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Bird's diversity of Wadi Fatimah Dam area, Makkah region, Saudi Arabia

Abdul-Rahman A. Alasiri, Hassan M. Felemban*, Mohammed I. Mujallid

Department of Biological Sciences, King Abdul-Aziz University, Jeddah, Saudi Arabia
Corresponding author E–mail:hfelemban@kau.edu.sa

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Study of birds' diversity in Wadi Fatimah dam area was carried out during the period of 12 months (April 2019-March 2020). A total of 87 bird species were recorded during this study. The study area is about 10 km. The dam is located in a narrow wadi in-between mountain slopes with width of 1.5 Km. The study area was divided into four different sites in upper and lower of the dam: Upper area of the dam: (1) Site with vegetation cover, (2) Site by the mountain slope. Lower area of the dam: (3) Agricultural farms site, (4) Site in the middle of the wadi. Of the 87 bird species observed, 40 were migratory. The most common bird species were: The black kite, The Little Egret, The Palm Dove, The Rock dove, The Little green Bee-eater, The black-bush Chat, The Crested Lark, The Graceful Warbler, The Ruppell's Weaver, The House sparrow. A list of all bird species occurred in the study area was recorded according to different seasons. A number of nesting material for breeding bird species was observed.
Keywords: Birds diversity, Bird species, Vegetation cover, Migratory, Nesting material, Breeding bird species.

Introduction

The Kingdom of Saudi Arabia predominantly desert environment like all desert ecosystems, the desert avian fauna of Saudi Arabia has received less scientific research attention than other ecosystems (Durant et al., 2012). Despite the vast size and diverse topography of Saudi Arabia, studies on the ecology and distribution of its terrestrial fauna have not been explored well, especially in the western Wadis of the country. There still remain significant gaps in our understanding of how animal diversity in these systems is changing seasonally with time due to a lack of systematic monitoring (Davies et al., 2012).

Compared to bird species, birds are generally not well represented in desert environments–including the Saudi Arabia. Unfortunately, published literature on the terrestrial birds of the Saudi Arabia is still few. However, contributions by various authors have increased the information for certain number of species (Jennings, 2010).

There is a need for a updated information to estimate the species richness of birds in Makkah region as the first step to increase knowledge of the regional bird fauna. The aim of this study was to fill the gap in the distribution of birds in Wadi Fatimah dam area. A survey can be an important addition to understanding the diversity of birds in the region of Makkah and also on the study area.

The study area of Wadi Fatima Dam has been built out of a large concrete, the length of this dam 600 m and a height of 15 m, the volume of storage of this dam is 20 million cubic meters of water. This dam was established in1985.

The study area of Wadi Fatima Dam is filled with water in certain season of the year and the Dam stays dry most of the year. Precipitation is very heavy in March and April. Therefor animal diversity between Jan to May is high, as water in the area may reach a height of 15 m above the Dam and extends more than 10 km below the Dam westwards.

Study area

This area is characterized by mountainous terrain reaching an altitude of 450 m. The rocky cliffs are located on both sides of the Wadi as well as farms to the north-west of the Wadi Dam (Figure 1).

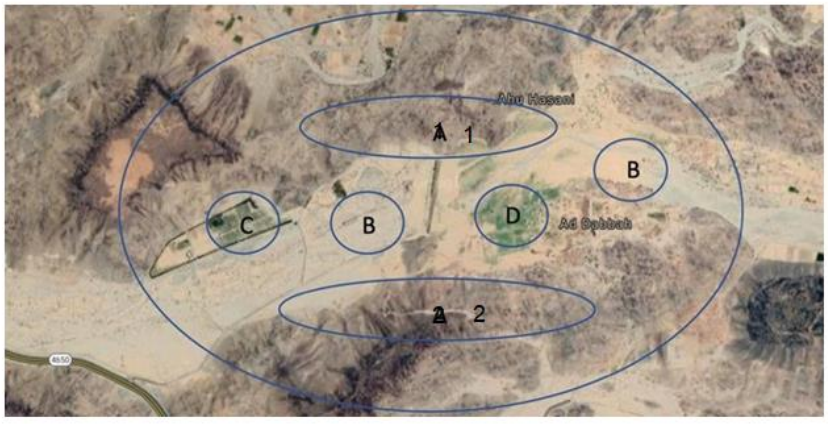

Fig. 1.A google map showing the location of different observation sites within the study area; (A1, A2) mountains slopes. (B) Middle of wadi and flood running area. (C) Farm's area, (D) the muddy sites. The large outer circle is the study area's boundary estimated by 5 km × 5 km. (Google map obtained on April 2019).

The study area is covered and dominated by some plant species including the followings (Table 1);

Table 1. Plant species with scientific names.

No	Plant species (English)	(Scientific name)
1	Al-samer Acacia	*Acacia sp.*
2	Al-salamAcaciaal	*Acacia ehrenbergiana*
3	Al-sunt Acacia	*Acacia raddiana*
4	Al-ushar	*Calotropis procera*
5	Zyziphus tree	*Spina Christi*
6	Al-Harmal	*Rhazya stricta*
7	Almarkh	*Leptadenia pyrotedhinica*

And other shrubs species e.g: Tarf (*Aervajavanica*), Alhandal (*citrullus sp.*) , *Argemone sp.*, and *Blepharis sp.*Farms are located in The lower side of the dam as dominated by several plant species such as Tamarix ,Manitoka , Palm trees , *citrullus sp.* And some crops of grapes, watermelon, corn, Tomato, and carrot.
The classifications of plant species were obtained using references of Migahid, (1988) and Collenette, (1985).
The study area temperature reaches between 40°C to 50°C in summer, and is characterized by high humidity dueto the increase the rate of water evaporation up to 50% humidity in the air.
In winter the temperature is reduced to 15°C and in the middle of the day the temperature reaches 27°C and gradually decreases as the temperature after sunset reaches 19°C. Thus this season is characterized to be drought. However, in spring, the heavy rain season and the temperature is moderate and the temperature is between 26°C to 32°C.

Materials and Methods

Migratory species have been identified, especially in March 2020, and bird species have been defined using some references and fields guide of bird species in the Middle East and neighboring countries (Porter et al., 1996); (Clayton el al., 1983).
Birds' behavior was also monitored by recording mating cases, building nests and marking the presence of species by noting songs & voices, bird droppings, and footprints in clay and soil areas. The duration of this study in Wadi Fatimah Dam area exist for 11 months (April, 2019–March, 2020). The spring season is most likely to be in March, April, and May.
Bird species were recorded out of field survey carried out in the upper and bottom of the dam area by observing them with binocular and taking pictures by a Nikon D5300 camera whenever that is possible. The duration of observation was from 6 am to 12 pm, and after 4 pm until sunset.

Results

87 species of birds were identified, including some residents, and migrants. The most common type in the study area in terms of their number of observations, which are mainly consider as resident species are as follows:

- Palm Dove, it had a population of 35 birds.
- House Sparrow, it hada population of 28 birds.
- Rock Dove, it had a population of 23 birds.
- African Collared Dove, it had a population of 22 birds.
- RÜppell's Waiver, it had a population of 22 birds.

The total of resident birds thirty-four(34) and its percentage 38.5%, total of migrants birds forty (40) and its percentage 45.5%, and the total of mixed birds reach fourteen (14) its percentage 16% (Table 2).
These resident species have been recorded to collect their total population, nesting, and mating cases which have been observed to see how rich the area is in birds. The area is considered to be rich in birds, also due to the presence of insects in the region, as some birds mainly feed on insects such as Little Green Bee-eater, or small reptiles such as hoopoe, or Agricultural crops as most of the birds.
Migratory birds are divided into four sections in different seasons: spring passage from (March–May), summer visitor from (June–August), autumn passenger from (September–November), and wintering\winter passenger birds from (December–February). The number of these birds reached about 54 species, as 14 of these birds are mixed birds which stayed at Wadi Fatimah dam area for breeding, lay eggs, and some of this birds stayed in study area, until the end of a particular season, and the other 40 are migrants.

Table 2. A list of residents, migrants, and mixed bird species and their status that were observed during the period from April 2019 to March 2020 in the Wadi Fatimah Dam area for different sites (A1, A2, B, C, and D).

Bird species	Scientific name	No. observed (Sites)	Migrants	Residents	Mixed
Cattle Egret	*Bubulcus ibis*	6 (B,D)	-	-	√
Little Egret	*Egretta garzetta*	9 (B,D)	√	-	-
Great White Egret	*Egretta alba*	5 (B,D)	√	-	-
Glossy Ibis	*Plegadis falcinellus*	9 (B,D)	√	-	-
Teal	*Anas crecca*	7 (B,D)	√	-	-
Black Kite	*Milvus migrans*	20 (A1,A2)	-	-	√

Short-toed Eagle	*Circaetus Gallicustusgallicus*	8 (A2)	√	-	-
Golden Eagle	*Aquila chrysaetos*	2 (A2)	√	-	-
Kestrel	*Falco tinnunculus*	19 (D,A1)	-	√	-
Merlin	*Falco columbarius*	6 (C)	√	-	-
Arabian Partridg	*Alectoris melanocephala*	17 (A1)	-	√	-
Sand Partridge	*Ammoperdix heyi*	9 (A2)	-	√	-
Quail	*Coturnix coturnix*	9 (C,D,A2)	√	.	-
Black-winged Stilit	*Himantopus himantopus*	11 (C,D,B)	-	-	√
Stone Curlew	*Burhinus oedicnemus*	5 (B,C)	√	-	-
Senegal Thick-knee	*Burhinus senegalensis*	1 (B)	√	-	-
Cream-colored Courser	*Cursorius cursor*	7 (B)	√	-	-
Spur-winged Plover	*Hoplop uterusspinosus*	4 (C)	√	-	-
Common Snipe	*Gallinago gallinago*	3 (B,C)	√	-	-
Great Snipe	*Gallinago media*	6 (B,C)	√	-	-
Redshank	*Tringa totanus*	16 (B,C)	√	-	-
Greenshank	*Tringa nebularia*	12 (B,C)	√	-	-
Lichtenstein's Sandgrouse	*Pteroclesl ichtensteinii*	10 (B,C,A1)	-	√	-
Crowned Sandgrouse	*Pterocles coronatus*	7 (B,C,A1)	√	-	-
Chestnut-bellied Sandgrouse	*Pterocles exustus*	15 (B,C,A2)	-	√	-
Rock Dove	*Columba livia*	23 (A1,B,C)	-	√	-
African Collared Dove	*Streptopelia rose grisea*	22 (A1,B,C)	-	√	-
Collared Dove	*Streptopelia decaocto*	20 (A1,B,C)	-	-	√
Turtle Dove	*Streptopelia turtur*	9 (A1,B,C)	√	-	-
Palm Dove	*Streptopelia senegalensis*	35 (A1,B,C)	-	√	-
Namaqua Dove	*Oena capensis*	7 (A1,B,C)	-	√	-
Barn Owl	*Tyto alba*	13 (A1,C)	-	√	-
Striated Scops Owl	*Otus brucei*	2 (A2)	√	-	-
Eagle Owl	*Bubo bubo*	1 (A1,A2)	-	√	-
Little Owl	*Athene noctua*	4 (C)	-	√	-
Nubian Nightjar	*Caprimulgus nubicus*	9 (A2,B,C)	-	√	-
Common swift	*Apus apus*	2 (C)	√	-	-
Pallid Swift	*Apus pallidus*	7 (C,B)	√	-	-
Alpine Swift	*Apus melba*	11 (C,B)	-	√	-
White-rumped Swift	*Apus caffer*	14 (C,B)	-	-	√
Little Swift	*Apus affinis*	3 (C,B)	-	-	√
Blue-cheeked Bee-eater	*Merops superciliosus*	7 (B,D)	√	.	-
Little Green Bee-eater	*Merops orientalis*	16 (B,D)	.	√	-
European Bee-eater	*Merops apiaster*	6 (B,D)	√	.	-
Hoopoe	*Upupa epops*	12 (B,C,D)	-	-	√
Bar-tailed Desert Lark	*Ammomanes cincturus*	6 (B,C,D)	-	-	√
Desert Lark	*Ammomanes deserti*	17 (A1,B)	-	√	-
Hoopoe Lark	*Alaemon alaudipes*	8 (A1,B)	-	-	√
Crested Lark	*Galerida cristata*	13 (B,D)	-	√	-
African Rock Martin	*Ptyonoprogne fuligula*	15 (C)	-	√	-
Red-rumped Swallow	*Hirundo daurica*	1 (C,D)	√	-	-
House Martin	*Delichon urbica*	15 (C,D)	-	-	√
Citrine Wagtail	*Motacilla citreola*	4 (B,D,A1)	√	-	-
Black-capped Bulbul	*Pycnonotus xanthopygos*	14 (B,C,D)	-	√	-
Rufous Bush Chat	*Cercotrichas galactotes*	18 (D,C)	√	-	-

Black Bush Chat	*Cercotrichas podobe*	13 (D,B)	-	√	-
Nightingale	*Luscinia megarhynchos*	6 (D)	√	-	-
Redstart	*Phoenicurus phoenicurus*	9 (D,B)	√	-	-
Black Start	*Cercomela melanura*	14 (A1,B,D)	-	√	-
Isabelline Wheatear	*Oenanthe isabellina*	7 (C,D)	√	-	-
Desert Wheatear	*Oenanthe deserti*	7 (C,D,B)	√	-	-
White-crowned Black Wheatear	*Oenanthel eucopyga*	9 (A2,B)	-	-	√
Graceful warbler	*Prinia gracilis*	17 (C,D,B)	-	√	-
Scrub Warbler	*Scotocerca inquieta*	2 (C,D)	-	√	-
Desert Warbler	*Sylvia nana*	6 (D,B)	√	-	-
Arabian Warbler	*Sylvia leucomelaena*	5 (B,D)	-	√	-
Whitethroat	*Sylvia communis*	5 (C,D)	√	-	-
Blackcap	*Sylvia atricapilla*	6 (B,D)	√	-	-
Chiffchaff	*Phylloscopus collybita*	3 (C,D,B)	√	.	-
Willow Warbler	*Phylloscopus trochilus*	8 (C,D,B)	√	-	-
Arabian Babbler	*Turdoides squamiceps*	1 (C,D,B)	-	√	-
Nile Valley Sunbird	*Hedydipna metallica*	9 (C,D,B)	-	√	-
Shining Sunbird	*Cinnyris habessinicus*	7 (D,B)	-	√	-
Palestine Sunbird	*Cinnyris osea*	2 (D,B)	-	-	√
Golden Oriole	*Oriolus oriolus*	4 (D,B)	√	-	-
Isabelline Shrike	*Lanius isabellinus*	4 (D,B)	√	-	-
Great Grey Shrike	*Lanius excubitar*	9 (D,B)	-	-	√
Tristram's Grackle	*Onychognathus tristramii*	11 (D,B)	-	√	-
Common Mynah	*Acridotheres tristis*	12 (A1,C,D,B)	-	√	-
House Sparrow	*Passer domesticus*	28 (A1,C,D,B)	-	√	-
Pale Rock Sparrow	*Petronia brachydactyla*	3 (A1,C,D,B)	√	-	-
Ruppell's Weaver	*Ploceus galbula*	22 (A1,C,D,B)	-	√	-
Indian Silverbill	*Euodice malabarica*	6 (C,D)	√	-	-
African Silverbill	*Euodicec antans*	13 (C,D)	-	√	-
House Bunting	*Emberiza striolata*	9 (C,D)	-	-	√
Ortolan Bunting	*Emberiza hortulana*	13 (C,D)	√	-	-
African Rock Bunting	*Emberiza tahapisi*	2 (C,D,B)	-	√	-
∑ N = 87	*∑ n*		40	34	14

*(A1, A2) Mountains slops. (B) Middle of wadi and flood running area. (C) Farm's area, (D) The muddy sites.

Building nests is one of the behaviors recorded for the resident birds in certain months of the year. Prepared for the mating season, and the months are different, or they may be similar to another species. It was also observed that birds fly in pairs as well. See Table 3.

Table 3. A list of resident bird species with nest build records: mating behavior, chicks' number, and nest shape observed in the study area from April 2019 to March 2020.

Species	Mating	Pair No.	Date of nesting	Nest shape and Location	chicks
African Collared Dove	2	5	March	Circular nest on Ziziphus trees branches and acacia trees.	1
Palm Dove	4	8	Aug-May	Circular nest on Ziziphus trees branches and acacia trees.	3
Little Green Bee-eater	1	3	Feb	In sandy hills borrows	16
Hoopoe	-	1	Feb	In trees trunk	-
Desert Lark	1	1	January	Under a rock in below side	-
Black Bush Robin	2	6	Aug and Oct	Under shrubs	-

Shining Sunbird	2	3	May	The shape of the nest is oval hanging	-
Ruppell's Weaver	5	7	Aug and Dec	Nest hanging from Acacia, palm trees, and Ziziphus trees	2
African Silver-bill	1	3	Nov and Mar	The conical shape on trees branches like V	-
Yellow-vented Bulbul	6	10	May and Oct	Circular nest on Ziziphus trees	5
Nail Valley Sunbird	2	6	Apr-May	The shape of the nest is oval hanging	-

Among the distinctive birds that were frequently seen in the study area was hoopoe, and it was easy to follow its different behavior. In May, it was recorded that hoopoe fly in pairs, and their activities are also different from other months (increasing). From June to February it's observed taking the materials to build nests and It is possible that there are cases of mating in the study area (Figure 2).

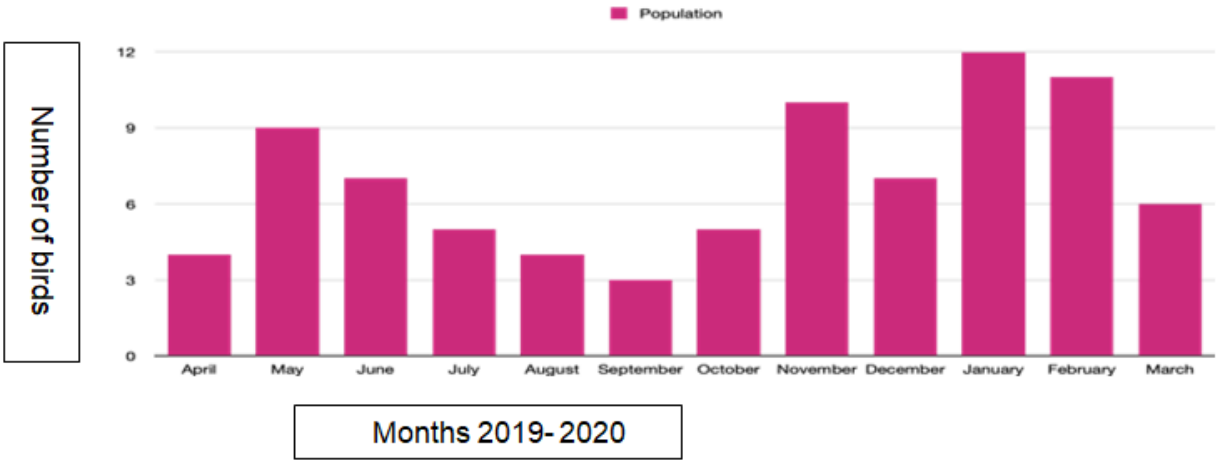

Fig. 2. Showing the Hoopoe activity from April 2019 until March 2020, and its numbers.

The total migrant species was 40 in the study area (Table 3). Four categories were considered, namely winter visitor, spring passage, summer visitor, autumn passage.

Table 3. Shows the migrant birds and its population during different season of April 2019 until March 2020, in Wadi Fatimah Dam area.

Species	Winter visitor 2019/2020	No.	Spring passage 2019	No.	Summer visitor 2019	No.	Autumn passage 2019	No.
Cattle Egret	√	19	√	5	-	-	√	9
Little Egret	√	9	√	6	-	-	√	8
Great White Egret	√	5	√	2	-	-	√	5
Glossy Ibis	√	9	√	3	-	-	√	6
Teal	√	7	-	-	-	-	-	-
Black Kite	√	20	-	-	-	-	√	5
Egyptian Vulture	√	15	-	-	-	-	√	7
Short-toed Eagle	√	8	-	-	-	-	-	-
Golden Eagle	√	2	-	-	-	-	-	-
Merlin	√	6	√	3	-	-	-	-
Quail	-	-	√	9	-	-	√	8
Black-winged stilt	√	11	√	5	-	-	-	-
Stone Curlew	√	5	√	2	-	-	√	3
Senegal Thick-knee	-	-	√	1	-	-	-	-
Cream-coloured Courser	√	7	√	3	-	-	-	-
Spur-winged Plover	√	2	√	4	-	-	-	-

Common Snipe	√	1	√	2	-	-	-	-
Great Snipe	-	-	√	6	-	-	-	-
Redshank	√	5	√	11	-	-	-	-
Greenshank	√	5	√	12	-	-	-	-
Crowned Sandgrouse	√	4	√	3	-	-	-	-
Collared Dove	-	-	√	20	√	10	-	-
Turtle Dove	-	-	√	9	-	-	-	-
Striated Scops Owl	√	2	√	1	-	-	-	-
Common Swift	-	-	√	2	-	-	-	-
Pallid Swift	-	-	√	3	√	4	-	-
White-rumped Swift	√	10	√	14	-	-	-	-
Little Swift	-	-	√	3	√	3	-	-
Blue-cheeked Bee-eater	-	-	√	4	√	7	-	-
European Bee-eater	-	-	√	2	-	-	√	6
Hoopoe	-	-	-	-	√	10	-	-
Bar-tailed Desert Lark	-	-	√	6	√	3	-	-
Hoopoe Lark	-	-	√	8	√	6	-	-
Red-rumped Swallow	-	-	√	1	-	-	-	-
House Martin	-	-	√	15	√	4	-	-
Citrine Wagtail	-	-	-	-	√	4	√	2
Rufous Bush Robin	-	-	√	10	-	-	-	-
Nightingale	√	2	√	6	-	-	-	-
Redstart	-	-	√	9	-	-	-	-
Isabelline Wheatear	√	7	√	7	-	-	-	-
Desert Wheatear	√	2	√	5	-	-	-	-
White-crowned Black Wheatear	-	-	√	9	-	-	√	5
Desert Warbler	√	6	√	2	-	-	-	-
Whitethroat	√	5	√	5	-	-	-	-
Blackcap	-	-	√	6	-	-	-	-
Chiffchaff	√	3	√	3	-	-	-	-
Willow Warbler	√	4	√	8	-	-	-	-
Palestine Sunbird	-	-	√	2	√	1	-	-
Golden Oriole	-	-	√	4	-	-	-	-
Isabelline Shrike	√	2	√	4	-	-	-	-
Great Grey Shrike	-	-	√	9	√	8	-	-
Pale Rock Sparrow	√	1	√	4	-	-	-	-
Indian Silver-bill	-	-	√	4	√	6	-	-
House Bunting	√	7	-	-	-	-	√	9
Ortolan Bunting	-	-	√	5	-	-	-	-

Migrant birds: 40; Mixed birds: 14; $\sum N=54$.

The Blue-cheeked Bee-eater was observed when they were catching bees and wasp. The male and female were shifted in taking care of chicks. Upon following up on this bird, it was found that it arrives in May as summer visitor and does not build a new nest, except that it uses the same sand borrows as for other Bee-eater. Then these birds migrate at the end of August to southwards. See Figure 3.

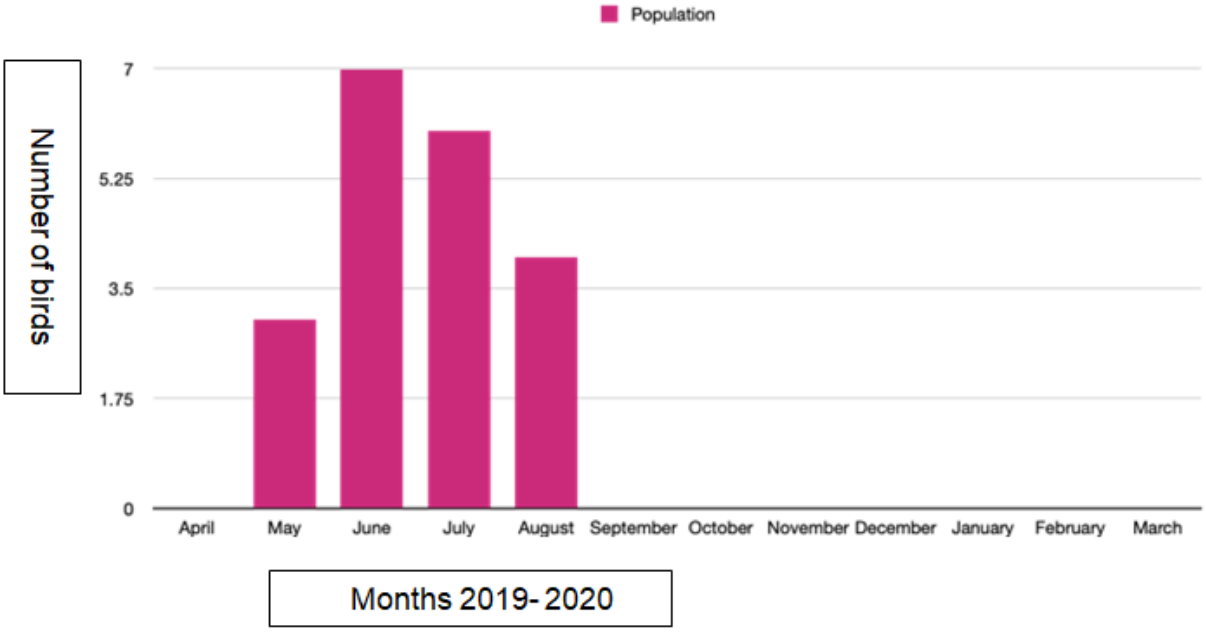

Fig. 3. A histogram of the blue-cheeked bee-eater arrival data in May and departed in August 2019, and its numbers during summer months, in the Wadi Fatimah dam area.

Statistical analysis was made for data of Table 3 to find out whether the differences is significant or not between birds of spring and autumn seasons. The (mathematical) show: The X-axis is the spring migratory birds count. The Y-axis is the count of the autumn migratory birds. There is a significant difference between spring and autumn birds' number (P>0.05) out of (SAS) program. This means the diversity of passage migrants in spring is much higher than in autumn, where the value of P=0.8681, the mean=4.195122, and standard deviation=3.116244 indicating the region received different species of birds in spring.

Discussion

It seems that the records of 87 species from this study area is highly distinguished during the period from April 2019–March 2020. Other studies (Alatawi et al., 2018) listed 19 species at Wadi Aldesa, Tabuk. Whereas in other study by (Felemban,1996) was carried out in Wadi Alahseba, south of Jeddah during12 months period was resulted to 82 species.

Due to the habitat diversity in Wadi Fatimah created by topography, vegetation, and especially permanent water is largely responsible for bird's species richnes that were observed.The percentage of migratory and mixed birds represents (61.5%) and this is a high percentage compared to other areas such as studies (Alatawi et al., 2018) in the Tabuk region received a rate (21%), and in the other studies (Felemban, 1996) of Wadi Alahseba the percentage of migratory birds (45.5%).

87 species of birds were identified and were very difficult in those rugged terrain and the Birds diversity at Wadi Fatimah dam area it depends on Water availability, e.g. Arabian Peninsula (Abu Zinada et al., 2004). The number of birds was recorded for 12 months starting from (April 2019–March 2020), in the winter was a little diversity in the dam area which representing resident birds in the region. The spring season in March, 2020 was a very large diversity significantly as the dam area was filled with migratory birds in this season especially for the heavy rains and the dam was full with water for several days. The water level in the dam reached 15 m, in this season whereas birds are seen and they extent their abundance significantly. The scarcity of rainfall in the Wadi Fatimah Dam area is an influential cause of different vegetation cover and land topography within desert environmental conditions (Tews et al., 2004; Korine et al., 2015).

Conclusion

The region varies significantly in birds numbers between spring and autumn seasons, and between the rainy and the dry seasons. However over all conclusions indicate that 61.5% of the total recorded bird species are migrants and mixed. And breeding birds are occur in numerous numbers.

The fluctuation of birds numbers is a reflection of rainy period or flood season in the area. As birds diversity is high due to good vegetation cover in a dry ecosystem. Therefore Biodiversity is an important project to evaluate the species richness in dam ecosystem for animal diversity especially birds diversity.

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