SEXUAL SEGREGATION OF RED-BILLED QUELEAS (*QUELEA QUELEA*) IN THE AWASH RIVER BASIN OF ETHIOPIA

M. M. JAEGER, W. A. ERICKSON, AND M. E. JAEGER
Food and Agriculture Organization of the United Nations, P.O. Box 5580, Addis Ababa, Ethiopia

ABSTRACT.—Evidence is presented supporting a seasonal segregation by sex and age of the Red-billed Quelea (*Quelea quelea*) in and associated with the Awash River Basin of Ethiopia. Sexual segregation is most pronounced in the late dry season/early rains period (March–June), which precedes breeding (July–September). At this time the males appear to be more concentrated in the middle Awash Valley, in the general area where breeding will occur, while the females remain more dispersed. A balanced sex ratio is found from July to September. Following breeding there is a general dispersal with many queleas moving out to the cereal growing areas that border the Awash Valley. This process of dispersal results in a separation of adults from juveniles and, to a lesser degree, males from females. *Received 3 October 1978, accepted 15 February 1979.*

A DRAMATIC seasonal imbalance has been reported in the sex ratio of the Red-billed Quelea (*Quelea quelea*) from the Lake Chad Basin (Ward 1965b). This is most pronounced in the late dry season and early rains period, when grass seeds are in relatively short supply. Intraspecific competition for food favoring the larger males is believed to be the most important contributing factor to such an imbalance (Lack 1954, Ward 1965a, Yom-Tov and Ollason 1976). With this explanation, however, it is difficult to account for the return to balance in the sex ratio of adult queleas during and immediately following breeding (Morel and Bourlière 1956; Ward 1965b, 1972). The greater dispersal of females, leading to partial segregation of the sexes, has received scant attention as an explanation for an uneven sex ratio. Evidence for differential dispersal can be difficult to obtain, requiring sampling over an area of sufficient size and over a sufficient time span.

Samples of queleas collected from widely scattered sites in the Awash River Basin of Ethiopia from 1976 through 1978 indicate a seasonal segregation of the sexes. This paper describes this segregation in relation to the ecologic zones (FAO 1965) associated with the Awash Basin.

STUDY AREA AND METHODS

The samples considered here are principally from the Awash River Basin, but also included are records from the adjoining Jijiga Plain to the east and Lake Zwai to the southwest. These, together with the remainder of the Afar Triangle north of the Awash Basin and the Hargeshia highland of northern Somalia, form what now appears to be the usual seasonal range of a semi-autonomous population of *Quelea quelea aethiopica* (Sundevall) (Fig. 1).

In Ethiopia queleas are rarely found above an elevation of 1,800 m (Urban and Brown 1971); therefore, their range is likely restricted by the highland plateaus, ranging to 3,000 m and above, which form two sides of the Afar Triangle. The extent to which the birds move into and out of this area is unknown; we do not believe, however, that queleas make mass, seasonal movements out of the basin as have been described for some other areas in Africa (Ward 1971). We have found them to be present in the basin throughout the year, although their distribution and relative numbers do change. This presence is possibly due to an altitudinal rather than a latitudinal gradient in the seasonal production of the grass seeds upon which the queleas feed. The relatively complex and variable rainfall pattern associated with the Rift Valley effects a staggered germination and maturation of natural grasses, providing an apparently constant supply of seeds from either the short-grass savanna at lower elevations or fallow areas and areas with maturing cereal crops at intermediate elevations.

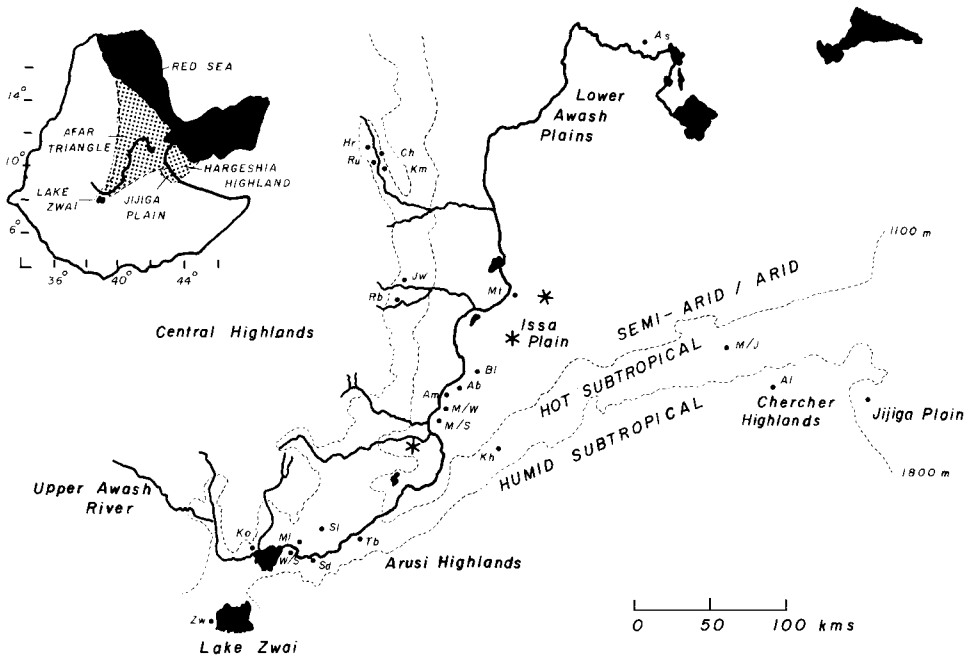

Fig. 1. Sampling sites for Red-billed Queleas (*Quelea quelea*) in and associated with the Awash River Basin of Ethiopia: Alemaya (Al), Amibara (Am), Ambash (Ab), Asayita (As), Belain (Bl), Chefa (Ch), Harbu (Hr), Jawa (Jw), Kemisse (Km), Khora (Kh), Lake Koka (Ko), Malkassa (Ml), Melka Jebdu (M/J), Melka Sede (M/S), Melka Werer (M/W), Metaka (Mt), Robi (Rb), Roofusay (Ru), Saluki (Sl), Sodere (Sd), Tabila (Tb), Wonji/Shoa (W/S), Lake Zwai (Zw). (Asterisks indicate breeding sites located during 1978 season.)

The quelea samples considered here were collected from the hot subtropical and semi-arid/arid zones associated with the Awash River Basin (FAO 1965). These ecological zones (Fig. 1) will be used in accounting for the spatial pattern of the segregation of queleas for this area.

The hot subtropical zone is from 1,100 to 1,800 m in elevation and includes the upper Awash Basin and piedmont areas to the north and east. Annual rainfall varies depending on location, ranging from 800 to 1,800 mm; it occurs seasonally from March to September, being most intense in the months of July, August, and September. The agriculture of cereals is important throughout this zone, and depredation by queleas is a major problem, particularly for sorghum (*Sorghum vulgare*) and tef (*Eragrostis tef*) (Jaeger 1978). Cultivated cereals were found to make up 40% of the yearly diet of queleas in the upper Awash Valley during 1977–78 (Erickson MS). Wild grass seeds prominent in the yearly diet included *Sorghum* spp., *Echinochloa* spp., and *Urochloa* spp.

The semi-arid/arid zone lies below 1,100 m in elevation and is adjacent to the hot subtropical zone; it covers the middle Awash Valley and lower plains. The annual rainfall varies from 150 to 600 mm, with rain showers occurring mainly during July and August. Large tracts of short-grass savanna are associated with the flood plains and higher terraces of this area (FAO 1965). Grasses, the seeds of which are commonly eaten by queleas, include: *Echinochloa* spp., *Panicum meyerianum, Tetrapogan* spp., and *Urochloa* spp. (Erickson MS). It is in this zone that the queleas breed during August and September (Jaeger unpubl. obs.). Found here also are extensive areas of thorn bush (*Acacia mellifera*) used by the queleas for nesting sites.

Queleas were collected within both zones between April 1976 and November 1978 as part of a general control program on this cereal grain pest. In some cases the samples represent the total catch at one site over a period of days (i.e. captures from dispersed feeding flocks); in other cases large numbers of birds were captured in a very short time from large flocks returning to a night roost. These are distinguishable from the date(s) of capture provided in Tables 1 and 2, which indicates the period of time over which a sample was collected. Nylon fowling nets (3.2-cm mesh, 12 × 2 m, with four shelves) were the usual

TABLE 1. Seasonal sex ratio and age of *Quelea quelea* samples from the hot subtropical zone associated with the Awash River Basin of Ethiopia.

Locality	Dates	Relative abundance	Number			Sex ratio ♂♂/♀♀		
			Adults	Juveniles	Total	Adults	Juveniles	Total
Jijiga	21 Aug. '76	10^{5-6}	3	89	92	0/3	51/38	51/41
Lake Koka	9, 10 Sept. '76	10^{2}	15	0	15	2/13[a]	—	2/13[a]
Jijiga	24 Sept. '76	10^{5-6}	0	97	97	—	57/40	57/40
Jijiga	2 Oct. '76	10^{5-6}	0	111	111	—	66/45[a]	66/45[a]
Malkassa	17 Oct. '76	10^{4}	107	63	170	93/14[a]	44/19[a]	137/33[a]
Khora	21 Oct. '76	10^{4}	0	95	95	—	48/47	48/47
Jawa	2 Nov. '76	10^{4-5}	44	33	77	29/15[a]	13/20	42/35
Lake Koka	14 Nov. '76	10^{2}	42	20	62	30/12[a]	17/3[a]	47/15[a]
Kemisse[b]	21 Nov. '76	10^{4}	80	19	99	50/30[a]	15/4[a]	65/34[a]
Robi	27 Nov. '76	10^{4-5}	2	100	102	1/1	33/67[a]	34/68[a]
Chefa[b]	29, 30 Nov. '76	10^{4}	78	20	98	40/38	12/8	52/46
Chefa	29 Nov. '76	10^{4}	84	16	100	42/42	7/9	49/51
Chefa	30 Nov. '76	10^{4}	80	18	98	30/50[a]	6/12	36/62[a]
Saluki	5–9 May '77	10^{2-3}	122	18	140	29/93[a]	8/10	37/103[a]
Sodere	10–14 May '77	10^{3}	94	39	133	28/66[a]	22/17	50/83[a]
Wonji/Shoa	15–20 May '77	10^{3}	115	41	156	28/87[a]	22/19	50/106[a]
Saluki	1–6 July '77	10^{3}	84	15	99	44/40	12/3[a]	56/43
Sodere	7–12 July '77	10^{3}	—	—	449	—	—	208/241
Tabila	13–18 July '77	10^{3}	—	—	178	—	—	101/77
Saluki	8–13 Sept. '77	10^{2-3}	63	21	84	33/30	13/8	46/38
Tabila	14–20 Sept. '77	10^{4}	~96%	~4%	510	—	—	248/262
Malkassa	19–22 Oct. '77	10^{4}	18	229	247	15/3[a]	114/115	129/118
Chefa	30, 31 Oct. '77	10^{5}	146	54	200	95/51[a]	37/17[a]	132/68[a]
Sodere	5–8 Nov. '77	10^{3}	40	556	596	21/19	—	—
Harbu	6 Nov. '77	10^{5}	41	8	49	21/20	5/3	26/23
Chefa[b]	9 Nov. '77	10^{5}	98	25	123	59/39[a]	18/7[a]	77/46[a]
Saluki	9–12 Nov. '77	10^{2-3}	1	110	111	1/0	—	—
Malkassa	13–15 Nov. '77	10^{4}	98	35	133	64/34[a]	10/25[a]	74/59
Robi	17–19 Nov. '77	10^{5}	103	97	200	24/79[a]	42/55	66/134[a]
Lake Zwai	19 Dec. '77	10^{5}	181	19	200	—	—	99/100
Saluki	12–16 Jan. '78	10^{2}	—	—	68	—	—	26/42[a]
Malkassa	16–19 Jan. '78	10^{3}	195[c]	26	221	—	—	166/55[a]
Lake Koka	20–23 Jan. '78	10^{2-3}	128[c]	14	142	—	—	34/108[a]
Saluki	13–17 Mar. '78	10^{4}	169	32	201	—	—	111/90
Sodere	17–20 Mar. '78	10^{3-4}	91	86	177	—	—	65/112[a]
Lake Koka	21–24 Mar. '78	transient[d]	41	5	46	—	—	9/37[a]
Chefa	23 Mar. '78	10^{3}	34	66	100	21/13	35/31	56/44
Wonji/Shoa	14, 15 Aug. '78	unknown	~97%	~3%	127	—	—	65/62
Malkassa	3, 4 Sept. '78	10^{4}	120	15	135	75/45[a]	10/5	85/50[a]
Melka Jebdu	10 Oct. '78	10^{4}	60	55	115	27/33	35/20[a]	62/53
Alemaya	14 Oct. '78	10^{4}	73	89	162	36/37	45/44	81/81
Malkassa	2 Nov. '78	10^{4}	91	30	121	66/25[a]	18/12	84/37[a]
Chefa	4 Nov. '78	10^{4}	4	72	76	3/1	35/37	38/38
Roofusay	6 Nov. '78	10^{4}	14	0	14	0/14[a]	0/0	0/14[a]
Harbu	5, 7 Nov. '78	10^{4}	24	32	56	6/18[a]	14/18	20/36[a]
TOTALS			3,396	2,470	6,585	1,013/965	864/739	2,987/2,890

[a] Chi-square significance at the 0.05 level.
[b] Sample of dead birds taken following a spraying operation.
[c] Number includes birds with cranial pneumatization scores of 3.
[d] Transient group not present throughout the collecting period.

means of collection, although some samples were taken from kills following aerial spraying of roost sites with fenthion.

Sex determination was by dissection or by the presence of male breeding plumage. When circumstances permitted, birds were further dissected for a rough determination of age to distinguish juveniles from adults. This was done by the combined use of the 0–4 cranial pneumatization index suggested by Ward (1973) and the presence of bill color and plumage condition characteristic of juvenile queleas. Birds with completed pneumatization (i.e. an index of 4) are considered to be adults, while all others are treated as juveniles (Ward pers. comm.). Furthermore, a subjective estimate was made of the relative numbers of

TABLE 2. Seasonal sex ratio and age of *Quelea quelea* samples from the semi-arid/arid zone associated with the Awash River Basin of Ethiopia.

Locality	Dates	Relative abundance	Number			Sex ratio ♂♂/♀♀		
			Adults	Juveniles	Total	Adults	Juveniles	Total
Asayita	6, 7 Apr. '76	10^5	53	30	83	7/46[a]	14/16	21/62[a]
Amibara	16 May '76	10^5	33	67	100	22/11	58/9[a]	80/20[a]
Ambash	24–26 June '76	10^5	63	64	127	35/28	48/16[a]	83/44[a]
Ambash	27 June '76	10^5	—	—	142	—	—	88/54[a]
Metaka	1, 2 Aug. '76	10^3	24	10	34	17/7[a]	5/5	22/12
Melka Werer	3–6 Aug. '76	10^4	109	11	120	60/49	7/4	67/53
Melka Werer	22–26 Dec. '76	10^4	84	66	150	45/39	37/29	82/68
Metaka	10, 11 Feb. '77	10^5	75	16	91	50/25[a]	12/4[a]	62/29[a]
Metaka	28 Feb. '77	10^5	84	15	99	55/29[a]	12/3[a]	67/32[a]
Metaka	2 Mar. '77	10^5	130	20	150	85/45[a]	14/6	99/51[a]
Amibara	9, 10 June '77	10^4	122	28	150	83/39[a]	21/7[a]	104/46[a]
Amibara	11–13 June '77	10^4	—	—	247	—	—	177/70[a]
Melka Sede	16–19 June '77	10^4	496	0	496	269/227	—	269/227
Belain	12, 14, 20 Aug. '77	10^{3-4}	213	0	213	97/116	—	97/116
Melka Sede	10, 13 Oct. '77	transient[b]	15	1,104	1,119	—	—	—
Ambash	22–25 Dec. '77	10^3	—	—	221	—	—	166/55[a]
Ambash	12–14 Feb. '78	10^4	—	—	142	—	—	93/49[a]
Melka Sede	15–18 Feb. '78	10^2	—	—	311	—	—	207/104[a]
Asayita	10–13 Apr. '78	10^3	225	61	286	—	—	192/94[a]
Melka Sede	16–22 Apr. '78	10^3	232	57	289	108/124	37/20[a]	145/144
Metaka	17 Aug. '78	10^{5-6}	85	6	91	46/39	1/5	47/44
Issa Plain[c]	22 Sept. '78	10^6	154	0	154	67/87	—	67/87
Melka Sede	18 Oct. '78	10^5	0	33	33	—	—	—
TOTALS			2,197	1,588	4,848	1,046/911	266/124	2,235/1,461

[a] Chi-square significance at the 0.05 level.
[b] Transient group not present throughout the collecting period.
[c] Breeding colony.

queleas present in any particular area. This is presented in Tables 1 and 2 by order of magnitude: x^2 = hundreds of birds, x^3 = thousands, x^4 = tens of thousands, x^5 = hundreds of thousands, and x^6 = millions.

RESULTS

The sex ratio and age composition of samples totaling 11,433 queleas collected at 25 sites from April 1976 to November 1978 are presented by zone in Tables 1 and 2. These data point to the seasonal tendency for grouping by sex both within and between sampling sites. Table 3 gives the combined sex ratio in each zone for the months corresponding to (1) maximum grass (Graminae) seed production and breeding (July–September), (2) minimum seed availability at the end of the dry season and during the early rains (March–June), and (3) the intervening dry season (October–February). This shows the seasonal nature of this segregation; it is most pronounced in the late dry season–early rains period. Evident, too, is the spatial pattern of segregation in the Awash River Basin whereby the males appear (first) to concentrate in the general area of the middle Awash Valley for breeding (semi-arid/arid zone), while females remain more dispersed at this time in the outlying areas (hot subtropical zone).

Samples that were significantly one sex or the other were commonly found in the hot subtropical zone during the dry season and into the early rains (October–June): 20 of 33 samples had significantly uneven sex ratios (Table 1). Female versus male samples occurred 12 and 8 times, respectively. The most noteworthy female samples were those from sites along the upper Awash River during May 1977 (Saluki, Sodere,

TABLE 3. Seasonal comparison of the sex ratio of *Quelea quelea* in the hot subtropical vs. the semi-arid/arid zones of the Awash River Basin.

Zone	Seasonal sex ratio[a]			
	March–June (Late dry season–early rains)	July–September (Rains)	October–February (Dry season)	Totals
Hot subtropical	40% (953)	51% (1,786)	54% (3,138)	51% (5,877)
Semi-arid/arid	61% (2,070)	49% (612)	67% (1,014)	60% (3,696)
TOTALS	54% (3,023)	51% (2,398)	57% (4,152)	55% (9,573)
Status	Segregation	Regrouping/breeding	Dispersal	

[a] Percent male, N in parentheses.

and Wonji/Shoa) and during January and March 1978 (Saluki, Lake Koka, and Sodere), and from Robi in November of both 1976 and 1977 (Table 1). The significantly male samples were found only in the dry season (October–February), whereas the significantly female samples were found throughout the dry season and early rains period (October–June). This apparent departure of males from the hot subtropical zone is reflected in the sex ratio; 46% of the 3,138 queleas sampled from October through February were female, while 60% of 953 were female in the March through June period (Table 3).

Predominantly male samples were the rule in the semi-arid/arid zone throughout the dry season and early rains. Of the 16 samples collected during this time, 12 were significantly male, 3 were even, and 1 was significantly female (Table 2). The overall numbers of queleas present in this zone, however, appeared to change seasonally. During the early dry season (October–December), relatively few were observed, the exception being Melka Sede in October 1978, where many juveniles remained following the occurrence of breeding somewhere in the general area. After this period, very large numbers of queleas were observed; the largest roosts were found at Asayita in April 1976, at Ambash in May and June 1976, and at Metaka in February and March 1977 (Table 2).

The lone female sample collected in the semi-arid/arid zone was from Asayita in April 1976 (Table 2). Here, however, we were not able to net any queleas from the main body of birds as they entered or departed their night roost in thick acacia. The entire sample was from those relatively few birds remaining in the general area during the day. Small feeding flocks that are predominantly female have been encountered in both zones (Jaeger pers. obs.), for instance at Lake Koka in September 1976 and at Roofusay in November 1978 (Table 1). A significantly female feeding flock was also found at Chefa in November 1977 (Table 1) in an area where and at a time when two other samples were of equal sex ratio and a third was significantly male.

The sex ratios of adults taken from both zones in July, August, and September were nearly even, although slightly in favor of males (51%) (Table 3). At this time the queleas were congregating along the middle Awash River, where breeding occurs from late August to early October. [The presence of large numbers of juveniles at Jijiga in August 1976 (Table 1) suggests that breeding may also occur in this general area as early as July.]

A separation of adults from their young occurs following breeding, presumably

due to the latter remaining for a longer time in the general area of the breeding colony. Samples that were almost exclusively comprised of young juveniles with cranial pneumatization indices of 0–1 were found in both zones in all 3 yr: in the hot subtropical zone (Table 1) at Jijiga (August 1976), Khora and Robi (November 1976), Malkassa (October 1977), Sodere and Saluki (November 1977), and Chefa (November 1978); and in the semi-arid/arid zone (Table 2) at Melka Sede (October 1977 and 1978).

Although the sex ratios of the juvenile samples were most often even, there is a suggestion that juveniles also segregate by sex. The Jijiga samples, for instance, showed a progressively greater percentage of males with time (Table 1), and in a situation where the cultivated sorghum on which they were feeding was extremely abundant. Possibly the juvenile females begin to disperse before the males. This might also explain the occurrence of juvenile females at Robi in November 1977 (Table 1). The adults at this time were farther up the valley system at Chefa and Kemisse (Fig. 1). The juvenile females were perhaps following after them from breeding sites along the middle Awash River. Predominantly male samples of older juveniles with cranial pneumatization indices of 2 and 3 were found at Amibara in May 1976 and at nearby Ambash that June (Table 2).

Discussion

The seasonal segregation of queleas by sex, if indeed a social characteristic of this species, presents intriguing questions as to the way in which this separation is brought about and its effect on local population dynamics. In terms of intraspecific competition for food, such segregation offers an alternative explanation for a seasonal imbalance in sex ratio appearing to favor males to that of differential mortality related to size (Mayr 1939, Ward 1965b, Yom-Tov and Ollason 1976). The data presented here suggest that the factors, both social and ecological, affecting the seasonal distribution of queleas warrant further investigation.

Some supportive information does exist for this seasonal segregation by sex. Recently Elliott (1978) reported catches of both queleas and *Ploceus capensis* (the Cape Weaver) that were significantly in favor of one sex or the other. Sexual segregation is widely acknowledged during bird migrations (Mayr 1939, Lack 1954), and it likely occurs for queleas (Elliott 1978), implying that females separate from males prior to the "early-rains migration" (Ward 1971), that is, during the late dry season. In addition, male flocks and roosts associated with nesting colonies have been observed for queleas in the Sudan (Allan and Jackson 1974). This, together with gradual dispersal observed from colonies following breeding (Allan and Jackson 1973), suggests that dispersal might occur in stages by age and possibly by sex.

We are suggesting, therefore, that the appearance of a seemingly higher percentage of late dry season males is the result of differential dispersal whereby the males are found in larger, more conspicuous roosts and in the general area of former breeding sites. Herman (1938) offered this as one possible explanation for similar observations on the preponderance of male Red-winged Blackbirds (*Agelaius phoeniceus*) returning to a station in Massachusetts where they were banded as nestlings. Nice (1937) suggested that for Song Sparrows (*Melospiza melodia*) "females do not return as faithfully to the place of their birth as the males and that their late arrival in the spring might often make it impossible to do so" (from Herman 1938). The data presented here for late dry season samples from along the middle Awash River,

where breeding occurs, parallel those of Ward (1965b), with a high percentage of males. But here, prior to breeding, the sex ratio becomes even. Ward (1972) suggests that the sex ratio at this time may appear to even itself out due to a number of males detaching to begin nest construction. This explanation does not seem to fit the situation here: first, the general tendency appears to be one of aggregation with increasingly large numbers of queleas, and second, the sex ratios from widely scattered sites in July, August, and September are nearly even.

That juveniles separate at the breeding colony from the earlier departing adults is commonly observed. The period for which this separation is maintained, however, is unclear. Samples that were predominantly of older juveniles, found in May and June of 1976 and March of 1978, suggest the possibility for continued separation throughout the juvenile period of approximately 7 months, based on the time to completion of the primary feather molt (Ward pers. comm.). Furthermore, the data presented here indicate that segregation by sex can also occur in juveniles and that this might begin soon after their departure from the breeding area, at a time when food is abundant and differential mortality unlikely. Samples favoring both sexes were found, with significantly male juvenile catches being made along the middle Awash River (semi-arid/arid zone) as late as May and June (1976).

The functional implications of male/female and juvenile/adult segregation are unclear. It is possible that competition for food between the sexes is more successfully avoided than previously believed, while competition within these groupings is greater. If we assume that when the sexes do compete directly the females are at a disadvantage (Ward 1965a), then at some point the advantages of large assemblages for finding food (Ward and Zahavi 1973) will be overshadowed by the disadvantages to the females of the resulting competition. The females might then reduce this competition by feeding in smaller, less attractive flocks originating from smaller and less attractive roosts.

In regard to competition for food as an explanation for adult/juvenile separation, it is curious that this separation can continue to exist for so long a period of time. This may indicate an experiential factor in feeding efficiency favoring the adults over the juveniles that exists into, or is possibly aggravated by, a late dry season–early rains period of food scarcity.

This discussion has assumed a seasonal food shortage based on Ward's findings in Nigeria (1965a). Too little is yet known of the year-round food situation in the Awash Basin to affirm the existence of such a shortage here. Queleas are found within the Awash Basin throughout the year and do not appear to make the mass movements reported elsewhere (Ward 1971) during the early rains period. The varied rainfall pattern associated with the Awash Basin likely effects an altitudinal rather than a latitudinal gradient of grass seed production. Gradients of seed production notwithstanding, females do not appear to splinter off and move away from a relatively stationary main body of birds, but rather a general dispersal of both sexes takes place immediately following breeding; moreover, it is the males that first seem to move back into the middle Awash Valley during the dry season. Segregation, then, may function to reduce competition, but there is no indication that it is the result of competition.

It is difficult to conceive of other advantages deriving from this segregation, particularly in terms of immediate communication about "off-season" opportunities for breeding. Perhaps, however, it does allow a delayed communication about aspects of the environment by helping to maintain the integrity of experience. This is to

suggest that of the collective experience within an aggregation (e.g. a night roost), that which is common to a discrete group rather than to isolated individuals is more likely to be acted upon. Furthermore, the integrity of sexually segregated groups might be more easily maintained in the face of the repeated process of joining and detaching from larger aggregations than that of mixed groups.

An important question now is by what means does this segregation come about? Interestingly, it occurs during the dry season, when all queleas are in the same non-breeding plumage. As previously stated, observations by Allan and Jackson (1973, 1974) suggest that there can be a separate departure of adult males and females from a breeding colony. In the Awash Basin, significantly male and female adult samples were collected in the hot subtropical zone shortly after breeding (October and November) in all 3 yr (1976–78). It is unlikely, however, that sexual segregation reaches its full extent until later in the dry season (Table 3). It may be that this separation is gradually occurring from day to day through a process of sorting at the night roost, where considerable activity takes place in mixing and shifting of positions prior to the birds' actually settling (Jaeger pers. obs.).

Two catches were found where samples that were predominantly females were taken from feeding flocks in areas where the overall sex ratios were believed to be even or favoring males. This process of segregation may be further facilitated and maintained by differences between the sexes in feeding preferences. Erickson (MS) has found differences in the food items taken by queleas in the upper Awash Valley versus the middle Awash Valley in the late dry season–early rains period of 1977, when segregation was most pronounced. Within either area, however, the same seeds were eaten by both sexes.

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