Workshop on Research Priorities for Migrant Pests of Agriculture in Southern Africa, Plant Protection Research Institute, Pretoria, South Africa, 24–26 March 1999. R. A. Cheke, L. J. Rosenberg and M. E. Kieser (eds) (2000) Natural Resources Institute, Chatham, UK.

5 Quelea Management in Eastern and Southern Africa

Clive C. H. Elliott

Migratory Pests, Plant Protection Service, AGPP, FAO, Rome, Italy
(email: clive.elliott@fao.org)

ABSTRACT

The paper argues that the context of management of the Red-billed Quelea, *Quelea quelea*, in 1999 is significantly different from the context that has occurred in any of the previous five decades. Economic constraints are making it increasingly difficult for some countries to sustain expensive management practices. 'Green' politics in most major donor countries is restricting the availability of donor support, either completely or unless a link to reduced pesticide usage and/or Integrated Pest Managment approaches is evident. 'Green' lobbies in certain quelea-affected countries are pressing for more environmentally friendly techniques as research shows that secondary poisoning is more of a problem than realised hitherto. In this relatively new context, it is proposed that research is urgently needed to create a different range of management options that better fit the economic and environmental concerns of the present day.

INTRODUCTION

Traditional methods to combat depredations of cereal crops by the Red-billed Quelea, *Quelea quelea*, have no doubt existed in eastern and southern Africa since man began cultivating cereal crops. Official management most probably started during the Second World War, when efforts were made to increase grain production to feed troops. Fifty or more years later, with hundreds of scientific papers produced, and, relatively recently, three books published on the quelea (Bruggers and Elliott, 1989; Mundy and Jarvis, 1989; Allan, 1997), one might expect that the subject would have been exhaustively covered and management practices well established. While the general principle applying to any living creature, that the more you know about it the more questions about its biology arise, applies equally to the quelea, the context of the depredations, including knowledge about aspects of management practices, has not remained static but has gradually evolved. It is suggested that the context of quelea management in 1999 is substantially different from the contexts that applied in any of the previous four or five decades.

My own view is that two elements of the context are relatively new. One is that economic constraints are exerting a more and more powerful brake on what can be done, on the amount that governments are prepared or able to invest in quelea management, and therefore what activities are practicable. The other is a combination of stronger 'green' political influences among major donor countries, the beginnings of 'green' lobbies in certain

quelea-affected countries, and the greater knowledge we now have indicating that the standard management practice of controlling quelea with organophosphate sprays, leads to more secondary poisoning than was generally supposed (van der Walt *et al.*, 1998). The consequences of this new context are that some donors have taken quelea off their list of priorities while others are willing to support quelea control activities only if they are clearly aimed at reduced pesticide usage and/or introducing Integrated Pest Management (IPM) approaches, and are obviously sustainable. Another result, specific to South Africa, has been an increase in the use of the environmentally cleaner fire-bomb technique, despite its considerably higher cost, in preference to pesticide sprays. It is suggested, that in the light of these developments, there is an urgent need for quelea management to be re-examined and re-orientated, through suitably directed research, to fit the resources and concerns of today.

EXISTING MANAGEMENT PRACTICES

Quelea management by government authorities (as opposed to individual efforts by subsistence or commercial farmers) is, to a greater or lesser extent, currently and regularly practised in eastern and southern Africa by Botswana, Ethiopia, Kenya, South Africa, Sudan, Tanzania, and Zimbabwe. Other countries in the region that previously identified quelea as a problem (Malawi, Mozambique, Somalia, Swaziland, Uganda, Zambia; FAO, 1980) have apparently stopped quelea control for lack of political stability, for lack of resources or for lack of priority, or carry it out only very infrequently. Two additional countries, Eritrea and Namibia, have not yet established regular quelea control, although Eritrea carried out its first operation against quelea in recent times in 1998, with the help of aircraft from the Desert Locust Control Organisation for Eastern Africa.

If only the seven major countries are considered, it appears that most of the control is by the aerial spraying of the organophosphate fenthion against breeding colony and non-breeding roost targets. Only Kenya and South Africa use the fire-bomb technique, and only Zimbabwe (high-volume tractor-borne and handheld ULV machines) and Botswana (vehicle-mounted ULV sprayers) use ground-sprayers. In four of the seven countries, obtaining the resources to continue regular quelea control is becoming more and more difficult. Only in Zimbabwe, Botswana and South Africa, and perhaps Kenya, do resources remain sufficient for control. In Zimbabwe, this is achieved because commercial farmers contribute substantially to the cost. In Zimbabwe and South Africa, it is likely that in future a higher proportion of the resources will go into controlling quelea populations attacking subsistence farming in austral summer. Up to now in these countries, the emphasis has been on protecting commercial farming in winter.

None of the countries attempts to make any routine assessment of the damage caused to cereal crops by measuring the losses incurred in the fields. Some countries make assessments if particularly heavy damage occurs, for example in Tanzania (T. M. C. Tarimo, pers. comm.). Others try to justify the expense of control by calculating the amount of crop that the birds killed would have consumed, e.g. Zimbabwe (Winkfield, 1989), South Africa (Geertsema, 1998). Such calculations often assume that all the birds killed would have eaten cereals on the standing crop, and make assumptions of daily consumption and wastage caused by each bird. The total damaged per bird per day, if the bird is exclusively feeding on cereal crops, has been variously estimated at 8 g (Winkfield, 1989) and 10 g (Elliott, 1989). Estimates based around this level are probably reasonable. Geertsema (1998) assumed only 4 g, which may be correct for the amount consumed but does not take account of the amount of crop wasted. On the other hand, he assumed that all the birds killed had been eating cereal crops. If he had used a damage level of 10 g/bird/day,

but had assumed that only 40 % of the birds killed had eaten crops exclusively, he would have reached the same conclusion. The assumption that all birds killed were exclusively eating cereals from the standing crop is likely to lead to large over-estimates of the cost-benefit because quelea almost always include wild grass seed in their diet (Erickson, 1989; Jarvis and Vernon, 1989) and, in any given roost, a significant number will usually eat only grass seed. Recent studies of the food eaten by quelea collected in two provinces in South Africa during control operations showed that none of the quelea had eaten commercial grain (Soobramoney *et al*., 1998).

Quelea management policy in the seven countries varies, but all of the countries would probably agree that quelea are only targeted when they are perceived to threaten crops or have already started to attack them. None would hold to the view, which was held in some quarters in the 1960s and subsequently discredited for ecological and economic reasons, that an effort should be made to eradicate the quelea from the face of the Earth. In the case of breeding colonies, sometimes the degree of threat is difficult to evaluate. If breeding colonies are near substantial areas of crop, which has become accepted to mean within 30 km (Elliott and Allan 1989; Allan, 1997), they would be controlled in Sudan, Ethiopia, Tanzania and Botswana, if the resources to do so are available. In Kenya, colonies normally occur only in areas relatively remote from agriculture, where they are not usually controlled and only those close to crops are controlled in South Africa. Although colonies occur close to subsistence farming in Zimbabwe, traditionally they have not been controlled there by spraying. Sometimes local people raid them to collect nestlings, but this appears to be done more to obtain some good quality protein food, than as a crop protection measure. The Zimbabwe colonies are remote from commercial cereal farms.

Management policy on roosts would be to control those that have already started to attack crops or that occur at certain times of year when crops are vulnerable and in traditional sites from which such attacks usually develop. Roosts occurring during seasons in which no crops were ripening would normally be left alone.

The policy on the choice of tactic varies from country to country. In eastern Africa, it appears to follow a tradition in that aerial spraying is used at certain times of year in certain areas. In Kenya, fire-bombs are used later in the cropping season when roosts form close to cultivation in tall eucalyptus plantations which are often less than a hectare in area. In Zimbabwe, the cost of the tactic is taken into account and the cheapest effective method chosen (Jarvis and Mundy, 1989). Interest in cutting costs has led to the development of the 'trap-roost' concept whereby stands of napier grass (*Pennisetum purpureum*) were grown near crops in such a way that they could easily be accessed with a tractor-borne mist-blower. It was hoped that the napier grass would be chosen as a roost by quelea, allowing easy and cheap control. In the event, this idea has not been widely adopted because the quelea did not choose the site prepared for them often enough. The policy has also tried to take into account the potential damage which a quelea roost can cause. Farmers are encouraged to count the birds and to assess whether there are sufficient numbers of birds to make an impact on the crop. Aerial operations were only carried out if the estimated number of birds reached about one million. The method for making such an estimate (Jarvis, 1989) is highly approximate. My own observation in Zimbabwe suggests that over-estimates may have often resulted, leading to aerial spraying taking place when it was not justified according to the official criteria. Aerial sprays are now done only when roosts are either too large or too difficult of access to be controlled with ground-sprayers (P. J. Mundy, pers. comm.). Allan (1997) suggested that only quelea in concentrations of more than 250,000 birds, which are a threat to crops, constitute legitimate targets, but

gave no explanation as to why this number should be chosen rather than a higher or lower one.

In South Africa, in response to concerns about secondary poisonings, a policy decision has been taken to control roosts with explosives whenever possible. In effect, the technique can only be applied to small roosts usually of up to about 4 ha in eucalypts or acacia and up to 2 ha in reed beds (L. Geertsema, pers. comm.). The proportion of control actions with fire-bombs has risen to about half of all the interventions made, although the proportion varies somewhat from season to season. Although the fire-bomb costs significantly more than aerial spraying, the number of birds killed is often considerably higher which makes the difference in cost smaller (L. Geertsema, pers. comm.).

In making the decision to control or not to control, apart from the threat to a cereal crop and the cost/benefits mentioned above, Elliott and Allan (1989) suggested that the policy on the decision should include an assessment of the importance of the crop. Importance was subdivided into local, national and political. While these factors would seem still to be valid, they are usually not articulated, especially the political element.

One last aspect of quelea management policy concerns environmental aspects. The fact that non-target birds and, occasionally, other vertebrates may be killed by quelea control operations is well-established (Meinzingen *et al.*, 1989; Keith *et al.*, 1994; van der Walt *et al.*, 1998; Verdoorn, 1998). The impact of this knowledge on management practice in eastern and southern Africa is variable from country to country. In most countries, the pressures to carry out control in situations in which serious crop damage is underway are sufficiently heavy that environmental considerations will have little impact. Despite appropriate training, many quelea control staff may not easily recognise that controlling a particular target will endanger a significant number of non-target birds.

Colonies that have attracted unusually large numbers of predators, or roosts that are adjacent to wetland habitats, are cases in point. Disasters involving the deaths of hundreds of raptorial or other non-target birds have been recorded from time to time. To keep the problem in perspective, it should be remembered that, compared to other forms of agricultural spraying, the areas of quelea concentrations sprayed are very small. For example, South Africa controlled annually an average of 185 sites, with an average size of 7.3 ha during the years 1987/88–1997/98 (Geertsema, 1998); Ethiopia, 37 sites of 41 ha (Abdurahman Abdullahi, pers. comm.); Sudan, 145 sites of 205 ha (Ali Mohamed Ali, pers. comm.). While some of these may sometimes cause ecological disasters, the impact on non-target bird populations is likely to be minimal. Most governments in principle support efforts to minimise side-effects, but only a few, primarily in southern Africa, have the resources, skills or priority to implement them.

DISCUSSION

In the past, efforts have been made to estimate the extent of crop damage caused by quelea (Elliott, 1989). The collecting of crop damage data directly from the standing crop has always been an arduous, time-consuming and costly exercise, with the result that data for making estimates are limited. When damage is underway or perceived to be imminent, priority is given to control action. There is seldom an opportunity to measure damage in circumstances in which no control at all has taken place. When resources are limited for control, they are likely to be non-existent for damage measurement. Such a situation is typical for migratory pests in general and makes it difficult to assess economic impact (see Joffe, 1998, for the Desert Locust, *Schistocerca gregaria*).

The conclusion reached previously by the author on the quelea was that on average annual losses suffered by major affected countries amounted to one or two million US dollars per country, but that these losses were probably less than 5% of national production of the cereals concerned (Elliott, 1989). Nevertheless individual farmers, groups of farmers or large farms could occasionally suffer catastrophic damage to their crops. As has been said many times, the situation is complicated in quelea, as it often is with other migratory pests, by farmers' perceptions and their tendency to exaggerate their losses. Because quelea flocks are so conspicuous, farmers often over-estimate the numbers of birds in their fields and over-estimate the threat they pose. Their concerns are transposed into political pressure for quelea control teams to take action against the birds, partly to reduce the farmers' complaints. An important element in the equation is that in most countries, quelea control is carried out by the government at no cost to the farmers. Farmers have nothing to lose financially if they complain to government and vociferously demand action, and they may gain a little more yield if the quelea are removed. Sometimes, of course, their complaints are fully justified and, if nothing is done, serious damage will result. It appears that this outcome is more often the exception than the rule. If so, the quelea problem is as much caused by farmers' perceptions as it is by the birds.

In summary, it could be said that the first element of the quelea problem is that the species eats cereal seeds from the standing crop, in addition to its natural diet of wild grass seeds. The second is farmers' perceptions and as an extension of this, the fact that control operations are normally conducted for them free of charge. The third is the environmental side-effects produced by all forms of control, but particularly by the aerial spraying of pesticides. On the last, the occasional disasters that occur can be very bad publicity for a government that espouses conservation and promotes ecotourism.

What does this summary mean in terms of defining research/development priorities? For quelea ecology, it would suggest that emphasis should be given to two elements. One is to understand more about what factors cause quelea populations to feed more on cereal crops in one year than another. Is the proposal, originally made by Ward (1965), that the quelea turns to cereal crops only when its natural food is short still valid? Given a situation such as in Zimbabwe, where irrigated winter wheat always provides a food source during the dry season when it is presumed that the quelea's natural food is becoming short, is the pressure on the crop always the same each year? In some years, only nuisance-level damage might occur, and control could be minimised. Answers to such questions might allow the years in which severe damage would occur to be identified, in which case control with pesticides would be justified. Furthermore, if it was known where quelea that cause damage were coming from, and how their population distribution changed during the year, it might be possible to identify certain times of the year when most of the population later causing damage was concentrated in one region. This might offer the possibility of strategic control of major roosts or colonies, such that bird pressure later in the year would be reduced. It would also justify another effort among southern African countries to establish a quelea population monitoring network. Standard monitoring forms are available and a network of observers who live and work in quelea areas (agricultural extension staff, game scouts, tsetse officers, etc.) could be established in the region. Resources would also have to be made available to collect and analyse the data.

In respect of farmer perceptions, it was proposed at the 22nd International Ornithological Congress that Integrated Pest Management (IPM) approaches should be investigated for quelea management (Elliott and Craig, 1998). The core of this approach, which is being used increasingly successfully in Asia to reduce pesticide usage, is to work with farmers to minimise as far as possible the vulnerability of their crop to quelea attacks. In so doing,

farmers are encouraged to understand where bird damage fits into the spectrum of all the factors that affect the final yield. The process is intended to help farmers recognise when quelea pose a serious threat and when they are merely a nuisance and likely to have little impact on the yield. The different IPM elements have been tried with quelea in the past in many different situations sometimes with success, but as a package combined with IPM techniques such as farmer field schools and demonstration farms, it would be a new development. Part of the IPM package is to give serious consideration to charging some of the cost of control to commercial farmers and to exerting pressure on subsistence farmers to follow directives on reducing crop vulnerability. Another aspect of IPM that deserves a new emphasis is the possibility of harvesting quelea for food. While present indications are that harvesting is probably not an option as a crop protection technique, it offers the possibility of providing income to rural populations in compensation for crop losses. It may also make a contribution psychologically, as farmers who are catching some birds for food may feel that they are combating the problem rather than doing nothing. Further research on the economics of quelea damage may help to clarify the issue, but it is suggested that the quelea problem, for governments, will not go away as long as many farmers perceive quelea as a problem and therefore complain.

There is also a strong case for further research on how to carry out control, especially pesticide control, in such a way as environmental side-effects are minimised. In the last 20 years, the direction of control improvements has tended to be towards decreasing the quantity of pesticide used per hectare treated by using smaller spray droplets. When quelea were first controlled aerially, fenthion was mixed 50:50 with diesel and larger droplets were used. Apparently, the following dawn, almost all of the quelea were dead (R. G. Allan, pers. comm.). Current techniques mean that 30% or more of the birds are still fluttering in the trees the next morning and a significant number, partially contaminated, are able to fly away from the roost and distribute themselves over a large area, very much extending the potential secondary poisoning. Research is needed on how to achieve a complete knockdown by the following morning with no movement away from the target site. In eastern Africa, investigation is also needed into target definition to find out why targets, in Ethiopia and Sudan for example, are reported as being six times and 30 times bigger, respectively, than those in South Africa, and whether this reflects a real difference in quelea biology or poor estimates of the size or location of the aggregation. Another element that requires investigation is how to make the fire-bomb easier and cheaper to use, so that it may be employed more often as an alternative to pesticides.

ACKNOWLEDGMENTS

Comments on an earlier draft of the paper were kindly made by Dick Allan, Luka Geerstema, Peter Mundy, Peter Jones and Thadeus Tarimo. I would also like to thank Ali Mohamed Ali and Munir Butrous, and Abdurahman Abdullahi and Christian Pantenius, who provided the information on quelea control in Sudan and Ethiopia respectively. The views presented in this paper represent those of the author, and not necessarily those of the Food and Agriculture Organisation of the United Nations.

REFERENCES

ALLAN, R. G. (1997) The *Grain-eating Birds of Sub-Saharan Africa: Identification, Biology and Management*. Natural Resources Institute, Chatham, UK.

BRUGGERS, R. L. and ELLIOTT, C. C. H. (eds) (1989) *Quelea quelea: Africa's Bird Pest*. Oxford University Press, Oxford, UK

ELLIOTT, C. C. H. (1989) The pest status of the quelea. pp. 17–34. In: *Quelea quelea: Africa's Bird Pest*. BRUGGERS, R. L. and ELLIOTT, C .C. H. (eds). Oxford University Press, Oxford, UK.

ELLIOTT, C. C. H. and ALLAN, R.G. (1989) Quelea control strategies in practice. pp. 317–326. In: *Quelea quelea: Africa's Bird Pest*. BRUGGERS, R. L. and ELLIOTT, C. C. H. (eds). Oxford University Press, Oxford, UK.

ELLIOTT, C. C. H. and CRAIG, A. J. F. (1998) Quelea: integrated pest management vs. lethal control, are migration patterns changing? *Ostrich* **69**: 173.

ERICKSON, W. A. (1989) Feeding ecology of quelea. pp. 230–247. In: *Quelea quelea: Africa's Bird Pest*. BRUGGERS, R. L. and ELLIOTT, C. C. H. (eds). Oxford University Press, Oxford, UK.

FAO (1980) Cereal Crop Pests in Africa, with Particular Reference to Birds. Unpublished internal report, FAO/UNDP, Rome, Italy.

GEERTSEMA, L. (1998) Redbilled Quelea: Annual Report. Unpublished report, National Department of Agriculture, South Africa.

JARVIS, M. J. F. (1989) Summarized recommendations for farmers with quelea problems. pp. 135–136 In: *Africa's Feathered Locust*. MUNDY, P. J. and JARVIS, M. J. F. (eds). Baobab Books, Harare, Zimbabwe.

JARVIS, M. J. F. and MUNDY, P. J. (1989) Current policies and future plans. pp. 142–147. In: *Africa's Feathered Locust*. MUNDY, P. J. and JARVIS, M. J. F. (eds). Baobab Books, Harare, Zimbabwe.

JARVIS, M. J. F. and VERNON, C. J. (1989) Food and feeding habits of queleas in southern Africa. pp. 24–35. In: *Africa's Feathered Locust*. MUNDY, P. J. and JARVIS, M. J. F. (eds). Baobab Books, Harare, Zimbabwe.

JOFFE, S. R. (1998) Economic and policy issues in Desert Locust management: a preliminary analysis. *Desert Locust Technical Series* 1998: 15–131.

KEITH, J. O., NGONDI, J. G., BRUGGERS, R. L., KIMBALL, B. A. and ELLIOTT, C. C. H. (1994) Environmental effects on wetlands of queletox applied to ploceid roosts in Kenya. *Environmental Toxicology and Chemistry* **13**: 331–341.

MEINZINGEN, W., BASHIR, E. A., PARKER, J., HECKEL, J. and ELLIOTT, C. C. H. (1989) Lethal control of quelea. pp. 293–316. In: *Quelea quelea: Africa's Bird Pest.* BRUGGERS, R. L. and ELLIOTT, C .C. H. (eds). Oxford University Press, Oxford, UK.

MUNDY, P. J. and JARVIS, M. J. F. (eds) (1989) *Africa's Feathered Locust.* Baobab Books, Harare, Zimbabwe.

SOOBRAMONEY, S., BAKER, C. M. and BERRUTI, A. (1998) The diet of the Red-billed Quelea *Quelea quelea. Ostrich* **69**: 376.

VAN DER WALT, E., MEINHARDT, H. R., VENTER, A. J. and BOUWMAN, H. (1998) Primary and secondary effects of Red-billed Quelea *Quelea quelea* control in South Africa. *Ostrich* **69**: 456.

VERDOORN, G. (1998) Solving the problems of pesticide misuse for avian conservation in Southern Africa. *Ostrich* **69**: 58.

WARD, P. (1965) Feeding ecology of the black-faced dioch *Quelea quelea* in Nigeria. *Ibis* **107**: 173–214.

WINKFIELD, R. A. (1989). The distribution and importance of small-grain crops in Zimbabwe and their susceptibility to quelea damage. pp. 100–103. In: *Africa's Feathered Locust*. MUNDY, P. J. and JARVIS, M. J. F. (eds). Baobab Books, Harare, Zimbabwe.