

PALM GROVES, AN IMPORTANT REFUGE FOR AVIAN SPECIES IN THE ALGERIAN SAHARA

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Abstract

We conducted an avian count from November 2017 to October 2019. This qualitative and quantitative study at the level of an artificial environment, in the case of the palm grove d'El Hadjed in El Ménea, provides an objective inventory of the birds' diversity. A total of 48 species have been identified by researchers, distributed among nine orders and 19 families. The order Passeriformes is the most dominant, with 11 families and 36 species, or 75% of the recorded species. As for Muscicapidae, the Sylviidae are the best represented, with 11 and 5 species, respectively. Depending on phenological status, there are 17 species of passage visitors (35.42%), 18 breeding species, of which 13 are residents (27.1%), and 5 are migratory species (10.42%). 12 species (25%) represent the winter visitor birds.

At the national level, executive Fiat Algerian law (N°12-235) protects 8 species, or 16.67%, while Ordinance (06-05) protects one other species (Peregrine Falcon). Two species have an international status of "near threatened" (*Lanius senator*), while one species is classified as "vulnerable" (*Streptopelia turtur*). Shannon index values fluctuate between 2.91 bits (2018) and 2.99 bits (2019), and evenness index (E) values fluctuate between 0.56 bits (2018) and 0.62 bits (2019).

Keywords: Avifauna, phenology, density, El Ménea, Sahara.

LES PALMIERS DATTIERS, UN REFUGE IMPORTANT POUR LES ESPÈCES AVIAIRES AU SAHARA ALGÉRIEN

Nous avons réalisé un comptage aviaire de novembre 2017 à octobre 2019. Cette étude qualitative et quantitative à l'échelle d'un milieu artificiel, dans le cas de la palmeraie d'El Hadjed à El Ménea, fournit un inventaire objectif de la diversité des oiseaux. Au total, 48 espèces ont été identifiées par les chercheurs, réparties en neuf ordres et 19 familles. L'ordre des Passériformes est le plus dominant, avec 11 familles et 36 espèces, soit 75 % des espèces recensées. Quant aux Muscicapidae, les Sylviidae sont les mieux représentés, avec respectivement 11 et 5 espèces. Selon l'état phénologique, il existe 17 espèces de visiteurs de passage (35,42%), 18 espèces reproductrices, dont 13 résidentes (27,1 %), et 5 espèces migratrices (10,42%). 12 espèces (25 %) représentent les oiseaux visiteurs hivernaux. Au niveau national, la loi exécutive Fiat algérienne (N°12 - 235) protège 8 espèces, soit 16,67 %, tandis que l'ordonnance (06- 05) protège une autre espèce (le faucon pèlerin). Deux espèces ont un statut international de « quasi menacée » (*Lanius Senator*), tandis qu'une espèce est classée « vulnérable » (*Streptopelia turtur*). Les valeurs de l'indice de Shannon fluctuent entre 2,91 bits (2018) et 2,99 bits (2019), et les valeurs de l'indice de régularité (E) fluctuent entre 0,56 bits (2018) et 0,62 bits (2019).

Mots clés : Avifaune, phénologie, densité, El Ménea, Sahara.

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Introduction

Birds are widely recognized as bioindicators due to their capacity to reflect the ecological well-being of an environment via changes in their population size, behavior, and reproductive capabilities [1–5]. From a biogeographical perspective, Algeria falls within the Western Palearctic region. It shares its northern border with the Mediterranean Sea and is next to the Sahel nations to the south. The climate of Algeria exhibits a varied range of characteristics, including sub-tropical, Mediterranean, semi-arid, and arid conditions [6 and 7]. Algeria's geographical situation contributes to its biological (fauna and flora), ecological, genetic, landscape, and cultural diversity [8].

One of the world's biggest, most ideal, and most arid deserts is the Sahara. Edapho-climatic conditions in the Sahara severely restrict the spontaneous survival of living beings. Low rainfall, erratic rainfall patterns, and noticeable temperature variations between day and night and across the months are the hallmarks of the Sahara. It makes up more than 80% of Algeria's entire surface area and 10% of the continent of Africa [6–15]. It contains various types of water bodies as well as oases, palm groves, and daias, which

makes it an important stopover site as well as a wintering and breeding area for many bird species [15–16]. In particular, artificial ecosystems have a significant role in providing shelter and food resources, including avian species, particularly in hot and dry areas [17–20, 43].

Since the last century, researchers have extensively studied the Algerian avifauna in various Saharan environments, focusing on landbirds or waterbirds. But in the El Ménéea region, despite its biodiversity, studies remain rare on the inventory of landbirds, especially in the palm groves, with the exception of the old records [21–24].

The current research intentionally situates itself within the context of the avian species in El Ménéea, specifically focusing on the organized palm grove known as “El Hadjedj.” The objective is to highlight the structure and diversity of this study area and to show the importance of artificial environments in the reception and refuge of avifauna in the Saharan regions. We also report their phenological and protection status based on laws at national and international levels.

1- Study area

El Ménéeais located in the northern Algerian Sahara [21]. The regional climate

is part of the Saharan bioclimatic stage, with mild winters (average temperature of the coldest month = 11.5°C), very hot summers (average temperature peaks in July at 35.5°C), and low annual rainfall (~ 50-70 mm) [25] (Figure 1).

The palm grove of El Hadjedj is located in the north, at a distance of 18 km from El Ménéea city. It spreads over an area of 60 ha and contains several varieties of date palms with a height that is between 2.5 and 12 m, and their age is between 6 and 28 years (30° 38'13.68" N; 2° 59' 37.44" E). Two species, *Phoenix* sp. and *Casuarina equisetifolia*, dominate the vegetal transect, with a sequential percentage of 77.22 and 23.17%, respectively [32] (Figure 2).

2- Materials and methods

Three methods were adopted to inventory the avifaunistic diversity:(i) the method of punctual abundance index (PAI) during the breeding season (mid-February–

September) during two years of studies (2017–2019);(ii) the method of progressive frequency sampling (PFS) outside the breeding period (October–early February) between 2017 and 2019, where the number of detected contacts, visual and/or auditory, was counted at 15 sampling points [26 and 27];(iii) the quadrat sampling method consists of mapping all the townships occupied by the breeding pairs over an area of 10.5 ha, divided into 42 squares (50 x 50 m).During the breeding period for the year 2018, we made seven passages early in the morning, starting at 6:30 a.m. and lasting until 2:30 p.m.The observer notes all the auditory and visual contacts he has with the species present [28].



Figure 1. - Map showing the location of the study area (palm grove El Hadjedj, El Ménéea)



Figure 2. - The organized palm grove (modern) of El Hadjedj, El Ménée; A: General view (Abdelwahab Chedad, 03/17/2018); B: Satellite image, February 2020.

The exploitation of the results is carried out by the ecological indices of composition and ecological indices of structure, such as the values of the Shannon-Weaver (H') diversity index and the equitability index (E), by the method of relative counts (PAI). We exploit the counting method (quadrats), as well as the total and specific density and the total and average richness. Algeria follows the Executive Fiat 12–235 of May 24, 2012, which establishes the list of protected non-domestic animal species, and Ordinance 06–05 of July 15, 2006, which is concerned with the protection and preservation of

endangered animal species. At the international level, we based our assessment on the IUCN Red List [29].

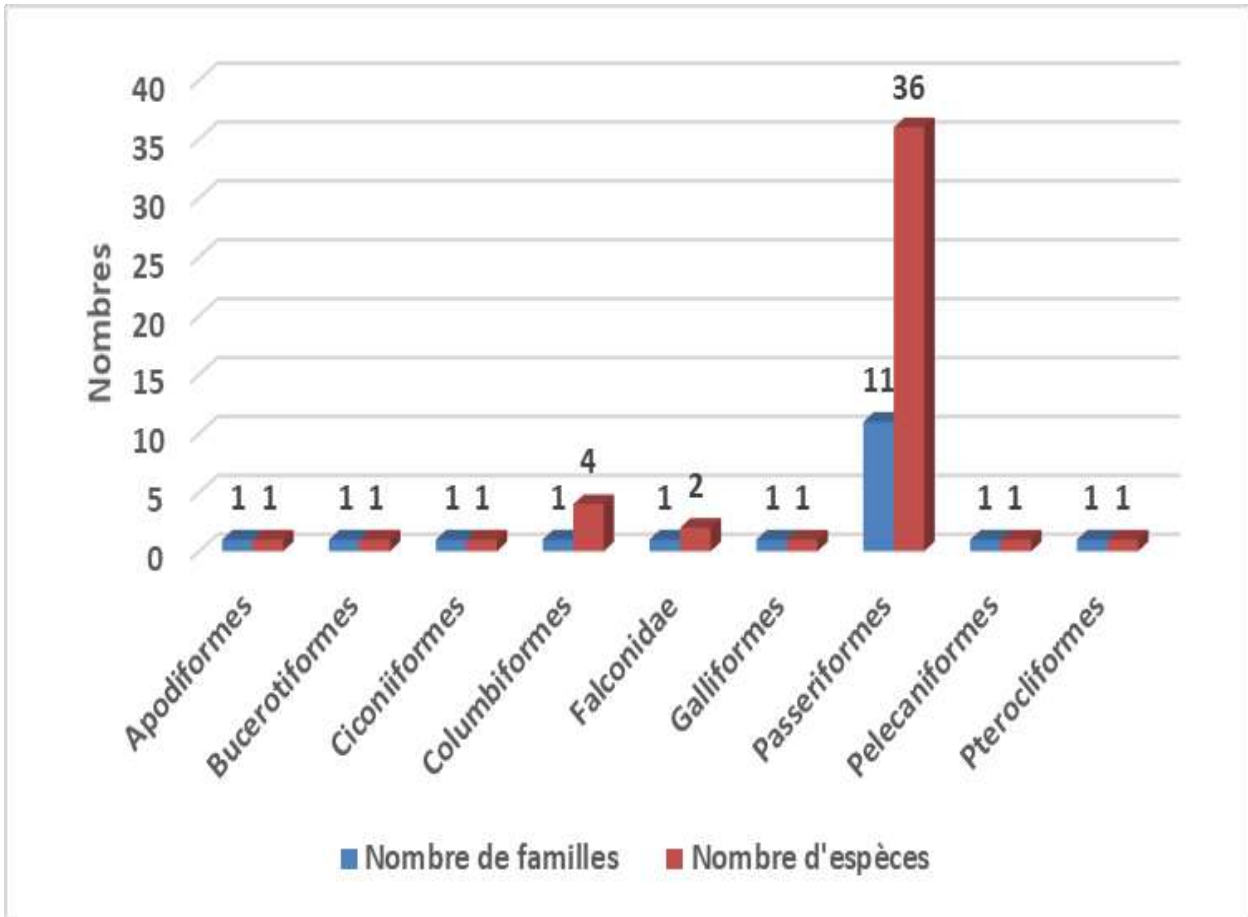
3- Résultats

3.1- Systematic list of avifauna

Table 1 provides details of the avian species documented in the study area from November 2017 to October 2019. Through the avifaunistic inventory, 48 species, comprising nine orders and 19 families, were identified. Passeriformes constitute the most numerous order, comprising 36 species and 11 families, or 57.87% of all

species recorded. In contrast, the Sylviidae have the greatest representation among the

Muscicapidae, with 11 and five species,



respectively (Figure 03).

Figure 3. - Number of avian families and species

Table 1. - Systematic list of avifauna

ORDER–FAMILY		Ph. St.	Pr. St.		
N°	Scientific name		A	B	C
A	APODIFORMES — APODIDAE				
1	<i>Apus a. apus</i>	PV	1	0	LC
B	BUCEROTIFORMES — UPUPIDAE				
2	<i>Upupa e. epops</i>	RB	1	0	LC
C	CICONIIFORMES — CICONIIDAE				
3	<i>Ciconia c. ciconia</i>	PV	1	0	LC
D	COLUMBIFORMES — COLUMBIDAE				
4	<i>Columba livia</i>	RB	0	0	LC
5	<i>Streptopelia t. turtur</i>	MB	0	0	VU
6	<i>Spilopelia senegalensis phoenicophila</i>	RB	0	0	LC
7	<i>Streptopelia decaocto</i>	RB	0	0	LC
E	CORACIIFORMES — MEROPIDAE				
8	<i>Merops persicus chrysocercu</i>	MB	0	1	LC
9	<i>Merops apiaster</i>	PV	0	1	LC
F	FALCONIFORMES — FALCONIDAE				
10	<i>Falco t. tinnunculus</i>	RB	1	0	LC
1	<i>Falco peregrinus peregrinus</i>	PV	0	1	LC
G	GALLIFORMES — PHASIANIDAE				
11	<i>Coturnix c. coturnix</i>	U	0	0	LC
H-1	PASSERIFORMES — ACROCEPHALIDAE				
12	<i>Iduna pallida reiseri</i>	MB	0	0	LC
13	<i>Acrocephalus a. arundinaceu</i>	MB	0	0	LC
H-2	PASSERIFORMES — ALAUDIDAE				
14	<i>Galerida cristata</i>	RB	0	0	LC
H-3	PASSERIFORMES — CORVIDAE				
15	<i>Corvus ruficollis</i>	RB	0	0	
H-4	PASSERIFORMES — HIRUNDINIDAE				

16	<i>Delichon urbicum meridionale</i>	W	0	0	LC
17	<i>Hirundo r. rustica</i>	W	0	0	LC
H-5	PASSERIFORMES — LANIIDAE				
18	<i>Lanius s. senator</i>	RV	0	0	NT
19	<i>Lanius excubito</i>	RV	0	0	LC
H-6	PASSERIFORMES — MOTACILLIDAE				
20	<i>Anthus pratensi</i>	W	0	0	LC
22	<i>Motacilla alba</i>	W	0	0	LC
23	<i>Motacilla flava</i>	PV	0	0	LC
H-7	PASSERIFORMES — MUSCICAPIDAE				
24	<i>Cercotrichas galactotes</i>	MB	0	0	LC
25	<i>Muscicapa s. striata</i>	PV	0	0	LC
26	<i>Ficedula h. hypoleuca</i>	PV	0	0	LC
27	<i>Luscinia m. megarhynchos</i>	PV	0	0	LC
28	<i>Phoenicurus p. phoenicurus</i>	W	0	1	LC
29	<i>Saxicola rubetra</i>	W	0	0	LC
30	<i>Saxicola r. rubicola</i>	W	0	0	LC
31	<i>Oenanthe deserti homochroa</i>	RB	0	0	LC
32	<i>Oenanthe oenanthe</i>	PV	0	0	LC
33	<i>Oenanthe hispanica</i>	PV	0	0	LC
34	<i>Oenanthe l. leucopyga</i>	RB	0	0	LC
H-8	PASSERIFORMES — MUSCICAPIDAE				
35	<i>Passer h. hispaniolensis</i>	W	0	0	LC
36	<i>Passer domesticus</i>	RB	0	0	LC
37	<i>Passer domesticus X Passer hispaniolensis</i>	RB	0	0	LC
H-9	PASSERIFORMES — PHYLLOSCOPIDAE				
38	<i>Phylloscopus collybita</i>	W	0	0	LC
39	<i>Phylloscopus trochilus</i>	PV	0	0	LC
40	<i>Phylloscopus sibilatrix</i>	PV	0	0	LC

41	<i>Phylloscopus bonelli</i>	PV	0	0	LC
H-10	PASSERIFORMES — SYLVIIDAE				
42	<i>Curruca cantillans</i>	W	0	0	LC
43	<i>Curruca c. communis</i>	PV	0	0	LC
44	<i>Curruca c. conspicillata</i>	W	0	0	LC
45	<i>Curruca m. melanocephala</i>	W	0	0	LC
46	<i>Curruca h. hortensis</i>	PV	0	0	LC
I	PELECANIFORMES — ARDEIDAE				
47	<i>Bubulcus ibis</i>	PV	0	0	LC
J	PTEROCLIFORMES — PTEROCLIDAE				
48	<i>Pterocles senegallus</i>	RB	0	0	LC

Ph. St.: phenological status (W: wintering, **RB:** resident breeder, **MB:** migrant breeder, **PV:** passage visitors); Pr. St.: protection status, A: Ordinance n° 06–05 of 15 July 2006; **B:** Executive Decree n° 12 235 of 24 May, 2012; **C:** The International Union for Conservation of Nature, IUCN (**LC:** Least Concern; **NT:** Near Threatened; **VU:** Vulnerable); 0: no, 1: yes

3.2- Phenological and protection status of the inventoried avifauna

According to the phenological status, there are 18 bird species breeding in this study area. Of these, 13 are sedentary and 5 are migratory. Non-breeding birds are represented by 30 species, 17 of which are passage visitors and 13 of which are wintering (Table 1).

Nationally, in Algeria, the Executive Fiat 12–235 of May 24, 2012, which establishes the list of protected non-domestic animal species, protects 8 species, or 16.67% of the species found during this study. However, only the Peregrine Falcon is protected by Ordinance 06-05 of July 15, 2006, which is

concerned with the protection and preservation of endangered animal species. Internationally, 95.83% of the counted species have a status of “least concern,” according to the IUCN Red List. One species has a “near threatened” status (*Lanius senator*), and one has a “vulnerable” status (*Streptopelia turtur*).

From the 7 passages carried out in the quadrat during the breeding period of the year 2018, the total density (D) in El Hadjedj Palm Grove fluctuates between 188.5 (Q 1) and 507.5 c. /10 ha (Q 7). Regarding specific densities, *Passer domesticus* x *P. hispaniolensis* ranks first with a value of 121 pairs per 10 ha. *Streptopelia turtur* (69 pairs per 10 ha),

Streptopelia senegalensis (42.5 pairs per 10 ha), and *Streptopelia decaocto* (32 pairs per 10 ha) are well represented among the Columbiforms, which have three congeneric species.

The values of the diversity indices (Shannon Index, maximum diversity, and equitability) recorded were high ($H' = 2.91$ bits (2018) and 2.99 bits (2019), $H' \text{ max} = 5.21$ bits (2018) and 4.81 bits (2019), $E = 0.56$ in 2018 and 0.62 in 2019).

4- Discussion

Between November 2017 and October 2019, the avifaunistic inventory identified 48 species in this palm grove, representing 11.82% of the Algerian avifauna. Compared to the data published by [24], which report 406 species nationwide and also 203 species reported in Ghardaïa across all forms of the biotope [30]. The research done by [31] shows an avian diversity equal to 43 species belonging to 23 families (palm groves of the Ouargla basin), 49 species belonging to 21 families (palm groves of Ziban in Biskra), and finally 32 species belonging to 17 families (palm groves in Souf). According to a study carried out by [32], 43 species belonging to

11 orders and 23 families were documented in the palm groves of Mekhadema and Hassi Ben Abdallah (Ouargla); within a study of the avifauna in an oasis in El Ménéa, 43 species belonging to 8 orders and 17 families were reported by [15]. Researchers have recorded an important avian diversity of 59 species classified in 7 orders and 23 families in the oases of the north-east of the Algerian Sahara [33].

The differences noted between the riches of one region and another are certainly due to microclimatic, floristic, and faunistic differences [33]. In addition to other factors influencing aviandiversity, for example, the presence or absence of these areas in migration routes, urbanization, pollution, modernization and extension of agriculture, and the appearance of new sites (green space, artificial or natural wetland, etc.) [16, 34]. There are 24 species in Algeria that have a distribution exclusively or partially Saharan, with 14 of these species noted in the study area: *Iduna pallida*, *Oenanthe leucopyga*, *Pterocles senegallus*, *Merops persicus*, and *Corvus ruficollis* [24].

Thirty non-breeding species represent the avifauna of the study area. It emerges that 17 species of them are strict migrants who only make stops. And similar research [35]

showed that in autumn, about 200 species of migratory passerine birds cross annually from the Palearctic to Sub-Saharan Africa. This study region, the Algerian Sahara in particular, plays a crucial role in the migration of avifauna during the two post- and pre-nuptial passages. Its significance stems from its location on the migratory routes between Europe and Africa [8, 25, 36, and 37].

Thirteen species represent the resident breeding category. [38] reports that the Ziban region is home to 47 species of sedentary nesters. Some migratory species come to nest in this palm grove; there are only five species. Sedentary species exert competition due to the low number of migratory species nesting in this palm grove. Thirteen species represent the wintering birds. Given climate changes, agricultural extensions, the appearance of new wetlands, especially artificial ones, etc., all these factors, as well as others, can influence the phenological status of species. This is what they cited [16, 39]. Executive Fiat 12–235 of May 24, 2012, which establishes the list of protected non-domestic animal species, protects a total of 8 species (16.67%). But only the Peregrine Falcon is protected by Ordinance 06–05 of July 15, 2006, which is concerned with the protection and preservation of endangered animal species. 96.83% of the species

recorded have a status of least concern according to the IUCN red list. One species has a "vulnerable" status (*Streptopelia turtur*), with another having a near threatened status (*Lanius senator*). These statuses are determined according to criteria based on various biological factors associated with the risk of extinction: population size, rate of decline, geographical distribution area, degree of settlement, and fragmentation of the distribution [40].

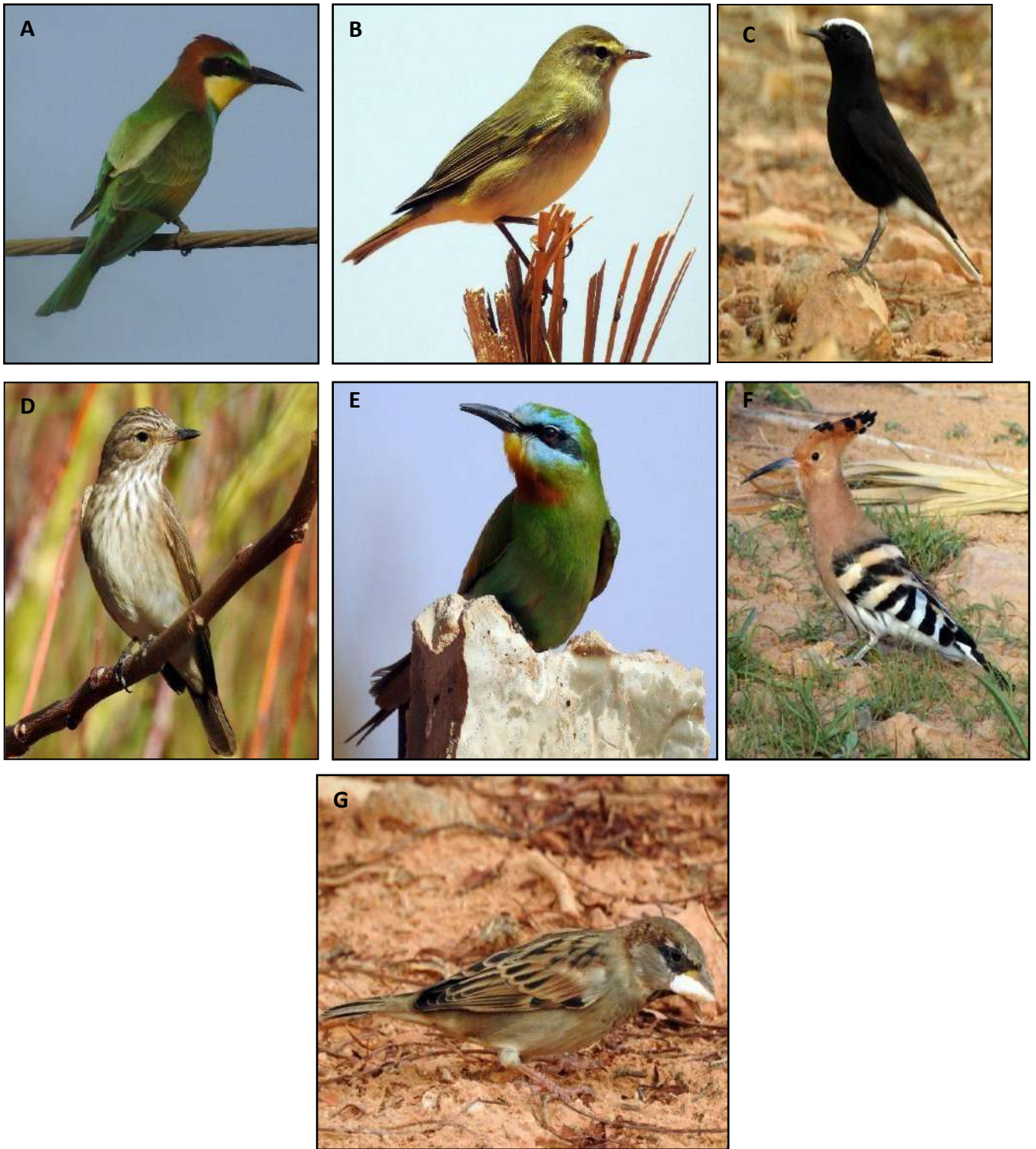
The values of the diversity of Shannon H' fluctuate between 2.91 bits (2018) and 2.99 bits (2019). Our values of H' are comparable to those that [41] mentions in the Zibans. These authors, in an Oasis environment in Filiach near Biskra, notice values between 4.69 bits and 4.88 bits. The values of E in the current study are relatively close to 1, 0.56 in 2018, and 0.62 in 2019. Our values of E are comparable to those obtained by [41] in Zelfana (0.89), approach 1, and show that the numbers of avian populations tend to be in equilibrium with each other. The indices of this study differ from those of [42] in Ouargla, which found values between 0.46 in Mekhadma and 0.57 in Said-Otba, values that do not tend towards 1.

Conclusion

The present work shows the importance of an artificial environment (the palm grove of El Hadjedj) in the reception and refuge of avifauna in the Saharan regions, where 48 species were recorded between 2018 and 2019, belonging to nine orders and 19 families. The order of the Passeriformes is the most dominant, with 11 families and

36 species, or 75% of the species recorded. As for the Muscicapidae, the Sylviidae are the best represented, with 11 and 5 species, respectively.

In perspective, it would be interesting to carry out other biological studies of certain species that characterize the desert regions, in particular El Ménée, such as *Oenanthe deserti*, *Oenanthe leucopyga*, *Passer simplex*, etc.



Appendix 1.- Some remarkable species of the PalmGrove El Hadjedj

(Photography by Abdelwahab Chedad) A : *Merops apiaster*; B : *Phylloscopus collybita*;
 C : *Oenanthe leucopyga*; D : *Muscicapa striata*; E : *Merops persicus*; F : *Upupa epops*; G :
Passer domesticus X *Passer hispaniolensis*

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