort, those over approximately 4 years of age. (Williams E E 1964. The growth and distribution of *Littorina littorea* (L.) on a rocky shore in Wales. *Journal of Animal Ecology 33:413-432).* Selection of *L. obtusata* is also directed at the larger individuals in the population. Size preferences by Song Thrush presumably reflect a trade off between the amount of effort required to break the shell and the size of the gastropod obtained. Why *Nucella lapillus* are not eaten in greater numbers is not known.

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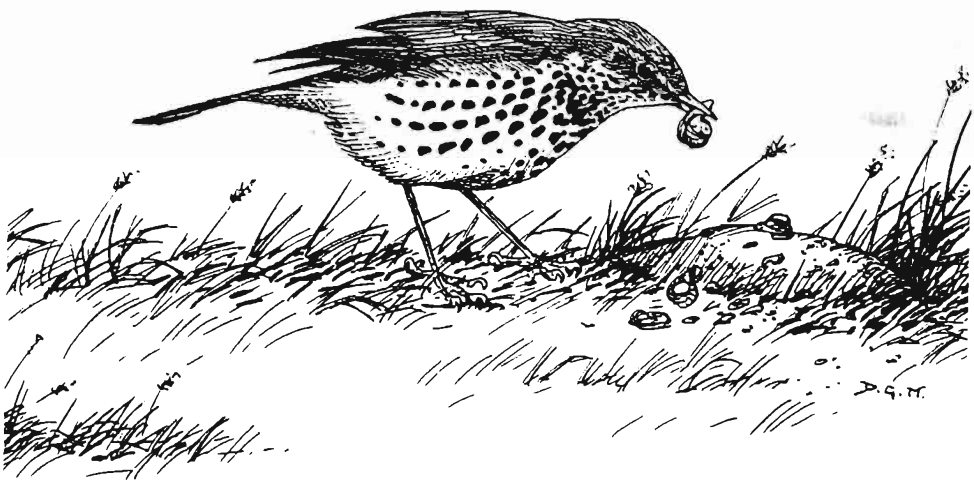
Accepted September 1997



Song Thrush *David Mitchell*

Advice to contributors

Authors should bear in mind that only a small proportion of the *Scottish Birds* readership are scientists, 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 2 members of the editorial panel and, in most cases, also by an independent referee. They will normally be published in order of acceptance of fully revised manuscripts. The editor will be happy to advise authors on the preparation of papers.

Reference should be made to the most 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; 2 copies are required and the author should also retain one.** We are happy to accept papers on computer discs, however, please contact Sylvia Laing on 0131 556 6042 to discuss this. Headings should not be underlined, nor typed entirely in capitals. Scientific names in italics should normally follow the first text reference to each species unless all can be incorporated into a table. Names of birds should follow the official Scottish list (*Scottish Birds* Vol 17:146-159). Only single quotation marks should be used throughout. Numbers should be written as numerals except for one and the start of sentences. Avoid hyphens except where essential eg in bird names. 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 c700 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 papers.

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 black ink and be camera ready, but drawn so as to permit reduction from their original size.

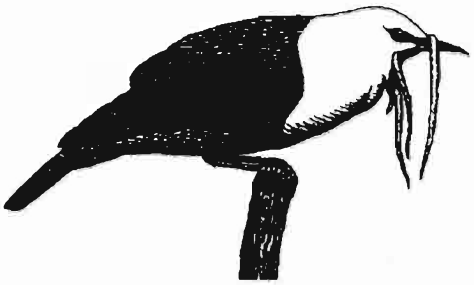
Erratum

Scottish Birds 19:2 pp105-113 Habitat use by Snow Buntings in Scotland from spring to autumn

Table1
Page 108 Flocks adults & fledglings - Beside snow should read 36^{9} and not 36.

Defective copies of *Scottish Birds*

We were disappointed to learn that some copies of the December 1997 issue had faults. So far, we know of 7; unusually the printing faults differ between each. If your copy is defective please return it and we shall send a replacement.



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'. '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,
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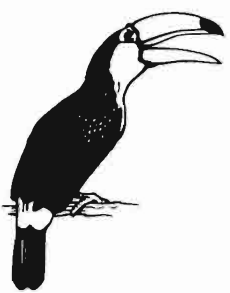
c/o The Lodge,
Sandy,
Bedfordshire SG19 2DL



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