INVENTORY OF INSECTS IN THE EL GHROUS' S PALM GROVE (BISKRA; ALGERIA)

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Abstract

The diversity and species richness of insects were studied at the palm grove of El Ghrous. The insects were collected using two types of traps: Barber and Aerial. Forty-four insect species were inventoried. This inventory shows a predominance of Order Coleoptera with 6 families, 13 species and 241 individuals, followed by Hemiptera with 5 families, 7 species and 111 individuals, and Orthoptera with 2 families, 7 species and 54 individuals.

Key words: Insects; Oasis; Agro-ecosystem; Inventory; Biodiversity.

INTRODUCTION

The oasis is an integral part of the Saharan ecosystem and ensures the regeneration of the palm tree in which other cultures are involved: trees and forests, and which, in turn, provide a microclimate and vegetation that allow wildlife peculiar to settle and are considered as a shelter of the rich and varied entomofauna (Breure-Scheffer 1989). In addition, the richness of an animal species is influenced by environmental climatic constraints as well as by the resources that natural environments can provide to animal communities (Leberre and Chevallier 1990). Besides that, the date palm offers an ideal environment for the conservation of insects of economic or other interest. The palm grove is often organized in strata (shrub or herbaceous) which, in unfavorable conditions, allow predators to survive in complete safety on date palms at palm level (Munier 1973).

Given the importance and value of palm trees in the Saharan regions, and their function of refuge for various pests, the reality is that the latter serves as a backbone or framework of the oasis system, allowing the creation of a good environment for humans and their livestock, thanks to its foliage-assured recovery (Munier 1973). Given the importance of the problems due to insects, and what the date palm faces each year in Algeria, and the economic and ecological importance of this community, as well as the scarcity of studies on the various comparisons of the fauna dependent on this plant, this study aim is to make an inventory of the different species of insects that exist at the palm of El Ghrous (Biskra).

MATERIAL AND METHODS

Geographic location

The Wilaya of Biskra is located in south-eastern part of Algeria, in the southern piedmont of the Saharan Atlas. It covers an area of 21,671.20 km^2. It is limited to the north by the wilaya of Batna, in the east by the wilaya of Khenchela, south by the province of Ouargla and El-Oued and west by the Wilaya of M'Sila and Djelfa. According to the meteorological conditions obtained over the last 30 years, Biskra is part of the Saharan bioclimatic stage with a hot climate of arid type (Haddad 2011).

Study area

The study area of El Ghrous is located at 47 km from the Wilaya of Biskra. It is an area of 23,760 ha, with an altitude of 468 meters above sea level, between 34° 36' 43" North and 5° 05' 22" East. This area is limited to the North by Tolga, the North- East and to the East by Foughala, the West by Echaiba, the South by Doucen, Lioua and Bordj Ben Azzouz (Fig. 1).

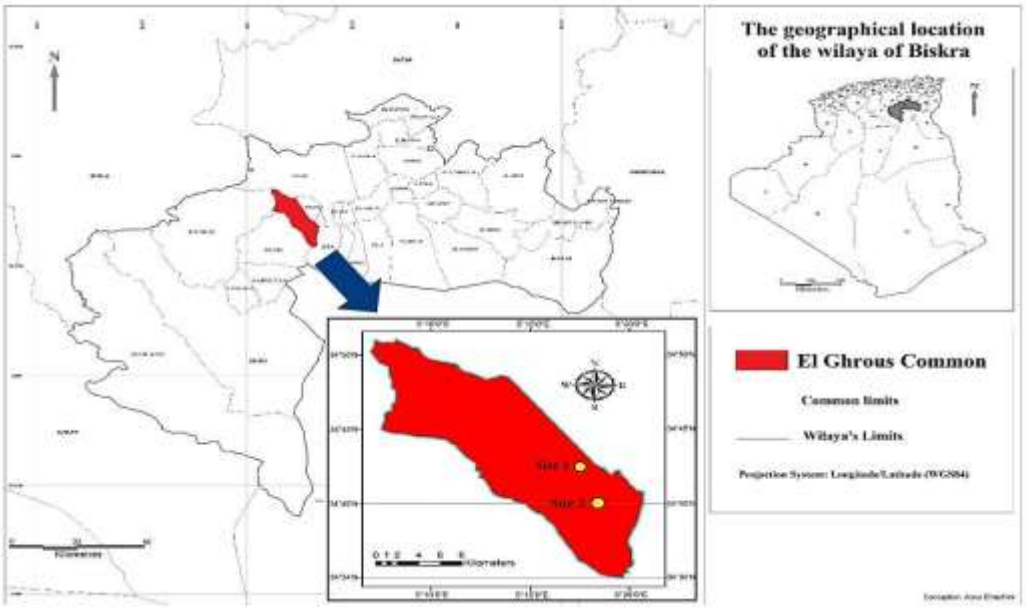


Fig. 1. Geographical location of El Ghrous.

Edaphic characteristics

The study area is under the influence of the combined effect of the aridity of the climate, the water table and irrigation by saltwater. The pedological study reveals the large traits of soil pedogenesis of arid climates: gypseous soils and salt soils. The soils of this zone differ mainly through their texture, morphology, mode of pedogenetic evolution and level, and mode of salinization. Their spatial extension is very variable (Halitim 1988).

Climatic characteristics

The temperature of the study area is often characterized by a relatively "cool" dry season, followed by a relatively "hot" dry season and finally by a "moderate" rainy season. In general, there are significant fluctuations in daytime temperatures within these seasons. Very often, during the "cool" dry season, daytime temperatures vary between 35° and 45°C, while nighttime temperatures drop to 10° from 15°C. During the rainy season, temperatures can range from 35°C during the day, to 20°C at night. In many cases, these temperature fluctuations during the same day limit the growth of plant species (FAO 1992).

According to Dubief (1963), the Saharan precipitation has a different origin depending on the season. In summer, it is due to monsoon depressions: in winter, it comes from depressions on the polar fronts; during the intermediaries' seasons, precipitation is due to the Sudano-Saharan depressions that cross south to the Sahara. Thus, unlike temperate regions, the distribution of precipitation in the arid areas varies between summer and winter, and from year to year. The difference between the lowest and highest precipitation recorded in different years can be large, although it is generally within a range of plus or minus 50% of the mean annual precipitation. The variation in monthly precipitation is even greater (FAO 1992).

The vegetation

The natural environments in our study region include diverse steppe environments and they are natural herbaceous and shrubby formations that are very open, sparse, isolated and very irregular. They include the combination of herbaceous, perennial and xerophilic plants (resistant to cold and drought). This vegetal carpet consists mainly of cespitose or tufted grasses (steppe with *Stipa tenacissima* L., steppe with *Lygeum spartum* L.), chaméphytique (steppe with *Artemisia herba-alba* L.) and halophyte steppes (Khachai 2001). The oases are particularly and mainly palm groves. The date palm *Phoenix dactylifer* L. is in association with an original flora which includes halophytes under the influence of the rise of salts and weeds linked to the crops themselves (Kaabeche 1990). The space between the palms in most cases is occupied by intercrops, such as fruit trees: fig trees (*Ficus carica*) and vines (*Vitis vinifera*) and food crops such as broad beans (*Vicia faba*) and onions (*Allium cepa*), and sometimes in some areas of industrial cultivation of tobacco (*Nicotiana tabacum*) and henna (*Lawsonia inermis*). Oasis cultivation is intensive; it is a crop whose work is done manually, and requires a lot of water, especially in summer (Ozenda 1991, Dubost and Larbi 1998).

Description of study sites

The site (1) is 4km from the town of El Ghrous. This site is located at the level of a palm grove, the date palms present a dominant aspect, with an area of 1 ha. The number of palm trees exploited by trapped pots is 30. The site (2) has an area of 3 ha. It is home to fruit trees, such as pomegranate (*Punica granatum*), olive (*Olea europaea*), fig (*Ficus carica*), and apricot (*Prunus armeniaca*), and also vines (*Vitis vinifera*). The number of palm trees exploited in this site is 30 trapped pots (Fig. 2).

a. **b.**

Fig. 2. The palm groves prospected: **a**. Site 1; and **b**. Site 2.

Insect sampling methods

The insect harvest was carried out in the study sites for six months (July - December 2017). A total of 30 traps was used for each roost, lined up 3 to 3 in 3 rows 5 m apart, and the aerial traps at 1.5 m height. By regularly making a field trip every seven days and visiting the two sites at the same time. Harvests were made in 17 surveys on each roost and using two trapping methods: “Barber” traps and “Aerial” traps.

Barber traps

The sampling technique most often used to collect insects is trapping by pit traps (Benkhelil and Doumandji 1992). The technique was adopted by Barber (1931). The traps used are metal or plastic containers used as yoghurt boxes. These are of a white colour with dimensions of 7 cm high and 5 cm in

diameter. Pots are buried vertically with a depth of 8 cm so that their openings are flush with the ground. The earth is packed all around to avoid the barrier effect for small species. These traps were made attractive by filling the jars 2/3 of their contents with vinegar water and salt (preservative) (Fig. 3).

Fig. 3. Methods used for insect sampling: **a**. and **b**. barber traps; **c**. and **d**. aerial traps.

Aerial traps

According to Lamotte and Bourliere (1969), these traps are particularly effective against sun-loving and flower-growing insects. They allow to capture aerial insect, mainly of the Order Diptera, Hymenoptera, Hemiptera and Orthoptera. This is a trap made up of pots (yoghurt boxes) that are hung on a tree branch with a cord or string at a height of 1.5 meter. These are filled with the same vinegar-salt mixture used in Barber jars (Fig. 3).

Conservation and identification

The content of trapped materials was separated, then preserved and stored in 70% Ethyl alcohol in small, tightly closed glass tubes. Each tube contains a label with the necessary information (name of the site, date of harvest, type of trap.

The identification of the insects collected was carried out in the Entomology Laboratory of the Agronomy Department at the University of Biskra, by using a stereo microscope and specialized determination keys (Chopard 1943, Carter and Hargreaves 1988).

Data analysis

Ecological composition indices

To determine the richness of species in the study region, several composition indices were calculated. The indices used are:

The average richness (Sm)

It was obtained for each survey by the following formula (Ramade 1984):

Sm = Σ S / N; where Σ S = S1, S2, S3, S4….. Sn. and N= Total number of readings.

Relative abundance

It was obtained by the following formula (Dajoz 2000):

F(%) = (ni×100)/N; where ni= number of individuals of the ith species; N= total number of individuals of all the species.

Consistency or index of occurrence

It is calculated by the following formula (Dajoz 1982):

C(%) = (Pi×100)/p; Where pi= number of records containing the studied species and p= total number of readings taken.

Depending on the value of C, the following categories are distinguished:

Constant species if 75% ≤ C ≤ 100%. Regular species if 50% ≤ C ≤ 75%.

Accessory species if 25% ≤ C ≤ 50%. Accidental species if 5% ≤ C ≤ 25%.

Ecological structure indices

Regarding the ecological structure following indices were calculated:

Specific diversity

The Shannon-Weaver diversity index is the amount of information provided by a sample on the stand structures from which the sample comes and on the way in which the individuals are distributed among various species (Daget 1976). It was calculated by the following formula: H'= -Σ Pi log 2Pi; where Pi = ni / N; Where ni= number of individuals of the ith species; N= total number of individuals in the collection and $\log_2$ = logarithmic change in base 2.

Equitability

The equity index (E) is the ratio between the calculated diversity H' and the maximum theoretical diversity (H max) which is represented by a logarithmic change in base 2 of the total richness (S). It is calculated by the following formula:

E = H' / (H max); where H'= $\log_2$ S and H max= total diversity.

RESULTS AND DISCUSSION

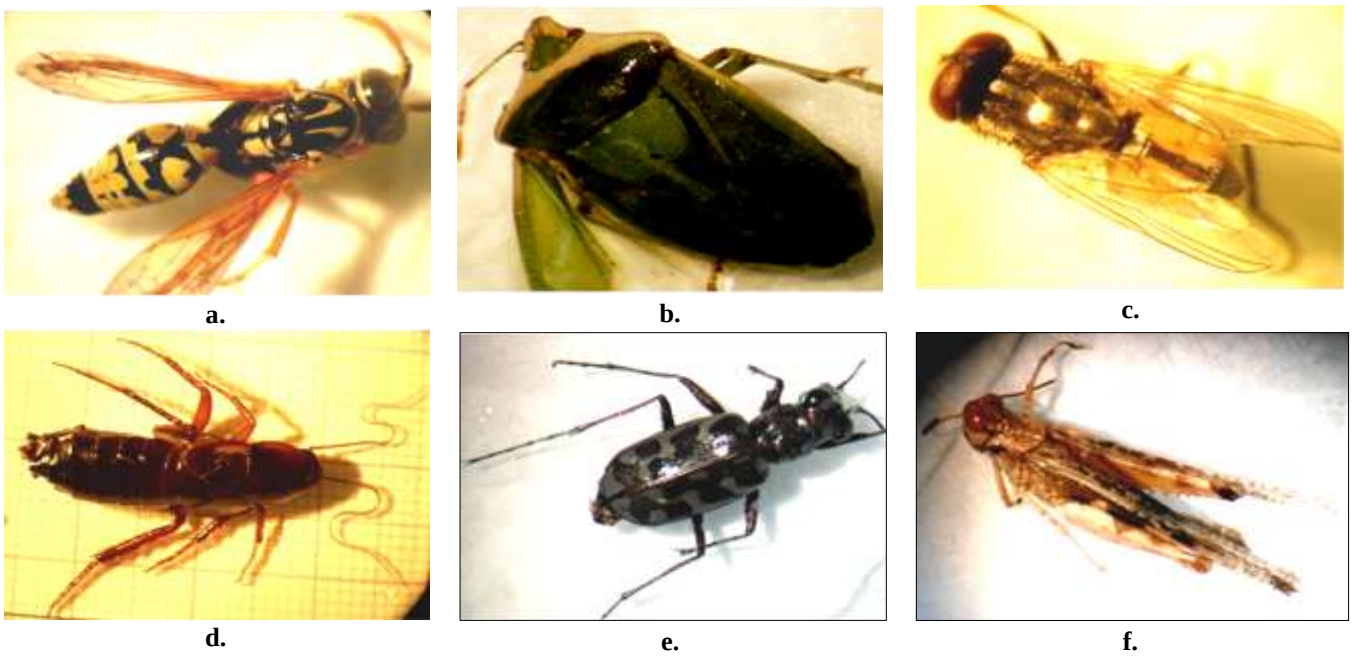
The study period spread over six months in El Ghrous sites. 501 insect individuals of 44 species belonging to 27 families and 11 orders were identified (Table 1 and Fig. 4).

Coleoptera was the dominant order both in number of families (6) and species (13) and also in terms of abundance (241 individuals). Hemiptera comes in the second place with 5 families, 7 species and 111 individuals, followed by Orthoptera with 2 families, 7 species and 54 individuals.

Table 1. Distribution of insects captured in the study region (El Ghrous).

Orders	Families	Species	No. of individuals		
			S1	S2	Ni
Coleoptera	Carabidae	*Cicindella flexusa* (Linnaeus, 1758)	2	0	2
		Pterostichus sp. (Bonelli, 1810)	0	1	1
		Pseudoophonnus griseus (Panzer, 1797)	0	1	1
		Ophonnus rufipes (De Geer, 1774)	0	3	3
	Chrysomelidae	*Clytra* sp. (Laicharting, 1781)	0	1	1
	Histeridae	*Hister Cadaverinus* (Hoffmann, 1803)	0	1	1
	Staphylinidae	*Ocypus Olens* (O.F.Müller, 1764)	0	2	2
	Tenebrionidae	*Balaps mortisaga* (Linnaeus, 1758)	0	2	2
		Trachyderma hispida (Forskl, 1775)	1	4	5
		Tenebrio molitor (Linnaeus, 1758)	0	48	48
		Tentyria sp. (Latreille, 1804)	6	164	170
		Balaps muconata (Latreille, 1804)	0	3	3
	Cetoniidae	*Cetonia* sp. (Fabricius, 1775)	1	1	2
Orthoptera	Acrididae	*Acrida ungarica* (Herbst, 1786)	6	0	6
		Eyprepocnemis plorans (Charpentier, 1825)	1	0	1
		Dociostaurus marocannus (Thunberg, 1815)	8	0	8
		Aiolopus thalassinus (Fabricius, 1781)	2	0	2
	Gryllidae	*Gryllotalpa gryllotalpa* (Linnaeus, 1758)	0	3	3
		Gryllomorpha uclensis (Pantel, 1890)	0	25	25
		Melanogryllus desertus (Pallas, 1771)	0	9	9
Phasmatodea	Bacteridae	*Bacillus rossius* (Rossius, 1790)	5	0	5
Lepidoptera	Nymphalidae	*Vanessa cardui* (Linnaeus, 1758)	0	2	2
Dermaptera	Forficulidae	*Forficula auricularia* (Linnaeus, 1758)	0	3	3
Blattodea	Blattidae	*Blatta orientalis* (Linnaeus, 1758)	2	8	10
		Periplaneta americana (Linnaeus, 1758)	5	22	27
	Blattellidae	*Blattella germanica* (Linnaeus, 1767)	0	14	14
Diptera	Asilidae	*Asilidae asilinae* (Latreille, 1802)	3	0	3
	Calliphoridae	*Lucilia Caesar* (Linnaeus, 1758)	1	0	1
	Muscidae	*Musca autumnalis* (De Geer, 1776)	0	2	2
		Hydrotaea irritans (Fallén, 1823)	0	5	5
	Syrphidae	*Heringia* sp. (Róndani, 1856)	1	0	1
	Tachinidae	*Tachina fera* (Linnaeus, 1761)	0	2	2
Hemiptera	Pentatomidae	*Nezara virudula* (Linnaeus, 1758)	2	0	2
		Eysarcoris ventralis (Westwood, 1837)	1	0	1
	Lygaeidae	*Eremocoris pellitus* (Seidenstucker, 1965)	24	74	98
		Pseudopachybrachius sp. (Malipatil, 1978)	0	1	1
	Psyllidae	*Cacopsylla malisch* (Ossiannilsson, 1970)	0	1	1
	Dictyophoridae	*Dictyophora europaea* (Linnaeus, 1767)	0	1	1
	Aleyrodidae	*Trialeurodes vaporariorum* (Westwood, 1856)	3	4	7
Hymenoptera	Chrysididae	*Stilbum cyanurum* (Forster, 1771)	0	1	1
	Formicidae	*Campontus ligniperda* (Latreille, 1802)	4	5	9
	Pompilidae	*Auplopus carbonarius* (Scopoli, 1763)	0	2	2
		Auplopus albifrons (Dalman, 1823)	1	1	2
	Vespidae	*Polistes* sp. (Latreille, 1802)	2	4	6

It is sense making to mention on temporal observation after 17 surveys in our study sites that the average number of species noted on average during each survey was equal to 29.47 and this parameter expresses the number of species most representative of the environment in the sense of the frequency of their presence. The greatest richness was recorded in July and decreases during the other months (August – December).



a. **b.** **c.**

d. **e.** **f.**

Fig. 4. Illustration of some insects in the study area: **a**. *Polistes* sp. (Latreille 1802); **b**. *N. viridula* (Linnaeus 1758); **c**. *M. autumnalis* (De Geer 1776); **d**. *B. orientalis* (Linnaeus 1758); **e**. *C. flexuosa* (Linnaeus 1758); and **f**. *D. marocannus* (Thunberg 1815).

Relative abundance of species

Among the 501 individuals captured, Coleoptera with 241 individuals (48.1%) was the most abundant order followed by Hemiptera with 111 individuals (22.2%) and Orthoptera with 54 individuals (11%). Among the families, Tenebrionidae of Order Coleoptera was the most abundant with 46%, followed by Lygaeidae of Hemiptera with 20% and Blattellidae of Blattodea with 7% (Fig. 5).

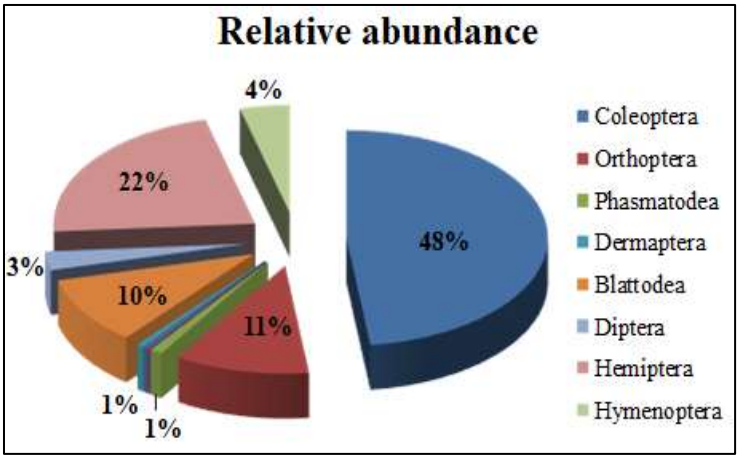


Fig. 5. Relative abundance of species caught in the study area.

Consistency or index of occurrence

The results of the ecological indices indicate that 37 species collected were considered as accidental species, with a frequency of occurrence between 5.88% and 23.52%. However, for the category of accessory species, we found six species, which have a frequency of occurrence between 29.41% and 47.05%, and a single species (Tentyria Sp.) in the category of regular species with a frequency of occurrence of 64.71%.

Specific diversity

This index expresses the complexity of the stand with its value which is H' = 3.56, denoting that the insect fauna in the study region is diverse (Tab. 2). This specific diversity is markedly variable from month to month, with an increase in July. The biocenosis drops considerably from August until December.

Equitability

Equitability index (E) displays a value of 0.65 indicating that the two sites are populated by a number of insect species with similar distribution (Table 2).

Table 2. Diversity and equitability values of the species encountered in the palm grove.

Parameters	Sites 1 and 2
Shannon Weaver (H)	3,56
Equitability (E)	0,65

The sampling using Barber traps and Aerial traps has identified 501 individuals of 44 species belonging to 27 families. The entomological species listed are divided into nine orders, of which that of Coleoptera is the best represented with 13 species covering six different families. Followed by the order Diptera with six species and five families; Hymenoptera and Blattodea each with five species belonging to four and two families, respectively. While the Orthoptera are represented with four species and one family. And finally, the Hemiptera with four species and two families followed by Homoptera with three species and three families. The other orders are weakly noted with one species each. In a similar study, Chowdhury and Bashar (2021) reported the differences in the abundance of insects from different orders with Hymenoptera as dominant order followed by Coleoptera while documenting 61 species of insects belonging to 54 genera, 33 families and 11 orders from tropical moist deciduous sal forest of Bangladesh.

The abundance of Coleoptera species is probably related to the design of traps (Spence and Niemela 1994) and climatic conditions (Dajoz 1985), as well as the presence of their host plants or their prey which favour their development. The presence of flourishing plants in a plot promotes the maintenance and multiplication of several species (Bertolaccini *et al.* 2011). This partly explains the representation of beetles in the different traps used. The representation of other orders in number could be explained by the effectiveness of the traps used (Barber pots and Aerial traps) towards the different behaviours (walking or flying) of the species (Spence and Niemela 1994). These results are comparable to that of Labbi (2009) who reported the presence of 286 individuals and 75 species in the traditional palm grove by the same trapping method in the region of Oued-Souf. On the other hand, in the planting of vegetable crops in Guemar (El-Oued), Alia and Ferdjani (2008) captured 1035 individuals with 32 species in the pots. In the Oued-Souf region also, Derki (2010) collected 50 species and 195 individuals from traditional palm trees and 28 species and 294 individuals from abandoned palm trees. While in other study in the palm groves of Ouargla, Ben Ameur-Saggou (2009) inventoried 142 species of insects.

We were able to distinguish three categorizes of species: among 44 species of insects collected, 37 species were accidental species. Accessory species were in the second place with six species, and only one regular species (*Tentyria Sp*.). The presence of a large number of accidental species can be explained by the fact that between one survey and the next, a species can complete its development cycle, then for the regular species category, where the species (*Tentyria* Sp.) is the only species captured, this is probably related to the use of Barber traps. In addition, the diversification of crops set up at each period, while following a feeding schedule for the sheep and the plots, promotes the establishment of different species. Our results are comparable to those obtained by Deghiche (2014)

whose constant species are represented by five species, 12 sporadic species, 30 accessory species and more than half of the species (80 species) trapped are classified as accidental. Damerdji and Chekrouni (2013) inventoried eight constant species, eight accessory species, 15 accidental species and 32 very accidental species in the region of Chlef (Algeria).

The values obtained for the species caught during the study period in the palm grove are characterized by the Shannon-Weaver diversity index value of 3.56. This specific diversity is clearly variable from one month to another, an increase was marked from August until December when the biocenosis drops considerably. According to N'zala *et al.* (1997), if the living conditions in a given environment are favorable, many species are observed; and each of them is represented by a small number of individuals. If conditions are unfavourable, only a small number of species is found; and each of them is represented by a large number of individuals. According to Barbault (1981) the quantity and diversity of plant species influence the richness of animal procession. So, the insect community is linked to the architecture, the quantity of plants and the diversity of ecological niches. Moreover, the value of equitability calculated for our study was E = 0.65. This value tends towards one, this means that the species in the environment are in equilibriism with each other. By comparing our results with the results of Benia (2010), indicates that the diversity values calculated from the Shannon index were between (2.63 and 2.70). Benchikh and Mana (2013) found a value of equitability which equals to 0.86, while Allioua (2012) reported equitability value, E = 0.85.

This study in southern Algeria in the region of El Ghrous (Biskra) allowed us to establish an updated list of the entomological biodiversity present in this region. This is a home to 44 insects' taxa composed of 501 individuals belonging over 11 orders and 27 families in which the order Coleoptera is dominant in number of families, species and individuals. This basic list can be a reference for other complementary studies to be carried out later to study the evolution of biodiversity in palm trees in the Biskra region.

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