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Original Research Paper

Diversity of vertebrates nesting in semi-arid areas of *Pistacia atlantica* Desf. (Tiaret, NW- Algeria)

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Abstract:

This is the first regional study aimed at understanding the diversity of the fauna nesting in the populations of Atlas Pistachio in Algeria. Fieldwork which lasted 6 years, consisted of mixed sampling (stratified then subjective) accompanied by surveys of the surrounding population in order to find the vertebrate species sought. A total of 160 species have been identified in all the study area (Tiaret region). There are 160 species of birds (46 migratory species and 66 sedentary species); 21 species of mammals; 5 species of freshwater fish; 17 species of reptiles and 5 species of amphibians. The present study revealed to us the existence of an exceptional fauna diversity in this area with some new data on the distribution of some species, especially birds and mammals. For the forest of Atlas Pistachio, there are less than all the study area, because of the location of the 4th forests, with two of them in the north of Tiaret region (mountains of Tagdemt and Guertoufa) and the the others forests in the south, in the steppe ecosystem (Rechaiga and Rosfa). Our study reveals that the most species and the diversity of fauna are located in the north (Tagdempt and Rosfa) with 47 species of birds of an total of 57 species that we mentioned in all the 4th forests of the Atlas Pistachio, 8 of the total of 12 species of mammals, 9 of the total of 13 reptiles and only one species of amphibians with is *Sclerophrys mauritanica*. We can say also that only two species have a direct relation with this tree, we talk about *Sturnus vulgaris* and *Mus musculus*, wich prefer the fruits and seeds of this tree; that Sturnus vulgaris with is a wintering migrant birds, and his migration come over the period of fruting of this endemic and important tree. For the mouse (*Mus musculus*), as all the rodentodia species, they prefer the seeds, that they collect into their hole. We can say at last, that the Tiaret region is very important biotope, for all the vertebrate species, for his heterogeneity ecosystems, and their location with consist of an migratory halt for many birds, also the nesting birds wicth come every year for the reproduction.

Keywords: Atlas Pistachio, Fauna diversity, Migratory, Nesting, Reptiles

الملخص

هذه هي الدراسة الإقليمية الأولى التي تهدف إلى فهم تنوع تعشيش الحيوانات في تجمعات أطلس الفستق في الجزائر. العمل الميداني الذي استمر 6 سنوات، ويتألف من عينات مختلطة (طبقية ثم ذاتية) مصحوبة بمسوحات للسكان المحيطين من أجل العثور على أنواع الفقاريات المطلوبة. تم تحديد 160 نوعًا في جميع منطقة الدراسة (منطقة تيارت). يوجد 160 نوعًا من الطيور (46 نوعًا مهاجرًا و 66 نوعًا مستقرًا) ؛ 21 نوعا من الثدييات. 5 أنواع من أسماك المياه العذبة؛ 17 نوعًا من الزواحف و5 أنواع من البرمائيات. كشفت الدراسة الحالية لنا عن وجود تنوع حيواني استثنائي في هذه المنطقة مع بعض البيانات الجديدة عن توزيع بعض الأنواع وخاصة الطيور والثدييات بالنسبة لغابة أطلس الفستق الحلبي، يوجد أقل من جميع مناطق الدراسة، بسبب موقع الغابات الرابعة، اثنتان منها في شمال منطقة تيارت (جبال تاجديمت وجيرتوفة) والغابات الأخرى في الجنوب. ، في النظام البيئي للسهوب Rechaiga) و .(Rosfa تكشف دراستنا أن معظم الأنواع وتنوع الحيوانات تقع في الشمال (تاجديت وروزفا) مع 47 نوعًا من الطيور من إجمالي 57 نوعًا ذكرناها في جميع الغابات الرابعة لأطلس الفستق، 8 من المجموع من 12 نوعًا من الثدييات، 9 من إجمالي 13 من الزواحف ونوع واحد فقط من البرمائيات مع .Sclerophrys mauritanica يمكننا أيضًا أن نقول أن هناك نوعين فقط لهما علاقة مباشرة بهذه الشجرة، نتحدث عن Sturnus vulgaris و Mus musculus ، اللذين يفضلان ثمار وبذور هذه الشجرة ؛ أن Sturnus vulgaris هو طائر مهاجر شتوي ، وتأتي هجرته خلال فترة تآكل هذه الشجرة المتوطنة والمهمة. بالنسبة للفأر (Mus musculus) ، مثل جميع أنواع القوارض ، يفضلون البذور التي يجمعونها في جحرهم .يمكننا أن نقول أخيرًا، أن منطقة تيارت هي بيئة حيوية مهمة جدًا ، لجميع أنواع الفقاريات ، لأنظمتها البيئية غير المتجانسة ، ويتكون موقعها من توقف هجرة العديد من الطيور ، كما تأتي الطيور التي تعشش كل عام للتكاثر

الكلمات المفتاحية فستق أطلس، تنوع حيوانات، مهاجرة، تعشيش، زواحف.

Introduction

The Mediterranean region, characterized by exceptional biological diversity, is currently in second position among the 34 hotspots of global biodiversity (Myers 1988, 1990; Mittermeier et al. 2004). Algeria, whose natural resources (fauna, soil, vegetation) were the subject of early solicitations (Louni, 1994) is home to very diverse ecosystems which are characterized by a remarkable biological richness (Miara et al, 2017).

In Alegria, there are approximately 701 vertebrate animal species, including about 416 species of birds, 110 mammal species, 64 fish species, 99 reptile species and 12 amphibian species. They are distributed from north to south, according to the bioclimatic stages, and make up this vast expanse, rich in landscape diversity (Doumergue, 1901; Heim de Balsac, 1936; Kowalskiand Rzebick-Kowalska, 1991; Schleichet *al*.,1996; Ahmim, 2004-2019; Isenmannand Moali, 1999). Studies on vertebrate fauna in Algeria are rare and occasional, althought there are some local works (Master, Magister or PhD Thesis) that frequently presenting some discourse on one or more species.

The region of Tiaret is known for its diversity of ecosystem and habitats (forests, scrub, steppes, cliffs, dams, reservoir of hill waters, wadis, chotts, cereal plains, temporary pools and dune corridors in the south). Further, it is also considered to be an important area in terms of vertebrate diversity. For instance, trees outside the forest that once formed parklands currently exist in certain places, in the form of isolated or grouped relics, which reflects their natural climax tree positions. The population of Pistacia atlantica growing in the semi-arid areas of this region have not been studied in terms of plant diversity only in terms of fauna.This special ecosystem on the ecological level is likely to shelter a unique fauna (Benhassaini et *al*., 2007) which will be the object of investigation in the present paper. There is a paucity in the study of the vertebrate diversity and ecology in the region of Tiaret (Djerbaoui, 2010; Loumassine, 2019). There has been no evidence that there has been any study on the fauna of the Pistachio of the Atlas locally, nationally, or in the North African region.

The aim of this study is to propose an exhaustive inventory of Atlas Pistachio populations in the Tiaret region.

Study area

The region of Tiaret is located in the northwest of Algeria (Figure 1), in the highlands. It is to the north of the Tellian Atlas, and south of the steppe.The presence of the Nador mountain range is in the steppe region, with unique vegetation and climate. A total of 68 sites were sampled during this study. The areas which have been the subject of a survey and counting of the vertebrate fauna, are located from north to south, forests, maquis, the cereal plain, the mountains, the steppe, the dams, the reservoirs hill waters, ponds, wadis, cliffs and chotts.In total, 4 Atlas pistachios forests were studied in order to bring out the vertebrate fauna subservient to this type of ecosystem. The sites are: Rechaiga, Guertoufa, Tagdempt and Rosfa.

Materials and Methods

This research was carried out during a period of 6 years, from 2011 to 2017. As this study has to be concern with several class of vertebrates present in the region, several sampling methods were used according to the five studied classes (birds, mammals, fish, reptiles and amphibians).

The sampling concerned only the regional forests of Atlas Pistachio tree previously localized using the map of International Plant Cover and Ecological Conditions, Algiers sheet 1 / 1,000,000 (Barry et *al*. 1974).According to the studied classes, several ecosystems were visited(wetlands, steppes, scrub, cliffs, etc.).

In these areas, subjective sampling was used (for the class of reptilia, amphibia and mamalia); for the others (Fishs and birds) we used different methods that we explain below. In parallel, surveys were carried out among local population to identify species and areas where they were presence. This approach was strategic in finding them more easily. For birds, several methods have been used for the census of avian fauna. For water birds, the counting one by one and by batch of 10 was carried out on the wetlands. For the forest birds, counting one by one and systemic research on birds in their environment, camouflage and use of song to locate them (Dorst, 1962 ; Ferry and Frochot, 1970).

To determined if mammals were in the area, we looked for droppings, footprints on the mud in the banks of wadis and wetlands. Also, systemic research on the location of caves and the species that shelter them. To find fish, the team used fishing rods, fish net and traps in plastic bottles.In search of reptiles and Amphibians, we used subjective sampling, witch consist to choose the ideal sampling situation based on knwoledge of the ecosystem and the behaviour of these animals, but also according to the prior experience and the sniff of the researcher; the method consists in traversing the area, walking at slow speed in order to see the species of reptiles and amphibians, in their natural state (to eat, to mate, to rest, to take a sunbathe). We also looked for them among bushes, under stones and bark of trees or to hear their noise while fleeing.

Figure. 1: Geographic location of the study area.

The animals observed are systematically photographed in their environment. Selected photos will be used to confirm the identification of the species. The identification of the species was carried out using the following documents: for birds (Harrinsonand Greensmith, 1993; Heinzelet *al*., 1995; Mullarneyet *al*., 1999), for mammals (Kowalski and Rzebik-Kowalksa, 1991; Ahmim2004, 2019), reptiles and amphibians (Bons, 1959; Bons and Girot, 1962; Bons and Geniez, 1967, 1996; Schleich et *al*., 1996).

In order to estimate regional biodiversity to be compared with other published works in Algeria, the diversity indices of Shannon-wiever (H') and Equity (E) were calculated for classes exceeding 10 different taxa:

Shannon diversity index (H') (Shannon and Weaver, 1949)

This index is a measure of entropy combining the numbers of taxa and individuals. Its value varies from 0 (a single species) to log S (when all species have the same abundance), S being the specific richness. This index varies directly with the number of species. It is calculated from the following formula: $H' = -\Sigma Pi.\log_2 Pi$, H, diversity index (in bits); Pi, probability of encountering species i.

Equity Index (E)

The evenness index, which is the Shannon index divided by the logarithm of the number of taxa. It is a measure of the uniformity of the distribution of individuals between taxa. Although partially correlated with taxonomic richness, it provides additional information that should not be overlooked.

The evenness index corresponds to the ratio of the observed diversity H to the maximum diversity Hmax, that is: E = H ⁄ Hmax.

The equitability E varies between 0 and 1. It tends towards 0 when almost all of the numbers correspond to a single species in the stand, which is unbalanced. It tends to 1 when each species is represented by the same number of individuals.

Results and discussion

The study of the fauna diversity of vertebrates in the studied areas revealed the existence of 160 species, divided into 111 species of birds "migratory and sedentary", 21 species of mammals, 6 species of fish, 17 species of reptiles and 5 species of amphibians.

Bird diversity

Regarding birds, 111 species have been inventoried (Table 1), distributed among 43 families and 20 orders. There are approximately 66 sedentary species, 18 wintering migratory species and 27 nesting migratory species. The Muscicapidae are the most represented in the study area with 10.81% of the composition of species of all families, then come the Alaudidae with 7.21%. All the other families are less than 5.5% and the most are composed only by 1 species (Fig.2). About 59% of the inventoried birds are resident species whereas 24, 32 % are migratory-nesting, and only 16.22 are migratory-wintering (Figure 3).From the official journal of Algeria N°35 of the 10/06/2012, 34.23% of the identified birds in our study area are protected by Algerian law. The rest of the species (65,77%) are considered of minor concern (Figure 4).

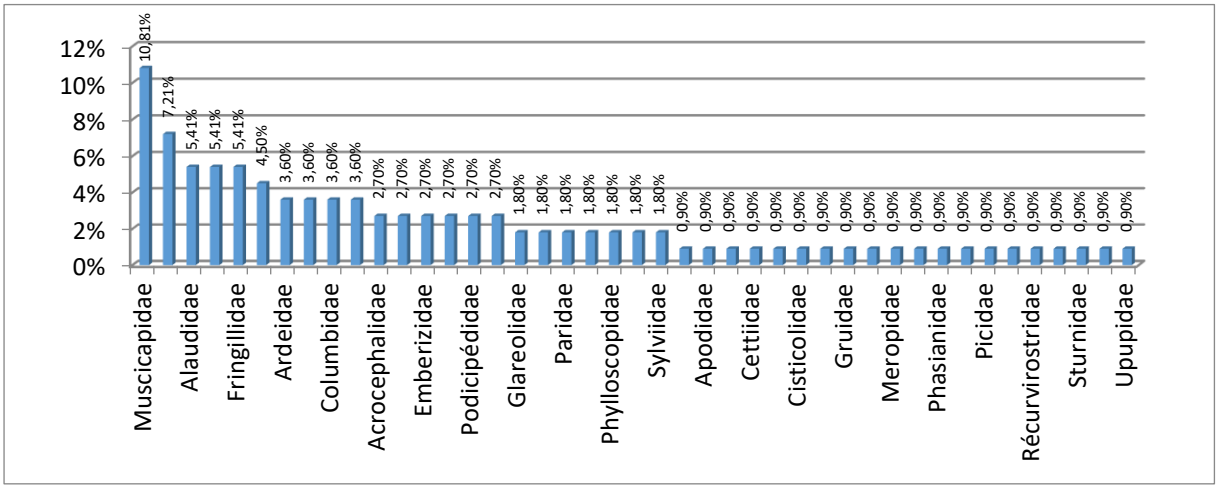

Figure. 2. Contribution of the families of birds (%)

Almost all the species reported during this study were already mentioned in the literature from sevral areas in Algeria (Heim De Balsac, 1936; Etcheopart and Hue, 1964). A variety ofnew species have been observed for the Tiaret region, namely: *Charadrius morinellus* (Eurasian Dotterel), *Cuculus canorus* (Common Cuckoo), *Eremophila bilopha* (Temminck's Lark), *Cettia cetti* (Cetti's Warbler), *Anthus spinoletta* (Water Pipit), *Phoenicopterus roseus* (Greater Flamingo), *Alcedo atthis* (Common Kingfisher) and *Phalacrocorax carbo* (Great Cormorant). By comparing the avian diversity of our study area with the works carried out in Morocco and Tunisia, we note that the majority of the species we reported are present in these two neighboring countries as the climate conditions are almost same (Azafzaf *et al*., 2015; Bergier *et al*., 2017). It should also be noted that the species (especially the migratory ones), pass during their migrations, through the Strait of Gibraltar (Morocco) and through Tunisia (in the complex of wetlands, in the extreme east of Algeria), thus a diffusion over the whole of Algeria is observed, from east to west and from north to south, and vice versa.

Table 1: list of bird species inventoried in the study area

N°	Class	Order	Family	Genus	Latin name	Statut
1	Aves	Accipitriformes	Accipitridés	Buteo	*Buteo buteorufinus*	Sedentary
2				Circaetus	*Circaetus gallicus*	Sedentary
3				Circus	*Circus aeruginosus*	Sedentary
4				Hieraaetus	*Hieraaetus pennatus*	Sedentary
5				Milvus	*Milvus migrans*	Migratory-nester
6		Ansériformes	Anatidés	Anas	*Anas platyrhynchos*	Sedentary
7					*Anas penelope*	Migrating-wintering
8					*Anas clypeata*	Sedentary
9					*Anas crecca*	Migrating-wintering
10				Tadorna	*Tadornaferruginea*	Migratory-nester
11					*Tadornatadorna*	Migratory-nester
12		Apodiformes	Apodidés	Apus	*Apus pallidus*	Migratory-nester
13		Bucérotiformes	Upupidés	Upupa	*Upupaepops*	Sedentary
14		Charadriiformes	Scolopacidés	Actitis	*Actitis hypoleucos*	Migrating-wintering
15				Calidris	*Calidris ferruginea*	Migratory-nester
16					*Calidris minuta*	Migratory-nester
17					*Calidris alpina*	Sedentary
18				Gallinago	*Gallinago gallinago*	Migrating-wintering
19				Philomachus	*Philomachus pugnax*	Migratory-nester
20				Tringa	*Tringa nebularia*	Migrating-wintering
21					*Tringa ochropus*	Migrating-wintering
22			Charadriidés	Charadrius	*Charadrius hiaticula*	Migratory-nester
23					*Charadrius alexandrinus*	Migratory-nester
24					*Charadrius morinellus*	Migratory-nester
25				Vanellus	*Vanellus vanellus*	Migrating-wintering
26			Glaréolidés	Cursorius	*Cursorius cursor*	Sedentary
27				Glareola	*Glareola pratincola*	Migratory-nester
28			Récurvirostridés	Himantopus	*Himantopus himantopus*	Migratory-nester
29			Burhinidés	Burhinus	*Burhinus oedicnemus*	Sedentary
30		Ciconiiformes	Ciconiidés	Ciconia	*Ciconia ciconia*	Migratory-nester
31		Columbiformes	Columbidés	Columba	*Columba livia*	Sedentary
32					*Columba palumbus*	Sedentary
33			Columbidés	Streptopelia	*Streptopelia turtur*	Sedentary
34					*Streptopelia decaocto*	Sedentary
35		Coraciiformes	Alcédinidés	Alcedo	*Alcedo atthis*	Migrating-wintering
36			Méropidés	Merops	*Meropsa piaster*	Migratory-nester

37	Cuculiformes	Cuculidés	Cuculus	*Cuculus canorus*	Migratory-nester
38	Falconiformes	Falconidés	Falco	*Falco tinnunculus*	Sedentary
39				*Falco biarmicus*	Sedentary
40				*Falco peregrinus*	Sedentary
41	Galliformes	Phasianidés	Alectoris	*Alectorisbarbara*	Sedentary
42	Gruiformes	Rallidés	Fulica	*Fulicaatra*	Sedentary
43			Gallinula	*Gallinulachloropus*	Sedentary
44		Gruidés	Grus	*Grus grus*	Migrating-wintering
45	passériformes	Acrocephalidés	Acrocephalus	*Acrocephalus schoenobaenus*	Sedentary
46				*Acrocephalus scirpaceus*	Migratory-nester
47			Hippolais	*Hippola ispolyglotta*	Migratory-nester
48		Alaudidés	Alaemon	*Alaemona laudipes*	Sedentary
49			Calandrella	*Calandrella brachydactyla*	Migratory-nester
50			Eremophila	*Eremophila bilopha*	Sedentary
51			Galerida	*Galeridama crorhyncha*	Sedentary
52				*Galerida cristata*	Sedentary
53			Melanocorypha	*Melanocorypha calandra*	Migratory-nester
54		Cettiidés	Cettia	*Cettiacetti*	Sedentary
55		Cisticolidés	Cisticola	*Cisticolajuncidis*	Sedentary
56		Corvidés	Coloeus	*Coloeus monedula*	Sedentary
57			Corvus	*Corvuscorax*	Sedentary
58			Pica	*Pica pica*	Sedentary
59		Emberizidés	Emberiza	*Emberiza sahari*	Sedentary
60				*Emberiza calandra*	Sedentary
61				*Emberiza cirlus*	Sedentary
62		Fringillidés	Carduelis	*Carduelis carduelis*	Sedentary
63			Chloris	*Chloris chloris*	Sedentary
64			Fringilla	*Fringilla coelebs*	Sedentary
65			Linaria	*Linaria cannabina*	Sedentary
66			Loxia	*Loxia curvirostra*	Sedentary
67			Serinus	*Serinus serinus*	Sedentary
68		Hirundinidés	Hirundo	*Hirundo rustica*	Migratory-nester
69		Laniidés	Lanius	*Laniussenator*	Sedentary
70				*Laniusmeridionalis*	Sedentary
71		Motacillidés	Anthus	*Anthuspratensis*	Migratory-nester
72				*Anthusspinoletta*	Migrating-wintering
73			Motacilla	*Motacilla alba*	Migrating-wintering
74				*Motacillaflava*	Migratory-nester
75		Muscicapidés	Erithacus	*Erithacusrubecula*	Migratory-nester
76			Ficedula	*Ficedulahypoleuca*	Sedentary
77			Luscinia	*Lusciniamegarhynchos*	Sedentary
78			Muscicapa	*Muscicapastriata*	Sedentary
79			Oenanthe	*Oenanthemoesta*	Sedentary
80				*Oenanthedeserti*	Sedentary
81				*Oenanthehispanica*	Migratory-nester
82				*Oenantheleucura*	Sedentary

83			Phoenicurus	*Phoenicurusmoussieri*	Sedentary
84				*Phoenicurusochruros*	Migratory-nester
85			Saxicola	*Saxicolarubetra*	Sedentary
86				*Saxicolarubicola*	Sedentary
87		Paridés	Cyanistes	*Cyanistesteneriffae*	Sedentary
88			Parus	*Parus major*	Sedentary
89		Passéridés	Passer	*Passer domesticus*	Sedentary
90				*Passer hispaniolensis*	Sedentary
91		Phylloscopidés	Phylloscopus	*Phylloscopustrochilus*	Migrating-wintering
92				*Phylloscopussibilatrix*	Sedentary
93		Sturnidés	Sturnus	*Sturnusvulgaris*	Migrating-wintering
94		Sylviidés	Sylvia	*Sylvia atricapilla*	Migratory-nester
95				*Sylvia melanocephala*	Sedentary
96		Turdidés	Turdus	*Turdus viscivorus*	Migrating-wintering
97				*Turdus philomelos*	Migrating-wintering
98				*Turdus merula*	Sedentary
99	Pélécaniformes	Ardéidés	Ardea	*Ardea alba*	Migrating-wintering
100				*Ardea cinerea*	Sedentary
101			Bubulcus	*Bubulcus ibis*	Sedentary
102			Egretta	*Egrettagarzetta*	Migratory-nester
103	Phoenicoptériformes	Phoenicoptéridés	Phoenicopterus	*Phoenicopterusroseus*	Migrating-wintering
104	Piciformes	Picidés	Picus	*Picusvaillantii*	Sedentary
105	Podicipédiformes	Podicipédidés	Podiceps	*Podicepsnigricollis*	Sedentary
106				*Podicepscristatus*	Sedentary
107			Tachybaptus	*Tachybaptusruficollis*	Sedentary
108	Pterocliformes	Pteroclidés	Pterocles	*Pteroclesalchata*	Sedentary
109	Strigiformes	Strigidés	Athene	*Athenenoctua*	Sedentary
110		Tytonidés	Tyto	*Tyto alba*	Sedentary
111	Suliformes	Phalacrocoracidés	Phalacrocorax	*Phalacrocoraxcarbo*	Migrating-wintering

Regarding sedentary birds, the wide distribution from Morocco to Tunisia, via Algeria on the latitudinal limits could explains the presence of this avian fauna in the three countries.

We encountered 9 rare species with a number of individuals that do not exceed 50 during a year. They are as follows: *Calidris minuta* (Little Stint), *Tringa nebularia* (Common Greenshank), *Burhinus oedicnemus* (Eurasian Stone-curlew), *Alcedo atthis*, *Cuculus canorus*, *Cettia cetti*, *Emberiza cirlus* (Cirl Bunting), *Ardea alba* (Great Egret), *Phoenicopterus roseus*. These species are more or less abundant in the study area during periods of migration. In general, we meet them during a period, which ranges from 15 days to 1 month.

Species of localized distribution are: *Hieraaetus pennatus* (Booted Eagle), *Milvus migrans* (Black Kite), *Charadrius morinellus* (Eurasian Dotterel), *Falco biarmicus* (Lanner Falcon), *Falco peregrinus* (Peregrine Falcon), *Alaemona laudipes* (Greater Hoopoe-Lark), *Carduelis carduelis* (European Goldfinch), *Passer hispaniolensis* (Spanish Sparrow). The species quoted above have a distribution almost reserved for the cliffs, although *Charadrius morinellus* and *Alaemona laudipes* are frequent the steppe zone of Sidi Abderrahmane, in the southwest of the Tiaret area.

Migratory birds are mainly composed of Charadriiformes and Anseriformes. These wintering migratory birds and nesting migratory birdsspecies visit the study area during the winter period where they burrow the cold areas of Europe and Asia, to stay there from North Africa to the countries of the Sahel. There is a total of 18 species of wintering birds in this semi-arid area. The second group is composed of

migratory species that nest in our region, 27 species, their presence is regular during the years when we surveyed the field. Sedentary birdsare that we meet throughout the year where they are nesters, as well as the number in individuals is higher. Some species are exclusively linked to forest. Others species are frequent only in the steppe environments, whereassome species are found around the cliffs. Many of these species are cosmopolitan.

The calculated Shannon index in the 04 sampled areas presents values between 2.94 and 3.11. This leads us to say that bird species diversity is very higher. In the study by Ouarab *et al.* (2018) in the wetland of Oued El Alleugue (Blida province), the Shannon-Weaver index varies between 1.43 and 2.69. These values are clearly lower than those we obtained, thus confirming the high diversity of our regions in birds.

For the Simpson index and equitability, calculated values allowed us to deduce that there is a codominance of species, since values tends towards 1 (Table 2). Ouarab *et al.* (2018) announce values of $0.48< E < 0.89$ contrary to the values obtained in the present study where in the 4 stations the values obtained are greater than 0.8. This indicates a fairly high biodiversity which remains more or less stable at the level of the region studied.

Table. 2. Diversity indices calculated for birds

	Rechaiga	Rosfa	Tagdempt	Guertoufa
Taxa_S	46	44	36	32
Individuals	2116	1711	1721	1814
Shannon_H	3.116	3.116	2.956	2.941
Equitability_E	0.8138	0.8233	0.8248	0.8487

Mammal's diversity

There are 21 species of mammals in the studied region (Table 3). They are divided into 12 families and 6 orders. Some species like *Sus scrofa* (Boar), *Canis anthus* (North African goden wolf), *Vulpes vulpes* (Red fox), *Felis sylvestris lybica* (Wild cat), *Hyaena hyaena* (Striated hyena), *Herpestesichneumon* (Mongoose), *Genetta genetta* (Genet), *Myotis punicus* (Felten's myotis), *Atelerix algirus* (Algerian Hedgehog), *Lepus capensis* (Cap Hare), *Hystrix cristata* (Porcupine), *Mus musculus* (Mouse) and *Meriones shawi* (Shaw's gerbil) occurs in all the sampled sites, means throughout the Tiaret area. The rest of the species *Pipistrellus kuhlii* (Kuhl's pipistrelle), *Rhinolophus ferrumequinum* (greater horseshoe bat), *Jaculus orientalis* (Great gerbil), *Rattus rattus* (Balck rat), *Rattus norvegicus* (Norvegian rat) and *Psammomys obesus*(Fat gerbil) are localized species, whose presence is limited to only a few sites.

Most of the mammal species found in the Tiaret region are protected by law due to hunting, poaching and the destruction of their habitats; we can cite *Canis anthus*, *Vulpes vulpes*, *Felis sylvestris lybica*, *Hyaena hyaena*, *Genetta genetta*, *Myotis punicus*, *Hystrix cristata*, *Pipistrellus kuhlii* and *Rhinolophus ferrumequinum*. *Canis familiaris* and *Felis catus*, two species mentioned in this study are domestic speciesthat co-exist with only with humans. During the study, we noticed their existence in distant environments, and appeared to have become wild again.They have been documented, since they are able to disturb the ecosystemwith other wild species and there is the potential for them to cross-breed with species of the same genus (domestic dog X North African wolf, domestic cat X wild cat).

It was observed that Muridae are the most represented with 23.81%, followed by Canidae, Felidae, Viverridae and Vespertillionidae with 14.29% and 9.52% respectively (Fig. 5). The rest of the families are only represented by 01 species (4.76%).

The most mammals of our study area are protected by law (Figure 6), with 52.38%, the rest are of minor concern (Official journal of republic of Algeria N°35, 12/06/2012).

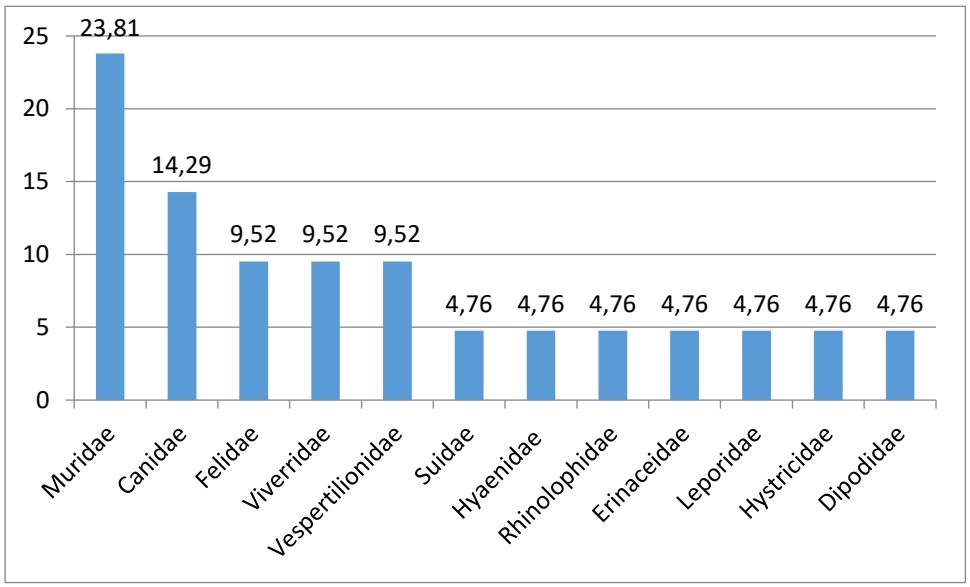

Figure 5. Contribution of mammal families (%)

Table 3: list of mammal species inventoried in the study area

N°	Class	Order	Family	Genus	Latin name
1	Mammalia	Artiodactyla	Suidae	*Sus*	*Sus scrofa*
2		Carnivora	Canidae	*Canis*	*Canisanthus*
3					*Canisfamiliaris*
4				*Vulpes*	*Vulpes vulpes*
5			Hyaenidae	*Hyaena*	*Hyaenahyaena*
6			Felidae	*Felis*	*Felissilvestrislybica*
7					*Feliscatus*
8			Viverridae	*Herpestes*	*Herpestes ichneumon*
9				*Genetta*	*Genettagenetta*
10		Chiroptera	Vespertilionidae	*Pipistrellus*	*Pipistrelluskuhlii*
11				*Myotis*	*Myotispunicus*
12			Rhinolophidae	*Rhinolophus*	*Rhinolophusferrumequinum*
13		Erinaceomorpha	Erinaceidae	*Atelerix*	*Atelerixalgirus*
14		Lagomorpha	Leporidae	*Lepus*	*Lepuscapensis*
15		Rodentia	Hystricidae	*Hystrix*	*Hystrix cristata*
16			Dipodidae	*Jaculus*	*Jaculusorientalis*
17			Muridae	*Mus*	*Mus musculus*
18				*Rattus*	*Rattusrattus*
19					*Rattusnorvegicus*
20				*Meriones*	*Merionesshawi*
21				*Psammomys*	*Psammomysobesus*

The most of the mammals existing in the study area have been mentioned in the work of Kowalski and Rzebick-Kowalska (1991) and Ahmim (2004-2019), with the exception of *Pipistrellus kuhlii* and *Psammomys obesus* which is considered new for the region of Tiaret.With regard to the comparison with the mammals observed in Morocco and Tunisia, all the species present in our region are founded in these countries (Thévenot and Aulagnier, 2006; Denys et al., 2015; Ridha et al. 2018; Thévenot and al., 2019).

The calculated Shannon index slightly exceeds 1, for the 4 visited stations. This indicate that there is a significant diversity of species in our study area. This results are alsmost similar to those observed by Lamrad and Chabouti (2019). Otherwise, Equitty index varies between 0,7 and 0,8 (Table 4).

Table 4. Diversity indices calculated for Mammals

Mammalia				
	Rechaiga	Rosfa	Tagdempt	Guertoufa
Taxa_S	8	7	7	6
Individuals	72	82	115	124
Shannon_H	1.659	1.662	1.396	1.262
Equitability_E	0.7978	0.854	0.7174	0.7043

Fish diversity

The class of fish in the study area includes 6 species (Table 5) belonging to 2 families, of which only one species is endemic to North Africa (*Barbus callensis*), 03 species are introduced into dams and reservoirs of waters hills: *Barbus bearded* (Common Barbel), *Carassius carassius* (Crucian fish) and *Cyprinus carpiocarpio* (Common Carp).Two other species are invasive: *Pseudoras boraparva* (Asian Stud) and *Gambusia affinis* (Mosquitofish) used against mosquitoes. For this class, the encountered species (introduced species) are all cited in the consulted literature (Kraiem, 1983; Djemali, 2006; Azeroual *et al*., 2015).

Table 5: list of fish species inventoried in the study area.

N°	Class	Order	Family	Genus	Latin name
1	Actinopterygii	Cypriniformes	Cyprinidae	*Barbus*	*Barbus barbus*
2				*Barbus*	*Barbus callensis*
3				*Carassius*	*Carassiuscarassius*
4				*Cyprinus*	*Cyprinuscarpiocarpio*
5				*Pseudorasbora*	*Pseudorasboraparva*
6			Poeciliidae	*Gambusia*	*Gambusia affinis*

Reptile diversity

The reptile class in our study area is represented by 17 species (Table 6) belonging to 10 families. According to several authors (Bons and Geniez, 1996; Bons, 1959-1967; Bons and Girot, 1962; Schleich *etal*., 1996), all species have already been cited in the bibliography. The rare and localized species are *Daboia mauritanica* (Mauritania pit viper), *Trapelus mutabilis* (Changing Agama) and *Timon pater* (Ocellated Lizard). The rest of the species are more or less abundant (throughout the study area) and with more or less high numbers. Lacertidae is the most represented family with 29.41%, followed by Colubridae with 17.65% and Agamidae with 11.76%. The rest of families are represented of less than 6% (Figure 7) From Reptile species found in this study, 41.18% are protected by the Algerian laws, and 58.82% are of minor concern (Figure 8).

The calculated Shannon index for Reptiles is slightly greater than 1, indicating a significant diversity in the studied area (Tab.7). In Kala National Park (Province of Annaba), Rouag and Benyakoub (2006) reported values varying between 0.9 and 1.7 for the 10 stations studied.

All the reptiles inventoried in this study were subsequently cited in the bibliography (Doumergue, 1901; Schleich *et al.* 1996), while only *Trapelus mutabilis* is considered new for our study area. It is the same by comparing our data with those of Morocco and Tunisia. Indeed, we found that all reported species have also been cited in the published bibliography of these countries (Bons, 1959; Bons and Girot, 1962; Fahd, 1993; Bons and Geniez, 1996; Geniez *et al*., 2004).

Regarding Equity, the values tend towards 1, which is quite close to the values observed by Rouag and Benyakoub (2006).

Table 6. List of reptile species inventoried in the study area.

N°	Class	Order	Family	Genus	Latin name
1	Reptilia	Amphisbaenia	Trogonophidae	*Trogonophis*	*Trogonophiswiegmanni*
2		Chelonia	Chelonia	*Mauremys*	*Mauremysleprosa*
3			Testudinidae	*Testudo*	*Testudograecagraeca*
4		Ophidia	Colubridae	*Hemorrhois*	*Hemorrhoishippocrepis*
5				*Malpolon*	*Malpoloninsignitus*
6				*Natrix*	*Natrixmaura*
7			Viperidae	*Daboia*	*Daboiamauritanica*
8		Sauria	Lacertidae	*Psammodromus*	*Psammodromusalgirusalgirus*
9				*Podarcis*	*Podarcisvaucheri*
10				*Timon*	*Timon pater*
11				*Acanthodactylus*	*Acanthodactyluserythrerus*
12					*Acanthodactylusboskianus*
13			Chamaeleontidae	*Chamaeleo*	*Chamaeleochamaeleon*
14			Gekkonidae	*Tarentola*	*Tarentolamauritanica*
15			Agamidae	*Agama*	*Agama impalearis*
16				*Trapelus*	*Trapelusmutabilis*
17			Scincidae	*Chalcides*	*Chalcidesocellatus*

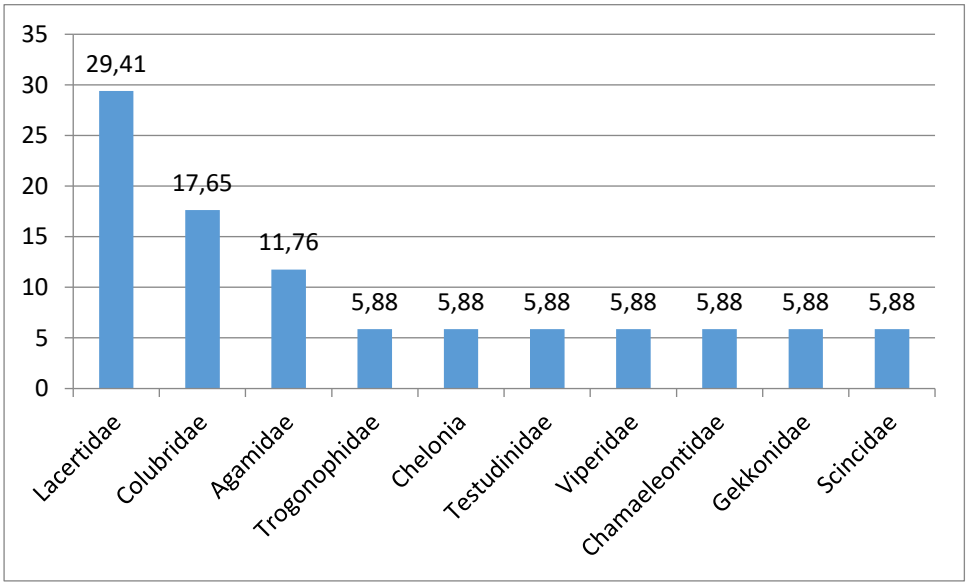

Figure 7. Contribution of Reptile families (%)

Table 7. Diversity indices calculated for Reptile

Reptilia				
	Rechaiga	Rosfa	Tagdempt	Guertoufa
Taxa_S	10	10	7	7
Individuals	144	121	87	70
Shannon_H	1.901	1.766	1.641	1.585
Equitability_E	0.8254	0.7668	0.8436	0.8147

Amphibian diversity

In total, 5 species of amphibians have been identified in the study area (Table 8), belonging to 4 families. The rare and endangered species due to the destruction of habitats (temporary pools, wadis, etc.) are *Hyla meridionalis* (Green tree frog), *Discoglossus pictus* (Peinted discogloss) and *Bufotes boulengeri* (Mauritania green toad). The two remaining species present more or less high proportions in terms of total individual number.

Table 8: list of amphibian species inventoried in the study area.

N°	Class	Order	Family	Genus	Latin name
1	Amphibia	Anoura	Bufonidae	*Bufotes*	*Bufotesboulengeri*
2				*Sclerophrys*	*Sclerophrysmauritanica*
3			Discoglossidae	*Discoglossus*	*Discoglossuspictus*
4			Ranidae	*Pelophylax*	*Pelophylaxsaharicus*
5			Hylidae	*Hyla*	*Hylameridionalis*

Bufonidae are the most represented family with 40% followed by Discoclossidae, Raniadae and Hylidae (20% each, Fig. 9). Among Amphibian species found in our study area, 40% are protected by the Algerian law. The rest, (60%), are not protected (Fig.10). All the Amphibian species mentioned here have already been observed (Doumergue, 1901 and Schleich *et al*., 1996). They are all cited for Morocco and Tunisia (Bons, 1959; Bons and Girot, 1962; Fahd, 1993; Bons and Geniez, 1996; Geniez *et al*., 2004).

Conclusion

A total of 160 species of vertebrate have been identified in this study. This fauna is more or less linked to the vegetation dominated by *Pistacia atlantica* in semi-arid areas. This first study reveals a certain richness of vertebrate, whose ecology and relationship with vegetation as well as local ecological conditions need to be further studied. This diversity in faunistic species makes it possible to offer the protection of these areas with an official status. This protection will lead to the safeguarding of this rich fauna that has been weakened by the anthropic action as well as the unfavorable ecological conditions due to the global changes, which the planet undergoes.

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