March 1980

THE SITUATION OF GRAIN-EATING BIRDS IN SOMALIA

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ABSTRACT: Research into the biology and control of pest birds in Somalia has continued intermittently since 1971 under UNDP funding of four projects. Data have been gathered on the identification, distribution, and status of the principal pest species to agriculture. These species include the Red-billed Quelea (Quelea quelea), of which northern and southern races occur, and several other ploceid weavers (Ploceus spp.) which may damage cereal crops. The movements, food habits, and corresponding impact of these species on agriculture in Somalia are discussed in detail.

As a result of the information obtained during these years of research, emphasis has recently shifted to developing the indirect control capacity of the Bird Control Unit and evaluating methods for directly protecting a crop. Scouting teams for locating concentrations of pest birds have been organized and initial control operations undertaken. Trials of frightening and scaring devices and techniques, physical barriers, and chemical repellents have been evaluated, but only on a limited scale and with variable results. The whole arena of managing bird pests is new in Somalia and progressing slowly. However, the necessary framework is being established upon which a crop protection strategy, integrating methods of indirect and direct control, can be implemented.

INTRODUCTION

The Somali Democratic Republic covers a total area of 637,500 km^2, of which the largest part is used exclusively as pasture for nomadic livestock. The total cultivatable area is estimated as 8 million ha, of which a much smaller percentage presently is under cultivation (Meliczek 1972). The government's objective is to raise the agricultural productivity to self-sufficiency and then to produce a surplus for export. Since traditional bird control methods can account for as much as 80% of production costs in some cereal schemes (Ash and Bruggers 1978), the need to strengthen the Plant Protection Service and, in particular, the sector of Pest Bird Control, has been given due consideration in the development program.

Several species of birds in Somalia damage ripening crops. Village Weavers (Ploceus cucullatus), Golden Palm Weavers (Ploceus bojeri), Chestnut Weavers (Ploceus rubiginosus), and Red Bishops (Euplectes franciscanus) are the main pests to cereal crops. Fischer's Starlings (Spreo fischeri), Ruppel's Weaver (Ploceus galbula), and Somali Sparrows (Passer castanopterus), where locally abundant, are potential pests. However, the most serious pest species is the Red-billed Quelea (Quelea quelea) which, because of its gregarious habits, large numbers, and distribution pattern, regularly affects adversely the agricultural production in certain parts of the country by its attacks on rice, sorghum, and wheat.

The Somali Government realized the gravity of the problem and sought technical assistance from the United Nations Development Program (UNDP). In March 1971, a national project--Quelea Bird Control--became operational with the appointment of an FAO Ornithologist-Ecologist. In January 1974, Somalia joined the regional project--Research into the Control of Grain-eating Birds (Quelea quelea)--a project extending throughout sahelian Africa, from Senegal to Somalia. Within the context of these two projects research into the movements and biology of pest bird species, some damage assessments, controls, and crop protection measures were carried out.

The information gathered shows the importance of birds as cereal pests and confirms the need to continue bird research and control activities (FAO 1976). Accordingly, a second national project-- Development of a Bird Control Unit in Somalia--whose principal purpose is to organize an effective scouting and control unit, was established in August 1978 with the arrival of a Plant Protection Officer, Coincidental with the termination of the first regional project, Somalia recognized the importance of continued research and participated in the organization of yet another regional project--Coordination of Cooperative Action to Reduce Bird Damage to Crops in Eastern Africa--and a Crop Protection Ornithologist arrived in early September 1978. The goals of this research project are to predict the movements of the Quelea populations in the five participating countries (Ethiopia, Kenya, Somalia, Sudan, and Tanzania) and, in conjunction with the respective national projects and interested organizations, develop methods of direct crop protection, which with increased efficiency of the destruction techniques presently employed could provide an effective, integrated approach to reducing crop losses.

Considerable information exists from the various projects and work of the Quelea Bird Control Unit, but much of it is in the form of notes, diaries, unpublished documents, or unanalyzed data. There is a risk that if a synthesis of this information is not made, much of the data will be misplaced or lost. This document, therefore, attempts to summarize the pertinent information collected to date on bird pests in Somalia. It presents an overall view of the current knowledge on the situation and, hopefully, can serve as a basis from which future control operations and research efforts within the country can evolve.

METHODS

The information in this report has been assembled primarily from the unpublished documents, trip reports, and diary notes of the various FAO ornithologists and/or consultants who have served intermittently

in the country since 1971. Very few published articles exist. Some research and control operations continued in the hiatus periods between FAO projects, and the data collected during these periods, primarily on food habits, have been analyzed.

Control operations usually were supervised by government personnel of the Bird Control Unit who had received post graduate training. Research was directed by FAO advisors. The methodology suggested by Ward (1973) generally was followed in dissecting birds and analyzing crop contents and breeding colonies. The crop content data are necessarily presented in a simple form because of inconsistency in the specific analysis techniques employed by the different researchers. Most estimates of damage prior to 1978 are based on visual "guesstimates", while those after that date are from transect samples taken from randomly selected fields. Bird distributions are based on literature references and actual sightings, as compiled by Ash (pers. comm.). A bibliography of known, pertinent references is included. Locations of villages mentioned in the text are shown on the map.

RESULTS AND DISCUSSION

Description of Somalia

Somalia is located between latitudes 2°S and 12°N and longitudes 41°W and 51°E (Fig. 1). Except for the coastal dunes, the vegetation over most of the country consists of various associations of dryland grass and scattered bush (Anonymous 1976). The inter-river area, which includes the principal range of Quelea, is a grass and shrub steppe with dense bush, dominated by Acacia mellifera, A. misera, and A. seyal, in the vicinity of the rivers or in depressions. The vegetation in the upper and lower flood plains of the Shebelli River and from the Juba River flood plain to the Kenya border includes many of the same species of Acacia, some Balanites spp. and several grasses Echinochloa, Cenchrus, Panicum, Bracharia, Chloris, Dactyloctenium, Pennisetum, and Aristida, species which provide the principal green seeds on which Quelea feed and are characteristic of their habitat throughout Africa (Ward 1965).

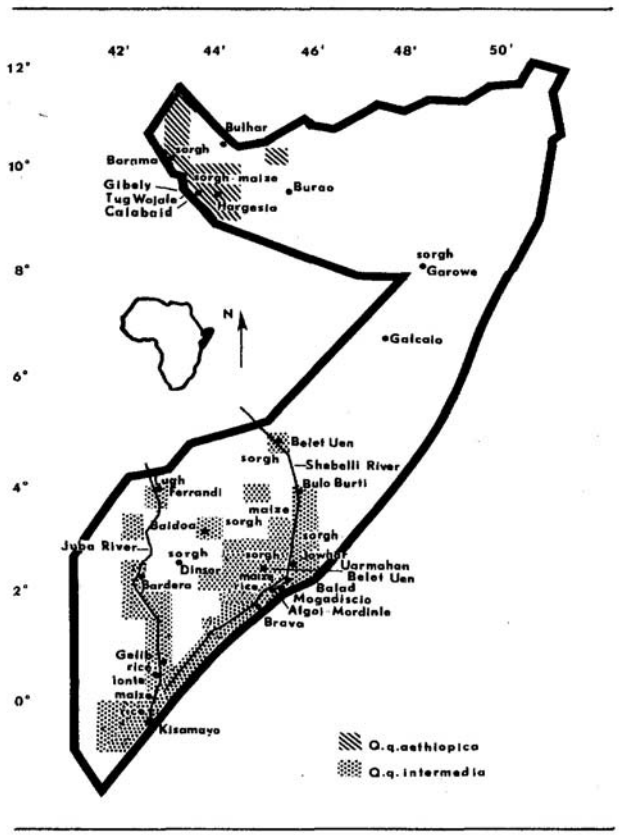

Fig. 1. Principal crop areas and distribution of Quelea in Somalia.

Agricultural production in Somalia is confined primarily to the Shebelli and Juba River Valleys and the inter-river region. Crops are cultivated twice annually, during the short-rains "DER" season between October and December and the long-rains "GU" season from April to July. Sorghum (Sorghum vulgare) and maize (Zea mais), grown under rain-fed conditions, are the staple, locally-produced cereals. The estimated area under cultivation for these crops is 70-133,000 ha for maize and from

196,000 to 250,000 ha for sorghum (Anonymous 1978, Barre 1978), and the production is rarely sufficient in normal years of rain (Anonymous 1976). Between 50-100 ha of experimental wheat (Triticum aestivum) is grown in the north near Tug Wajale. A small amount of rice (Oryza sativa) (2,800 ha in 1975) is grown under irrigated conditions on government schemes or crash programs. The approximate 400,000 ha under cultivation represent only about 0.5% of the total area of Somalia.

Quelea Populations in Somalia

Ward (1966) developed the technique of distinguishing different races of Quelea in Africa on the basis of the relative percentage of black in the facial masks of males in breeding plumage. Based on extensive surveys by Allan (1971-1972) and the results of his unpublished mask index studies on 300 and 205 Quelea in southern and northern Somalia, respectively (Allan, pers. comm., recently confirmed by Bruggers (1979a) for southern Somalia), it has been established that two races occur in Somalia: Quelea quelea aethiopica in the north and Q. q. intermedia in the south. According to Allan (1973) "the northern population is non-resident and limited to an area circumscribed by the Ethiopian border in the south, from Borama in the west to Calabaid in the east, Hargesia in the northwest and Burao in the northeast (Fig. 1). Birds cross the border from Ethiopia in March and April (or as late as May) (Barre pers. comm.) and depart again in September and October." The actual dates probably depend on the rain pattern. Rain was delayed in 1979, and Quelea were not seen in any sizable numbers until August 1979, despite survey trips being made in May and July into the region. Although I collected Quelea in breeding condition in August 1979, there are as yet no confirmed breeding records in Somalia for the northern population.

Allan (1973) describes the southern population as occurring mainly south of 5°N from Belet Uen to the coast, although it is not common along the Ethiopian border in the southern part of this area. Birds are especially concentrated in the grassland savannah areas between the rivers and west of the River Juba in the Lac Dera area. This population breeds in June/July and again in December/January towards the end of the two rain seasons. The actual movements have not been determined, but there is circumstantial evidence that December breeders are young of the year reared in Somalia in June/July. The July breeders may arrive from Kenya in February or March, but evidence now suggests that they disperse from the immediate area during April prior to returning to breed in July. The distribution and boundaries of both populations are being more clearly defined as a result of present survey work.

Quelea Migration and Movement Patterns in Somalia

The predicted movements of Quelea in eastern Africa are tied to the rains and related to food availability (Ward 1971). Early rains cause wild grass seed to germinate, resulting in a food shortage for the birds (Ward 1965). Quelea must either move ahead of the rain or return behind it to areas where rain has fallen earlier and where green grass seed is available (Holcomb 1975a). The situation in Somalia seems to generally follow this pattern but seems to be becoming more complicated as additional information is obtained.

The rains move southward in October and November, the DER season, and Quelea breed in December/January. The actual movements of the birds have not yet been determined, so that birds breeding in December probably are adults returning from Tanzania and perhaps, as suggested by Allan (1973), young of the year reared in Somalia from the June/July colonies. Birds collected in October/November 1973 were primarily juveniles (although Holcomb (pers. comm.) noted at least 50% adults in October 1974 samples), but those collected in December included increasing numbers of adults. Four breeding colonies covering 191 total ha (range 11.7-77.5 ha) and consisting of about 5 million adults were located in the Uarmahan-Hawaala Buray area in December 1978 (Ash 1978) (Table 1). Breeding colonies had previously been found in Somalia in Wanle Weyn and Johwar Districts during the DER seasons in 1971, 1972, 1973, and 1976 (Tables 2 and 3).

After breeding in December/January, some birds apparently migrate southward in February to Kenya and Tanzania, where circumstantial evidence suggests that under favorable conditions (as in 1979) they may renest (Allan, Elliott, pers. observ.). Many other birds, however, congregate in numerous large roosts, several of which reform annually in the Afgoi District, where they remain until the first rains of the April/May GU season. Because these early rains are scattered, so that seed is not germinating simultaneously within any region, Quelea must necessarily move and change their roost location frequently until the time when the advancing rains have sufficiently covered the area and virtually no seed is available (Holcomb 1975a). They then suddenly abandon the entire area, as on 14 April 1979 following 5 rains totaling 57 mm in the Afgoi District, presumably in reaction to a decreasing food supply due to germination of the grass seed. Departing birds are not in breeding condition. The location of the birds between this date and early to mid-June, when they reappear in the same area in breeding condition (one breeding colony was found in Uarmahan in June/July 1979 and another in Afgoi in August 1979) has not yet been determined. They may move to the more southern Kismayo-Lower Juba region of Somalia (although no Quelea were seen in that area during a 3-week survey in May 1979), or possibly to northern Kenya or as far as Tanzania, where it had been raining earlier. Ornithologists presently are studying the situation in these other countries. Clarifying the local and migratory movements of Quelea is of utmost importance and can perhaps be delineated by an extensive program of marking them with colorful, polyvinyl leg streamers (Bruggers in press [a]).

Table 1. Summary of Quelea nesting data obtained from four colonies during December 1978 and January 1979 in southern Somalia. Table reproduced from unpublished report of Ash 1978.

Characteristic	Colony A	Colony B	Colony C	Colony D
Locality	Hawaala Buray	Hawaala Buray	Uarmahan	Uarmahan
Hectares	51.71	77.48	11.71	50.26
Habitat				
Acacia	74%	58%	85%	94%
Bush	18%	38%	15%	6%
Acacia/Bush	8%	3%	0%	0%
Nesting Activity				
Commenced	30 Nov 78	1 Dec 78	5 Dec 78	-
Date found	20 Dec 78	20 Dec 78	20 Dec 78	1 Jan 79
No. nest samples	100 (24 Dec)	100 (24 Dec)	100 (24 Dec)	-
No. nests active	84 (84%)	99 (99%)	83 (83%)	-
Eggs only	0	1 (1%)	33 (33%)	
Av. young/nest (total)	1.7 (24 Dec)	2.2 (24 Dec)	1.7 (24 Dec)	(2.0)
Av. young/nest (active)	2.0 (24 Dec)	2.2 (24 Dec)	2.0 (24 Dec)	(2.1)
Av. age/nest (days)	6.5 (24 Dec)	5.5 (24 Dec)	0.9 (24 Dec)	?
Nest Density				
Sample size (ha)	1.25	2	2	2
Total nests (all)	405,531	469,296	33,842	412,985
Total nests (active)	340,646	464,603	28,089	?
Population				
Estimated young	681,292 (24 Dec)	1,022,127	56,178	825,970
Estimated adults	681,292 (24 Dec)	929,206	56,178	825,970
Total	1,362,584	1,951,333	112,356	1,641,940

Crop Content Analysis of Principal Pest Species

A unique opportunity exists in the Afgoi District to study the feeding habits of mixed ploceids feeding in the same area. From regular monthly collections made between 1975 and 1979 in several roosts, Village Weavers, Golden Palm Weavers, Chestnut Weavers, and Quelea are known to be the most important pests to crops in southern Somalia. Species differences and annual variations exist in the percentage of these birds eating crops during the year, but the general trends are similar and related to the crop calendar (Fig. 2). More birds consistently eat crops during the DER season than during the GU season. Although during the DER season more than 80% of the Village and Chestnut Weavers ate cultivated grain, compared to 30-50% of the Quelea, Quelea cause more damage because of their greater numbers.

Fifteen percent of 3,282 Quelea collected between December 1975 and July 1979 had eaten cereal crops (Table 4). Sorghum and rice (the only cultivated grain eaten in August and September 1976) were found in 43% and 26%, respectively, of these birds, but Holcomb (pers. comm.) occasionally found cracked maize, presumably gleaned from around villages, in their crops. Quelea did not attack maize. Ward's (1965) contention that Quelea eat primarily wild grass seeds is supported by their being the exclusive food item in 84% of the birds. Insects supplemented the diet during the GU season rains in April (74%) and May, but were found in only 5% of the birds during the year. Insects seldom were the only food item present and, except for 8 birds, were absent between May and January.

Although the data are too incomplete to generalize greatly, there appear to be some inconsistencies as to whether adults or juveniles (based on aging by cranial ossification; see Ward 1973) are mainly responsible for damage. During August and September 1976, 71% of 251 birds collected with rice in their crops were adults. Contrastingly, 24% of 176 birds collected during January 1978 and January 1979 were juveniles, all of which had eaten sorghum. The reasons behind these differences need further study but appear to be related to the particular season and the migrations of the adults (who seem to remain longer following the GU than the DER season), the type of cultivated grain, and its proximity to the nesting colony.

Table 2. Indirect control operations conducted against Quelea in Somalia between 1971 and 1978.*

Date	Location/Village	Colony type	Colony size (no. adults)	Control method	% Conc. Queletox	Kill
Jul 71	Wanle Weyn	breeding	-	explosives	-	ineffective due to dispersion of colony
Aug 71	Butur	roosting	-	explosives	-	ineffective but impressive
Jul 72	Hargesia	roosting	-	knapsack sprayer	-	(very small scale) 65% adults, 35% juveniles
Jul 72	Bur Acuba	breeding	1.2 ha	movable ground sprayer	-	results not reported
Jan 73	Wanle Weyn (Lama donka)	breeding	-	movable ground sprayer	10	80-85% mostly juveniles
Jun 73	Jowhar (Sarsar)	roosting	-	movable ground sprayer	15	low percent of which 60-65% adults
Dec 74	Wanle Weyn (Awkule)	roosting	-	fixed ground sprayer (boom & nozzle)	40	low percent of which 70-75% adults & juveniles
Jun 76	Wanle Weyn (Uarmahan)	breeding	1/4 million	aerial spray--ULV	-	low percent; mostly adults
Sep 76	Genale (Human Samay)	roosting	1/2 million	tractor-mounted ground sprayer	12	10-15% adults
Nov 76	Afgoi (Gavero)	roosting	1 million	aerial spray--ULV	-	5-10% adults
Sep 78**	Burfule (Hawai)	roosting	1/2-3/4 mil.	tractor-mounted ground sprayer	25	35-40% but questionable
Dec 78**	Hawaala Buray	breeding	6.8 million	aerial spray--ULV	60	1% adults & juveniles
Dec 78	Hawaala Buray	breeding	1 million	aerial spray--ULV	60	1% adults & juveniles
Dec 78	Uarmahan	breeding	56,000	aerial spray--ULV	60	1% adults & juveniles
Dec 78	Uarmahan	breeding	0.8 million	aerial spray--ULV	60	1% adults & juveniles

* Data were not available for any columns with vertical line.
** Based on Murshid (1978 field report) and Ash (1978).

Table 3. Additional verified roosts and nesting site localities of Quelea in Somalia. Data on colony size was unavailable.

Location	Date	Type colony	Size
Jowhar	Jul 72	nesting	250 ha (very dispersed)
Bur Acuba	Jul 72	2 nesting	1.2 ha & 0.5 ha
Harado	Jul 72	roost	-
Uen el Had	1972	roost	150,000 birds
Tug Wajale	Jul-Aug 71	roost	large
Jowhar	Aug-Nov 72	roost	in sugarcane
Afgoi*	annual	roosts	in citrus and Acacia
Jowhar	Dec 76/77	breeding/breeding	60 ha (?)--abandoned
Dugiuma	Jul 72	roost	-
Hargesia	Jun 72	roost	-
Cariole District	Oct 78	4 roosts	small--1.5 million birds

* Several regular roosts: Galawar, H. Abukar, Salah, Indole, Gilberti, Jabaluul, and Dhajalakh.

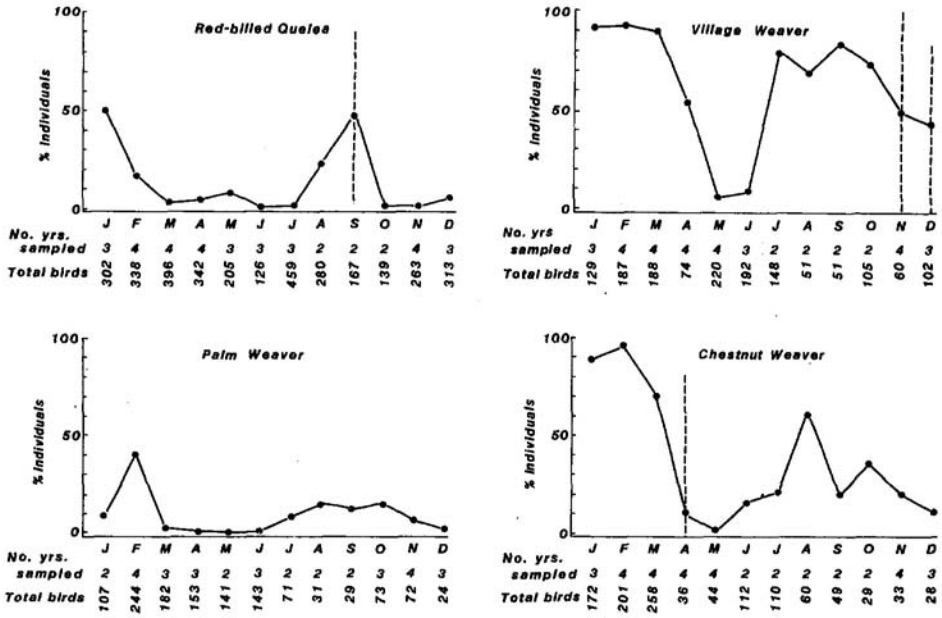

Fig. 2. Monthly feeding patterns (avg. % individuals having eaten cultivated cereals) of four ploceid pest species collected from roosts in Afgoi, Somalia between November 1975 and July 1979. Ranges are included for months in which extreme variation occurred. Cereal crops are vulnerable from December to February and from July to September.

Table 4. Summary of crop contents of ploceid weavers collected from roosts near Afgoi, Somalia, between 1975 and 1979.

Type of food items	Quelea quelea	Ploceus rubiginosus	Ploceus bojeri	Ploceus cucullatus	Ploceus intermedius
No. birds sampled (1975-1979)	3,282	1,098	1,085	1,484	1,464
% eating cultivated grain*	15	62	13	63	0.8
% with only sorghum	48	42	14	22	75
% with only maize	0	48	56	78	17
% with only rice	26	0	0	5	17
% eating wild seeds	84	50	83	36	71
% eating insects	5	3	20	7	41
% with mixed diet	5	8	14	7	8
Av. dry weight (g) of crop contents	0.41	0.49	0.28	0.50	0.16**

* The percent may exceed 100% since many birds ate more than one type of food item.
** Stomach contents.

The food habits of Village Weavers and Chestnut Weavers were similar to each other. More than 60% of each species ate cereals, of which 50-75% was maize. Both species ate cultivated grain through out the year and Village Weavers perhaps even preferred it to wild seeds, a feeling also shared by Erickson (1979) for Village Weavers in Ethiopia. Where these species occur in large numbers they can be serious pests for several reasons. First, their bills are larger (heavier and stouter) than those of Quelea and better adapted to tearing the tough husk protecting the ear of maize. Secondly, because maize is less susceptible than rice or sorghum to most bird pests, it is usually harvested after the others and is, therefore, available longer. Thirdly, Village Weavers in particular glean spilled grain from threshing and storage sites during April, May, and June when it is not available in the fields, Village Weavers also eat rice and a greater percentage of insects than Chestnut Weavers. Sunflower cultivation apparently was abandoned in 1973 in Afgoi just 2 or 3 years after its introduction on an experimental basis due to damage by these species. Both species eat wild seeds but are less dependent on them than are Quelea.

Golden Palm Weavers are the least important of the four major pest species to agriculture in Somalia. They are numerically less abundant, they are relatively scattered, and they usually feed in small, exclusive flocks, or sometimes in mixed flocks with other ploceid weavers. Only 13% of the 1,085 birds analyzed had eaten cereal crops, of which 56% had eaten maize. They are responsible for notable damage to the GU season crops. Their diet is more varied than that of the other weavers. Like Quelea, they rely more heavily on wild seeds, but 14% had eaten more than one type of food item; 20% also ate insects.

Masked Weavers are not pests to cereal crops, an observation in agreement with the findings of Erickson (1979). Only 0.8% of the 1,464 birds collected had eaten cultivated grains. Their diet was predominantly wild seeds and insects, which were found in 71% and 41% of the birds between April and July and again in November, respectively. Fruit was eaten occasionally.

Other Pest Species

No systematic observations have been made on any of the other species of birds which are reported to damage cereals or other agricultural crops in Somalia. Red Bishops are seen frequently in and around the ricefields at Afgoi and Mordinle and often cause more minor damage during the early milky maturation stages. At Mordinle in December 1978, 200-300 Bishops in mixed feeding flocks with Quelea, were responsible for some of the 70% loss in 72 ha. However, most Red Bishops mist-netted in the rice at the Afgoi Research Center in August 1979 had eaten wild seeds (Miskell pers. observ.; also noted by Erickson [1979]). Holcomb (unpubl.) occasionally found cultivated rice and sorghum in their crops, but also considers cereals to be a minor part of their diet. Fan-tailed Widow Birds (Coliuspasser axiliaris) are known to nest in ricefields (Holcomb 1977a) and occasionally eat grain as well.

In the north, Ruppell's Weaver is reputed to damage sorghum during August and September; I also have seen Chestnut Weavers attacking this crop in August near Gebiley. Somali Sparrows also reportedly damaged sorghum at Galcaio and Garowe (Allan, Barre pers. comm.), and have recently been recorded nesting in the south in Baidoa and Merca Districts (Ash and Murshid in prep.). Red-billed Buffalo Weavers (Bubalornis niger) have been seen in sorghum heads at Hawaala Buray, apparently eating grain (Ash pers. observ.). Additional information needs to be gathered on these three species to clarify their pest status. Unlike the situation in some other African countries (FAO 1976), neither starlings nor doves damage cereal crops with any regularity, although doves are suspected to occasionally attack sorghum near Hawai and Brava.

Some other species are known to attack fruits, with only minimal impact. Fischer's Starlings were responsible for 17% damage to tomatoes near Afgoi in September 1978. This is the first bird damage to tomatoes reported in this area but seems to be only a minor part of the problem; over 56% of the tomatoes also were damaged by insects and diseases (Bruggers 1978). Speckled Mousebirds (Colius striatus) also eat papaya in the Afgoi District. House Crows (Corvus splendens) (Allan pers. observ.) and White-crowned Starlings (Spreo albicapillus) (Ash pers. observ.) damage dates at Bulhar.

Damage to Agriculture

With a few exceptions (Barre 1974, Holcomb 1975-1977), most reports of damage to ripening crops in Somalia prior to 1979 are very generalized and, at the best, only guesses of the actual field losses (Table 5). Usually such values are inflated and are not representative of the true situation in a particular area, since the most heavily damaged fields attract attention while adjacent undamaged fields go unnoticed. Likewise, heavy losses from parts of fields which were harvested late due to mechanical problems often are reported as representing the entire field. It also is necessary to keep bird damage in perspective relative to losses due to insects, fungus, and weeds which are important pests in Somalia.

The extent and nature of damage depends on several factors, including the type of farm and crop, the bird species, their numbers, biological condition (breeding and age), their proximity to the crop, and the rainfall and subsequent availability of wild grass seeds. The paucity of reliable, objectively collected data on crop losses is not unique to Somalia (Jackson and Jackson 1977), and a systematic approach to the problem is overdue.

During the 1978 DER season, a network of randomly selected sampling locations on government and private farms was established in three of the main agricultural regions of Somalia, It is planned to visit these farms over several seasons to obtain more accurate estimates of actual crop losses to birds. Estimates during the first cropping season indicate that sorghum was the most severely damaged crop, but as characteristic of most Quelea situations (Crook and Ward 1968), the losses were localized (Table 6). Rainfed sorghum away from riverine and inundation areas were attacked much less (1-6%) than sorghum in wetter areas (2-100%) (Ash and Bruggers 1979). For example, losses were less than 1% to sorghum fields sampled in the Baidoa Region, the main sorghum region which reportedly cultivates about 71,000 ha annually (Anonymous 1979). In contrast, damage in the Afgoi, Wenle Weyn, and Balad Districts, where Quelea nesting colonies were located, averaged 31-75% loss. Many fields in these districts, including a 100-ha government scheme, were completely eaten.

Damage to rice and maize was considerably less than to sorghum. Rice, when harvested before mid-December as at LIBSOMA (Mordinle), escaped almost undamaged. Maize was much less damaged than sorghum. Losses in 21 fields totaling 92 ha in the three districts averaged 0-2% with a maximum of 3.2%. The contrast is even more pronounced by comparing losses to adjacent fields of sorghum and maize grown by the same farmers. Losses for five such paired fields in the Lower and Middle Shebelli Regions were 0 and 100%, 0 and 100%, 1.5 and 100%, 2.5 and 15%, and 5 and 75% for maize and sorghum, respectively.

Table 5. Summary of crop losses attributed to birds between October 1975 and February 1979 and obtained during discussions with farmers, regional Ministry of Agriculture Officers, and/or Directors of Government schemes or farms. This information should be treated with reserve since much of it was not verified.

Location	Type farm	Date	Crop	Area (ha)	% Loss	Bird Species
Mordinle*	govt	Oct 75	rice	36	0.2-37	Quelea, Euplectes
Jowhar	govt	Dec 75	rice	80	26	Quelea
Hawai	govt	Nov 76	rice	500	10	Quelea
Mordinle	govt	Sep 76	rice	300	6	Quelea
Jenale	govt	Sep 76	rice	300	18	Quelea
Jelib	govt	Sep 76	rice	200	31	Quelea
Galiley	govt	Aug 76	sorghum	500	9	Quelea, Euplectes
Tug Wajale	govt	Aug 76	sorghum	800	3	Quelea
Abu Rien	govt	Aug 76	sorghum	20	13	Quelea
Wanle Weyn	priv farm	Jul 76	sorghum	5,000	8	Quelea
Uarmahan	priv farm	Nov 76	sorghum	2,000	18	Quelea
Mordinle*	govt	Sep 76	rice	36	1-6	Quelea, Euplectes
Hawai	govt	Sep 77	rice	400	24	Quelea
Mordinle	govt	Sep 77	maize	2	8	P. cucullatus; P. bojeri
Belet Weyn	priv farm	Aug 77	sorghum	5,000	15	Quelea
Burao	priv farm	Aug 77	sorghum	2,000	6	Somali Sparrow
Goshen Der	priv farm	Aug 77	sorghum	20,000	1	Ploceus spp.
Dinsor	priv farm	Aug 77	sorghum	500	10	Ploceus spp.
Boale	cooperative	Mar 78	sorghum	500	70	Quelea
Kisimayu	govt	Jul 78	rice	90	50	Quelea
Afgoi	research	Jul 78	sorghum	1	35	Q., Ploceus spp.
Afgoi	research	Jul 78	sorghum	1	58	Q., Ploceus spp.
Belet Weyn	govt crash prog	Sep 78	sorghum	130	75	Quelea
Ionte*	govt	Oct 78	rice	3	78	Quelea
Sablale	govt crash prog	Sep 78	rice	130	5	Quelea
Kurtenwarey	govt crash prog	Sep 78	rice	45	40	Quelea
Jenale*	priv farm	Oct 78	maize	10	12	Q., Ploceus spp.
Kisimayu	govt	Feb 79	maize	10	5-10	P. cucullatus
Jamama	cooperative	Feb 79	maize	100	30-40	P. cucullatus

*Indicates sites where actual damage estimates were made.

Although the 600 mm minimum rainfall requirement for maize is unreliable and patchily distributed, these farmers indicated that they would switch to that crop during the 1979 GU season, which they did. Such crop changes should be encouraged in areas with a history of crop loss to birds and in which there is a reasonable chance of obtaining the minimum rainfall requirement and where Quelea are known to breed.

The damage pattern during the 1979 GU season was similar to that observed the preceding DER season (Table 6). Heavy damage (10-85% average; 100% in some fields) occurred in the Afgoi, Wenle Weyn Districts, little or no damage in the Baidoa Region. Again there was less damage to maize than sorghum, and heavy damage to rice. Much damage, attributable to Quelea, was noted along the Shebelli River toward Belet Weyn, a district not sampled the previous season. Damage was beginning in the north at Tug Wajale on sorghum in mid-August.

Some of the variability in annual damage levels may be due to climatological patterns. General trends during recent years suggest that damage during the GU season to cereal crops and sorghum in particular is less in years of high than low rainfall. According to farm managers, farmers in the Baidoa Region, and our own estimates during 1979, extensive losses and large numbers of birds in the area were last characteristic of the drought year of 1976, which presumably led to a shortage of wild grass seed. Little damage and relatively few birds have been reported during the subsequent wet years (Vander Poel 1978) when wild seed presumably was abundant. Both findings might explain the otherwise highly contrasting results of the Quelea crop content data collected during 1976 with those of the 1978 and 1979 GU seasons (Fig. 2) and are compatible with Ward's (1965) observations in Nigeria, that in the same area damage was heavier in years in which rainfall was poor.

Damage was greater on large government schemes than on the small 0.25- to 1-ha fields of individual farmers. This is mainly because a farmer has a vested interest in protecting his field and often does so more energetically and effectively than the guards working on government schemes. Larger schemes also have difficulty in obtaining a sufficient number of guards, since many are occupied protecting their own farms. The cost to government schemes of using bird scarers represents from 15 to 80% of the total production cost/ha (Table 7). Based on these systematic assessments, crop losses to birds certainly represent several million Somali shillings (Ash and Bruggers 1979), or a minimum of 1 million dollars U.S. This amount must be used with caution since figures for the areas under cultivation in each district are difficult to obtain and inconsistent, and it is uncertain whether the area sampled is representative of the district. The importance and necessity of effective scouting and control units to locate and deal with Quelea is readily clear.

Table 6. Summary of crop losses to birds during 1978-1979 'DER' and 1979 'GU' seasons--samples from some of the principal agricultural regions of Somalia.

Location & Crop	No. Sampled: Fields DER	Fields GU	ha DER	ha GU	Panicle DER	Panicle GU	% Panicles With Some Damage DER	% Panicles With Some Damage GU	Average % Loss in Field DER	Average % Loss in Field GU	Type of Field
LOWER SHABELE REGION											
Merka District											
Maize	6	7	30	12	1245	340	7	2.5	<1(0.3-3.2)	<1(0-1)	priv farms
Sorghum	4	1	20	2	1435	200	<1	5	3(0.0-5.0)	2	priv farms, crash prog
Rice	2	-	402	-	600	-	0	-	0(0.0-1.0)	-	crash prog
Afgoi District											
Maize	9	4	34	5	1340	210	7	20	1(0.8-2.5)	2(<1-3)	priv farms, Res ctr, govt scheme
Sorghum	3	1	8	1	390	100	77	100	59(15-100)	99	priv farms, Res ctr, govt scheme
Rice	1	2	36	38	1000	600	8	41	7(7)	20(15-100)	govt scheme and research
Wanle Weyn District											
Maize	2	-	2	-	45	-	0	-	0	-	priv farms
Sorghum	14	6	122	15	4459	440	32	82	31(1.2-100)	53(10-100)*	priv farms, govt scheme
MIDDLE SHABELE REGION											
Balad District											
Maize	2	-	10	-	410	-	5	-	<1(0.7-0.8)	-	priv farms
Sorghum	4	1	75	12	3150	100	88	59	75(22-100)	13	priv farms
Jowhar District											
Maize	2	1	16	2.5	695	180	19	0	2(0.6-3.0)	0	priv farms, crash prog
Rice	1	-	4	-	300	-	65	-	33(33)	-	crash prog
Sorghum	-	3	-	5.5	-	1000	-	100	-	100(100)	priv farms
BAYDOA REGION											
Bur Hakaba District											
Sorghum	2	6	8	23	1415	850	2	21	<1(0.1-0.3)	3(0.3-8)	priv farms
Dinsor District											
Sorghum	2	13	12	34	730	1500	1	35	<1(0.0-0.4)	6(0-12)	priv farms
Baydawa District											
Sorghum	10	7	73	32	6310	950	3	14	<1(0.0-1.9)	1(1-3)	priv farms, Res ctr, govt scheme
HIRAN REGION											
Bulla Burti District											
Sorghum	-	8	-	23	-	3800	-	11	-	2(<1-4)	priv farms
Beled Weyne District											
Sorghum	-	2	-	26	-	750	-	73	-	68(5-99)	priv farms
Maize	-	3	-	4.5	-	370	-	<1	-	<1(0)	priv farms
Jalalagsi District											
Sorghum	-	1	-	5	-	1000	-	18	-	1.3	priv farms
BAKOOL REGION											
Tayeegla District											
Sorghum	-	3	-	14	-	1750	-	<1	-	<1(0.03-0.14)	priv farms

*Most farmers in district lost 75% to 100% before harvesting early.

Bird Control and Crop Protection Efforts

In the past, the work of the Bird Control Unit of the Plant Protection Service has principally been oriented towards determining the distribution of Quelea in Somalia and researching its biology and population dynamics. Research on the pest status of other Ploceid species also has been conducted; only minor emphasis was placed on bird control operations.

The initial attempts to control Quelea were carried out by the military. During 1971 they attempted to destroy a breeding and a roosting colony using explosives, but with relatively little success. Allan's (1973) observation at both sites confirmed the relative ineffectiveness of pure explosives when used alone in Quelea control. Holcomb and Murshid (1976a) later developed a ground spraying unit for spraying the avicide Queletox in Quelea roosts or colonies, but between 1973 and 1976 only six actual indirect control efforts were conducted (Table 2). Four colonies and one roost were treated in 1978 (Ash 1978). The percent success in most control efforts has been relatively small, and the actual impact of the control operation on reducing damage (when it has been monitored), such as during the 1978 spray operations (which probably are the most reliable data of all operations), has been negligible. For example, damage to sorghum fields near two of the colonies at Balad and Uarmahan was 8% and 29%, respectively, prior to the spray operation and 22% and 98% after. The kill during these 1978 operations was <1% due to improper spraying procedures.

Table 7. Production and crop protection costs from government schemes obtained during discussion with government personnel during a 2-14 October 1978 survey trip to southern Somalia (reproduced from Ash and Bruggers 1978). Present sale values of rice and maize are 150-160 and 75 So. Shs/Quintal (100 kg), respectively--6.23 So. Shs. = US $1.00. Figures should be regarded as indicators, not precise amounts.

Scheme/source of information	Avg. yield (range) Crop	(Quintal/ha)	Cost/ha (So. Shs.) Production*	Protection	Protection/ha % Prod. cost	No. days	No. guards	Salary per guard (So Sh/day)
Fanole-Jelib Scheme,	rice	20(15-30)	5,500-6,000	4,500	80	35-40	16	7
Dr. Huessin Bessei, General Manager	maize	15(10-20)	3,000	2,000	65	30-35	16	7
Ionte Scheme,	rice	15(5-25)	4,000	675	17	45	3-4	5
Mr. Mulidi, Research Station Manager								
LIBSOMA-Mordinle Scheme,	rice	15(10-35)	2,500	1,080	43**	45	2-4	8
Mr. Mohamed Burale, General Manager								

* Includes protection costs.
** Average costs more likely closer to 15% for this scheme based on figures from the Libsoma Annual Internal Report, Spring 1976-1977 and a budget report for 1978-1977 and a budget report for 1978-1979, 13 pp.

Because of the inaccessibility of much of the Somali terrain, particularly under wet season conditions, ground spraying equipment has limited application. If control operations are deemed necessary, that is, colonies are within striking distance of vulnerable crops, it is important to develop an efficient aerial spray program with highly trained personnel. Since no agricultural spray pilots with appropriately fitted aircraft presently operate in Somalia, one immediate solution to the aircraft problem is through external hiring of a spray operator. Because of the complexity of this problem, a detailed discussion of the requirements of organizing a scouting and control unit for Somalia are outside the realm of this paper.

Other methods of protecting ripening crops have been evaluated on a limited scale in Somalia. They are still in the experimental stage, are giving variable results, and cannot yet be recommended for general use. Direct crop protection research against Quelea in Somalia was first undertaken by Marvin (1969) during 1969-1970. He tested baiting techniques for Avitrol (4-aminopyridine), the use of aluminum strips as frightening objects, the repellency of dense clouds of smoke, and two chemicals, anthraquinone and thiram, as repellents, on grain crops. The results were somewhat disheartening. In the Avitrol trials he concluded that Quelea will sometimes (but not regularly) accept sorghum treated with 0.83%, 0.1%, and 0.2% Avitrol from platform feeders and the ground. The concentrations of 0.1% and 0.2% killed Quelea. Although the dying birds did exhibit some of the typical distress symptoms, they did not frighten other birds from the field. Field tests with the 0.83% formulation were inconclusive. Holcomb (in letter) also had unsatisfactory results with Avitrol--principally due to an inability to attract Quelea to a bait.

A network of 60x30-cm strips of aluminum spaced throughout 0.5 ha of rice also was ineffective (Marvin 1969). Within 24 h the strips had been torn by the 10- to 15-km/h winds, and after 3 days birds fed alongside the aluminum fragments. Also, Quelea were not affected by smoke produced by burning rubber tires. They flew through the smoke and fed on the sorghum beneath it. Finally, 12 kg/ha of anthraquinone and 8.5 kg/ha of thiram also were ineffective as repellents on small plots of ripening rice.

Holcomb (1976b) obtained limited positive results with the Av-Alarm, a noise-making device which is designed to irritate or cause anxiety in birds and result in their leaving the area. In his tests during 1975 and 1976, bird damage (principally due to Quelea) to ripening rice increased linearly with distance from the speakers up to 250 m, but was only 2-5%. He also was unsuccessful in using methiocarb as a repellent on a small plot of isolated ripening millet (Holcomb 1977b). While minor differences in damage between the treated and untreated plots existed, the overall losses in both fields were more than 60%.

During 1979, crop protection trials evaluating a chemical repellent, two kinds of plastic netting as barriers to birds over a crop, and the frightening effect (if any) on Quelea of colored cloth sacks placed over ripening heads of sorghum were conducted with farmers near Uarmahan and research agronomists at Afgoi (Bruggers 1979b).

Two applications of methiocarb at 1 kg/ha to the edges and middle of a 0.5-ha plot (3 kg a.i. in the treated area) of ripening rice at Afgoi repelled small feeding flocks of Village Weavers and Fan-tailed Widow Birds. However, the chemical did not affect several thousand Quelea that began feeding in the rice as it matured; no differences in yields were detected between the treated and adjacent untreated plot. At the LIBSOMA scheme in Mordinle, 3 ha of rice which had been treated twice in a fashion similar to that at Afgoi, had only 5% loss despite the presence of a Quelea nesting colony within 300 m. In contrast, 2 months earlier, 98% of 36 ha of untreated rice on the same farm was eaten by Quelea (Bruggers

et al. in prep). The method deserves additional evaluation because of its generally positive results worldwide (Guarino 1972, Crase and DeHaven 1976) and in West Africa (Bruggers in press [b]) and its recent success on sorghum in Ethiopia and on large wheat farms in Tanzania (Bruggers et al. in prep.).

The applicability of Xiro and Conwed plastic netting to protect 0.05 ha and 0.15 ha of ripening rice was compared. Both completely inhibited bird passage to the crop. Xiro net was light and easy to install but also easily torn by the continuous 8- to 10-km/h winds (12- to 15-km/h gusts). Conwed net was more durable, did not tear, but was heavier and required a more extensive support structure. The support structures for both nets occasionally blew over, and the guide wires sometimes snapped. Other brands of light, durable, UV stabilized nets with a mesh of 2.0-2.5 cm^2 should be evaluated; with appropriate support structure modifications, they could be used over larger areas.

Over 5,000 brightly colored cloth bags were placed over sorghum heads in the fields of seven farmers to determine their usefulness in protecting sorghum as well as to see their frightening effect on Quelea. No bird damage occurred to the covered heads, but insect and mold damage was prevalent, averaging from 2 to 37%. This was due to continuous rains during the 2-week trial period and the humid microclimate in the bags which exaggerated the normal insect damage. Since the rest of the fields lost 10-86% to birds, and it is one way a farmer can do something himself to protect his crop, variations in the method should be pursued. As in West Africa, grasses or leaves could be used; larger cloth bags, perhaps of gauze material, could be tried. In any case, colors alone will not deter Quelea from the crop.

CONCLUSIONS

Many data have been obtained on the identification, distribution, and impact of the principal pest bird species on agriculture in Somalia. Based on this available information (which is limited by inaccessible terrain and a lack of aerial survey facilities), it appears that pest birds in general and Quelea in particular are a serious threat to agricultural production in some areas more than others. Extensive losses tend to be restricted to particular districts such as Balad, Johwar, Afgoi, and Kismayo, the traditional nesting range of Quelea. Other areas, most notably the principal rainfed sorghum districts of the Baidoa Region, receive only minor losses to birds in most years.

However, birds may be a constraint on the future development of agriculture (particularly rice), since it centers along the Shebelli and Juba Rivers, areas which include the range of all the main bird pest species in Somalia. Consideration should be given to potential bird problems when planning agricultural schemes in these areas. Our present knowledge on the location and impact of Quelea in the main affected area seems sufficient to provide an excellent opportunity to evaluate a control strategy based on the destruction of colonies or roosts in or known to affect these vulnerable cropping areas. Cropping pattern changes may also alleviate somewhat the problem. Since very little is known of the situation in the more southern Juba River Region, where other large roosts or nesting colonies likely are present, and it is one of increasing agriculture development, the situation in that area merits immediate attention.

The direct crop protection methods tested to date have been employed on a limited scale, have given variable results, and cannot yet be recommended for widespread use. Plastic netting, when correctly mounted, is applicable to high-value research or seed-multiplication crops. Likewise, the chemicals methiocarb and Curb should continue to be evaluated as bird repellents, since they have given positive results in numerous situations worldwide.

In conclusion, the whole area of managing bird pests is in its infancy in Somalia. However, the necessary framework is being developed upon which a crop protection strategy, integrating methods of indirect and direct control, can be implemented.

ACKNOWLEDGMENTS

The report was written while I was employed during 1978/1979 in Somalia in the UNDP/FAO Regional Project RAF 77/042--Coordination of Cooperative Action to Reduce Bird Damage to Crops in Eastern Africa. Copies of my unpublished trips, monthly, and progress reports are on file with UNDP Mogadiscio, and Project Headquarters, c/o UNDP, Nairobi, Kenya.

I am most grateful to Mohamed Hassan Barre and Ali A. Murshid, former and present heads, respectively, of the Bird Control Unit in Somalia. Without their assistance, suggestions, and general encouragement, such a report would have been impossible. I also wish to acknowledge the assistance of colleagues J.S. Ash and J.E. Miskell for help in various aspects of the research during 1978 and 1979. The manuscript was reviewed by R.G. Allan and L. Holcomb, former FAO Ornithologists in Somalia, and J.S. Ash, present FAO Plant Protection Officer with the Unit. Their constructive comments as well as those of W.B. Jackson and P. Ward were very useful and greatly appreciated.

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