DIVERSITY AND ECOLOGY OF THE EPIGEAL FAUNA OF SOME OLIVE GROVES IN THE TEBESSA REGION (EXTREME EAST OF ALGERIA) AND INTERACTION WITH SOME ENVIRONMENTAL PARAMETERS

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Abstract. The epigeal fauna of olive groves was studied in three sites in the Tebessa region according to the altitudinal factor, Desert (Negrine), cultivated land (Ain Zaroug) and open environment (El Gaagaa) during the period January-April 2018. Forty-three families are listed in Negrine, sixty-seven families in Ain Zaroug and seventy-two families in El Gaagaa. El Gaagaa is the most diversified site according to the Simpson and Shannon Weaver indices, the differences in diversity are either very significant or very highly significant according to the student test and the populations are balanced in the three sites. The abundance of taxa varies from one site to another. Diversity and abundance of the fauna studied are positively correlated with altitude, soil moisture and pH, but negatively correlated with soil electrical conductivity.

Keywords: epigeal fauna, olive groves, Tebessa.

Rezumat. Diversitatea și ecologia faunei epigee a unor plantații de măslini în Regiunea Tebessa (Estul Extrem al Algeriei) și interacțiunea cu unii parametri de mediu. Fauna epigee a plantațiilor de măslini a fost studiată în trei situri din regiunea Tebessa în funcție de factorul altitudinal, Deșert (Negrine), teren cultivat (Ain Zaroug) și mediu deschis (El Gaagaa) în perioada ianuarie-aprilie 2018. Patruzeci și trei de familii sunt enumerate în Negrine, șaizeci și șapte de familii în Ain Zaroug și șaptezeci și două de familii în El Gaagaa. El Gaagaa este cel mai diversificat sit conform indicilor Simpson și Shannon Weaver, diferențele de diversitate sunt fie foarte semnificative, fie foarte înalt semnificative în funcție de cercetarea studentului și echlibrarea populațiilor în cele trei situri. Abundența taxonilor variază de la un loc la altul. Diversitatea și abundența faunei studiate sunt corelate pozitiv cu altitudinea, umiditatea solului și pH-ul, dar corelate negativ cu conductivitatea electrică a solului.

Cuvinte cheie: fauna eigee, plantații de măslini, Tebessa.

INTRODUCTION

The Mediterranean is the land of the olive tree, it is considered the most emblematic species due to its ecological, economic and cultural importance (KANIEWSKI et al., 2012; ZOHARY et al., 2012). Its cultivation is an essential element in the fight against desertification, one of the most important ecological problems in the Mediterranean region (ARGENSON et al., 1999). The ground is an element of great importance for epigeal fauna, it provides it with an adequate environment, it is a shelter, a place of spawning, a place of feeding. Hence the importance of characterizing it and defining its role in the distribution of stands. The studies carried out to date mainly concern olive pests (ALEXANDRAKTS, 1986), parasitoids (WARLOP, 2006), control agents (KATSOYANNOS & LAUDEHO, 1975). In the Greater Maghreb, olive growing and its yield are targeted by various works (LABAALI, 2009; MAZOUZ & AZOUZ, 2019).

In Algeria, studies on the fauna associated with the olive tree are rare or sporadic (FRAH et al., 2015), hence the interest of this approach. The aim of this study is to know the diversity and dynamics of the faunal population of the cultivated olive tree and then to highlight the impact of local conditions on this spatial distribution of this fauna.

MATERIAL AND METHODS

Presentation of the study sites: This study is carried out during the period January to April 2018 in three sites in the region of Tébessa chosen according to altitude and habitat (Table 1).

Table 1. Coordinates, altitudes and bioclimatic stages of the study sites.

Sites	Coordinates	Altitude	Bioclimatic stage
Negrine	34°30’24’’N, 7°31’15°E	280m	Arid
Ain Zerroug	35°26’24’’N, 8°01’47’’E	792m	Semi- arid
Gaagaa	35°25’40’’N, 7°55’26’’E	922m	Semi- arid

1. **The Negrine site** is located to the south of Tebessa (115km), it is completely sandy land, the olive grove (in cultivation) includes 400 olive trees that belong to the species Olea europaea variety Chemlali; this site belongs to the great Algerian desert.
2. **The Ain Zaroug site** is located to the west of Tébessa (10 km), the olive grove (in cultivation) includes 200 olive trees that belong to the same species and the same variety surrounded by wheat fields (*Tricicum durum*).
3. **The El Gaagaa site** is located at the foot of the ELGaagaa mountain west of Tébessa (nearly 20km) the olive grove (in cultivation) also includes 200 olive trees that belong to the same species and the same variety. The site is located in the middle of an open meadow (Fig. 1).

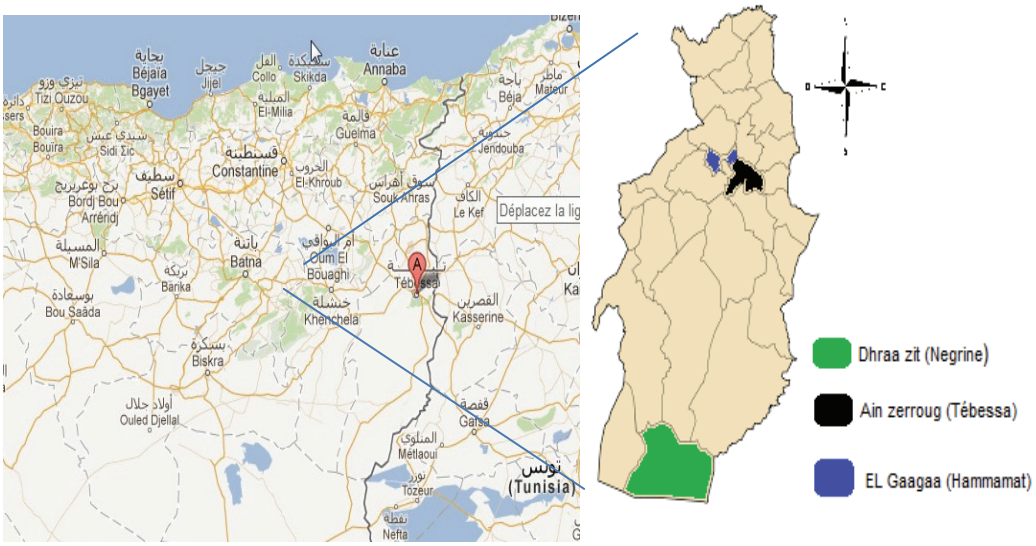

Figure 1. Location of study sites (original).

Sampling. The main method adopted for the realization of this study is that of Barber pots. Eight Barber pots are placed in each study site, four in the centre of each orchard and four at the edge. These containers are placed as close as possible to the tree (the olive tree). Field trips are carried out every 15 days and the recovered samples are stored in dilute ethanol (75°). The determination of the species is carried out under a binocular magnifying glass, using the various identification keys.

Data analysis. After the determination of the different samples, the results are expressed either by the absolute abundance (N) or by the relative abundance in percentage (AR%). In our case and because of the large number of families of the order Aranea and the class Insecta we have grouped the taxa and we have adopted the order instead of the family. The comparison of the faunal similarity between the sites is carried out by calculating the Jaccard similarity index. The study of the difference in diversity between the sites is carried out by the index of Shannon Weaver and Simpson, the student test is adopted to evaluate the degree of difference in diversity between the sites.

The impact of local conditions on the diversity and abundance of this fauna were studied by evaluating some physical and -chemical parameters of the soil: pH, electrical conductivity (EC) and soil humidity (H%) and by the altitudel effect. The results are obtained by the correlation test of the Minitab 20.4 software.

RESULTS

Diversity. The comparative study of the faunal richness of the study stations has shown that El Gaagaa is the most diversified station at all taxonomic levels, while Negrine is the least faunally rich station (Table 2). A total of 72 families are found in El Gaagaa belonging to 19 orders and 06 classes, on the other hand 43 faunistic families are noted in Negrine belonging to 06 orders and 02 classes (Table 2).

Table 2. Fauna richness (S) in study sites.

Sites / Taxa	Phylums	Classes	Orders	Families
Negrine	1	2	06	43
Ain Zerroug	2	6	18	67
El Gaagaa	4	8	19	72

Similarity index. The comparison of the diversity between the sites showed that the samples have a similarity of 0.37 between Negrine and El Gaagaa, 0.41 between Negrine and Ain Zaroug and 0.47 between Ain Zaroug and El Gaagaa. The captured fauna fits into several statuses of different importance depending on the sites (Table 3). A total of 07 statuses were identified in this study, predators are present in the three sites while necrophages and coprophages are more present in Ain Zaroug, pollinators in el Gaagaa and omnivores in Ain Zaroug and El Gaagaa (Table 3).

Ecology. The study of faunal abundance during the study period revealed that the most abundant fauna is in the Ain Zaroug site and the weakest in the Negrine site (Table 4). Study of the population's abundance in the study sites during the period January to April 2018 has shown that the most abundant fauna is captured at Ain Zaroug and the least abundant in Negrine (Tab.4). Three main orders of insects are retained at El Gaagaa: Diptera (28.92%), Coleoptera then Hymenoptera, at Ain Zaroug the three main orders also belong to the class of insects: Orthoptera (26.90%), Coleoptera and Hymeoptera, on the other hand the three main Orders are Hymenoptera, especially Formicidae (39.75%), Aranea and Coleoptera (Table 4).

Table 3. The percentage of importance of the statuses of the fauna associated with the olive tree in the study sites.

Site Status	Negrine %	Ain Zerroug %	El Gaagaa %
Predators	24,99	22.82	30,43
scavengers	33,34	45,81	21,59
coprophages	8,75	31,28	2,63
Phytophages	22,5	19.41	19,63
Pollinivores	7,92	2,6	12,41
Insectivores	2,50	7,49	0,11
Omnivores	0 ,48	12,82	13,20

Table 4. Abundance (A) and relative abundance of fauna in the study sites.

Site	El Gaagaa		Ain Zarroug		Negrine	
Fauna Orders	A	AR%	A	AR%	A	AR%
Aranea	74	8,80	113	11,34	67	27,45
Pseudoscorpiones	0	0	1	0,10	0	0
Scorpiones	1	0,11	0	0	7	2,86
Trombidiformes	12	1,42	18	1,80	23	9,42
Coleoptera	174	20,71	215	21,58	39	15,98
Diptera	243	28,92	118	11,84	11	4,50
Hymenoptera	118	14,04	187	18,77	97	39,75
Orthoptera	76	9,04	268	26,90	0	0
Dermaptera	41	4,88	12	1,20	0	0
Hemiptera	1	0,11	6	0,60	0	0
Lepidoptera	3	0,35	3	0,30	0	0
Neuroptera	5	0,59	1	0,10	0	0
Heteroptera	11	1,31	5	0,50	0	0
Blattodea	1	0,11	1	0,10	0	0
Isopoda	8	0,95	9	0,90	0	0
Scolopendromorpha	4	0,47	10	1,00	0	0
Stylommatophora	25	2,97	25	2,51	0	0
Opiliones	41	4,88	0	0	0	0
Rodentia	1	0,11	3	0,30	0	0
Anura	1	0,11	1	0,10	0	0
Total	840		996		244	

Diversity indices. The highest Shannon Weaver index of diversity is noted in the El Gaagaa site (3.001bit) and the lowest in Négrine (2.14bit) and the Simpson index is higher in El Gaagaa (0.83) and lower in Nègrine (Table 5). The greatest dominance is observed in Negrine (0.26) which corresponds to the order of Hymenoptera. The stands are balanced in the three sites where the greatest value is recorded in Nègrine, then El Gaagaa and finally Ain Zaroug (Table 5).

Table 5. Diversity indices of Shannon, Simpson and the equitability of faunal populations in the study sites.

Sites	El Gaagaa	Ain Zaroug	Negrine
Taxa_S	19	18	6
Individuals	840	996	244
Dominance_D	0,1675	0,1817	0,2677
Simpson_1-D	0,8325	0,8183	0,7323
ShannonH_log2	3,001	2,789	2,148
Equitability_J	0,7065	0,6689	0,8311

The student test applied to the comparison of the Shannon Weaver diversity index between the sites showed that the difference between El Gaagaa and Ain Zaroug is very significant and between El Gaagaa and Negrine and Ain Zaroug and Negrine it is very highly significant (Table 6).

Table 6: Student's (T) test for diversity between study sites.

The sites	El Gaagaa	Ain Zaroug	Negrine
El Gaagaa	-	3,28**	-
Ain Zaroug	-	-	8,24***
Negrine	10,69***	-	-

(Student's t-test with $p<0,05$; $p<0,01$; $p<0,001$)

The study of the correlation between the diversity and the abundance of the fauna and the altitude and some physical and chemical parameters of the ground made it possible to note the presence of positive correlation with the altitude where the coefficient of correlation is significant with the threshold 5% (r2= 0.999, r2= 0.855) (Fig. 2), with soil moisture where the correlation coefficient is significant at the 5% threshold (r2= 0.948, r2= 0.691) (Fig. 3) and with the pH where the correlation coefficient is significant at the 5% threshold (r2= 0.949, r2= 0.983) (Fig. 4).

Moreover, the diversity and abundance of fauna are negatively correlated with electrical conductivity where the correlation coefficient is significant at the 5% threshold (r2= 0.985, r2= 0.945) (Fig. 5).

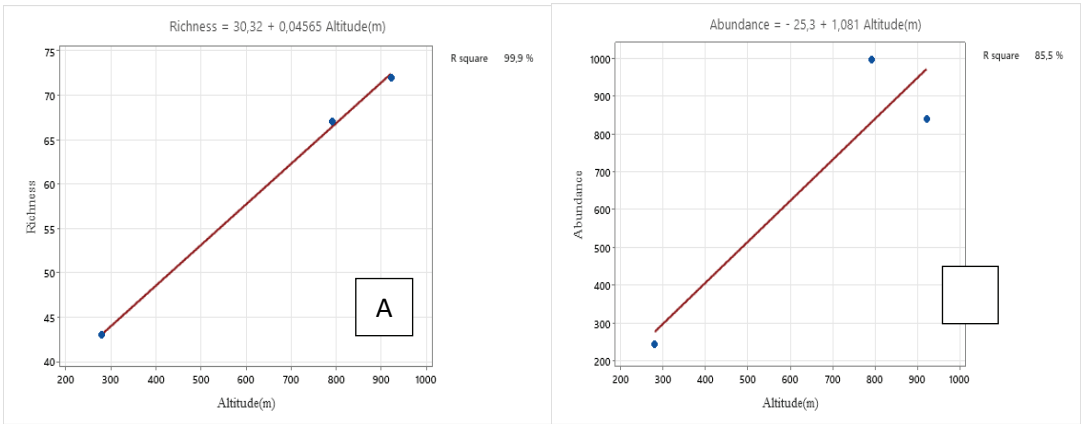

Figure 2. Regression lines of richness (A) and abundance (B) as a function of altitude.

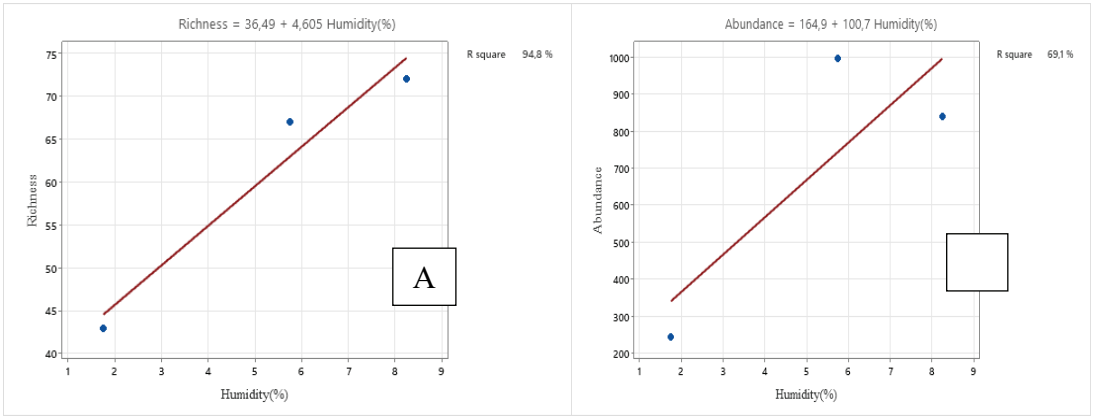

Figure 3. Regression lines of richness (A) and abundance (B) as a function of soil moisture.

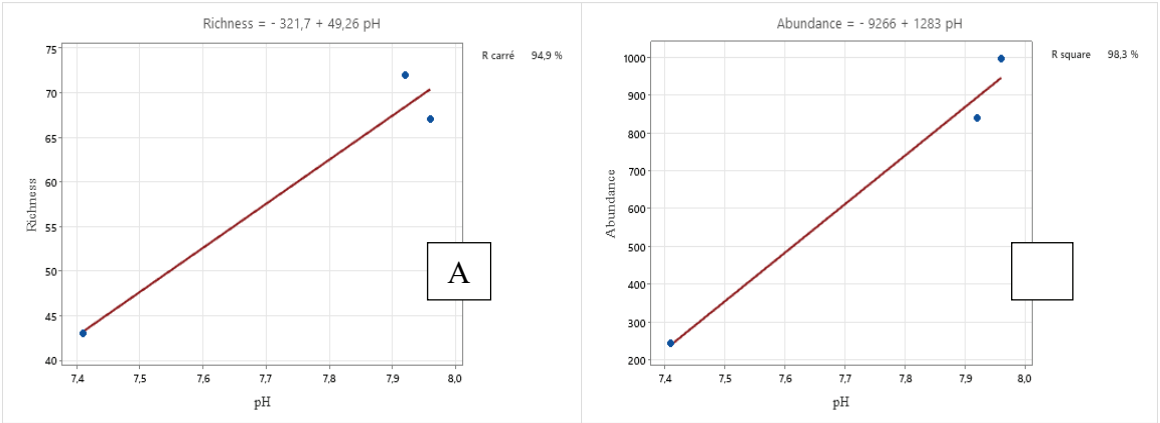

Figure 4. Regression lines for richness (A) and abundance (B) as a function of soil pH.

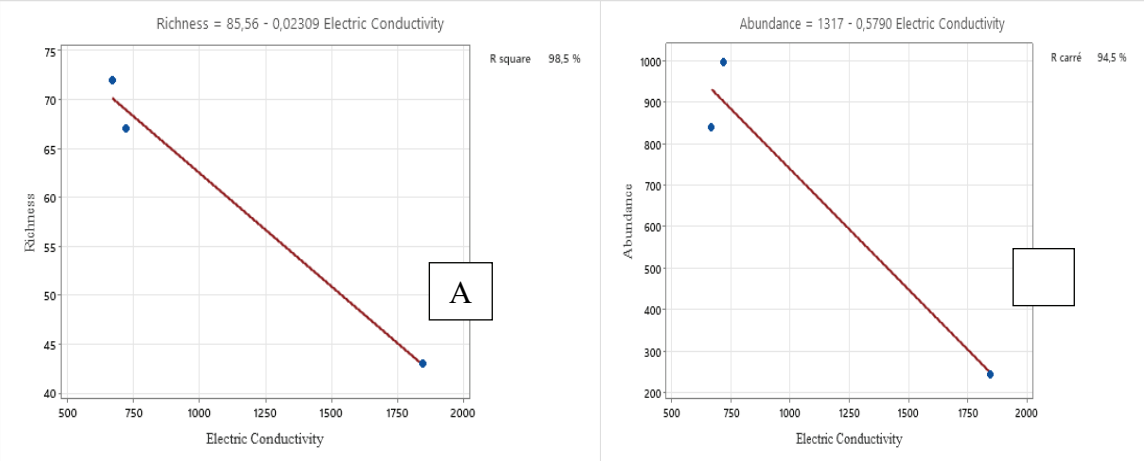

Figure 5. Regression lines of richness (A) and abundance (B) as a function of electrical conductivity (EC) of the soil.

DISCUSSIONS

The study of the epigeal fauna associated with *Olea europaea* L. in the sites chosen for the realization of this study, during the period January to April 2018 made it possible to note that the maximum diversity is noted at El Gaagaa (72 families) distributed in 19 orders, 8 classes and 4 phylums while the minimum is found in Negrine with 43 families spread over 06 orders, 02 classes and 01 single phylum. In an orchard in the Batna region (eastern Algeria), FRAH et al. (2015) obtained 74 families belonging to 16 orders and 06 classes, in Tipaza (Central Algeria) CHABOU & GROUNE (2020) identified 21 families belonging to 10 orders and 04 classes and in M'sila further south FODHIL & REGUIG (2017) obtained 55 families spread over 12 orders and 3 classes. At Tlemcen (Algeria) six orders are retained in 2014 and eight orders in 2015 belonging to the class Insecta and the order Aranea (TAHRAOUI, 2015), and at Tipaza (Algeria) CHABOU & GROUNE (2020) have inventoried a fauna consisting of three classes, five orders and seven families associated with the olive tree.

The degree of similarity of the diversity between the sites is below average (I=0.5), the similarity is greater between Ain Zaroug and Gaagaa and lower between Nagrine and El Gaagaa. The most diverse taxa are Aranea and Insecta at El Gaagaa.

The fauna is more abundant in Ain Zaroug, then in El Gaagaa, it is low in Negrine. Insecta are dominant followed by Aranea in the 03 sites, in perfect agreement with the results at M'sila where insects (Formicidae) are far ahead of other taxa (FODHILI & REGUIG, 2017), at Tlemcen Coleoptera are dominant in 2014 and Hemiptera in 2015 (TAHRAOUI, 2015). At Tipaza the fauna is dominated by Hymenotera Formicidae (CHABOU & GROUNE, 2020). On the other hand, PART (1997) points out that more than 60 known insect species live on the olive tree in the Mediterranean region.

The faunal diversity is important in Tebessa (H'= 3,001bit) probably due to the different factors present in the study habitats, on the other hand the stands are balanced in their environments, on the other hand the diversity is low in Tipaza due to the high dominance of Formicidae and stands are not balanced (CHABOU & GROUNE, 2020).

Altitude has a positive effect on fauna diversity, thus concurring with the results obtained by BERNADOU et al. (2006) on the myrmecofauna in the Pyrenees chain (France) and by BOUZIANE et al. (2020) in Jijel (Algeria) on the other hand BOUGUESSA-CHERIAK et al. (2018) obtained negative results of the effect of altitude on the diversity of spider fauna in Tébessa (Algeria).

Many animals can only live between certain pH limits. The soils of Tebessa belong to raw calcareous soils according to the classification of MATHIEU & PIELTAIN (2009). Our results showed that the captured fauna evolves positively in diversity and abundance in an alkaline environment, on the other hand HOUD-CHAKER et al. (2012) noticed the presence of a negative correlation between the abundance of Myriapods and soil acidity. The soils are basic to frankly basic because the pH is between 8.2 and 8.9 in the region of Marrakech (LABAALI, 2009).

Electrical conductivity of a soil makes it possible to determine the degree of salinity of the latter, in Tebessa the soils are very salty compared to the soils of the region of Marrakech (Morocco) where the maximum value is 333µS/cm (LABAALI, 2009).

Water remains a primary factor for the soil fauna, the soil humidity factor is important for the distribution of terrestrial species, it is positively correlated with the soil fauna in the olive groves under study, LORBER (1982) demonstrated the importance of soil moisture in the distribution of ants of the *Formica rufa* group in Alsace in France, FERRAHI & DJEMA (2004) showed that soil moisture is positively correlated with microarthropods and insect larvae in the Yakouren forest in Tizi Ouzou (Algeria).

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