

## FIRST DATA ON ORTHOPTERA FAUNA DIVERSITY IN THE ARID REGION OF NAËMA (SOUTH WEST OF ALGERIA)

BRAHIMI Djamel<sup>1\*</sup>, MESLI Lotfi<sup>1</sup> and RAHMOUNI Abdelkader<sup>2</sup>

1. University. Abou Bakr Belkaid - Faculty of Sciences of Nature and Life and Sciences of the Earth and the Universe- Department of Ecology and Environment-Laboratory of Valorisation of the actions of the man for the protection of the environment and application in public health., B.P. 119, 13000 Tlemcen, Algeria.
2. University Ahmed Benbella Oran1-Faculty of Sciences- Department of Chemistry -Laboratory of Polymer Chemistry- BP 1524, El'Menouer, 31000 Oran, Algeria.

Reçu le 19/05/2019, Révisé le 03/06/2019, Accepté le 23/06/2019

### Abstract

**Description of the subject:** FAO considers the regions of Naâma, Adrar and Béchar, as the theater of signaling of swarms and intervention, by geographical location, Naâma region is considered a South West corridor of migratory pest locust in Algeria.

**Objective :**The aim of the present study is to know the abundance and the diversity of Orthoptera species, which shelter the area of Naâma, in order to better control against the pest species threatening the steppe vegetation.

**Methods :**The study of Orthoptera was conducted in three stations located in Naâma arid region ,the collection of species was carried out by transect method , samples were taken from August 2015 until August 2017 ,the specimens collected were preserved using dry freeze preservation methods.

**Results :** This inventory makes to identify 19 species divided into two sub-orders and five families; Acrididae family is the most represented with five species. The highest ecological indices were recorded in the wetland of Ain Ben Khelil, explained by the floristic diversity in this zone .Two breeding sites of pest locust were found.

**Conclusion :**This database shows a significant diversity of Orthoptera species and two breeding areas of the *Anacridium aegyptium* ,that could have dramatic consequences for steppe formations and ecological balance in the Naâma region.

**Keywords:** Orthoptera, inventory, arid, Naâma, Algeria.

## PREMIÈRES NOTES SUR LA DIVERSITÉ DE LA FAUNE ORTHOPTÉROLOGIQUE DANS LA RÉGION ARIDE DE NAAMA (SUD-OUEST DE L'ALGÉRIE)

### Résumé

**Description du sujet :** FAO considère les régions de Naâma, Adrar et Béchar comme le théâtre de la signalisation des essaims et des interventions, suite à sa localisation géographique, la région de Naâma est considérée comme un couloir sud-ouest de locustes ravageuses migratrices en Algérie.

**Objectifs :** Le but de la présente étude est de connaître l'abondance et la diversité des espèces d'orthoptères, qui abritent la région de Naâma, afin de mieux lutter contre les espèces ravageurs menaçant la végétation steppique.

**Méthodes :** L'étude des Orthoptères a été menée dans trois stations situées dans la région aride de Naâma. La collecte des espèces a été réalisée par la méthode du transect. Des relevés ont été prélevés d'août 2015 à août 2017, les spécimens recueillis ont été conservés à l'aide de méthodes de conservation par congélation à sec.

**Résultats :** Cet inventaire permet d'identifier 19 espèces divisées en deux sous-ordres et cinq familles ; La famille des Acrididés est la plus représentée avec cinq espèces. Les indices écologiques les plus élevés ont été enregistrés dans la zone humide d'Ain Ben Khelil, expliqué par la diversité floristique dans cette zone. Deux sites de reproduction du criquet ravageur ont été trouvés

**Conclusion :** Cette base de données montre une diversité significative d'espèces d'Orthoptères et deux foyers de reproduction d'*Anacridium aegyptium*, qui pourraient avoir des conséquences dramatiques sur les formations de steppes et l'équilibre écologique de la région de Naâma.

**Mots clés:** Orthoptères, inventaire, aride, Naâma, Algérie.

\* Corresponding Author: BRAHIMI Djamel , E-mail : dgebiomel@hotmail.fr

## INTRODUCTION

The locust activity developed in the vast region of North-West Africa countries causes one of the most serious invasions that these regions have known. In Algeria, the FAO considers that the regions of Naâma, Tindouf, Adrar, Bechar as the signaling theater of swarms and intervention [1].

In Algeria, the orthoptera fauna has been the subject of numerous works, in particular the works conducted in eastern Algeria [2, 3, 4, 5, 6].

Other works was conducted in the southern regions of Algeria; Khelil [7]; Mesli *et al.* [8]; Mesli [9] and Mekkioui [10]. In the Algerian Sahara some works have been conducted such as Doumandji *et al.* [11]; Moussi [12] and Ould Elhadj [13].

We studied the arid natural environment and the steppe, which had never been studied before. This steppe region characterized by fragile steppe formations and threatened by locust invasions. In addition, by geographical location, the Naâma region considered a South West corridor of migratory pest species.

It is interesting to note that these arid steppes in Naâma region, are the richest in locust species because these biotopes characterized by dry soils and low humidity [14].

The present study was conducted in three stations located in the wetland of the region of Naâma (Algeria), namely Mécheria, Ben Amar

and Ain Ben Khelil from August 2015 to August 2017.

The aim of this work is to study the abundance and diversity of orthoptera species, which shelter the Naâma area (Algeria), in order to better control against the pest, and harmful species threatening the cultures and the steppe vegetation of this region.

## MATERIALS AND METHODS

### 1. Generalities about the region of Naâma

The area that the current study is concerned is the southwestern part of the high plains of Oran. It is administratively attached to the region of Naâma (western Algeria), it is inserted between the Tell Atlas to the north and the Saharan Atlas to the south; it covers an area of 29,825 km<sup>2</sup> (Fig. 1). The Naâma region is a steppe zone formed by a vast plain (74% of the territory of the wilaya) dominated by the following plant formations): Alfa steppe, Artemisia Steppe, Spartan Steppe, Halophyte steppe and psamophyte Steppe. The annual precipitation is 273.18 mm, the highest average temperatures are 31.21°C in August and 31.83°C in July. The Ombrothermal Diagram characterized by a drought season of 08 months per year going from the month of April to the month of November. The Emberger Climbing Rainfall shows that the climate of our study area is arid superior.



Figure 1: situation of the three stations in the area of Naâma (Algeria)

## 2. Study site

**Mécheria station:** It is located on the southern slopes of *Jebel Antar* mountain, north of the town of Mécheria, Geographic coordinates :longitude 0°, 20', 08' 'W, Latitude 33° 29', 46" N

*Stipa tenacissima* L. (Poaceae), *Peganum harmala* L. (Zygophyllacées) and *Aleppo pine* Miller (Pinaceae) are the most dominated plant formations in this station. This station characterized by Soils with little erosion on hard, with a high proportion of coarse elements, a high stony charge and a low organic matter content.

**Station of Ben Amar:** It is located 70 Km north of the Mécheria city, geographic coordinates are longitude 0°, 37', 32' 'W, and Latitude 33° 41', 42 " N, *Stipa tenacissima* L.

(Poaceae), *Tamarix gallica* L. (Tamaricaceae) and *Ziziphus lotus* (L.) Lam. (Rhamnaceae) are the representative species in this station. This station characterized by calcimagnetic soils.

**Wetland of Ain Ben Khelil station:** Located 50 km west of the city of Mécheria, and (4 km) at the NW of the chief town commune Ain Ben Khelil. The resort is a Wetland Oglat Ed Daira listed by Ramsar, geographic coordinates are 0°48'16 " W longitude and latitude 33°18'09 "N. The water of the wetland concerned 200 hectares, surrounded by several units or peripheral areas; immediate area of water characterized by *Tamarix gallica* L. (Tamaricaceae) and *Stipa tenacissima* L. (Poaceae) formation. This station characterized by calcimagnetic soils (Fig. 2).



Figure 2: the three stations of the Naâma region (South west of Algeria)

## 3. Orthoptera Study

The Study of Orthoptera for each station was studied with transect method, the number of adult individuals belonging to each locust species was counted separately on sight in a band 100 meters long and 1 meter wide. The bands were defined randomly within each environment but representative of the rest of the site. The counts in the bands are repeated three times, each output and in each station. 13 samples were taken from August 2015 until August 2017, and six (6) samples were taken in the winter seasons (December, January, and February), no species were caught in this season because of extreme climatic conditions. The number of mature individuals belonging to each locust species is counted separately. The specimens collected were preserved using dry freeze preservation methods.

The determination of Orthoptera species is based on the Chopard key [15] and the Acridoidea catalog of North West Africa of [16].

## 4. Ecological indices

To study the orthoptera fauna structure, we use the following indices:

### 4.1. Sampling quality

According to Dajoz [17], the quality of a sample is a measure of the homogeneity of the stand.  $Q=a/N$ . a: Number of species seen once, N: Total number of pots collected during the entire period of the experiment.

### 4.2. Relative abundance

The relative abundance of a species is the number of individuals species ( $n_i$ ) in proportion to the total number of individuals (N), all species contained in the same sample [17].

### 4.3. Fairness

Fairness E varies between 0 and 1, E tends to zero when the quasi-totality of the populations corresponds to a single species of the stand, E tends to 1 when each species is represented by the same number of individuals [18].

### 4.4. Diversity Index of Shannon-Weaver

The Shannon diversity index ( $H'$ ) is the determined abundance distribution of the species [18].  $H' = -\sum((n_i/n) \times \log_2(n_i/n))$ ,  $n_i$ : number of individuals of a given species,  $i$  ranging from 1 to S (total number of species).  $n$ : total number of individuals

### 4.5. Dispersion index and distribution type

The knowledge of the distribution mode is useful during a density evaluation population by sampling [17].  $S^2 = \sum(x-m)/n-1$ ,  $n$ : collection set;  $m$ : the average number of individuals in each sample;  $x$ : number of individuals from each sample. If:  $S^2 = 0$ : the distribution is uniform or regular;  $S^2 < m$ : the distribution is contagious or aggregated.

### 5. Factorial Correspondence Analysis (CFA)

Factorial correspondence analysis is a descriptive method. It aims at the representation with the minimum loss of information in a space with  $n$  dimension [18].

The purpose of this analysis is to realize several graphs from data table 1. The observation of the graph can give an idea of the interpretation of the factors and show which variables are responsible for the proximity between this or that observation. Correspondence factorial analysis is a method that consists of summarizing the information contained in a table with  $n$  rows (the stations in this case) and  $p$  columns or variables (Orthoptera species). In addition, a technique has for describing in particular in a graphical form the maximum of the information contained in a rectangular array of data. Allows the construction of an entire hierarchy of objects in the form of a tree in ascending order. Each individual as a class and try to merge two or more appropriate classes (according to a similarity) to form a new class.

## RESULTS

### 1. Fauna of the Naâma region

This inventory includes 19 Orthoptera species. The determination is based on several morphological criteria; the shape of the pronotum, the color of membranous wings and the shape of the hind legs. This work was conducted over two years from August 2015 to August 2017 in Naâma region (table 1).

Table 1: List of identified Orthoptera species in the region of Naâma

sub-order	Family	Sub- Family	Genus-species
Ensifera	Tettigonidae	Tettigoniinae	<i>Tettigonia albifrons</i>
	Gryllidae	Gryllinae	<i>Melanogryllus desertus</i> (Pallas, 1771)
Caelifera	Pamphagidae	Pamphaginae	<i>Ocneridia volxemii</i> (Bolivar, 1878)
		Thrinchinae	<i>Tmethis marocanus</i> (Bolivar, 1878) <i>Tmethis cisti</i> (Fabricius, 1787)
	Acrididae	Oedipodinae	<i>Acrotylus fischeri</i> (Azam, 1901)
			<i>Oedipoda fuscocincta</i> (Lucas, 1849)
			<i>Oedipoda miniata</i> (Pallas, 1771)
			<i>Sphingonotus rebescens</i> (Walker, 1870)
			<i>Sphingonotus octofasciatus</i> (Serville, 1838)
			<i>Sphingoderus carinatus</i> (Saussure, 1888) <i>Sphingonotus lucasii</i> (Saussure, 1888)
	Pyrgomorphidae	Pyrgomorphidae	<i>Calliptamus barbarus</i> (Costa, 1836) <i>Calliptamus wattenwylanus</i> (Pantel, 1896)
			<i>Catantopinae</i>
<i>Cyrtacanthacridine</i>			<i>Anacridium aegyptium</i> (Linné, 1764)
<i>Gomphocerinae</i>			<i>Omocestus lepineyi</i> (Chopard, 1937) <i>Omocestus lecerfi</i> (Chopard 1936)



In the present work, we have found five families of Orthoptera: Tettigonidae, Gryllidae, Pamphagidae, Acrididae and Pyrgomorphidae. All species of these families belong to the two sub-orders of Orthoptera; Caelifera and Ensifera. The family Tettigonidae is represented by a single sub-family Tettigoniinae species; *Tettigonia albifrons*. The family Gryllidae has only one subfamily Gryllinae with only one species: *Melanogryllus desertus* (Pallas, 1771).

The family Pamphagidae contains three species distributed in two sub-families: Thrinchinae, Pamphaginae. These species are *Ocneridia volxemii* (Bolivar, 1878), *Tmethis marocanus* (Bolivar, 1878) and *Tmethis cisti* (Fabricius, 1787). The family Acrididae includes nine (5) subfamilies: Oedipodinae, Catantopinae, Calliptaminae, Cyrtacanthacridinae and Gomphocerinae. To know the distribution of Orthoptera species, the table 2 gives a summary list of the species recorded by their distributions in the three stations of the Naâma region.

Table 2: Distribution of species recorded by stations

	Mécheria	Ben Amar	Ain Ben Khelil
<i>Tettigonia albifrons</i>	1	0	1
<i>Melanogryllus desertus</i>	0	1	1
<i>Ocneridia volxemii</i>	1	0	1
<i>Tmethis marocanus</i>	1	1	1
<i>Tmethis cisti</i>	1	0	1
<i>Acrotylus fischeri</i>	0	1	1
<i>Oedipoda fuscocincta</i>	1	1	1
<i>Oedipoda miniata</i>	1	1	1
<i>Sphingonotus rebescens</i>	1	1	1
<i>Sphingonotus octofasciatus</i>	1	1	1
<i>Sphingoderus carinatus</i>	0	0	1
<i>Sphingonotus lucasii</i>	0	1	1
<i>Calliptamus barbarus</i>	1	1	1
<i>Calliptamus wattenwylanus</i>	0	1	1
<i>Pezotettix giornai</i>	1	1	0
<i>Anacridium aegyptium</i>	1	1	1
<i>Omocestus lecerfi</i>	0	1	1
<i>Omocestus lepineyi</i>	1	1	1
<i>Pyrgomorpha conica</i>	0	1	1

In this work, we found five families of Orthoptera: Tettigonidae, Gryllidae, Pamphagidae, Acrididae and Pyrgomorphidae, all species of these families belong to the two sub-order of Orthoptera; the Caelifera 89% and Ensifera 11% (Fig. 3).

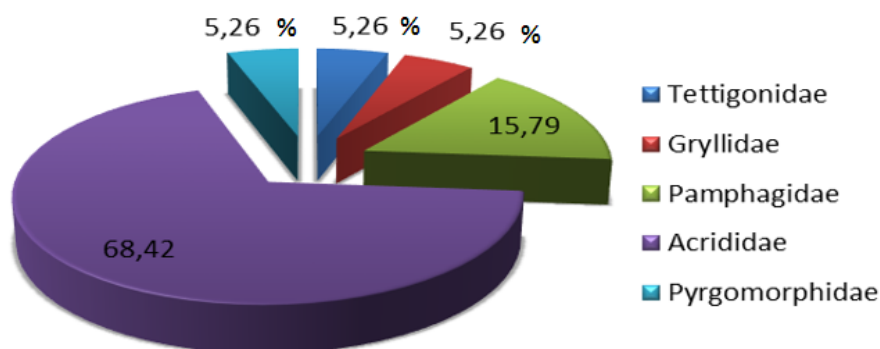


Figure 3: Repartition of Orthoptera species by families

**2. Study and analysis of the structure of the fauna of Naâma.**

The number of the species, which we inventoried in the region of Naâma, adds up 19

species, 13 species are recorded in both stations Mécheria and Ben Amar, and 16 species for wetland of Ain Ben Khelil.

The value of the Shannon Weaver diversity index for species caught is 1.89 bit for Mécheria, 2.06 bits for Ben Amar station and 2.12 bits for the wetland of Ain Ben Khelil. The values of equitability (E) for each station are respectively 0.73 for Mécheria station, 0.8 for Ben Amar station, and 0.76 in wetland of Ain Ben Khelil. Measurements of maximal diversity show that both Mécheria and Ben Amar stations represent an equal diversity of 2.66; whereas the high diversity registered in Ain Ben Khelil with 2.77.

**2.1. Quality and sampling effort**

Sampling qualities registered at the Mécheria station are 0.006, 0.005 for Ben Amar station and 0 for Wetland of Ain Ben Khelil. The three Q values tend to 0, sampling can be qualified

good in the three stations. The Gleason score ranges from 5.42 in Mécheria Station and 5.53 in Ben Amar, reaching 6.19 in Ain Ben Khelil wetland, the three values are relatively similar, show that diversity is important.

**2.2. Abundance of Orthoptera species identified in the region of Naâma**

The total number of individuals of identified in the three stations of the region of Naâma (Algeria) is 606 individuals, the most important abundance values are recorded in the wetland of Ain Ben Khelil, the following species: *Oedipoda fuscocincta*, *Sphingonotus rebescens*, *Tmethis marocanus*, *Anacridium aegyptium* and *Oedipoda miniata* are the most abundant species in the region of Naâma (Algeria) (Fig. 4).

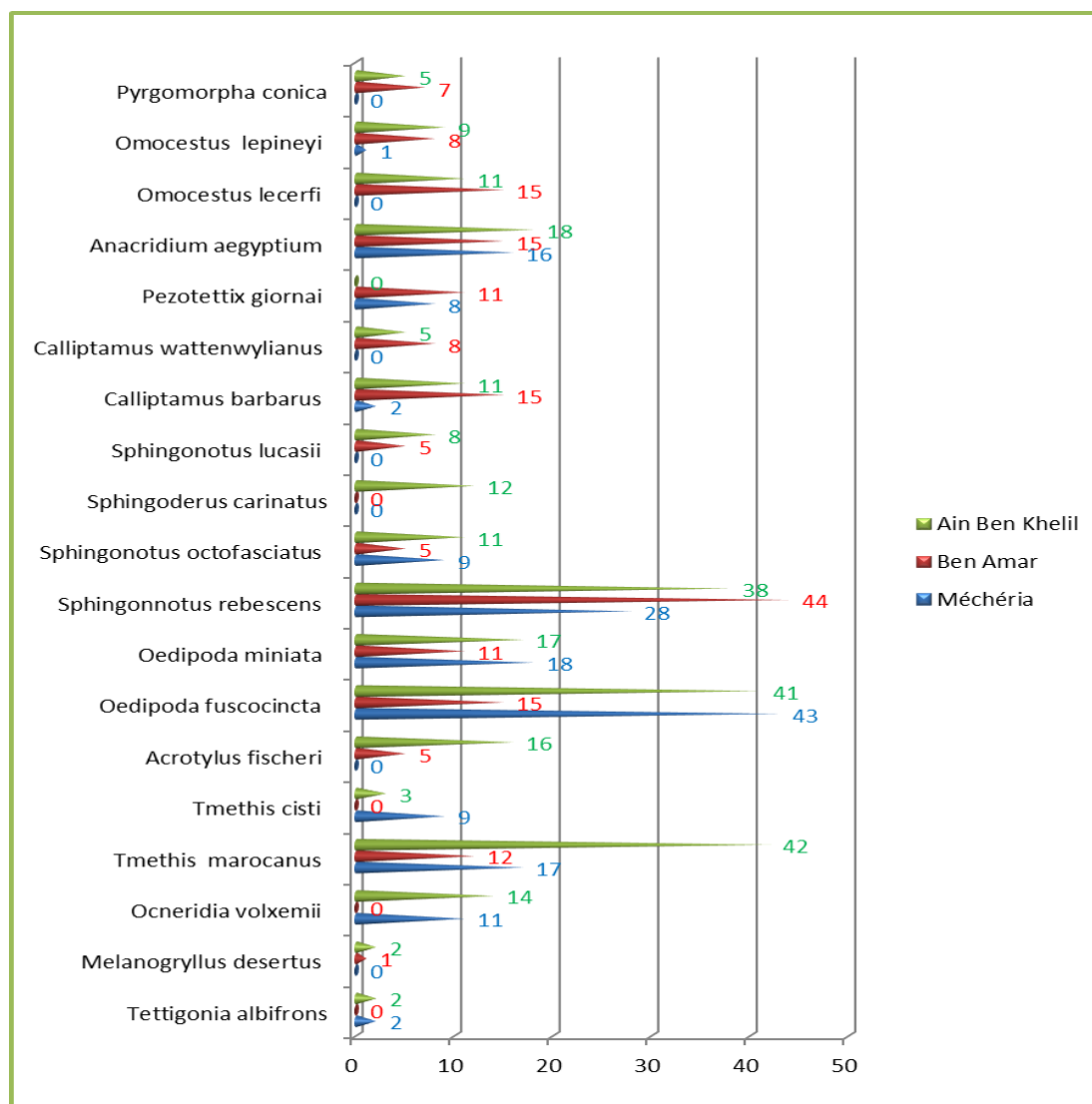


Figure 4: Abundance of species identified in the three stations of the region of Naâma

**2.3. Relative frequencies of orthoptera species identified in the region of Naâma**

At the Mécheria station, the highest frequency is that of *Oedipoda fuscocincta* with 26.21%, followed by *Sphingonotus rebescens* with 17.07%. The study of the frequency of each species in the Ben Amar stations allowed to

know the highest frequency of the species *Sphingonotus rebescens* with 24,85% ,in the Ain Ben Khelil wetland station, the highest frequencies are recorded with the two species *Tmethis marocanus* 15.84% and *Oedipoda fuscocincta* with 15.47% (Fig. 5).

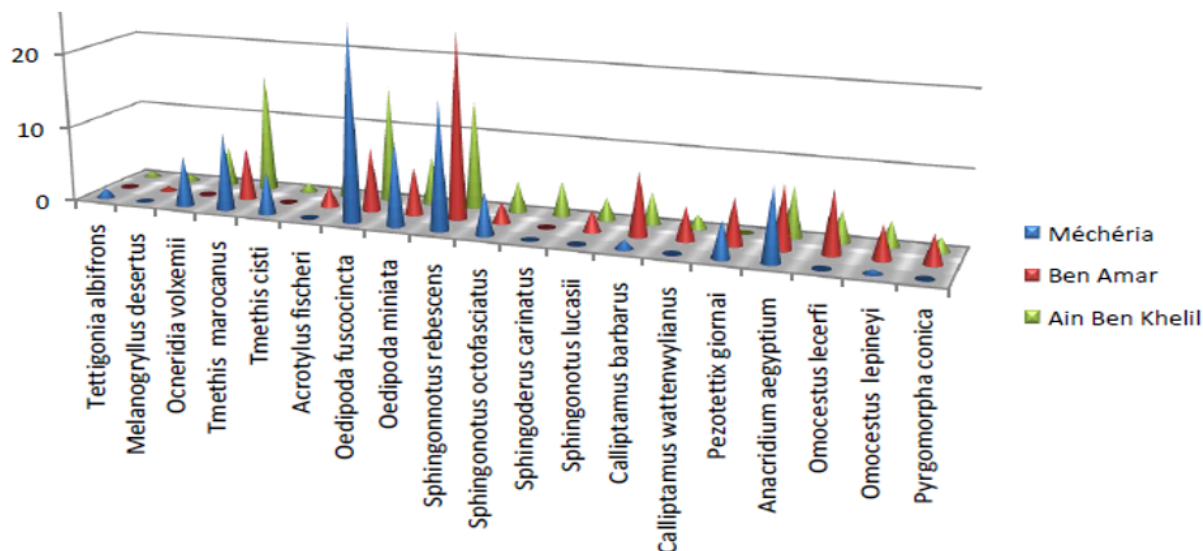


Figure 5: Relative frequencies of Orthoptera species identified in the region of Naâma

**2.4. Dispersion index and type of distribution**

*Tmethis*, *Oedipoda fuscocincta* and *Oedipoda miniata* are among the common infected

species found in all stations. On the other hand, regular and common species are *Calliptamus*, *Pezotettix*, *Sphingonotus*, *Acrotylus* and *Calliptamus wattenwylanus* (Fig. 6).

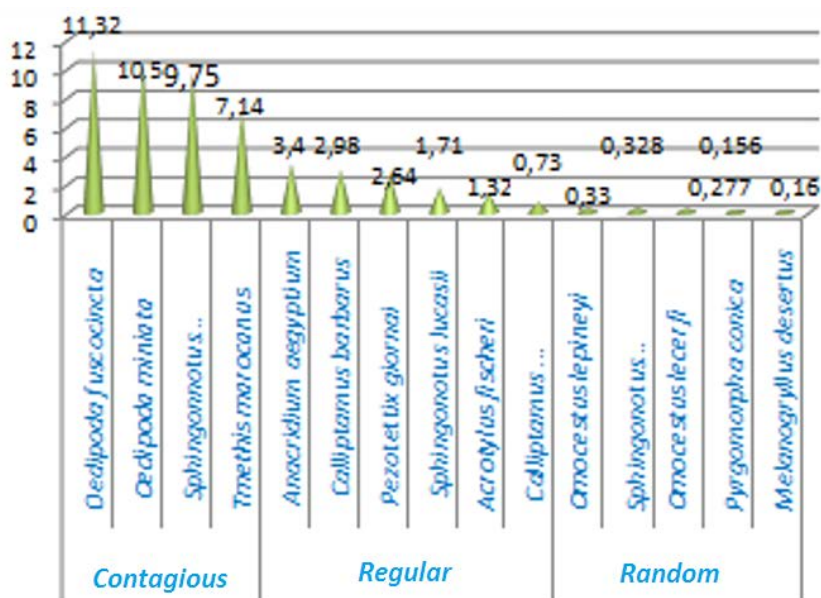


Figure 6: Dispersion index and type of distribution of Orthoptera of Naâma

**2.5. Correspondence factor analysis (CFA)**

The initial table (1) corresponding to 20 surveys show the presence of species in the stations according to the type of environment; degraded and stony (Mécheria station), steppe (Ben Amar station), diversified steppe and rich

(wetland). An AFC conducted on this matrix allowed to build a hierarchical classification calculated from the coordinates of species. Dendrogram clearly differentiates three groups of species of unequal size: **Group A:** It includes species specific to degraded and rocky

environments, **Group B:** It is mainly represented in the steppic station, **Group C:** Species represented in the diversified environments.

The first entity in the right of the projection is the largest as it includes 42.10% of species (8 species). It represents the species caught in wet land of Ain Ben khelil (C): *Oedipoda fuscocincta*, *Sphingonotus*, *Oedipoda miniata*,

*Omocestus*, *Tmethis*, *Calliptamus*, *Anacridium* and *Sphingonotus octofasciatus*.

The second entity located in the right of the projection includes 6 species which are found in the steppe station of Ben Amar (B): *Pyrgomorpha*, *Melanogryllus*, *Acrotylus*, *Sphingonotus* and *Calliptamus*.

The third entity brings together the rest of the species (Fig. 7).

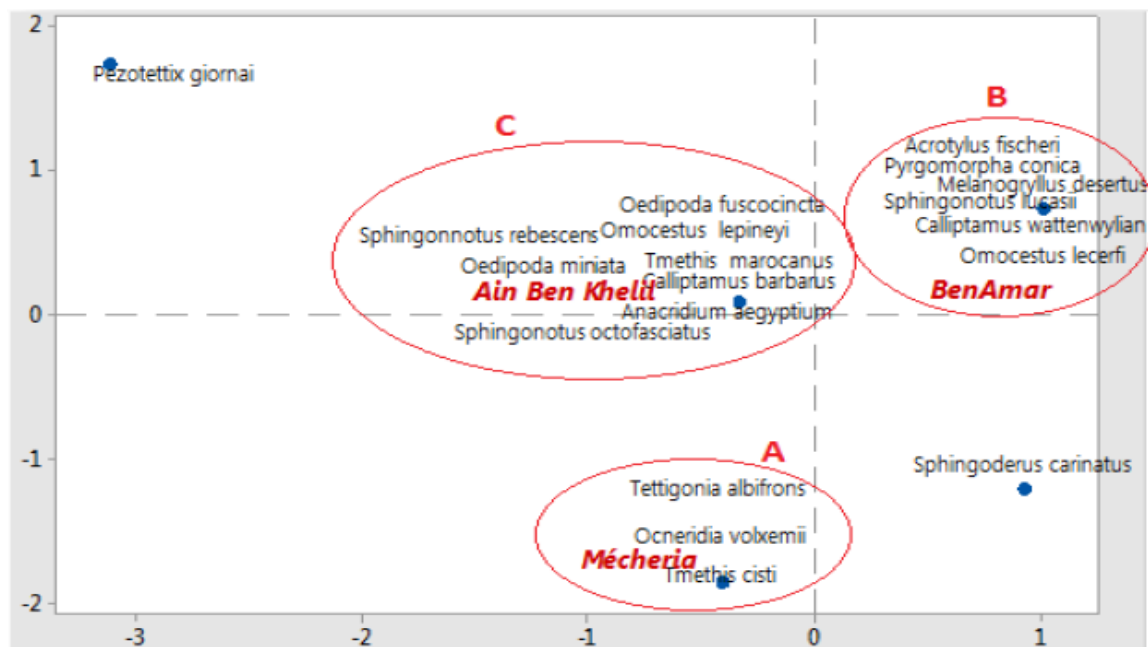


Figure 7 : Factorial analysis of the correspondence of Orthoptera species of Naâma

**2.6. The ascending hierarchical classification (C.H.A)**

From the Euclidean distances based on the scores of the three factors A.F.C (Fig. 9), it is possible to recognize three groups: The first

includes the surveys carried out in the rock station during the whole year, The second group includes wetland surveys conducted in all seasons; The third concerned with the steppe surveys of Ben Amar (Fig. 8).

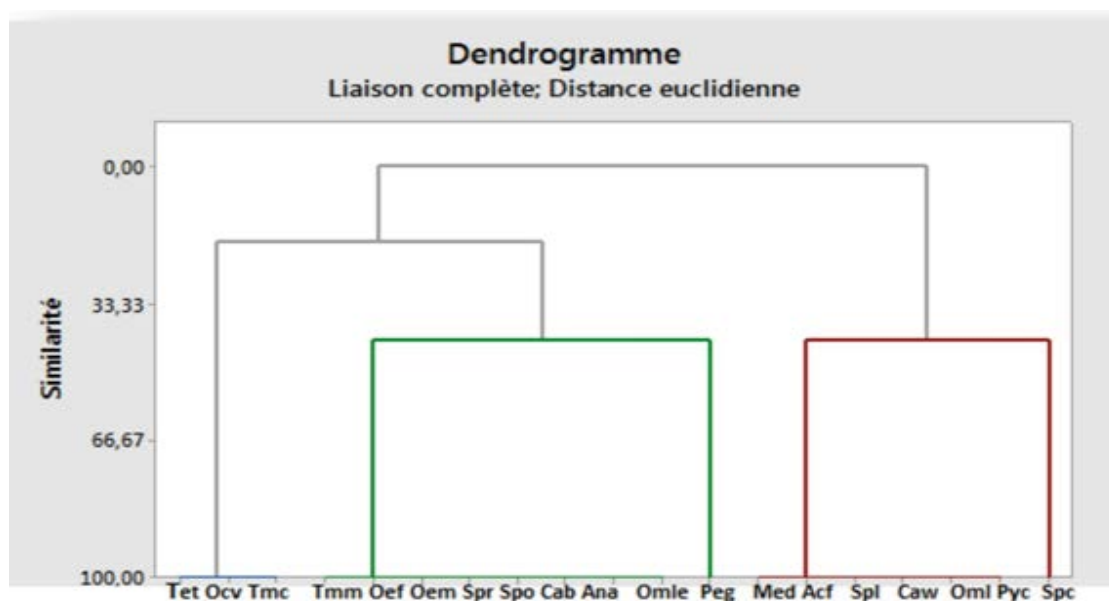


Figure 8: Hierarchical ascending classification of Orthoptera species of Naâma



## DISCUSSION

We identified 19 species of Orthoptera during the period from August 2015 to August 2017. The large number of species shows the richness in the Naâma region. Mesli [9], identified 31 species for five regions in the province of Tlemcen. In the same vein, Moussi [12], identified 57 species for four years in the Biskra region (Algeria). The Pamphagidae Family contains three species divided into two subfamilies: Thrinchinae, Pamphaginae, these species are *Ocneridia volxemii* (Bolivar, 1878), *Tmethis marocanus* (Bolivar, 1878) and *Tmethis cisti* (Fabricius, 1787).

25 species of Pamphagidae Family were recorded in Algeria [15]. The species *Ocneridia volxemii* is present in both stations Mécheria and Ain Ben Khelil. Chopard [15], reported that this species is sometimes very common in the highlands. Further this species has a great epidemic and causes a lot damage [10]. The subfamily Oedipodinae is the most numerous genus (four 4) and species (seven 7), genus *Sphingonotus* is more important in this inventory list with three species.

*Oedipoda fuscocincta* was found in the High Plains of Setif (Algeria) [19], and in the region of Boussaâda (Algeria), this specie was reported in the Sahara of Bechar (Algeria) by Defaut [20]. *Oedipoda Miniata* was reported in the Constantine region [6], and in the Algerian Sahara by Ould Elhadj [13].

The study of the Orthoptera structure shows that the Superior Diversity Index of Shannon is obtained in the Ain Ben Khelil Wetland with 2.12 bits, due to the most diverse vegetation cover and the high temperature corresponds to living conditions for the development of locust species. At Mécheria station, the diversity index is 1.89 bits, this decrease is due to the degradation of the environment due to overgrazing and human action [11]. A low diversity index reflects unfavorable living conditions [21]. The spatial distribution of Orthoptera is related to environmental conditions; in particular, the vegetation that serves not only food for locusts, but also shelter [20].

The correspondence factor analysis shows that the species, which are divided into different groups, can only be explained by the differences between the environments so that Orthoptera species react with two environmental factors: the humidity and the diversity of environments.

The first group contains rich species, natural wetlands where the soil is more or less saturated and even where there are hygrophilous free water species (wet environment of Ain Ben Khelil). The second group includes species that prefers dry degraded rocky habitats that is to say, drought-resistant species (Mécheria station). The third group includes those species that prefer open and vast steppes, characterized by plant formations dominated by *Peganum harmala* and *Artemisia campestris* (Ben Amar station). This distribution of orthoptera groups due to floristic diversity and trophic availability exist in the three stations.

## CONCLUSION

With the aim of knowing the abundance and the diversity of the species of Orthoptera, which shelter the region of Naâma (south-west of Algeria), and in order to set up a base of data on these species for an effective fight against these pests that threaten steppe vegetation in this region. An study of Orthoptera fauna in the region of Naâma (South west of Algeria) was conducted in three stations, namely Mécheria, Ben Amar and wetland of Ain Ben Khelil during the period from August 2015 to August 2017. 19 species have been identified divided into two sub-orders; Ensifera and Caelifera, and five (5) families Orthoptera: Tettigonidae, Gryllidae, Pamphagidae, Pyrgomorphidae and Acrididae. The Acrididae family is the largest with five (5) species.

The study of the Orthoptera structure stands shows that the highest Shannon-Weaver diversity index is obtained at the Ain Ben Khelil wetland with 2.12 bits. The correspondence factor analysis shows that the species are divided into different groups and they can only be explained by the differences between the environments. Thus, Orthoptera species react with two environmental factors: the humidity and the diversity of environments.

This database shows a significant diversity of Orthoptera species and two breeding areas of the *Anacridium aegyptium* that could have dramatic consequences for steppe formations and ecological balance in the Naâma region.

## BIBLIOGRAPHY

- [1]. **FAO (1989)**. *Report of the fifteenth session of the Commission against the Desert Locust in Northwest Africa*. FAO held in Tripoli.
- [2]. **Benharzallah N. (2004)**. Contribution à l'inventaire et étude bio systématique de la faune Acridienne dans la région des Aurès, wilaya de Batna, Algérie Thèse Magister en Entomologie, Univ., Constantine, 141 pp.
- [3]. **Benrima A. (1993)**. Bioécologie et étude du régime alimentaire des espèces Orthoptères rencontrées dans deux stations d'études situées en Mitidja. Etude histologique et anatomique du tube digestif de *Doclostaurus jagio jagio* (Soltani 1978). Thèse Magi. Agro., Inst. Nat. Agro., El Harrach, 192p.
- [4]. **Doumandji S.E., Doumandji B. et Briki Y. (1992)**. Bio-écologie des orthoptères de trois types de stations dans la région de Dellys (Algérie). Medical Faculty Landbouw, Ghent University.
- [5]. **Hamdi H. (1989)**. Contribution à l'étude bioécologique des peuplements orthoptérologiques de région médio septentrionale de l'Algérie et la région de Gabes (Tunisie). Thèse. Ing. Agro. Inst. Nat. Agro, El-Harrach, 27 pp
- [6]. **Harrat A. and Moussi A. (2007)**. Inventory of the locust wildlife in two habitats in eastern Algeria. *Science & Technology*, 26: 99-105.
- [7]. **Khelil M.A. (1984)**. Bio écologie de la faune alfatière dans la région steppique de Tlemcen (Algérie). Thèse Magister. Institut National d'Agronomie, El Harrach, Alger, 62p.
- [8]. **Mesli L., Doumandji S. et Khelil M.A. (2005)**. Contribution à l'étude du régime alimentaire de *Calliptamus barbarus* dans les monts de Tlemcen. *Intergrated protection in oakforests IOBC Wprs Bull.* 28(8): 285-286.
- [9]. **Mesli L. (2007)**. Contributing to the bio-ecological study and diet of the main species in the province of Tlemcen. Thèse Doc. Univ. Tlemcen, Algeria, 102 p.
- [10]. **Mekkioui A. (1997)**. Etude de la faune Orthopérologique de deux stations dans la région de Hafir (Monts de Tlemcen) et mise en évidence d'*Ampelodesma mauritanica* (espèce pâturée) dans les fèces de différentes espèces de Caelifères. Thèse Magister, Université de Tlemcen, 93p.
- [11]. **Doumandji M., Doumandji S., Kadi A., Kara F., Ayou A. et Sahraoui L. (2001)**. La faune Orthoptérologique de quelques oasis algériennes – 8<sup>ème</sup> Conf. Internat. sur les insectes Orthoptéroïdes, Montpellier France.
- [12]. **Moussi A. (2002)**. Preliminary study of Locusts (Orthoptera, Caelifera) in two different habitats (Constantine and Biskra). Thèse Magister, Univ. Mentouri Costantine, Algeria, 104 p.
- [13]. **Ould Elhadj D. (2004)**. Le problème acridien au Sahara algérien. Thèse Doctorat d'Etat, Inst. Nat. Agro., El Harrach, Algeria, 279p.
- [14]. **Bensaid A. (2006)**. Sig et télédétection pour l'étude de l'ensablement dans une zone aride : le cas de la wilaya de Naâma (Algérie). Thèse Doctorat, Université Joseph Fourier-Grenoble 1. France, 319 p.
- [15]. **Chopard L. (1943)**. Contribution to the study of Orthoptera, North Africa (4th grade). *French Review of Entomology*, 4: 147-160.
- [16]. **Louveaux A. and Benhalima T. (1987)**. Catalogue of Orthoptera Acridoidea North Africa Ouest. *Bull. Soc. Ent. Fr.*, 4:73-87.
- [17]. **Dajoz R. (1970)**. *Précis d'écologie*. Ed. Dunod, Paris, 357 p.
- [18]. **Ramade F. (2003)**. *Eléments d'écologie – Ecologie fondamentale*. N° 03, Ed. DUNOD, Paris, 690 p.
- [19]. **Doumandji S., Harizia M., Doumandji M. et Ait Mouloud K. (1993)**. Régime alimentaire du Héron garde-bœuf *Bubulcus ibis* L. en milieu agricole dans la région de Chlef (Algérie). *Med. Fac. Landbouw. Univ. Gent*, 58/2a : 365-372
- [20]. **Defaut B. (2005)**. Note complémentaire sur les *Sphingonotus* du groupe Rubescens en région paléarctique occidentale (Caelifera, Acrididae, Oeodipodinae). *Matériaux entomocénétiques*, 10 : 25-33
- [21]. **Dajoz R. (1985)**. *Précis d'écologie, Ecology Accurate*. Ed. Dunod, Paris, 505p.