

Orthopterological Fauna in the Region of Djelfa (Algeria)

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ABSTRACT

Following the study of Orthopterological fauna in the region of Djelfa (Algeria), 33 species have been listed. Calculation of centesimal frequency index showed that dominant species vary from station to another. In Faid El Botma, the dominant species is *Tmethis pulchripennis* (26,7 %). In station of Moudjebara, the species of *Euryparyphes quadridentatus* (18,6 %) is the most dominant. As for station El Mesrane, *Oedipoda miniata* is on top of the list with 18.3%. At level of Ain El Ibel, the dominate one is *Pyrgomorpha cognata* (10,9 %). In Messad, there are two dominant species, it is about *Acrotylus patruelis* (26,15 %). Using the distribution types index we noticed that Orthopterological species inventoried, present different distribution types according to stations and months of sampling. Some species are regularly distributed, other are random or contagious.

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INTRODUCTION

The problems originated by insect's pests have been attracting a great deal of attention. However, locusts are without doubt the most redoubtable enemies of human since emergence of agriculture [4]. They are presented in Old Testament as the most terrifying and catastrophic natural event [25]. Economic importance of locusts has been fully demonstrated. In effect, since many centuries well before the Christian era, problems caused by these Orthoptera have attracted attention. The mankind's history is sprinkled by grasshopper's infestations [14]. Several studies were carried out around the world and in Algeria dealing with systematics. In the world, on systematic plan, we must quote Chopard [8,9] who was interested to Orthoptera of North Africa, Lecoq works on Orthoptera of West Africa. In Algeria, Many studies were interested in arthropod biodiversity, the most recent is that of Benabbas-Sahki Ilham [2] about ants. Regarding orthopterans, we find works of Fellaouine [18], Doumandji-Mitiche *et al.* [15,16], Doumandji and Doumandji-Mitiche [12], Doumandji *et al.* [13], Benfekih [3], Benrima [5], who were interested to bioecological study. The aim of our study is based on species' study of Orthoptera existing in the region of Djelfa by selected five stations to perform this study. This work strengthened research on Locust Ecology.

Presentation of study's environment:

The study is carried out in region of Djelfa, one of the widest area of Algerian Hauts Plateaux in which we selected 5 studies stations (Fig1). The first is called "Messad", situated on the South-East of DJELFA region N 34° 15' 42" E 03° 20' 05". It is very rich in plant species such as *Stipa tenacissima*, *Artemisia herba-alba*, *Stipagrostis pungens*, *Thyrnelea microphylla*, *Artemisia campestris*, *Ziziphus lotus*, *Arthrophytum scoparium* and *Helianthemum lippii*. The 2nd station is that of EL Mesrane, located at about 32 km in North Djelfa at altitude of 870m N 34° 57' 8" E 03° 03' 07". It is a dune ridges composed of small isolated dune massifs; among plant species which shelters *Thymelaea variegata*, *Plantago albicans*. The 3rd station is Ain El Ibel, located at 40 km in South-East of Djelfa at altitude of 620 m N 34° 16' 50" E 03° 15' 42". From physiognomic point of view, area is characterized by presence of forest species such as *Pinus halepensis*, *Juniperus oxycedrus*, *Juniperus phoenicea* et *Rosmarinus tournefortii*; and also steppe vegetation based on perennial grasses, essentially presented by *Stipa tenacissima*, and woody chamaephytes, a steppe of *Artemisia herba-alba*, *Lygeum spartum*, *Stipa Parviflora*. While the 4th station is called Faid el Botma, is located at 50kms in South-East of

Djelfa's region, spreading on a flat land, with altitude of 1063 m N 34° 31' 46'' E 03° 46' 55''. That is an Alpha *Stipa tenacissima* steppe characterized by vegetation cover generally clear and with reduced size which presents 15 plant species belonging to 8 botanic families among them that of Poaceae and Chenopodiaceae with cover rate of 40.01%. The last station is that of Moudjebara. It is located at 26km in South-East of Djelfa in altitude of 1214m, (N 34° 37' 58'' E 03° 19' 39''). Contrary to the previous one, Moudjebara is a steppe with white wormwood *Artemisia herba alba* which presents 13 plant species belonging to 9 botanic families among them that one of Chenopodiaceae and Anthemidae. Global cover rate of the soil is of 20.47%.

2.2 Sampling of Orthoptera:

In the majority, sampling of Orthoptera must be made on a random basis in a uniform area [1]. In the present study, the selected method is that of quadrats; the more traditional method used for peopling study of terrestrial ecosystem [17]. The principle of this method involves accurate counting of individual's number which are present on a well-determined surface. In order to obtain a satisfactory estimate of population density, counting must be done several times on as many sample-plots [1]. Effectively, it is consisting to delineate with a string of 12m length, square or quadrats of 3m by side either, a surface of 9m² [11] (Figure 2). Samplings are made once a month in each of the 5 stations of study during March period until September 2014. The locust's determination has been made in laboratory by using binocular magnifier which allows observing and considering precisely morphological characteristics of each individual and based on determination keys of Orthoperoid from North Africa of Chopard [9]. The results obtained are exploited by several ecological indices: the sampling quality, ecological indices of composition, which are: total richness, centesimal frequency and structure as diversity of Shannon-weaver, indices of distribution, and so by statistical method, (Tow-way Hierarchical Cluster Analysis).

Table 1: Centesimal Frequencies (%) of Orthoptera species captured in the five stations.

STATIONS ESPECES	FEID ELBOTMA	MOUDJEBARA	ELMESRAN E	AIN EL IBEL	MESSAAD
<i>Acrotylus patruelis</i> (Herrich-Schaeffer, 1838)	8,89	7,14	3,48	20,31	26,15
<i>Oedipoda miniata</i> (Pallas, 1771)	0,00	5,71	18,26	14,06	0,00
<i>Oedipoda</i> sp.	0,00	4,29	0,00	0,00	1,54
<i>Sphingonotus azurescens</i> (Rambur, 1838)	6,67	7,14	2,61	1,56	10,77
<i>Sphingonotus coeruleus</i> (Linne, 1767)	0,00	1,43	0,00	4,69	0,00
<i>Sphingonotus laucasi</i> Uvarov, 1930	0,00	0,00	0,00	3,13	0,00
<i>Sphingonotus rubescens</i> (Walker, 1870)	2,22	0,00	0,00	1,56	0,00
<i>Sphingonotus vosseleri</i> Krauss, 1902	0,00	0,00	0,00	6,25	0,00
<i>Sphingonotus</i> sp.	6,67	2,86	1,74	4,69	0,00
<i>Oedaleus decorus</i> (Germar, 1826)	0,00	5,71	0,00	6,25	6,15
<i>Acrotylus</i> sp.	2,22	1,43	0,87	0,00	1,54
<i>Omocestus raymondi</i> (Yersin, 1863)	0,00	12,86	17,39	0,00	4,62
<i>Omocestus ventralis</i> (Zotterstedt, 1821)	0,00	0,00	1,74	6,25	0,00
<i>Omocestus</i> sp.	2,22	0,00	0,87	0,00	9,23
<i>Doclostaurus jagoi jagoi</i> Soltani, 1978	0,00	7,14	0,00	0,00	0,00
<i>Ochrilidia rothschildi</i> Bolivar, 1913	0,00	0,00	0,87	0,00	3,08
<i>Ochrilidia gracillius</i> (Krauss, 1902)	2,22	0,00	0,00	0,00	3,08
<i>Ochrilidia geniculata</i> (Bolivar, 1913)	6,67	1,43	0,87	0,00	3,08
<i>Ochrilidia</i> sp.	2,22	0,00	0,87	0,00	4,62
<i>Acrida turrita</i> Linne, 1758	0,00	0,00	2,61	9,38	15,38
<i>Aiolopus thalassinus</i> (Fabricius, 1781)	0,00	0,00	0,00	1,56	0,00
<i>Calliptamus wattenwyllianus</i> (Pantel, 1896)	0,00	0,00	0,87	1,56	1,54
<i>Calliptamus barbarus</i> (Costa, 1836)	15,56	4,29	1,74	3,13	0,00
<i>Calliptamus</i> sp.	0,00	0,00	0,00	0,00	1,54
<i>Dericorys millierei</i> Finot et Bonnet, 1884	0,00	0,00	0,00	1,56	0,00
<i>Acridella nasuta</i> (Linne, 1758)	6,67	2,86	4,35	3,13	6,15
<i>Euryparyphes quadridentatus</i> (Brisout, 1852)	0,00	18,57	0,00	0,00	0,00
<i>Euryparyphes stitjensis</i> (Brisout, 1852)	0,00	0,00	0,87	0,00	0,00
<i>Tmethis cisti</i> (Fabricius, 1787)	2,22	2,86	5,22	0,00	0,00
<i>Tmethis pulchripennis</i> (Serville, 1839)	26,67	8,57	17,39	0,00	0,00
<i>Pygomorpha cognata</i> (Krauss, 1977)	6,67	4,29	16,52	10,94	1,54
<i>Platycleis laticauda</i> Brunner, 1882	2,22	0,00	0,87	0,00	0,00
<i>Platycleis</i> sp.	0,00	1,43	0,00	0,00	0,00
33 species	100 %	100 %	100 %	100 %	100 %

RESULTS AND DISCUSSION

The use of quality index of sampling (Q) allows us to qualify it as sufficient. In fact, the number (a) of species seen once in region is 5 during a sampling period of 7 months, the report (a/N is equal to 0, 01. According to Ramade [26], when sampling's quality tends to zero, we say that inventory is made with sufficient accuracy. At level of arid region of Ain Maabad (near Djelfa) value of the ratio a/N is equal to 0,05 [29]. Likewise, in humid area of Algiers, and precisely at level of wasteland plot in Rouiba, Zenati found that value of this quotient is very close to zero, it is of 0.04. We say that achievement of sampling was carried out with precision.

Table 2: Values of the Shannon-Weaver diversity (H'), diversity Maximum (H'max) and equitability (E) index of Orthoptera species.

Stations Indices	Faid El Botma	Moudjebara	El Mesrane	Ain El Ibel	Messaad
H'(en bits)	3,2	3,3	3,7	2,2	2,7
Hmax (en bits)	4,1	4,2	4,8	3,1	3,9
E	0,81	0,85	0,87	0,72	0,77

Table 3: Distribution Type Orthoptera in El Feid Botma station.

Espèces	III	IV	V	VI	VII	VIII	IX
<i>Acrotylus patruelis</i>		R		R			C
<i>Sphingonotus azurescens</i>				C	C		
<i>Sphingonotus rubescens</i>						R	
<i>Sphingonotus sp .</i>			R	C	R	R	R
<i>Acrotylus sp</i>			R				
<i>Omocestus sp</i>				R			
<i>Ochrilidia gracillis</i>				R			
<i>Ochrilidia geniculata</i>				R		C	
<i>Ochrilidia sp</i>						R	
<i>Calliptamus barbarus</i>					C	C	
<i>Acridella nasuta</i>		R			R		
<i>Tmethis cisti</i>			R				
<i>Tmethis pulchripennis</i>		C	R				
<i>Pyrgomorpha cognata</i>		R		R	R		
<i>Platycleis laticauda</i>	R	R					

C : contagious, R : regular

Table 4: Distribution Type Orthoptera in Moudjebara station.

Espèces	III	IV	V	VI	VII	VIII	IX
<i>Acrotylus patruelis</i>				A		A	R
<i>Oedipoda miniata</i>					A	R	A
<i>Oedipoda sp</i>		C					
<i>Sphingonotus azurescens</i>				A	R	A	C
<i>Sphingonotus coeruleans</i>							A
<i>Sphingonotus sp</i>				A	A	A	R
<i>Oedaleus decorus</i>				C			
<i>Acrotylus sp</i>				A		A	
<i>Omocestus raymondi</i>				C		R	
<i>Dociopterus jagoi jagoi</i>							C
<i>Ochrilidia geniculata</i>						A	
<i>Calliptamus barbarus</i>					R		A
<i>Acridella nasuta</i>						A	A
<i>Euryparyphes quadridentatus</i>	C	R	C	C			
<i>Tmethis cisti</i>			A	A			
<i>Tmethis pulchripennis</i>		C	C				
<i>Pyrgomorpha cognata</i>			A	A			
<i>Platycleis sp.</i>		A					

A : aleatory (random), C : contagious, R : regular

In total, a listing of 33 Orthopterological species inventoried in the 5 study environments is made (Table 1). It should be recalled that identification of these species is made based on classification of Louveaux et Benhalima [4] concerning Acrididae and that of Chopard [20] for Ensifera. The number of counted species in region of Medea is 28 species [28]. The furthest south in region of Ghardaia , Zergoun [31] reported 29 Orthoptera species. The important number of 33species shows richness in locust peopling of that study region.

Calculation of centesimal frequency index showed that dominant species vary from station to another (Table 1). In Faid El Botma, the dominant species is *Tmethis pulchripennis* (26,7 %). It is followed by *Calliptamus barbarus* (15,6%). In station of Moudjebara, the species of *Euryparyphes quadridentatus* (18,6 %) is the most dominant, and is followed by *Omocestus raymondi* 12,7 %. As for station El Mesrane, *Oedipoda miniata* is on top of the list with 18.3%. It is followed by *Omocestus raymondi* and *Tmethis pulchripennis* 17,4 %. *Pyrgomorpha cognata* with rate of 16.5% classified in 3rd position. This last species presents the higher centesimal frequency value at level of Ain El Ibel. It is followed by *Oedipoda miniata* 10,9%. In Messad, there

are two dominant species, it is about *Acrotylus patruelis*, *Acrida turrata* (F.C.= 26,15% et 15,38%). Results obtained confirm relationship of vegetation – climate – specie of each environment. Bottier [6] has confirmed that peopling is organized firstly, according to the need of species in vegetal cover term. For instance, *Tmethis pulchripennis* is a very characteristic species of the steppe. Within the present study, this last species is found in 3 stations among the 5 which are Faid El Botma, Moudjebara et El Mesrane. That was noted by Khadraoui and Ouanouki.

Table 5: Distribution Type Orthoptera in El Mesrane station.

Espèces	III	IV	V	VI	VII	VIII	IX
<i>Acrotylus patruelis</i>		A		A		R	
<i>Oedipoda miniata</i>			C	C	A	A	
<i>Sphingonotus azureus</i>					C		
<i>Sphingonotus</i> sp				A		A	
<i>Acrotylus</i> sp			A				
<i>Omocestus raymondi</i>		A	C				
<i>Omocestus ventralis</i>					R		
<i>Omocestus</i> sp			R				
<i>Ochrilidia rothschildi</i>						A	
<i>Ochrilidia geniculata</i>						A	
<i>Ochrilidia</i> sp						A	
<i>Acrida turrata</i>				A	R		
<i>Calliptamus wattenwyllianus</i>					A	A	
<i>Calliptamus barbarus</i>						R	
<i>Acridella nasuta</i>			C			A	
<i>Euryparyphes sitifensis</i>			A				
<i>Tmethis cisti</i>			C				
<i>Tmethis pulchripennis</i>		C	C				
<i>Pyrgomorpha cognata</i>		C	C	C		R	
<i>Platycleis laticauda</i>		A					

A : aleatory (random), C : contagious, R : regular

Table 6: Distribution Type Orthoptera in Ain El Ibel station.

Espèces	III	IV	V	VI	VII	VIII	IX
<i>Acrotylus patruelis</i>		A	A		C	R	C
<i>Oedipoda miniata</i>				R	C	A	A
<i>Sphingonotus azureus</i>						A	
<i>Sphingonotus coeruleus</i>				R	A	A	
<i>Sphingonotus laucasi</i>				A			
<i>Sphingonotus rubescens</i>				A			
<i>Sphingonotus vosseleri</i>				R			
<i>Sphingonotus</i> sp		R		A			
<i>Oedaleus decorus</i>				C		A	
<i>Omocestus ventralis</i>				C			
<i>Acrida turrata</i>		C					R
<i>Aiolopus thalassinus</i>				A			
<i>Calliptamus wattenwyllianus</i>				A			
<i>Calliptamus barbarus</i>				A		A	
<i>Dericorys millierei</i>							A
<i>Acridella nasuta</i>				A		R	
<i>Pyrgomorpha cognata</i>		C		A			

A : aleatory (random), C : contagious, R : regular

Table 7: Distribution Type Orthoptera in Messaad station.

Espèces	III	IV	V	VI	VII	VIII	IX
<i>Acrotylus patruelis</i>		C		C	C	C	R
<i>Oedipoda</i> sp		A					
<i>Sphingonotus azureus</i>					R	C	A
<i>Oedaleus decorus</i>				A			
<i>Acrotylus</i> sp		A					
<i>Omocestus raymondi</i>		A		C			
<i>Omocestus</i> sp	C	R					
<i>Ochrilidia rothschildi</i>				A			
<i>Ochrilidia gracillis</i>				A			
<i>Ochrilidia geniculata</i>				A			A
<i>Ochrilidia</i> sp				A			A
<i>Acrida turrata</i>		A		A			C
<i>Calliptamus wattenwyllianus</i>				A			
<i>Calliptamus</i> sp				A			
<i>Acridella nasuta</i>				A			
<i>Pyrgomorpha cognata</i>				A		A	

A : aleatory (random), C : contagious, R : regular

Among 33 species, *Acrotylus patruelis* is reported in the 5 studied environments but, Hassani [20] approved it as representative in littoral region, while Chopard [9] affirmed that species inhabits the major part of North Africa notably in region of Djelfa. With regards to the results of diversity, the Shannon-Weaver's index values vary between 2,2 bits and 3,7 bits (Table 2) which translates favourable environmental conditions allowing installation of several species [10]. Hassani [20] found near values to those of the present study between 2.22 bits and 2.71 bits.

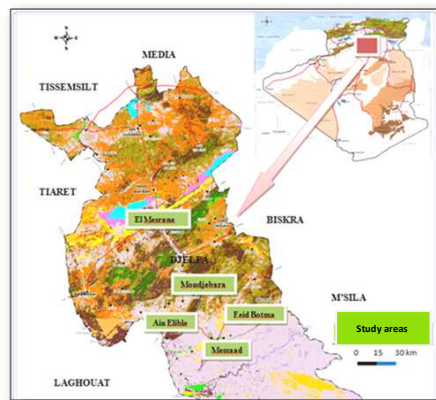


Fig. 1: Location of the 5 Study areas Source (National Agency for Territory Development, Algiers).

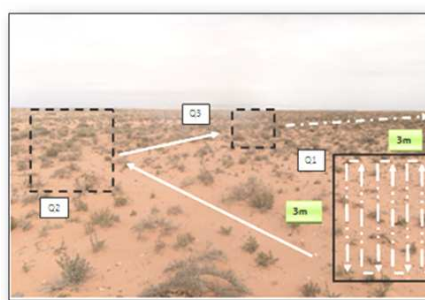


Fig. 2: Sampling of Orthoptera by method of quadrats.

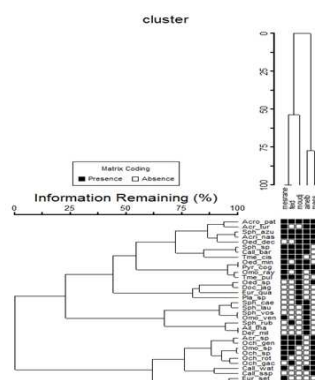


Fig. 3: Bidirectional hierarchical classification (Two-way Hierarchical Cluster Analysis).

At the study's conclusion on distribution of Orthoptera, we can see that Orthopterological species inventoried, present different distribution types according to stations and months of sampling (Tables 3 to 7). Generally, the spatial distribution of Orthoptera is linked to ecological conditions, and more specifically to vegetation which is used not only as food for locusts, but also as shelters. At level of station Faïd El Botma, only 2 types of distribution are noticed for species. It is about the regular and contagious distribution (Table 3).

Among regular species, we can quote *Sphingonotus rubescens*, *Omocestus* sp. et *Ochrilidia* sp. Within contagious species *Sphingonotus azureus* and *Calliptamus barbarus*, Benrima [3] reports in level of cultivated plots, locust species present a distribution of contagious type and that non cultivated environment is

characterized by a random distribution of locust species attending this environment. In station of Moudjbara, the randomness of species is the most dominant. It is noticed by 9 species notably *Acrotylus patruelis*, *Oedipoda miniata*, *Acrotylus* sp. *Acridella nasuta* et *Platycleis* sp. Other species are either regular such as *Calliptamus barbarus* or contagious *Tmethis pulchripennis* and *Dociostaurus jagoi jagoi* (Table 4).

As for station of El Mesrane (Table 5) species with randomness are the most noticed, it is notably the case of *Oedipoda miniata*, *Sphingonotus* sp., *Ochrilidia rothschildi* and *Ochrilidia geniculata*. They are followed by species "called" contagious such as *Oedipoda miniata*, *Sphingonotus azureus* et *Tmethis pulchripennis*. By contrast, those which are described as regular are only represented by 5 species. Among them *Omocestus ventralis* and *Omocestus* sp. Doumandji–Mitiche et al. in region of Lakhdaria quote two types of distribution.

Species with random distribution in natural environment (bush) and those with contagious distribution found in degraded area (wasteland) or unstable (culture). In Ain El Ibel, the randomness is the most noticed for all species, notably *Sphingonotus azureus*, *Sphingonotus laucasi*, *Sphingonotus rubescens*, *Calliptamus barbarus* and *Dericorys millierei*. Other distribution's types are either the contagious for *Omocestus ventralis*, or the regular as for *Sphingonotus vosseleri* (Table 6). In station of Messad, species 'called' either random, the case of *Sphingonotus vosseleri*, or contagious the case *Acrotylus patruelis*, *Omocestus raymondi* or regular as for *Sphingonotus azureus* (Table 7).

According to Künelt [22], the various groups constituted by all level of organisms determine an irregularity of spatial distribution in the very spots where the total available surface would be appropriate as vital environment for those species Doumandji et Doumandji–Mitiche relating to existing species in Mitidja, have noted that distribution control is translated by adaptation of feed type, and the lack of movement of certain species which are concentrating in spot where are deposited oothecas the first time. We note that Cherair, recorded that regular distribution type has marked the following species: *Oedaleus decorus* at Moudjebara, *Oedipoda fuscocincta* at Benchikao et *Sphingonotus rubescens* at Hassi Bahbah. According to Rouibah [27], contagion occurs in the beginning of summer and autumn. Distribution becomes random or regular in winter and in spring.

To achieve our study, we tried doing a Tow-way Hierarchical Cluser Analysis in the aim to gather a set of data in different homogeneous packages; stations which share common characteristics are station of Faid el Botma and El Mesrane, which correspond most often to proximity criteria. This classification shows that both stations Faid el Botma and El Mesrane involve 13 common species which are *Acrotylus patruelis*, *Sphingonotus azureus*, *Sphingonotus* sp, *Acrotylus* sp, *Omocestus* sp, *Ochrilidia geniculata*, *Ochrilidia* sp, *Calliptamus barbarus*, *Acridella nasuta*, *Tmethis cisti*, *Tmethis pulchripennis*, *Pyrgomorpha cognata*, *Platycleis laticauda*. (Figure 3).

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