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Research Progress Report

G.M. Dunnet

A Forty-three year study on the Fulmars on Eynhallow, Orkney

In the 1930s, 40s and 50s a great deal of interest focused on the biology of the North Atlantic Fulmar *Fulmarus glacialis*. The species, apart from its population on St Kilda which had been established for centuries, spread from the Sub-Arctic and began breeding in Shetland in 1878. Since then it has colonised most of the coastline of Britain. Being a conspicuous and spectacular bird the progress of its colonisation of the British coastline was well observed and documented and was fully described in a New Naturalist book, The Fulmar, by James Fisher, in 1952. Before the war, V C Wynne-Edwards studied Fulmars at sea off the Labrador coast and came to the conclusion that adults may not breed every year, but probably every second year or so. There was also much speculation about the age at which fulmars breed for the first time, and Eric Duffy, stationed on Fair Isle during the war, noted that there were many more apparently adult Fulmars present at the breeding colonies there than could be accounted for by the number of occupied nests. He assumed that these 'extra' birds may be young birds not yet breeding, and non-breeding adults. He postulated that Fulmars may not breed for the first time until two or three years old and thereafter as adults in alternate years. James Fisher in a short chapter on the biology of the Fulmar in his book, was able to demonstrate that in some situations adults did breed in consecutive years, and further speculated from very limited evidence that young Fulmars may spend the first three years or so of their life at sea followed by about four years 'prospecting' at breeding colonies or new breeding locations and would then lay for the first time at the age of about seven. The expansion of the breeding range of the Fulmar was almost certainly associated with a dramatic increase in numbers, so that the facts that they did not begin to breed until they were seven and then laid only a single egg which could not be replaced, and with a fledging success likely to be of the order of 50% or less, implied that breeding adult Fulmars must live for a long time. Fisher speculated that he would not be surprised if some birds lived to be 50 years old. None of these controversial and exciting ideas had been tested by direct field studies of marked individual Fulmars.

While visiting Orkney with a party of students in the summer of 1950, the late Dr Robert Carrick and I were introduced to the bird sanctuary of Eynhallow, then owned by the late Miss Jean Robertson, by the late George T Arthur, the well known Orkney ornithologist. On Eynhallow we found Fulmars nesting in very accessible places: on the ground at the base of walls, on low cliffs and on ruined buildings. It immediately occurred to us that here we could have a splendid opportunity on an undisturbed, uninhabited island to carry out studies of individually marked Fulmars with a view to solving some of these problems. George Arthur was able to persuade Miss Robertson, who held the island in trust and maintained it as a bird sanctuary in memory of her father, Duncan J Robertson, who himself was an excellent Orkney naturalist, that we should be given the privilege of access to the island for the purpose of studying the Fulmars. Little did we know that this was the beginning of a study which has been maintained continuously until the present time and that some of the birds and I myself have met each other regularly on the island for over 40 years. I, at least, have enjoyed it.

With no long-term plans in mind we began in 1950 to seek to determine whether or not adult Fulmars breed every year. We

addressed this by catching breeding adults off their egg or chick and giving them individually distinguishable combinations of coloured rings as well as the numbered BTO rings. We marked 11 birds in 1950, one from each of 11 nests. In July 1951 we found some of the 1950 birds nesting again, and caught and marked an additional 66 breeding adults including pairs from several nests. By the breeding season of 1952 we had established that some birds bred in three consecutive years, some pairs nested together in two consecutive years and that both birds which failed in one year and those which bred successfully bred in the following year. We therefore concluded that normally Fulmars, once they start breeding, do breed in consecutive years, thereby demonstrating that the breeding pattern proposed by Wynne-Edwards for Fulmars in the Arctic did not apply in Orkney.

We ringed Fulmar nestlings in each of these years but found none returned as breeders.

From 1953 to 1957 inclusive both Robert Carrick and I were in Australia, but the study was continued during those years by Vero Wynne-Edwards, Sandy Anderson and Eric Duffy. These observers continued to record the presence of ringed breeding birds each year, caught and coloured ringed additional breeding adults, and ringed the nestlings.

When I returned to Aberdeen to establish the new Field Station at Culterty in January 1958 the Eynhallow project had not produced answers to any of the other questions that had interested us. For example no Fulmar ringed as a nestling had been recovered breeding on Eynhallow, and we had no idea of how long Fulmars lived. Accordingly I felt that the study on Eynhallow, which had already been running for eight years, constituted a valuable investment in marked birds and decided that it should be developed and carried forward. Two new primary objectives were established. The first was to determine the age at which Fulmars breed for the first time. Up until that time we had ringed Fulmars with soft aluminium rings and we had plenty of evidence that over the years some of these fell off. It seemed very likely that rings might be falling off the legs of young Fulmars before they had returned to nest. Accordingly we used new much more durable rings made of monel and subsequently incaloy to overcome this problem. The second main objective was to attempt to determine how long Fulmars live and clearly, if they were long lived, we would need to have the same type of durable metal rings, but also types of colour rings which were colour-fast and durable over long periods of time. We devised a method, based on bill measurements, to estimate the sex of individual Fulmars with a considerable degree of confidence. The study then continued over the years with three basic data collecting visits to the island each year. We went first at the end of May (the end of the egg laying season), again in the middle of July when the nestlings were hatching, and again in late August to ring the surviving fledgelings. On the first two of these visits we identified every colour-ringed bird we could, and caught any bird with only a metal ring, or with imperfect colour ring combination, so that their identity could be determined and new rings could be put on. This routine has been maintained over 43 years, but in some years additional projects were undertaken. For example, for four years we covered the entire egg-laying period, but found the effects of our disturbance were quite significant.

The first attempt to estimate the longevity of Fulmars was published in 1963. The simple approach to the problem was to measure the rate at which colour ringed breeding adults disappeared from the breeding population. This involved many assumptions, some of which were more likely to be true than others. The concept is simple: if we start off in year 1 with 100 colour ringed breeders, and detect 90 of these in year 2 and only 81 of them in year

3 then we have a mean annual survival rate of breeding adult fulmars of 90% (.90). To get such data in the field, we have to identify as many as possible of the ringed birds in year 1, detect and identify all of these which survive into year 2, and again, in year 3, identify all of the survivors of the first group of 100 which are breeding in year 3. In practice this is impossible to achieve because some birds lose their rings or otherwise become unidentifiable, some birds may lose their egg early and not be available for detection and identification later in the breeding season, and some birds may be breeding but not detected by the observers. All of these 'errors' have the same effect on the calculations: they over-emphasise the number of birds that have disappeared and are assumed to have died. In other words, the resultant estimate of survival rate is too low. A further basic assumption underlies the use of this method. It is that all breeding adult Fulmars have the same survival rate, regardless of their age. It will be clear that when we catch an unringed breeding adult off its egg or chick we do not know its age, and are therefore unable to avoid making this assumption. The assumption is known to hold for many small short-lived birds with survival rates of under 50% per year, but it is very unlikely to hold for long-lived birds. We also have data over many consecutive years on the presence in the colony of individually known breeding birds. In many cases birds, which have not been seen in a particular year, are recorded breeding subsequently and therefore, of course, are assumed to have been part of the breeding population throughout. This makes the data set much more informative, but more difficult to handle. In 1963 we estimated a mean survival rate for breeding adult Fulmars of 0.9378 (93.78% per annum) which led to an estimate of the mean duration of adult life of 15.58 + 1.93 years.

As the data continued to accumulate they became very difficult to validate, to handle and to process. In 1974 a computer database was designed so that all the available and verifiable data could be stored in such a manner that they could readily be accessed for examination and statistical analysis. This task, covering the previous 26 years of the study, was undertaken by janet Ollason who listed, checked and put into the database all the data accumulated up to that time. Subsequently the data for each year have been added so that analyses can access all the data available. Using the database and thereby accessing very much more data than were available to us in 1963, we have made a number of estimates of survival rate of Fulmars, and the latest is a mean annual survival rate of 0.986 (standard error 0.0042) giving a mean duration of adult life of approximately 35 years. We have calculated this separately for males and females and there is very little difference between them. It is important to realise that this estimate is still based on the concept of constant survival rate throughout life and, although we have made numerous attempts using the data available to us to demonstrate that survival rate decreases with age, we have not been able to do so over spans of up to 20 years of adult breeding. The real problem is that such a small number of birds survive to be 'old' that the disappearance of any one of these in a particular year brings about a substantial increase in the mortality rate calculated for that cohort in that year.

In 1963, 14 years after our study began, we caught our first Fulmar which had been ringed as a nestling breeding on Eynhallow. It was 7 years old – exactly as predicted by James Fisher! However we now have over 50 birds which were ringed as nestlings in Orkney and whose age we therefore know, recorded breeding on Eynhallow. The youngest is five years old and the oldest 20 years old. However it is very likely that these older records are birds which may have bred previously without being recorded. Indeed we cannot be sure that the first time we recorded a bird at a nest, was the first time that it actually bred. Given these problems

we use the modal age of first breeding (i.e. the age at which most birds do breed) rather than the mean, and for males the mode is 8 years and for females 12 years old. It is interesting to consider why young Fulmars do not breed at ages earlier than these.

From the fledging success of Fulmar pairs which include one young breeder of known age, we have been able to demonstrate that pairs containing a young male can breed as successfully as experienced pairs, whereas pairs including a young female improve their breeding performance over the first 6-8 years or so of their breeding experience. Supporting this difference between males and females, we have also been able to show that females which breed for the first time when younger than the modal age of first breeding do much less well than females which breed for the first time when older than the modal age. Further, the main difference in breeding success is not at hatching (therefore involving the quality of the egg or the efficiency of incubation) but survival of the young to fledging: parental care of the nestling by the female therefore seems to be the limiting factor. These relationships do not hold good for male Fulmars.

Once Fulmars become established as breeders they show a remarkable fidelity both to their nest site and to their mate. Pairs generally stay together at the same nest site for a run of years, but changes do take palce often as a result of breeding failures. Breeding Fulmars are very restricted in their distribution at land, so that new nest sites are normally within a few tens of metres of previous ones and new mates are often found among neighbouring breeders.

In general breeding success of Fulmars averages about 35% from egg to fledging.

Over the period of study the breeding population of Fulmars on Eynhallow has shown an increasing trend, consistent with what has been happening around the British coastline in general. However the trend has not been smooth, and there have been quite dramatic changes between years in the numbers of birds breeding. Our estimate of the size of the breeding population comes from the numbers of occupied nests counted at the beginning of June each year, when egg laying has ceased. This number is corrected for the early loss of eggs, using an average figure derived over four years of intensive study of the complete laying period.

We are particularly interested in the factors which determine the numbers of breeding Fulmars on Eynhallow, and have carried out detailed analyses and modelling of the relationship between changes in the numbers of breeding birds between years, and the estimated adult mortality of breeding adults, the number of new nest sites, and the recruitment of new breeders (that is unringed birds) to the breeding population in each year. All of these measurements have some degree of error associated with them, but our analysis showed very clearly that variations in the survival of breeding adults from one year to the next has little influence on the size of the breeding population. Bearing in mind that our estimate of the survival rate of adults in any year is based on data from a run of subsequent years (that is birds not seen in a particular year may be recorded in later years and are therefore known to have been alive but not seen) does not exclude the possibility that intermittent breeding of established adults may influence the numbers of birds breeding in any particular year. However the number of new recruits to the breeding population had by far the greatest influence on the variation of the numbers of birds breeding. New recruits are by definition first-time breeders, and a vast majority of these are unringed birds of unknown age and from an unknown source. It is difficult to calculate precisely the number of such birds in the population in any year, owing to the fact that about 30% of our established breeders are unringed. However we are able to conclude that inexperienced breeders, who breed much less successfully than

experienced birds, may not have the same degree of fidelity to nest site or perhaps even nest colony, as breeding adults. Recruitment may not be a once for all arrival and establishment of a bird in a local breeding population, but may be much more complex with birds moving between sites or colonies in their early breeding years. It is very difficult indeed to get information on this since we need marked birds, and the catching and marking may well influence whether or not the bird will remain in the population. However these calculations did highlight the need for better information on the process of recruitment of new birds to the breeding colony, and the behaviour and success of new and inexperienced breeders.

This brought a completely new element to the study. Hitherto our information had been derived almost entirely from breeding Fulmars caught off the nest. Now we required information about birds who as potential recruits were prospecting Eynhallow before becoming established in the breeding population. This raised two problems: firstly how to catch such birds; and secondly how to identify them. The first was overcome by using the Icelandic fleigh to catch Fulmars as they flew along the clifftops, and this could be done in almost any month of the year. In the course of a PhD project, 449 birds were captured in this way and these included many unringed birds, a number of birds ringed as nestlings and not yet recorded breeding, and colour-ringed breeding birds. Useful new information was obtained from all of these, especially during the months outside the breeding season. All birds caught were individually coloured ringed. While there are considerable problems of interpretation, especially regarding the status of individual birds, we estimated that the number of Fulmars visiting Eynhallow is between two and five times the number that breed there. Even making allowances for intermittent breeding among both inexperienced and experienced breeders, there is a large number of potential recruits visiting the island, and a high proportion of those marked were not seen again on Eynhallow.

The study continues, seeking to understand better the processes of recruitment, and the nature of intermittent breeding.

The following reference includes a complete list of our Fulmar publications:

Dunnet, G.M. 1991. Population Studies on the Fulmar on Eynhallow, Orkney Islands. *IBIS* 133 suppl. 1:24-27.

Scottish Birds (1992) 16: 160-164

Research Progress Report

P.J.B. Slater

Variations in the Song of the Chaffinch

This article takes its title from one written exactly 40 years ago by Peter Marler (1952). As a young botanist employed by the Nature Conservancy he was carrying out survey work in various highland glens and became fascinated by the way in which the songs of the Chaffinches *Fringilla coelebs* appeared to differ from one glen to the next. Indeed, so interested did he become that he renounced his botanical career and went to work for Professor W.H. Thorpe, who was studying the development of Chaffinch song at Cambridge. Thorpe was then the leading authority on bird song in Britain, so Marler got a good start on his own work in the area. From Cambridge he went to America, and he has probably contributed more than anyone else to our understanding of bird song in the course of the past few decades. But it all started with Scottish Chaffinches.

Although Marler's first descriptions of Chaffinch song were done by ear, they are remarkably accurate. Today those of us who study song have the benefit of the sound spectrograph. This machine prepares charts (or sonagrams) from tape-recordings and gives a detailed picture of the pattern of the sound. As sonagrams are increasingly used to illustrate sounds in bird books, such as *The Birds of the Western Palearctic*, they are becoming increasingly familiar to bird watchers. Four examples from Chaffinch song are shown in Fig. 1, and will be discussed further below. They have enormous practical advantages for scientists studying song, because the plots they provide are extremely detailed: songs can be compared and tiny differences spotted. I was lucky to have one of these machines available when I first became interested in Chaffinch song, some 25 years after Marler. In my case it was the few males that sing in the small and scattered pockets of woodland in Orkney that set me wondering (Slater & Ince 1979). So I recorded and sonagrammed their songs, became fascinated by their variations, and have been studying Chaffinches on and off ever since.

Some male Chaffinches have only a single type of song, which they sing in virtually identical form over and over again. But some may have up to six different types. They sing each one several times in a row before switching to one of the others, and tend to cycle round all the different songs at their disposal before returning to the first again (Slater 1983). Fig. 2 is a map of Binscarth wood in Orkney showing the territories I found there when I first started studying Chaffinches. It shows the repertoire of each male, the different song types labelled by different letters. Clearly, not only do the birds vary a lot in how big a repertoire they have, but the songs vary in how widespread they are as well. Some birds sing songs unique to themselves (like E, X and Y); other songs may be sung by half the birds in the wood (such as B in this example). The sharing is very striking: Chaffinch song is quite complicated, with its series of different phrases (the trill) followed by the terminal flourish. Where I have labelled two songs with the same letter, they are made up of precisely the same sequence of phrases.

How does this great similarity arise? The answer is simply that young birds learn the songs that they sing from others round about them, and they often do so with great accuracy (see Fig. 1). Thorpe (1958) showed this originally, and we have also found that they may learn either as young adults, when they are just setting up their territories, or in the summer before when they are still juveniles. In this case, rather remarkably, they memorise the sounds they hear and reproduce them months later when they start to sing themselves (Slater & Ince 1982).

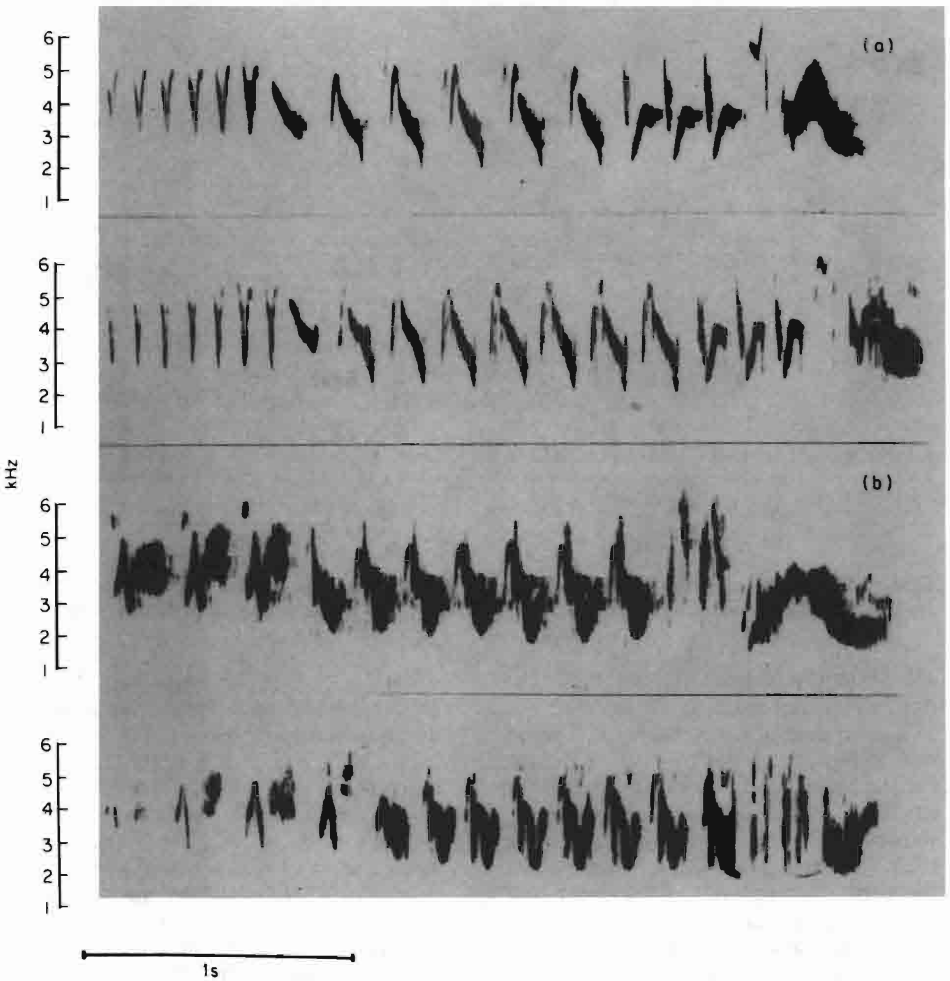

FIGURE 1. **Four sonagrams of chaffinch songs. These charts are plots of frequency (in 1000s of cycles per second, or kiloHertz) against time, the trace being black where there is energy at that particular point. The upper pair of songs (labelled a) are virtually identical to each other, as are the lower two (b), because the second of each pair was recorded from a young male that had been trained with a tape-recording of the song shown above. The young birds concerned were, in fact, hatched in Sussex, but trained with songs from Orkney, so that they sang songs totally unknown to the area from which they came. The lower song in (b) is also unique to that bird. The final section in the song on which it was trained rises and then falls. As can be seen from the sonagrams, the young bird copied the rising part, but omitted the subsequent downwards sweep (After Slater & Ince 1982).**

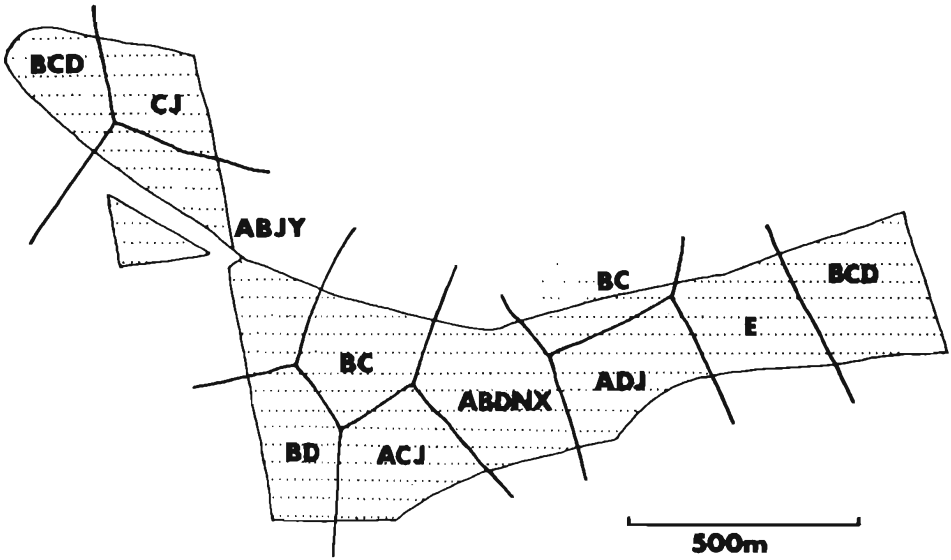

FIGURE 2. **A map of Binscarth wood, Orkney, showing boundaries of the territories of the male chaffinches nesting there. The letters indicate the song types possessed by each of the males.**

Male Chaffinches do not move far from where they hatch to where they breed so a good deal of song sharing in a wood such as Binscarth is perhaps to be expected. On the other hand, recordings at Balfour wood on Shapinsay, some 12 km away, showed that the two commonest songs were G and H, and quite distinct from any at Binscarth. Subsequently, I did find a bird in the village of Finstown close to Binscarth that sang both of these types: in my excitement I startled someone who happened to be passing by assuring them that the bird up there came from Shapinsay! I presume that he had learnt these songs on that island before moving to Finstown to breed.

Some of the songs labelled as different types in Fig. 2 are really quite similar, perhaps differing in the structure of just one phrase. Types X and Y, for example, are very like C. This led us to propose that new song types arise because birds do not always copy accurately: they may blend phrases from the songs of two neighbours, they may miss out a section, or they may improvise to create some new feature. This appears to be the main reason why there are so many songs in one area. Most of the time the birds copy songs exactly, but sometimes (we think perhaps 15% of the time) they do so inaccurately so that a new type is created (Slater *et al.* 1980). Thus, new songs are continually arising and, conversely, some of the songs which do not get copied disappear when their owners die. We now have a lot of evidence that this is exactly what does happen. One pointer, for example, comes from recordings that were made in the same wood 18 years apart (Ince *et al.* 1980). The songs present had changed almost totally, but three were still the same: this number matched almost exactly what one would expect if young birds setting up territories for the first time had copied songs accurately 85% of the time, but produced new songs on the remaining 15%.

These changes with time may also

account for changes with distance, like those between the birds at Binscarth and those on Shapinsay. In a way this is just like human dialects, but in other ways it is a bit more complicated. By listening to a person one can often tell where they come from to within a fairly short distance. But the songs of Chaffinches in Orkney do not all have some feature that other Chaffinch songs lack. They vary enormously amongst themselves and their characteristics overlap a great deal with ones from other places. If you played me a Chaffinch song, I certainly could not tell you where it came from – unless I happened to have heard it there myself. There is perhaps one exception to this, and that is the 'kit'. Some Chaffinches on the continent produce a 'kit' at the end of their song, which sounds just like the call of a Great Spotted Woodpecker *Dendrocopos major*. It is widespread: for example, I have heard it both near Berlin and in the foothills of the Dolomites in northern Italy. But it has never been recorded in Britain. So, if I hear a 'kit', I will know I must be abroad, but not all the birds in an area do it so that lack of a 'kit' does not tell me anything about where I am. Peter Marler was right: Chaffinch songs do vary from glen to glen, but the variations are rather more complicated than he supposed.

Thus, a lot of the variation in Chaffinch song, from place to place and from time to time, is because they learn their songs and they do not always get it quite right. In a way, this rather simple answer just takes the question one stage further back: why do they learn their songs? This question is not an easy one to answer. A rather nice idea is that song learning may help to match the song to the habitat in which it is sung. If young birds learn songs some distance away from the bird they copy, the sounds they will imitate will be those that reach them best. In a dense wood rapid trills get disrupted by echoes off the trees and would thus tend not to be copied. There is evidence for this in some other species where songs do vary between the different sorts of habitat that they occupy. But this idea does not appear to apply to Chaffinches as Williams (1991), who has recently examined the songs of Chaffinches in Fife and in Speyside, totally failed to find any relationship between the characteristics of their song and those of the wood in which it is sung.

Another suggestion is that birds may learn song so that they interact better with neighbours. Again, there is evidence of this in other species. Often small groups of neighbours share song types and, when they sing at the same time as each other, they will match the songs that they produce. But this is not likely to be true of Chaffinches as the amount of sharing they show is close to random and some of them do not match neighbours at all. The bird in Fig. 2 who sang song type E would clearly have a language problem if he needed to match his neighbours!

So, the reasons for song learning are not clear. Indeed, it may just be an evolutionary legacy. Many bird calls are learnt, including the Chaffinch 'chink', the form of which varies from place to place. Perhaps the calls from which song evolved were learnt, so the learning process was locked into the system before song even arose. But it seems clear that song learning has all sorts of other consequences, like the variations discussed above. It may also be a reason why birds like the Chaffinch have several different song types in their repertoire. If some songs are more effective than others, in repelling rivals or attracting mates, then having an armoury at one's disposal may be a key to success.

Study of the song of Chaffinches has certainly helped us to answer various questions about the remarkable variety that the songs of birds display. We now understand more about why it varies with time and between areas. But a lot of questions remain to be answered. With luck, Chaffinches will help us with them too.

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Adult female merlin on breeding grounds

Status, distribution and breeding biology of the Merlin in north-east Scotland, 1980-1989

G.W. REBECCA, B.L. COSNETTE, J.J.C. HARDEY AND A.G. PAYNE

Surveys for breeding Merlins were carried out in north-east Scotland during the 1980s. Breeding was confirmed at 81 separate nesting areas. They were associated with heather moor, old Caledonian pine forest and recently afforested moor at altitudes of between 190 and 750 metres. The population was estimated at 80-90 pairs and was considered to have been stable during the survey period. In approximately two-thirds of the nesting areas that were checked breeding was confirmed, with fledged young reared in approximately two-thirds of them. Average productivity was between 1.7 and 2.2 fledged young per pair and the sex ratio of the young was one to one. Of known nests, 89% were on the ground amongst heather, 7% were in old crow nests in trees and 4% were on crags. Predation and the apparent effects of pesticides were the main causes of nest failure.

Introduction

During this century the Merlin *Falco columbarius* has been widely reported as a declining species over much of its British breeding range. Loss of breeding habitat, disturbance and persecution are thought to have caused earlier declines (Prestt 1965, Parslow 1967). More recent studies in Northumbria, Orkney, the Peak District and Wales describe continuing declines.

Reduced breeding success, degradation and loss of breeding habitat, increased disturbance, weather and the effects of organochlorine pesticides and other pollutants were all implicated (Newton *et al* 1981, 1982, 1986; Roberts & Green 1983, Bibby 1986, Meek 1988, Newton & Haas 1988). One exception was in Shetland where, following the loss of half the breeding population in the early 1980s, numbers had recovered to the original estimated level by 1987 (Ellis & Okill 1990). In 1984 the Merlin was considered to be the only British breeding diurnal raptor still in decline despite a wide reduction in pesticide use (Newton 1984). Recent evidence shows that the Hen Harrier *Circus cyaneus* was also declining (Bibby & Etheridge *in press*). A national Merlin breeding survey during 1983 and 1984 resulted in a suggested British population of between 550-650 pairs with about 330-430 in Scotland (Bibby & Nattrass 1986). It was estimated that around 80-100 pairs could be present in north-east Scotland (Rebecca & Payne 1985). This paper reviews the breeding of Merlins in north-east Scotland (Fig. 1) and presents data from all nesting areas monitored between 1980 and 1989.

Historical Background

During the latter half of the 19th century Merlins occurred as breeders on the uplands and in some lowland areas of north-east Scotland. They were probably a common breeding species in the 1850s around Braemar and elsewhere on Deeside and also in the Banchory-Ternan area of north Kincardineshire (MacGillivray 1855, Adams & Adams 1859). In Banffshire they bred on the main hill ranges and on moorland almost at sea level (Edward 1856). They also bred on low altitude moorland in Buchan, Aberdeenshire (Serle 1895). Human disturbance was evident: for example, a pair were shot at the nest in Buchan in 1898 and a nest was robbed in south Kincardineshire in 1895 (Sim 1903, Harvie-Brown 1906). By the turn of the century they appeared to have declined in Aberdeenshire and Kincardineshire (Sim 1903). Although not quantified, this decline paralleled the national trend (Parslow 1967). There appears to be no published information on breeding distribution or numbers during the first half of this century. Scattered records gleaned mainly from gamekeepers indicate that they were still breeding on the hills and were probably widespread but uncommon. During the early 1950s five or six pairs bred on upper Deeside below 600m above sea level at a density estimated at about one pair per 40km^2 (Nethersole-Thompson & Watson 1981). Following concern over the status of some birds of prey, the British Trust for Ornithology (BTO) organised a national enquiry covering the period 1953-63. Banffshire and Kincardineshire were not represented. In south Aberdeenshire, a noticeable decrease was reported (Prestt 1965). The BTO Atlas, covering fieldwork during 1968-73, recorded Merlins in 25 10 × 10km Ordnance Survey (10-km OS) squares within the study area. Breeding was confirmed in ten squares, considered probable in four and considered possible in eleven (Sharrock 1976). During the early and late 1970s at least one pair per 16-20km^2 were found on the Kincardineshire moors (N. Picozzi in Nethersole-Thompson & Watson 1981; G.W.R., P.H. Shaw & L.D. Steele *pers. obs.*). The present study began in 1980, attempting to estimate overall breeding numbers and monitor breeding performance.

Study Area

This study primarily covered the upland heather *Calluna vulgaris* moors and hills of the counties of Aberdeen, Banff and Kincardine, now all part of Grampian Region (Fig. 1). Areas that were apparently unsuitable for breeding Merlins (Cramp & Simmons 1980) such as extensive mature tree plantations and land above 750 m were not surveyed intensively. In some years

suitable looking lowland mosses, maritime heath and sand dune systems were also visited.

At the time of this study in Grampian, dry heath (heather moor) occupied about one half of all the natural or semi-natural habitat. Where trees such as birch *Betula spp.*, rowan *Sorbus aucuparia* and Scots pine *Pinus sylvestris* occurred on the moorland, they were usually found scattered along burn sides or in areas where muirburn was impracticable or had ceased. There were remnants of Old Caledonian pine forest at Glen Tanar and on upper Deeside. Hill farms were situated along glens with fenced fields and shelterbelts occasionally reaching 500 m a s l. There were no extensive areas of grassy sheepwalk of the type utilized by

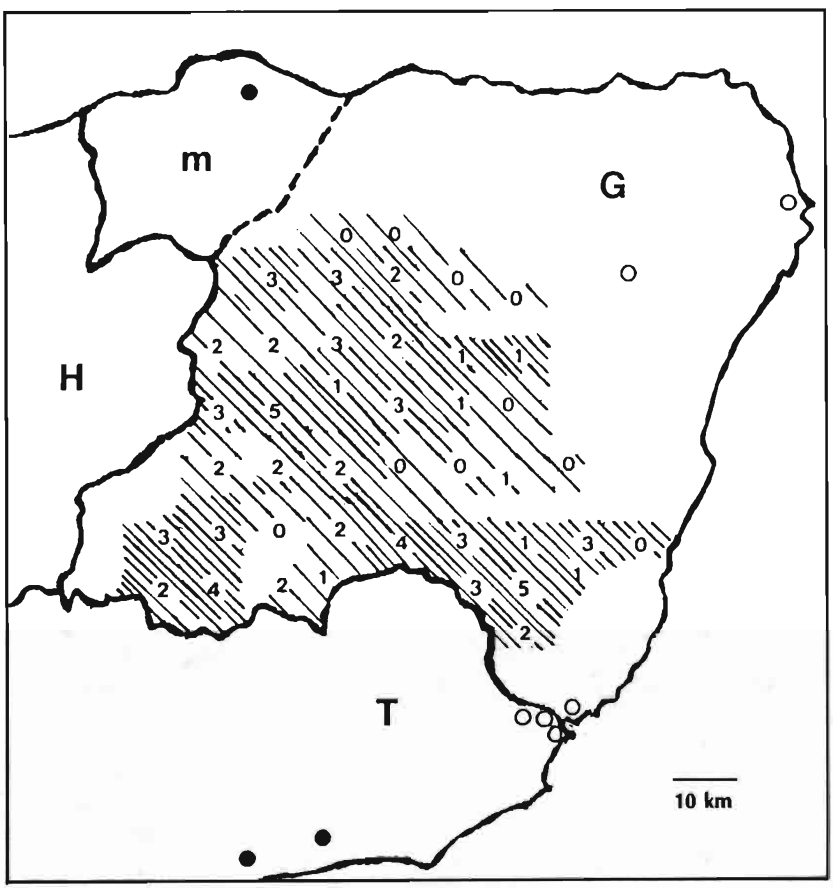

FIGURE 1. Map of north-east Scotland Merlin study area (upland Grampian Region less Morayshire) showing maximum number of breeding pairs located in 10 × 10 km OS squares in any year 1980-89 and recoveries, away from breeding areas, in Grampian and Tayside Regions, of chicks ringed within the study area. Open circles = yearlings, solid circles = adults. G = Grampian Region, H = Highland Region, T = Tayside Region, m = Morayshire, close hatch = well surveyed areas, open hatch = moderately surveyed areas, no hatch = poorly or not surveyed areas.

Merlins in other upland areas of Britain such as in Northumbria or Wales (Newton *et al* 1978, Bibby 1986). The moorland was managed primarily for Red Grouse *Lagopus lagopus* and red deer *Cervus elaphus*. Muirburning and grazing pressure, especially from sheep and deer, maintained the open moorland and largely prevented the regeneration of native trees. Since the late 1940s large areas of the lower moorland hills have been converted to commercial conifer plantations. Grampian Regional Council Department of Physical Planning (1987) and Buckland *et al* (1990) give detailed accounts of the physical landscape, vegetation, land use and habitats of the study area.

Methods

Merlin nesting areas were defined as in Newton *et al* (1978). Nesting areas were also known to be occupied in consecutive years. Tree nest sites and crag sites have been used for at least three years and at two areas the same patch of heather was used in 12 and 19 consecutive seasons (Cramp & Simmons 1980). A list of such areas in north-east Scotland where breeding had previously been confirmed or was considered to have been probable was compiled. Most of these areas were monitored annually and additional areas of apparently suitable habitat but not previously noted as nesting areas were searched. Information was also received from ornithologists, birdwatchers, naturalists, hill walkers and estate staff. In an attempt to increase the annual total of nesting areas that were monitored, other ornithologists were invited to participate and interested gamekeepers were encouraged to help in particular areas.

Areas were visited during March-May to search for signs of occupation or a nest.

Female Merlin brooding young G.W. Rebecca

Female Merlin with prey near nest : July. **B.L. Cosnette**

A nesting area was considered to have been occupied if a pair or single Merlin was seen or heard, or if moulted Merlin feathers or several fresh pellets, droppings and prey remains were found.

Breeding was considered to have been confirmed if courtship display, including the feeding of the female by the male, copulation or nest scraping was seen (Feldsine & Oliphant 1985); if eggs, shells or young were found; or if masses of prey remains, pellets and droppings were found along with moulted Merlin feathers. If nests were located visits were made to record clutch size and brood size at 3-13 days from hatching and again at 14-24 days to ring and sex the young using a combination of measurements and weight (Picozzi 1983). Clutches showing signs of depletion, i.e. broken shells or fragments, were excluded from clutch size analysis. Most nesting areas were visited to count young seen flying or obviously capable of flight. When the expected number of fledged young were not observed the area around the nest was searched for casualties. Despite this a minimum count was recorded at some nesting sites. Some were not visited until after the young had dispersed when it was possible to determine that at least one had fledged by finding moulted down away from the nest. Occasionally nesting areas were located for the first time in autumn or winter by finding down and other signs of breeding. Seven nests found between 1980 and 1983 and not visited after the ringing

of the brood are each assumed to have fledged at least one young. Where nests failed completely (i.e. no young fledged) we tried to identify the cause. Feathers, hair and droppings found near the nest or the condition of Merlin corpses gave clues towards identifying predators. Wounds caused by mammal bites were compared with skulls of museum specimens using the size and spacing of the canine teeth to aid identification. The altitude of a nesting area was calculated by averaging all known nest site heights previously plotted on 1:25000 scale maps. Unhatched eggs, collected under licence, and corpses were examined by the Institute of Terrestrial Ecology (ITE) or Department of Agriculture and Fisheries for Scotland (DAFS) to determine levels of organochlorine pollutants (DDT, dieldrin & aldrin), polychlorinated biphenyls (PCB) and mercury. Statistical tests, denoted by superscript numbers, are given in the Appendix 1.

Results

Breeding survey

The cumulative total of known nesting areas increased annually from 25 in 1979 to 91 in 1989 (Table 1), while the number of nesting areas checked on an annual basis rose from 24 to 81 (Table 2). During the study period, breeding was confirmed in 81 discrete nesting areas. They were located at altitudes of between 190 and 750 m a s l, with most between 200 and 500 m (Fig. 2). Only one nesting area was found in each of the 100-199 m and 700-799 m ranges. In the earlier years survey work was concentrated in the lower altitude ranges resulting in proportionally more breeding attempts found there overall (Fig. 2). The proportion of breeding attempts that fledged at least one young varied between 67% and 76% for the altitude ranges. No significant difference in this proportion was found between altitude ranges[1] or between nests above and below 400m[2]. Breeding success was also found to be unrelated to altitude in

TABLE 1. Cumulative total of known Merlin nesting areas in NE Scotland, 1980-89.

		confirmed breeding	probable breeding
pre	1980	22	3
end	1980	25	2
end	1981	30	—
end	1982	39	1
end	1983	47	—
end	1984	54	—
end	1985	60	—
end	1986	70	1
end	1987	74	3
end	1988	81	4
end	1989	87	4

Northumberland during 1961-76 (Newton *et al* 1978). Breeding pairs were located in 78% of the upland 10-km OS squares that were searched (Fig. 1). In well surveyed squares three to five pairs were located. The distance between occupied nesting areas was observed to vary between 0.5 and 6.0 km.

Despite repeated thorough searching, breeding Merlins were not detected in some large areas of apparently suitable upland habitat. A survey in Kintyre has also reported no breeding Merlins over large areas of apparently suitable habitat (Petty 1985).

Breeding was also not confirmed on the low lying mosses and moorland (where it occurred in the 19th century, see Historical Background), maritime heath or sand dune systems. Survey work there was not intensive, although individual summer sightings of Merlins were followed up by visits to nearby suitable looking areas. The possibility of a small number of breeding pairs in these areas cannot be ruled out.

Occupation of nesting areas

Over the 10 years breeding pairs were located on 328 occasions. Of the pairs located 20 were not revisited the same year.

TABLE 2. Occupation of nesting areas and breeding performance of Merlins in NE Scotland, 1980-89. Numbers right of colons are areas not revisited the same year, ringing done at 14-24 days.

	no. of nesting areas monitored	no. with only signs of occupation	no. (%) where breeding confirmed	no. (%) of pairs rearing at least one young to ringing	flying	no. (%) of pairs failing to rear young
1980	24	4:2	15 (63):3	10	10 (83)	2 (17)
1981	25	5:3	14 (56):1	13	13 (100)	- (0)
1982	28	7:3	21 (78):2	10	10 (53)	9 (47)
1983	45	8:5	32 (71):1	21	20 (65)	11 (35)
1984	48	7:3	29 (62)	21	20 (69)	9 (31)
1985	54	5:2	37 (69):3	22	21 (62)	13 (38)
1986	62	7:2	44 (71):3	31	30 (73)	11 (27)
1987	65	6:2	43 (66):4	27	27 (69)	12 (31)
1988	76	11:3	45 (59):2	30	30 (70)	13 (30)
1989	81	4:2	*48 (59):1	30	30 (63)	18 (37)
TOTAL	508	64.27	328 (65):20	215	211 (68)	98 (32)

* one area had probable bigamy (Cosnette, 1991)

For the remainder, 215 reared young to the ringing stage (14-24 days), and 211 (68%) of them each reared at least one young to fledging; 98 breeding pairs failed completely. In addition, signs of occupation were found, but breeding not confirmed that year, at 64 nesting areas during the survey period, 27 of which were not revisited the same year (Table 2). In approximately two thirds of the nesting areas that were checked breeding was confirmed.

Occasionally a Merlin in brown plumage summered in a nesting area, apparently without breeding. Evidence that there were unmated birds within the population was obtained when in two pairs the female and in another two pairs the male was replaced during the nesting period (Cosnette 1985, Rebecca *et al* 1988, Rebecca 1991). There was also one case of apparent bigamy (Cosnette 1991).

Nest site description

The nest site was known for 292 breeding attempts: 89% were on the ground, 7% were in old Crow *Corvus corone* nests in trees and 4% were on crags (Table 3). They were associated with heather moorland, old Caledonian pine forest or recently afforested heather moor.

TABLE 3. Number of known Merlin nest sites in NE Scotland, 1980-89 (left of colons) and number of these which fledged at least one young (right of colons).

	ground	crag	tree
1980	9:7	1:1	
1981	10:10	1:1	
1982	17.9	1.0	
1983	23.14	3:1	1:1
1984	23.15	2.2	2:1
1985	30:18	2:1	1:0
1986	36:26	1:0	4:2
1987	32:22		6:5
1988	37:26		5.4
1989	44:27		1.1
TOTAL	261:174	11:6	20:14
(%)	(89):	(4):	(7):

tree sites all in old crow nests

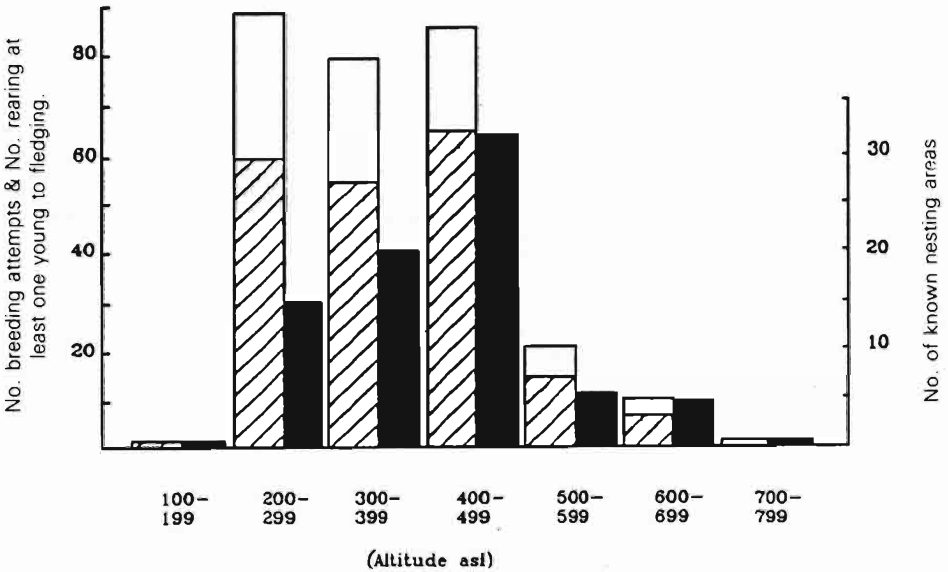

FIGURE 2. Altitude of known Merlin nesting areas in NE Scotland ■. Number of breeding attempts monitored 1980-89 □ and number rearing at least one young to fledging ▨.

Ground nests, with one exception, were in heather between 30-70 cm high and situated on hillsides or in glens. Eleven were next to small trees (ten Scots pine, one Larch *Larix*), one was next to a tree stump, four were next to fence posts and 11 were behind boulders. The remainder were in uniform stands of heather but many had similar landmarks nearby. When on recently afforested moor, nests were in small patches of uplanted heather and once in a mixture of bilberry *Vaccinium myrtillus* and bracken *Pteridium aquilinum*. Nests were usually a scrape on the bare ground or in moss but occasionally a substantial amount of vegetation was accumulated during incubation. One clutch, incubated for about two weeks past the hatching date, was on a pad of vegetation measuring 30 cm diameter and 7 cm deep. On three occasions exactly the same nest scrape was re-used, twice in consecutive years and once after a gap of two years.

Tree sites were all in old Crow nests. nine of them were in isolated Scots pines, three on moorland and six on recently afforested moor. Two nests in isolated rowans were also on recently afforested moor. Seven nests were in Scots pines in old Caledonian pine forest, six near the open moor and one about 300 m into the forest. The remaining two were about 30 m from the open moor in 10 m high unthinned lodgepole pine *Pinus contorta* plantation. The same crow nest was re-used on four occasions, twice in consecutive years and twice after a gap of one year.

When nesting on crags they used open ledges on the face or short heather (10 cm) at the top of the crag. The actual nest site usually changed annually but on one occasion the same ledge scrape was used in two successive years. One crag was used for at least nine consecutive years.

Kestrels *Falco tinnunculus* once used the same ledge scrape as the Merlins (in a

different year) and also used the same crow nest on four occasions, twice before the Merlins and twice after. At tree and crag nesting areas there were usually alternative sites available and for Merlins, there were always potential ground sites nearby. Occasionally both species nested successfully within 100m of each other. In some nesting areas the Merlins changed nest site from ground to tree and from crag to ground and vice versa in consecutive years.

Adult male Merlin portrait. **B. Cosnette**

Where Hen Harriers and Short-eared Owls *Asio flammeus* were also present they were often found nesting near the Merlins, occasionally all three within 200 m. There was probably benefit to each species regarding awareness of, and defence against, potential predators. The Merlins basically tolerated the harriers and owls early in the breeding period but once the young hatched and especially after brooding ceased they would harass and mob them regularly. Peregrines *Falco peregrinus* apparently displaced Merlins from nesting areas on several occasions and one was found at a Peregrine plucking site. In four Merlin nesting areas where Peregrines became established Merlins did not nest within a 2 km radius. In addition, at four other nesting areas where Peregrines nested in heather banks for one year, Merlins were absent that year. During the study period the number of breeding Peregrines increased dramatically in north east Scotland (Hardey 1992).

Tree sites were successful on 14 out of 20 occasions, ground sites successful on 174 out of 261 occasions and crag sites successful on six out of 11 occasions (Table 3). Crag sites could have been classed as ground sites on the basis of being vulnerable to similar predators. Analysis showed there was no significant difference between the success rates of the three nest site types[3]. In Northumbria tree sites were significantly more successful than ground sites, but in Wales this was not the case (Newton *et al* 1986, Bibby 1986).

Clutch size, brood size, sex ratio and dispersal of young

The mean annual clutch size ranged between 4.0 and 4.6 and averaged 4.4 $\pm$ 0.6 standard deviation (n = 195). The mean brood size for nests still viable at 3-13 days from hatching was 3.7 $\pm$ 0.9 SD (n = 164) and at 14-24 days it was 3.5 $\pm$ 1.0 SD (n = 160). The mean number of fledged young per successful nest counted was a minimum of 3.0 $\pm$ 0.9 SD (n = 166) (Table 4). For a large number of confirmed breeding attempts pairs were located early in the breeding season (March-April i.e. before laying). They were followed through to the ringing stage (14-24 days) and then for the majority their subsequent number of fledged young was counted. Including failed nests this gives more accurate figures for productivity (Table 5). Average brood size per pair at 14-24 days was 2.2 $\pm$ 1.9 SD (n = 249) and at fledging was at least 1.7 $\pm$ 1.7 SD (n = 232).

For 147 broods where the young were

TABLE 4. Clutch and brood size of Merlins from nests found at all stages in NE Scotland, 1980-89. Clutches showing signs of depletion excluded, flying count is a minimum, includes five repeat clutches 1×1, 2×3, 2×4.

	clutch							brood														
								3-13 days						14-24 days						flying					
	1	2	3	4	5	6	$\bar{x}$	1	2	3	4	5	$\bar{x}$	1	2	3	4	5	×	1	2	3	4	5	×
1980				3	5		4.6	1	1	1	2	2	3.4	1	1	1	2	2	3.4	1		2	2		3.0
1981			1	5	1		4.0		1	4	3		3.3	1	2	3	3		2.9	1	4				2.8
1982			1	9	3		4.2		3	2	5		3.2		3		5		3.3		3	1			2.3
1983			1	10	2		4.1		1	2	10		3.7		1	2	5		3.5		3	4	2		2.9
1984				10	5		4.3		2	5	7	1	3.5		2	3	6	1	3.5		5	6	4		2.9
1985				10	12	1	4.6		2	3	6	6	3.9	1	3	3	7	1	3.3	1	4	8	4		2.9
1986	1		1	13	11		4.3	1	1	2	16	1	3.7	1	3	3	16	1	3.5		6	14	9		3.1
1987				17	12		4.4	1	2	4	9	5	3.7	1	4	4	10	5	3.6	1	8	10	7	1	3.0
1988			1	16	16		4.5			4	17	7	4.1			4	18	6	4.1	1	2	9	14	3	3.6
1989			1	17	10		4.3	1	1	6	12	4	3.7	1	2	8	12	2	3.5	3	6	10	6	1	2.9
TOTAL	1	-	6	109	78	1	4.4	4	14	33	87	26	3.7	6	21	31	84	18	3.5	8	41	64	48	5	3.0
± SD							±0.6						±0.9						±1.0						±0.9

SD standard deviation

TABLE 5. Productivity of Merlins found occupying nesting areas early in the breeding season (March-April i.e. before egg-laying) and followed through in NE Scotland, 1980-1989.

	nesting areas with young aged 14-24 days								nesting areas with fledged young							
	no. of areas	no. of young							no. of areas	minimum no. of young						
		0	1	2	3	4	5	$\bar{x}$		0	1	2	3	4	5	$\bar{x}$
1980	9	2	1	1	1	2	2	2.7	6	2	1		1	2		2.0
1981	7		1		3	3		3.1	3		1	2				2.5
1982	17	9		3		5		1.5	12	9		3				0.7
1983	21	11		1	2	7		1.7	19	12		1	4	2		1.1
1984	18	7		1	3	6	1	2.2	17	8		2	5	2		1.6
1985	28	14		3	4	6	1	1.7	28	15		4	5	4		1.4
1986	31	10	1	3	3	13	1	2.4	31	11		4	9	7		2.2
1987	35	12	1	4	4	9	5	2.3	35	12	1	6	9	6	1	2.1
1988	40	13			4	17	6	2.8	39	13	1	2	9	11	3	2.3
1989	43	18	1	2	8	12	2	2.0	42	18	3	6	9	5	1	1.7
TOTAL	249	96	5	18	32	80	18	2.2	232	100	7	30	51	39	5	1.7
± SD								±1.9								±1.7

SD standard deviation

known to have fledged the sex ratio was very close to one to one, with 264 males and 258 females. On an annual basis the ratio occasionally differed by up to a factor of two (Table 6).

After fledging the young usually remained in the nesting areas for about two weeks and then dispersed. During the 1970s and 1980s over 600 young Merlins were ringed in the study area and 17 have been recovered away from the nesting areas. Those recovered within Grampian and Tayside are shown in Fig. 1. The others were: five from England, two from south-west France and one from south-east Spain. For England, two were found in their first year, 220 km away in Northumbria and 440 km away in Lincolnshire, two in their second year, 390 km away in Lancashire and 570 km away in Gloucestershire and one in its third year 540 km away in Cambridgeshire. In France one was shot near La Rochelle 1210 km away within four months of fledging, the other was found near Arcachon 1375 km away in its second year. The Spanish recovery was near Alcira 2025 km away and was also found within four months of fledging. All recoveries were found in autumn or winter and, for the British ones, at lower altitudes than the nesting areas and mainly in association with coasts or estuaries, for example four were found in their first winter near Montrose basin, Tayside (Fig. 1). In ten cases the recovery circumstance was recorded: three were shot (one in a flock of Starlings *Sturnus vulgaris*), four hit windows (two subsequently released), one hit a van when making a kill, one hit wires and one had a broken wing. These recoveries away from nesting areas of Merlins ringed as chicks show a similar pattern to those from all of Britain up to 1986 i.e. moving to lower altitudes and estuaries and occasionally reaching the continent (Heavisides 1987). It is interesting to note that none were found north of Grampian Region.

TABLE 6. Sex ratio of nestling Merlins in NE Scotland, 1980-89. Broods sexed at 14-24 days and known to have fledged.

	no. of broods	sex female	male
1980	6	12	9
1981	9	15	11
1982	7	13	11
1983	8	8	19
1984	11	19	11
1985	14	28	17
1986	22	35	45
1987	23	48	34
1988	24	40	58
1989	23	40	39
TOTAL (%)	147	258 (49)	264 (51)

Age ratio of breeders

The ratio of brown-backed (first year) to blue-grey backed (adult) males seen at nesting areas was 0:10 in 1980, 0:11 in 1981, 0:16 in 1982, 0:23 in 1983, 2:25 in 1984, 0:31 in 1985, 2:35 in 1986, 1:37 in 1987, 0:38 in 1988 and 3:43 in 1989; overall 8:269. Two of the apparently paired first year males were subsequently replaced by adult males during the nesting period (Rebecca *et al* 1988). After taking these two cases into account the overall proportion of first year male breeders was 2%. We could not ascribe age to females in the field. After 1983 we aged females that were caught or found dead at the nest by plumage characteristics (Cramp & Simmons 1980). The ratio of first year to adults was 0:8 in 1984, 1:12 in 1985, 0:7 in 1986, 0:4 in 1987, 1:8 in 1988 and 0:6 in 1989; overall 2:45 equivalent to 4% first year female breeders. This was considerably less than the 18% and 8% first year females and males found in Northumbria and the 18% and 6% first year females and males found in Shetland (Newton *et al* 1986, Ellis & Okill 1990).

Nest failures and pollutants

Approximately one third (32%) of all breeding attempts failed completely (Table

2). The types of complete failure were recorded for 104 nesting attempts (Table 7). In 23% of the nesting failures evidence of laying or of incubation was not found. In 30% of complete failures the clutch was depleted and then deserted, failed to hatch or was broken (small eggshell fragments found), suggesting that the eggs might have been affected by organochlorine pesticides and that the birds had probably broken them (Newton *et al* 1982). Predation accounted for 43% of the failed nests and 4% failed due to human disturbance (twice deliberately). 12 females were depredated at ground nests along with their clutch or brood. One female was a road casualty. The 13 complete broods which died in the nest were all at ground sites. Corvids took some clutches and killed a brood but it is possible that the clutches had already been abandoned. The Merlins were often seen driving off crows, raptors and other large birds and they appeared competent when dealing with crows. A Golden Eagle *Aquila chrysaetos*, a Hen Harrier and a Short-eared Owl each killed a female on the nest and these predators were also suspected of taking young Merlins. Foxes *Vulpes vulpes* were probably the main mammalian predator as their signs were often found near failed nests. A stoat *Mustela erminea* and a mink *Mustela vison* each killed a female on the nest and a 'wild cat' *Felis spp.* killed a brood. Deliberate disturbance by gamekeepers occurred at two nesting areas in the earlier years. Predation and the apparent effects of organochlorine pollutants accounted for 73% of the failures. Pesticides may also have been implicated in those cases where clutches were apparently not laid or not incubated (23%), but other factors (e.g. weather, age of female) could have been the cause. Unhatched eggs from 49 clutches were

TABLE 7. Types of complete nest failure in Merlins in NE Scotland, 1980-89. Includes three repeat clutch failures and three first clutch failures where repeat clutches successful.

	no evidence of incubation or laying	clutch depleted & deserted, unhatched or small fragments	clutch disappeared or depredated	female depredated at nest with clutch, brood	brood died depredated by bird, mammal, ?	human disturbance
1980		1	1			1[1]
1981						
1982		5		1	1 1	1[2]
1983	4	4		2	1	1
1984	2		2	1 1	1 1[3]	1
1985		8	4	1	1 1 1[4]	
1986	4	3	4		1	
1987	3	4	1	1	2 1	
1988	3	4	3	1[5] 1	1	
1989	8	2	4	3 1		
TOTAL	24	31	19	13	13	4
(%)	(23)	(30)	(18)	(12.5)	(12.5)	(4)

[1] pair killed, [2] nest destroyed, [3] brood disappeared, [4] brood starved, [5] female was road casualty at the incubation stage.

TABLE 8. Mean eggshell index and mean Organochlorine, PCB and Mercury levels in Merlin eggs, NE Scotland 1980-89 (n = 53). HEOD, DDE and PCB units are p.p.m. in lipid, Mercury units are p.p.m. dry weight. % shell thinning calculated using pre DDT mean shell index of 1.26, eggshell index = wt (mg)/l x b (mm).

	eggshell index	% shell thinning	HEOD	DDE	PCB	Mercury
arithmetic means	1.06	16.2				
geometric means			4.82	118.10	49.28	1.96

individual results in Appendix 2a

analysed by ITE at Monks Wood Experimental Station for concentrations of organochlorine residues (DDE, the main metabolic breakdown product from the insecticide DDT and HEOD, derived from the insecticides dieldrin and aldrin), industrial polychlorinated biphenyls (PCB) and mercury (mainly from agricultural and industrial sources) as described by Newton *et al* (1982) and Newton & Haas (1988) (Appendix 2a). Mean eggshell index was 1.06 (range 0.78-1.35) equivalent to a 16% mean reduction in thickness compared to the mean thickness prior to the use of DDT (Newton *et al* 1982) (Table 8, Appendix 2a). The geometric mean concentrations were: DDE 118.10 ppm (range 44.17-340.83), HEOD 4.82 ppm (range 0-32.55), PCB 49.28 ppm (range 9.07-219.49) and mercury 1.96 ppm (range 0.52-6.01) (Table 8, Appendix 2a). These results are similar to those for unhatched Merlin eggs from all of Britain for 1981-86 (Newton & Haas 1988).

Young fledged from 32 of the nests where unhatched eggs were collected and the other 17 failed completely (Appendix 2a). 20 corpses were analysed at Monks Wood or DAFS Edinburgh, and results are shown in Appendix 2a. DDE, dieldrin and PCB residues were found at levels described as low and background and were similar to those now found in some other predatory birds.

Discussion

Status and Distribution

As the survey was extended annually additional nesting areas were continually being located. Breeding was confirmed at 81 discrete areas but not at ten nesting areas known from the 1970s. For reasons unknown these areas may no longer be viable as nesting areas. Merlin nesting areas are often used in successive years (summarised in Cramp & Simmons 1980). This was also found in north-east Scotland. The annual occupancy by breeding pairs at known nesting areas averaged about two thirds of those monitored. With no earlier quantitative data available it is difficult to assess the status of this population. An indication of the status can be derived by examining and comparing occupation of nesting areas, trends and productivity from other studies where some knowledge of past status was known. This does not take into account possible immigration or emigration. However, there was no indication that either occurred on a large scale in north east Scotland during the study period. There were no breeding season recoveries or controls of Merlins that had been ringed outwith the study area. Nor were there any from elsewhere of Merlins ringed within the study area.

In three widely separated breeding

studies, where the populations were reported to be in decline, annual occupancy of nesting areas was 14-24% in Orkney 1981-87 (Meek 1988), 23-39% in Northumbria 1974-83 (Newton *et al* 1986) and 40-60% in Wales 1970-84 (Bibby 1986). In Shetand population recovery was recorded between 1984-87 with occupation of nesting areas by pairs of 34-45% (Ellis & Okill 1990).

In a delimited intensively studied part of Deeside, the area surrounding every previously recorded nest site within the discrete nesting areas was searched annually during the study period. The occupancy by breeding pairs averaged 13 (n = 10-15), which represented about 68% occupation of the known nesting areas (G.W.R., B.L.C., A. Duncan & L.D. Steele *in prep*). In the remainder of the present study area not all nesting areas were monitored annually but the average proportion of those examined that were occupied by breeding pairs was 65%, similar to the 68% found in the intensively studied area, so the figure for occupancy could be general. There was no evidence of any decline during the study period and the population in north-east Scotland was considered to have been stable.

Despite this, some extensive areas of apparently suitable habitat did not hold any breeding Merlins. In these areas prey numbers, predator level and land use appeared no different from areas where Merlins were breeding. Some apparently alternative nests sites were separated by up to 3.5 km. This may have reflected a naturally low density level or an artificially depressed population. It was subsequently discovered that on one sporting estate, with the potential to hold three to four pairs of Merlins, illegal persecution of raptors, including Merlins was occurring up to about 1988. Two other Merlin nests were interfered with by gamekeepers on two other sporting estates (in 1980 & 82) and persecution cannot be ruled out as a possible reason why some areas were devoid of Merlins. If every known nesting area had been examined and all additional suitable habitat within the study area surveyed in a single year a population of 80-90 pairs could have been present.

Recent studies in Wales and Northumberland have shown that Merlins have adapted to using new breeding sites. They are now commonly found nesting in old crow nests at the edge of, or in, maturing conifer plantations (Parr 1991, Little & Davison *in press*). During this study, mature conifer plantations and their edges were not searched because, at that time, the habitat was not considered suitable (Cramp & Simmons 1980). Surveys were concentrated in open country and to a lesser extent in old Caledonian pine forest.

In 1987 a pair of Merlins were found breeding at the edge of a maturing lodgepole pine plantation (B. Etheridge *pers. comm.*). In 1991 a second conifer forest plantation site was located, but about 60 km from the first site (Rebecca 1992). There are large areas of maturing conifer plantations in the study area so future surveys for breeding Merlins should include forest edges as well as the remnant low-lying moors and mosses where the remaining habitat still appears suitable.

Breeding biology

These Merlins laid clutches that were on average slightly larger, $\bar{x}$ 4.4 than those from Wales $\bar{x}$ 4.3 (Roberts & Green 1983, Bibby 1986) and Northumbria and Shetalnd, $\bar{x}$ 4.2 (Newton *et al* 1986, Ellis & Okill 1990). Clutches were also 0.5 eggs per clutch larger than the average for Orkney (Meek 1988).

Brown (1976) and Olsson (1980) calculated that Merlins should fledge 2.5 young per pair to maintain numbers. Bibby (1986) suggested that if Merlins have similar survival rates to Sparrowhawks *Accipiter nisus* and bred at two years, productivity would need to be about 2.6 fledged young per pair for numbers to remain stable.

Overall productivity in north-east Scotland was between 1.7 and 2.2 fledged young per pair (and was probably nearer the latter figure). The population was considered to have been stable during the 1980s with an occupancy of nesting areas, by pairs, of 65%. These figures suggest that an output of no more than 2.2 young fledged per pair can be sufficient to maintain numbers. In an expanding urban population in Saskatoon, Canada productivity was 3.7 fledged young per pair (Oliphant & Haug 1985). In contrast the study area reporting the most serious decline was Orkney, productivity there was 1.3 fledged young per pair (Meek 1988). Brown's calculation (1976) allowed for Merlins to live for two years and rear 3.2 young per successful pair. The Merlins in north-east Scotland fledged between 3.0 and 3.5 young per successful pair and the vast majority found breeding were adults i.e. more than one year old.

More details are needed on adult survival, age of first breeding and fidelity to breeding regions to assist in assessing occupation and productivity from geographically separate study areas. For example, it was suggested, in north Wales that some Merlins may have moved from one study area to another following habitat degradation (Roberts & Green 1983).

Almost a third of all breeding attempts failed to produce fledged young, about half of them due to predation. This population must have been vulnerable to predation because most nests were on the ground. 12 females were known to have been killed at the nest. This was a considerably higher figure than reported from other breeding studies (Williams 1981, Roberts & Green 1983, Newton *et al* 1986, Meek 1988, Ellis & Okill 1990). It is possible that commercial conifer plantations provide a safe haven for predators such as foxes and crows and, with the reduction of gamekeepers following the afforestation of grouse moors, these predators are likely to increase. If so, Merlins that breed near maturing plantations, of which there are many in the study area, could be subjected to a higher predator level unless they switch to three nesting.

The apparent effects of pollutants accounted for at least 30% of the nests that failed completely and unhatched eggs from a further 49 nests reduced potential productivity, as did individual eggs that broke during incubation. Altogether 53 unhatched eggs were analysed. Average organochlorine, PCB and mercury levels were similar to the average levels found for the whole of Britain from 1981-86 (Newton & Haas 1988). There was no evidence that organochlorines or PCB, at the levels reported by Newton & Haas, influenced productivity. However in clutches where mercury levels were above 3 ppm productivity fell markedly. The mean mercury level from north-east Scotland at 1.96 ppm was below this. One egg from 1982 and seven since 1987 contained mercury higher than 3ppm. The fact that so many eggs did not hatch gives cause for concern. Mean eggshell thickness for unhatched eggs was 16% lower than the DDT era mean. Where whole clutches and individual eggs broke it is likely they were thinner than those that failed to hatch. Raptor populations that showed an average of more than 16-18% eggshell thinning over several years were all declining (Newton 1979).

The future

In north-east Scotland Merlin nesting areas should remain suitable so long as there are no widespread land use changes. Probably the most serious threat to the population is the afforestation of extensive areas of moorland with conifers. Some breeding sites, known from earlier decades, have been lost to maturing conifer plantations. Fewer forests have been planted since 1988, following changes in tax legislation and the introduction of environmental assessments for certain new forestry schemes. In

addition conservation bodies in north-east Scotland, such as the Scottish Natural Heritage and the Royal Society for the Protection of Birds, are now consulted on forestry applications over 30 hectares in size and can argue the case to retain Merlin habitat. The Merlin is an Annex I species under the EC Directive 79/409/EEC on the Conservation of Wild Birds, and in theory their nesting areas and hunting ranges should be protected from damaging factors. Under this directive "The species mentioned in Annex I shall be the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution" (Article 4). However, there is little information available on the extent that breeding Merlins use the surrounding habitat. For example, Merlins in south-east Grampian hunted at least 5.6 km from the nest (Rebecca *et al* 1990) but it was not known how often. Further study is needed to ascertain what quantity of open habitat and forestry is necessary to sustain Merlin breeding populations.

Another potential threat to the heather moorland is overgrazing by deer and sheep. Subsidies on hill sheep have been reduced so this threat has also decreased and it is possible also that deer numbers will reduce in the future given the expressed concern of the Red Deer Commission and others.

The recurring effects of pollutants continue to be a serious problem. It is alarming that the Merlin is still affected by these chemicals, particularly DDT and that overall numbers in Britain have not recovered to the same extent as other bird eating raptors such as the Peregrine and Sparrowhawk (Ratcliffe 1984, Newton & Haas 1984). It is essential to monitor the situation and to continue to collect unhatched eggs and corpses for analysis. It is planned to continue studying the Merlin population in north-east Scotland and to survey the remaining suitable habitat during the 1990s.

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APPENDIX 1. Results of statistical tests.

1. Chi-square = 2.39, 3df, ns
2. Chi-square = 1.73, 1df, ns
3. Chi-square = 0.84, 2df, ns

APPENDIX 2(a). Eggshell indices, Organochlorine, PCB and Mercury levels in Merlin eggs, as described in Table 8.

	eggshell index	% shell thinning	HEOD	DDE	PCB	Mercury	nest successful = s failed = f
1980	0.91	28	5.50	80.00	46.00	—	s
	0.95	25	5.40	174.00	77.00	—	s
1981	1.05	17	2.16	131.65	15.35	1.63	s
			10.62	140.52	75.72	1.34	s
			5.88	253.53	71.37	2.29	s
	1.11	12	6.29	176.16	45.36	1.18	s
1982			4.46	141.96	89.88	6.01	f
	1.20	5	3.51	47.08	21.35	0.80	s
	1.15	9	1.37	114.16	12.79	0.82	s
	1.00	21	3.68	142.14	141.14	2.75	f
	1.00	21	8.66	114.33	58.51	1.60	s
	1.01	20	5.86	92.79	43.69	2.63	f
1983	+		9.96	148.89	81.19	0.52	s
	+		19.88	147.40	92.66	2.74	
	0.78	38	4.71	114.41	116.76	1.58	s
			11.31	88.64	37.37	1.00	s
	+0.79	37	n d	170.93	30.52	2.44	f
	+0.80	36	n d	114.60	15.24	3.00	
1984	0.96	24	7.61	48.79	32.53	0.86	f
			13.71	157.94	102.80	1.25	s
	0.82	35	4.99	200.83	44.32	2.21	s
	0.88	30	4.62	88.00	56.31	2.17	s
	0.89	29	5.49	97.25	47.84	2.42	f
			6.84	132.57	45.93	1.35	f
1985			5.49	133.79	9.07	1.26	f
	1.23	2	0.68	176.03	68.26	0.67	s
	1.02	19	17.36	340.83	101.22	3.75	f
	1.21	4	3.75	163.27	12.33	1.24	f
	1.00	21	3.52	89.87	14.98	1.12	f
1986	1.19	6	4.88	92.68	15.68	2.17	s
	1.22	3	6.97	115.28	30.11	0.81	s
	0.97	23	12.89	220.21	54.36	3.24	f

	eggshell index	% shell thinning	HEOD	DDE	PCB	Mercury	nest successful = s failed = f
1987	1.21	4	1.98	52.78	16.67	2.14	s
	1.02	19	1.81	178.92	27.71	1.98	s
	1.25	1	3.05	110.31	34.73	2.70	s
	0.94	26	14.17	141.73	159.45	4.34	f
	1.03	18	32.55	189.15	77.36	4.18	s
			7.35	65.71	9.80	1.68	f
1988	0.98	22	3.58	105.79	116.01	3.68	s
	1.17	7	6.17	98.77	117.78	1.94	s
	+1.06	16	0.65	121.35	51.89	3.07	f
	+1.03	18	7.66	152.20	219.49	4.30	
	1.20	5	11.51	102.96	55.59	2.56	f
	1.21	4	8.62	166.09	165.23	5.15	s
	1.17	7	2.19	124.11	99.73	2.98	s
1989	1.35	7*	n d	44.17	32.77	2.24	s
	1.09	13	8.14	97.67	78.29	1.79	s
			3.49	100.78	51.94	2.46	s
	1.01	20	5.20	118.80	54.00	4.66	f
	1.22	3	3.52	126.02	152.44	0.69	s
	+1.17	7	2.57	61.09	64.63	2.49	s
	+1.22	3	n d	52.70	46.62	1.87	
	0.90	29	7.46	157.97	57.63	2.11	s

* shell thicker than pre DDT mean, + eggs from same clutch, n d not detected, — not tested

APPENDIX 2(b) Organochlorine, PCB and Mercury levels in liver tissue of Merlins, a = adult, y = yearling, n = nestling. Units are as described in Table 8.

	age	Dieldrin	DDE	PCB	Mercury
1983	n	0.09	0.24		
1985	n	0.06	0.34		
	n	0.06	0.49		
	n	0.06	0.64		
	n	0.08	0.52		0.21
	n	0.14	0.66		
	n	0.09	0.49		0.09
	n	0.11	0.55		0.12
	n	0.05	0.21		0.18
	n	0.04	0.20		
	n	0.04	0.44		
	n	0.04	0.47		
	a	0.16	2.32		0.65
1987	a	0.22	1.07	0.74	5.39
	y	0.42	1.30	0.34	1.62
	n	0.08	0.84	0.50	1.48
	n	0.11	0.22	n d	0.88
	n	0.09	0.20	n d	0.68
1988	a	0.05	0.44	0.53	1.58
1989	n	0.03	0.06	0.12	0.58

n d not detected

Distribution and number of feral Greylag Geese in Scotland

ALLAN W. BROWN AND GERALD DICK

The results of an enquiry on introduced Greylag Geese revealed 2,673 birds for Scotland in 1989 including some additional data for 1990 and 1991. Apart from the well known sites of release, information about feral geese was gathered from areas not previously documented. The current situation is discussed with regard to distribution and population trend.

This paper is dedicated to John Berry who initiated much of the early research on geese in Scotland.

Introduction

The Greylag Goose, *Anser anser*, was formerly a widespread breeding species in Britain but the native population, comprising 2,500-3,000 birds, is restricted now to north-west Scotland centred on the Uists (Owen *et al.* 1986, Paterson 1987, 1991, Thom 1986). Resident birds which occur elsewhere in Scotland at present are the result of reintroductions which have established feral populations. After a dramatic decrease of Greylag numbers early this century (Berry 1939), mainly due to persecution, efforts were made to establish feral flocks in south-west Scotland in the 1930s. An attempt to assess the establishment and size of the feral population in Britain and Ireland (Owen & Salmon 1988) suggested a total population in 1986 of over 13,700 birds, with at least 2,300 in Scotland.

The latter were based around four main locations – Loch Tummel (Tayside), Loch Achray (Central), Duddingston Loch (Lothian) and Galloway (Fig. 1). The purpose of this paper is to provide additional data on the establishment of feral groups throughout Scotland with an estimate of population size for the period 1989-91.

Methods

In September 1989 the Goose Research Group (Greylag Goose Sub Group) of the International Waterfowl and Wetlands Research Bureau (IWRB) contacted the Scottish Ornithologists' Club concerning the intention to publish an Inventory of Introduced Greylag Goose Populations. For the population in Scotland information was requested on each site or population, including year and origin of introduction, population size and trends, number of young produced per year and any other relevant material.

Given that published data on the size of feral flocks was likely to be incomplete, recording forms were sent to all SOC recorders to obtain the information required and enable a comprehensive assessment to be made of the distribution and size of the feral population in Scotland. Most of the results are for 1989, but some additional data for 1990 and 1991 have been incorporated.

Results

Recording forms were returned from all recorders and the results for each Region

(and District where appropriate) are given below (Fig. 1, Table 1).

Borders

Occasional sightings of birds in Tweeddale (Murray 1986) and elsewhere in the Region (*Borders Bird Reports* 1979-89) are thought to be from the Lothian population but no feral population has become established. However, in 1990 and 1991 one pair bred successfully at Baddinsgill Reservoir, Tweeddale.

Central

Wildfowlers released Greylag Geese in the area of Lochs Achray and Venacher in 1970 and 1971 (50 and 20 birds respectively) establishing a reserve for the Wildfowlers Association of Great Britain (WAGBI, now British Association for Shooting and Conservation BASC). BASC interest in the site apparently ceased around 1979. Owen *et al* (1986) and Owen & Salmon (1988) refer to a feral flock of 200 birds being established and still present in this area in 1985-86. However, although the maximum population of 200 birds was attained by the late 1970s, since then the release site has become overgrown, disturbed and subject to erratic water levels. This has resulted in the disappearance of the birds (C.J. Henty pers. comm.).

By the late 1980s the population had been reduced to about 50 birds which were based at Loch Katrine. These may have been the origin of the scattered breeding pairs now noted in the Trossachs, with occasional pairs or broods around the Lake of Menteith.

It seems likely that the counts referred to by Owen *et al* (1986) and Owen & Salmon (1988) are of wild/wintering birds as

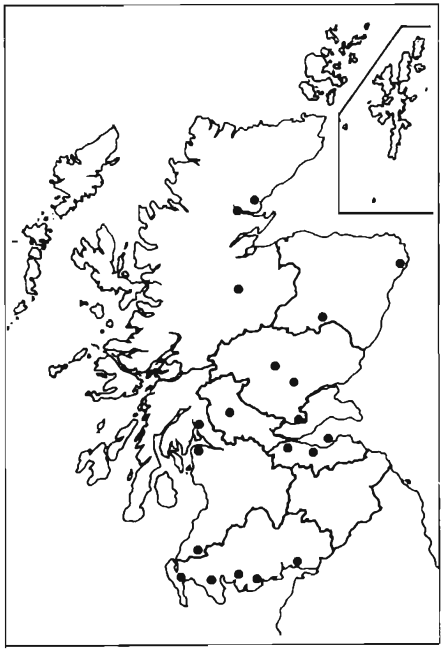

FIGURE 1. *Regions of Scotland and breeding records of feral Greylag Geese after Thom (1986).*

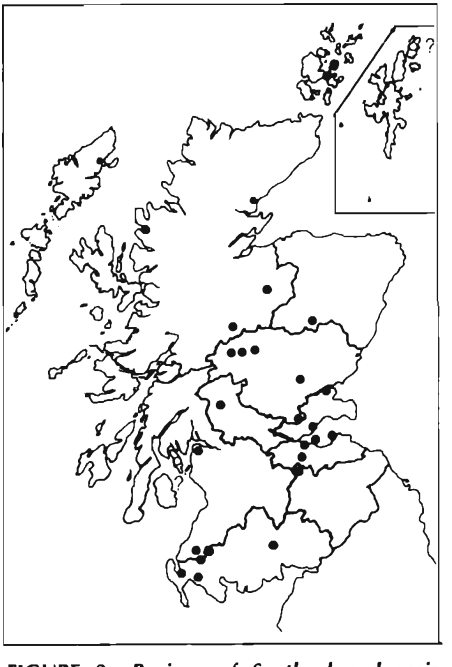

FIGURE 2. *Regions of Scotland and main breeding sites of feral Greylag Geese, 1989-91.*

TABLE 1. Estimate of Minimum Number of Breeding Pairs and Minimum Total Population of Feral Greylag Geese in each Scottish Region in 1989-91.

Region	Number of Breeding Pairs	Total Population
Borders	1	2
Central	5	50
Dumfries & Galloway*	88	1,469
Fife	6	56
Grampian	3	6
Highland	48	331
Lothian	30	300
Orkney	6	12
Shetland	3	6
Strathclyde	16	55
Tayside	31	368
Western Isles	5	18
Total Scottish Population	**242**	**2,673**

*** Data refer to 1988**

opposed to feral flocks as they were in October and April (C.J. Henty pers. comm.). Both references are likely therefore to misplace and overestimate the present population which no longer occurs in the Achray – Venachar area; it is restricted to a small and scattered breeding population in the Trossachs, probably originating from the feral release in the early 1970s with a small group based on Loch Katrine. In 1991 only a few summer pairs (5+) were found in the Trossachs (C.J. Henty pers. comm.).

Dumfries and Galloway

The history of feral Greylag Geese in south-west Scotland has been well documented (Young 1972 a, b, Shimmings *et al.* 1989) and need only be summarised here. The species was introduced to the area around 1930 using birds reared from eggs taken from the indigenous Greylag population on South Uist, Western Isles. The initial release site was at Loch Inch near Stranraer (Wigtown) but during the 1930s further releases took place at Monreith (Wigtown). Since then the population has spread naturally, especially through Wigtown and Stewartry but also into Nithsdale. However, in addition a flock of about 30 birds was introduced to Glenkiln, Nithsdale, in the early 1980s for wildfowling purposes and three broods were recorded there in 1989 (E.C. Fellowes pers. comm.).

By 1971 the total population was estimated as 1,160 birds, and at least 129 breeding pairs reared 300 young (Young 1972a). Owen & Salmon (1988) considered the population as stable at around 1,500 birds in 1985-86 while Shimmings *et al.* (1989) recorded 1,469 birds in June 1988 at 18 sites with at least 88 pairs breeding and rearing 354 young.

The main centre of the population is still around Loch Inch (White Loch) with other concentrations at Castle Loch, Loch Dornal and Loch Moan (all Wigtown). Some of these areas also support substantial moulting and post-breeding flocks.

Fife

Smout (1986) refers to only a few pairs of feral birds trying to breed in recent years although wild birds are known to have bred at Morton Lochs and possibly Tentsmuir in 1930. A small flock formerly based around Tayport has not been reported for several years (D.E. Dickson pers. comm.). However, at least two pairs bred in Newport-on-Tay in 1990 and 1991 (J. Berry pers. comm.). A flock of up to 50 birds is present at Beveridge Park, Kirkcaldy (with three broods in 1991), but its origin and date of introduction is not known. One pair was present at Loch Gelly in 1990 and 1991 (B. Little pers. comm).

Grampian

A small flock was introduced to the Ballater area of Kincardine & Deeside in the early 1970s.. The origin of these birds is not

known but the 2-3 pairs that now occur between Lochs Muick, Ullachie and Davan show no signs of increase (K. Shaw pers. comm.).

Highland

Feral Greylags have been released into several areas as follows, apparently from the native stock in north and central Sutherland and/or from the population in South West Scotland: –

a) Sutherland: Introductions occcurred at Loch Brora in 1937, and these resulted in 200 birds there in 1952; they were then reduced to only 30-40 birds and numbers have remained stable since then. The native stock on Loch Badanloch was reinforced in the 1960s to 60 pairs, and the population there is now about 500 birds; breeding has also occurred at Loch Shin (Owen *et al* 1986). In the 1950s around 10 birds were released in the Migdale/Spinningdale area and after remaining low in numbers up to the mid 1970s (maximum 30-40 birds), a noticeable increase has occurred in recent years. Breeding has extended to Loch Fleet and the overall population numbers between 200-300 birds (R.H. Dennis pers. comm.). The total feral population is likely to be a minimum of 285 birds with 30 breeding pairs. The presence of native stock is known to have resulted in inter-breeding with the feral birds, thus complicating assessment of the feral and native populations in this area (Thom 1986).

b) Ross & Cromarty: In the early 1960s about six birds were released at Loch Maree, and the population there has remained at 3-5 pairs.

c) Badenoch & Strathspey: In the early 1970s 5-10 birds were released at Loch Laggan, and 2-3 pairs still breed there. In the early 1980s they colonised the Inch Marshes and in 1989 they reached the Boat of Garten. The total population is thought to number 10-15 pairs. (R.H. Dennis pers. comm.).

d) Caithness: No feral population is known (E.W.E. Maughan pers. comm.) although breeding of native birds was reinforced with feral birds in the 1960s and mainly occurs around Loch Calder (Owen *et al.* 1986).

Lothian

13 feral Greylags were introduced to Duddingston Loch in Holyrood Park, Edinburgh, on 3 March 1961. The birds originated from eggs collected from the population at Loch Inch, Wigtown (J. Berry pers. comm.; Anderson & Waterston 1961). They were not recorded in wildfowl count data until 1965 (Owen & Salmon 1988). Since introduction, the population has become well established and, by the late 1970s, 200 birds regularly occurred in Holyrood Park with up to 15 pairs breeding at Duddingston Loch (Andrews 1986).

Holyrood Park has remained the principal base for the flock, holding 250-350 birds, the maximum in November 1990. 5-7 broods and 30-40 young have been found regularly at Duddingston Loch. However, the 1980s have also seen a considerable dispersal of breeding pairs and flocks throughout the Region, especially from spring to autumn (*Lothian Bird Reports* 1979-90). Breeding pairs have even occurred on the islands of Fidra and Inchkeith in the Firth of Forth.

Threipmuir Reservoir, by Balerno, is now an important location for flocks in late spring and autumn, holding 70 birds on occasion and with up to 7 pairs present (2-3 pairs regularly breeding) since 1984. The presence of a flock of up to 60 birds in the Aberlady/Dirleton/Eyebroughty area of East Lothian in summer since 1981 suggests that this area is used as a moult site. Since 1988 a small flock has become established in winter at Linlithgow Loch, West Lothian, with 25 birds in 1989 increasing to 50 in 1990.

Interestingly, it appears that most of the Lothian population returns to Holyrood Park to winter, although the presence of Icelandic wintering birds at Threipmuir Reservoir and the possibility that they mix

with the feral flock there in late autumn makes it hard to be sure about this.

It is estimated that the Lothian population consists of at least 300 birds with a minimum of 30 pairs breeding.

Orkney

1-2 pairs of unknown origin are thought to have been released in Orkney around 1984, and a further 19 birds in 1987. They occur on the West Mainland in the Kirkwall area and on Shapinsay and are believed to be increasing, although only six pairs were recorded breeding in 1989 (C.J. Booth pers. comm.).

Shetland

The first recorded breeding of Greylags occurred on Unst in 1985 (Scottish Bird Report 1986) and since then 2-3 pairs have bred annually and rear 10-15 young (D. Suddaby pers. comm.). There is no evidence to suggest that these birds were introduced to the island and they may well be wild birds either of Icelandic origin or from native Scottish stock, although the latter seems unlikely given that population's restricted range.

Strathclyde

Data here can be divided into three distinct areas:

a) Birds in the south of the Region, in the former county of Ayrshire (now Kyle & Carrick), form part of the introduced south-west Scotland population of Dumfries & Galloway. Feral birds were first recorded in Ayrshire in the mid 1950s and first bred at Loch Goosey in 1963 (R.H. Hogg pers. comm.; Young 1972a). No breeding birds were located by Shimming *et al* (1989) but a small stable or slightly declining breeding population of up to ten pairs is still present around Barrhill. R.H. Hogg (pers. comm.) considers that further expansion of the population is unlikely due to afforestation in the upland areas.

b) In the rest of mainland Strathclyde small populations have been introduced from sources unknown and become established since the mid 1970s at several locations in the Clyde Valley/Glasgow areas such as Hogganfield Loch, Lochend Loch and Kilmalcolm area. Hogganfield is the main centre with up to 35 birds present in 1990, while the breeding population overal is probably at least six pairs (I.P. Gibson & B. Zonfrillo, pers. comm.).

C) Most birds recorded in Argyll & Bute have been primarily on the islands and are thought to be native birds which have colonised from the Western Isles. No details have been obtained of a 'sizeable' flock of feral birds believed to occur on Bute (M. Madders pers. comm.).

Tayside

A small flock was introduced at Lochs Tummel and Faskally, Perth & Kinross, around 1964 when six adults and seven juveniles were seen. Only 16 were present in June 1975, but there were 103 in June 1980 and then the population built up to a peak of 278 (including 61 young) in June 1983 (Scottish Bird Report 1984). It appeared to decrease to under 100 birds by 1988. However, 1989 saw a dramatic increase, with 226 birds (including 40 young) present in July.

Smaller groups totalling 20-30 birds in 1988 occur at the nearby Loch Rannoch and Dunalastair Reservoir, but most of the population remains around the south side of Loch Tummel (W. Mattingley pers. comm.). The breeding population is probably around 25 pairs.

In addition, in early autumn (August/ September) 1987 and 1989, between 60 and 100 birds were recorded at the Loch of Clunie, West of Blairgowrie, and breeding there was also confirmed in 1989. It seems likely that this group may represent a separate feral colony of unknown origin (W. Mattingley pers. comm.; *Perth & Kinross Bird Report* 1989).

In the 1960s occasional breeding took place at Loch Leven but a pair with young in 1982 was the first confirmed breeding

there for several years (Wright 1986). 48 young were recorded in 1988 and 62 birds (19 of them young) in 1989 (*Perth & Kinross Bird Report* 1989) suggesting a breeding population of over five pairs. It is thought that these are injured birds from the Icelandic population and that their failure to increase into a sizeable flock may be because the young depart with the wild birds (A. Lauder pers. comm.).

Western Isles

Within the main breeding area for the native population in the Uists there are no known feral flocks. However, on Lewis, which holds only 10-15 pairs of native birds (Thom 1986), there is a stable flock of 18 birds (5+ pairs) by Stornoway where they were first introduced about 1980 (W.A.J. Cunningham pers. comm.).

Table 1 presents a summary of the results with an estimate of the number of breeding pairs and total population for each Region. This suggests a minimum Scottish breeding population of 242 pairs and a minimum total population of 2,673 birds.

Discussion

Baxter & Rintoul (1953) made no mention of feral Greylag Geese while Bannerman (1957) referred to feral birds in south-west Scotland and Caithness and Sutherland but with little detail. Feral birds are probably not recorded by many birdwatchers, especially when they hybridise so easily with native geese as well as other goose species. However, results of this assessment of the feral Greylag population indicate it is very much a part of the Scottish avifauna. Indeed it appears to be more widespread and numerous than suggested by Owen & Salmon (1986) because they concentrated on the main long established flocks which are still the principal centres of the population, except for that in Central.

If, as seems likely, the population has been under-recorded then it is likely that other smal flocks exist elsewhere in Scotland. These may have arisen from introductions which have never been reported, while other releases that have failed will not have been submitted as part of this survey e.g. the small flocks that existed in Aberdeenshire in the 1970s (Buckland *et al.* 1990). Also, injured wild birds will on occasion attempt to breed and may be confused with members of the feral population.

Most introductions in the 1960s and 1970s were for wildfowling purposes, mainly from eggs obtained from the south-west Scotland population, and it appears that Caithness and Sutherland was a favoured release area (Owen *et al.* 1986). This must have caused problems in identifying feral birds when in close proximity to the native stock and some mixing of the groups is likely to have occurred. Elsewhere it appears that the released birds remain in fairly discrete groups with little or no migratory movements, even when joined by Icelandic birds during the winter months.

This would suggest that a co-ordinated census of the breeding and total population of feral Greylag Geese would readily identify the overall population of each specific group without the need for any concern over movement between grops which would complicate population assessment. Such a census would be a useful means of assessing more completely present distribution and whether or not the introduced birds, in the absence of new introductions, are dispersing and colonising new sites around their original release area as has happened in south-west Scotland and, more recently, in Lothian and in Highland.

The factors affecting the successful establishment and subsequent expansion of a feral flock are likely to include the level of shooting, predation and disturbance, the availability of suitable nest sites and the extent of available feeding. The last of these is balanced against the potential to cause damage to crops, which results in increased

shooting pressure or control of numbers through egg collecting.

Shimmings *et al.* (1989) have shown that the average increase in the South West Scotland population was only 2.4% per year for the period 1966-88 compared to 13% for Britain as a whole. They felt this was due to human persecution keeping the population in check. The weather also may be an important factor for a sedentary population as severe winters may increase mortality. The recent run of relatively mild winters in Scotland may be the reason for the increase in dispersal of the Lothian birds during the 1980s.

Owen & Salmon (1988) estimated the feral Greylag population of Scotland at 2,300 birds in the years 1985-1986 while this survey found 2,673 (Table 1). This is about the same number as in the native population (2,500-3,000 birds). These figures clearly indicate that the population growth of 13% p.a. predicted by Owen & Salmon (1988), which would have led to a population of 3,750 birds in 1990 in Scotland, did not occur. Although the feral stocks may have increased locally (e.g. in Lothian), on the whole population growth seems now to be limited by availability of suitable and safe nesting sites, and by disturbances (and probably persecution) as well as shooting.

The origin of most of the released birds can probably be traced back to the native Scottish stock. These introductions served mainly to benefit wildfowlers, rather than to increase the population whereas, to prevent a further decrease in numbers, an end to persecution and to habitat deterioration would have been a better conservation tool.

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Colonisation and population growth by Gannets at Fair Isle

N. RIDDIFORD AND
P.V. HARVEY

This paper records the colonisation, in 1974, and growth of the Fair Isle Gannet colony. There were two periods of rapid expansion, 1974-83 and 1985-89. There was no population growth in 1990-91. By 1985 birds were breeding at eight localities. Each locality was occupied by non breeders, in 'clubs', prior to breeding, and increases in numbers of birds ashore preceded increases in the breeding population. Population growth was considerably greater than overall North Atlantic population growth, peaking at 48.8% per annum in 1985-89, and was achieved largely through recruitment from other colonies. Breeding success was lower than that published for some long established colonies. Food brought to chicks included herring, mackerel and sandeels and chicks continued to fledge during a period of sandeel shortages. Non breeders were ashore at a number of new localities from 1986 and space is not a limiting factor for further population growth.

Introduction

The growth of the North Atlantic Gannet *Sula bassana* population this century has been well documented (Gurney 1913; Wynne-Edwards, Lockley & Salmon 1936; Fisher & Vevers 1943-44, 1951; Cramp, Bourne & Saunders 1974; Nelson 1978; Wanless 1987). Scotland is of international importance for the species. Population growth led to the estabishment of six new colonies, three of them Scottish, between 1970 and 1985 (Wanless 1987). Fair Isle was one of these and this paper describes the colonisation and growth of this colony.

Material and Methods

Information gathered included counts of birds ashore, number of apparently occupied nest sites, the dates on which birds were first noted ashore, breeding success, food brought to chicks and feeding behaviour of adults. Apparently occupied nest sites were defined as sites suitable for breeding and occupied by one or two adults with at least some nest material present. Successful fledging was defined as live chicks large enough to fledge at the last observation. Data were collected from vantage points on Fair Isle and supplemented by observations from the sea. The last date for information used in this paper was July 1991, and 1990 the last year for breeding success data.

Results

Counts of birds ashore. The first Gannets seen ashore were 7 in 1969 (Table 1). Up to 450 were seen regularly ashore from 1972 to 1984. It was not possible to demonstrate the exact rate of increase of birds ashore because counts were made irregularly.

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Baillon's Crake, Porzana pusilla, Fair Isle, Shetland, September 1991 *(Dennis Coutts)*

(D.E. Dickson)

(I.G. Cumming)

Chimney Swift, Chaetura pelagica, St Andrews, November 1991

Pied Wheatear, Oenanthe pleschanka, Shetland, October, 1991 *(Dennis Coutts)*

Pied Wheatear, Oenanthe pleschanka, Shetland, October, 1991 *(Dennis Coutts)*

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TABLE 1. Maximum counts of Gannets ashore at Fair Isle, 1969-88.

1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
7	0	0	30	300	101	8	nc	450+	208
1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
190	400	310	289	450	450	1100	4000	2000	1000

nc = no count

However, there was a large increase from 1985, with maximum counts in 1985-88 2.5 to 9 times higher than the maximum 1977-84 count. No counts were made in 1989-91.

A considerable increase of club birds occurred from 1985 and this heralded an acceleration in the rate of increase of breeding pairs, which from 1986-89 averaged 48.8% per annum, the highest sustained increase of any four year period. No new localities were colonised after 1985, but non breeders were regularly ashore from 1986 in a number of new areas, including Haaluv in the west, Gumpin in the south-west and Da Burrian in the south-east of the isle.

Nest counts and colonisation of new localities. The number of nests increased annually until 1990, apart from 1984 when a 45% decrease occurred. (see Table 2). The first breeding locality was Dronger, where the first nests were built in 1974. Yellow Head was colonised in 1978, Inner Stack in 1980 and Kirki Stack (also known as Outer Stack), Toor o Ward Hill and Matchi Stack in 1981. One pair bred on a narrow Sheep Rock ledge and two pairs bred at North Felsigeo in 1982. There were no further breeding attempts at Sheep Rock, and North Felsigeo was temporarily abandoned in 1983 and 1984. The latest locality to be colonised was Kame o Guidicum, in 1984. Breeding localities are marked in Figure 1.

The mean rate of increase during the main period of expansion, 1975-89, was 30.1% per annum. However, there were large annual variations. There was a marked initial colonisation, slow growth in 1978-79 and three years of rapid growth in 1980-82. A decline in the rate of increase in 1983 was the prelude to the only marked decrease, in 1984. This was followed by a period of strong increase in 1985-89 and a levelling off of the population in 1990-91. There was a similar pattern to peak numbers of birds sitting ashore. In all years, a large proportion of birds ashore were non breeders. This was established by their choice of locality (e.g. the storm washed Da Fless) and the inclusion in these 'clubs' of birds in various stages of immature plumage. Most immatures were, however, in third to fourth year plumage (i.e. an estimated one to two moults short of full adult plumage).

Arrival dates of Gannets. Birds were first ashore in late June or July in 1969 and 1972-73 but in 1974 four were ashore on 26 April and in 1975 the first date ashore was 11 April. As the population grew birds came ashore earlier, attending nest sites in March in each year, 1976-80, and prior to March in 1981-91. The earliest recorded date was 7 February in 1981. There was no observer coverage in the early part of subsequent years, but island inhabitants confirmed that birds were ashore by at least the end of

TABLE 2. Number of occupied nest sites on Fair Isle by locality, 1974-91, and annual rates of change in breeding population, 1976-91.

	KG	MS	TW	NF	DL	KS	IS	YH	SR	Tot	% change from previous year
1974					3					3	
1975					17					17	
1976					27					27	59
1977					34					34	26
1978					36			1		37	9
1979					38			2		40	8
1980					c50		2	6		c58	45*
1981		3	27		nc	nc	nc	nc		100+	72*
1982		nc	nc	2	nc	nc	nc	nc	1	172	72*
1983		nc	nc		nc	nc	nc	nc		c200	16*
1984	3	6	40		41	4	14	13		121	-45*
1985	5	9	40	2	49	12	5	16		138	14
1986	15	16	65	47	58	17	17	23		258	87
1987	12	14	53	118	51	19	16	21		304	18
1988	18	20	69	190	78	47	34	32		488	61
1989	14	27	79	213	89	167	56	31		676	39
1990	14	24	81	218	67	164	55	31		654	-3
1991	15	19	92	243	71	163	53	31		687	5

Key: KG = Kame o Guidicum; MS = Matchi Stack; TW = Toor o Ward Hill; NF = North Felsigeo; DL = Dronger ledges; KS = Kirki Stack; IS = Inner Stack; YH = Yellow Head; SR = Sheep Rock; nc = nests present but individual locality count not recorded

*** % change in each year, 1980-84, approximate: calculated from imprecise figures**

February, and probably early February, in all years 1981-91.

Breeding success. Breeding success was monitored annually in 1974-77 and from 1986. Only casual observations were made in 1978-85, leading to comments such as 'most chicks fledged' (FIBO Reports 1979-81). Measurement of breeding success in 1974-77 was achieved by counting all nests with eggs or tightly incubating adults and recording the number of young which when last seen were at fledging or near fledging age. The same criteria were used in 1986-90 but breeding success was measured from annual samples of 107-159 nests, the sample comprising all nests readily visible from mainland vantage points. Each nest in the sample was watched to confirm presence of an egg but nests where eggs were not seen, because of prolonged incubation by an adult, were also included. The sample comprised 48% of the total number of nests in 1986 but had declined to 22% in 1989 as more and more nest sites became established on outer stacks. The mean breeding success in 1975-77 was 0.58 chicks per nest (range 0-0.78) and 0.66 in 1986-90 (range 0.48-0.78) (Table 3).

Food and feeding. Seven food samples regurgitated by chicks and adults attending chicks were collected at Matchi Stack and one at Kame o Guidicum in 1989. A single mackerel *Scomber scombrus* was present in one sample and two mackerel in another. The other samples were all herring *Clupea harengus*, comprising a single fish in each

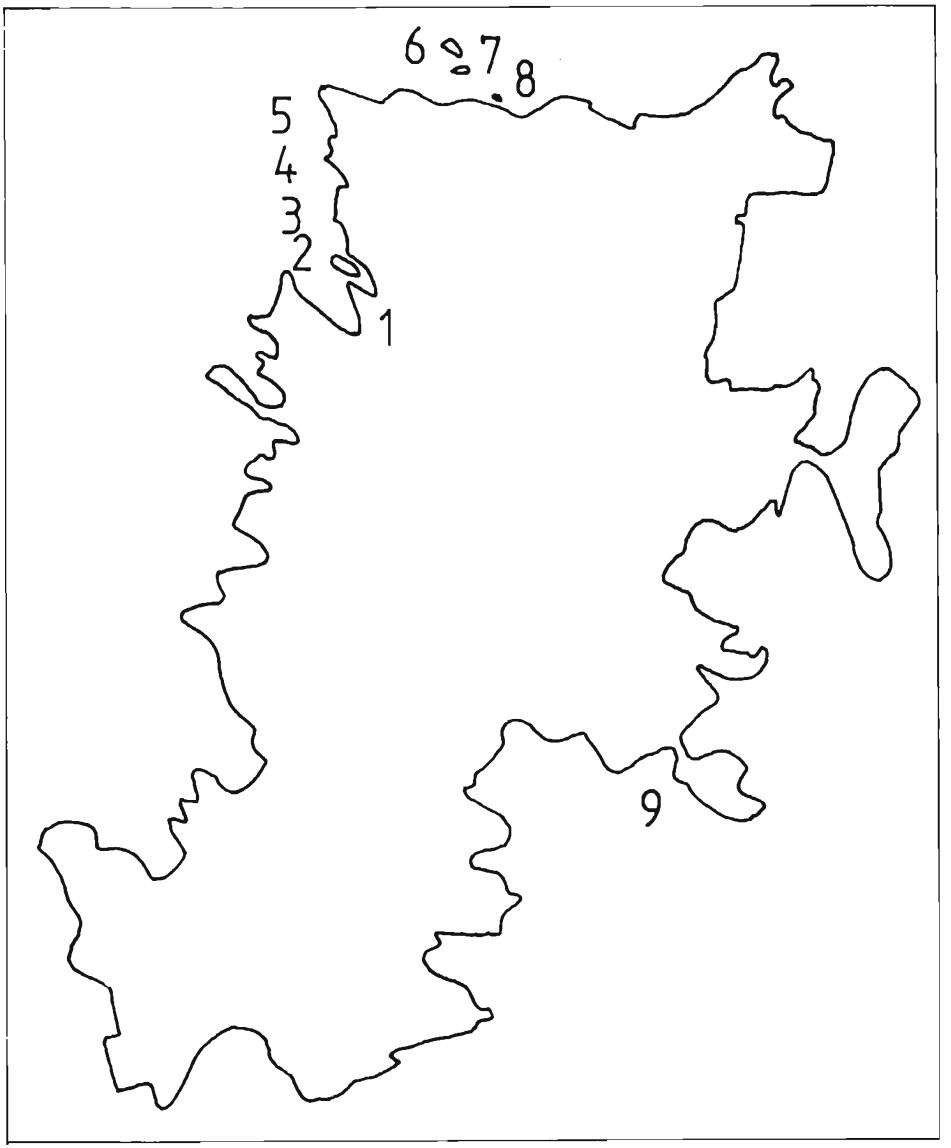

FIGURE 1. Sketch map showing the positions of Gannet breeding localities on Fair Isle.

KEY:

1 = Kame o Guidicum
2 = Matchi Stack
3 = Toor o Ward Hill
4 = North Felsigeo
5 = Dronger ledges
6 = Kirki Stack
7 = Inner Stack
8 = Yellow Head
9 = Sheep Rock

TABLE 3. Breeding success at monitored nests, Fair Isle, 1974-77 and 1986-90.

	Monitored nests	No. of chicks fledging	Mean success rate
1974	3	0	0
1975	8	3	0.38
1976	18	14	0.78
1977	26	15	0.58
1986	124	84	0.68
1987	107	51	0.48
1988	126	98	0.78
1989	147	114	0.78
1990	159	95	0.60

of 3 samples and 2 in each of the other three. Three of the 'double' samples (2 herrings and one mackerel) were hardly digested complete fish, one herring measuring c 350mm and each of the other five fish c 300mm. A single regurgitated mackerel was obtained from an adult attending a chick at Yellow Head in 1985. Adults were occasionally observed plunge diving offshore, particularly off the stacks of the north coast and were also observed flying long distances from the isle, most frequently in the direction of Shetland. Although analysis of 1991 food regurgitates are not yet complete, 14 out of 16 samples obtained from Yellow Head and Matchi Stack in 1991 comprised sandeels. This was not unexpected because 1991 was the first year of sandeel abundance for which we have food data.

Discussion

Colonisation of Fair Isle occurred soon after a 21 year period, 1949-69, in which the North Atlantic Gannet population increased at a rate of approximately 3% per annum (Nelson 1978). Growth and expansion at Fair Isle occurred during a period (1969-85) when the North Atlantic population continued to increase at an estimated rate of 2% per annum (Wanless 1987). Growth on Fair Isle in 1975-89 was at a rate of 30.1% per annum and it reached 48.8% per annum in 1985-89. Both colonisation and subsequent growth on Fair Isle were the result of the long period of growth of the North Atlantic population. Gannets do not usually breed before five years of age (Nelson 1978) so there was no possibility of recruitment by birds hatched on Fair Isle to the breeding population prior to 1980. Annual colony increases of more than 5% are considered to indicate net immigration (Nelson 1978). Apart from 1984, when there was a 45% decrease in the number of breeding pairs, the smallest annual rates of increase in the period 1974-1989 were 9% and 8%, in 1978 and 1979 respectively. Thus immigration to the breeding population of birds fledged at other colonies continued to play a major part in the Fair Isle growth to at least 1989. The origin of colonists was not known, the only ringing evidence being rather inconclusive – a Hermaness 1980 hatched bird rescued from discarded fish net on a Fair Isle beach some distance from nest sites in May 1988.

Nelson (1978) showed that some new colonies, such as Bempton and Great Saltee, showed a sudden and rapid increase whereas this tended not to happen at populous and long established colonies. Wanless (1987) demonstrated that rates of increase at east Atlantic gannetries were smallest at long established and larger colonies. This may have been due to lack of space for further

Gannets have colonised Fair Isle's north coast and outlying stacks. **N. Riddiford**

massive expansion in densely occupied colonies. Nevertheless, the rate of increase at Fair Isle in 1969-85 was the highest of any North Atlantic colony except at other small colonies on the Shetland island of Foula and Hovsflesa in Norway (Wanless 1987). Birds sitting ashore and occupying nests may have attracted potential first time nesters, thus encouraging strong recruitment and growth.

Data on breeding success were obtained in the three years following colonisation and from 1986. Success in both periods was lower than the breeding success of approximately 0.75 chicks per nest recorded from three British colonies by Nelson (1978). The 1986-90 success rates were calculated from samples of nests in the longest established parts of the Fair Isle colony. Nelson (1978) found that inexperienced birds at Bass Rock, Scotland, hatched 20% fewer eggs than experienced breeders. More recently, established nests on Fair Isle's outer stacks probably included a greater proportion of first-time and inexperienced recruits to the population. Results obtained from monitored sites may therefore have over-estimated breeding output of the colony as a whole.

In 1986-90 Fair Isle and Shetland seabird species which were primarily surface sandeel feeders were experiencing breeding failures, apparently as a result of food shortages (Heubeck 1989; Harris & Riddiford 1989; Harvey *et al.* 1989). Gannets were not affected because they were able to obtain prey below the surface by plunge diving, have a large foraging range (Nelson 1978), and are able to find alternative food sources.

In other colonies it has been shown that 'clubs' comprise pre-breeders some of which probably eventually contribute to the breeding population (Nelson 1978). Though some club birds sat in unsuitable breeding

Dronger, the first site to be colonised by Gannets. **N. Riddiford**

sites, non breeders were known to have assembled at all eventual breeding localities and this may have been a necessary prelude to colonisation of the locality. The size of the club was probably an indication of subsequent rates of recruitment. Thus population growth in the mid 1970s followed an early club peak in 1973, and another major period of recruitment in 1980-82 may have been related to the count of 450+ in 1977. Rather lower peak numbers in 1978-82 presaged the lower rate of increase in 1983 and the only marked decrease, in 1984.

The only reversal to the trend of annual population growth prior to 1990 was in 1984, when counts revealed 45% fewer nests than in 1983. The reason for this decrease was not known, but suggested an atypically high loss of breeding birds, little or no recruitment or both factors combined, and this may also have contributed to years of relatively small growth in 1983 and 1985. It may also have been a factor in the two year absence of nests at North Felsigeo after 1982; and the failure of birds to permanently colonise Sheep Rock despite successful fledging of a chick there in 1982 and the existence of suitable looking broad ledges at the south-east corner which had attracted birds in the pre colonisation years of 1969 and 1972-73. This short-term decrease coincided with a decrease in the rate of increase in 1982-85 in four of five Norwegian colonies (Montevecchi *et al.* 1987) and a decline in 1984 at two monitoring plots at Noss, Shetland (Tyler & Dixon 1984).

One of the most popular club locations throughout the 1970s-80s was the tip of Dronger, a large area of horizontal, stepped rock strata capable of supporting a very large number of breeding pairs. Unlike the nearby breeding locality of Dronger ledges

it is accessible, being at the base of a steep grassy slope. Disturbance is low as the steepness of the slope discourages most humans from visiting the area but sheep probably make more frequent incursions and this may be sufficient, at present, to discourage nesting attempts. Other recently attended locations were offshore stacks, some of which could potentially support a considerable number of breeding pairs. Thus, though some localities such as Yellow Head were probably at maximum carrying capacity by 1989, space should not limit further growth. Though the second phase of dynamic expansion, from 1985, appeared to have ended by 1990, peak counts of non breeders ashore in 1986-88 consistently numbered 1000+ and the possibility remains of a further period of growth, particularly if the North Atlantic Gannet population continues to increase.

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Counts of Seabirds in Easter Ross in 1969-91

R.L. SWANN

This paper records counts of seabirds on the Easter Ross coast of the Moray Firth. The Firth holds internationally important colonies of seabirds the largest being on the east coast of Caithness, where approximately 141,770 auks and 76,851 pairs of other seabirds were counted in 1977 (Mudge 1986). In Grampian, there is another large and well documented colony at Troup and Pennan Heads, estimated in 1986 to hold 17,500 auks and 20,600 pairs of other seabirds (Lloyd & North 1987). Between these large colonies, the Inner Firth holds only small numbers of breeding seabirds, mainly gulls and terns (Lloyd *et al.* 1991), except on the coast of Easter Ross and particularly the North Sutor of Cromarty. Although there has been a lot of ringing there since the 1960s, little has been documented about it. Seabirds along the whole coast from Nigg Ferry to Portmahomack (Fig. 1) were counted in 1969 as part of the 'Operation Seafarer' project (Cramp *et al.* 1974) with the

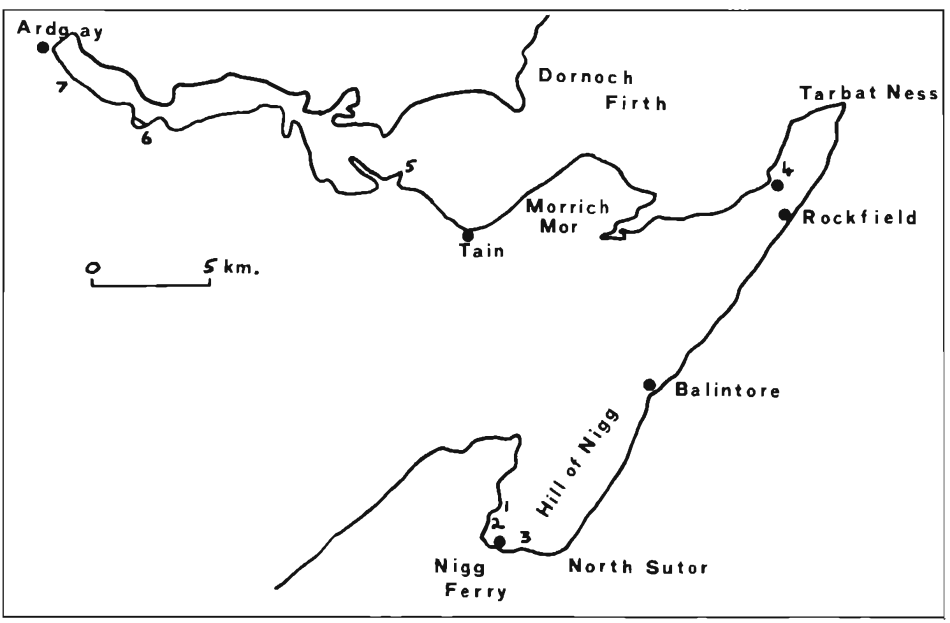

FIG. 1 **Places where seabirds were counted in East Ross 1969-91.**

KEY

1 BP Oil Terminal
2 Highland Fabricators
3 Castlecraig Quarry
4 Portmahomack
5 Ardjachie Point
6 Mid Fearn Mere
7 Ardchronnie Quarry

intention of a recount in 1984-1987 for the Seabird Group/NCC Seabird Colony Register. These counts provided the information for species totals and details of regional changes in seabird breeding numbers produced in 'The Status of Seabirds in Britain and Ireland' (Lloyd *et al.* 1991). However, the coasts from Balintore to Portmahomack and around Nigg Ferry were omitted from the second survey. In addition, counts of gulls for the North Sutor itself may have been underestimates because most were done from the sea so that parts of the colony were overlooked. But in May and June 1991, all breeding seabirds between Nigg Bay and Portmahomack were counted, and information was also gathered from smaller colonies on the south side of the Dornoch Firth.

Methods

All colonies were visited on foot between 26 May and 28 June and in addition the North Sutor was also counted from the sea. Units and methods used follow recommended counting techniques (Seabird Group/NCC Seabird Colony Register Instructions). Apparently occupied sites were counted for Fulmar *Fulmarus glacialis*, apparently occupied nests for Cormorant *Phalacrocorax carbo*, Shag *Phalacrocorax aristotelis*, Kittiwake *Rissa tridactyla*, gulls and terns and individual birds on land in the case of Guillemot *Uria aalge* and Razorbill *Alca torda*. We used the method for measuring breeding productivity developed by Harris (1989) photographing or sketching a colony in mid May and following the status of each nest through a series of visits till the number of large chicks fledging was noted. This was done at North Sutor in 1990 and 1991 for Kittiwakes and in 1991 for Cormorants. In addition reasonably accurate counts were made at Nigg of the numbers of fledged young terns and of Great Black-backed Gulls *Larus marinus*, produced inside a fenced area.

Results

Most seabirds were at the North Sutor. Counts in 1969, 1984 and 1991 (Table 1) show an apparent continuing increase in the numbers of Cormorants, Shags, Kittiwakes, Guillemots and Razorbills. Both Herring *Larus argentatus* and Great Black-backed Gulls declined, whilst Fulmars peaked in the mid 1980s and then declined. For Cormorant the 1969 figure was very low. In 1969 110 nests were located on the South Sutor, giving an overall total of 197 nests in the area. In recent years, all the birds nested on the North Sutor in two distinct groupings.

Table 2 shows numbers at other places on the Easter Ross coast between Balintore and Portmahomack. Herring Gulls mostly declined, particularly south of Rockfield, though a new colony appeared north of Portmahomack and 9 pairs nested on roof tops in Portmahomack. Fulmars also

TABLE 1. Numbers of seabirds counted at the North Sutor.

	1969	1984	1991
Fulmar	779	1393	1014
Cormorant	87	203	259
Shag	25	30	136
Herring Gull	2950	350	404
Great Black-backed Gull	325	10	93
Kittiwake	400	329	568
Guillemot	750	933	1270+
Razorbill	60	41	95
Black Guillemot	0	2	4

Notes: For units see text.
Herring and Great Black-backed Gulls were counted in 1986 not 1984 and the figures quoted are the maximum counts taken from estimates. The Guillemot figure for 1991 is an underestimate as it was known that many chicks had already left the colony. A truer figure would lie between 1500 and 2000 birds. The 1991 counts may be high for some species due to a combination of counts from both land and sea. (The 1984 counts were mainly from the sea.)

TABLE 2. Numbers of seabirds counted on the East Ross coast from Hilton to Portmahomack.

	Hilton-Rockfield		Rockfield-Tarbat Ness		Portmahomack-Tarbat Ness	
	1969	1991	1969	1991	1969	1991
Fulmar	550	431	252	188	0	0
Herring Gull	2750	38	300	200	0	115
Great Black-backed Gull	7	2	4	6	0	7
Arctic Tern	6	1	0	126	25	0

Note: The 1969 counts were done in mid-July and are therefore likely to be underestimates.

showed a decrease on this section of coastline.

Terns nesting at Dunskeath, Nigg Ferry in 1969 have been displaced by Highland Fabricators Oil Platform Yard and the BP Oil Terminal for the Beatrice Field. The increase shown in Table 3 is due to terns and gulls now nesting within the confines of the yards (mainly at the oil terminal) where they are relatively free from disturbance and predators.

Elsewhere in the area 100 pairs of Great Black-backed Gulls and 250 pairs of Common Gulls *Larus canus* nested on the Hill of Nigg in 1969, but none now do because the hill has been reclaimed for agriculture. Six pairs of Common Gulls nest in the quarry at Castlecraig. The Morrich Mor held 16 pairs of Common Gull, 200 pairs of Herring Gull, 1000 pairs of Sandwich Tern *Sterna sandvicensis* and 20 pairs of Common Tern *Sterna hirundo* in 1969. Now only six pairs of Common Gulls nest there plus another 20 pairs on the old airfield. Although stupification exercises were carried out by the RAF in the early 1970s, increased disturbance on the bombing range and high fox predation are thought to be responsible for the drop in numbers. West of Tain there was a colony of 100 pairs of Arctic Terns *Sterna paradisaea* at Ardjachie Point in 1969. In 1991, 2 pairs of Common Terns and 5 pairs of Common Gulls attempted to breed but failed. A small Common Tern colony now exists on a small island in Mid Fearn Mere, where 20-30 pairs have nested in recent years along with 10-20 pairs of Black-headed Gulls *Larus ridibundus*. This is now the only colony of Black-headed Gulls in the area. All those previously found on inland lochs and pools have disappeared, but 120 pairs of Common Gulls and 20 pairs of Herring Gulls nest in the actively worked Ardchronnie quarry 2.5 km east of Ardgay.

TABLE 3. Numbers of seabird counted at Nigg Ferry.

	1969	1991
Common Gull	0	15
Herring Gull	0	3
Great Black-backed Gull	0	27
Common Tern	30	115
Arctic Tern	30	72

Numbers of young Cormorants and Great Black-backed Gulls fledged per occupied nest in 1990 and 1991 in Easter Ross were very high, that of Kittiwakes average, with terns very variable (Table 4). Arctic Terns had almost total failure in 1990.

Discussion

In Easter Ross between 1969 and 1991, major increases in numbers were recorded for Cormorants (31%). Shags (444%),

TABLE 4. Breeding productivity of selected East Ross seabirds.

	1990		1991	
Cormorant			2.54	(n = 37)
Great Black-backed Gull			2.0	(n = 20)
Kittiwake	0.84	(n = 98)	0.89	(n = 114)
Common Tern	0.57	(n = 65)	1.2	(n = 117)
Arctic Tern	0.03	(n = 63)	0.65	(n = 72)

Note: Units are the number of young fledged per occupied nest. Sample sizes are given in brackets.

Kittiwakes (42%), Guillemots (100 + %) and Razorbills (58%). Fulmars showed a smaller increase of 3.2%. Gulls, however, showed major decreases (−60% for Great Black-backed Gulls and −87% for Herring Gulls).

The Cormorant colony at North Sutor is the second largest in Scotland (Lloyd *et al.* 1991). In 1991, breeding productivity was high (Table 4). The Shag colony is also doing well and has shown a very large increase in numbers in recent years unlike many other colonies where Shags have declined (Walsh *et al.* 1991). Guillemots, Razorbills and Kittiwakes also appear to be continuing to increase in numbers despite widespread decreases recorded in other regions (Walsh *et al.* 1991). Fulmar numbers appear to have peaked and are now declining. The biggest declines have been amongst the large gulls, and occurred in the early 1970s (A. Scobbie pers. comm.). Numbers now appear to have stabilised at a much lower level. Counts were made of apparently occupied nests, but it was noted that all colonies held substantial, but varying numbers of non-breeding adults.

Why have some seabirds continued to increase but the gulls have decreased in numbers? Major declines of Herring and Great Black-backed Gulls in SW Wales were shown to be coincident with botulism poisoning of adult birds feeding on refuse dumps during the breeding season (Sutcliffe 1986). There is no evidence of this in Easter Ross. In the late 1960s and 1970s, the Moray Firth was the location of a large winter fishery for 0-1 year old sprats *S. sprattus* which peaked in 1966 and had collapsed by 1979/80 (McKay 1983). There has been a decline in the amount of Herring and demersal fish caught in the Moray Firth since the 1960s. Overall, the amount of time spent fishing in the Moray Firth by both seine netters and light trawlers dropped from around 200,000 hours a year 1963-69 to 100,000 hours a year 1972-81, and to even lower levels more recently (Hopkins 1986). Hudson & Furness (1988) have shown that discards from fishing boats provide an important food supply during the breeding season for a number of seabird species including Fulmar and gulls. The demise of these fisheries may well be responsible for the major decrease in gull numbers since 1969. The remaining gulls plus the Kittiwakes and auks are now mostly feeding on sandeels and a few sprats (pers. obs.). Sandeels still appear to be available in large numbers, supporting not only the seabirds but also seals (P. Thomson pers. comm). The breeding productivity figures also support the view that this food is still fairly plentiful locally.

The increase in numbers of some species is unlikely to be totally due to high breeding productivity. There is evidence from ringing of movements into the North Sutor colony. Three Guillemots ringed as chicks in Caithness have been caught at North Sutor, two of which were definitely breeding. One Kittiwake chick ringed in Caithness was also breeding and a two year old Shag colour ringed as a chick in Caithness was defending a site on North Sutor in 1991.

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Operation Seafarer and Arctic Terns

W.R.P. BOURNE AND
DAVID SAUNDERS

Recent criticism of 'Operation Seafarer' tern counts in Shetland on the grounds that they must have been low because they were made late in the season and did not cover the whole of Shetland fails to allow for the fact that the organiser of the entire enquiry camped at two of the sites involved and personally examined most of the rest at the peak of the breeding season. The history of Arctic Terns in the northern Scottish isles is re-examined; their breeding success is known to have fluctuated with the number of sand-eels present which may in turn be related to the number of larger fish for at least 75 years. There may have been an exceptional concentration to exploit a flush of sand-eels in north-west Orkney in the early 1970s. The birds then dispersed throughout first Orkney and then Shetland as well over the following decade, and despite seven lean years there may still be two to three times as many in Shetland as there were in 1969-70.

Introduction

Since it appears from a contribution by Avery (1991) that it has already been forgotten how the first comprehensive national census of all British and Irish breeding seabirds, 'Operation Seafarer[1], was organised, and he questions the results for the Arctic Tern *Sterna paradisaea* in Orkney and Shetland in particular, it may be useful to re-examine them and their implications.

Operation Seafarer

'Operation Seafarer' was based on over a century of surveys of individual seabird species culminating in three decades of decennial censuses of the Gannet *Sula bassana* and Fulmar *Fulmarus glacialis* organised by James Fisher, subsequently joined by John Coulson with the Kittiwake *Rissa tridactyla*. When Bourne (1965) observed, at the start of the discussions that led to the formation of the first Seabird Group, that such surveys wasted labour and resources, and it would be more economical to count all our seabirds in the process, Fisher enthusiastically agreed. Therefore one of the first actions of the Group was to appoint him Chairman of a Census Committee set up to carry out the first comprehensive census, which he christened 'Operation Seafarer' after the 7th century Anglo-Saxon poem which first mentions several important species including the 'stearn' (Fisher 1966). Unfortunately, owing to his early death, he never received fair credit for this initial planning.

The Census Committee first convened a meeting of experienced observers. It was agreed that, while current counting

techniques were often imprecise, owing to imminent North Sea oil development it was more important to have a baseline against which to show its impact (eventually small, perhaps owing to the precautions taken), than to refine them; and indeed, many difficulties have still not been overcome. It was decided to use as the basic unit an apparently occupied nest-site, except for the Common Guillemot *Uria aalge* which builds no nest, when the birds would be counted, and record the results for all species on one card for each colony. While Bourne made the preliminary arrangements as secretary of the Group, once finance became available from superfluous funds subscribed for the Torrey Canyon Seabird Appeal the Group advertised for a full-time organiser, and appointed Saunders.

The formation of the Seabird Group led to many offers of assistance from the public and other organisations including the RSPB. Several RSPB staff helped run the Group, while the Chairman, Stanley Cramp, later also agreed to serve the Group and then, when we lost James Fisher, its Census Committee in the same capacity, making the facilities of the *Birds of the Western Palearctic* available for the preparation of the report (Cramp *et al.* 1974), greatly expediting its publication. Since there appears to be confusion in Scotland over the role of the Nature Conservancy Council, it should also be noted that, while many of their individual staff were very helpful and they were given a copy of the results as a public service which has served as the basis for subsequent activities, they played no other part in the original Operation Seafarer. We have therefore became rather sensitive over the regular attribution of its results to them (Bourne 1991).

The census was carried out by over a thousand volunteers. It was obvious that the northern isles of Scotland would present difficulties, so in addition to sending some 15 individuals and parties there, a major expedition organised by Norman Hammond was sent to north-west Orkney (Hammond 1975), and the Organiser took a caravan to Shetland in the summers of both 1969 and 1970 to fill in gaps. Bourne also visited and flew with Cramp around both Orkney and Shetland to see that the results there seemed reasonable and no major colonies had been missed. Our conclusions were reported soon afterwards to conferences organised by the Nature Conservancy Council on the Natural Environment of first Shetland (Bourne and Dixon 1974) and then Orkney (Lea and Bourne 1975) attended by all the most knowledgeable people, and nobody disagreed with them.

Progress was reviewed by the census committee several times a year. The discrepancies were considered at length, and most time was spent on the unprecedented number of terns reported from north-west Orkney. This was one of about half a dozen issues still left unresolved when the report (Cramp *et al.* 1974) went to press, all of which, except for the total numbers of the nocturnal petrels, have since been dealt with and would not have made much difference. It is not clear that any other investigation of British seabirds has either received such close supervision, or made its results so freely available, without which it would have been difficult to criticise them.

Observations of Arctic Terns in Orkney

In this type of enquiry discretion has to be left to the observers over how they count the nests or birds, depending on the species involved, the type of terrain, and the time and resources available. Terns present problems because both breeding and non-breeding birds may come and go erratically throughout the season, and it may be difficult to find all the nests without either causing the birds to desert, or making the eggs and young unduly vulnerable to predators. In view of this, particular emphasis, greater than for any other group, was laid in the original counting instructions for terns (Lloyd *et al.* 1991, appendix IV)

on the need to avoid disturbing individual birds for more than twenty minutes when it was not realised how large some of the northern colonies might be. In such cases we sometimes counted the nests in only part of the colony and assessed what proportion it formed of the whole.

Conventional wisdom before 'Operation Seafarer' held that Arctic Terns normally breed in scattered pairs in the south of England, in colonies of tens or hundreds further north and in Ireland, and a few thousands on the Farne Islands and northern isles of Scotland. When our results conformed very well to this pattern, except for a still unequalled grand total of some 27,500 pairs in north-west Orkney including 17,500 in one colony on Papa Westray, the Census Committee therefore spent considerable time discussing this, and searching for precedents. The most important proved to be the distortion of the results of the first census of the Black-headed Gull *Larus ridibundus*, owing to the inclusion of an exaggerated estimate for one large colony (Marchant 1952), and we wished to avoid creating a similar problem.

It was therefore decided by the census committee, and confirmed after considerable further discussion by the Executive Committee of the Seabird Group, including representatives of the three main national ornithological societies and the Chairman and several senior staff of the RSPB, that it might be better to publish in the report an admittedly cautious estimate of the total number of Arctic Terns found in Orkney which was still much larger than anything previously reported in Europe, and leave the full figures on file, where they remain available for examination. The counts were still being repeated at the time of publication of the report, by which time the total was already changing (Hammond 1975), and were duly published a year later (Lloyd *et al.* 1975). We suggest that it might be as well if some other people were also more careful over what they say about Arctic Terns.

Observations of Arctic Terns in Shetland

While the inhabitants of Shetland have always been interested in seabirds, nobody had previously tried to count them all. Therefore when it was found that despite the assistance of both local people and a number of visitors the cover might not be very good, it was decided to send the Organiser, who knew where the gaps were, in his caravan to cover them during 10-22 July 1969 and 2-20 June 1970. The situation in the areas on Mainland for which Avery (1991: Fig. 1) was unable to find counts was as follows: –

1. ***East coast of South Mainland.*** This area was visited by the Organiser who camped at Scatness in both summers, the visit in 1970 occurring in June, but failed to find any significant number of terns. The large colonies reported there and at Sumburgh by Bullock & Gomersall (1980) and at Garthness by Monaghan *et al* (1989) were certainly not present at that time.

2. ***East coast of Mainland from Lerwick south to the Bay of Okraquoy.*** This area was covered on 18 July 1969, when no terns were found. While this may have been rather late in the season, there should still have been some birds present if there had been large colonies there.

3. ***South Nesting.*** Examined on 8, 10 and 11 June 1970. Small inland colonies might have been missed, but none on the coast.

4. ***Whiteness, Weisdale, Sandsound Voe area.*** Much of the shadowed area was visible from various places, while the islets were covered by Dr Peter Stanley. The extreme south-west from Spoot-hellier to Ayre of Deepdale was visited on foot on 20 July 1969.

5. ***Interior of Walls and Sandness.*** The coast was covered on foot from Voe to Footabrough north to Melby on 16 June

1970. Since no birds were seen flying inland this area, which was still nearly blank in 1980, was not examined.

6. ***Brindister to Aith Voe***. This area was covered on 15 June 1970.

7. ***South side of Olna Firth***. Examined from the road on the north-east shore in June 1970.

8. ***Interior of North Roe***. The organiser camped at Collafirth between 2-7 June 1970, and saw several hundred Arctic Terns fishing in the firth on the 4th. No birds were noticed flying inland, where none were reported in 1980.

9. ***Collafirth to Lunna peninsula***. Examined on 5 and 7 June 1970.

We are unable to comment on the situation in Yell and Unst from personal experience on the ground, but they were supposed to be covered by experienced people, and few terns were visible from the air. In view of the situation on Mainland we doubt if many Arctic Terns were missed anywhere in Shetland in 1969-70. It is notable that the count of 347 pairs breeding on Whalsay in June 1969 was made by a resident, while the total of 375 pairs reported from Papa Stour in July 1969 had risen to 500 or more pairs by the time Saunders visited this island on 17 June 1970, so that an increase may already have been under way towards the thousands found later (Bullock & Gomersall 1980).

It is perhaps unfortunate that it did not occur to us at the time that we would later be criticised, not because of the unprecedented number of birds found in Orkney, but because of the small number found in Shetland, otherwise we might have listed all the places where they were absent.

Discussion

It is surprising that in view of a previous complaint that he misrepresents data (Bailey 1989a) both the RSPB and the Editorial Committee of *Scottish Birds* did not see fit to check the reliability of the statements by Avery (1991) before publication. In fact the situation on Orkney was fully explained in the original report on 'Operation Seafarer' (Cramp *et al.* 1974: 164), and the results reported there revised after further checking with our approval by Lloyd *et al.* (1975) shortly afterwards. While, as Bourne (1989a) has already observed in a publication quoted by Avery (1991), we may have missed a few terns in Shetland in 1969-70, there is also independent evidence that no more than 10-12,000 pairs were found there when many Orkney birds had apparently already started to move to Shetland in 1978 (Berry & Johnston 1980), and it would not have been difficult to ask us whether we had any observations for areas which did not appear to have been counted. Perhaps it may be useful to record what we deduce may have happened.

In fact, as stressed by Bailey (1989b) with regard to conditions in the sea, the whole situation is rather complicated. There is a long history of seabird fluctuations (Bourne 1990). Some factors affecting tern breeding success are listed by Galloway & Thomson (1914) in a report on observations during the first British ringing of Common Terns *Sterna hirundo* on the Sands of Forvie in the Grampian Region between 1907-14. Many young died in the middle of the season in both 1910 and 1912, sometimes in association with droughts or gales, which buried some dead young in sand. Most chicks appeared to have died of starvation due to a shortage of their main food sand-eels *Ammodytes*, but more died in 1910 where there was more cover, where some bodies appeared to be gnawed by rats.

The fact that such considerations are not confined to Common Terns was also first shown then by a report by Bain (1913) that in May 1913 thousands of Arctic Terns settled on the Pentland Skerries and started to lay, then suddenly left the island for a month in early June, but returned to lay

again in July. A possible explanation was provided by the Head Lightkeeper on the Out Skerries, T.E. Arthur, who reported that the Arctic Terns also appeared short of food and suddenly deserted their hatching eggs during fine weather in July following the arrival of immense shoals of mackerel *Scomber scombrus*, whiting *Gadus merlangus* and dogfish which appeared to have consumed all the sandeels (Tulloch 1915).

Nobody seems to have paid much further attention to the terns in the northern isles until our census in 1969-70. At this time there was a shortage of larger fish around the north of Scotland variously attributed to overfishing and a reduction of the turbulent inflow of Atlantic water into the North Sea past Orkney (Corten 1990), and the sea in this area was literally boiling with shoals of the smaller fish on which the larger fish and seabirds feed in a way that is no longer seen (Bourne, pers. obs.), which may explain the accumulation of Arctic Terns found in north-west Orkney. Thus a colony on Papa Westray then was larger than any previously reported in Europe, and the only similar reports found are of 'hundreds of thousands' of Arctic Terns breeding on Sable Island off Nova Scotia in 1913 where there were less than 2,000 in 1971 (A.R. Lock, quoted by Nisbet 1973), and the past collection of 100,000 eggs annually from Gronne Ejland in Disco Bay, West Greenland (Salomonsen 1967), in two other areas where local marine turbulence also leads to an exceptionally high plankton and fish production.

The huge accumulation of some 27,800 pairs of terns in the Westray area in 1969 appears to have begun to disperse throughout Orkney when there were disturbed breeding seasons in the mid 1970s (Hammond 1975, Lloyd *et al.* 1975, Lloyd 1976). In 1975 and 1976 many terns also bred on Foula, and then apparently dispersed around Shetland (Berry & Johnston 1980, Furness 1981), so that after further good breeding seasons totals comparable to that for Orkney in 1970 were present in both groups by 1980 (Bullock & Gomersall 1980). Then, following an increase of the larger fish and collapse of sandeel recruitment (Kunzlik 1989), there was a series of poor seabird breeding seasons after 1983, which Bourne (1989b) has suggested may also have been partly due to unusually fine weather which led to the early stratification of the water at sea, so that the fish swam deep, and it became difficult for aerial seabirds such as the terns, which require moderately rough water, to be able to surprise their prey (Dunn 1973), to catch them.

It therefore seems likely that the failure of 8000 pairs of Arctic Terns to raise more than two young in Shetland in the fine summer of 1990 promptly followed by the appearance of 24,000 pairs which raised 30,000 young in the cold, late summer of 1991 (Anon. 1991) was at least as closely related to the weather, oceanography and inter-relationships between marine organisms (Bourne and Vauk 1988, Aebischer *et al.* 1990) as to a ban on catching sandeels. In any case, it would appear that any future widely-publicised predictions of the imminent extinction of terns should be treated with caution.

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Rare Migrants

Baillon's Crake, Fair Isle, Shetland

Just after noon on 28 September 1991, DS had brief views, approximately 15 seconds, of a small crake (*Porzana* sp.), skulking away from him in dense reed grass (*Phalaris arundinacea*) along the Meadow Burn, Fair Isle. After an unsuccessful search other observers were summoned, notably T. Francis, R.J. Johns and S.J.M. Gantlett. After a further half hour of unsuccessful searching it was decided to leave the area and return after lunch to sit and wait for further glimpses. Having agreed on this most observers started to head back to the road and north. SJMG was the last to make his way back to the road when the crake ran across in front of him and into the burn, followed by SJMG who made a spectacular dive and catch!

DS took the crake from SJMG and 'bagged' it. At this stage it was identified as a juvenile Little Crake (*P. parva*) due mainly to the fact that it lacked any white spotting on the lesser and median coverts. PVH arrived with the Observatory mini-bus and the crake was taken to the observatory.

In the 'bird room' at the Observatory PVH took the crake out of the bag and immediately began to wonder about the identification. It showed a very small primary projection and extensive barring on the fore flanks – both good features for Baillon's Crake (*P. pusilla*), but the one feature that 'stuck' for Little was the lack of white spotting on the median coverts, as given by Wallace (1976), *BWP* Vol 2 (1979).

At this point the crake was handed to N.J. Riddiford who was asked to do a full in the hand description while DS and PVH searched the relevant literature. Finally a wing formula was taken and this again pointed strongly to Baillon's. So we had a crake showing the structure of Baillon's (although it is difficult to know how primary projection in the hand would relate to that in the field), with intermediate biometrics and several plumage features in favour of Baillon's and one in favour of Little Crake.

After a photographic session the crake was released in the Observatory garden where it performed well skulking amongst the vegetables and, as most observers agreed, looked like an obvious Baillon's Crake – showing a very small primary projection (c. 1 cm), extensive flank barring, a lot of white on the scapulars and (in the hand) a white leading edge to the wing. It continued to perform well in the area of the Observatory garden until 1 October when the weather became much colder and wetter. Unfortunately it was found dead at first light on the 2nd.

The following details were taken in the hand by NJR and added to after examination of the corpse by PVH.

Description

AGE: Juvenile.
SEX: Female (by dissection, per G. Jamieson)
WEIGHT: 28.5g (when trapped), 24.8g (when found dead)
WING FORMULA: p10 -12mm, p9 wingpoint, p8 wingpoint, p7 -2mm, p6 -5mm, p5 -7mm, p1 -26mm. Longest tertial = p6.
(NOTE: Wing formula follows the convention for non-passerines)
DETAILED DESCRIPTION:
UPPERPARTS: Crown and forehead, feathers black centred with rich buff fringes, the dark area tapering to a point above the bill. Supercilium rich chestnut buff, from eye broadening above bill and extending to rear of ear covert, becoming a paler almost orange buff behind eye. Lores similar but slightly paler. Cheeks rich warm buff. Ear coverts dirtier brownish. The richest colour on the face was the fore supercilium. Nape, feathers as crown but with broader ginger buff fringes and less evident black centres (due to overlapping of fringes). Mantle, feathers with black centres and broad ginger fringes but with black and white

bands and white fringes on inner and outer webs of many feathers. This giving a complex admixed black, ginger and white appearance to the upper mantle, the distribution of the white appearing very random. Back similar to mantle but feathers with narrow ginger fringes and less prominent and more scattered white areas. Uppertail coverts black centred but with much broader ginger fringes and large areas of white on both inner and outer webs (but mainly inner webs). The white appeared variously within the black centre or within the ginger fringe or in place of the ginger fringe. The shape of the white also varied from being in longitudinal lines down the inner webs, to forming wavy lines across the feather or even circles with black centres! towards the tip of the feather.

UNDERPARTS. Chin and upper throat white, malar area rich orange ginger running into lower throat and across breast. Sides of neck and breast a dirtier brownish ginger. Foreflanks ginger brown with admixed black and white areas on some of the feathers towards the shoulder area. Rest of flanks from just below shoulder area extensively barred with greyish black and white. Individual feathers with grey then thin black band then white band then grey then broad ginger area then black band then white band again and then grey then broad ginger then blackish line and white tips i.e. almost a barring pattern repeated in triplicate. Centre of belly and lower breast white with suggestion of ginger buff toning on vent. Some feathers (especially towards flanks) with broadish grey subterminal bands and broad white tippings. Undertail coverts appearing extensively barred black and white with detail of feathers as follows, broad black bases then white bands followed by broad black band then white band and then narrower black band then another white band followed by another black band and then a white tip, some of the feathers had some ginger buff areas admixed in their distal half usually on the fringes of the feathers.

REMIGES: Lesser coverts grey with relatively broad duller ginger brown fringing. Median coverts same but centres blacker, two of longest with slightest black and white tips to inner webs. Greater coverts, greyish bases with distal halves ginger. On inner webs about two thirds from base a black white black mark, on some feathers the white almost forming a circle within the black, with black within the circle. Tips of all Greater coverts with blackish subterminal band then white band (V shaped with point of v pointing to base) and fine black tips. Alula, all three feathers greyish black but with broad white fringe to outer web of outermost feather extending from base to two thirds down feather. Primary coverts greyish black. Primaries greyish black with outermost with broad white fringe to outer web. Secondaries greyish black with narrow white tips to all but one. Tertials greyish black centres with pale ginger brown fringing but on outer webs several (two to four) patches of black white black banding between tip and half way up feather. Some of the white patches almost forming circles. Underwing coverts – under primary coverts grey with ginger brown tone with some white tipping on inner webs. Lesser and Median underwing coverts mid grey with zig zag white barring the bars bordered finely with black. These merged to give three or four zig zag white lines across underwing. Underwing greater coverts darker grey with black subterminal line and white tip. Rest of underwing pale grey.

RECTRICES: Feathers with blackish central band to tip and broader duller ginger brown fringing.

BAREPARTS: Bill dark horn upper mandible with fairly broad green cutting edge at base narrowing to disappear at about two thirds. Lower mandible base to two thirds yellowish green with horn outer third. Gape bluish grey. Eye, pupil dark, iris greenish towards pupil becoming brick red towards outside of eye. Legs dull greyish with greenish tone and slight rosy tint to tarsus (especially so in field). Toes similar. Nails grey with slight olivy tinge.

IDENTIFICATION: Of the crakes on the British list, Baillon's Crake most closely resembles Little Crake. With good views both are separable on size, structure and plumage features (*BWP* 1979, Wallace 1976) as was the Fair Isle bird in the field. However, in the hand, the Fair Isle bird was found to be intermediate with regards to some of the biometrics – being long winged for Baillon's and short winged for Little, the same being for tail length. The rest of the biometric measurements fitting within the ranges given for Baillon's (see Table 1 below). The main feature that caused

TABLE 1: Measurements in mm of Little Crake (*P. parva*), Baillon's Crake (*P. pusilla*) (From BWP Vol. 2, 1979) and the Fair Isle Baillon's Crake.

All measurements given are for Females

	Wing	Tail	Tarsus	Bill	Total Length	Toe (inc. nail)
Little	96-108	50-58	29-32	16-19	180-200	38-42
Baillon's	87-94	40-46	25-29	15-17	170-190	33-38
Fair Isle bird	96	47	27.5	16	179	36

confusion and the initial mis-identification of this bird was the degree of white spotting on the upperwing coverts. Several observers presnt mentioned that Little Crake show no white spotting on the wing coverts whereas Baillon's Crake do. After consulting Wallace 1976 and *BWP* Vol. 2, 1979 it became evident that some of the literature is misleading. Wallace states that the wing coverts for immature Baillon's Crake are warm brown with several lines of obvious white flecks whereas for Little Crake they are uniform olive brown with one line of white flecks. *BWP* states a similar pattern – for Baillon's Crake, inner (median?) and greater coverts red brown with black centres marked with small white dots or streaks outlined by black and for Little Crake, uniform olive brown (adult) with white spotting on the greater coverts (juvenile).

The Fair Isle bird had an upperwing pattern similar to that stated for Little Crake: no white spotting on the lesser or median coverts (apart from two feathers with very small white spots on the inner webs of the lower median coverts, these not being visible in the field), the only white spotting being on the greater coverts. As the plumage showed only slight wear, meaning that white tips could not have worn or broken off, it seems likely that Wallace (1976) had mistaken the scapulars for the wing coverts. The scapulars did show several lines of white markings, and in the field the scapulars cloak much of the wing coverts. The only coverts visible being the greater coverts which in both species show some white spotting in juvenile plumage, more so in Baillon's Crake than Little Crake.

The Fair Isle bird was (eventually) identified as a juvenile Baillon's Crake because of the small size and squat ball-shaped structure with short primary projection and on plumage features – rich buff supercilium, ginger brown mantle, extensive white spotting/streaking on the mantle and scapulars, heavy barred flanks extending from vent to fore flanks, white edge to outer primary (although some juvenile Little Crakes can show this feature) and the colouration of the bill and legs. The degree of white spotting on the wing coverts being of no consequence in separating Baillon's Crake from Little Crake. Although if white spotting is present on the median coverts then the bird would almost certainly be a Baillon's Crake.

RANGE: Breeds from Iberia and France discontinuously eastwards through Asia to Japan and Australasia; also southern Africa. Winter distribution poorly known but majority of European population probably Africa south of the Sahara. (Dymond *et al* 1989).

Baillon's Crake is a vagrant to Britain, although sporadic breeding occurred in the 19th Century. Since 1958 there have only been 6 accepted records, none of which were in Scotland (Dymond *et al* 1989). The last Scottish record was of a female shot on Fair Isle, 11 May 1929 (Thom 1986).

Summary

A juvenile female Baillon's Crake was present on Fair Isle from 28 September to 2 October 1991, when it was unfortunately found dead. The identification of this bird

in the hand was initially confusing largely due to the description of the extent of white spotting on the wing coverts in some of the relevant literature. The last Scottish record was of a female shot on Fair Isle, 11 May 1929.

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Pied Wheatear in Shetland: the fifth record for Scotland

The 9th October 1991 was a dull day with light north-westerly winds. I had just called over Dave Suddaby and Alan McCall to see an Ortolan Bunting *Emberiza hortulana* in a sandy and blighted "tattie rig" adjacent to the Sumburgh Hotel, when I caught a brief glimpse of a bird with a mostly white tail disappearing behind some nettles. After a few seconds a small pale wheatear with a dark, mottled throat hopped past a gap in the nettles. It then hopped out of the nettles and I could see its sandy-earth brown upperparts with obvious pale fringes, so I shouted to D.S. and A.M. "its a Pied" *Oenanthe pleschanka.* After several minutes D.S. went to phone out the news whilst A.M. and I continued watching the first-winter male Pied Wheatear, sometimes at very close range, as it fed from the fence line along the side of the 'tattie rig'. The apparent colour tone of the upperparts varied between pale sandy-brown to dark earth-brown depending on the light conditions, background and how wet the bird was. It was very tame and throughout its stay it remained along the same section of fence until it was last seen on 13th October.

Description

SIZE AND SHAPE. In comparison to Northern Wheatear *Oenanthe oenanthe* (which it was sometimes alongside), it was smaller, much slimmer, longer tailed, longer winged and finer billed. The head was more rounded, with a steeper forehead than a Northern Wheatear. The primary projection was slightly longer than the exposed tertials and the tips of the primaries fell just short of the upper margin of the incomplete dark tail bar. The tail was obviously notched.

HEAD AND NECK. Forehead and sides of head earth-brown, slightly less greyish than the rest of the upperparts. Centre of crown greyish-earth-brown, paler than mantle, but becoming darker at the rear. The pale ginger fore-supercilium was separated from the pale sandy-buff rear-supercilium by a very thin brown line just in front of the eye which ran upwards and backwards at an angle. Supercilium flared behind the eye and extended to the nape where it was broadest. Lores

dark grey with pale tips to each feather. Eye-stripe, behind the eye, and ear-coverts black with pale, sandy-grey tips to many feathers. Slightly darker than throat. Eye-ring thin and white, only present on the lower lid. Each chin and throat feather was black with a pale, sandy-grey tip, giving the chin and throat a 'blotchy' appearance. There was a long, black drop-shaped streak on the right hand side of the malar region. The throat was divided from the breast by a thin off-white line, forming a pale necklace. Nape slightly greyer than rear of crown, forming a greyish shawl across the nape and upper mantle.

UPPERPARTS. Mantle grey-earth-brown, slightly greyer on the upper part. Each feather three-toned, with a black base, grey-earth-brown main section and extremely thin pale, sandy-grey tip. When seen from the rear, perched against a darker background, the pale tips formed thin scales arranged in fairly neat lines. Scapulars similar to mantle but noticeably darker. Rump and uppertail-coverts white. The white area appeared long but fairly narrow and extended forward to the base of the tertials on the closed wing. Central tail feathers black with sandy fringes and broad white tips. Other tail feathers, except outermost mostly white with black restricted to drop-shaped marks on the outer web of each feather, just before the tip. The proximal extent of the black marks was only abut one fifth of the way along the tail. The inner web of each feather appeared to be all white. Each feather had a broad pale gingery tip which itself gradually became paler towards the tip. Outer tail feathers similar to the others, but the black on the outer webs (which also had pale gingery tips) ran forwards for almost half the length of the tail. This could only be seen if the bird was perched, facing away and with the tail fanned. On the closed tail, seen from the side, the outer webs appeared to be whitish.

WINGS. Tertials black with broad, but not very clearly defined, pale sandy-buff fringes. Greater coverts black with broad, pale sandy-buff fringes and even broader and paler sandy-buff tips, forming an obvious wing bar. Median coverts black, with relatively narrow pale, sandy-buff fringes and broader tips. Lesser coverts black with very broad, pale, sandy-buff fringes, which almost obscured the centres. Primary coverts black with relatively narrow pale, sandy-buff fringes and tips. Alula black with a very narrow sandy-buff fringe and tip. Secondaries black with broad, pale gingery-buff fringes and tips forming a pale but warm-coloured wing panel. Primaries black with narrow, pale sandy-buff fringes and broader off-white tips. Axillaries and underwing-coverts black.

UNDERPARTS. Upper breast pale, sandy-buff in the centre with a fairly bright peachy wash, but dark, grey-earth-brown at the sides. Lower breast, belly and flanks uniform, pale sandy-buff. Vent and undertail-coverts pale, buffy-white.

BARE PARTS. Bill, eye and legs black.

BEHAVIOUR. The call was a rasping 'cherrk', quite different from the hard 'chack' of a Northern Wheatear. The stance was more horizontal than Northern Wheatear. The feeding action was very characteristic, it fed from the fence, dropping to the ground and either returning directly to the fence or only hopping a few steps before returning to the fence. It never spent any length of time on the ground, hopping along as a Northern Wheatear often does.

The Pied Wheatear breeds from Bulgaria, Rumania and southern Russia eastwards through southern Siberia, central Asia, Iran and north-west Afghanistan to Lake Baikal, Mongolia, northern China and the Himalayas, between 54 N and 27 N. It winters in southern Arabia, northeast and east Africa south to northern Tanzania (British Ornithologists' Union 1971).

There are four previous Scottish records; a female shot Isle of May 19 October 1909 (the first British record), a female shot Swona, Orkney 1 November 1916, an adult male trapped Bridge of Don, Aberdeen 26 September to 7 October 1976 (Dymond *et al.* 1989) and a first-winter male trapped Fair Isle 10 October 1989 (Rogers *et al.* 1990). Pied Wheatears have become considerably more regular in Britain in recent years. The 1976 Aberdeen record was only the 5th British record (Rogers *et al.* 1978, Knox & Ellis 1981), whereas the 1989 Fair Isle record was the 20th British record (Rogers *et al.* 1990). Up to the end of 1990 there had been 22 records accepted by the

British Birds Rarities Committee (BBRC) (Rogers *et al.* 1991).

October 1991 brought an unprecedented influx of this attractive wheatear to Scotland, with two further records, both first-winter males at Lerwick, Shetland on 17 October (*Birding World* 4: 343) and at Thornton Loch, Lothian on 27-29 October (*Birding World* 4: 343). In addition during 1991 there was a first summer male at Spurn, Humberside on 20 June later relocated at Scarborough from 22-23 June (*Birding World* 4: 191) and a male at Penare, Cornwall from 1-5 November (*Birding World* 4: 379). Although all the 1991 records were photographed they still await formal acceptance by BBRC.

Summary

A first-winter male Pied Wheatear was present at Sumburgh, Shetland from 9-13 October 1991. This was the fifth record for Scotland and preceded two further Scottish records during October 1991.

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Pete Ellis, Seaview, Sandwick, Shetland.

Chimney Swift in St Andrews : a first for Scotland?

At 8.45 on Friday 8 November 1991 JAG saw a swift which appeared small and short-tailed but lacked a white rump flying over the Bute Medical Building parking lot. JAG then rang RWB at work, who suggested some sort of *Chaetura*, perhaps a Chimney Swift, and RWB soon joined JAG at the Bute Medical Building, where the swift continued to perform obligingly for the next 40 minutes. RWB ran home and got a pair of binoculars. It was obviously a *Chaetura*, with rapid bursts of slightly bat-like flight, small size and cigar-shaped body and, with the aid of the binoculars, details of the plumage confirmed the suspicion of a North American Chimney Swift *Chaetura pelagica.*

The bird repeatedly circled over the town, passing along the Bute Building and close over our heads each time before going out over the gardens to the south, then back out of sight to the east. Thus we are able to watch it many times at ranges down to 1 meter, in sunshine and shade, until about 9.40 when it vanished. Only P.J.B. Slater and P.J. Branscombe also managed to see it during this time, and agreed with the identification. It was seen again briefly in the neighbourhood by Sam Taylor later in the afternoon.

The next day it reappeared in the same place and was seen by several hundred birdwatchers over the course of the day, at times resting on the building. Amazingly,

Chimney Swift, Chaetura Pelagica, photographed 8/11/91 on Bute Medical Building, University of St. Andrews
Mary Macintyre

a Common Swift *Apus apus* was also in the area, and on occasions the two could be seen together. The Chimney Swift was last seen briefly on the morning of Sunday 10 November before rain started when it disappeared for good.

Identification

Obviously small and fat-bodied (tapered like a cigar), the swift had a rather short, rounded tail, and wings shorter and less pointed that an *Apus*, which was confirmed later that morning when a Common Swift appeared in the same area: this appeared large, thin-winged and black. Rapid bursts of flaps, interspersed with glides on down-angled wings gave it a 'bat-like' flight, and when the tail was fanned occasionally the spiked tip was visible. Plumage was brown, dark but less so than Common Swift, and somewhat paler on the chest; however there was no pale throat or any whitish area in the plumage. When it rested on the building the spikes at the tip of the tail were clearly visible, and the back appeared to be a slightly paler brown than the wings.

The Chimney Swift is a North American species, the range of which extends east of Missouri and Mississippi rivers from the great lakes in the north and

to Florida and Texas in the south. It winters in Brazil. It is 5¼" (13 cm) long, being larger and darker than the rather similar Vaux's Swift *Chaetura vauxi* which is 4¾" (12 cm) long as well as somewhat paler below and on the rump than the Chimney Swift. The range of Vaux's Swift is much further west, being along the coast of the Pacific, and it has never been recorded in the Western Palearctic. Length of Common Swift is 6½" (16 cm).

Three previous records of Chimney Swift are reported in *The Field Guide to the Rare Birds* as having been accepted by the British Birds Rarities Committee, and they are as follows:
Porthgwanna, Cornwall (2 between 21-27 October 1982); Isles of Scilly (1 on 4-7 November 1986); Grampound, Cornwall (1 on 18 October 1987).

There was apparently also a possible Chimney Swift at Coldingham on 5 November 1983 which is still under consideration by the BBRC (*Birding World* 4: 400).

The St Andrews bird also awaits the BBRC's formal acceptance.

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J.A. Graves, 8 Woodburn Terrace, St Andrews, Fife.

Short Notes

Aberrant plumages in a pair of Peregrines in north Scotland

In 1991 I checked a coastal Peregrine, *Falco peregrinus*, site in North Sutherland. There had been no recent breeding record, although the site is traditional with breeding from the 1940s, but only single birds having been seen over the last decade.

On my first visit, on 11 April a female Peregrine glided out to sea when approached at about 100 m, and circled without calling, in poor visibility about 300 m away. No male was seen. An old Raven nest nearby was a potential nest site.

On 31 May, a Peregrine was seen incubating on the Raven nest. The bird did not flush, and was judged to be a male, though the light was not good. There was no sign of a second bird.

On 25 June, a pair were alarming over the nest which held three eggs. One egg was the usual reddish colour, the second was significantly paler, and the third was almost white. The smaller male quickly disappeared, but the female continued circling, this time in better light.

This bird was unusually dark, almost sooty black without a hint of the normal grey or blue upperparts or pale underparts. After several approaches the bird landed on the nest and stood by the eggs. Seen through a telescope, the dull dark back was very apparent, and the underparts were of a dull mid to dark grey shade, with barring of a slightly darker shade just discernible. The 'moustache' was not clearly defined on the dark face.

After 10 minutes the male arrived with a kill and passed it to the female which left immediately. At this point it became apparent that the male also exhibited unusual plumage, with no brightness in the colour, the upperparts being dull blue-grey, the underparts pale and barred. The bird did have the usual 'moustache', and there was a light patch on the right shoulder. The overall impression was of a rather poor example of female plumage. The bird stood for about a minute before moving forward to cover the eggs.

On 4 July, the female was seen to be incubating. Midges and haze made detailed viewing impossible.

On 18 July, the female was seen to be standing on the edge of the nest which still contained three eggs, presumably infertile. Through a 60X telescope, at about 120 m, the female's bill, legs and orbital ring were clearly yellow. No white or pale colour was discernible at all, but the face was slightly paler than the back, with the 'moustache' just discernible. After some minutes the bird took off, when the overall impression was of a uniform sooty colour.

That one bird of a pair should have obviously aberrant plumage should be considered unusual, that both could be so seems remarkable. Conversations with observers familiar with Peregrines have revealed no other records of similar plumage. It is unfortunate that the eggs failed to hatch, but it will be interesting to see the results of successful breeding if the birds return to the site for the next season.

G.G. Bates, 105 Strathy Point, Strathy, Sutherland KW14 7RY.

Merlin feeding on rabbit carrion

On 3 August 1989 in east Tayside a Merlin *Falco columbarius* landed on a roadside fence post. It flew to a fresh rabbit *Oryctotagus cuniculus*, which had been run over, and ate several pieces of meat. No attempt to take insects was made. When observers tried to get closer it flew off.

Merlins are not generally regarded as

carrion feeders. They usually chase and kill their prey (Newton, I. 1979. *Population Ecology of Raptors*. Poyser, Berkhamsted; *BWP* Vol. 2). In Wisconsin, USA, one fed on injured Purple Martins *Progne subsis* which had been run over by a vehicle. It appeared to select active wounded Martins rather than dead ones (Haugh, E. 1985. *Raptor Research* 19: 103). There are also two records of migrating Merlins feeding on carrion. In 1956 a female took scraps of meat provided for it on a weather ship in the North Atlantic (McLean, I. & Williamson, K. *British Birds* 51: 157-58) and in 1986 on a production platform in the North Sea one scavanged at least two bird carcasses (Rebecca, G.W. 1989. *North Sea Bird Club Report* 8: 69-77).

The offshore records could reasonably be assumed to be of very hungry birds, perhaps accounting for this uncharacteristic behaviour. However, the observation described above came from a period of good weather in mid-summer with plentiful food supply. While the Merlin was on the post, it was observed at close range for several minutes through a telescope. It was presumed to be a juvenile due to its fresh plumage (adults would be in moult), dark streaking on the underparts (*BWP* Vol. 2) and slightly unco-ordinated movements. It was probably a female judging by size. Perhaps it had only recently become independent and was struggling to catch food.

Thanks are due to Graham W Rebecca for helpful comments.

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Alarm calls used by a presumed Spotted Crake in the Grampian Region

While there are long-standing rumours that Spotted Crake *Porzana porzana* occur in the Grampian Region, more recently there had been only three records of the presence of apparent autumn migrants along the coast until 1989 and 1990, when they were heard calling at three sites by D.J. Bain and others (*North-East Scotland Bird Report*). Since a statement on the last occasion that "a pair and young were seen at one site" apparently derives from a second-hand report of an observation by me of a little-known call of this bird whose use may provide the most easily-obtainable evidence for the occurrence of breeding, it may be useful to place on record what I actually replied to an enquiry about the record from the recorder.

On the evening of 28 June 1990 I visited what appears to be one of the three known sites with Gordon Simpson in search of Grasshopper Warblers *Locustella naevia*. While we were wading round the edge of a uniform open patch of sedges about a metre high and fifty metres across growing in standing water a few centimetres deep we suddenly heard an extremely loud, regularly repeated alarm call about 3m away in a small patch of sallows *Salix caprea*, and another bird calling in a more subdued manner from more sallows further away on the other side of the open area. The call was an explosive, abrupt 'trrt...trrt...trrt...' repeated continuously at intervals of a couple of seconds like a metronome which was new to me although I know all the usual waterbird noises, notably Water Rail *Rallus aquaticus* alarm calls, which we also heard a few minutes later in a lusher part of the marsh.

We tried to see the birds without disturbing them further, but were unable to detect the slightest movement, although they continued to call loudly at very close quarters for the ten minutes or so that we remained in the area, and started again immediately when we returned the same way about twenty minutes later. I concluded that

they could only be Spotted Crakes, which I have seen elsewhere in the past, and decided that since from the intensity of the calling they must have young it would be best to leave them in peace. We later saw a small rallid which appeared to come from the same area flutter over the sedges to land in an open space some way away as we left the marsh, which might have been either a Spotted Crake or possibly a Water Rail, though I was unable to see any long red bill.

The main problem with the location of Spotted Crakes in the north of Scotland appears to be that they normally only use their "song" which has been compared to the musical whistle of a whip through the air (and not a whip-crack) erratically in the small hours. Presumably the call described here was the 'quitt', 'quick' or 'kick' also attributed to them in the *Handbook of British Birds*, and the 'hard ke(a)ck' said to indicate parental anxiety in the *Birds of the Western Palearctic*. Judging by the behaviour of the birds that we encountered, and the fact that I have never heard this call before during many visits to suitable marshes, its use provides firm and obvious evidence for the presence of small chicks, though I suggest recorders should report when this sort of evidence is used.

It should perhaps be stressed that the main problem with conservation of these birds does not appear to be disturbance, though clearly it should be minimised, but the progressive EEC-subsidized drainage of their habitat. Perhaps it might therefore be better if instead of being kept secret some of their sites were publicised, in the hope that the authorities, who seem rather dilatory in this respect (see *BTO News* 134: 12), would make more effort to conserve them.

W.R.P. Bourne, Department of Zoology, Aberdeen University, Tillydrone Avenue, Aberdeen AB9 2TN.

Waxwings actively searching for insects

An invasion of Waxwings *Bombycilla garrulus* into Britain during late October and November 1990 allowed us to carry out a fairly intensive ringing and behavioural study of this irruptive winter visitor.

In Grampian, Waxwings fed predominantly on berries (mainly various rowans and whitebeams) but also apparently on insects.

JC first saw a gradually increasing flock of Waxwings on 8 November 1990 in a group of sycamore trees *Aser pseudoplatanus* near Aberdeen city centre. The birds appeared to be feeding on insects as they were seen daily for lengthy periods at this site, continually active amongst the branches. Closer observations by us both on 17 and 18 November revealed that the birds were indeed spending periods of up to an hour actively searching for insects among the sycamores. Up to 100 birds were present, dispersed throughout the trees, searching along and beneath branches and around the buds. One tree which still retained many dead leaves was particularly favoured, presumably as more insects could be found there.

At favoured berry sites the normal behaviour of Waxwing flocks involves bursts of feeding activity interspersed with resting periods on nearby elevated perches such as trees or TV aerials. However, in this case birds were flying up to 0.25 km from surrounding berry trees back to this line of sycamores to rest and seek out insects. As the berries within commuting distance diminished so did the attraction to these particular sycamores, but insect-searching was again observed in some sycamores closer to a berry site. Between 18-22 November a flock of around 260 Waxwings converged on a line of whitebeam trees *Sorbus aria* feeding in bursts with resting periods on nearby trees and TV aerials. On

21 November following their drinking in roadside puddles, about 10-15 Waxwings were observed insect-searching in two nearby sycamore trees. The identification of two colour-ringed birds indicated that the same individuals were involved in both insect and berry feeding during one period of observations.

After the dispersal of the large Waxwing flocks from Aberdeen at the end of November 1990, active insect searching was not observed again despite regular observations of smaller Waxwing flocks throughout the winter until early May 1991.

Waxwings are chiefly insectivores in summer and frugivores in winter. The transition from one food type to another occurs gradually according to weather and insect abundance (Greschik 1934; Holzinger 1972, cited in *BWP* Volume V, S. Cramp *et al.*). In winter in Britain, Waxwings can often be seen flycatching from elevated perches during spells of warmer weather. This opportunistic feeding is possible due to the emergence of flying insects, induced by a rise in temperature. Waxwings actively searching for insects seem quite unusual in Britain. In 1959, birds at Nigg in elder bushes and at Montrose on a damson tree were thought to be searching for and taking insects, but it was difficult to be quite certain, as both elder and damson might be visited in search of the fruits (MacMillan, *Scottish Birds* 1: 102-108). Another record reports birds in Dundee in 1937 which seemed to be finding insects under the eaves (Baxter & Rintoul, *The Scottish Naturalist*, 226: 93-101).

All correspondence to Raymond Duncan.

Raymond Duncan, 86 Broadfold Drive, Bridge of Don, Aberdeen.
Jim Church.

Female natal philopatry in a Scottish Wigeon population

An estimated 300-500 pairs of Wigeon *Anas penelope* breed in the British Isles (Sharrock, J.T.R. 1976. *The Atlas of Breeding Birds in Britain and Ireland*). The majority of this breeding population is found in the upland areas of sheep-grazing and moorland in Scotland and Northern England.

A local population of 13-15 pairs of breeding Wigeon, representing 3-5% of the British population, has been monitored since 1989 in a glen in Upper Deeside, Grampian. In 1989, 25 ducklings of various ages were trapped, ringed (with a BTO metal ring), measured and then released. Subsequent observations suggested that most of these ducklings fledged successfully. A further eight and six ducklings were ringed (with a BTO metal ring and colour-rings) in 1990 and 1991. The lower numbers ringed in 1990 and 1991 were a result of poor breeding success, probably due to bad weather. During observations in 1990 two metal-ringed female Wigeon were seen in the study area. One was trapped on a nest on 20 May and was found to have been ringed as a duckling at nearby pools in 1989. In 1991, a colour-ringed female Wigeon was observed in the area. Its behaviour on 13 May suggested that it had a nest somewhere in the glen but unfortunately the nest was never located. This bird had been ringed as a duckling at the same site in 1990.

Natal philopatry (returning to the natal area to breed) is rare amongst birds generally (Greenwood, P.J. 1980. *Anim. Behav.* 28: 1140-1167), but is usual for females of a variety of ducks (e.g. Savard, J.P.L. & Eadie, J.McA. 1989. *Condor* 91: 198-203). Our observations for two duck Wigeon appear to be the first published records of natal philopatry for this species.

All correspondence to Raymond Duncan.

Raymond Duncan, 86 Broadfold Drive, Bridge of Don, Aberdeen.
Judy Cooper and Alan Leitch.

Correspondence

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

Letters

Sawbill ducks at fish farms in Argyll

The SOC Clyde Branch Committee has expressed criticism of the paper on the above subject, published recently in *Scottish Birds*, 15: 145-150 (1989). Their comments are as follows: –

'We are most concerned that the paper by D.N. Carss gives credence to the allegations that Goosanders have been making holes in fish farm nets. The "strong circumstantial evidence" does not bear up to cross-examination, and in particular the following possibilities were not taken into account: –

a) **human involvement, i.e., vandalism by anglers, which is known to occur at Loch Awe. The timing of damage may coincide with the presence of Goosanders, but it also coincides with the start of the game fishing season.**
b) **other mammalian involvement, with the most likely culprits being otter or American mink.**
c) **the birds being attracted to the vicinity of the nets by escaping fish, (due to a) above), rather than with the *intent* of tearing holes in the nets.**
d) **the birds being attracted to wild fish, which themselves have been attracted by waste food from the cages.**
e) **the farm manager may have presented prejudiced information.**

The paper presents no proof, or experimental evidence, that Goosanders damage, or are capable of damaging, fish cages. We believe it to be highly unlikely that they could do so, unless nets were so badly maintained by their owners that they became weak and worn, and in such circumstances the owners should be held responsible for the outcome.

It is of considerable concern to us that the SOC has published a paper which may create further undeserved pressure on Goosanders by angling interests (see *Scottish Bird News* 15: Goosander Culls in the Borders). The "discussion" made no helpful comments about resolving the alleged problem by means other than shooting the birds. Goosander's bills are designed for grasping fish, not "sawing" nets open; if indeed they were damaging nets this would merely serve as proof of the inadequacy of the material being used'.

Bernard Zonfrillo for and on behalf of The SOC Clyde Branch Committee, 28 Brodie Road, Glasgow G21 3SB.

Sawbill ducks at fish farms in Argyll: a reply to the Clyde Branch

I welcome the SOC Clyde Branch Committee's interest in my recent paper (Carss, 1989). Their remarks certainly require comment, and I shall answer them in turn.

I am well aware that fish cages are the targets for vandalism but find it hard to believe that vandals would visit a farm almost daily merely to fray the nets of cages holding smaller fish. It is the cages holding

larger fish which are their targets and the clean-cut slashes made by vandals are quite unlike those believed to have been made by the ducks. Furthermore, although the fishing season for wild brown trout begins on 15 March, in open flowing water systems there is no close season for either charr or rainbow trout. Therefore on Loch Awe, an established rainbow trout fishery, angling continues throughout the year.

At no time were otters or their tracks and signs seen in the area of the fish farm and although mink were occasionally present, there was no evidence that they were there when this damage was recorded.

I feel it is unlikely that Goosanders would be attracted to most of the fish released by vandals as they would be too large to swallow. As to their *intent*; I have watched birds at fish farms for many hours and would be reluctant to comment on their intentions, which cannot be determined by observation alone. In my paper I do not ascribe intentions at all.

Birds, and other diving predators, may well be attracted to the fish living outside farm cages. I studied this in detail at Loch Awe and several other cage sites in Argyll. At freshwater sites it was farm escapees, rather than wild fishes, which were concentrated in high numbers in the waters adjacent to the cages. These fish were present throughout most of the year but on the whole they were too large for the ducks to swallow (Carss 1990a).

I visited the Loch Awe farm every few days for over two years and built up good working relationships with the managers and staff and I am sure that the information I received from them was the truth as they perceived it. It was not my intention to *prove* that Goosanders damaged cage nets in my paper, merely to report that staff at the farm believed this to be the case, and that as a result, birds were shot.

Along with a colleague, Dr Mick Marquiss, I am currently involved in a six year investigation into the predator-prey relationships of sawbill ducks and juvenile salmon. This brings me into contact with the appropriate licencing authorities and I can assure the Clyde Branch that my paper has certainly not increased the pressure to 'control' Goosanders. On the contrary, it highlighted the vulnerability of the small, local breeding population in Argyll.

I also stated in my paper that trials were needed to produce more effective underwater anti-predator nets as the existing weighted sheets of neeting were rather ineffective. I did not discuss all the methods available to fish farmers for reducing bird predation at their site because I did not believe that *Scottish Birds* was the most appropriate publication for such material. However, I have published such information elsewhere (NCC 1989, 1990, Carss 1990b, Carss and Marquiss 1992), much of which has also been incorporated into Guidelines produced by the fish farming industry itself (SSGA 1990).

I agree it is unlikely that Goosanders can tear holes in new netting but, as the Clyde Branch suggest, many cage nets are very worn. Nets become weakened by constant immersion and regular exposure to sunlight to kill off algal growth; Goosanders are certainly capable of fraying such nets. If this is the case, it gives a clear indication to the fish farmer on how such damage might be prevented without recourse to shooting a scarce bird.

I trust that the above comments will allay the reservations and fears of the Clyde Branch. I once again thank them for their interest in my paper and would encourage them to read my other publications.

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Carss, D.N. 1990a. Concentrations of wild and escaped fishes immediately adjacent to fish farm cages. *Aquaculture* 19: 29-40.

Carss, D.N. 1990b. 'Beak prints' help in war against aerial invaders. *Fish Farmer* 13: 46-47.

Carss, D.N. & Marquiss M. 1992, in press. Avian predation at farmed and natural fisheries. *Proc. 22 Inst. Fish Mgmt. Ann. Study Course,* Institute of Fisheries Management.

NCC. 1989. *Fishfarming and the Safeguard of the Natural Marine Environemtn of Scotland.* NCC, Edinburgh.

NCC. 1990. *Fishfarming and the Scottish Freshwater Environment.* NCC, Edinburgh.

SSGA. 1990. *Salmon Farming and Predatory Wildlife, A Code of Practice.* Scottish Salmon Growers Association, Perth.

D.N. Carss, Institute of Terrestrial Ecology, Hill of Brathens, Banchory, Kincardineshire AB31 4BY.

(This correspondence is now closed. eds.)

Richard's Pipits on Stronsay

In the Winter 1991 edition of *Scottish Birds* (16:148), under Scientific Papers, my own paper on Richard's Pipits *Anthus novaeseelandiae*, which appeared in *British Birds* 83:505), is mentioned as referring to 'Behaviour of birds on Fair Isle'. In fact, the vast majority of my own sightings of Richard's Pipits behaving in the manner mentioned have been on Stronsay. For some reason 'BB' edited my paper and made no reference to the Stronsay birds, thus creating a misleading picture. The whole gist of my letter revolves round the amount of traffic on roads in particular, during 'falls' of migrants in the autumn, and it is a fact that many of the roads on Stronsay have less traffic on them during the course of a day than even the Fair Isle roads.

Of the eight Richard's Pipits I have seen on Stronsay at least six were first seen feeding in the road and the other two were first seen flying along the road and had probably been flushed from it. Several of the birds were seen subsequently feeding along the edges of roads in the manner of Pied Wagtails, and my own feelings are that if left undisturbed the species may prefer to feed in this manner particularly in wet conditions. I have seen 3-4 of the species (all newly arrived birds) feeding in the road on Fair Isle. All those feeding in this way were seen pecking from overhanging grass at the verges.

Naturally, the birds are very popular with visitors and the main point of my paper is that if they are left undisturbed they may prefer not to frequent areas of long grass, although it is understood that the species can and will tolerate such habitat. At busy birdwatching 'sites', the birds are soon inadvertently driven away from roads, either by traffic, birders or other disturbances, leading to a false impression of their 'preferred' habitat and, of course, where to look for them during 'falls'.

John Holloway, 'Castle', Stronsay, Orkney.

Items of Scottish Interest

Most of the following papers and reports on birds in Scotland are available in the Waterston Library for reference, and we have included all that have come to notice in the period September 1991 to March 1992. The last list of this kind was in SB 16: 147-150. We would be glad to learn of any that have been missed, and indeed to receive reprints or copies of papers on any aspect of ornithology or natural history.

Bird reports marked with an asterisk are available from the SOC at the prices quoted, but please add 50p for postage and packing, regardless of the number of items ordered.

Scientific papers

Avery, M.I., Suddaby, D., Ellis, P.M. & Sim, I.M.W. 1992. Exceptionally low body-weights of Arctic Terns on Shetland. *Ibis* 134: 87-88. (Comment on a previous paper only).

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Baines, D. 1991. Factors contributing to local and regional variation in Black Grouse breeding success in northern Britain. *Orn. Scand.* 22: 264-269.

Baines, D., Goddard, J. & Hudson, P. 1990. Capercaillie in Scotland. *Game Conservancy Ann. Rep.* 22: 153-156.

Bourne, W.R.P. 1991. Dark-rumped Storm Petrels in the North Atlantic. *Sea Swallow* 40: 63. Of potential Scottish interest since several have been reported from Tynemouth.

Caldow, R.W.G. & Furness, R.W. 1991. The relationship between kleptroparasitism and plumage polymorphism in the Arctic Skua. *Functional Ecol.* 5: 331-339.

Craik, J.C.A. 1991. More serious than Shetland? *Seabird Group Newsletter* 60: 2-4. Formerly secure breeding sites for seabirds on the numerous grassy and rock-strewn islets off the west coast of Scotland are being heavily predated by Mink.

Dougall, T.W. 1991. Winter distribution and associated movements of northern Pied Wagtails as shown by ringing. *Ringing and Migration* 12: 1-15.

Doyle, P. 1991. Movements and habits of the Sparrowhawk offshore in the North Sea. *North Sea Bird Club Ann. Rep.* for 1990: 54-68.

Dunnet, G.M. 1991. Population studies of the Fulmar on Eynhallow, Orkney Islands. *Ibis* 133 Suppl. 1: 24-27.

Grant, M.C. 1991. Nesting densities, productivity and survival of breeding Whimbrel in Shetland. *Bird Study* 38: 160-169.

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Harris, M.P., Heubeck, M. & Suddaby, D. 1991. Results of an examination of Puffins washed ashore in Shetland in winter 1990-91. *Seabird* 13: 63-66.

Harris, M.P. & Wanless, S. 1991. The importance of the Lesser Sandeel *Ammodytes marinus* in the diet of the Shag. *Orn. Scand.* 22: 375-382.

Harris, M.P., Webb, A. & Tasker, M.L. 1991. Growth of young Guillemots after leaving the colony. *Seabird* 13: 40-44.

Henty, C.J. 1991. Birds of the River Devon surveyed over 10 years. *Forth Naturalist & Historian* 14: 50-64.

Heubeck, M. 1991. Reprieve for Shetland's seabirds? *Seabird Group Newsletter* 60: 2. Twice as many Arctic Terns are thought to have nested in 1991 than in 1990.

Heubeck, M., Harvey, P.V. & Okill, J.D. 1991. Changes in the Shetland Guillemot population and the pattern of recoveries of ringed birds 1959-1990. *Seabird* 13: 3-21.

Heubeck, M. & Suddaby, D. 1991. Post-mortem examination of Little Auks, Shetland, December 1990. *Seabird* 13: 51-53.

Jacobsen, O.W. 1991. Rooks attacking Oystercatcher in water. *British Birds* 84: 395. An occurrence in 1984 near Newburgh, Grampian.

Keller, V.E. 1991. Effects of human disturbance on Eider ducklings in an estuarine habitat in Scotland. *Biol. Conserv.* 58: 213-228.

Linton, E. & Fox, A.D. 1991. Inland breeding

Shelduck in Britain. *Bird Study* 38: 123-127. Includes Shetland.

Newton, I. 1991. Habitat variation and population regulation in Sparrowhawks. *Ibis* 133 Suppl. 1: 76-88. The study area was in Eskdale, south Scotland.

Percival, S.M. 1991. The population structure of Greenland Barnacle Geese on the wintering grounds on Islay. *Ibis* 133: 357-364.

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Birds and Pastoral Agriculture in Europe. D.J. Curtis, E.M. Bignal & M.A. Curtis (eds) 1991. 137 pp. Proceedings of the 2nd European Forum on Birds and Pastoralism, Port Erin, Isle of Man, October 1990. Published by the Scottish Chough Study Group. £12.50 post free from Publications Branch, JNCC, Monkstone House, City Road, Peterborough PE1 1JY.

Proceedings of the 5th International Symposium on Grouse. David Jenkins (ed) 1991. 128 pp. Published in *Orn. Scand.* 22(3): 213-228.

RSPB Conservation Review no. 5. C.J. Cadbury (ed) 1991. 97 pp. £7.00 post free from RSPB, The Lodge, Sandy, Bedfordshire SG19 2DL. Includes 'Species and Habitat Action Plans' for White-tailed Eagle, Corncrake, Roseate Tern, and lowland wet grasslands.

Waders breeding on wet grasslands. H. Hötker (ed) 1991. Proceedings of a Workshop held in Ribe, Denmark, September 1989. Published as a Supplement to *Wader Study Group Bulletin* 61.

Bird Reports

Angus and Dundee Bird Report for 1990. M.S. Scott (ed) 1991. 46 pp. *£3.00 Berwickshire Bird observations 1990, in *Hist. Berwickshire Naturalists' Club* 45: 79-82.

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Islay Bird and Natural History Report for 1990. M. Ogilvie (ed) 1991. 24 pp. *£1.50.

Livingston Bird Report for 1991. Livingston Ranger Service (ed) 1992. 20 pp. *A few free copies are available at SOC, but please send post & packing charge.

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W.G. Harper

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Only single quotation marks should be used, and numbers one to ten should be written out whereas 11 and above should be written as numerals. Dates should be written '11 August 1991' or 'the 11th' if no month is mentioned.

Tables, maps and diagrams should be designed to fit either a single column or the full page width. Tables should be self-explanatory and headings should be kept as simple as possible, with footnotes used to provide extra details where necessary. Each table should be on a separate sheet. Maps and diagrams should be in Indian ink and drawn so as to permit reduction to half their original size. If necessary they may be submitted without lettering and accompanied by a photocopy showing the lettering required. Captions should be typed on a separate sheet. Relevant line-drawings (in ink) will be welcomed, as will photographs (preferably black & white glossy prints).

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Many members are probably unaware of the wealth of material available in the Library beyond the extensive range of books. Thanks to the efforts of Bill Harper, many foreign journals are regularly received on an exchange basis and are available for members to consult. This arbitrary selection of some 30 articles follows on from the list in Vol 16 No 2, and is taken from the following journals received in the period Nov 1991 to Mar 1992:

Netherlands:	*Ardea, Limosa, Dutch Birding*
France:	*Alauda*
Switzerland:	*Nos Oiseaux, Der Ornithologische Beobachter*
Belgium:	*Aves, Le Gerfaut, Mergus*
Germany:	*Die Vogelwelt, Limicola, Corax*
Austria:	*Egretta*
Spain:	*Ardeola*
Sweden:	*Vår Fågelvärld, Ornis Svecica*
Norway:	*Vår Fuglefauna, Cinclus*
Denmark:	*Ornis Scandinavica, Dansk Ornitologisk Forenings Tidsskrift*
Finland:	*Ornis Fennica, Lintumies*
Ireland:	*Irish Birds*

Articles are arranged in species order; square brackets indicate that the article is in the original language (usually, but not invariably, with an English summary – I might be able to arrange a translation for anyone interested); the abbreviated reference gives the journal number and year.

Divers to Ducks:

van Nes, E.H. & Marteijn, E.C.L. [Waterbird population development in the first two years of a new freshwater lake] – *Limosa* 4/91.

Coppee, J-L. [Analysis of observations of Divers at the Eau d'Heure dams] – *Aves* 1/91.

Leibl, F. & Zach, P. [Migration, population size and breeding biology of Black-necked Grebes in NE Bavaria] – *Vogelwelt* 1/92.

Harris, M.P. & Wanless, S. Importance of the lesser sandeel in the diet of the Shag – *Orn Scand* 4/91.

Nilsson, L. & Pirkola, K. Migration pattern of Finnish Bean Geese – *Orn Svec* 2/91.

Nehls, G. [Numbers, annual cycle and feeding ecology of the Eider in the Waddensee] – *Corax* 3/91.

Ydenberg, R. & Guillemette, M. Diving and foraging in the Common Eider – *Orn Scand* 4/91.

Birds of Prey:

Bekhuis, J. & Zijlstra, M. [Increase in Dutch breeding population of Hen Harrier] – *Limosa* 4/91.

Norriss, D.W. Status of the Buzzard as a breeding species in the Republic of Ireland – *Irish Birds* 3/91.

Shirihai, H. & Forsman, D. Steppe Buzzard morphs at migration and their separation from Long-legged Buzzard – *Dutch Birding* 6/91.

Grouse to Cranes:

Mjelstad, H. Displaying intensity and sperm quality in the Capercaillie – *Cinclus* 4/91.

Rinne, J. [Following Crane migration by satellite] – *Lintumies* 5/91.

Waders to Auks

Brader, M. [The Bar-tailed Godwit in Austria] – *Egretta* 2/91.

Pulliainen, E. & Saari, L. Breeding biology of Wood Sandpiper in Eastern Finnish Lapland – *Orn Fenn* 3/91.

Noordhuis, R. & Spaans, A.L. Interspecific competition for food between Herring and Lesser Black-backed Gulls in the Waddensee – *Ardea* 1/92.

de Mesel, D. [Yellow-legged Gulls in Belgium: an analysis] – *Gerfaut* 1-4/90.

Densley, M. Ross's Gulls in Siberia – *Dutch Birding* 5/91.

Durinck, J. *et al* [Winter food of Guillemots in the Skaggerrak] – *Dansk Orn For Tidsskr* 3-4/91.

Pigeons to Woodpeckers:

Michelat, D. & Giraudoux, P. [Size of Barn Owl territories during breeding season] – *Alauda* 3/91.

Sierro, A. [Ecology of the Nightjar in Valais] – *Alauda* 4/91.

Passerines:

Virtanen, H. [Occurrence and nesting biology of Woodlark in S W Finland]– *Lintumies* 6/91.

Dierschke, V. & Dierschke, J. [Migration of Red-throated Pipit through Central Europe] – *Limicola* 6/91.

Peris, S.J. *et al.* [Factors affecting Dipper numbers in West-central Iberia] – *Ardeola* 1/91.

Borgström, E. [Distribution and breeding ecology of the Dipper in Värmland] – *Orn Svec* 2/91.

Ullman, M. [Wheatears: a particularly exciting genus] – Vår Fågelvärld 1/92.

Vergauwen, G. [Lanceolated Warbler in Zeebrugge Oct 91] – *Mergus* 3/91.

Schlenker, R. [Flight direction of Reed Warblers through South Germany] – *Ök der Vögel* 1/91.

Tyssandier, Ph. [The Orphean Warbler in France] – *Alauda* 3/91.

Christen, W. [Decline of Whitethroat and Corn Bunting in the Aare plain] – *Orn Beob* 2/91.

Tombre-Steen, I. [Breeding biology of Parrot Crossbill] – *Vår Fuglefauna* 4/91.

Tyrberg, T. Crossbill evolution in the West Palearctic – *Orn Svec* 1/91.

Michael Murphy

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