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Evaluation of the food of red-billed quelea (*Quelea quelea*) during cropping season in gyawana and environs, Adamawa State, Nigeria

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Abstract

Evaluation of the food of red-billed quelea (*Quelea quelea*) during cropping season in Gyawana and environs, Adamawa State, Nigeria, was carried out to identify the food of *Quelea quelea* during the cropping season. A total of one hundred and fifty (150) male and female birds were captured in the wild; using black nylon mist nets with dimensions of 7 x 2.5m and mesh size of 16 mm. Subtotals of fifty birds were captured per month. The crop contents of the *Q. quelea* sampled for this research work reveals a total number of twelve taxonomically different food items. In terms of frequency and magnitude of occurrence in the food items, *Dactyloctenium aegyptium* appears to be the most consumed food of Red-billed Quelea with mean of 161.24 ± 2.16 and 157.33 ± 2.14 in male and female respectively. This was followed by *Oryza barthi* 63.25 ± 4.26 in male and 61.23 ± 1.61 in female, then *Oryza sativa* 42.16 ± 1.21 in both male and female, while *Digitaria iburua* has the mean of 27.16 ± 2.46 and 31.14 ± 0.37 in male and female respectively. *Roetboellia exaltata* was 36.11 ± 1.23 in male and 37.13 ± 4.33 in female. Soghum bicolor with mean value of 28.08 ± 1.43 in male and 26.13 ± 2.21 in female. *Setaria pallidofusca* was 26.08 ± 3.22 in male and 24.06 ± 3.3 in female; *Echinochloa colonum* has 18.741 ± 1.47 and 15.43 ± 1.27 mean in male and female respectively. *Brachiaria mutica* has 09.21 ± 0.27 and male and 11.04 ± 1.63 in female, this was followed by the least seed consumed *Digitaria ciliaris* with a mean of 3.44 ± 1.09 in both male and female *Q. quelea*. The mean value of grits in the crop contents of male *Q. quelea* was 04.21 ± 2.06 and in female was 04.73 ± 3.03 . Some quantities of insect remains were observed in the crop contents of female *Q. quelea*, with the highest mean value of 07.13 ± 05.01 . Analysis of variance was used to compare the mean value of various seeds consumed by the *Q. quelea* during the period of study. The result shows there was significant difference in the food items consumed by *Q. quelea* during cropping season. In conclusion, for this period of study September to November, it was observed that *Q. quelea* is euryphagous, *Dactyloctenium aegyptium* was the most preferred seed foraged upon, although it varied in quantity, while the least preferred seed was found to be *Digitaria ciliaris*. Insects remains were found in the diet of female *Q. quelea*, while grits was found in small quantities in both male and female *Q. quelea*. The researchers therefore, recommend that further studies should be carried out on biological control on Quelea birds, by the reintroduction of their predators such as the red-necked falcon *Falco chicquera* into the area.

Keywords: Food, Evaluation; Red-Billed Quelea; Gyawana ecosystem; Environs; Cropping Season

1. Introduction

Red-billed Quelea (*Quelea quelea*) is the world's most abundant wild bird with an estimated adult population of 1.5 billion (Oschadleus, 2000; BirdLife international, 2004). *Quelea quelea* is native to sub-Saharan Africa. They are small, highly gregarious birds with average length of 12.5cm and weight of between 15-20 grammes. Apart from their deep red bills, non-breeding males and females have a drab non-descript plumage at which stage they resemble sparrows (Burrow and Demey, 2001). During breeding the male *Quelea quelea* is distinguished by its more colorful plumage and red bill. In some areas the male may possess a facial mask, which ranges from black to white in colour as well as a breast

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and crown plumage which vary from yellowish to bright red. During the non-breeding period, male plumage resembles that of the female, which is a cryptic beige coloration. The female's bill is yellow during breeding and red during the non-breeding season. Breeding season begins with the seasonal rains which come at different times in different parts of their distribution range starting at the north western edge around the beginning of September (GTZ, 1987; Borello and Cheke 2011; Oschadleus, 2000). Red-billed *Quelea* usually moves in flocks of several hundreds and has a capacity for long distance migration (Bernitz, 2010).

There are three Species of *Quelea quelea* with little or no genetic variation that occurs over areas in Africa. *Quelea quelea* occurs mainly in West Africa, *Q.aethiopica* in Sudan, Ethiopia and northern Somalia, while *Q. lathamii* is found in Somalia, Kenya, Tanzania, South Africa and Angola (BirdLife international, 2004). In Nigeria the areas fitting the above descriptions and most suited therefore for *Quelea* bird are Borno, Yobe, Adamawa, Jigawa, Kano, Kaduna, Sokoto, Zamfara and Bauchi states (Jones *et al.*, 2001; Dallimer *et al.*, 2003). The Lake Chad region is home to a hybrid population of *Quelea quelea quelea* and *Quelea quelea aethiopica*. The hybrid population of *Quelea quelea aethiopica* and *Quelea quelea lathamii* occurs in east Africa (Ward 1965; GTZ, 1987).

The food of the Red-billed *Quelea* consists of grass seeds and grain (cultivated cereals). As soon as the sun comes up the birds come together in their huge flocks and cooperate in finding a suitable feeding place. After a successful search, they settle rapidly and often cause serious damage to crops. In the middle part of the day they rest in shady areas near water and spend the time preening. In the evening they once again fly in search of food and drink water before returning to their roosting site. (Bernitz, 2010). Although *quelea* birds often ignore crops and feed on the seeds of wild grasses, they are a constant threat and at times when their natural food is scarce they may cause spectacular damage to cultivated grains (Jackson, 1973).

Many species of grainvorous birds more especially Red-billed *Quelea (Quelea quelea)* cause damage to crop plants. Alarming damage to cereal crops caused by Red-billed *Quelea* led to control measures against this pest being introduced in many countries throughout Africa during 1945-1955. National control teams were set up and a variety of control techniques tested. Although the fight against the Red-billed *Quelea (Quelea quelea)* as a major pest has now been going on for several decades, no satisfactory solution to this problem has so far been found and the constant danger to cereal crops still remains (Yusuf *et al.*, 2004b). In Nigeria, especially where cereal farmers are many, there occur also high losses due to *Quelea* birds. In Kano State, were devastated by *Quelea quelea* invasion which reduced the annual crop yield of the area by 60%. This translated to a monetary value of several millions of naira (Anonymus, 2001). In the year 2017, Federal Government of Nigeria, spend two hundred and twenty six million naira to forestall *quelea* birds' epidemic in the north eastern part of Nigeria (Audu, 2017). In Adamawa State, results of investigations carried out showed that, Red-billed *Quelea* cause significant losses in yield and sometimes total crop loss owing to their fast destructive feeding habit. In the year 2019, eight (8) Local Government Areas (Yola north and south, Girei, Guyuk, Lamurde, Numan, Demsa and Shelleng) were affected in Adamawa State whereby additional flight hours, pesticides and logistics were assisted to supplement Federal Government to control *quelea* birds in the state (Kazaure 2019). Strategies adopted so far to control Red-billed *Quelea* have been chemical. Perhaps biological mitigation measures that divert the birds' attention from cultivated cereals may present a better alternative. So far only few have been reported in the area of "lure food items and their effect in mitigating *Quelea quelea* damages on crop feeds." This research will be another step in that direction. This research work aimed at identifying the food of the Red-billed *quelea (Quelea quelea)* during cropping season in Gyawana and environs, Lamurde Local Government Area of Adamawa State, Nigeria.

2. Material and methods

The study was carried out 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). Adamawa State is located in the North Eastern part of Nigeria, and lies between latitudes 7° and 11° N and between longitudes 11° and 14° E. It is on an altitude of 185 meters above Sea level and covers a land area of about 39,741km². The State shares boundaries with Taraba State in the south and west, Gombe State in the northwest, Borno State in the north and an international boundary with the Republic of Cameroon along its Eastern border (Fig.1). The Benue River, which transects the State, rises from the highlands of Cameroon and flows southwards to join the River Niger at Lokoja in Nigeria. Two seasons are obtainable in the State; the wet (rainy) and dry seasons. The months of May to October constitute the wet season, during which no place receives less than 600mm of rainfall. The months of November to April constitute the dry season, during which the dry wind (harmattan) period is experienced between the months of November and February. The months of March and April are the hottest with an average temperature of 42 °C while November, December and January are the coolest months with an average temperature of 11°C (Adebayo *et al.* 2012).

2.1. Sample collection

2.1.1. Trapping of the birds

A total of one hundred and fifty (150) male and female birds were captured in the wild; using black nylon mist nets with dimensions of 7 x 2.5m and mesh size of 16 mm. Subtotals of fifty birds were captured per month. The birds were captured at their night roosts and water drinking points. The mist nets were set between 9:00a.m and 11:00 a.m to catch the birds that went to drink after morning feeding and 5:00pm and 6:00pm to catch those that went to drink before going to their night roosts as in (Kirkpatric *et al.* 1969; Jonathan and Frederich, 1994; Cheke, 2011; Buij, 2012;).

Birds were trapped fortnightly for a period of three months September to November, 2022. Two days were spent collecting samples at each site. Eight (8) birds each were collected at Gokumbo and Nguro Bemun Rivers sampling sites. Nine (9) birds were collected at Italiah Canal River, making a total of twenty five quelea birds in the first phase of trapping. The same numbers of quelea birds were collected in the second phase of trapping, making total of fifty (50) quelea birds in each month. Twenty birds of either sex with full or partially full crops were collected and used for the crop contents analysis.

2.1.2. Sacrificing Birds To Obtain Crop Contents

Netted *Quelea* birds were carefully removed from the mist net and immediately killed by suffocation with chloroform in air tight transparent plastic containers for about ten (10) minutes as in Yusufu *et al.*, (2004b). The dead birds were dissected as in (Kirkpatric *et al.*, 1969; 1994; Carina *et al.*, 2013). The crops 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 about three hours at 40°C – 43°C. Each dried crop content of a bird was put in small envelop and labeled according to the date the bird was caught, site where bird was caught and sex of the bird. The samples were then transported to the Department of Zoology laboratory, Adamawa State University, Mubi for analysis.

2.1.3. Analysis Of The Crop Contents.

Following the method of Buba *et al.* 20013, in the laboratory the crop contents (seeds of different grasses, insects and grit) were sorted out based on their physical characteristics using visual observation with the aid of magnifying lens. These seeds, insects 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 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 in the Department of Plant Science, Ahmadu Bello University, Zaria and Department of Botany, Adamawa State University Mubi,

2.1.4. Vegetation And Soil Analysis

A random survey of seed plants was made particularly around the vicinity of areas where the birds foraged. Seeds of the plants within the vicinity were compared with those present in the crops of the birds; 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 soil was 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.

2.2. Statistical Analysis

Data obtained was analyzed by one way analysis of variance (ANOVA) followed by Duncan's Multiple Range Test (DMRT) for means separation. Student t-test was used to test for difference between the male and female food items consumed by the birds. Using a statistical software package (SPSS for Windows). The results were presented as mean±standard error and $P > 0.05$ will be regarded as not statistically different.

3. Results

3.1. Crop contents of Red-billed Quelea

The result of this study revealed that *Q. quelea* is euryphagous during cropping season (September to November). Several seeds of different plants, insects and grits were recovered from the crops contents of *Q. quelea* making a total of twelve taxonomically different food items during the study period and these were presented in Tables 1- 3.

3.2. Crop contents of male red-billed quelea (*Q. quelea*) for the month of September to November, 2022

In the month of September, the most consumed seed by males red-billed Quelea (*Q. quelea*) is *Dactyloctenium aegyptium* with mean of 161.24 ± 2.16 , followed by *Digitaria iburua* with 27.16 ± 2.46 and the least seed consumed by the *Q. quelea* during the period of study is *Brachiaria mutica* (0.08 ± 0.14). The most preferred food item in the month of October by males red-billed Quelea (*Q. quelea*) was *Oryza barthi* with a mean of 63.25 ± 4.26 ; this was followed by *Oryza sativa* with the mean value of 40.38 ± 2.17 , then the least seed foraged on was *Brachiaria mutica* with a mean of 09.18 ± 2.71 as shown in table 1.

It was observed that in the month of November, the most consumed seed by male *Q. quelea* is still *Oryza barthi* with a mean value of 63.14 ± 2.31 , followed by *Oryza sativa* (42.16 ± 1.21), while the least was also *Brachiaria mutica* (09.21 ± 0.27) as presented in table 1. There was small quantity of grit in the crop contents of male red-billed Quelea (*Q. quelea*) and insects remained was totally absent in the crop contents of male *Q. quelea* sampled for this study.

3.3. Crop contents of female red-billed quelea (*Q. quelea*) for the month of September to November, 2022

Nine different food items including grits and insect remains were recovered from the crop contents of female red-billed quelea (*Q. quelea*) sampled for the month of September, the crop contents reveals *Dactyloctenium aegyptium* was the most consumed food item with a mean of 157.33 ± 2.14 . This was followed by *Digitaria iburua* with a mean of 31.14 ± 0.37 and the least consumed seed for the month of September by the females *Q. quelea* was *Digitaria ciliaris* with a mean of 0.04 ± 1.09 . *Oryza barthi* (59.57 ± 3.51) has the highest mean value, followed by *Oryza sativa* (42.16 ± 1.19) and the least mean value was *Digitaria ciliaris* (1.01 ± 0.06) in the crop contents of female *Q. quelea* sampled in the month of October 2022 as shown in table 2. There were twelve different food items including grits and insects remain in the crop contents of female sampled in October.

The most consumed food items in the month of November by female *Q. quelea* was *Oryza barthi* with the highest mean of 61.23 ± 1.61 , followed by *Oryza sativa* with a mean of 41.27 ± 0.23 and the least seed consumed for this month was *Brachiaria mutica* with a mean of 08.33 ± 1.34 as shown in table 2

Table 1 The mean food items recovered from the crop of male *Quelea quelea* from the Months of September to November

Months	Bm Mean S.E	Da Mean S.E	Dc Mean S.E	Di Mean S.E	Ec Mean S.E	Ob Mean S.E
September	0.08 ± 0.14	161.24 ± 2.16	3.44 ± 1.09	27.16 ± 2.46	15.12 ± 2.01	00.00 ± 00.00
October	09.18 ± 2.71	19.08 ± 2.43	1.04 ± 0.06	14.09 ± 1.32	18.741 ± 1.47	63.25 ± 4.26
November	09.21 ± 0.27	10.02 ± 0.37	1.13 ± 1.46	23.16 ± 1.17	17.36 ± 3.11	63.14 ± 2.31

P > 0.05

Table 2 The mean food items recovered from the crop of male *Quelea quelea* from the Months of September to November

Months	Os Mean S.E	Re Mean S.E	Sb Mean S.E	Sp Mean S.E	Gr Mean S.E	In Mean S.E
September	00.00 ± 00.00	21.11 ± 0.38	00.00 ± 00.00	19.13 ± 0.29	04.21 ± 2.06	00.00 ± 00.00
October	40.38 ± 2.17	36.11 ± 1.23	13.47 ± 2.14	26.08 ± 3.22	03.05 ± 1.13	00.00 ± 00.00
November	42.16 ± 1.21	11.04 ± 0.25	28.08 ± 1.43	21.37 ± 0.13	04.07 ± 1.04	00.00 ± 00.00

P > 0.05; Key: Bm= *Brachiaria mutica*, Da= *Dactyloctenium aegyptium* Dc= *Digitaria ciliaris*, Di= *Digitaria iburua*, Ec= *Echinochloa colonum*, Ob= *Oryza barthi*, Or = *Oryza sativa* Re= *Roetboellia exaltata*, Sb= *Sorghum bicolor* Sp= *Setaria pallido-fusca*, Gr= Grit, In= Insect

Table 3 The mean food items recovered from the crop of female *Quelea quelea* from the Months of September to November

Months	Bm Mean S.E	Da Mean S.E	Dc Mean S.E	Di Mean S.E	Ec Mean S.E	Ob Mean S.E
September	2.79 ± 0.09	157.33± 2.14	3.44 ± 1.09	31.14 ±0.37	09.71 ±2.11	00.00 ±00.00
October	11.04 ± 1.63	19.11 ±3.02	1.01 ±0.06	10.27 ±2.06	15.43±1.27	59.57± 3.51
November	08.33 ±1.34	09.74 ±1.33	0.93 ±03.07	19.57 ±1.13	11.33 ±2.13	61.23± 1.61

P >0.05

Table 4 The mean food items recovered from the crop of female *Quelea quelea* from the Months of September to November

Months	Os Mean S.E	Re Mean S.E	Sb Mean S.E	Sp Mean S.E	Gr Mean S.E	In Mean S.E
September	00.00 ±00.00	20.21±3.35	00.00 ±00.00	17.61 ±0.09	04.73 ±3.03	06.26 ±10.03
October	42.16±1.21	37.13 ±4.33	14.33 ±1.14	24.06 ±3.31	03.02 ±1.41	07.13 ±05.01
November	41.27 ±0.23	09.07 ±0.32	26.13 ±2.21	19.19 ±0.13	03.03 ±1.07	03.28 ±06.07

P >0.05

Table 5 Comparison of Grass Seeds in the Vicinity of the birds' feeding area, the top soil of birds' habitat, and birds' crops

Grass (seeds)	Vicinity of birds feeding area	Top soil of the birds' habitat	Birds' crops
<i>Brachiaria mutica</i>	+	+	+
<i>Cenchrus biflorus</i>	+	+	-
<i>Chloris pilosa</i>	+	+	-
<i>Dactyloctenium egyptium</i>	+	+	+
<i>Digitaria ciliaris</i>	+	+	+
<i>Digitaria iburua</i>	+	+	+
<i>Echinochloa colonum</i>	+	+	+
<i>Eragorastis tremula</i>	+	+	-
<i>Eragorastis gangetica</i>	+	-	-
<i>Oryza barthi</i>	+	+	+
<i>Oryza sativa</i>	+	+	+
<i>Panicum sp</i>	+	+	-
<i>Roetboellia exaltata</i>	+	+	+
<i>Sacciolepis Africana</i>	+	+	-
<i>Setaria pallidofusca</i>	+	+	+
<i>Schoenefeldia gracilis</i>	-	+	-
<i>Sorghum bicolor</i>	+	-	+

Key + = Positive, - = Absent

3.4. Comparison of Grass Seeds in the Vicinity of the birds' feeding area, the top soil of birds' habitat, and birds' crops

Brachiaria mutica, *Cenchrus biflorus*, *Chloris pilosa*, *Dactyloctenium aegyptium*, *Digitaria ciliaris*, *Digitaria iburua*, *Echinochloa colonum*, *Eragrostis tremula*, *Oryza barthi*, *Oryza sativa*, *Panicum sp*, *Roetboellia exaltata*, *Setaria pallidofusca*, *Schoenefeldia gracilis*, *Sacciolepis Africana* and *Sorghum bicolor* were found in the *Quelea quelea*'s feeding area, top soil of the *Quelea quelea*'s habitat and in the crop of birds. It was observed in this study that most of the soil seeds reserved and grass seeds within the birds' vicinity were also found in the *Quelea quelea*'s crops. While *Eragrostis gangetica* is absent in both the birds' vicinity and crop of the *Quelea quelea* sampled for this study. *Schoenefeldia gracilis* was present only in the top soil (soil seed reserves) of the *Quelea quelea*'s habitat.

4. Discussion

The result of this study on evaluation of the food of *Quelea quelea* in Gyawana ecosystem and environs revealed that *Q. quelea* is euryphagous during cropping season (September to November, 2022). Several seeds of different plants, insects and grits were recovered from the crops contents of *Q. quelea* making a total of twelve taxonomically different food items during the study period and these were presented in tables 1- 3. In the month of September, the most consumed seed by *Q. quelea* is *Dactyloctenium aegyptium* with mean of 161.24 ± 2.16 in male and 157.33 ± 2.14 in female, followed by *Digitaria iburua* with 27.16 ± 2.46 and 31.14 ± 0.37 in male and female respectively, and the least seed consumed by the *Q. quelea* in the month of September is *Brachiaria mutica* (0.08 ± 0.14) in male and *Echinochloa colonum* 09.71 ± 2.11 in female *Q. quelea*. Eight different food items were found in the male crop contents of *Q. quelea*, while in female crop contents there were nine different food items recovered including insect's remains. The findings of this research is in line with (GTZ, 1978; Buba *et al*, 2013), who reported several food items recovered in the crop contents of Red-billed quelea birds (*Q. quelea*) in Sambisa Game Reserve and environs.

The most preferred food item in the month of October by males *Q. quelea* was *Oryza barthi* with a mean of 63.25 ± 4.26 and 59.57 ± 3.51 in male and female respectively; this was followed by *Oryza sativa* with the mean value of 40.38 ± 2.17 in male and 42.16 ± 1.21 in female. Then the least seed foraged on by male *Q. quelea* was *Brachiaria mutica* with a mean of 09.18 ± 2.71 and in female *Q. quelea* was 1.01 ± 0.06 *Digitaria ciliaris* as shown in table 1 and 2. In male crop contents of *Q. quelea*, eleven different food items were recovered, while the female *Q. quelea* foraged on twelve different food items including grits and insects remains. The result of this study concur 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.

It was observed that in the month of November, the most consumed seed by male *Q. quelea* is still *Oryza barthi* with a mean value of 63.14 ± 2.31 and 61.23 ± 1.61 in male and female respectively. This was followed by *Oryza sativa* male (42.16 ± 1.21) and female (41.27 ± 0.23), while the least seed consumed was *Brachiaria mutica* 09.21 ± 0.27 in male and 08.33 ± 1.34 in female, as presented in table 1 and 2. There was small quantity of grit in the crop contents of both male and female *Q. quelea*, insect's remains was totally absent in the crop contents of male *Q. quelea* but present in the crop contents of female *Q. quelea* sampled for this study. The result of this present study is not in line with the results of Yusuf and Bello (2004), who reported that food of *Quelea* birds during the early dry season in the months of November – December in Borno State include; *Pennisetum glaucum*, *Tetrapogon aestevum*, *Echnochloa colonum*, *Schoenefeldia vulgare*, *Oryza. barthi* and sand. Furthermore, in their work, they reported the consumption of uncultivated food types as significantly higher than cultivated food types. This means that cultivated crop would be less vulnerable when uncultivated grass seed are available. The differences in the food items observed in this study with those reported by other researchers may be as a result of the different crops cultivated in which the studies were carried out. During the period of November – December, cultivated crops such as *Pennesetum glaucum* were abundantly available to the birds since harvesting was still on in Borno State, while in Gyawana, Adamawa State, *Oryza sativa* and *Sorghum bicolor* were also abundantly available in the vicinity of the birds since harvesting was on. It may also be due to the geographical location and the few numbers of birds the researchers used in Borno State.

The finding of this study reveals that only female crop contents of *Q. quelea* contained insect's remains. This result agree with the findings of (Welty and Baptista 1990; Buba *et al*, 2013), who 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.*, (2004b), 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 comparison of the grass Seeds in the *Q. quelea*'s crops, grass plants in the habitat of the *Q. quelea* and seed reserved in the top soil of the *Q. quelea*'s habitat, reveals that *Brachiaria mutica*, *Cenchrus biflorus*, *Chloris pilosa*, *Dactyloctenium aegyptium*, *Digitaria ciliaris*, *Digitaria iburua*, *Echinochloa colonum*, *Eragrostis tremula*, *Roetboellia exaltata*, *Sacciolepis Africana*, *Schoenefeldia gracilis* and *Setaria pallido-fusca*, were found in the top soil of the *Q. quelea*' habitat when cultured for seeds reserved. It was also reveals that, most of the soil seeds reserved and grass seeds within the *Q. quelea*' habitat were also found in the *Q. quelea*' crops. While *Digitaria acuminatissima*, *Echinochloa obtusiflora* and *Echinochloa pyramidalis* were present in the top soil of *Q. quelea*'s habitat (soil seed reserves) but absent in both the *Q. quelea*'s crops and their habitat. The result of this present study is in line with other researchers like Ward (1965); Erickson, (1979); GTZ (1987), Yusuf *et al.*, (2004a) 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 grass seeds, they may travel to distant places of about 10km – 20km away from their night roost to forage.

5. Conclusion

In conclusion, for this period of study September to November 2022, it was observed that *Q. quelea* is euryphagous. *Dactyloctenium aegyptium* was the most preferred seed foraged upon by *Quelea quelea* during cropping season in Gyawana ecosystem and its environs, Adamawa State, Nigeria. This might be due to the fact that it was found throughout the bird's vicinity, although it varied in quantity, while the least preferred food items was found to be *Digitaria ciliaris*. The rest of the Quelea food items observed in this study are; *Brachiaria mutica*, *Digitaria iburua*, *Echinochloa colonum*, *Oryza barthi*, *Oryza sativa* *Roetboellia exaltata*, *Sorghum bicolor*, *Setaria pallido-fusca*, Grits and Insect. The most consumed seed of them on field was *Dactyloctenium aegyptium* which was also found to be the most abundant in the top soil seed reserve after cultivation. The least in the field was *Sacciolepis Africana* and the least in the top soil was *Chloris pilosa*. The presence of insects in the diet of only females is an indication of the importance of protein-rich food in the life of female birds, especially with regard to the demands and stress of egg production. Grit was found in small quantities in both male and female *Q. quelea*, which aid in seed grinding.

From the outcome of this study, the researchers, therefore suggests the following recommendation: That further studies should be carried out on biological control on Quelea birds, by the reintroduction of their predators such as the red-necked falcon *falco chicquera* into the area, since there were cultivated crops found in the crop of *Quelea quelea* such as *Oryza sativa* and *Sorghum bicolor*

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed. There is no conflict of interest

Statement of ethical approval

The ethical approval was obtained from Adamawa State University, Mubi, Institutional Animal Care and Ethic Committee with REF: ADSU/IACEC/ANP-A045/2021. The approval Number: ADSUIACEC/2021/011




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