Diversity and abundance of wild birds species' in two different habitats at Sharkia Governorate, Egypt

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Abstract

Background: Birds' survey is the best method to understand different species distribution, abundance, and diversity. The present study aimed to survey wild birds, using point count method, in two habitat types (water canals and field crops) at two districts, Zagazig and Hehia, located at Sharkia Governorate, Egypt.

Methods: Surveying birds was conducted using point count method, from a fixed raising position within a circle of 50 m radius for a specific period of time (10 min) at every point. It started early in the morning, from 6 am to 8 am, at four points in two habitat types, agriculture water canals habitat (AWCH) and field crops habitat (FCH), in (Zagazig and Hehia) at Sharkia Governorate, Egypt. Each point count was visited once every month from December 2016 to November 2017.

Results: The total number of birds' species recorded in the two districts was 33, belonging to 24 Families and ten Orders. Twenty-five species were resident birds and eight species were migratory. The number of birds' species (resident and migratory) in AWCH was higher than those in FCH. Resident wild birds at AWCH had higher value of species diversity (Shannon-Weiner Diversity Index $H' = 2.63$, Simpson Diversity Index $D = 0.90$, Evenness $J' = 0.82$ and Species richness $r = 25$) than at FCH ($H' = 2.56$, $D = 0.89$, $J' = 0.83$, and $r = 22$). In contrast, species diversity for migratory wild bird was lower in WCH ($H' = 1.66$, $D = 0.74$, $J' = 0.80$, and $r = 8$) than in FCH ($H' = 1.81$, $D = 0.78$, $J' = 0.87$, and $r = 8$).

Conclusion: Birds species (resident and migratory) numbers and abundance were higher in AWCH according to the habitat suitability than in FCH.

Keywords: Wild bird, Survey, Point count method, Water canals, Habitat, Crops, Diversity index, Resident, Migratory

Background

Egypt is located at the Northeastern corner of Africa and occupies an area of about one million kilometer. It enjoys a unique strategic location, at the crossroads between Africa, the Middle East, and Europe. Egypt is divided into four physiographical regions: Nile Valley and Delta, Western Desert, Eastern Desert, and Sinai. The country is rich in wild bird species due to its wide range of habitats. Egypt is a "centralized" zone of wild bird migration pathways from Central Asia and Europe to Eastern and Central Africa expiration in South Africa (Soliman, Saad, Elassal, Amir, Plathonoff, Bahgat, El-Badry, & Mohamed. 2012). About 515 birds species

occurred in Egypt, 186 are resident and the rest are migratory (Tharwat, 1997). At Ismailia Governorate, 27 resident wild bird species, belonging to 20 families and nine orders, were recorded, while migratory birds were six species that belonged to five families and three orders (Abbasy, Mostafa, Khattab, El-Danasory, & Attia, 2011; Attia, 2013). Sharkia Governorate is a home of many wild bird species. Khattab (1998) recorded 23 resident species and eight migratory species. Attia (2006) recorded 25 resident species belonging to nine orders and 21 families, and 26 migratory species belonging to six orders and 15 families. Population density and species diversity of birds is differing, increasing or decreasing according to habitat type and richness.

This study aimed to investigate the abundant, distribution, and diversity of wild bird species, in two different

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habitats within two districts (Zagazig and Hehia), at Sharkia Governorate, and their probable impact on agriculture.

Materials and methods
Study areas
Sharkia Governorate is located at the eastern site of the Nile Delta. It covers about 1,200,000 feddans (1 feddan = 4200 m^2), one million of them is cultivated with different field crops and fruit orchards. Desert and swampland, with their different preferred birds habitats, are located to the eastern and southern borders of this governorate.

Data was collected from two districts; Hehia (30° 67′ N, 31° 59′ E) and Zagazig (30° 60′ N, 31° 51′ E). Two main habitats were chosen in each district:

1- Agriculture water canal habitat (AWCH): this site was around and beside main agricultural water canals, where dense vegetation, shrubs, and high trees usually located. Different field crop lands, cultivated with wheat, alfalfa, and onion in winter, maize and rice in summer, are nearby. Very low human settlements and activities are in this habitat.
2- Filed crops habitat (FCH): including the main agricultural fields planted with different traditional crops (wheat, alfalfa, and onion in the winter and maize and rice in summer) with some scattered palm trees. Farmers' houses and animal farms are adjacent to this habitat, with considerable human activities.

Field methods
Field data were obtained using the "point counts" method, which is a count from a fixed location, for a fixed time period, at any time of the year. This method is suitable for studying highly visible, and/or vocal bird species, in a wide variety of habitats (Gibbons, Hill, & Sutherland, 1996). In this study, birds were counted from a fixed raising position within a circle of 50 m radius for a specific period of time (10 min) at every point. After 5-min settling period, all birds seen and heard within this 50 m radius were recorded during the 10 min. Bird counts were carried out early in the morning, from 6 am to 8 am, at two points in each habitat within each district (four points at Zagazig and four points at Hehia). Each point count was visited once every month from December 2016 to November 2017 (Bibby, Burgess, Hill, & Mustoe, 2000; Haselmayer & Quinn, 2000; Lande, 1996). No detected windy or rainy conditions during the days of this study. A binocular (10 × 50) was used to confirm species identity. Proofs of identifications were done using Collins Bird Guide (Svensson, Mullarney, Zetterström, & Grant, 2009).

Species were assigned to families and orders according to Clements, Schulenberg, Iliff, Roberson, Fredericks, Sullivan, and Wood (2018).

Data analysis
Data were arranged to obtain the following parameters:

I) The relative abundance of bird species per habitat/district was determined using:

$$\text{Relative abundance} \ = \ \frac{n}{N}$$

where n is the total number of birds of a particular species and N is the total number of birds of all species.

II) Bird species diversity:

Species richness is the number of different species present in an area (Deitmers, Buehler, Bartlett, & Klaus, 1999). Species richness was estimated for each habitat.

Shannon-Weiner Index (H') was calculated in order to know the species diversity (Hutcheson, 1970) based on species abundance using the Shannon and Weaver (1949) formula:

$$H' \ = \ -[\Sigma Pi * LN(Pi)]$$

where H' is the Diversity Index, Pi is the proportion of each species in the sample, and LN (Pi) is the natural logarithm of this proportion.

Evenness of birds species compares the similarity of the population size of each species. Evenness Index (J') (Kiros, Afework, & Legese, 2018) was calculated using the ratio of observed diversity to maximum diversity using the equation.

$$J' = \frac{H'}{H_{\max}}$$

where H' is the Shannon Wiener Diversity index and $H_{\max}$ is the natural log of total number of species.

Simpson Index (D) measures the probability of any two individuals drawn from noticeably large community belonging to different species (Simpson, 1949). It was measured by the following formula:

$$D \ = \ 1 - \frac{\Sigma n(n\text{-}1)}{N(N\text{-}1)}$$

where n is the total number of birds of a particular species and N is the total number of birds of all species.

Results and discussion

Wild bird species records

The structure of birds communities recorded at Sharkia Governorate was varied. The checklist in Table 1 showed wild bird species recorded in the two different habitats (AWCH and FCH) at Zagazig and Hehia districts; Sharkia Governorate, during the period from December 2016 to November 2017.

The obtained data showed that the total number of wild bird species found was 33, with 25 resident and eight migratory, belonging to 24 Families and ten Orders. Order Passeriformes was the dominant one represented by 13 families including 15 species, four migratory, and 11 residents. Order Coraciiformes was in the second rank with two families including five species, two residents, and three migratory. Order Pelecaniformes represented by one family with two resident and two migratory species. While the lowest orders in numbers were Accipitriformes, Bucerotiformes, Cuculiformes, Falconiformes, and Gruiformes, which is represented by one species for each.

Table 1 Wild birds species recorded from the two districts; Zagazig and Hehia, at Sharkia governorate

Order	Family	English name	Species	Status
Accipitriformes	Accipitridae	Black-winged kite	*Elanus caeruleus*	R
Bucerotiformes	Upupidae	Hoopoe	*Upupa epops*	R
Chardriiformes	Burhinidae	Senegal thick-knee	*Burhinus senegalensis*	R
"	Charadriida	Spur winged plover	*Vanellus spinosus*	R
Columbiformes	Columbidae	Rock dove	*Columba livia*	R
"	"	Palm dove	*Streptopelia senegalensis*	R
Coraciiformes	Alcedinidae	Kingfisher	*Alcedo atthis*	M
"	"	Pied kingfisher	*Ceryle rudis*	R
"	"	White throated kingfisher	*Halcyon smyrnensis*	M
"	Meropidae	Blue-cheeked bee-eater	*Merops persicus*	M
"	"	Little green bee eater	*Merops orientalis*	R
Cuculiformes	Cuculidae	Senegal coucal	*Centropus senegalensis*	R
Falconiformes	Falconidae	Kestrel	*Falco tinnunculus*	R
Gruiformes	Rallidae	Moorhen	*Gallinula chloropus*	R
Passeriformes	Acrocephalidae	Clamorous reed warbler	*Acrocephalus stentoreus*	R
"	Alaudidae	Crested lark	*Galerida cristata*	R
"	Cisticolida	Zitting cisticola	*Cisticola junicides*	R
"	"	Graceful prinia	*Prinia gracilis*	R
"	Corvidae	Hooded crow	*Corvus cornix*	R
"	Estrildidae	Red avadavat	*Amandava amandava*	R
"	Hirundinidae	Barn swallow	*Hirundo rustica*	R
"	Motacillidae	White wagtail	*Motacilla alba*	M
"	"	Yellow wagtail	*Motacilla flava*	R
"	Muscicapidae	Bluethroat	*Luscinia svecica*	M
"	Passeridae	House sparrow	*Passer domesticus*	R
"	Ploceidae	Streaked weaver	*Ploceus manyar*	R
"	Phylloscopidae	chiffchaff	*Phylloscopus collybita*	M
"	Pycnonotidae	Common bulbul	*Pycnonotus barbatus*	R
"	Sylviidae	Lesser whitethroat	*Sylvia curruca*	M
Pelecaniformes	Ardeidae	Cattle egret	*Bubulcus ibis*	R
"	"	Little egret	*Egretta garzetta*	R
"	"	Black-crowned night heron	*Nycticorax nycticorax*	R
"	"	Squacco heron	*Ardeola ralloides*	M

R resident birds species, *M* migratory birds species

Relative abundance of resident wild bird species

Resident wild bird species numbers were presented in Table 2 for both habitats. In the AWCH, the following species were recorded in a descending order: House sparrow, Hooded crow, Rock dove, Palm dove, and Cattle egret. Their numbers were the highest as follows: 1133, 575, 538, 528, and 462 individuals, respectively. Their relative abundances were 0.214, 0.108, 0.102, 0.099, and 0.087, respectively. The lowest number of birds was eight individuals with relative abundance of 0.001, for black-winged kite.

In the FCH, the highest birds number was the House sparrow followed by Palm dove, Hooded crow, Rock dove, Cattle egret, and Graceful prinia in a descending order as follows: 817, 403, 384, 318 and 193 individuals and relative abundance of: 0.230, 0.113, 0.108, 0.089, and 0.054, respectively. The Black-crowned night heron number was the lowest, with 6 individuals and 0.002 relative abundance.

Relative abundance of migratory wild bird species

The data in Table 3 demonstrated the numbers and relative abundance of migratory wild bird species in AWCH and FCH at Sharkia governorate. In the WCH, the following species were recorded in a descending order: White wagtail, Blue-cheeked bee-eater, Lesser whitethroat, Bluethroat, and Kingfisher. Their numbers were the highest as follows: 254, 88, 62, 49, and 40 individuals, respectively. Their relative abundances were 0.450, 0.156, 0.109, 0.086, and 0.071, respectively. The lowest number of birds was five individuals with relative abundance of 0.008, for chiffchaff.

In the FCH, the highest bird number was the White wagtail followed by Lesser whitethroat, Kingfisher, White throated kingfisher and Bluethroat in a descending order as follows: 175, 53, 43, 42, and 39 individuals. Their relative abundances were 0.404, 0.122, 0.099, 0.096, and 0.090, respectively. The lowest number and relative

Table 2 Relative abundance of resident wild birds observed at Sharkia governorate

English name	AWCH				FCH			
	Number in sample (count)	Relative abundance "Pi"	LN "Pi"	Pi * LN(Pi)	Number in sample (count)	Relative abundance "Pi"	LN "Pi"	Pi * LN(Pi)
Black-winged kite	8	0.001	− 6.495	− 0.009	14	0.003	− 5.535	− 0.022
Hoopoe	88	0.016	− 4.096	− 0.068	79	0.022	− 3.805	− 0.085
Senegal thick-knee	39	0.007	− 4.910	− 0.036	18	0.005	− 5.284	− 0.027
Spur winged plover	158	0.029	− 3.511	− 0.105	148	0.042	− 3.177	− 0.132
Rock dove	538	0.102	− 2.286	− 0.232	318	0.089	− 2.412	− 0.216
Palm dove	528	0.099	− 2.305	− 0.229	403	0.113	− 2.175	− 0.247
Pied kingfisher	168	0.032	− 3.450	− 0.109	152	0.042	− 3.150	− 0.135
Little green bee eater	92	0.017	− 4.052	− 0.070	53	0.015	− 4.204	− 0.063
Senegal coucal	9	0.002	− 6.376	− 0.011	0	0	0	0
Kestrel	82	0.015	− 4.167	− 0.064	66	0.018	− 3.985	− 0.074
Moorhen	402	0.076	− 2.577	− 0.196	0	0	0	0
Clamorous reed warbler	12	0.002	− 6.089	− 0.014	0	0	0	0
Crested lark	123	0.023	− 3.761	− 0.087	89	0.025	− 3.685	− 0.092
Zitting cisticola	119	0.022	− 3.795	− 0.085	67	0.018	− 3.969	− 0.075
Graceful prinia	268	0.051	− 2.983	− 0.151	193	0.054	− 2.912	− 0.158
hooded crow	575	0.108	− 2.219	− 0.241	384	0.108	− 2.224	− 0.240
Red avadavat	40	0.007	− 4.885	− 0.036	18	0.005	− 5.284	− 0.026
Barn swallow	132	0.025	− 3.691	− 0.092	102	0.028	− 3.549	− 0.102
Yellow wagtail	93	0.017	− 4.041	− 0.071	68	0.019	− 3.955	− 0.076
House sparrow	1133	0.214	− 1.541	− 0.329	817	0.230	− 1.468	− 0.338
streaked weaver	26	0.005	− 5.316	− 0.026	7	0.002	− 6.228	− 0.012
Common bulbul	152	0.028	− 3.550	− 0.102	184	0.052	− 2.959	− 0.153
Cattle egret	462	0.087	− 2.438	− 0.213	318	0.089	− 2.412	− 0.216
Little egret	36	0.007	− 4.991	− 0.034	45	0.013	− 4.367	− 0.055
Black-crowned night heron	10	0.002	− 6.271	− 0.012	6	0.002	− 6.383	− 0.011
Total	5293	1	− 99.80	− 2.63	3549	1	− 83.13	− 2.56

Pi proportion of each species (relative abundance), *LNPi* natural logarithm of Pi

Table 3 Relative abundance of Migratory wild bird species observed at Sharkia governorate

English name	AWCH				FCH			
	Number in sample (count)	Relative abundance "Pi"	LN "Pi"	Pi * LN(Pi)	Number in sample (count)	Relative abundance "Pi"	LN "Pi"	Pi * LN(Pi)
Kingfisher	40	0.071	− 2.646	− 0.187	43	0.099	− 2.309	− 0.229
White throated kingfisher	34	0.060	− 2.808	− 0.169	42	0.096	− 2.333	− 0.226
Blue-cheeked bee-eater	88	0.156	− 1.857	− 0.289	27	0.062	− 2.774	− 0.173
White wagtail	254	0.450	− 0.797	− 0.359	175	0.404	− 0.905	− 0.366
Bluethroat	49	0.086	− 2.443	− 0.212	39	0.090	− 2.407	− 0.216
chiffchaff	5	0.008	− 4.725	− 0.041	30	0.069	− 2.669	− 0.184
Lesser whitethroat	62	0.109	− 2.207	− 0.242	53	0.122	− 2.100	− 0.257
Squacco heron	32	0.057	− 2.869	− 0.162	24	0.055	− 2.893	− 0.160
Total	564	1	− 20.36	− 1.665	433	1	− 18.39	− 1.814

Pi proportion of each species (relative abundance), *LNPi* natural logarithm of Pi

abundance was 24 individuals and 0.055 with Squacco heron.

The relative abundance of birds species in an area usually related to the availability of main life requirements (food, water and shelter) as well as suitable weather conditions. Goodman, Meininger, Bahaa El-Dine, Hoobs, and Mullie (1989) mentioned that House sparrow, *Passer domesticus*, Hooded crow, *Corvus corone*, Palm dove, *Streptopelia senegalensis*, and Rock dove, *Columba livia* were abundantly resident species in numerous portion of Egypt. White wagtail, *Motacilla alba* is abundant passage migrants and winter visitor to Egypt from the beginning of autumn (late September) to the end of spring (early May). Also, the Bee-eater, *Merops apiaster* is a common migrant throughout the country in autumn from late August to late November and spring from mid-March to late June. Attia (2006) surveyed the resident birds at Sharkia governorate in three habitats (old lands, reclaimed area, and aquatic area); he indicated that the resident birds represented in a higher value in old lands followed by aquatic area and reclaimed area while the migratory birds were highest in aquatic area followed by old lands and reclaimed area. Attia (2013) cleared that higher numbers of bird species (resident and migratory) were recorded in field crop than vegetable crop areas at Ismailia governorate. The resident wild bird species included were Crested lark, *Galerida cristata*, Fan tailed warbler, *Cisticola juncides*, Graceful warbler, *Prinia gracilis*, Hooded crow, *Corvus corone cornix*, House crow, *Corvus splendens*, Goldfinch, *Carduelis carduelis*, House sparrow, *Passer domestica*, Swallow,

Hirundo rustica, Yellow wagtail, *Motacilla flava flava*, Common bulbul, *Pycnonotus babatus*, Rock dove, *Columba livia*, Palm dove, *Streptopelia senegalensis*, Cattle egret, *Bubulcus ibis*, Little egret, *Egretta garzetta*, Pied kingfisher, *Ceryle rudis*, Little green bee-eater, *Merops orientalis*, Black-shouldered kite, *Elanus caerulus*, Kestrel, *Falco tinnunculus*, Spur-winged plover, *Hoplopterus spenosus*, Moorhen, *Gallinula chloropus*, Senegal coucal, *Centropus senegalensis*, and Hoopoe, *Upupa epops.* While he recorded six bird species as migratory birds: White wagtail, *Motacilla alba alba*, Chiffchaff, *Phelloscobus collybita*, Stonechat, *Saxicola torquata*, and Kingfisher, *Alcedo atthis.* Noura-Barakat (2016) illustrated that the number of bird species in Tanta district at Gharbia governorate were highest in field crops, followed by trees, water canals, and building, while in Zifta district, were in water canals, trees, building, and field crops. The resident wild birds at Gharbia governorate were Senegal thick knee, Spur-winged plover, Cattle egret, Little egret, Squacco heron, Palm dove, Pied kingfisher, Senegal coucal, Kestrel, Moorhen, Crested lark, Fan tailed warbler, Graceful warbler, Hooded crow, Swallow, Yellow wagtail, House sparrow, Common bulbul, and Hoopoe, while the white wagtail was migratory. El–Danasoury, Khalifa, Omar, and Saber (2017) surveyed the resident and migratory bird species at Assiut governorate. The birds were found in a highly numbers in the fields nearby trees, while they were found in moderate numbers in fields nearby building and field crops. The resident birds were House sparrow, Hooded crow, Crested lark, Common bulbul, Fan tailed warbler,

Swallow, Palm dove, Rock dove, Little green bee eater, Hoopoe, Pied kingfisher, Cattle egret, Spur winged plover, Kestrel, and Black winged kite. The migratory birds were White wagtail and chiffchaff. El–Danasoury, Omar, and Hassan (2018) surveyed wild bird species at Sohag governorate; they found that the resident wild birds were Black winged kite, cattle egret, Common bulbul, Fantailed warbler, Hoopoe, Kestrel, Spur winged plover, Swallow, Yellow wagtail, Crested lark, Hooded, House sparrow, Little green bee, Moorhen, Palm dove, Pied kingfisher, and Rock dove. The migratory bird species were chiffchaff and White wagtail.

Birds species diversity
Species diversity is the number of species and abundance of each species that live in a specific location. A diversity index is a quantitative measure of how many different species are in a community (species richness) and how individuals are distributed within those species (species abundant) (You, Vasseur, Régnière, & Zheng, 2009). Therefore, Diversity Index is considered as a calculation of variety, which is a useful tool to understand the profile of biodiversity across study area (Bibi & Ali, 2013).

Diversity indices for resident and migratory wild bird species in two different habitats
Table 4 demonstrated some parameters associated with diversity of wild bird species at two different habitats. The total number of resident bird species at AWCH was 5293 individuals, which is higher than FCH (3549 individuals). Also, species richness in AWCH was $r = 25$, which is also higher than FCH ($r = 22$). At the same trend, AWCH had the highest values of Shannon-Weiner diversity index ($H' = 2.63$) and Simpson's Diversity ($D = 0.90$), than FCH ($H' = 2.56$) and ($D = 0.89$). While evenness (J') were higher in FCH ($J' = 0.83$) than AWCH ($J' = 0.82$).

The same trend existed in migratory bird species, which represented by higher numbers of individuals (564) at AWCH while at FCH was 433 individuals. Species richness was the same in AWCH and FCH ($r = 8$). But in contrast, the FCH give the higher values of Shannon-Weiner diversity index ($H' = 1.81$), Simpson's

Diversity ($D = 0.78$), and evenness ($J' = 0.87$), than AWCH with, Shannon-Weiner diversity index ($H' = 1.66$), Simpson's Diversity ($D = 0.74$), and evenness ($J' = 0.80$).

Diversity indices for the total numbers of wild birds in two different habitats
The data in Table 5 evinced that the AWCH give the highest values of diversity index, the total number of birds species were (5857) individuals, species richness ($r = 33$), Shannon-Weiner diversity index ($H' = 2.85$), and Simpson's Diversity ($D = 0.92$), while in FCH, the total number were (3982) individuals, species richness ($r = 30$), Shannon-Weiner diversity index ($H' = 2.82$), and Simpson's Diversity ($D = 0.91$). In contrast, evenness (J') were higher in FCH ($J' = 0.83$) than in AWCH ($J' = 0.81$).

These results were in line with Mengesha and Bekele (2008). They mentioned that the avian diversity is an indication of habitat heterogeneity and the number of species and individuals in an area implies the importance of the area. Each habitat has a specific set of microenvironment that is suitable for a species. Bibi and Ali (2013) cleared that the values of Shannon-Weiner Diversity Index usually falls between 1.5 and 3.5, only rarely it surpasses 4.5. Kiros et al. (2018) mentioned that the variation in bird species diversity, richness, and abundance associated with the vegetation composition that make changes in food sources, nesting, and protection based on birds' habitat preference and feeding.

Conclusion
It is concluded from the present study that birds species varied among the study sites and between habitats. Birds species (resident and migratory) numbers and abundance were higher in AWCH according to the habitat suitability, which support free water and abundant food supply (insects, grasses, and aquatic fauna) as well as nesting and resting sites. Also, most migratory birds feed on insects. On the other hand, the FCH is an agriculture area with several seasonal and daily human activities, during the day hours and part of the night, which disturbs birds. Additionally, the structure of AWCH, which include many trees and shrubs, make it a protective cover for different bird species from predators as black-winged kite, which was recorded with a higher

Table 4 Diversity indices for resident and migratory wild birds at Sharkia governorate

Diversity Index	Resident species		Migratory species	
	AWCH	FCH	AWCH	FCH
Overall abundance	5293	3549	564	433
Species richness (r)	25	22	8	8
Evenness (J')	0.82	0.83	0.80	0.87
Shannon-Weiner (H')	2.63	2.56	1.66	1.81
Simpson diversity (D)	0.90	0.89	0.74	0.78

Table 5 Diversity indices of wild birds at Sharkia governorate

Diversity Index	AWCH	FCH
Overall abundance	5857	3982
Species richness (r)	33	30
Evenness (J')	0.81	0.83
Shannon-Weiner (H')	2.85	2.82
Simpson diversity (D)	0.92	0.91

numbers at FCH than AWCH. The order Passeriformes was the dominant order related to its wide range of species and food types (omnivorous, insectivorous, frugivorous and granivorous). Therefore, furthermore studies of the species of this order are required in Egypt, to measure their impact on agriculture crops and to develop safe methods of crop-protection.

Recommendation

Based on the obtained results, it is clear that the majority of recorded birds species were granivorous attacking field crops. Therefore, there is an urgent need to study different species' habitat requirements, behavior, and influence on agriculture crops. This information, from this work and from future studies, can help in the development of a successful integrated birds management program to protect affected agriculture crops from birds attack.

Abbreviations
AWCH: Agriculture water canals habitat; D: Simpson Diversity Index; FCH: Filed crops habitat; H': Shannon Wiener Diversity Index; J': Evenness; M: Migratory bird species; R: Resident bird species; r: Species richness

Availability of data and materials
All data are available upon request.

Authors' contributions
The final manuscript was read and approved by the author.

Ethics approval and consent to participate
Not applicable.

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