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Overview of Plant Pollinators, Including Apoidae (Hymenoptera, Apoidea) in two Regions in Algeria

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Abstract

This study was conducted during the period from July 2013 to February 2016, concerning the diversity of plant pollinators, spontaneous and cultivated, especially the group Apoidea (Hymenoptera, Apoidea) in Algeria. In this study, two regions have been chosen. The first zone located in Mitidja, Algerian coast and the second in Biskra, in the south of Algeria. Several flowering species could be caught using a pillbox, a butterfly net or a sweep net. Captured specimens were sacrificed then spread out and pinned. The different groups were separated and placed in entomological boxes. The determination was made subsequently. The observations revealed the presence of 47 species of Apoidea, 5 families of Apoidea represented by 15 genera. These 5 families are *Apidae* with an abundance of 52.9%, represented by the genera *Apis, Anthophora, Amegilla, Eucera, Melecta, Bombus* and *Xylocopa*. Among Halictidae (17.8%) are *Halictus* and *Lasioglossum* species. Andrenidae corresponds to 14.5% of the species caught, represented with a single genus *Andrena*. Megachilidae (12.0%) are present in 3 genera. Those of *Megachile, Osmia* and *Heriades*. The family Colletidae is little mentioned with two genera, *Colletes* and *Hylaeus* (2.7%). The diversity of the species sampled is close to the maximum value with a Shannon-Weaver index value equal to 5, 0 bits and fairness equal to 0. 92. The study area had a great diversity of Apoidea which provides many pollinating insects from wild and cultivated plants.

Keywords: Apoidea, Vegetation, Pollination, Diversity, Algeria.

INTRODUCTION

The pollination of flowering plants is carried out mainly by passive self-pollination as well as by wind (anemophilia) and insects (entomophilia). According to [1], self-pollination is rarely the dominant pollinator, and wind is the main pollen vector in only 10% of flowering plants, however insects exclusively pollinate all other species or dominant. While the honeybee, which represents a single species of *Apis mellifera*, is a major pollinator of plants, there are a large number of wild insect species, mainly Apoidea, which also contribute decisively [2]. The survival or evolution of more than 80% of the world's plant species depends directly on pollination by insects that are essentially bees [3]. Like social species, solitary bees are located within the Apoidea super family belonging to the Aculeate group, the suborder Apocrites and the order Hymenoptera [4]. Bees are a monophyletic group [5]. [6] Indicates that, based on the morphology of their mouthparts, apiform apoidea are separated into two distinct groups, those with short tongues (Colletidae, Andrenidae, Halictidae, Melittidae, Meganomiidae, Stenotritidae, and Dasypodaidae) and those with long tongues (Megachilidae and Apidae). The number of Apoidea species is estimated at 20,000 worldwide [6]. The major interest of studying bees is the key role they play in ecosystems. In fact, they play a major role in the pollination of many plants. The majority of them could not complete their development cycle without bee intervention [7]. The purpose of this work is to present the current state of knowledge of pollinating fauna, including Apoidea in two regions in Algeria. A preliminary list of known species of this region is drawn up. The Maghreb or North Africa has not been the subject of in-depth studies on Apoidea fauna. In Algeria, the study concerning the fauna of the apoidea is very insufficient and fragmentary. Until a fairly recent period, this fauna remained very poorly known. Most of the research carried out on Apoidea stands in Algeria is based on an inventory of the species observed, their ecology not being discussed. The most recent work is done by [8, 9], [10, 11], [12], [13] near of Constantine. Around Algiers, some research is done by [14-16]. Other studies are noted as those of [17], [18], and [19]. The only studies undertaken in Tizi-Ouzou region are those of [20, 21]. The problem of the present study concerns a better knowledge of the faunistic biodiversity of these insects of ecological and economic interest in Mitidja and Biskra. Inventory was conducted in different ecosystems, natural and agricultural, in both study areas.

MATERIAL AND METHODS

Study area

This study was conducted in two regions in Algeria. The first is a part of Mitidja (36° 45'N, 3° 23'E. 35 m). It belongs to the sub-humid bioclimatic stage in temperate winter. The vegetation of Mitidja has a great diversity of Mediterranean type, the trees and shrubs being almost all evergreen. The plants are divided into three layers, ornamental trees, fruit trees, shrubs and herbaceous plants. Two stations were chosen; an horticultural station in El Harrach and a citrus orchard in Rouiba. The second is the region of Biskra (34° 13 '28 "N 5 ° 6' 15" E. 120 m), located in the south-east of Algeria, belonging to the Saharan bioclimatic stage. Plant of this area consists of natural steppe formations and particularly oasis of date palm groves of Phoenix dactylifera L. In addition, intercropping occupy the space between the palm trees like fruit trees and food crops. Both stations, El Hadjeb

and El Besbes, are the two regions of our study illustrated in Figure 1.

Figure 1: Map of northern Algeria shows the two sample regions.

Sampling of insect pollinators

Specimen collection was done mostly on sunny days during the hot hours when Apoidea are usually the most active. The captures were made on the flowers of spontaneous plants in thermophyte lawns and on trees at human height. The entomological net was the most used tool for capturing flying insects. It was indispensable in this study. It was generally used in two ways; the first was the capture in flight. It's about making lateral movements. The second way is mowing. It is a hunt "blindly". To sample insects on the grass or foliage of bushes [22].

Once in the laboratory, the insects were sacrificed without damaging it. Dead specimens are mounted on entomological pins with data tags.

The different taxa are determined up to the genus using the dichotomous keys of Plateau-Quenu (1972), Batra (1977) and Scheuchl (2000). The confirmation of the determination is made by comparison with the collection of insects of Morel and Pasquier in the department of agricultural and forestry zoology at ENSA (National School of Agronomy, Algiers).

Counting bees

During the period of the experiment, counts were made at the time of flowering of the plants. A large number of plant species was discussed. 10 observations were made per day, from before noon till 5 pm (Gmt + 1). The observer counted the bees every hour of the day for 15 minutes. The counts were carried out 3 times at the level of each flowering plant.

To study the diversity of insects sampled, the results obtained were studied by ecological indices; such as the total wealth (S) which is the total number of Apoidea species captured by the different sampling means [23]; Relative abundance (R.A. %) which is the ratio of the number of individuals of a species to the total number of individuals, all species combined N [24].

And also the Shannon-Weaver index. Diversity is a function of the probability of the presence of each species in a set of individuals. According to [25] and [26], this index is the most commonly used in the literature [27]. It is based on $H' = -\sum Pi \log_2 (Pi)$

$Pi = ni/N$

ni : number of species i

N : total population of the stand

Equitability E is the ratio of the observed diversity index H' to the maximum diversity H'max [23]. His equation is written as follows: $E = H'/H'max$ in which $H'max = Log_2 S$

S is the total species richness.

Census and determination of spontaneous flora

The identification of spontaneous flora was mainly made by using the determination keys of [28] and [29, 30]. The classification of these plants was made according to the strata to which they belong and taking into account their floral structures.

RESULTS AND DISCUSSION

The composition of pollinating Entomofauna

The composition of pollinating Entomofauna captured on the flowers of spontaneous and cultivated plants in the two regions, Biskra and Mitidja, revealed the presence of certain species in a permanent way and during several months of sampling. The list of the most represented families is shown in Table 1.

Table1: Principal insects, pollinator of plants by order and systematic families .(n: number of specimens; n %: relative abundance of the taxon considered; NE: number of species; NE%: frequency of the number of species).

Orders	***Familles***	***N***	***n%***	***N***	***N%***
Hymenoptera	Vespidae	3	4.69	132	13.85
	Scoliidae	5	7.81	96	10.07
	Formicidae	2	3.13	34	3.57
	Apoidea	46	71.88	433	45.44
Diptera	Syrphidae	3	4.69	98	10.28
	Calliphoridae	1	1.56	17	1.78
Lepidoptera	Pieridae	1	1.56	22	2.31
	Nymphalidae	1	1.56	43	4.51
Coleoptera	Scarabaeidae	1	1.56	21	2.20
	Cetoniidae	1	1.56	57	5.98
Total		64	100.00	953	100.00

From the list of insects captured in the two regions of Biskra and Mitidja, out of a total of 953 individuals collected, there were 64 species distributed over 27 genera, 14 families including Apoidea. These insects were divided into 4 orders, the Hymenoptera are best represented with an abundance of individuals of 72.9%, of which the Apoidea family is best represented in number of species with 46 species and in number of individuals with 433 specimens apart from the honey bee *Apis mellifera* which has been the subject of another study. In second place is the order of Diptera with 12.1% of individuals. Coleoptera and Lepidoptera contribute modestly with 8.2% and 6.8% respectively.

Table 2: Abundance of Apoidea group specimens by genus in study stations. Ni: number of specimens.

Families	Sub-families	Genus	Mitidja		Biskra		Ni
			Boufarik	Mitidja Orientale	El Hadjeb	El Besbes	
Apidae	Anthophorinae	*Anthophora*	5	18	14	6	43
		Amegilla	0	8	4	5	17
		Eucera	11	47	3	23	84
	Melectinae	*Melecta*	0	1	0	0	1
	Bombinae	*Bombus*	6	21	0	0	27
	Xylocopinae	*Xylocopa*	12	21	19	5	57
Halictidae	Halictinae	*Halictus*	4	18	10	0	32
		Lasioglossum	6	24	6	9	45
Andrenidae	Andreninae	*Andrena*	4	36	21	2	63
Megachilidae	Megachilinae	*Megachile*	1	8	5	3	17
		Osmia	2	16	5	11	34
		Heriades	0	1	0	0	1
Colletidae	Hylaeinae	*Hylaeus*	0	1	0	0	1
	Colletinae	*Colletes*	0	0	11	0	11
Total	-	-	51	220	98	64	433

46 taxa, 14 genera and five families. The eastern part of Mitidja is the most diversified in number of plant species, and as a result, it has been over-sampled compared to other stations. This explains the diversity of Apoidea raised in species numbers and in individual numbers. The station of Boufarik presents a less important diversity than that the other part of the Mitidja. Because the sampling took place in fruit tree orchards; Such as citrus fruits [*Citrus Clementina* (Tanaka, 1961), *Citrus limon* (L. Burm.f.), *Citrus sinensis* (L.Osbeck, 1765)], apricot tree *Prunus armeniaca* (L., 1753), pear tree *Pyrus communis* (L., 1753) and the apple tree *Malus pumila* (Mill., 1768). These orchards are well maintained, dominated by the honey bee *Apis mellifera* as a pollinator and the weeds grow only on the periphery of the orchards, where some specimens of Apoidea have been captured. The two stations of Biskra which are part of the arid climate, showed a more or less different diversity, this difference can be explained by the unequal sampling between the two stations

and the different characters of the stations, the first El Hadjeb is an agro -Oasian ecosystem, and the second El Besbes is a natural meadow with a forage crop.

Abundance distribution of Apoidea species

Relative abundances of bees collected during the study period and grouped by family of Apoidea are summarized in Table 4.

Table 4 : Relative Abundances of the Different Families of Apoidea

Families	Count of species	R.A. species (%)	count of individuals	R.A. of individuals (%)
Apidae	14	29.79	229	52.89
Halictidae	12	25.53	77	17.78
Andrenidae	12	25.53	63	14.55
Megachilidae	7	14.89	52	12.01
Colletidae	2	4.26	12	2.77
Total	47	100.00	433	100.00

The species presented are distributed among 5 families, of which Apidae is the most represented in number of individuals with 52.9% compared to all species caught (Table 4). The family Halictidae is represented by 17.8% of the species. The family Andrenidae represents 14.5% of the species caught. Megachilidae are more modest (R.A. % = 12%) and Colletidae (R.A. % = 2.7%) (Figure 2).

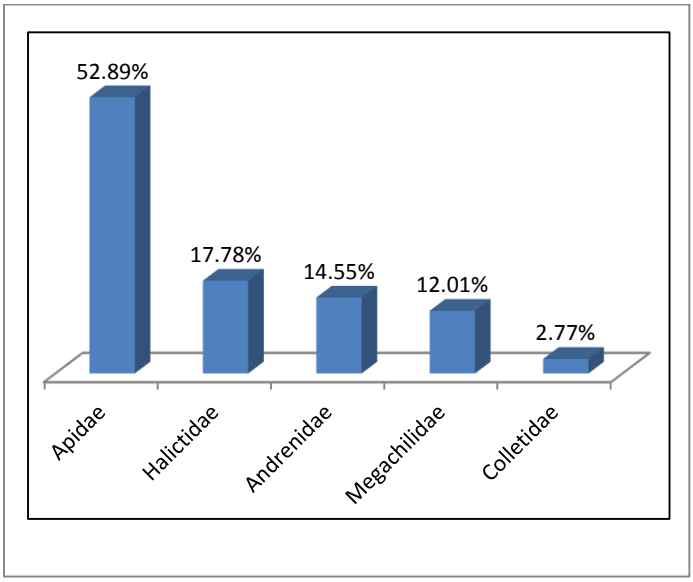

Figure 2: Relative abundances of the various families of collected Apoidea

Study of diversity of Apoidea

Table 5. Presentation of the Shannon-Weaver Index Values and Equitability

Setting	Period 2013- 2016
H' (bits)	5.07
H'_{max} (bits)	5.58
E	0.91

The value of the Shannon-Weaver Diversity Index of the collected Apoidea is 5.1 bits. The Shannon-Weaver index indicates that the population of wild bees is diverse and that species richness is important.

Equitability, defined by the ratio between the diversity H 'and the maximum diversity (E = H' / log2 N) is 0.9. Thus the stand taken into account has a high diversity and the numbers of the species involved tend to be in equilibrium with each other.

Daily activity of Apoidea

Observations begin the early morning, often between 7:00 and 8:00 in the fall, winter furthermore in spring. Morning temperatures are very low in the second half of autumn and in winter. Dew is important and the relative humidity of the air is high. The appearance of wild bees is staggered over time. Depending on the climatic conditions, the flight of bees may spread over a few hours from 7:00 am to 10:00 am to reach a peak between 10:00 and 13:00. The activity of the bees gradually decreases from 15:00 '. The activity of the foraging bees coincides with the appearance of the first rays of the sun. These are installed on the flowers, from 7:00 'in early September to 10:00' in December. Celles-ci s'installent sur les fleurs, soit à partir de 7 h 00' au début du mois de septembre jusqu'à 10 h 00' en décembre. From November, the wild forms of Apoidea become very rare with the exception of some Bombinae (*Bombus*), Xylocopinae (*Xylocopa*) and Halictinae (*Lasioglossum*). Then they disappear at the beginning of winter. The spring period is the most interesting for wild bees. This is the period of their emergence. They become very active and numerous. Their flights are very early compared to other seasons, between 7:00 and 8:00. The first wild Apoidea that appear is Halictidae of the genus *Lasioglossum* around 8h 35' followed by the drones of the genus *Bombus* around 9h15'. Xylocopinae and other wild forms occur soon after 9.30 am.

Flora frequented by wild bees and period of flight

Some plant species such as *Sonchus oleraceus* (Asteraceae) attract many bees of the genus *Lasioglossum*. This genus is also frequently observed foraging for asparagus (*Asparagus falcatus*, Liliaceae). Other plants such as *Wisteria floribunda* (Fabaceae) are very attractive to Xylocopinae (*Xylocopa sp*.) and Bombinae (*Bombus terrestris*). *Oxalis pes-caprae* is also very popular with wild bees, especially of the genus *Halictus* and *Eucera*. On the other hand, there are botanical species that

have never been observed being pollinated by bees such as fumitory (*Fumaria officinalis*), boxwood (*Buxus sp*.), Madder (*Rubia tinctoris*) and nettle (*Urtica dioica*).

Period of the activity of foraging Apoidea

The first appearances of wild bees spread over time. *Apis mellifera intermissa* is observed throughout the period of the study foraging for several plant species. *Bombus terrestris* appeared for the first time 7 VII and a second time on 3 XII. *Xylocopa pubescens* first appeared during this study on 7 VII and several times in March and April. The summer period shows a very small number of browsers, in the region of Biskra. These are the observed *Osmia* foraging the sunflower during the months of July and August during the study period. Most Wild bees have short-term foraging activity. It is synchronized with the flowering period of their favorite plants. Their survival depends on the availability of the necessary food resources. Social Apoidea, such as bumblebees and honeybees, forage almost all year round with the flowers of various plants. Here again, the availability of the food resource is essential, especially in the spring.

DISCUSSION

Out of a total of 953 specimens collected, there is a dominance of the order Hymenoptera, in particular by the Apoidea group, on all the pollinating insects. Followed by Diptera then Coleoptera and Lepidoptera. According to [31], the importance of Coleoptera as pollinators are secondary, however, some Diptera take an active part in pollination such as Syrphidae. Lepidoptera also plays a role whose importance only gives way to that of the Hymenoptera. According to [31] and [32], Hymenoptera is best endowed for the floral life of all insects. The most advanced of these are bees and bumblebees.

According to the results of this study, the group Apoidea is most represented in number of individuals and species. The Apidofauna of the two studied regions consists of 5 families. These are Andrenidae, Halictidae, Megachilidae, Colletidae, and Apidae. These families are largely represented by common species. There are also rare species. Enumeration identified 46 taxa of Apoidea. 14 genera belonging to 5 families of Apoidea. [14] counted 4 families of Apoidea in the region of El Harrach, namely those of Andrenidae, Halictidae, Megachilidae, and Apidae. The family Colletidae was later reported by [15]. The families of Apoidea represented in this study are the same as those reported by [8 and 9] near Constantine. However, the family Mellitidae is not represented in this study, because the sampling method is not suitable for the capture of specimens of this family. [14] noted that this same family is the most represented by 30% of species and that Halictidae appeared to be the most diversified in northern Algeria. The total number of bees and bumblebees captured during this study showed the highest abundance of the Apidae family, followed by those of the Halictidae and Andrenidae families. Depending on the number of species, Megachilidae and Colletidae are poorly noted. The family Apidae is the most represented with 32.3% compared to all the species caught.

[8] report that the number of floral visits made by wild bees increases during the day with a maximum at 11:00 am. Their disappearance at 16h 00' would be related to the duration of sunshine in the afternoons which is on average of 4 hours. From November, the wild forms of Apoidea become very rare with the exception of some Bombinae (*Bombus*), Xylocopinae (*Xylocopa*) and Halictinae (*Lasioglossum*). These last mentioned species end up disappearing at the beginning of winter. The spring period is the most interesting for wild bees. This is the period of their emergence. They become very active and numerous. Their flights arrive very early compared to other seasons, between 7:00 and 8:00. The first wild Apoidea that appear are Halictidae genus *Lasioglossum* around 8:35' followed by drones like *Bombus* around 9:15'. Xylocopes and other wild forms come right after 9:30 am. [9] noted that the appearance of *Bombus ruderatus Siculus* and certain wild bees occurs between 8 am and 9 am. Some days *B. ruderatus* appears first when temperatures are around 6° C and the relative air humidity is around 90% RH The activity of wild bees begins when the climate becomes slightly milder (8 ° C < □ <12 ° C, HR% = 80%). Some botanical families such as Asteraceae, Fabaceae, and Liliaceae attract many bees of the genus *Lasioglossum*, *Halictus* and *Eucera*. [2] Detected the presence of *Apis mellifera* 7 times more than the visits of other wild bees to the sunflower. [14] Reported that the estimation of the degree of food specialization shows that some solitary bees are polylectic, but the majority of them are oligolectic.

CONCLUSION

The pollinating fauna of Mitidja and Biskra consists essentially of 4 orders of insects: Hymenoptera, Coleoptera, Lepidoptera, and Diptera. The Apoidea group is the most represented by 5 families: Andrenidae, Halictidae, Megachilidae, Colletidae, and Apidae. The stand being considered is of high diversity and the numbers of species sampled tend to be in equilibrium. The first appearances of wild bees spread over time. Most wild Apoidea have a short foraging activity, synchronized with the flowering period of their favourite plants. Their survival depends on the availability of the necessary food resources. Social Apoidea, such as bumblebees and honeybees, forage almost all year round with the flowers of various plants. Here again, the availability of the food resource is essential, especially in the spring.

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REFERENCES

[1]. Allen-Wardell G., Bernhardt P., Bitner R., Burquez A., Buchmann S., Cane J., Cox V., Dalton P.A., Feinsinger P., Ingram M., Inouye D., Jones C.E. and Kennedy K., 1998 "Potential consequences of pollinator declines on the conservation of biodiversity and stability of food crop yields" *Conserv. Biol.*, 12, (1), pp 8-17.

[2]. Sardinas S.H. and Kremen C., 2015 "Pollination services from field-scale agricultural diversification may be context-dependent". *Agric. Ecosyst. Environ.* 207 pp: 17–25.

[3]. Terzo M. et Rasmont P., 2007 - *Abeilles sauvages, bourdons et autres insects pollinisateurs*. Ed. Victor Thomas, les livrets de l'agriculture, n°14, Namur, 61 p.

[4]. Remacle J.A., 1990 - *Abeilles sauvages et pollinisation*. Ed. Unité Zool. génér. Appl., Fac. Sci. agro., Gembloux. 39 p.

[5]. Michener C.D. and Kaufman L., 1994 - *Stable isotope ratios as tracers in marine aquatic food webs*. Un update, Blackwell Scientific, Oxford, 278 p.

[6]. Michener C.D., 2007-*The Bees of the World*. Ed.The Johns Hopking Univ. press Baltimore, 972 p.

[7]. Michez D., 2002 - *Monographie systématique, biogéographique et écologique des Melittidae (Hymenoptera, Apoidea) de l'Ancien Monde – Premières données et premières analyses*. Ph.D. thesis, Fac. Univ. sci. agro., Gembloux. 161 p.

[8]. Louadi K., et Doumandji S., 1998 – Note d'information sur l'activité des abeilles (domestiques et sauvages) et l'influence des facteurs climatiques sur les populations. *Science et technologie, Univ. Mentouri,* (*n°* 9): 83 - 87.

[9]. Louadi K., et Doumandji S., 1998b – Diversité et activité de butinage des abeilles (Hymenoptera : Apoidea) dans une pelouse à thérophytes de Constantine,(Algérie). *Can. Entomol.,*130 pp : 691–702.

[10]. Louadi K., 1999a – Contribution à la connaissance des genres *Halictus* et *Lasioglossum* de la région de Constantine (Algérie) (Hymenoptera, Apoidea, Halictidae). *Bull. Soc. Entomol. France*, 104 (2): 141 – 144

[11]. Louadi K., 1999b – *Systématique, Eco-éthologie des abeilles (Hymenoptera, Apoidea) et leurs relations avec l'agrocenose dans la région de Constantine*. Ph.D. thesis, Univ. Mentouri, Constantine, Algeria 201 p.

[12]. Benachour K., Louadi K. et Terzo M., 2007- Rôle des abeilles sauvages et domestiques (Hymenoptera : Apoidea) dans la pollinisation de la fève (*Vicia faba* L. var. *Major*) (Fabaceae) en région de Constantine (Algérie), *Ann. Soc. entomol. Fr*. 43 (*n.s.*) (2): 213 - 219.

[13]. Benachour K. et Louadi K., 2011 – Comportement de butinage des abeilles (Hymenoptera: Apoidea) sur les fleurs mâles et femelles du concombre (*Cucumis sativus* L.) (Cucurbitaceae) en région de Constantine (Algérie). *Ann. Soc. entomol. Fr.,* 47 (*n.s.*)(1–2): 63 - 70.

[14]. Bendifallah L., Louadi K. et Doumandji S., 2010 – Apoidea et leur diversité au Nord d'Algérie. *Silva Lusitana,* 18 (1): 85 – 102.

[15]. Bendifallah L., Louadi K., Doumandji S. et Iserbyt S., 2012 – "Geographical variation in diversity of pollinator bees at natural ecosystem (Algeria)". *Int. j. sci. adv. Technol.*,2 (11) 26 -31

[16]. Bendifallah L., Koudjil M., Acheuk F., Doumandji S., Louadi K., Boudia I. et Achour O., 2015 - Distribution spatio-temporelle des abeilles sauvages à travers les régions du Nord-Ouest d'Algérie. *Rev. Nature et Technologie, B- Sci. Agro. biol.* (12) pp : 86-99.

[17]. Cherair E.H., Scheuchl E., Doumandji S. & Louadi K., 2013 – A new record and a new subspecies of *Andrena haemorrhoa* (Fabricius, 1781) in Algeria (Hymenoptera : Apoidea : Adrenidae). *Afr. Entomol. Vol.* 21 (2) 2013: 287 – 293.

[18]. Aguib S., Louadi K. et Schwarz M., 2010 - Les Anthidiini (Megachilidae, Megachilinae) d'Algérie avec trois espèces nouvelles pour ce pays : *Anthidium (Anthidium) florentinum* (Fabricius, 1775), *Anthidium* (*Proanthidium*) *amabile* (Alfken, 1932), *Pseudoanthidium (Exanthidium) enslini* (Alfken, 1928). *Entomofauna Zeitschrift Für Entomologie, Band* 31, *Heft* 12: 121 – 152.

[19]. Djouama H., Louadi K. & Scheuchl E., 2016 – Préliminary inventory of the genus *Andrena* (Hymenoptera, Apoidea) from som Saharien localities in eastern Algéria. *Ann. Soc. Entomol. Fr.* 52 (5), (2016) 300-310.

[20]. Aouar-Sadli M., Louadi K. et Doumandji S., 2008 - Pollination of the broad bean (*Vicia faba* L.var. *major*) (Fabaceae) by wild bees and honey bees (Hymenoptera: Apoidea) and its impact on the seed production in the Tizi-Ouzou area (Algeria). *Afr. J. Agric. Res. Vol.* 3 (4), pp. 266-272.

[21]. Aouar-Sadli M., Louadi K. and Doumandji S., 2012 - New Records of Wild Bees (Hymenoptera, Apoidea) for Wildlife in Algeria. *J. Entomol. Res. Soc.,* 14 (3): 19 – 27.

[22]. Bourbonnais G., 2007 - *Directives pour la collection d'insectes et d'arthropodes, techniques de bioécologie*. Ed. Department of biology. Cégep de Sainte-Foy, 22 p.

[23]. Blondel J., 1979 - *Biogéographie et écologie*. Ed. Masson, Paris, 173 p.

[24]. Zaime A. & Gautier J.Y., 1989 - Comparaison des régimes alimentaires de trois espèces sympatriques

de Gerbillidae en milieu saharien au Maroc. *Rev. Ecol.* (*Terre Vie*) 44(3) pp.263-278.

[25]. Blondel J., Ferry C. & Frochot B. (1973). "Avifauna and vegetation". *Alauda* 41(1-2), pp. 63-84.

[26]. Grall J. et Hily C., 2003 - *Traitement des données stationnelles (faune).* Ed. Rebent, Rés. surveil. biocén. benth. Paris, 10 p.

[27]. Dajoz R., 2006 - *Précis d'écologie*, Ed. Dunod, Paris, 551 p.

[28]. Fournier P., 1946 – *Les quatre flores de la France*. Ed. Paul Lechevalier, Paris, 1091 p.

[17]. Grall J. et Hily C., 2003 – "*Traitement des données stationnelles (faune)".* Ed. Rebent, Rés. surveil. biocén. benth. Paris, 10 p.

[29]. Quezel P., Santa S., 1962, *Nouvelle flore d'Algérie et des régions désertiques méridionales* C. N. R. S., T.I, Paris (1962) 565.

[30]. Quezel P., Santa S., 1962, *Nouvelle flore d'Algérie et des régions désertiques méridionales*. C.N.R.S., T. II, Paris (1962) 566 – 1170.

[31]. Jaeger P., 1957 – "Les aspects actuels du problème de l'entomogamie (Première partie)", *Bull. Soc. Bot. France*, 104:3-4, pp: 179-222.

[32]. Pouvreau A., 1987 "Sur quelques aspects de l'ecologie et de la préservation des Apoides sauvages, Hymenopteres pollinisateurs". *Cah. Liaison O.P.I.E. Vol.* 21(2), 65: 3-12.