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Biological diversity and patrimony evaluation of the fauna and flora of a wetland of "Sebkhet el mahmel" in the arid region of Khenchela in the North-east of Algeria

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Abstract

The objective of our work is to determine the floristic and faunistic biological diversity and the patrimonial evaluation of the wetland of sebkhet El Mahmel in the arid zone of Khenchela located in the north east of Algeria, in order to allow the decision makers to take adequate measures for the protection and the preservation of this wetland. The results of the study reveal a remarkable floristic, faunistic and patrimonial value richness, where we inventoried 78 plant species, divided into 23 families, the majority of which are herbaceous forms including a protected species and two endemic species. As we counted 21 species of migratory water birds, divided into 6 orders grouping 8 families; dominated by the family of anatidae, all of which are protected. For the terrestrial birds we noted the presence of 35 species, divided in 07 orders containing 19 families dominated by the order of passeriformes with 11 families. For us we report the presence of 98 species; divided into 16 orders containing 44 families dominated by the order of Coleoptera with 13 families, of which 09 species are protected. As we note the presence of an order of amphibians with two families and two orders of reptiles with 05 families and 12 species, the majority of which are protected. For the mammals we noticed the presence of 14 species grouped in 06 orders containing 09 families, we point out that the area is frequented by species of important patrimonial value such as the striped hyena.

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Introduction

Algeria hosts a great diversity of wetlands, constituting wintering and passage sites for migratory birds (Stevenson *et al.,* 1988; Fishpool and Evans 2001; Boulkhssaïm *et al.,* 2006).

These wetlands are known for their rich biodiversity, hosting almost all the habitats of the Western Palearctic domain belonging to the southern Mediterranean, as they hold a very diverse patrimonial of faunistic and floristic species inflated to the wetlands (Bensaci 2013).

The natural resources of these wetlands have a strong scientific, economic and aesthetic interest that justifies the implementation of conservation measures (Saheb 2009; Bouldjedri 2011).

The wetland of Sebkhet El Mahmel is part of the wetland complex of southern Constantine, representing the only natural wetland in the arid area of Khenchela located in eastern Algeria, is an essential ecosystem for biodiversity. Indeed, it is a place of wintering of the avifauna and a parking area for many migratory birds and many plants and animal species (Khabtane et Rahmoune 2010).

Despite its qualities, this area remains fragile because it is threatened by many deleterious fact The preservation of nature is a fundamental necessity if we want to ensure sustainable development.

The environmental and biological patrimony is of inestimable richness, it is diversified, but fragile (Elafri 2021). Of all the natural ecosystems, there is not one that can be better off than another, but there are those that are better known than others, because they are better studied and benefit from a more abundant literature.

The observation of major gaps in the knowledge of the functioning of wetlands of the High Plains of southern Constantine and the socio-economic relations maintained by the various actors with these environments has triggered reactions to the questions posed by the identification and characterization of these ors that could lead to its destruction. Among these threats are (Bouakkaz 2015).

-Changes in the hydrological cycle, i.e., precipitation, evaporation, runoff, recharge and groundwater flow that affect the study area will affect the water allocated for the wetland, for domestic needs and for irrigation;

-The soils of the area due to the accumulation of high quantities of salts exported by the process of wind erosion from the sebkhas become increasingly halomorphic;

-The pressure of anthropic activities represented by solid and liquid discharges in the sebkhas basin.

For all these causes, it is necessary to reconcile human activities and the maintenance of the natural properties of wetland ecosystems and allow the exploitation of resources without jeopardizing their potential for future generations. The interest of these concerns the obligatory consideration of the socio-economic context in which our site is located (Khabtane 2019). It is in this perspective that our work aims to determine the biologic diversity and the patrimony evaluation of fauna and flora of the wetland of sebkhet el mahmel.

Materials and methods

Presentation of the study area

The wetland of Sebkhet El Mahmel constitutes by its typology the only natural water body in the whole territory of the wilaya of Khenchela, located in the southern steppe part of the wilaya.

The sector of Sebkha belongs to the complex of continental wetlands of the high palatals of the South Constantine which covers the wilayas of Batna, Oum El Bouaghi, Khenchela and Tebessa, which are located between 750 and 1200m altitude, they constitute a long boulevard bordered by the North by the Tellian Atlas and the Saharan Atlas in the south. Their relief is very compartmentalized, and they are,

moreover, crossed in scarps by small limestone ranges, of atlas style, elongated SW-NE, and which generally correspond to faulted or asymmetrical anticlines. This topography combines with the aridity to impede drainage (Ouldjaoui 2020).

In the North, there is an exoreic drainage made up of small streams that meander through the High Plains before crossing the Tell. The center and the South are the domain of the endoreic drainage towards the sebkhas (See Fig.1).

Noting that despite the national and international ecological importance it represents, this wetland has never been the subject of a classification study as a wetland of importance.

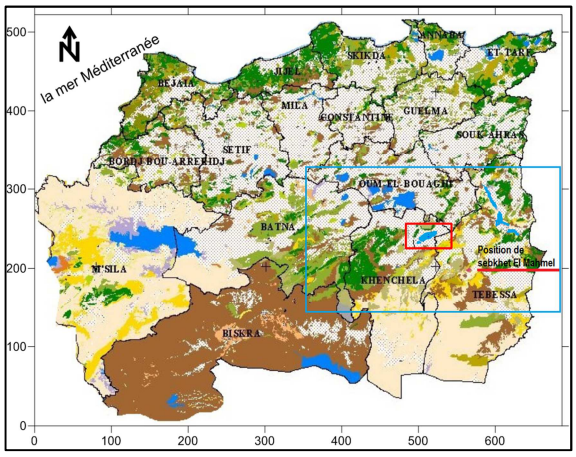

Fig. 1. Geographical position of Sebkhet El Mahmel in relation to the humid continental complex of South Constantine (Source DGF that we modified).

Regionally, the area of Sebkhet El Mahmel is located between: the municipality of El Mahmel with more than 80% and the rest in the municipality of Ain Touila, which is located in the eastern and northeastern extension of the Aurès-Nemamcha mountains, at the eastern boundary of the wilaya of Khenchela, in the geographical area between:

- Longitude: (7°15' 33.88" and 7°22' 47.28") East;
- Latitude: (35°20' 26.63" and 35°24' 24.97") North;
- Average altitude: 1070m;
- Surface of the plan is about 612 ha in high water divided into three compartments:
- Chott ouled Bouali-Lakhlefna 75 ha,
- Chott Oled Amara 370 ha
- Chott Ouled Mbarek 182 ha,

While the total area of the wetland of Sebkhet El Mahmel is about 2800 ha, which we estimated for the first time in this study using the software ArcGis Version 9.1, (Kabtane *et al.,* 2010) (See Fig.2).

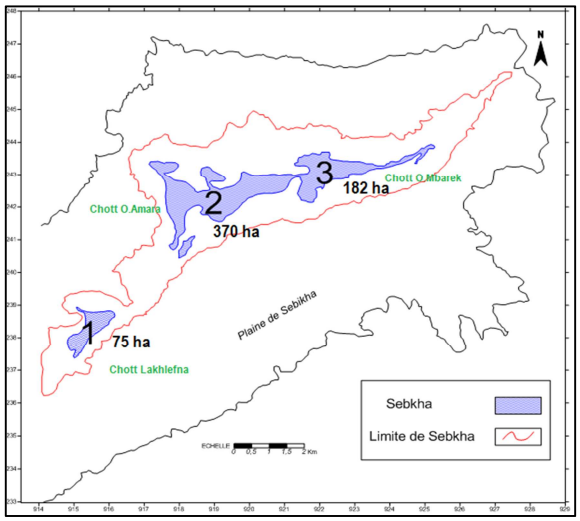

Fig. 2. Delimitation of the wetland of Sebkhet El Mahmel.

Collection of floristic data and patrimonial evaluation

We applied the SIGMATISTE method based on phytosociological surveys and the notion of the minimum area, where different sampling stations are implanted throughout the perimeter of the study, to determine the different plant species and their distribution that is linked to other environmental conditions (pedology, slope, geology, hydrogeology) (Khabtane and Rahmoune, 2010, 2012 ; Delpech R 2006). To highlight the patrimonial value and status of vegetation identified at the wetland Sebkhet El Mahmel we have taken into consideration the classification of Quezel and Santa (1962) and the Algerian regulations in force including the Executive Decree No. 12-03 of 10 Safar 1433 corresponding to January 4, 2012 establishing the list of protected non-cultivated plant species, where we have classified the species as follows, taking into account the medical or fodder interest (Ozenda (1991).

- Characteristic species (Ec),

- Rare species (Er)
- Endemic species (Ee)
-Protected species (Ep)
- Species of medical interest (Em)
-Species of forage interest (Ef)

Collection of wildlife data an patrimonial evaluation For waterbirds

We conducted individual waterbird counts if the group or population was less than 200 individuals and no more than 200 m away. Otherwise, if the group or population of waterbirds was far away and had a larger number of individuals, we relied on visual estimates (Blondel 1969, 1970, 1975 ; Meddour *et al.,* 2018). This method, which is the most commonly used in winter waterfowl censuses, has an estimated margin of error of 5-10%, as well as the exploit of our previous research on the area and the Forest Service inventories (Khabthane. *et al.,* 2010).

For the patrimonial evaluation, we have added bioecological status of the inventoried birds, in order to give an overview of their bioecological characteristics. The statuses considered in this study are the following:

- The faunal status,
- Phenological status
- Trophic status
- The protection status.

The faunal status indicates the biogeographic range of origin of each species of avifauna surveyed. The faunal type is established according to VOOS (1960), and then we have divided the faunal types according to the major biogeographic distribution regions:
Holarctic (H), Siberian (SB), Mediterranean (M), Palearctic (P), Paleo-Xeric (PX), Arctic (A), Ethiopian (ETH), Indo-African (IA), Cosmopolitan (C), European (E), Old World (OW).

The phenological status of avian species are (Boudraa 2014):

- Sedentary breeding,
- Wedentary non-breeding,
- Wintering,
- Summering and migratory
- Migratory, wintering
- Passing visitor

The trophic status is based on the determination of the food categories for each species of the set of species surveyed following the consultation of several articles and books. This status is defined as follows:

(Invertebrate Consumers (I), Polyphagous (Pp), Carnivorous (C), Piscivorous (P),Grainivorous (G), Omnivorous (OM),Vegetarian (V). (Bensaci *et al.,* 2013)

The protection status indicates the degree of protection of the species according to the regulations and legislation:

At the national level, we based ourselves on the list of species protected by Decree No. 83-509 of August 20, 1983 relating to non-domestic animal species protected in Algeria amended by Executive Decree No. 12-235 of 3 Rajab 1433 corresponding to May 24, 2012 setting the list of non-domestic animal species protected (Chenchouni 2016).

At the international level, We referred to the lists and annexes of the different conventions and treaties (ANNEX 2), namely: the IUCN red list (IUCN. 2021 ;Vié *et al.*,2008 ; Baillie *et al.*,2004 ; Hilton-Taylor 2000); the Washington Convention (CITES 1994); the Bonn Convention (VAGG 2009); the AEWA Agreement (AEWA 2008a); the Barcelona Convention (CEC, 1999); the Algiers Convention (Tematea 2007) and the Bern Convention (Admin 2007), as described in (Tab. 1). *For landbirds* We applied the method called STOC-EPS program launched in 1989 by the MNHN. This inventory method consists in carrying out 10 PSS (Simple Point Sampling) in a square of 4 km² (2km x 2km) chosen at random. These 10 listening points are distributed as homogeneously as possible and are spaced about 300 meters apart to avoid counting the same individual twice. The observer remains static for 5 minutes per point and notes all the contacts of individuals of all the species that he sees and hears.

Table 1. lists and annexes of various international conventions.

Treaty protection		Code used
Algerian law (Decree 83-509 and decree of 1995) and (decree 12-235)		D
IUCN Red List	Least Concern	LC
	Near Threatened	NT
	Vulnerable	VU
	Endangered	EN
CITES Convention "Washington"	Annex1	C 1
	Annex2	C 2
	Annex3	C 3
Bonn Convention	Annex 1	N 1
	Annex 2	N 2
AEWA Agreement		W
Barcelona Convention	Annex 2	L 2
Algiers Convention	List A	A
	List B	B
Bern Convention Annex	Annex 2	R 2
	Annex 3	R 3

For terrestrial fauna

The census of the terrestrial fauna of the region of the wetland of Sebkhet El Mahmel is based on field surveys, investigations with the local population, use of guides, the study of traces and excrements of animals as well as the consultation of bibliographic references and our most perfect knowledge of the region (Kerfouf *et al.,* 2015; Zouaidia *et al.,* 2021).

For the invertibrates

The systematics of the species of invertebrates is established according to "the methodological guide for the faunistic inventories of the terrestrial metropolitan species part 2 (Bendali-Saoudi *et al.,* 2014).

For reptiles and amphibians

Searches for reptiles and amphibians were conducted by visual and acoustic observations during field inventories in suitable habitats. Trapping was conducted at the site, using black plastic drift fences and funnel traps, which plastic drift fences and funnel traps, which supplemented the field inventories (Bezzaz 2019 ; Tlidjane and Maazi 2020). Additional information was gathered through interviews with local people.

For mammals

The study of the present species was carried out partly "by sight", by trying to observe the species or by looking for their signs of presence (droppings, footprints, remains of meals, hairs, possible lodgings) in the various potential or proven habitats (Kouakou *et al.,* 2018 ; Boulanger and Loubry 2020). For that, a set of routes were determined and followed, so as to grid the whole surface to be prospected. The pedestrian displacements were essentially random routes in the various habitats, which random routes in the different habitats, but also along the existing paths (hiking trails and (hiking trails and farm roads), also used by wildlife (Vaudry 1995 ; Tanguy et Gourdain 2011; Pagès *et al.,* 2013; Barataud 2015).

Results and discussion

Floristic diversity and patrimonial evaluation

The inventory of the flora and vegetation of the wetland of Sebkhet El Mahmel has allowed us to identify 78 species grouped into 23 families, pointing out that the majority of species are herbaceous and annual with the absence of tree forms with the exception of a few feet of *Tamarix gallica*, with the dominance of the family of Asteraceae (former Composaceae) which has 28% of the total species with 22 species, which reflects the themoxerophytic character of the environment, followed by the family Poaceae (former Grasses) with 15% and which has in turn 12 species indicative of the sensitivity of the environment to the work of the soil by plowing and the propagation of fields, then comes in third place the family Brassicaceae (former Crucifers) 12% with 09 species, also showing the dominance of cultivated fields, followed by the Chenopodiaceae family with 10% with 08 species (Fig.3), that are indicator species of saline environments par excellence (Aboura 2011; Koull et Chehma 2013; Bahi 2021).

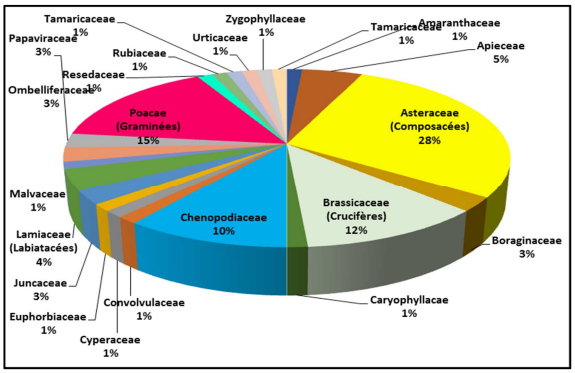

Fig. 3. Frequency of abundance in number of families of flora in the wetland of Sebkhet El Mahmel.

In terms of patrimonial value of the vegetation of the wetland Sebkhet El Mahmel, we note a species protected by the Executive Decree No. 12-03 of 10 Safar 1433 corresponding to January 4, 2012 establishing the list of protected non-cultivated plant species that is the *Papaver malviflorum* (Poppies) as we raise two species endemic to the high plains of Constantine which are *Juncus maritimum* (rush maritime) and *Phalaris minor* (Small Phalaris) (Beghami Y *et al.,* 2015 ; Fetnaci *et al.,* 2019), as we distinguish several species characteristic of salty wetlands, so four plants with midical interest and almost more than 50% of the plants have a forage interest.

Waterbirds

Among the 21 species that usually frequent the wetland of Sebkhet El mahmel with the observation of the marbled teal (*Marmaronetta angustirostris*) during our observation in the year 2013 with a record number of flamingo with 1600 individuals, which did not leave the area during the month of July only.

The 21 recorded species are distributed on 6 orders with the dominance of the order of *Charadriiformae* with 30% (03 families) followed by the order of Gruiformes and *pelecaniformae* with 20% (02 families) then the orders of *Anseriformae* 10%, *Phoenicopteriformae* 10% and Ciconiiformes 10% with 1 family for each Order (Fig.4).

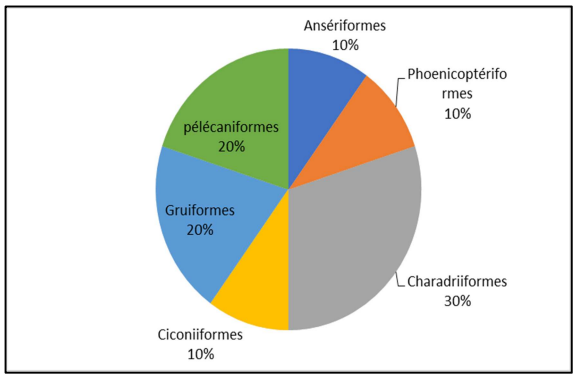

Fig. 4. The 6 orders of the waterbirds population identified in the wetland of Sebkhet El Mahmel.

The 21 species recorded are distributed in 8 families dominated by the *Anatidae* family with 10 species followed by the *Charadriidae* and *Ardeidae* familiy with 2 species and the families of*: Rallidae, Ciconiidae, Recurvrostridae, Scolopacidae, Phoenicopteridae* and *Gruidae,*represented with only one species each (Fig. 5).

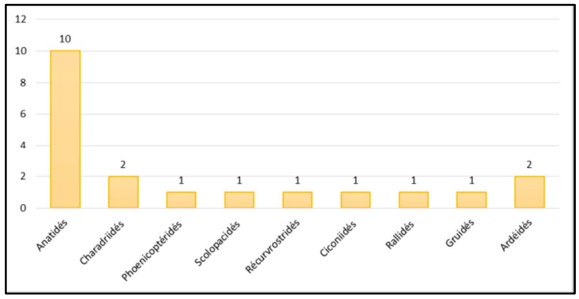

Fig. 5. The families specific richness of the waterbirds population identified in the wetland of Sebkhet El Mahmel.

The specific richness is dominated by the *Anas platyrtynchas* with 4600 individuals representing 18% of the total population and the *Phoenicopterus roseus* with 3400 individuals or 17% followed by the *Ciconia ciconia* with 3000, where the three species represent 52% of the total population of water birds that frequent the wetland of Sebkhet El-Mahmel (Fig. 6).

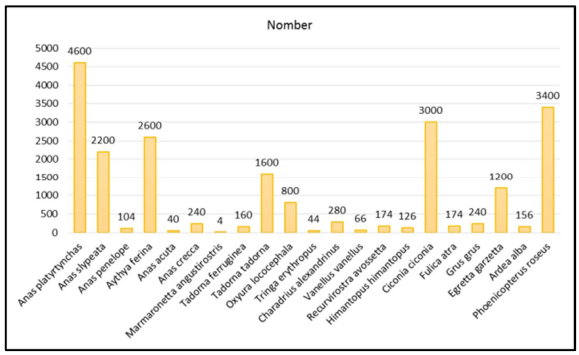

Fig. 6. The specific richness number of the waterbirds population identified in the wetland of Sebkhet El Mahmel.

The results of patrimonial evaluation which we obtained reveal that almost all the waterbirds listed in (Tab. 2) are protected by at least three international conventions and agreements (case of the White-headed Duck), while the most protected by the texts is the Pink Flamingo. Of the 21 species are 10 species or 47.61%, which are protected by Algerian regulations (Decree No. 83-509 of August 20, 1983 followed by

the Executive Decree No. 12-235 of 3 Rajab 1433 corresponding to May 24, 2012 settings the list of protected non-domestic animal species). These are: Marbled teal, Shelduck, Shelduck of belon, Elegant avocet, White stilt, White stork, Crane, Great egret, Little egret, Pink flamingo (Hermann 2004 ; Houhamdi *et al.,* 2009; Seddik *et al.,* 2012; Samraoui *et al.,* 2013; Aberkane *et al.,* 2013).

Table 2. The bioecological status of the waterbirds recorded in the wetland of Sebkhet El Mahmel (D: Algerian law, LC: IUCN Red List (Least Concern), C2:CITES Convention.

Name	Faunic status	Phénologic status	Trophic status	Protection status
Anas platyrtynchas	Holarctic (H)	Sedentary breeding, wintering	(Pp)	LC, N2, W, R3
Anas slypeata	Holarctic (H)	wintering	(Pp)	LC, C3, N2, W, R3
Anas penelope	Paléarctic (P)	wintering	(V)	LC, C3, N2, W, R3
Aythya ferina	Paléarctic(P)	wintering	(Pp)	LC, N2, W, R3
Anas acuta	Holarctic (H)	wintering	(Pp)	LC, C3, N2, W, R3
Anas crecca	Holarctic (H)	wintering	(G)	LC, C3, N2, W, R3
Marmaronetta angustirostris	Holarctic (H)	Sedentary breeding	(Pp)	D, VU, N1, W, R2
Tadorna ferruginea	Paléo-xéric(PX)	Sedentary breeding, wintering	(Pp)	D, LC, N2, W, R2
Tadorna tadorna	Paléarctic (P)	wintering	(Pp)	D, LC, N2, W, R2
Oxyura lococephala	Old World (OW)	Sedentary breeding, wintering	OM	LC, A, R3
Tringa erythropus	Siberian (SB)	wintering	(I)	LC, N2, W, R3
Charadrius alexandrinus	Paléarctic(P)	Sedentary breeding	(I)	LC, N2, W, R2
Vanellus vanellus	Paléarctic (P)	Migratory, wintering	(I)	LC, N2, W, R3
Recurvirostra avossetta	Paléarctic (P)	Sedentary breeding, wintering	(I)	D, LC, N2, W, R2
Himantopus himantopus	Paléarctic (P)	Sedentary breeding	(I)	D, LC, C3, W, A, R2
Ciconia ciconia	Paléarctic(p)	Sedentary breeding, wintering	(I)	D, LC, N2, W, A, R2
Fulica atra	Paléarctic (p)	Sedentary breeding, wintering	(Pp)	LC, N2, W, R3
Grus grus	Cosmopolitan (C)	Migratory, wintering	(Pp)	D, LC, C2, N2, W, R2
Egretta garzetta	Old World (OW)	wintering	(P)	D, LC, C3, W, A, R2
Ardea alba	Cosmopolitan (C)	Passing visitor	(P)	D, LC, A, R3
Phoenicopterus roseus	Mediterranean (M)	Sedentary breeding, wintering	(Pp)	D,LC,C2,N2,W,L2,A, R2

Annex 2, B: Algiers Convention List B, A: Algiers Convention List A, R2: Bern Convention Annex 2, R3: Bern Convention Annex 3, W: AEWA Agreement, L2: Barcelona Convention Annex 2, N1: Bonn Convention Annex 1, N2: Bonn Convention Annex 2)

Land birds

The 35 species recorded are distributed on 07 orders containing 19 families with the dominance of the order of passeriformes with 58% (11 families) followed by the order of strigiformes and coraciiformes with 11% (02 families) then the other four orders with 05% each (Fig. 7).

As shown in the Fig. below, the 19 families of land birds recorded in the area are dominated by the Columbidae family, representing 14% of the total population with 5 species, followed by the Turdidae, Strigidae, Fringillidae and Audidae families with 9% (3 species each), then the Accipitridae, Loceidae, Motacillidae, Laniidae with 6% (02 species), and the rest of the families with 3% or one species each (Fig. 8).

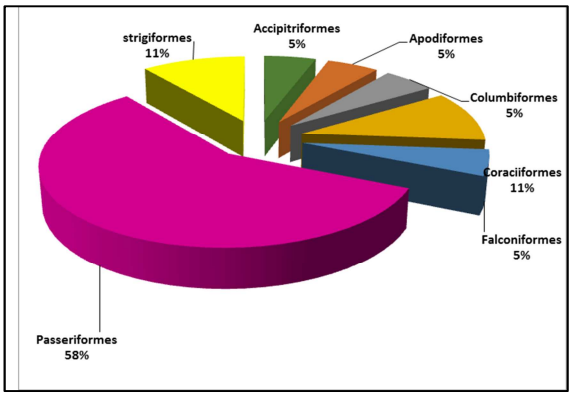

Fig. 7. Frequency of abundance in number of orders of land birds recorded or mentioned in the wetland of Sebkhet El Mahmel.

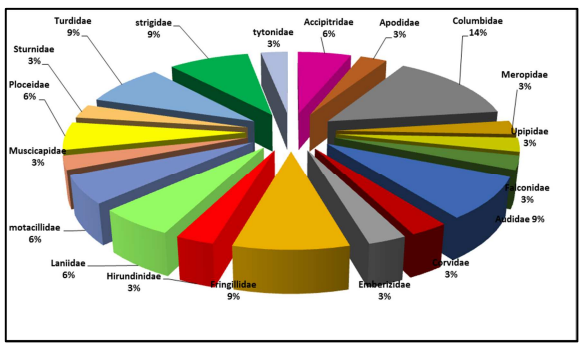

Fig. 8. Frequency of abundance in number of families of land birds recorded or mentioned in the wetland of Sebkhet El Mahmel.

The analysis of the results of patrimonial evaluation summarized in (Tab. 3), below, show that almost all the species of land birds in the study area are on different international lists of preservation and conservation of avifauna with the exception of two species only, from the point of view of patrimony, find 11 species or 31. 5% which are protected by the Algerian laws (D) according to the decrees (Decree No. 83-509 of August 20, 1983 followed by the Executive Decree No. 12-235 of 3 Rajab 1433 corresponding to May 24, 2012 setting the list of non-domestic animal species protected), which increases the avian heritage value of our study area.

The species protected by the Algerian regulations are: *Buteo rufinus*, *Milvus migrans*, *Columba oenas*, *Merops apiaster*, *Upupa epops, Carduelis carduelis, Asio otus, Athene noctua*, *Strix aluco*, and *Tyto alba*

Table 3. The patrimonial evaluation of the land birds of the Sebkhet El Mahmel wetland (D: Algerian law, LC: IUCN Red List (Least Concern), C2: CITES Appendix 2, N2:, B: Algiers.

Scientific Name	Status of protection	Scientific Name	Status of protection
Buteo rufinus	D, LC, C2, N2, B, R2	*Carduelis chloris*	LC, R2
Milvus migrans	D, LC, C2, N2, B, R2	*Hirundo rupestris*	LC, R2
Apus apus	LC, R3	*Lanius excubitor*	LC, R2
Columba liva	LC, C3, R3	*Phylloscopus collybita*	LC, R2
Columba oenas	D	*Anthus pratensis*	LC, R2
Columba palumbus	LC	*Motacilla alba*	LC, R2
Streptopelia decaocta	LC, R3	*Phoenicurus moussieri*	LC, R3
Streptopelia turtur	LC, N2, R3	*Passer domesticus*	LC
Merops apiaster	D, LC, N2, R2	*Passer hispaniolensis*	LC, R3
Upupa epops	D, LC, R2	*Sturnus vulgaris*	LC
Falco tinnunculus	D, LC, C2, N2, B, R2	*Oenanthe leucura*	LC, R2
Alauda arvensis	/	*Phoenicurus ochruros*	LC, R2
Calandrella rufescens	/	*Turdus merula*	LC, R3
Galerida cristata	LC, R3	*Asio otus*	D, LC, C2, B, R2
Corvus corax	LC, R3	*Athene noctua*	D, LC, C2, B, R2
Miliaria calandra	LC, R3	*Strix aluco*	D, LC, C2, B, R2
Carduelis cannabina	LC, R2	*Tyto alba*	D, LC, C2, B, R2
Carduelis carduelis	D, LC, R2		

Convention List B, R2: Bern Convention Appendix 2, R3: Bern Convention Appendix 3)

Terrestrial fauna

The invertibrates

The invertebrates recorded in the wetland of Sebkhet El Mahmel are divided into three branches ; Annelida, Mollusqua and Arthropoda contain 06 classes dominated by the class of insects. Thise invertibrates wasdivided on 98 species, into 16 orders containing 44 families with the dominance of the order of Coleoptera with 13 families containing 36 specie. The six classes of invertebrates count 16 orders dominated by the order of Coleoptera representing 29% of the totality of the orders, which counts 13 families followed by the order of Hymenoptera with 16% that is to say which gathers 07 families, followed by the order of Lepidoptera with 11%, odonata with 9%, deptera with 7%, heteroptera and othoptera with 4% and the remainder of the orders which represent 2% (Fig. 9).

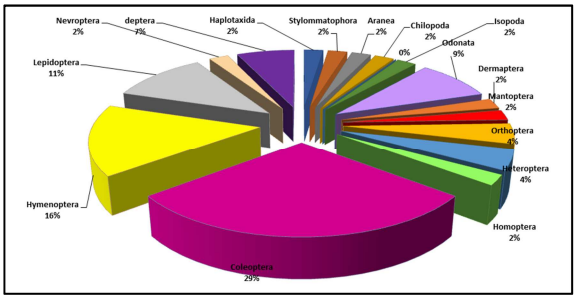

Fig. 9. Frequency of abundance in number of orders of invertebrates recorded or mentioned in the wetland of Sebkhet El Mahmel.

The families of invertebrates recorded are 54 families grouping 98 species with a dominance of the family Scarabidae which represents 8% of the total number of invertebrates recorded with 8 species, then the family Formicidae with 7% with 07 species, then the families Apidae and Carabidae with 6% and finally the rest of the families whose rate varies between 4% and 1% (Fig.10).

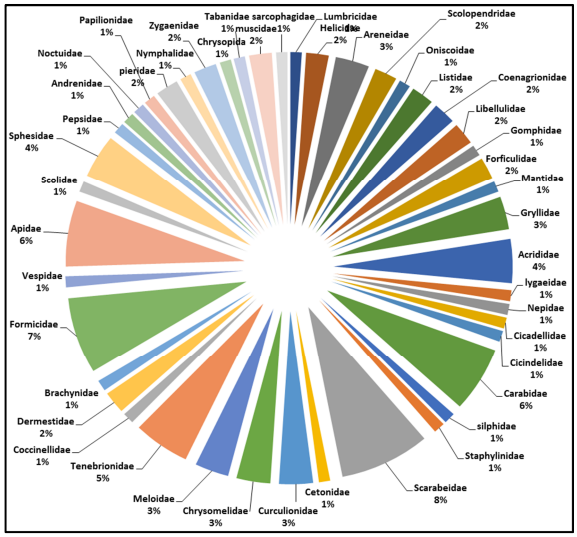

Fig. 10. Frequency of abundance in number of families of invertebrates identified or mentioned in the wetland of Sebkhet El Mahmel.

The evaluation of the patrimony of invertebrates that contains the wetland of Sebkhet El Mahmel represent an important richness in terms of species that are or turn of 98 dominated by carabids, orthopterans, dipterans what characterize the arid and dry conditions of the region, as we noted the presence of species of economic interest such as bees and other species of agronomic and ecological interest as ladybugs and the religious mounts. Also these invertebrates constitute an important link in the trophic chain of several birds of the region.

Because of the quality of the very salty water which exceeds 50g/l of salts we point out the absence of aquatic invertebrates in the study area. In terms of ecological and biological patrimony we report the presence of 09 species or 9% that are protected by Algerian law because of their economic and ecological importance these species are: *Sympetrum sanguineum, Mantis religiosa, Onthophagus taurus, Mylabris variabilis, Cataglyphis bicolor, Apis mellifica, Bombus terrestris, Coccinella septempunctata,* and *Chrysopa carne*

Reptiles and amphibians

The amphibians and reptiles surveyed reveals the presence of an order of amphibians which contains two families with two species each and two orders of reptiles with 05 families containing 12 species with the dominance of the lizard family with 07 species. The amphibian species are grouped in a single order of Anoura which represents 29% with two families, however the reptile population is grouped in two orders, the Squameta with 57% with 04 families and the Chelonia with 14% with one family (Fig. 11).

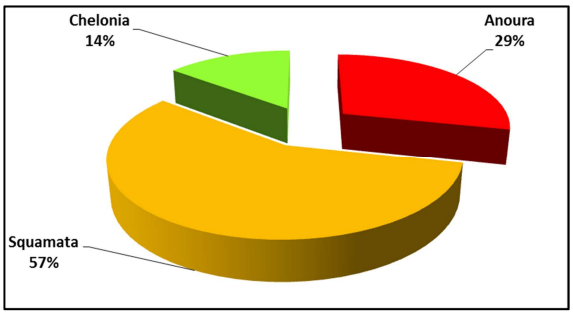

Fig.11. Frequency of abundance in number of orders of amphibians and reptiles recorded or mentioned in the wetland of Sebkhet El Mahmel.

The 16 species recorded are grouped into 7 families with the dominance of the family Lacertidae which represents 44% of the total number of species of reptiles and amphibians or 7 species, followed by the family Testudinidae and the family Ranidae, representing 13% each, then the family Bufinidae with 12% and finally the Colubridae, Viperidae and the family Chamaeleonidae with 6% each (Fig. 12)

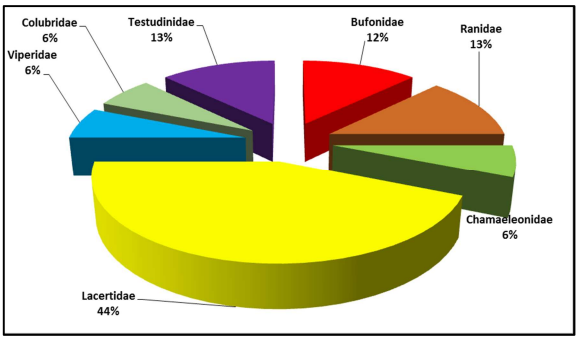

Fig. 12. Frequency of abundance in number of families of amphibians and reptiles recorded or mentioned in the wetland of Sebkhet El Mahmel.

A total of 16 species including 4 species of amphibians and 14 species of reptiles, which translates the rarity of species of this taxonomic round; that is due thanks to the very intense anthropic actions exerted in the region especially the

agricultural activities of which the deep work of the ground is necessary what results in the destruction of the ecological niches of these species.

In terms of patrimonial value on the 14 species of reptiles finds 06 or 42% of species that are protected by Algerian law including the Executive Decree No. 12-235 of 3 Rajab 1433 corresponding to May 24, 2012 establishing the list of animal species not domestic protected and finds on the totality of species amphibians and reptiles 06 species characteristic of the region (Tab. 4). (Amrouche-Larabi *et al.*, 2015).

Tab 4. the patrimony value of amphibians and reptiles in the wetland of Sebkhet El Mahmel (Cs: characteristic species, Ps: protected species).

Nom scientifique	Cs	Ps	Nom scientifique	Cs	Ps
Bufu bufu	+		*Coluber algirus*		
Bufu viridis	+		*Ophisops occidentalis*		
Rana saharica	+		*Psammodromus blanci*		+
Rana esculenta	+		*Tarentola mauritanica*		
Chamaeleo chamaeleon		+	*Echis leucogaster*		
Lacerta ocellata		+	*Malpolon monspesulanus*		
Lacerta pater			*Testudo graeca*	+	+
Psammo dromus algirus		+	*Mauremys leprosa*	+	+

Mammals

In terms of biological diversity, the wetland is experiencing a significant decline in the number of mammals that frequent the area because of overpopulation and the various roads that cut the area which results in the refuge of large mammals in the mountains bordering the area, but this has not prevented the presence of the passage where we noted the presence of 14 species in total. The totality of the mammals inventoried or reported are grouped in 06 orders dominated by the order of Fissipeda with 34% of the totality counting 03 families followed by the order of Rodenta with 22% and the rest of the four orders with 11% each (fig. 13).

The 14 species of mammals are distributed in 09 families dominated by the family of small mammals, the family of Muridae with 36% of the total number of species, that is to say 5 species, followed by the family of Canidae with 15% (02 species), then the 07 other families with a percentage of 7%, that is to say one species for each family (Fig. 14).

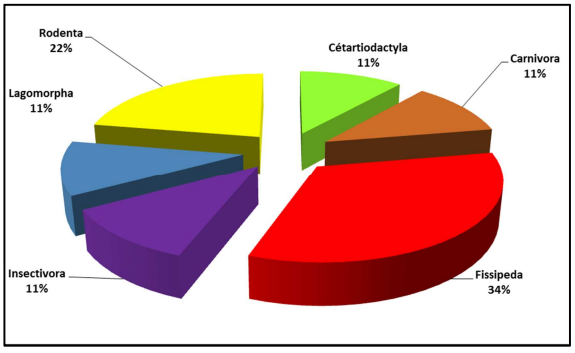

Fig. 13. Frequency of abundance in number of orders of mammals recorded or mentioned in the wetland of Sebkhet El Mahmel.

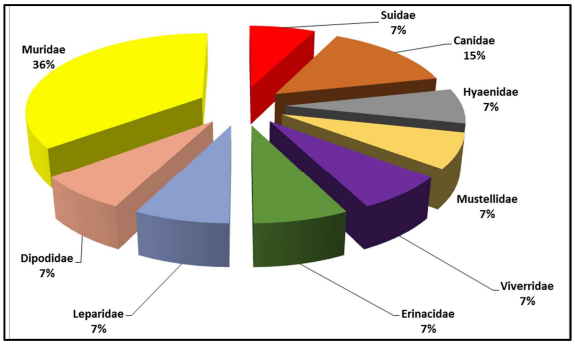

Fig. 14. Frequency of abundance in numbers of families of mammals recorded or mentioned in the wetland of Sebkhet El Mahmel.

As mentioned above, the mammal species in our area are dominated by small mammals (rodents), which represent 36% of the total species recorded, which confirms the alteration of the ecosystem of the area by the ploughing and the spread of cereal fields, which dominate the land use.

Despite the rarity of this taxon we note the existence or the frequentation of the area by species of very important patrimonial value such as the striped hyena which is a species threatened with distinction, as well as other species protected by the Algerian law, such as the *Atelerix algirus* (hedgehog of Algeria), *Genetta genetta* (the genet) and the *Mustela numidica* (weasel of Numidia) (Ahmim 2019).

Conclusion

Considering the biological diversity and the heritage value that represents the fauna and flora of the wetland of Sebkhet El Mahmel, which represents the only one of its nature in the arid region of Khenchela, knowing that it suffers from very important anthropic pressures to which is added the conditions of the climatic changes, which worsened the situation. In this vision we recommend a set of measures of protection, preservation and enhancement such as:

-The encouragement and the subsidy of the fodder cultures to demineur the pressure of the overgrazing;
- Awareness and encouragement of organic farming and the use of organic manure (sheep and cattle manure) by farmers, as well as the use of sludge from the future sewage treatment plant to be installed in front of the Sebkha as an important resource of organic fertilizer in the area, which will lead to the elimination of the use of chemical fertilizers;

-For the reduction of the use of phytosanitary products we recommend the promotion of research programs of biological control by exploiting the bio-aggressors that the zone contains such as the ladybug and the religious Mente;

-The popularization and the sensitization on the importance of the application of the technique of the direct seeding especially for the plots bordering the water level to reduce the use of ploughings;
- Creation of an afforestation belt to create natural habitats for wildlife;

- Creation of ecotourism areas;
- creation of observatories to monitor the fauna and flora to further scientific research on the wetland. In addition, the local decision-makers will have to prepare a file for the classification of this wetland as a RAMSAR zone.

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