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INNOVATIVE APPROACHES IN THE CONTROL OF QUELEA, *Quelea quelea lathimii*, IN ZIMBABWE.

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ABSTRACT: Ever since crops have been grown, quelea have been a threat to summer subsistence crops and winter commercial wheat/barley cropping in Zimbabwe. Control techniques spraying toxicant Queletox through ground spray units and aircraft, developed in Zimbabwe, have produced 90% kills keeping the level of depredation down to acceptable levels. Zimbabwe, like most developing countries, faces protein shortages, and utilization of dead quelea by the rural population has always occurred even from sprayed colonies despite repeated warnings of possible side effects. Traditionally quelea have been sold on the black market for 10-20 Zimbabwe cents/bird and recently a far wider potential, even export, has been realized with a potential value increased to 40 cents/bird. Several applications for permits to harvest large numbers have been processed by the Department for export and local consumption provided a suitable method of capturing large numbers could be perfected. The recognition of quelea as a potentially economic renewable resource has intensified research in this area and several mechanical systems have been tried over the years finally culminating in the promising development of the "Impact" trap. The method potentially provides large numbers of uncontaminated quelea for the market. With careful monitoring and the parallel development of the trap roost concept, it is possible this approach could also sufficiently reduce toxic control beneficial to the environment as a whole while providing a source of food and revenue to Zimbabwe.

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INTRODUCTION AND BACKGROUND

The southern race of quelea, *Quelea quelea lathimii*, breeds largely outside Zimbabwe, to the south, west, and in the north where conditions are arid, ideally suited for breeding (Ward 1971). Most of the border areas in Zimbabwe form part of Parks and Wild Life Estates; however there are some communal lands adjacent to the border which experience quelea damage to summer subsistence small grain crops. Greater concentrations of quelea occur during the winter months when the birds congregate in large roosts often numbering several million adjacent to commercial irrigated wheat/barley crops. Unlike most other African countries, which do not have sophisticated irrigation facilities, damage is more noticeable at this time and tremendous effort and expenditure over the last 20 years has led to the development of effective aerial and ground methods resulting in greater than 90% kills regularly being achieved using the toxicant Fenthion (La Grange 1978). Studies in Zimbabwe, based on work originally carried out in Botswana (Jones 1975, 1976), has shown strong correlations between the level of depredation, presumably indicative of the birds' status, and the previous season's rainfall. Where good rains are experienced over a long period quelea appear capable of breeding several times with greater numbers threatening crops the following season. Observations in Zimbabwe indicated that this correlation occurs irrespective of control measures implying that in the long term they have no effect upon seasonal numbers (La Grange unpublished government reports). Consequently, since 1980 Zimbabwe has adopted an approach to control only those quelea which are a direct threat to the standing crop. At the Quelea Symposium in Nairobi in 1986 this approach was similarly adopted as a general resolution by most African States.

Seasonal rainfall has become reasonably reliable as a source to predict the following season's quelea problems, although there are further factors which need to be clarified: for example, the degree of grass cover, particularly annual species, still standing at the commencement of winter which the birds seem to prefer (Jarvis and Mundy, in press). Research findings indicate that grass seed is preferred except possibly sorghum, particularly the white varieties. The percentage of the birds observed in lands actually feeding upon wheat and barley appears relatively small. All the samples taken from the wheat lands where the birds were apparently feeding upon them indicate only one-third of the population feeding on the crop, the remainder preferring *Panicum* spp. grass growing within the crop. Studies of wheat damage have indicated low levels of depredation, less than 5%, even where no control is effected, leading to the conviction that damage claims in respect to wheat are probably overrated; and should effective protection methods be devised, lethal control would no longer be necessary. It is admitted, though, that damage is more serious to barley and can be devastating to sorghum and millet during the summer months. Unfortunately pilot studies in Zimbabwe using both repellents Trimethiocarb and Methicarb did not indicate repellency for more than 3 days; however, it is possible that the mode of application could be improved (Bruggers pers. comm.).

ARGUMENT FOR HARVEST POTENTIAL

Africa experiences an acute shortage of protein food and any source of protein must therefore be exploited. Traditionally in Zimbabwe quelea have always been harvested by various means using sticks to beat roosts after sunset or elastic strips from inner car tubes to smash through birds

massing on baited open ground, for example.

Breeding colonies close to human settlements are raided just prior to the fledgling stage primarily for their food source, it is believed, rather than damage they inflict upon crops. Experience over 14 years has clearly shown that virtually all the dead birds are collected, usually over 2 days, from controlled roosts and consumed despite warnings of possible poisoning. Fortunately no cases of poisoning have been substantiated and trading on the black market has flourished with 10-20% local currency being realized for each bird, often transported several hundred kilometers from spray sites. On several occasions people have even been found occupying the roost prior to spraying in anticipation of collection although death of the quelea takes place several hours afterwards. The sight of an aircraft at dusk signifies quelea control attracting people from far afield almost in a frenzy to collect them. Analysis studies of quelea poisoned with Fenthion indicate some residue even though its effect is questionable. According to toxicity studies by WHO (1972) based on a LD 50 for rats of 220mg/kg, a person would have to consume 225 kg of quelea to reach this level assuming that each bird is contaminated with a level of 10,1ppm (GTZ Quelea Handbook 1987). Studies carried out at the International Order for the application of Pesticides (Granfield, UK) in reports prepared for F.A.O. indicated that as little as 20 birds could exceed the minimum dose producing toxicological effect (Mundy pers. comm.). Despite its probable little effect based on experience, because of the world's resistance to pesticides and possible poisoning, a method was urgently required which was humane, providing for the collection of a large number of uncontaminated birds. The traditional collection of quelea poisoned was generally unhygienic, often several hours later, usually in water, which in the past has discouraged large-scale processing.

During the last 5 years the economic value of harvesting quelea on a large scale has been realized with strong possibilities for export. Over the last 2 years several applications have been lodged with the Department for permits to collect, process, distribute and export quelea. Enquiries have indicated that quelea, properly dressed out, could potentially realize up to 40-50% each in Europe, amounting to Z\$400000-00 could be grossed. The number of quelea controlled each year varies between an estimated 10-80 million indicating value far in excess of possible overheads, provided of course a successful means of harvesting could be guaranteed.

The use of mistnets are able to cope with large numbers though removing the birds after dark in the roost is both tedious and damaging to the nets (Mundy pers. comm.). In breeding colonies where collection can be carried out during daylight hours, this problem is alleviated to a large extent and catches of up to 1000 birds per day have been achieved in Zimbabwe (Mundy unpublished government report). Misuse of this method has occurred in the past and permits issued have resulted in "non-target", valuable species being exported. The Department has understandably become reluctant to allow mistnets for this purpose relegating them solely

for scientific purposes.

An enterprising farmer in the Banke/Trelawny area of the country, Mr. Cavin Crawford, found that he could successfully trap quelea by building several walk-in traps which he loaned out at no cost to his employees who used them around his wheat lands. These people in return were allowed to keep or sell the quelea they caught. In this way he was able to trap up to 475 quelea a day, with an average of 150 birds from each of his 12 traps (Crawford pers. comm.). Although this method proved popular they had little apparent impact on damage inflicted to the crop nor were they attractive for large-scale collection. It is believed there is room for improvement based upon the Australian crow-trap principle.

Clearly a more efficient method was necessary capable of collecting several 1000 quelea at one time. Considerable research has been carried out on quelea throughout Africa although little information is at hand regarding roosting behavior in both the overnight roosts or daily resting places where they congregate in fair numbers. Behavioral studies to determine where mass capture could be best directed was carried out in 1978 (La Grange 1978). Two methods have been tried in the U.S.A. and Canada particularly against blackbirds and starlings to capture or destroy them in large numbers without toxicants. These included the use of surfactants (Stickley 1986) and flood-lit traps (Mitchell 1963), both of which appear to have been fairly successful. Aviary experimentation in Zimbabwe indicated the possibility of using surfactants even at temperatures 4-5 degrees Celsius above zero, however an elaborate irrigation system involving a lot of water, up to 50 mm precipitation, is necessary. In addition the problem of collection still arises. In respect to floodlit traps, in Zimbabwe most of the roosts controlled are remote, requiring powerful generators to provide the necessary power for the flood-lit system. Pilot studies in aviaries failed to indicate positive results and the system was generally thought to be too sophisticated for a rural use.

SPECIFIC RESEARCH AND OBSERVATIONS OF ROOSTING QUELEA PAVING THE WAY FOR TRAP DEVELOPMENT

Studies of quelea congregating at daily resting places during depredation of crops indicated that more damage occurred near the edge of the lands, particularly in the vicinity of large trees where they "siesta" during the heat of the day. Roost observations indicated that at sunset quelea moved in flocks from the lands following tree lines and river courses, presumably to escape aerial attack by raptors, eventually reaching water where they drink before finally moving onto the roost. The flight into the roost is characteristic, allowing for reasonable estimation of numbers entering over a period of 45 minutes at dusk (La Grange 1978, Jarvis and Mundy in press) (Fig. 1). Initially the birds would occupy a large area of the vegetation, but as the evening progressed they would gravitate toward the area of greatest noise, the true roost, characterized by large deposits of excreta, depending upon length of occupancy. Soon after the arrival of the birds each

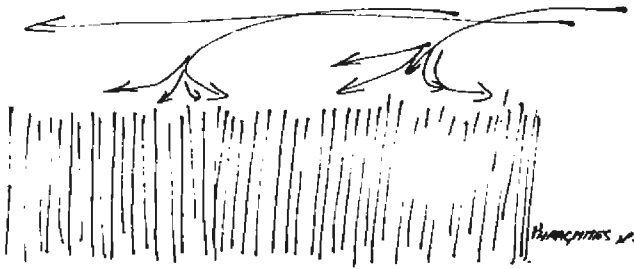


Fig.1. *Quelea* movement into roost at dusk.

evening there is a lot of bird movement within the roost which settles down prior to the onset of darkness.

It was observed that provided the roost was fairly homogenous the birds would move readily within it when disturbed, hopping forward short distances of 1-2 meters each time. Provided the roost was isolated the birds were reluctant to move out of the roost except where it abutted similar type of vegetation. It also became evident that the birds could be successfully "herded" back and forth down the length of the roost allowing for repeated exposure to a trap suspended across the middle (Fig. 2).

Early experimentation into trap mechanisms examined the feasibility of providing electrified steel roosts which were substituted into an existing roost which would electrocute any birds settling upon it. The principle behind the method relied upon the birds replacing one another, once others had fallen, in order to crowd. The method failed, however, as the birds completely avoided the trap. It was discovered that they disliked any form of modification to the roost, vacating it completely where major modifications had taken place during occupancy. They appeared to tolerate disturbance from without the roost but rejected any change to it. It became evident that any apparatus placed in the roost would have to be installed without any modification to it. Further parallel studies, primarily to effect lethal control, provided for the growing of trap roots of nappier fodder grass grown in isolation to other similar vegetation in close proximity to drinking water and the crop in question. Nappier fodder was chosen as it closely approximated *Phragmites* spp. reed bed, beds which proved to be the most popular choice of roost after dense thickets of *Dicrostachyes cinera* which are only found in the Midlands area of Zimbabwe (La Grange 1978). Research also indicated that although there was preference for vegetation type, proximity to the crops and open water was more important. Most of the trap roosts implemented since have successfully attracted *quelea* improving toxic control, reducing contamination to non target species. The system also provided the possibility of tailor made roosts which could be adapted for mass harvesting techniques developed in the future.

Using the principle of adaptive management research it became evident that a system was necessary which could be

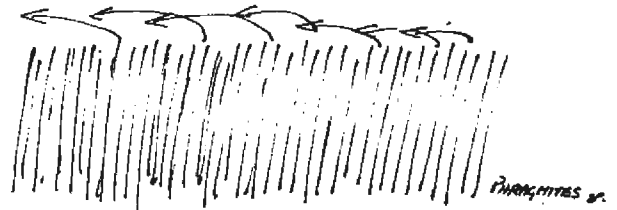


Fig. 2. *Quelea* movement within the roost after sunset.

placed over the roost into which either the incoming birds each evening would be caught or where birds could be "herded" into a trap from either side after dark.

Initially a 6 mm steel cable was thrown over the roost using a modified rifle launcher and pulled tight over two specifically designed poles strained taut using a 2000 kg winch. Experimentation began using large clear panes of glass suspended from the cable by rollers which were pushed into the roost from one side. In this way there was no disturbance to the roost itself. Beneath each of the panes a tin bin was suspended to collect the birds (Fig. 3). The advantage of this system was that several units could be placed on the cable from one side of the roost and pushed in to it along the cable until the entire width of the roost was covered. The units could be similarly retrieved to remove the captured birds again without any disturbance to the roost vegetation. The method proved immediately successful in that *quelea* coming in did collide with the glass. Once the birds had settled at dusk, though they were easily herded up and down the roost towards the glass, they avoided it possibly because of the sunset reflected off the glass. After dark, however, they readily flew into it, though they did not strike the glass sufficiently hard enough to knock them down. This method later proved cumbersome to set up resulting in several panes being broken; however the concept proved worth while following up.

Experimentation continued using a frame in which several rows of fishing line were suspended from the top through holes in the bases of the frame to maintain a 10 mm spacing between each line. The individual strands were kept taut by weights suspended beneath. The concept relied upon the birds flying through the first couple of strands before becoming snagged up. It was reasoned that their wing movement would be sufficiently disturbed by the other lines causing them to drop to the bottom. Under trials, however, the birds penetrated completely through with less than 5% falling through to the bottom. It is possible that individual strands of fishing line set closer together would work; however, there were no further roosts to test this theory during 1987. A cage design was tested at the same time, suspended in the same manner, each side at right angles to the birds' flight, comprising of several windows set in a wire frame approximately 40-

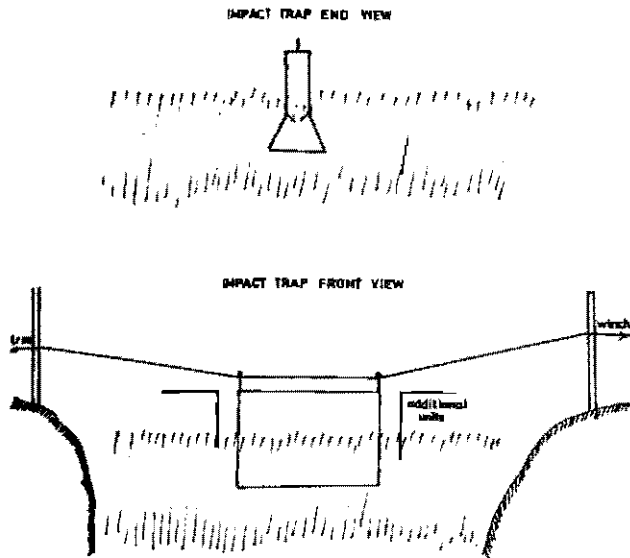


Fig. 3. Sketch of field placement of impact trap (front and end view).

60 mm in size. Into each of these windows, a small wire gate was hinged from the top only opening to the inside (Fig. 4). Although the trap was visual and thus avoided by the incoming birds at dusk, they successfully collided with it after dark during "herding" from each side. Several hundred were caught in this manner which later managed to escape through the gates due to poor construction. Unfortunately, again it was too late in the season to improve the system. Further variations to this system were tried by suspending small rectangular perspex pieces in each of the windows instead of the wire frames. These proved least effective due to light reflection and unaccustomed clattering against the frame from the wind blowing them, which the birds avoided. Evaluation of the systems experimented clearly indicated that the principle had enormous potential. Certainly the birds could be "herded" into it and the system was capable of trapping several thousand birds each evening; however, further trials are necessary to improve upon design. It would appear that the cage design with wire gates in the windows would be most successful, "herding" the birds into it after dark. Observations of the struggling birds caught in each of the cages appeared to warn off others and future trials will incorporate a holding cage beneath the trap section into which the trapped birds can fall. The birds will be unable to return back up to the trap section, clearing it constantly. The holding section would be below the top of the reed bed hidden from the herded birds.

Field trials indicated that numbers caught could be greater than using mistnets as the system clears itself after each drive and that the birds were considerably easier to remove. Best results were achieved by setting the trap low, about 20-30 cm above the roost with the rest of the trap hanging within it. Higher than this the birds appeared to fly over it although the reason is not entirely clear. It was imperative to set up the system early on the same day to trapping during the absence of the birds and obviously to have it completed before they

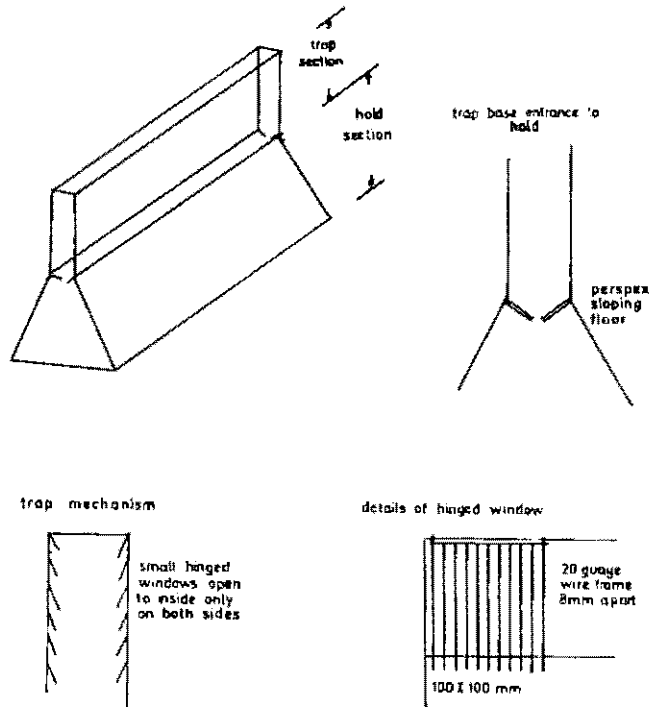


Fig. 4. Proposed impact trap design details.

return. In all cases the birds accepted the intrusion of the system into the roost; however, after the third or fourth night of "herding" the roost was eventually vacated.

There appears no reason why several cages could not be suspended along the same cable covering the entire width of the roost. Used in this manner with several drives over three consecutive evenings it may be possible to harvest the majority of the birds in the roost.

Once caught the birds could be transferred alive to suitable transport and then taken directly to the processing plant or they could be dispatched humanely through a gas box arrangement situated over the cable to one side into which the trap and holding cage could be pulled into after capture.

Should the method prove effective in controlling large numbers, not only will it provide for the utilization of this remarkable renewable resource but it could also provide sufficient control probably in conjunction with repellents to obviate the need for toxic measures to provide protection to standing crops. The method is target specific in that it is only operational at night when birds cannot see it commanding a relatively small area compared to a mistnet. Research has shown that large roosts of quelea are invariably pure with few other species co-inhabiting them. The reed-loving species, for example, African Crane etc., are unlikely to be at the top of the reedbeds during disturbances.

Research has indicated that only a small percentage of all quelea use roosts adjacent to crops, preferring natural grass elsewhere instead (Jones 1975). It is therefore unlikely that harvesting them will have a major impact upon their overall population. Population dynamics appear to be largely con-

trolled by seasonal rainfall and therefore available food in their breeding areas with no correlation to lethal control of roosts, even in years where an estimated 80-90 million quelea have been destroyed. Their breeding potential even the following year after heavy control following good rains appears to completely mask control effect (La Grange 1980).

The "Impact trap" system provides ideally for the protein-starved Third World. The operation is relatively simple not requiring high-level skills, whilst providing a measure of control against damage of subsistence and commercial grain crops. Developed to potential, the system could also provide a valuable foreign currency resource to the country.

Trap roosts of nappour fodder could be tailor made for the "Impact trap" providing slightly narrowed waists in the center where the traps could be placed. These roosts are deliberately grown in isolation to other vegetation which would successfully contain the quelea population during "herding" on dark nights. This parallel development provides ideally for the system and recovery of these birds thereafter.

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