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SOME PROBLEMS CONCERNING THE CONTROL OF BIRD DAMAGE IN BRITAIN

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Summary The problems of controlling bird damage may be practical, social or legal; although the practical problems, involving ecological and environmental factors, are themselves difficult to solve, they are made more complex by the social and legal aspects which restrict the methods that can be used and the species that can be killed. The two main ways of preventing damage are, first, by controlling or killing the pest species involved and, second, by deterring or preventing the birds from eating the crop. As long-term reduction of whole populations is virtually impossible, control is most useful as a local measure to alleviate damage for a limited period. The suggested use of reproduction inhibitors as a form of control has additional problems and is unlikely to prove particularly effective. Scaring devices suffer from the defect that their effect is very short-term and, as yet, there appears to be no safe chemical repellent that will deter really hungry birds.

Résumé Les problèmes de régler les dommages qui résultent des oiseaux peuvent être pratiques, sociaux ou légaux; bien que les problèmes pratiques y compris les facteurs oecologiques et les facteurs environnementaux soient difficiles à résoudre, ils sont rendus plus complexes à cause des aspects sociaux et légaux qui limitent les méthodes qu'on peut employer et les espèces qu'on peut tuer. Les deux façons principales d'empêcher le dommage sont les suivants; d'abord par régler en tuant l'espèce nuisible et aussi le découragement ou empêchement des oiseaux qui mangent la récolte. Parce que la réduction de longue durée des populations entières est presque impossible, le réglage est utile seulement comme mesure vicinale pour alléger le dommage pendant une durée courte. L'emploi d'inhibiteurs de reproduction comme méthode de réglage comporte des problèmes additionaux et il est peu probable que ce soit le moyen le plus efficace. Les appareils qui font peur aux oiseaux ne sont pas la solution parce que leur effet ne dure pas longtemps et, jusqu'à maintenant, il semble qu'il n'y ait pas de chose chimique repoussante qui puisse décourager les oiseaux qui ont beaucoup de faim.

INTRODUCTION

Most people in Britain look upon birds as attractive creatures and regard them with some affection; many belong to various bird societies and clubs, and bird watching is a popular hobby. To such enthusiasts the thought of destroying any bird life is abhorrent. Some members of the general public may regard certain birds as a nuisance; amateur gardeners dislike some species because of damage to plants in gardens and allotments; in residential areas populated by feral pigeons (Columba livia var.) or collared doves (Streptopelia decaocto) representations may be made to local authorities for action to be taken against these birds. But in general, most birds are regarded with favour, and even those people that cannot be classed as "bird-lovers" dislike the idea of birds being killed. On the other hand, professional growers, such as farmers and horticulturalists, often regard birds in a very different light; to them birds are pests which damage their crops and so cause financial losses. They tend to favour bird control and are not always too particular about the methods that may be used; such people, however, are in a minority. There exists, therefore, a conflict of opinion forming a background against which the problems of bird damage have to be considered; this in itself is a problem having a direct bearing on the others.

DAMAGE

Birds are capable of causing many different types of damage. It can be relatively simple and straightforward, such as a bird pecking an apple; or it can be of considerable importance and have severe financial consequences, such as the bird-strike hazard to aircraft, where millions of pounds and even human lives may be at risk. The cumulative effect of instances of simple damage, however, may be financially greater than isolated spectacular incidents. Regarding crop damage, a few examples will serve to illustrate the variety of species and crops involved. The wood-pigeon (Columba palumbus) may damage brassicae and clover in winter, and possibly cereals or legumes in spring and summer; the house-sparrow (Passer domesticus) can cause local damage to ripening cereals; the starling (Sturnus vulgaris), apart from damaging trees by its roosting habit, can cause severe damage to cherries; the rook (Corvus frugilegus) may damage cereals, notably maize seed and seedlings; and the bullfinch (Pyrrhula pyrrhula) damages fruit by eating dormant buds during the winter. Damage in urban situations includes the fouling of buildings by starlings and feral pigeons; and the fouling or eating of stored food by feral pigeons and house-sparrows.

All birds are legally protected under the Protection of Birds Acts 1954 to 1967 and most cannot normally be killed. The exceptions are certain species regarded as "harmful" and listed in the Second Schedule to the 1954 Act; these birds may be killed or taken by "authorised persons" - usually the owner or occupier of any land on which action is taken. All the bird species mentioned above are on the Second Schedule (the bullfinch in certain fruit growing areas only), but it must not be assumed that only scheduled birds are responsible for causing damage. Many protected species may damage crops - for example, the skylark (Alauda arvensis) may peck and defoliate young plants of sugar beet, brassicae or lettuce; and the blackbird (Turdus merula) and other Turdidae can damage fruit.

The problems of controlling bird damage may be practical, social or legal. The greatest problems are practical ones, it being necessary to devise techniques which will prove effective and efficient, but not too costly; methods which will overcome the ecological and environmental factors involved. But these practical problems of control are made more complex by the social and legal aspects. As most people object to action being taken against birds, any control methods used must, in the main, be acceptable to the general public or, at least, tolerated because they are considered to be humane; some techniques, although possibly legal, are not normally used because they are regarded as socially (or perhaps politically) unacceptable. The Protection of Birds Acts not only restrict the species that can be killed, but also prohibit some control methods; others may only be used under licence. Social and legal considerations thus strictly limit the practical measures that can be taken to control bird damage and, at the same time, restrict the species that can be tackled. This last restriction causes additional problems for, although with some methods it would be comparatively simple to catch large numbers of birds, it is particularly difficult to be sufficiently selective to ensure that only a target species is caught. Similarly there are difficulties in dealing with damage caused by legally protected species. Although a grower may kill protected birds if he can prove to a court that such action was necessary to prevent serious damage to crops, most growers are reluctant to take this step openly.

BIRD CONTROL

Control of damage can be attempted in two main ways: one can either try to control the pest concerned, or one can concentrate on the crop or product itself, taking preventative action to stop it from being attacked. The word "control", when applied to pests, is really a euphemistic term for "kill"; the animals responsible for damage are killed in an effort to reduce their numbers to an acceptable level, whatever this may mean. The three principal methods of bird control are shooting, trapping and the use of stupefying baits. Shooting can be applied to most species, with varying success; it is time-consuming if large numbers are to be killed, but it is still the main control method used against wood-pigeons and has the advantage that even if small numbers are shot, there may be a scaring effect. Trapping can only be used against a limited number of species - those that can be readily persuaded to enter traps; it is usually a slow process requiring considerable effort and patience if large catches are to be obtained. Trapping suffers from the disadvantages that it is often difficult to apply at the actual site of damage and that "fringe" birds (juveniles or those low in the social hierarchy) and most likely to be caught; as traps have to be left unattended for long periods they are subject to interference from members of the public. Stupefying baits may be used for control purposes only under licence from the Ministry of Agriculture, Fisheries and Food, and at the present time, treatments are only permitted against feral pigeons and house-sparrows, in and around buildings. The main advantage of the method is that, under the right circumstances large numbers of birds can be caught in a relatively short period of time; the main disadvantage is the risk to protected species, although this is minimised by using an efficient stupefying drug rather than a quick-acting poison (Thearle 1968, Thearle et al. 1971). The legal restrictions and conditions which surround this method make its use impracticable against other species in rural areas.

Control is often thought of as a means of reducing whole populations, it being assumed that if sufficient animals are killed, total numbers will be reduced. With existing techniques, population control is virtually impossible, the reason being the productivity or reproductive capacity of pest birds (which are among the most vigorous of species) combined with the mortality effects of various "natural factors" which, in reality, control populations regardless of the attentions of man. Of these natural factors, by far the most important is food - as a gross oversimplification it can be said that, in general, all bird pests are in balance with their existing food supply; it is because the food is so frequently provided, incidentally, by man, that damage occurs and the birds become pests. To illustrate the problems of population control, it is possible to take as an example the wood-pigeon, whose population dynamics have been particularly well studied (Murton 1965). The annual adult mortality of the wood-pigeon is about 36%; the annual productivity, measured in terms of viable young reared per pair per year, is just over two. This means that in a year 50 breeding pairs (100 adults) would produce about 110 young (so by the end of the breeding season the population would have approximately doubled) but, if the population is to remain constant, only 36 of these would be required to replace adult losses; thus 74 young would have to die, giving a juvenile mortality rate of about 67%. It would seem therefore that every year a great number of wood-pigeons are produced which are superfluous to maintaining a stable population; the population does not actually increase because natural mortality factors remove the surplus birds, the main factor being the winter food supply - the amount of clover available in February being critical. In the face of this large natural mortality, man's efforts at control (usually by shooting) are puny, and to produce any noticeable effect artificial control must kill more birds than would normally die of starvation - probably well over 50% of the population. Any attempt to control the birds at other times of the year are compensated by a lower natural mortality during the winter. It is thus unrealistic to think of population control of the wood-pigeon. Although the picture presented above is greatly simplified, the basic principles are true and apply in a similar way to other vigorous pest species. It is possible that if more drastic control methods were used, such as the widespread use of acute poisons, sufficient numbers could be killed to produce a long-term effect, but such techniques would be unacceptable not only legally, because of the consequent slaughter of many protected birds and the risks to other species, but also socially because of public opposition to any such plan.

Control, therefore, is most useful when carried out on a local scale to provide short-term relief by killing birds actually causing damage; if done at a time when crops are particularly vulnerable, reasonable protection may be obtained before other birds move in to fill the gap. The success of such efforts will depend on the circumstances, and killing birds at the source of damage does not always provide the expected result. This may be illustrated by considering the feral pigeon in a dock environment; here the birds are in urban surroundings and damaging stored food rather than attacking crops in a rural area, but the principle is the same. During a nine-year study of the feral pigeon in the Manchester Docks (Murton et al. 1972), regular censuses of the dock population were made and for several years the numbers of birds remained relatively stable at about 2,600. During this time, some of the factories and mills in a section of the docks employed contractors to carry out a series of stupefying bait operations and over a period of two months 1,500 pigeons were killed; but the census figure obtained a few days after the completion of the treatments was 2,600. So a large number of birds had been removed from a small area where damage was occurring, without apparently having any effect. This sort of result occurred every year when stupefying bait treatments were carried out. The reasons appeared to be twofold: first, the treatments were always preceeded by a long period of prebaiting with untreated grain to condition the birds to feeding at certain points. As the dock population was in balance with the existing food supply, consisting mainly of spilled grain and certain easily accessible stored products, the provision of extra food, in the form of prebait, attracted additional birds from areas outside the docks, where food supplies were less favourable; the control treatments were thus successfully killing birds which were not responsible for damage in the docks. Second, any sudden vacuum caused by the removal of birds from the dock area was quickly filled by birds from outside, eager to populate a preferred site. Under these circumstances, local control attempts, although producing good catches were achieving little in relieving the problems of the factories concerned.

In recent years it has been suggested that the use of reproduction inhibitors or chemosterilants could be used successfully for bird control. This method has the theoretical advantage that birds are not actually killed but are prevented from breeding thus causing a gradual reduction in the population; because killing is not involved, the suggestion seems particularly attractive to the bird-loving community. The practical problems of such a technique, however, are great. It is necessary to find a suitable inhibitor - one that is safe, does not produce side-effects and is reasonably long-term in effect. So far no substance has been found which adequately fulfils these conditions. Most of the chemicals investigated have been oestrogen derivatives which, although safe, are very short-term in action. Even if a satisfactory chemosterilant were found, there would be problems regarding its application in the field (Murton 1972). To safeguard protected species it would probably be necessary to develop selective baits and, in spite of considerable work on this subject in connection with the use of stupefying substances (Murton and Westwood 1963, Murton et al. 1968), this has not proved possible. Without this safeguard, the risk to protected species could be great and harm could be done without it being apparent until it was too late. Reproduction inhibitors are often suggested as a form of control for the feral pigeon in towns, where dangers to protected birds are negligible. For this species, however, a long-term effect is essential for some feral pigeons are capable of breeding throughout the year and the normal breeding season is a long one; preventing breeding for 2 or 3 months is unlikely to have a significant effect. The matter is further complicated because at sites such as the Manchester Docks, it appears that only about one third of the adult population ever breeds, so that additional problems arise in ensuring that the inhibitor is actually applied to breeding birds (Murton et al. 1972). Although certain chemosterilants have been field tested in the USA and on the Continent, they all seem to suffer from certain disadvantages which prevent their being seriously considered in this country. Furthermore, it is possible that in Britain, the use of this method is illegal under the Protection of Birds Acts, and it would probably require a test court case to establish this point.

CROP PROTECTION

Apart from controlling the pests concerned, damage may be prevented by concentrating on the crop itself to prevent birds from feeding. The best method of achieving protection is by using a physical barrier, such as netting, which ensures that the birds cannot reach the crop; this, of course, is impracticable other than on a small scale, so one has to resort to methods such as repellents and scaring devices. There are many forms of scaring device available, both visual and auditory; some are more successful than others but all suffer from the drawback that birds quickly habituate to scarers and learn to ignore them. To achieve reasonable success, it is necessary to use a succession of different devices and this can prove costly and time-consuming. Probably the most successful type of scarer is one that releases an innate biological or behavioural response in the birds (Davis 1974). The use of model hawks or predators has been attempted, but appears to suffer from the same defects as more conventional scarers, with the birds treating the models as they would any new or strange object (Melzack et al. 1959). Against wood-pigeons, it has been suggested that the white wing-bar might possibly provide a biological signal to cause the birds to react (Murton 1970, 1972; Hunter 1974), and this is currently being investigated.

Regarding chemical repellents there are two types - gustatory and tactile. Tactile repellents have certain limited applications in keeping birds off buildings but are not suitable for crops. Gustatory or taste repellents must fulfil a number of conditions if they are to be successful (Duncan et al. 1960), the most important being that they should deter even hungry birds and should not be phytotoxic. Although the subject has been investigated extensively, there appears to be no chemical repellent that will adequately fulfil the required conditions.

The main disadvantage of all types of repellent is that, if they are successful, they merely shift the birds from one place to another so that, although an individual may gain from their use, they do not ensure against damage occurring elsewhere. Their main advantage is that they are relatively non-controversial with few legal or social restrictions; some scarers are prohibited, however, such as electrical devices which, though designed to frighten birds, could accidentally cause injury.

DAMAGE ASSESSMENT

One final controversial question regarding bird damage must be considered; what really constitutes damage and how much does it cost? This involves the complex subject of damage assessment which has many problems of its own that cannot be gone into here. Because of the recovery powers of many plants, what appears to be damage in the early stages of growth may prove to be insignificant at the time of harvest, and this complicates the problem of attempting to assess damage accurately. Often there is a long gap between occurrence of damage and final yield, and it becomes necessary to establish that the yield is affected by the damage and not by factors that have intervened. To obtain good assessments it is necessary to devise really reliable sampling techniques and this can prove difficult. Such problems are not easily overcome but, apart from these difficulties, there is the question of whether damage should be considered locally or nation-wide; frequently damage is severe in certain limited areas but is insignificant taking the country as a whole. To an individual grower, the effects may be serious, involving him in heavy financial losses; it is of little comfort to him that such damage is unimportant when considered on a national scale.

It is, however, important that the cost of any control should not exceed the cost of damage; and it is essential that attempts should not be made to control any particular bird species until it is certain that it causes significant damage. For these reasons, some estimate of the value of damage is essential to the rationalization of control programmes, however difficult it may prove to be.

CONCLUSION

The problems of controlling bird damage in Britain are thus many and varied, and this paper has only touched on some of the difficulties involved. When considering new control techniques, one is often faced with the problem of trying to evaluate whether they are acceptable on moral or ethical grounds. Two examples will serve to illustrate this. In the USA, a method of "eliminating" starling and red-winged blackbird (Agelaius phoeniceus) roosts has recently come into prominence; this involves spraying the roosting birds with a detergent or wetting agent so that, on a cold night, the birds die of exposure. This technique could be used on starling roosts in this country. There seem to be no legal barriers since the method is not listed in Section 5 (prohibited methods) of the 1954 Act; it would be reasonably specific and no toxic substances would be involved. In view of the public outcry produced by recent operations in the States, however, it is unlikely that this technique would be considered acceptable in Britain. Similarly, the use of 4-aminopyridine ("Avitrol") has been developed in the USA as a repellent; this substance is toxic and produces symptoms of distress and pain in birds that take it. It is possible to devise a baiting technique in which only a few birds are affected and the symptoms produced scare away other birds feeding in the vicinity; the chemical is thus classified as a repellent, although it is, in fact, a rather nasty poison. Although it seems that the use of this substance can produce successful results, it has never been tried in this country because it is considered to be socially and politically unacceptable.

Anyone working on bird control in Britain feels like a modern Ulysses trying to steer a course between Scylla and Charybdis with, on the one side, growers demanding more drastic action and, on the other, protectionists and bird-lovers demanding less. Sadly, in attempting to achieve a balance between the two, one usually succeeds only in offending both factions and pleasing neither.

References

DAVIS, P.J. (1974) Fundamentals of bird scaring - a laboratory approach, Annals of Applied Biology, 76, 353-358.

DUNCAN, C.J., WRIGHT, E.N. and RIDPATH, M.G. (1960) A review of the search for bird-repellent substances in Great Britain, Annales des Épiphyties, No. hors série, 1-8.

HUNTER, F.A., (1974) Preliminary practical assessments of some bird scaring methods against wood-pigeons, Annals of Applied Biology, 76, 351-353.

MELZACK, R., PENICK, E. and BECKETT, A. (1959) The problem of 'innate fear' of the hawk shape: an experimental study with mallard ducks, Journal of Comparative and Physiological Psychology, 52, 694-698.

MURTON, R.K. (1965) The wood-pigeon. Collins, London.

MURTON, R.K. (1970) Sophisticated 'scarecrows' could be the answer, Arable Farmer, September 1970, 2pp.

MURTON, R.K. (1972) The use of biological methods in the control of vertebrate pests. In 13th Symposium of the British Ecological Society, 'Biology in Pest and Disease Control' (ed. Price-Jones and Solomon), 211-232.

MURTON, R.K., NORRIS, J.D. and THEARLE, R.J.P. (1958) Wood-pigeons, Agriculture, December 1968, 587-592.

MURTON, R.K., THEARLE, R.J.P. and THOMPSON, J. (1972) Ecological studies of the feral pigeon Columba livia var. I. Population, breeding biology and methods of control, Journal of Applied Ecology, 9, 835-874

MURTON, R.K. and WESTWOOD, N.J. (1963) The food preferences of pheasants and wood-pigeons in relation to the selective use of stupefying baits, Transactions of the VIth Congress of the International Union of Game Biologists, 369-377.

THEARLE, R.J.P. (1968) Urban bird problems. In Symposium of the Institute of Biology No. 17, 'The Problems of Birds as Pests' (ed. R.K.Murton and E.N. Wright), Academic Press, London, 181-197.

THEARLE, R.J.P., MURTON, R.K., SENIOR, M.M. and MALAM, D.S. (1971) Improved stupefying baits for the control of town pigeons, International Pest Control, 13, 11-19.

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THE SIGNIFICANCE OF BIRD MIGRATION TO BIRD PEST CONTROL STRATEGY

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Summary All the major bird pests in the African savanna are migrants; migration begins with the rains when seeds, previously available as food, germinate and the birds move into, and breed in, areas where new seeds from grasses or cultivated crops are available. Crop damage is caused by adults on migration and in breeding areas, by juveniles near the areas in which they were bred and by dry season populations if they occur in areas where irrigated crops are available. Because of the mobility of the birds, attempts to reduce crop damage by reducing populations are unlikely to succeed, and control strategy must depend on a knowledge of the migratory habits of the birds.

Résumé Les principaux oiseaux ravageurs de la savane africaine sont tous migrateurs. La migration commence avec les pluies, lorsque germent les graines qui constituaient jusqu'alors la nourriture des oiseaux; ceux-ci se déplacent vers les zones où ils trouvent des graines nouvelles de graminées sauvages ou cultivées, et s'y reproduisent. Les dommages aux récoltes sont causés par les adultes en migration et dans leurs zones de reproduction, par les jeunes a proximité de leur lieu d'origine, et, en saisan seche, par les populations se trouvant dans des zones de cultures irriguées. Du fait de la mobilité des oiseaux, les efforts faits pour diminuer les dommages aux recoltes par la réduction des populations ne peuvent guère aboutir, et la stratégie de la lutte doit se fonder sur la connaissance des habitudes migratoires de l'espèce.

INTRODUCTION

The majority of cereal crops in the tropics are grown in the savanna regions. These areas comprise large tracts of annual and perennial grasslands that support many species of granivorous birds at high densities. Because of the similarity of cultivated cereals to grass seed, the birds' natural food, ripening crops may provide alternative sources of food for very large populations of birds, and damage may be widespread and serious. Many attempts have been made, particularly in Africa, to minimise crop damage by reducing bird populations permanently to a level where they are no longer of economic importance. These attempts have been unsuccessful, but only recently have the reasons for failure been understood. It is now known (Ward & Jones in prep.) that in Africa the majority of granivorous birds in the highly seasonal savanna environment are migrants, including all the major pest species. This has already been established for the most important pest species, the Red-billed Quelea (Quelea quelea) in different parts of Africa (Ward 1971), and is now known to be true in West Africa of two Euplectes spp., the Red Bishop (E.orix) and Yellow Bishop (E.afra), the Village Weaver (Ploceus cucullatus), the Golden Sparrow (Passer lateus) and a little-known pest, the Yellow-fronted Canary (Serinus mozambicus) (Ward & Jones in prep.). This paper relates the occurrence of crop damage by these species to their migration patterns, and demonstrates how the migration pattern of a bird pest species must determine the choice of an appropriate control strategy.

MIGRATION SYSTEMS

The migration pattern of Quelea in southern Africa may be used as an illustration of the ecological principles involved, and as an example of the importance of the correct choice of control strategy. A major concentration area for Queleas in the dry season in southern Africa is north-west Botswana. During the wet season the rains spread across the subcontinent from south-east to north-west, reaching north-west Botswana some 1-2 months after they have begun in Swaziland, Mozambique and the Transvaal in South Africa. The first heavy rain in north-west Botswana causes widespread germination of the dry grass seed on which the birds have been feeding throughout the dry season. Food is suddenly no longer available for the birds, which are forced to migrate out of the area. They perform an 'early-rains migration' (Ward 1971) in the direction from which the rainfront advanced, thus bringing them to areas in the Transvaal etc. where it has already been raining for some time and where insects and fresh grass seed are now available. Many birds come into breeding condition in these reception areas and remain there to breed. Others take longer to come into condition and meanwhile begin the return journey north-westwards, remaining 1-2 months behind the advance of the rainfront in the zone of freshly seeding grasses and emergent insects. As birds come into breeding condition they halt their migration and establish colonies. In general this north-westerly 'breeding migration' results in the earliest colonies being established in the south-east in South Africa, and the latest in the north-west in north-west Botswana. It is almost certain that Quelea adults that breed in the earliest colonies can breed again in the same season by leaving the young of the first brood as soon as they become independent, and migrating north-westwards to catch up with conditions suitable for a second breeding attempt. Thus adults from the first colonies in South Africa in December/January appear in Botswana in February/March and breed again, and indeed a third breeding attempt may frequently follow after this. The young from each breeding attempt remain behind for several weeks in the vicinity of the colony where they were born, and later move north-west to join their parents in the dry-season concentration areas.

The two species of Bishop are migrants in Nigeria (Jones & Ward in prep.), and are probably so elsewhere in Africa. In Nigeria their migration is similar to that of the local Quelea population, the birds moving out of their northern dry-season concentration areas as the rains begin and seed germinates. They fly south to regions of earlier rainfall where insects and fresh seeds are already available. Very large flocks occur at this time comprising birds in various stages of readiness to breed. As in Queleas, the earliest birds to come into breeding condition breed first in the areas of earliest rainfall, while the others move back northwards behind the advancing rainfront before breeding.

The same pattern is repeated by the Yellow-fronted Canary, a bird of the middle belt of Nigeria whose 'early-rains migration' takes it south in large flocks to the derived savanna regions within the rainforest.

The migratory pattern of the Village Weaver in West Africa is somewhat different. This species has a largely southern distribution in Nigeria so that, when the rains begin, birds cannot move further south to areas of fresh food as there is nowhere suitable. Large numbers of birds appear in the north at this time in advance of the rainfront, remaining in areas that have not yet received rain and where dry seed is still available. It is likely that, after sufficient time has elapsed for the southern areas to have produced fresh seed, the birds move back south to commence breeding. Meanwhile the northern areas too have become suitable and many birds move north to breed, following a 'breeding migration' some 1-2 months behind the rainfront, similar to that of Quelea.

The Golden Sparrow is a bird of the Sahel region of West Africa. It breeds in association with the flush of emergent insects, particularly grasshoppers, at the beginning of the rains (pers. obs.), so possibly does not perform an 'early-rains migration' like other granivores. However, large numbers appear far to the south of their normal range in mid dry season, returning north well before the beginning of the rains. That they perform a regular migration is certain, but the reasons for it are unknown.

CROP DAMAGE AND CONTROL STRATEGY IN RELATION TO MIGRATION PATTERNS

Crop damage is caused by three categories of birds: (1) adult birds on migration and in early-rains reception areas; (2) newly independent juvenile birds close to the breeding colony; and (3) non-migrant first-year and older birds during the dry season.

1. Damage by migrating adult birds

The early-rains migrations of granivorous birds take them into areas where not only are the wild grasses seeding, but also rapidly maturing cereal crops are ripening. In Nigeria flocks of Bishops and Canaries on migration may do damage to ripening millet and sorghum in the southern savannas. In the case of the Yellow-fronted Canary the migration takes some of the birds further south into the derived savanna regions in and around the rainforest zone where the natural grasses are slow to mature, and the only readily available seed may be cultivated millet.

Indeed it is possible that in such cases extensive cultivation within the rainforest zone has opened up new areas as early-rains quarters for some granivorous birds. In South Africa intensive cultivation of cereal crops now takes place in areas which have always been the natural early-rains quarters for the southern African Quelea population. Damage to early maturing crops is therefore inevitable during the great influx of Queleas from regions receiving late rain, such as Botswana, Rhodesia, Angola etc. Because the start of the rains in all these areas is not synchronous, the timing of the 'early-rains migration' varies greatly from place to place, and the arrival of new birds in the reception areas may extend over a period of weeks.

To control local bird populations under these conditions is difficult. At least in the case of Quelea, and possibly also of other pest species, birds in the early-rains quarters do not form stable roosts; roosts change their location frequently, and probably there is a rapid turnover of individuals using them. Destruction of a roosting site may reduce the local bird population for only a few days before other birds arrive on migration, as has been found in Swaziland (W.H. Rodgers pers. comm.). The logistic problems involved in destroying the entire migrant population are insuperable, though it has been attempted every year in South Africa for more than twenty years. Many tens of millions of birds are destroyed there annually, but the eventual reduction in the Quelea population each season may more properly be ascribed to the departure of the birds on their return breeding migration to the north and west than to the efforts of the control teams.

If mass extermination of Quelea concentrations results in only a temporary local relief from bird damage, what other measures are available to alleviate damage? Under the unstable conditions of the early-rains quarters, disuasive agents (scaring methods, repellent chemicals, bird-resistant varieties, etc.) may offer a solution. However, disuasive agents are likely to work only where birds can be induced to return to their natural food, or to migrate out of the area, or, presumably, to die of starvation. The reported successes of these methods, which seem to be few, do not indicate which of these results was achieved. In most cases it is more probable that all that was achieved was deflection of the damage onto another crop that was not so protected. The use of repellents to induce migration out of an area has not been reported, but it is conceivable that the widespread use of disuasive agents in areas where a migrant population is in transit may cause birds to move on more readily and so reduce damage. The early-rains quarters of most granivores are used as such because of the naturally abundant insect and seed food available there, and it should be possible to induce birds to return to such wild food. This may well be impossible in forest areas, for instance, where the only seed food available is cereal crops and the alternative is starvation.

2. Damage by young birds

The most serious damage by Queleas to wet-season crops is caused by newly independent juvenile birds close to the breeding colony. In Botswana adult Queleas prior to breeding preferred wild seed and insects, and after breeding either left the area completely to breed again elsewhere, or continued taking wild food in preparation for another breeding attempt locally. Elsewhere in Africa juvenile Queleas are responsible for much crop damage, and also amongst other bird pest species juvenile birds may be largely to blame. Damage to rice in Ghana appears to be caused largely by juvenile Village Weavers (G.G. Pope pers. comm.). Possibly this also is a situation where the adult birds either depart immediately after breeding to breed again elsewhere, or are taking a different diet in prepartion for repeat nesting.

The apparent faithfulness, in Quelea at least, of juvenile birds to the vicinity of the colony for several weeks after fledging means that some reduction of crop damage is possible by destruction of local Quelea colonies. The local reduction of the Quelea population often persists for long enough for the crops to be harvested before re-invasion occurs. On the other hand, the destruction of distant colonies is of little benefit, and is wasteful of resources, if the young of those colonies remain faithful to that area and pose no immediate threat to crops. Likewise there is no advantage in continuing the destruction of colonies after the harvest. The next 'early-rains migration' will take all the local bird population out of the area completely, to be replaced by a different set of individuals the following season. With migrant species there can be no long-term advantage in the elimination of a local population, only a short-term alleviation of damage.

In some situations, however, costly methods of mass destruction may be dispensed with if the damage situation can be avoided entirely. This could be achieved by a change of crop, or a change in the timing of the crop. The former is often impossible or unacceptable, but a change in crop timing, given knowledge of the pattern and timing of migration of the major pest species, could be effective in some situations to avoid damage. For example, the damage caused by newly fledged Queleas in north-west Botswana could be avoided if the harvest could be brought forward by about a month. Adult birds are absent from the area following the 'early-rains migration' in mid November, until they return to breed in February on their 'breeding migration'. The first independent young, potentially capable of causing damage, are produced in March, shortly before harvest when the crops are most vulnerable. Local farmers have recognised that crops planted earliest suffer least damage because they can be harvested before the young Queleas from local colonies become independent. Conditions are apparently suitable for Queleas to breed before this, but few birds are present, the majority being engaged in a first breeding attempt in their early-rains quarters. Early planting is desirable for other agronomic reasons, but is usually not possible where farmers using traditional ox-ploughing methods must wait for the oxen to become fit enough to draw a plough. In such a situation the growing of a more rapidly maturing crop variety could be of benefit. However, it should be noted that damage avoidance in this way would not be possible if north-west Botswana were itself subject to an influx of birds on an 'early-rains migration' from elsewhere. The areas further to the north-west receive their first rain late, at a time when Botswana already has fresh seed and could serve as a reception area, but the number of birds needing to take advantage of this situation is apparently small.

In northern Nigeria such a simple solution to crop damage by Queleas is not possible. The early-rains quarters to the south provide suitable breeding conditions for only a small proportion of the population and the majority return quickly to the north. Planting is in any case early where the fields are hand-tilled, and the early harvest does not avoid damage from young birds.

3. Damage to dry-season crops

Only a few dry-season crops are grown traditionally in Africa, notably the dry-season sorghum grown on the flood plains of Lake Chad, but increasing acreages of cereals are now grown under irrigation outside the wet season. All these are vulnerable to very serious damage from granivorous birds since they produce seed at a time when stocks of natural grass seed are diminishing during the dry season. Damage to crops in the Lake Chad region is caused mainly by Queleas, and it is unlikely that crop damage can be reduced other than by extermination of local Quelea concentrations. The birds from very large roosts (sometimes comprising millions of individuals) that often persist in the same locations for months at a time, and from there they may forage over a very large area (often a radius of 25 km). Any one crop may therefore attract birds from a number of different roosts, and the reduction of crop damage may require the extermination of all of them. The amount of interchange between roosts is not known, but the dry-season population is known to contain young birds arriving from elsewhere, at least in the early dry season. About 10% of the juvenile Queleas in the dry-season population in the Lake Chad region are birds that were born further south at the beginning of the breeding season, and have subsequently moved northwards. Birds born in the north do not appear to move south, so there occurs a net influx of birds into the north during the dry season. Early-hatched juveniles represent only a small proportion of the dry-season population in northern Nigeria probably because the early breeding attempts in the early-rains quarters do not contribute greatly to the total production of young. In other parts of Africa the mixture of young birds in the dry-season concentration areas could include a much higher proportion of yearling birds born elsewhere. In southern Africa it is known from ringing recoveries that some young Queleas undertake long-distance dry-season movements. Such movements may be of importance in limiting the long-term effectiveness of local Quelea extermination.

The status of the Golden Sparrow as a pest of dry-season crops in West Africa is not known. Its mid dry-season movements south coincide with the period immediately before the harvest of dry-season sorghum, and it could pose a potential threat to proposed irrigation. Damage may be difficult to prevent if the Sparrow population is in transit during migration.

Little is known also of the possible effects of large-scale cereal irrigation on the migratory patterns of local granivorous bird populations. For instance, the onset of the first heavy rains of the season results in a sudden widespread shortage of wild seed as germination occurs. The presence in the area of an alternative source of food such as an irrigated out-of-season cereal crop may induce birds to delay their migration and cause heavy damage.

CONCLUSIONS

A proper approach to the solution of any bird pest problem lies in an understanding of the ecology of the species concerned. The recognition that the majority of bird pests of cereals are migrants is an important first step. It provides an obvious reason why the permanent reduction of a bird population is not a workable strategy to pursue to reduce crop damage. Given a more detailed knowledge of the pattern and timing of migration of a particular pest species, it may often be possible to tailor the control strategy more appropriately to a given pest situation. In tropical countries the value of the crop is often small, and the correct choice of control strategy is essential if it is to be economically worthwhile.

References

WARD, P. (1971). The migration patterns of *Quelea quelea* in Africa, *Ibis*, *113*, 275-297.