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THE STRATEGY FOR PROTECTING CROPS FROM THE DEPREDATIONS OF QUELEA BIRDS IN KENYA

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ABSTRACT

Population reduction of quelea by lethal means is no longer considered to be a crop protection strategy in Kenya. Lethal control of quelea feeding on, or threatening, crops is practiced. The substitution of crops on which the quelea do not feed for those prone to depredation is undertaken in one province. In one large irrigation scheme a single rice crop is grown, as the second crop, formerly planted, suffered unacceptable losses to quelea. No other method of protecting crops from the depredations of quelea is currently practiced.

INTRODUCTION

The red-billed quelea, *Quelea quelea,* is one of the most notorious cereal pests in Africa. It is a small, sparrow-like, weaver bird of the sub-family Ploceinae and is nomadic throughout the short-grass Acacia savannahs where it breeds opportunistically when and wherever conditions are suitable. A number of separate populations have been postulated (Ward, 1966; Jaeger et al., 1981).

In Kenya there are possibly three separate populations of quelea which overlap in two strategic areas (see Map 1). One of these populations, the Kenya/Somalia one of north-eastern and eastern Kenya, causes little or no crop damage at the moment. It overlaps with the Kenya/Tanzania population in a common breeding area south of the river Tana and north of the Kenya/Tanzania border. The Kenya/Tanzania population of southern Kenya overlaps with the northern, or Ethiopia/Kenya population, in both central and western Kenya. It is in the areas of overlap of these two populations that the birds can sometimes reduce both wheat and rice yields in central Kenya and, perhaps, rice yields in western Kenya.

The Government of Kenya, like most governments of other countries in Africa which experience crop losses caused by quelea, established a quelea control unit to deal with the problem. Quelea control, developed almost thirty years ago, is comparatively easily undertaken, requires little or no critical appraisal and, when undertaken efficiently, is readily seen to be effective in controlling bird numbers and thus, by inference, in reducing crop damage. Basically the strategy is that of search and destroy — "Go and look for colonies during the breeding season, or roosts at the end of the dry season, and kill as many of the birds as you can during these seasonal periods when the birds assemble in enormous numbers". The strategy implies that population control is the long term objective. Thirty years of following this strategy have not produced any marked diminution in the problem and have cost governments dearly.

In Kenya the quelea control unit of the Ministry of Agriculture has recently been developed into the Crop Protection Branch of the Crop Production Division and an improved crop protection strategy is emerging.

THE BASIC STRATEGIES

All attempts to find an economical alternative to the lethal method of stopping crop damage by quelea birds have failed, with one exception. Dr. Peter Ward, from 1972 until his untimely death in 1979, stressed the importance of turning the "search and destroy" strategy to more enlightened methods of crop protection (Ward, 1972; 1973; 1979). He offered two options, immediate crop protection or agronomy change. By immediate crop protection Ward meant the lethal destruction of only those breeding colonies or roosts close to vulnerable crops, and by agronomy change the advancing or retarding of crop maturation times. Either of these strategies, according to Ward, could be employed depending on the local situation relative to the time when crops are in the vulnerable stage and to the activity of the quelea in the area; that is to say, whether they are moving through, roosting locally, or breeding in the area.

Ward's strategies have been adopted by the Food and Agriculture Organization of the United Nations (FAO) during the Organization's investigations into quelea control which started in the early 1970's. Details are outlined in the control section of the Organization's Crop Protection Manual (FAO, 1979). How far these strategies have been adopted in Kenya and how far they have developed since 1979 will now be considered.

CURRENT OPTIONS

Accepting that population reduction is not one of the options, we can expand a little on Ward's "appropriate strategies", as he called them, and offer the following options.

(1) The foremost economically sound option is to kill all those birds threatening, or already feeding on, crops. An extension to Ward's immediate crop protection strategy is that birds threatening crops may not be nearby but may be some distance away at a site where control, if necessary, may be more effective and economical if carried out before the birds move to the cropping area. In this case careful monitoring of the quelea population in the area (Anon, 1981) can determine whether or not such birds are threatening the crops and thus the necessity for their control.

(2) In areas where cereal damage is an invariable annual event, alternative crops such as maize (*Zea mays*) or pigeon peas (*Cajanus cajan*), which are not eaten by quelea, can be grown. If the damage occurs only during a limited period every year, then a change in cropping practice can be made to ensure that the crop is not susceptible to damage during this period. This may be done by growing a crop variety with a different growth rate from that of the susceptible one, of a different palatability or phenotype, or by altering the planting date.

(3) In those areas where damage is occasional the remedy will depend on whether those birds causing the damage are from local breeding colonies, are birds in passage through the area, or the crops are being grown out of season but within the birds' dry season feeding range. In these cases monitoring will again indicate whether or not the birds have to be controlled.

Let us now look at some applications of the strategies in Kenya.

APPLICATION OF THE STRATEGIES IN KENYA

The Rift Valley Province Wheatlands

It has long been believed that the birds which enter the Rift Valley wheatlands at the time when the crops are ripening come from breeding grounds some 120 to 220 kilometers away (Map 2). It has always been considered necessary to control the breeding colonies in this area in order to prevent losses in the wheat crops. However, quelea do not invariably leave the area after breeding and thus it is not always

necessary, or desirable, to undertake control operations against colonies. Careful monitoring of the situation in the area has permitted a tentative strategy to be drawn up (Kitonyo, 1981) based on the rainfall pattern and the annual grass productivity.

There are three major rainfall zones in central Kenya (Map 3). To the east of the Rift Valley is an Equatorial zone with a bimodal pattern of annual long and short rains alternating with periods of relative drought. In the Rift Valley and to the west of it as far as the Lake Victoria basin there is a northern and southern tropical single season rainfall zone, the northern with the rainfall coinciding with that of the long rains and the southern with that of the short rains of the Equatorial zone. The borders of these three zones show considerable annual variation which in turn affects the pattern of quelea movement. The control strategy used in the Rift Valley depends on the rainfall. (See Figure 1 for a description of control strategies for various rainfall scenarios.)

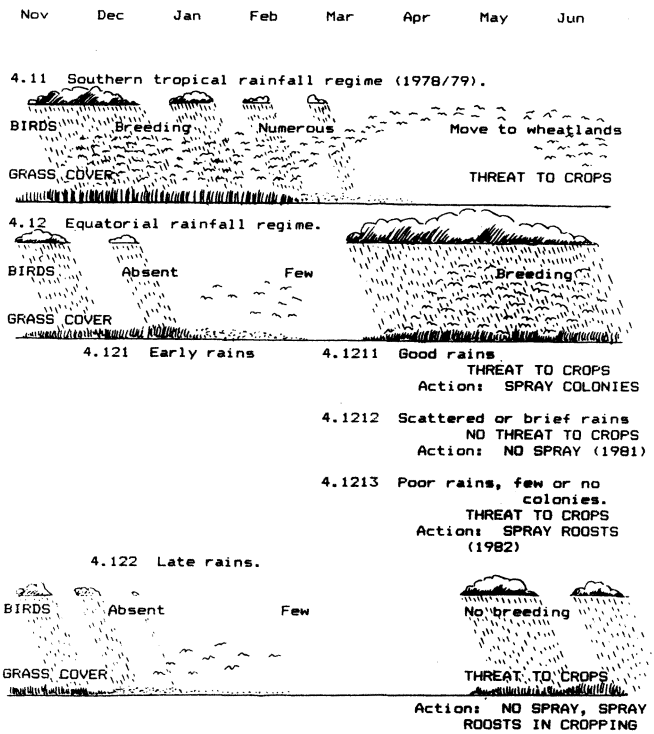

FIGURE 1. Schematic representation of control strategy in the Rift Valley (Lake Magadi).

1. If the southern tropical rains of January to May penetrate the area, breeding may be expected early in the year and there will be a threat to the wheat crops in the Rift Valley if breeding colonies are established. Control operations should be carried out against all colonies.

2. If the equatorial rain pattern prevails, breeding may be expected in the long rains from late May into June.

a. If the rains are early, starting before the middle of April, the seedset in annual grasses will start at the time when quelea arrive from the south and widespread breeding may occur.

(1) If the rains are widespread and prolonged, continuing well into the breeding season, then wheat crops in the Rift Valley will be threatened. Control operations should be undertaken against all colonies.

(2) If the rains are scattered or brief but plentiful, there will be little threat to the wheat crops and control operations need not be undertaken. In this case it will be more economical to control the few roosts which may be established in the wheat-growing areas.

(3) If the rains are poor, no breeding will occur and any roosts established in the area in May or June should be controlled promptly as the birds will almost certainly pose a threat to the wheat crops.

b. If the rains are late, starting in late April or May, then birds are likely to move right through the area when they arrive from the south and will almost inevitably have to be controlled in roosts in the cropping areas.

If careful monitoring is not undertaken and widespread operations are launched during the rains, then there is a distinct possibility that this could be counter productive and drive the birds out to the wheatlands where, had they been left alone, they need not necessarily have gone. It seems certain that such a situation occurred in 1958 after a total of 1000 hectares of dense colonies had been bombed, burned, and sprayed in Tanzania and another 300 hectares similarly treated in Kenya. In the annual report of the Department of Agriculture for 1958 it is reported that "frustrated" adult survivors arrived in the wheatlands two months earlier than usual and established colonies there: a unique occurrence apparently caused by the largest campaign ever launched against quelea in East Africa.

Sorghum and Millet Crops in Eastern Kenya

Many subsistence farmers in Eastern Province of Kenya have substituted the growing of a dryland maize variety, Katumani, for the more reliable dryland cereals, millet (*Pennisetum typhoideum*), and sorghum (*Sorghum vulgare*), which are very liable to depredation by quelea birds. Where this option has been undertaken, agronomic problems have developed but these are outside the present discussion. However, it should be noted that very careful planning is necessary when a traditional crop is to be replaced by an exotic one not yet tried in the area.

Irrigated Rice in Central Kenya

Rice has been grown under irrigation at the Mwea-Tebere scheme in central Kenya for at least fifteen years. In the early days of the scheme two planting seasons were exploited. The main growing season coincided with the long rains and the crop was maturing at the time when quelea birds were dispersing from their long rains breeding areas some 200 kilometers away to the south-west. As a result major control operations against roosts in the area had to be undertaken in order to safeguard the crop. In time it became apparent that the short rains crop did not suffer the depredations of quelea to the same extent. This was because the crop was ripening at the same time as the quelea were breeding in an area some 220 kilometers to the south-east. Harvesting of the short rains crop is completed before the breeding birds begin to disperse. The scheme management now discourages tenants from growing rice during the long rains season.

Irrigated Rice in Western Kenya

In Western Kenya rice and sugarcane are grown together in large irrigation schemes. Quelea tend to move into the area from the north in November and from the south in July. Large numbers assemble in roosts in the sugarcane and in the early mornings and evenings feed on the surrounding rice crops when leaving and entering the roosts. These roosts are generally destroyed by aerial spraying. In the future consideration

should be given to separating the two crops as widely as possible so that the quelea will no longer find convivial roost sites within the rice schemes.

DISCUSSION

All the crops on which quelea feed are annual or biennial cereals, which may be rainfed or irrigated. If rainfed it is usually the case that they are ripening at the end of the rains, which will be coincident with the time when young quelea have become independent of their parents and are desperately learning the art of self reliance. Any small-grain cereal crop grown in the vicinity of quelea breeding colonies is thus at high risk to damage from marauding flocks of juveniles. On the other hand, cereals grown under irrigation will only be at risk to juveniles from a nearby colony if the planting date has been in synchrony with the first rains in the area.

Cereals grown away from the vicinity of breeding colonies may or may not be at risk to quelea depending on the movement of the birds into, or through, the area. It is not the ripening crops which attract the quelea to the area but it may be their presence which keeps them there. The birds will be in the area because they have been forced out of another area by deteriorating conditions and have happened to move in the direction in which the crops lie. The direction of movement onto crops will generally follow well-defined migratory routes from major dry season feeding grounds to early breeding grounds, from one breeding ground to another, or from an end of season nesting site to the dry season feeding grounds. The routes are known in some areas and can be deduced for others as information on the local quelea birds accumulates.

Grass seeds make up 96% of the diet of quelea (Ward, 1965), and grasses of the Paniceae are preferred. The remainder of the diet is made up of insects and only rarely has a non-grass seed been found in the crop, or food-sac, of a quelea. The grasses on which quelea feed are essentially annuals growing in semi-arid areas or in places, such as riverine habitats, which are seasonally flooded. The availability to the quelea of the preferred seeds depends on the abundance of the seed crop; this, in turn, depends on the distribution and amount of the seasonal rainfall.

The twice yearly trans-equatorial movement of the inter-tropical convergence zone (ITCZ) of easterly winds brings in its wake the conditions which give rise to the seasonal rains. The rains, which may be widespread or scattered, torrential or sparse, deprive the quelea of their preferred food, the annual grass seeds on the surface of the ground which germinate and begin to grow. This obliges the quelea to move. If the rains are widespread, and the grasses fed on by quelea take four to six weeks to flowering, birds may have to travel some considerable distance in order to find an adequate food supply. In this they are aided by the flush of insects, particularly termites, which the rains induce. For a short period the quelea gorge themselves on this rich food source, building up a fat reserve sufficient to sustain them on their migration (Ward, 1965). In seasons of scattered or poor rains the quelea may not move far, or may not move at all, if a sufficient supply of seeds remain ungerminated and thus available somewhere nearby throughout the period of the rains.

Birds arriving in areas of prolific grass growth, at the time when seed setting is taking place, are stimulated to establish breeding colonies. In this way there is generally an abundance of grass seeds available at the end of the breeding season on which the fledglings can feed. If there is not, or if the seeds are unavailable to the birds because of the rankness of the vegetation into which the seeds have been shed, then the birds must seek feeding grounds elsewhere. Adult birds in prime condition will continue the breeding migration and remain in the rainbelt moving to areas where grasses are still flowering and there they may breed again. Birds in poor condition, and perhaps beginning their post-nuptial moult, fledglings, and birds which have reached the limit of suitable breeding habitat will disperse to areas where the season's grass seed is available to them on exposed ground. If there are cereal crops in the area they may move on to them. In the dry, or non-breeding, season good feeding grounds become gradually more difficult to find, and the quelea assemble in increasingly larger roosts to

exploit the diminishing food reserves (Ward and Zahavi, 1973). Ripening cereals near these roosts are obviously at serious risk.

Any strategy to limit the amount of cereals eaten by quelea birds in any particular area must be founded on a seasonal inventory of the factors likely to affect the availability of the birds' natural food supply, an understanding of the likely response of the birds to the situation in the area, and finally the right choice of strategy option available. There is no justification for following a search and destroy policy now that so much is known of the ecology of these birds.

CONCLUSION

The principle of quelea control in Kenya is that the birds should only be destroyed when they are damaging, or threatening to damage, cereal crops. Wherever possible, attempts are made to avert crop damage by avoiding having susceptible crops in the known feeding range of quelea populations. Where this cannot be avoided, regular monitoring of the populations determines when they are threatening a crop. Careful interpretations of the monitoring data determines which strategy option can be employed to prevent crop damage most economically and effectively in any particular area.

A current problem is that data collection for monitoring tends to be restricted to those limited areas where field staff are based and to where they can travel; also, the sorting and analysis of data can be tedious. In the future it is hoped that more trained staff and remote sensing of one sort or another will alleviate the first problem and that the use of a microcomputer will speed up and reduce the tedium of the second problem.

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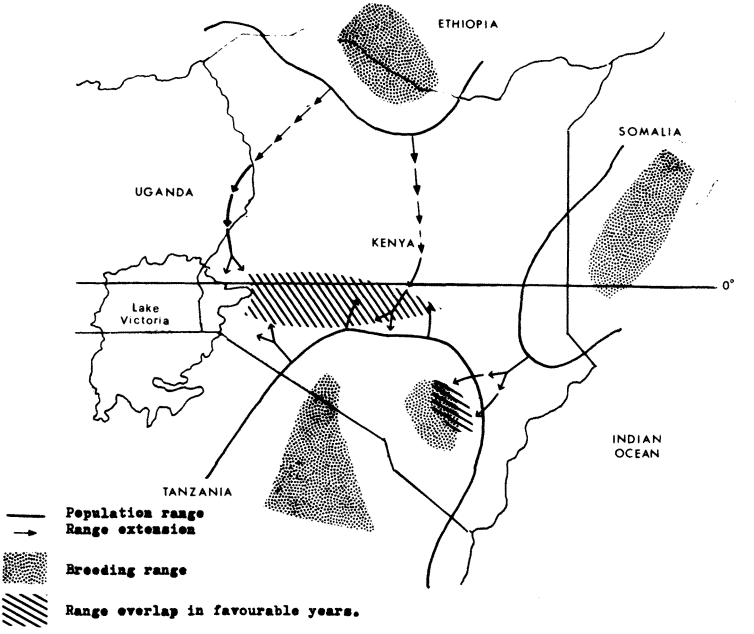
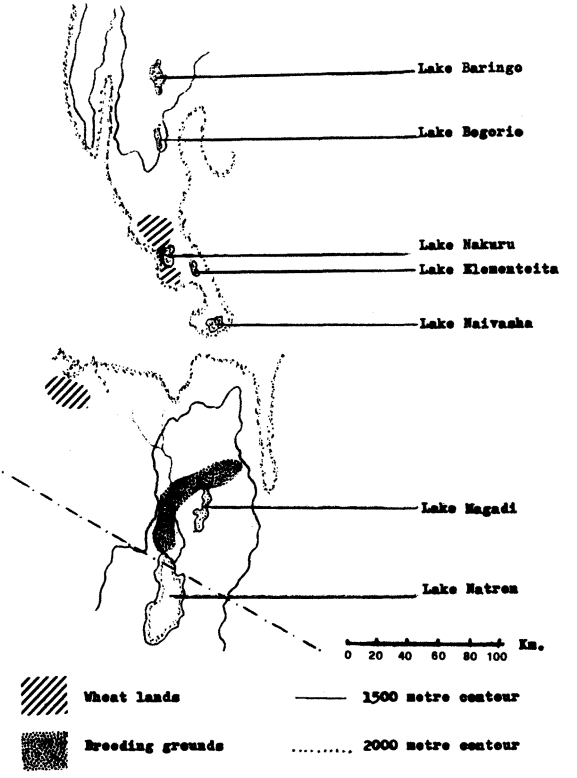
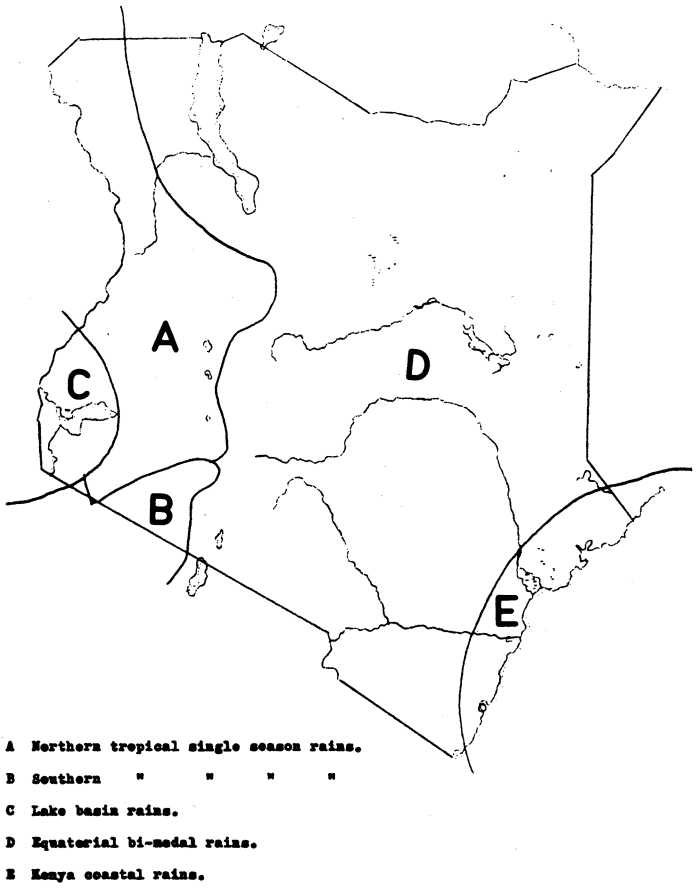


MAP 1. The Distribution of Quelea in Kenya.



MAP 2. Quelea Breeding Grounds in the Rift Valley and Neighboring Wheatlands.



MAP 3. Rainfall Zones of Kenya (after Brown & Britton 1980).

DISCUSSION

Jackson: Clarify (in contrast to red-winged blackbirds why quelea is not a hazard to corn. It is timing of the crop, so birds are not there at milk stage? The kernel too big? Husk too difficult to penetrate? The growth habit of corn?

Allan: I think it's the growth habit of corn that keeps quelea from getting into it. In Kenya Speke's weaver (a ploceid) has never been known to feed on corn; but when ears have been opened by lovebirds (*Agapornis*) this weaver species readily feeds on the corn. In times of food shortage, right at the height of the dry season, quelea might do this as well; but I have never observed it. I think the answer is that quelea feed on much smaller grains than the red-winged blackbird.

Jackson: Expand on the comment about preferential feeding on wild seeds vs. cultivated seeds.

Allan: Quelea is the most successful bird in the grassland steppes of Africa. Where these grasslands have been cleared to grow cereal crops, these are areas where quelea cause major problems. The natural food of quelea is the annual grasses growing in these areas, which are often subjected to seasonal flooding.

Quelea feed in very tight flocks and require that a sufficient biomass of seeds be available. There may be annual grass seeds in the area but not in sufficient quantity. Hence, the quelea turn their attention to the cereals.

Question: What about the use of Avitrol?

Allan: They don't seem to have any vocal threat calls. The flock is kept together by sight. They must be in sight of each other. They feed only in open areas in view of each other. They will not take a bait on the ground inside a field.

Jackson: If you modify the culturing technique by providing hedge rows, would you reduce fields to a size they wouldn't drop into?

Allan: It depends what the hedge rows are like. When juveniles which are not in condition to move out with the adults continue to seek food in an area, they tend to join flocks of other ploceid weavers. And these mixed flocks feed on fields from hedge rows and bush cover. So you wouldn't alleviate the bird damage problem. Major flocks of adult quelea could possibly be kept out of fields by this technique, however.

Question: Are there figures on the total damage from quelea in Kenya?

Allan: It's hard to say. There's so much year-to-year variation. In 1978 major damage occurred in an area where 1/3 of the wheat was lost to quelea. We haven't had that level of damage since. This year a very large control operation prevented damage that might have risen to the same level in the same area. There has been no increase or decrease in damage by quelea over the years that has been measured. The changes that have taken place have been the replacement of sorghum and millet in areas of heavy damage with dryland maize; thus there has been a very marked reduction of quelea damage.

Question: What new problems are popping up?

Allan: If we ever did reduce the population of quelea, I believe the chestnut weaver would immediately take its place. It's a larger bird. It's in the wheat fields in about equal proportions with the quelea. They breed in small colonies but roost in large aggregations; it would be impossible to control breeding colonies, and we'd have to look at other means of control. They would be more susceptible to repellents and frightening agents which have been particularly unsuccessful with quelea.

We have had this kind of situation in West Africa (Senegal), where the golden sparrow has taken over the place of quelea. Whether quelea left because the area became too arid or because of the very large scale control operations by Senegal Bird Control Unit is not known. The Bird Control Unit has taken credit for what may have been a natural decline of quelea.

Jackson: Several questions came up from the quelea movies that you might want to comment on. What is the dosing pattern of queletox when applied to these roosts using ULV? Are you using 100% fenthion? What kind of dosages are you putting out?

Allan: We are looking at use of fenthion quite critically. We are experimenting with use of one litre of active ingredient (technical fenthion, 95-98%)/ha. People working on this method have just demonstrated its success at a workshop in Ethiopia. However, what I believe they are ignoring is that applications can be made only under ideal conditions. If the wind speed is too high, it could put large numbers of non-target species at risk.

Rather, if we use droplet size of 120 microns, we won't get drift and we won't have these problems. We can spray in atmospheric conditions that are more variable — something that is necessary in a regular operational program. We couldn't keep the pilot on standby, waiting for the proper conditions, even if the treatment were more effective. It might be cheaper in terms of pesticide cost, but it's not cheaper in terms of aircraft cost.

Jackson: People were very much impressed with the spectacular use of explosives to deal with night roosts. Are they effective?

Allan: Farmers in Kenya have windbreaks of tall eucalyptus trees (1/4 ha-1 ha). To spray these from the air is difficult, and you will not get good control. In these situations it's much easier to blow the birds up. What we do is to use drums 2/3 filled with a mixture of petrol and dieselene with a gelegnite charge under each. We link it all together. We use six drums/acre and blow them up with an instantaneous fuse. It's a fire-bomb effect. It's just a tremendous percussion and flame; it's the flame that kills the birds. We get very good kills of these birds.

Laidlow: With strobe lighting, could you go into a roost, stimulate early breeding, and thus cause reproduction when the food supply was inadequate?

Allan: A lot of work was done with quelea on this question in the late 1950s by A. J. Marshall from Aberdeen University. It was proven quite conclusively that quelea don't respond to photoperiod. The work then suggested that vegetation color had a great deal to do with what happened, that "greeness" of the environment had a lot to do with the quelea coming into breeding condition.

When they're feeding in a dry season area, seeds are on the ground. As soon as it starts to rain, that seed is no longer available; and they then usually feed on termites. Because of this high protein food, they quickly build up high levels of labile protein, which allows them to complete their prenuptial molt. It also allows them to build up fat and migrate out of the area.

They usually fly through the rains to an area that is completely green. This is supposed to be the added stimulus to bring them into full breeding condition. The males react much more rapidly to this than females; they move out to areas where the grass is already flowering and start to build their nests. The females follow, and within two days after their arrival the eggs may be laid.

Question: If you could control the termite, could you limit the quelea?

Allan: Yes, I think so. Several years ago we came upon a situation in which the quelea had deserted a nesting colony; dead young were in the nests. We know that no amount of disturbance or predation will cause quelea to desert after the eggs hatch; they will continue to feed the young regardless.

Rick Bruggers and Peter Ward observed the same phenomenon in Somalia. They examined the young and found that they had been fed seeds (the same food the adults were eating), had probably been unable to digest them, and had died. The adults then deserted the area. They concluded that because of the unavailability of insects in this small area, breeding had been unsuccessful.

However, it might be considered more damaging environmentally to control the insect food supply in a large area than to treat the limited area of the nesting colony. I have no qualms about lethal roost control in that you get very dense roosts that only contain quelea. If you use a large droplet application to the roost, you're not causing any environmental problem.