

Determination of the Food of Red-Billed Quelea (*Quelea quelea*) During Raining Season in Gyawana Ecosystem, Adamawa State, Nigeria

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Abstract— Determination of the food of Red-billed Quelea (*Quelea quelea*) in Gyawana ecosystem, Adamawa State of Nigeria, was carried out to identify the alternative food Red-billed Quelea foraged on, during the raining season. The Red-billed Quelea is a small gregarious Afro-tropical weaver bird. Over the years there has been frequent cereal crop depredation in the state by the grainvorous quelea birds. The Red-billed Quelea (*Q. quelea*) appears to have alternative food sources which ensure its survival and breeding when there are no cultivated crops. Using black nylon mist nets with dimensions of 7 x 2.5m and mesh size of 16 mm, one hundred and fifty (150) males and female *Q. quelea* were captured in the wild and their crop contents were analyzed. Eighteen (18) taxonomically different food items were recovered including seeds of different plants, grits and insects remains from the crops of *Q. quelea* sampled during the period of study. In terms of frequency and magnitude of occurrence in the food items are in this order: *Setaria pallidifusca* was the most consumed of all the birds' foods, with a mean of 62.38 ± 1.03 followed by *Dactyloctenium aegyptium* with a mean of 60.01 ± 0.61 , *Echinochloa colonum* (49.81 ± 1.01), *Roetboellia exaltata* (26.19 ± 0.09), *Digitaria ciliaris* (23.67 ± 0.73), *Digitaria iburua* (23.16 ± 0.65), *Sacciolepis africana* (17.05 ± 1.04), *Brachiaria mutica* (10.56 ± 0.24), *Panicum subalbidum* (08.45 ± 1.01), *Eragrostis gangetica* (06.31 ± 0.03), *Eriochloa nubica* (06.26 ± 0.15), *Eragrostis tremula* (06.12 ± 0.08), *Schoenefeldia gracilis* (05.06 ± 0.07), *Chloris pilosa* (03.71 ± 0.04), *Andropogon gayanus* (03.47 ± 1.13). While the least seed consumed was *Cenchrus biflorus* with a means of 03.21 ± 1.07 . Grit was consumed in small quantity (01.29 ± 0.16) by both sexes, while insects remained (01.09 ± 0.09) was observed only in female's crop of the *Q. quelea*. Analysis of variance was used to compare the mean number of various seeds consumed by the *Q. quelea* during the period of the study. Statistically, there was no significant difference in the consumed food of Red-billed Quelea during raining season at $P > 0.05$. But there was significant difference between the consumed food by male and female *Q. quelea* at $P < 0.05$. From the outcome of this study, the researchers therefore proffer the following recommendation. Sensitisation on Biological mitigation measures to farmers should be carried out. And further studies should be carried out during cropping season to compare between the wild food items and the cultivated cereal consume by Red-billed Quelea (*Q. quelea*).

Keywords— Determination, Food, Red-billed Quelea, Gyawana-Ecosystem, Raining Season.

I. INTRODUCTION

Red-billed Quelea usually flocks in groups and may number about hundreds of thousands per group, feeding usually on cereal crops. Due to their huge numbers they often swoop on mature cereal crops in the field (BirdLife International, 2013).

The Red-billed Quelea belongs to the Class: Aves, Order: Passeriformes, Family: Ploceidae, Genus: Quelea, and Species *Quelea quelea*. Its common name is the Red-billed Quelea or the Black-faced Dioch (GTZ, 1987; Buba *et al.*, 2012). Three sub-species have been reported in the African continent. These are: *Quelea quelea aethiopica* which occur in the north-eastern quadrant of Africa. *Quelea quelea lathamii* in Zambia, Zimbabwe and Malawi and *Quelea quelea quelea* in West Africa (Yaji *et al.*, 2002; Craig, 2010). The distinguishing features of the Red-billed Quelea are its size which on the average is about 12.5cm in length and weighs 15-20g (BirdLife International, 2013). The color of Red-billed Quelea, which during breeding the male adorns a more colorful plumage and red-bill generally. The male may also wear a facial mask which varies in color from black to white, a breast and crown plumage which could also be yellow or bright red. For the rest of the year male plumage resembles that of the female, which is a cryptic beige coloration. The female bill is yellowish during breeding and red during the nonbreeding season (Ezealor and Gile, 1997; Yusufu *et al.*, 2004a; BirdLife International, 2013; Buba *et al.*, 2022).

The distribution range of the Red-billed Quelea (*Quelea quelea*) covers most of sub-Saharan Africa, excluding the rain forest areas and parts of South Africa (Craig, 2010). The birds live and breed in huge flocks mostly in grassland regions. They are also recorded in other vegetation's types but not in rain forests. The species prefers woodlands and grass lands at any altitude below 2000m. Despite its prevalence in ranges dominated by grass matrix, it breeds only in such ranges that have thorny or spiny vegetation (Clancey, 1964; Borello and Cheke, 2011).

In Nigeria, *Quelea queleas* are found in upper Sudan zone, Sahelian or thorny scrub woodland. They are particularly predominant in Borno, Yobe, Adamawa State, Sokoto, Jigawa Kano State (Walter, 1971; Safford, 2013). Vegetation and floristic composition is not uniform throughout Adamawa State. This condition imposes commensurate food adaptation not only in human dietary food stuff, which differs between people of the regions of these states but also in wildlife and game from one region and the other (Berniz, 2010).

Adamawa State physiognomic nature of the plants cover is thorn wood land, this makes the state predisposed to *Quelea quelea* habitation. Over the years there has been frequent cereal crop depredation in the state by the grainvorous quelea birds.

The effects have been disastrous to the point that relief materials have had to be distributed to affected areas in some cases (Audu, 2017; Muhammed, 2019). Federal Government intensifies aerial spray in north east of Nigeria to mitigate *Quelea quelea* (Kazaure, 2019). Its chemical control is a threat to life, in 2008; three Councils Staff were hospitalized due to the inhalation of the Avitoxic used to control the Birds in Konduga Local Government Area of Borno State (Ndahi, 2008). Recently in January, 2022, there was *Quelea quelea* invasion in Firgi and environs, Gwoza Local Government Area of Borno State, that cause serious devastation to their *sorghum bicolor* (Massakwa). So far nothing has been reported in the area of “lure food items and their effect in mitigating Red-billed quelea (*Q. quelea*) damages on crop feeds.” That is by using these lure food items to surround farm lands where grain foods are cultivated in other to divert the attention of the birds from the cultivated cereal food. This research work aimed at identifying alternative wild food of the *Q. quelea* during raining season in Gyawana Ecosystem, Adamawa State.

II. MATERIALS AND METHOD

Study Area: The research was conducted in Gyawana ecosystem, Lamurde Local Government Area, Adamawa State of Nigeria. Gyawana is located at latitude 9°.35' N and longitude 11°.55' E and is 135 meters above Sea level. Lamurde Local Government Area lies between longitude 9°.36' 03.92"N and latitude 11°.47' 36.25"E at an elevation of 137 meters above sea level and has a population of 77,522 people (Adebayo *et al.*, 2012).

Sample Collection

Trapping of the birds: Using black nylon mist nets with dimensions of 7 x 2.5m and mesh size of 16 mm, a total of one hundred and fifty (150) male and female Red-billed quelea (*Quelea quelea*) were captured in the wild, (Plate 1). Subtotals of fifty (50) *Quelea quelea* were captured per month. The *Q. queleas* were obtained from birds entering night roosts whenever possible and from drinking places. The mist nets were set between 9:00a.m. and 11:00 a.m. when some of the birds came to drink, after they had fed and between 5:00pm and 6:00pm when the flocks came to drink water before going to their night roosts as in (Kirkpatric *et al.*, 1969; Jonathan and Frederich, 1994; Cheke, 2011; Buij, 2012; Buba *et al.*, 2013).

Birds were trapped fortnightly for a period of three months June to August, 2022. Three days were spent collecting samples at each site. Thirteen (13) and twelve (12) *Q. quelea* were collected at Nguro Bemun Rivers and Gokumbo sampling site respectively, making a total of twenty five (25) *Q. quelea* in the first phase of trapping. The same numbers of *Q. quelea* were collected in the second phase of trapping, making a total of fifty (50) *Q. quelea* in each month. Twenty five (25) *Q. quelea* of each sex with full or partially full crops were collected and used for the crop contents analysis following the method of (Kirkpatric *et al.*, 1969; Buba *et al.*, 2013).

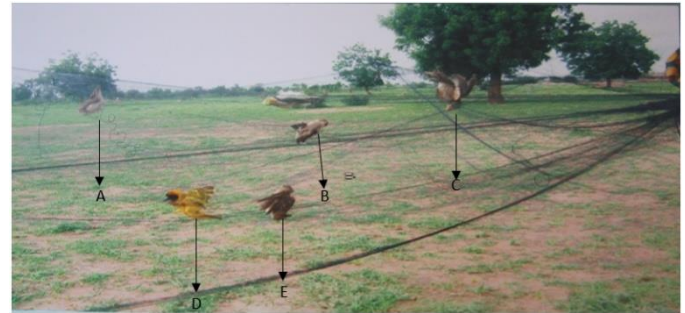


Plate I: Various species of birds trapped in a mist net.

Field Source: 2022

(A = Red-billed Quelea, B = Scaly-fronted Weaver, C = Red-billed Quelea, D = Vitelline masked Weaver, E = Orange-cheeked waxbill). Species not targeted in this research were removed and released back into the wild.

Sacrificing Birds to Obtain Crop Contents

Following the methods of (Kirkpatric *et al.*, 1969; Yusufu *et al.*, 2004ab; Carina *et al.*, 2013; Buba *et al.*, 2022), netted *Q. Quelea* were carefully removed from the mist net and immediately killed by suffocation with chloroform in air tight transparent polypropylene containers for about ten (10) minutes (Plate II). The dead birds were dissected and the crops (Plate III) were cut open with a pair of scissors and the contents put into a fine sieve, washed with cold water and air dried on Petri-dishes for five hours at 37°C – 40°C as in (Yusufu *et al.*, 2004ab; Buba *et al.*, 2022). Each dried crop content of a *Q. quelea* was put in a small brown envelop and labeled according to the sex of the *Q. Quelea*, date it was caught and site where the bird was caught. The samples were then transported to the Department of Zoology Laboratory, Adamawa State University Mubi, for further analysis.



Plate II: *Q. Quelea* in transparent polypropylene container ready for Sacrifice

Field Source: 2022



Plate III: Sacrificed *Q. Quelea* ready for dissection to obtain birds crops

Field Source: 2022

Analysis of the Crop Contents of Q. Quelea Sampled

As in (Kirkpatrick *et al.*, 1969; Yusufu *et al.*, 2004ab; Buba *et al.*, 2013; Buba *et al.*, 2022), crops content were sorted out based on their physical characteristics using visual observation with the aid of magnifying lens. The seeds, insects remained and grits were counted and recorded. Some of the physically unidentifiable foods items especially seeds were sown in sterilized soil in a germinating tray placed in a glass house and watered daily to enable them germinate. Where germination occurred, the plants were nursed to flowering for easy and further identification. The germinated plants and the food items found in the birds' crops were identified with the help of preserved specimens in the herbarium, Department of Plant Science, Ahmadu Bello University, Zaria and Department of Botany, Adamawa State University, Mubi.

Vegetation and Soil Analysis

A random survey of seed plants was made particularly around the vicinity where the birds foraged. Seeds of the plants within the vicinity were then compared with those present in the crops of the *Q. Quelea*; this was done particularly for grass seeds. The top soil in the foraging habitat was collected from fifteen different sites using a quadrant of 30 x 30 cm, thrown randomly, five times at each site of the study area. The soils were irrigated in a germinating tray, to determine plants represented in the soil seed reserves. The seeds were also compared with the seeds in the crops of dissected birds as in (Buba *et al.*, 2013; Buba *et al.*, 2022).

Statistical Analysis

The analysis of variance (ANOVA) was used to compare the mean number of various seeds consumed by the *Q. Quelea* during the period of study. Student T-test was used to test for possible difference between the food items consumed by male and the female quelea birds. The Statistical software package (SPSS for Windows) was used. The results of this study were presented as mean±standard error and P > 0.05 was regarded as not statistically different.

Photography

Some of the birds caught in the mist nets and in the polypropylene container, and sacrificed (dead) birds, were photographed. All photography was done using a Canon 450D digital camera.

III. RESULTS

Crop contents of Red-billed Quelea

From the crops contents of one hundred and fifty (150) Red-billed Quelea (*Q. quelea*) sampled, during raining season in Gyawana ecosystem, Adamawa State of Nigeria. The result reveals eighteen (18) taxonomically different food items including seeds of different grass plants, insects remains and grits were recovered and these were presented in Tables 1- 3.

Crop contents of male Red-billed Quelea (Q. quelea) for the month of June to August

The most preferred food items in the month of June by male Red-billed quelea was *Setaria pallido-fusca* having the highest

mean of 74.47± 5.26, followed by *Dactyloctenium aegyptium* with a mean of 72.06 ±4.07 and the least seed consumed for this month was *Cenchrus biflorus* with a mean of 09.15 ±2.31 as shown in table 1.

Seventeen different food items including grits were recovered from the crop of male Red-billed quelea in the month of July. *Setaria pallido-fusca* has the highest mean value of 79.19± 3.37, this was followed by *Dactyloctenium aegyptium* (71.37 ±2.23), while the least consumed food (seed) item is again *Cenchrus biflorus* with a mean of 10.24 ±1.26.

Dactyloctenium aegyptium was again the most consumed seed with the mean value of 76.34± 2.13 in the month of August. This was followed by *Digitaria ciliaris* with mean value of 74.42 ±3.09 and the least consumed seed was *Chloris pilosa* with the lowest mean value of 11.17 ±1.15 as presented in table 1.

Table 1: The mean food items recovered from the crop of male Red-billed Quelea from the Months of June to August

Months	Ag	Bm	Cb	Cp	Da	Dc
	Mean S.E	Mean S.E	Mean S.E	Mean S.E	Mean S.E	Mean S.E
June	16.43 ± 1.07	36.36 ± 2.03	09.15 ±2.31	10.12 ±2.33	72.06 ±4.07	43.29 ±1.37
	16.66 ± 1.11	30.51 ± 1.06	10.24 ±1.26	14.23 ±3.27	71.37 ±2.23	46.38 ±1.46
August	18.27 ± 2.04	38.17 ± 4.03	13.16 ±1.13	11.17 ±1.15	76.34 ±2.13	74.42 ±3.09

P>0.05

Key: Ag= *Andropogon gayanus*, Bm= *Brachiaria mutica*, Cb= *Cenchrus biflorus*, Cp= *Chloris pilosa*, Da= *Dactyloctenium aegyptium* Dc= *Digitaria ciliaris*, Di= *Digitaria iburua*, Ec= *Echinochloa colonum*, Eg= *Eragrostis gangetica*, Et= *Eragrostis tremula*, En= *Eriochloa nubica*, Ps= *Panicum subalbidum*, Re= *Roetboellia exaltata*, Sa= *Sacciolepis africana*, Sg= *Schoenefeldia gracilis* Sp= *Setaria pallido-fusca*, Gr= Grit, In= Insect

Table 1 Cont: The mean food items recovered from the crop of male Red-billed Quelea from the Months of June to August

Months	Di	Ec	Eg	Et	En	Ps
	Mean S.E	Mean S.E	Mean S.E	Mean S.E	Mean S.E	Mean S.E
June	49.64 ±2.11	67.18± 3.27	19.53± 4.09	20.61± 5.21	16.52± 2.16	31.18± 4.27
	47.46 ±1.26	69.43± 3.56	24.74± 1.18	20.22± 3.13	21.34± 1.31	33.26± 1.41
August	44.35 ±2.17	60.17± 1.13	20.12± 3.09	18.55± 2.63	19.71± 1.07	36.32± 3.13

P>0.05

Table 1 Cont: The mean food items recovered from the crop of male Red-billed Quelea from the Months of June to August

Months	Re	Sa	Sg	Sp	Gr	In
	Mean S.E	Mean S.E	Mean S.E	Mean S.E	Mean S.E	Mean S.E
June	52.61± 2.09	41.91± 3.18	18.53± 3.08	74.47± 5.26	06.21± 1.06	00.00± 0.00
	50.37± 3.11	44.67± 3.13	16.41± 2.33	79.19± 3.37	07.37± 0.85	00.00± 0.00
August	49.63± 1.21	43.36± 4.17	19.33± 2.37	76.34± 2.13	07.91± 1.41	00.00± 0.00

P>0.05

Crop contents of female Red-billed Quelea (Q. quelea) for the month of June to August

It was found that female Red-billed Quelea (*Q. quelea*) consumed eighteen different food items including grits and

insects' remains. In the month of June, *Dactyloctenium aegyptium* was the most consumed food item with a mean of 72.51 ±1.58, this was followed by *Setaria pallido-fusca* with a mean of 69.38± 3.07 and the least consumed seed for this month for females was *Chloris pilosa* with a mean of 08.63 ±2.33.

In the month of July, *Setaria pallido-fusca* was the most preferred grass grain as shown in Table 2, with a means of 72.21± 2.63. This was followed by *Dactyloctenium aegyptium* with mean of 72.08 ±2.41, while *Cenchrus biflorus* was the least consumed diet, with a means of 10.61 ±3.93 for females.

Setaria pallido-fusca was again the most consumed grass grain in the month of August, having the highest mean of 70.73± 2.47 by females Red-billed quelea per crop of a bird, then followed by *Dactyloctenium aegyptium* (69.87 ±4.66), *Chloris pilosa* was the least consumed seed by the females Red-billed quelea with a mean of 09.83 ±1.57 as shown in Table 2.

Table 2: The mean food items recovered from the crop of female Red-billed Quelea from the Months of June –August

Months	Ag	Bm	Cb	Cp	Da	Dc
	Mean S.E	Mean S.E	Mean S.E	Mean S.E	Mean S.E	Mean S.E
June	14.16 ± 2.11	39.29 ± 1.09	11.32 ±2.43	08.63 ±2.33	72.51 ±1.58	40.74 ±1.72
July	15.35 ± 1.21	32.37 ± 3.26	10.61 ±3.93	12.77 ±2.86	72.08 ±2.41	41.63 ±1.57
August	14.39 ± 1.18	40.28 ± 1.16	14.71 ±1.53	09.83 ±1.57	69.87 ±4.66	49.27 ±4.06

P>0.05

Table 2 Cont: The mean food items recovered from the crop of female Red-billed Quelea from the Months of June to August

Months	Di	Ec	Eg	Et	En	Ps
	Mean S.E	Mean S.E	Mean S.E	Mean S.E	Mean S.E	Mean S.E
June	50.23 ±2.07	65.34± 2.41	16.78± 1.17	18.49± 2.66	16.03± 2.83	33.67± 3.43
July	41.31 ±1.41	70.19± 1.82	18.39± 1.33	18.57± 1.74	20.18± 2.94	30.33± 1.08
August	43.72 ±3.37	61.38± 2.71	15.53± 2.16	17.38± 1.33	17.39± 4.03	37.91± 2.71

P>0.05

Table 2 Cont: The mean food items recovered from the crop of female Red-billed Quelea from the Months of June to August

Months	Re	Sa	Sg	Sp	Gr	In
	Mean S.E	Mean S.E	Mean S.E	Mean S.E	Mean S.E	Mean S.E
June	53.11± 2.35	42.74± 1.42	16.59± 1.13	69.38± 3.07	06.47± 1.21	09.36± 3.43
July	51.46± 2.61	40.33± 1.76	16.72± 3.17	72.21± 2.63	07.83± 0.85	07.34± 1.52
August	50.23± 1.47	41.71± 4.32	17.67± 2.83	70.73± 2.47	04.74± 0.97	10.51± 2.81

P>0.05

Food items observed in the crops of one hundred and fifty (150) Red-Billed quelea sampled for the period of study (June to August)

A pooled result of the crop contents of male and female Red-billed Quelea (*Q. quelea*) for the sampling period (June – August), shows that eighteen different food items including wild grass seed, insects remains and grits were recovered from the crops of Red-billed Quelea (*Q. quelea*). *Setaria pallido-fusca* was the most consumed, with a mean of 62.38±1.03

(19.59%), followed by *Dactyloctenium aegyptium* with a mean of 60.01±0.61 (18.85%) while the least seed consumed was *Cenchrus biflorus* with a means of 03.21±1.07 (1.16%) as shown in Table 3.

Table 3: Food items observed in the crops of one hundred and fifty (150) Red-Billed quelea sampled for the period of study (June to August)

Food item	N	Total (%)	Mean ± SE	Min	Max
<i>Andropogon gayanus</i>	150	601 (1.18%)	03.74±1.13	00	17
<i>Brachiaria mutica</i>	150	1584 (3.32%)	10.56±0.24	08	43
<i>Cenchrus biflorus</i>	150	549 (1.16%)	03.21±1.07	03	16
<i>Chloris pilosa</i>	150	557 (1.17%)	03.71±0.04	00	15
<i>Dactyloctenium aegyptium</i>	150	9001 (18.85%)	60.01±0.61	28	126
<i>Digitaria ciliaris</i>	150	3553 (7.44%)	23.67±0.73	07	43
<i>Digitaria iburua</i>	150	3475 (7.28%)	23.16±0.65	04	52
<i>Echinochloa colonum</i>	150	7472 (15.65%)	49.81±1.01	11	103
<i>Eragrostis gangetica</i>	150	947 (1.98%)	06.31±0.03	00	61
<i>Eragrostis tremula</i>	150	918 (1.92%)	06.12±0.08	03	53
<i>Eriochloa nubica</i>	150	939 (1.97%)	06.26±0.15	00	39
<i>Panicum subalbidum</i>	150	1268 (2.66%)	08.45±1.01	00	40
<i>Roetboellia exaltata</i>	150	3929 (8.23%)	26.19±0.09	06	83
<i>Sacciolepis Africana</i>	150	2557 (5.35%)	17.05±1.04	00	60
<i>Schoenefeldia gracilis</i>	150	759 (1.59%)	05.06±0.07	00	23
<i>Setaria pallidofusca</i>	150	9357 (19.59%)	62.38±1.03	13	102
Grit	150	194 (0.41%)	01.29±0.16	00	09
Insect	150	163 (0.34%)	01.09±0.09	00	02

P>0.05

Table 4: Comparison of Grass Seeds in the Habitat of the birds, the top soil of birds' habitat, and birds' crops.

Grass (seeds)	Birds' crops	Habitat of the birds	Top soil of the birds' habitat
<i>Andropogon gayanus</i>	+	+	+
<i>Brachiaria mutica</i>	+	+	+
<i>Cenchrus biflorus</i>	+	+	+
<i>Chloris pilosa</i>	+	+	+
<i>Dactyloctenium aegyptium</i>	+	+	+
<i>Digitaria acuminatissima</i>	-	-	+
<i>Digitaria ciliaris</i>	+	+	+
<i>Digitaria iburua</i>	+	+	+
<i>Echinochloa colonum</i>	+	+	+
<i>Echinochloa obtusiflora</i>	-	-	+
<i>Echinochloa pyramidalis</i>	-	-	+
<i>Eragrostis gangetica</i>	+	+	+
<i>Eragrostis tremula</i>	+	+	+
<i>Eriochloa nubica</i>	+	+	-
<i>Panicum subalbidum</i>	+	+	-
<i>Roetboellia exaltata</i>	+	+	+
<i>Sacciolepis Africana</i>	+	+	+
<i>Schoenefeldia gracilis</i>	+	+	+
<i>Setaria pallidofusca</i>	+	+	+

Comparison of Grass Seeds in the Habitat of the birds, the top soil of birds' habitat, and birds' crops.

In comparison of the grass seeds in the Red-billed Quelea's crops, habitat of the birds and the top soil of birds' habitat, it was observed that *Andropogon gayanus*, *Brachiaria mutica*, *Cenchrus biflorus*, *Chloris pilosa*, *Dactyloctenium aegyptium*,

Digitaria acuminatissima, *Digitaria ciliaris*, *Digitaria iburua*, *Echinochloa colonum*, *Echinochloa obtusiflora*, *Echinochloa pyramidalis*, *Eragrostis gangetica*, *Eragrostis tremula*, *Roetboellia exaltata*, *Sacciolepis africana*, *Schoenefeldia gracilis* and *Setaria pallidofusca* were found in the top soil of the Red-billed Queleas' habitat when cultured for seeds reserved. It was also observed that, most of the soil seeds reserved and grass seeds plants within the Red-billed Queleas' habitat were also found in the crops *Q. queleas*. While *Digitaria acuminatissima*, *Echinochloa obtusiflora* and *Echinochloa pyramidalis* were present in the top soil of *Q. queleas*' habitat (soil seed reserves) but absent in both the crops of *Q. queleas* and their habitat. *Eriochloa nubica* and *Panicum subalbidum* were found throughout the period of the study in the crops of the *Q. queleas* and their habitat, but not found in the soil seed reserves.

IV. DISCUSSION

The finding of this research work shows that, Red-billed Quelea (*Q. quelea*) is euryphagous. The results in the month of June, the male *Q. quelea* consumed seventeen different food items including grit. *Setaria pallido-fusca* was the most consumed with the highest mean of 74.47 ± 5.26 , followed by *Dactyloctenium aegyptium* with a mean of 72.06 ± 4.07 and the least seed consumed was *Cenchrus biflorus* with a mean of 09.15 ± 2.31 . While it was found that female Red-billed Quelea (*Q. quelea*) consumed eighteen different food items including grits and insects' remains in the month of June. *Dactyloctenium aegyptium* was the most consumed food item with a mean of 72.51 ± 1.58 for female *Q. queleas*, this was followed by *Setaria pallido-fusca* with a mean of 69.38 ± 3.07 and the least consumed seed for this month for female was also *Chloris pilosa* with a mean of 08.63 ± 2.33 . Small quantity of grits was also recovered in both male and female *Q. quelea* crops. The high number of food items consumed in this month may be due to the availability of these grass seeds and the scarcity of the other food items. Wild grass grains have been shown by GTZ, (1978; Buba *et al.*, 2013), to have high crude protein percentage. They were therefore, highly foraged upon by *Q. quelea*. The result of this study is in line with the findings of Ozolua (1986), who reported that grainvorous birds generally prefer wild seeds and tend to go for cultivated cereal crops when the grass seeds are in short supply.

Insects remained were recovered only in crops of female *Q. quelea*. This may be due to the female birds' requirement of animal protein for egg formation. Welty and Baptista (1990), stated that relatively larger amounts of animal materials consumed by females' birds are vital to egg formation as well as the accumulation of body fats that are metabolized during incubation and chick rearing. Yusuf *et al.*, (2004c), reported that female birds consumed more animal food than males during pre-breeding times, for egg-making and during breeding to withstand the stress of brooding and for feeding their nestlings.

In the month of July, *Setaria pallido-fusca* was the most preferred grass grain with a means of 79.19 ± 3.37 and 72.21 ± 2.63 for male and female respectively. This was followed by *Dactyloctenium aegyptium* with mean of 71.37 ± 2.23 for male

and 72.08 ± 2.41 for female, while *Cenchrus biflorus* was the least consumed seed, with a means of 10.24 ± 1.26 and 10.61 ± 3.93 for male and females respectively. There was no single cultivated grain observed in the crop content analysis carried out in *Q. Quelea* for this period of study. The findings of this study concur with the results of Brugger and Jaeger (1982) and Robert *et al.* (2001), who reported that wild annual grasses form the bulk of the diet of Red-billed Quelea. This suggests that, Red-billed Quelea all over the sub-tropics, despite their taxonomic and geographic differences prefer wild grass seeds (Birdlife International 2013). The findings of this study therefore, agree with Erickson (1979), who reported that, there are naturally preferred foods of the Red-billed Quelea.

Seventeen different food items including grits were recovered from the crop of sacrificed male Red-billed quelea in the month of August. *Dactyloctenium aegyptium* was again the most consumed seed with a mean value of 76.34 ± 2.1 , this was followed by *Digitaria ciliaris* with mean value of 74.42 ± 3.09 and least consumed seed was *Chloris pilosa* with the lowest mean value of 11.17 ± 1.15 as shown in table 1. The result of the crop contents analysis of female Red-billed Quelea for the month of August; reveals that eighteen different food items including grits and insects remained were recovered. *Setaria pallido-fusca* was the most consumed grass grain having the highest mean of 70.73 ± 2.47 per crop of a bird, then followed by *Dactyloctenium aegyptium* (69.87 ± 4.66), *Chloris pilosa* was the least consumed grain by the females Red-billed quelea with mean of 09.83 ± 1.57 as shown in Table 2. The result of this study does not agree with Birdlife International (2014), who reported that the food of the *Q. quelea* consists of grass seeds and cultivated grains. As only wild grass seed, few grits and insects remained were recovered in the crops contents analysis of Red-billed quelea (*Q. quelea*) in this study and no cultivated grains were encountered. This is not surprising however as this study was conducted during the raining season and cultivated crops are not yet matured. The result of this study is in line with the findings of Erickson (1979), who reported that in the late dry season Quelea birds were feeding entirely on grass seed and there was no evidence of food shortage in the life of *Q. quelea* in Awash River Basin of Ethiopia.

The result of this study conform to the findings of Ward (1965; Yusuf *et al.*, 2004c; Buba *et al.*, 2013) who reported that *Q. quelea* are not usually entirely dependent upon cereal crops for food. In fact there are often periods when *Q. quelea* ignores crops or cause only negligible damage to them. They prefer the small seeds of wild grasses and when these are available and abundant, the birds do not attack cereals. The present study has shown that Red-billed quelea consumed only wild grass grains and survived and lived on them comfortably in this period.

In this study it was observed that grits occurred in the bird's crops both male and female throughout the period of study. This is in line with the findings of Yusuf *et al.*, (2004c), who reported that grits are necessary for birds generally because this help in grinding their food since birds do not have teeth. Grits are also a source of mineral salts such as calcium to the *Q. quelea*.

Pooled result of the food items observed in the crops of one hundred and fifty (150) Red-Billed Quelea sampled for the period of study (June to August) shows that eighteen different

food items including wild grass seed, insects remained and grits were recovered from the crops of Red-billed Quelea (*Q. quelea*). *Setaria pallido-fusca* was the most consumed of all the birds' foods, with a mean of 62.38 ± 1.03 (19.59%), followed by *Dactyloctenium aegyptium* with a mean of 60.01 ± 0.61 (18.85%). While the least was *Cenchrus biflorus* with a means of 03.21 ± 1.07 (1.16%) as shown in Table 3. The preference for *Setaria pallido-fusca* and *Dactyloctenium aegyptium* compared to other food items may be because it is more palatable. Quelea birds appeared not to like very tiny food items like *Cenchrus biflorus* and also very thick, hard- husk food items because they are difficult to de-husk, as reported by GTZ (1987), Red-billed quelea apparently avoided very thick and hard- husk food items.

The result of the comparison of the grass Seeds in the Red-billed Quelea's crops, grass plants in the habitat of the birds and seed reserved in the top soil of the birds' habitat, reveals that *Andropogon gayanus*, *Brachiaria mutica*, *Cenchrus biflorus*, *Chloris pilosa*, *Dactyloctenium aegyptium*, *Digitaria acuminatissima*, *Digitaria ciliaris*, *Digitaria iburua*, *Echinochloa colonum*, *Echinochloa obtusiflora*, *Echinochloa pyramidalis*, *Eragrostis gangetica*, *Eragrostis tremula*, *Roetboellia exaltata*, *Sacciolepis Africana*, *Schoenefeldia gracilis* and *Setaria pallido-fusca*, were found in the top soil of the Red-billed Queleas' habitat when cultured for seeds reserved. It was also reveals that, most of the soil seeds reserved and grass seeds within the Red-billed Queleas' habitat were also found in the Red-billed Queleas' crops. While *Digitaria acuminatissima*, *Echinochloa obtusiflora* and *Echinochloa pyramidalis* were present in the top soil of Red-billed Queleas' habitat (soil seed reserves) but absent in both the Red-billed Quelea's crops and their habitat. *Eriochloa nubica* and *Panicum subalbidum* were found throughout the period of the study in the crops of Red-billed Quelea and also their habitat. The result of this present study is in line with other researchers like Ward (1965), Erickson, (1979), GTZ (1987), Yusuf *et al.*, (2004b) and Buba *et al.*, (2022). This implies that Quelea birds foraged within their vicinity if there is abundance of wild grass seeds, but in the absence of their preferred wild grass seeds, they may travel to distant places of about 10km – 20km away from their night roost to forage. This was an indication that the birds not only foraged in their roost area where they were caught but also from other areas, as reported by GTZ, (1987).

V. CONCLUSION

In conclusion, Red-billed Quelea (*Q. quelea*) is euryphagous in this study period (June to August, 2022), in Gyawana Ecosystem, Adamawa State, Nigeria. it was observed that there are up to seventeen taxonomically different food items including seeds of different grass plants and grits were recovered in male Red-billed Quelea (*Q. quelea*), while eighteen different food items were found in the female. *Setaria pallido-fusca* was the most preferred of all the birds' foods, followed by *Dactyloctenium aegyptium*, while the least seed plants was *Cenchrus biflorus*. Small quantities of grits were observed in the crops of both male and female *Q. quelea*, throughout the period of this study. Insects remained were recovered only in crops of female *Q. quelea*. Other food items recovered in the crop of *Q. quelea* are: *Andropogon gayanus*,

Brachiaria mutica, *Chloris pilosa*, *Digitaria ciliaris*, *Digitaria iburua*, *Echinochloa colonum*, *Eragrostis gangetica*, *Eragrostis tremula*, *Eriochloa nubica*, *Panicum subalbidum*, *Roetboellia exaltata*, *Sacciolepis africana* and *Schoenefeldia gracilis*. Statistically, there is no significant difference between the foods items consumed by the *Q. Quelea* at $P > 0.05$ during the study period. But when compare by sex, there is significant differences between the foods items consumed by the male and female *Q. Quelea* at $P < 0.05$.

Recommendations

Based on the outcome of this study, the researchers therefore proffer the following recommendation:

1. That further studies should be carried out during cropping season to compare between the wild and the cultivated cereal most consume by Red-billed Quelea (*Q. Quelea*).
2. Sensitisation on Biological mitigation measures to farmers should be carried out, so that farmers should learn to leave some uncultivated portion of land between their farms, to enable these wild grass seeds grow, in other to divert the attention of the birds from their cultivated crops during cropping seasons.

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