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#### M Slim

PhD student in Biology: Faculty of Sciences Ibn Tofail, Kenitra, Morocco, Laboratory of Nutrition, Health and Environment

#### S Sassa

PhD student in Biology: Faculty of Sciences Ibn Tofail, Kenitra, Morocco, Laboratory of Nutrition, Health and Environment

#### N Zouaki

PhD student in Biology: Faculty of Sciences Ibn Tofail, Kenitra, Morocco, Laboratory of Nutrition, Health and Environment

#### H Lougraimzi

PhD student in Biology: Faculty of Sciences Ibn Tofail, Kenitra, Morocco, Laboratory of Nutrition, Health and Environment

#### T Berrady

PhD student in Biology: Faculty of Sciences Ibn Tofail, Kenitra, Morocco, Laboratory of Botany, Biotechnology and Plant Protection

#### M Fadli

Professor in Faculty of Sciences Ibn Tofail, Kenitra, Morocco, Laboratory of Nutrition, Health and Environment

#### Correspondence

##### M Slim

PhD student in Biology: Faculty of Sciences Ibn Tofail, Kenitra, Morocco, Laboratory of Nutrition, Health and Environment

## Contribution to the study of the wildlife Orthopteric of the biological reserve of Sidi Boughaba (North-East of Morocco): Biodiversity and ecology

M Slim, S Sassa, N Zouaki, H Lougraimzi, T Berrady and M Fadli

#### Abstract

In this work, a comprehensive inventory of Orthoptera and Mantoptera of the biological reserve of Sidi Boughaba was established. 15 species in total were identified and divided between Caelifera and Ensifera. The majority of Caelifera are Acrididae, distributed mainly among four subfamilies: Gomphocerinae with five species (*Euchorthippus albolineatus*, *Dociostaurus maroccanus*, *Dociostaurus jagoi*, *Chorthippus jucundus*, *Stenobothrus stigmaticus*), the Oedipodinae with four species (*Oedipoda caerulescens*, *Paracinema tricolor*, *Aiolopus puissantii*, *Aiolopus strepens*), the Calliptaminae and Eypreocnemidinae with one species for each which are respectively (*Calliptamus barbarus* and *Heteracris lieutaghii*). The Ensifera are represented by the Gryllidae, (subfamily of Nemobiinae with one species (*Nemobius sylvestris*)). The Mantidae are represented by two sub-families, the Mantinae with two species (*Mantis religiosa* and *Sphodromantis viridis*) and the *Angelina* represented by *Euchomenella* sp. On the plan ecologic, *Dociostaurus maroccanus* and *Dociostaurus jagoi* behave as the eurytopic insects, *Stenobothrus stigmaticus*, *Chorthippus jucundus* and *Paracinema tricolor* are the *Stenotopic* insects.

**Keywords:** Orthoptera, inventory, biological reserve, Sidi Boughaba, Morocco

#### Introduction

The Orthoptera are considered as good indicators because of its high sensitivity to changes in vegetation structure and stationnal humidity [1-3]. Similarly, it constitutes a huge food resource, especially for the avifauna [4, 5]. They also play a very important role in the cycle of the organic matter and favour the growth of plants from their excrement which are easily absorbed [6].

They are divided into two main groups: the Ensifera, corresponding to grasshoppers and crickets and the Caelifera, represented by the locusts.

We distinguished those which were strictly linked to the specific environments and others that meet in varied biotopes to which they were able to adapt. This distribution seems to be influenced by many factors such as the temperature, the humidity, the light, the soil and the vegetation [7, 8].

Thereby, the study of the Orthoptera is a relevant tool to quantify and follow the quality of natural areas of the reduced size such as the biological reserve of Sidi Boughaba. The novelty of this research resides in the fact that with the exception of the works realized by Chopard [9], Defaut [10-13], no thorough work has been addressed in the area of Sidi Boughaba. By this work, we will contribute to the systematic knowledge, the diversity and the information on the ecology of Orthopteric species of this area of Morocco which constitutes a biological and ecological interest site (BEIS).

#### Material and method

##### Geographical location of the study area

The site of Sidi Boughaba (34° 15' N - 06° 39' W) is situated on the left shore of the mouth of the Sebou River, a 13 km south of the city of Kenitra (North-West of Morocco). The lake is located in the NNE-SSW oriented inter-dunal depression; its length is about 6 km with a width of 100 to 350 m and a depth that varies between 0.5 and 2.50 m. This is in its hydrology that this body of water must largely its originality, its alimentation being related to the outcrop of the groundwater and, to a lesser extent, to the precipitations.

Going from the north to the south, we find a swampy area of 700 meters separated from the

rest of the lake by a small dam; this area dries quickly at the early summer. Next comes the widest and deepest part of lake, which stretches over 2.5 km. Further to the South, the rest of the lake becomes totally dewatered during the dry season. In this last part, the bottom rises from place to place and emerges more or less completely permitting the installation of aquatic vegetation (Figure 1). These marshy meadows alternate with the water bodies of shallow depth that communicate with each other during the high water period (December to May), discovering on their edges wide mud flats. Following the water level, the submerged area varies between 150 and 200 hectares [14]. Concerning the humid zone in the strict sense since its extreme limit south

until the level of the current building of the National Center for Environmental Education (NCEE), the forest township of Sidi Boughaba of 652 ha (data of NCEA), encompassing the biological reserve in addition to a domanial forest. The limits of canton are the south, the Marabout of Sidi Boughaba, to the west, the Atlantic Ocean, to the north, the Kasbah of Mehdiya and to the east, the collective lands and the forest of Maâmora. According to the water and forests, the biological reserve of Sidi Boughaba is one of the rare humid zones composed of a freshwater lake and the massive forest (matorral) very dense of red Juniper (*Juniperus phoenicea* L.).

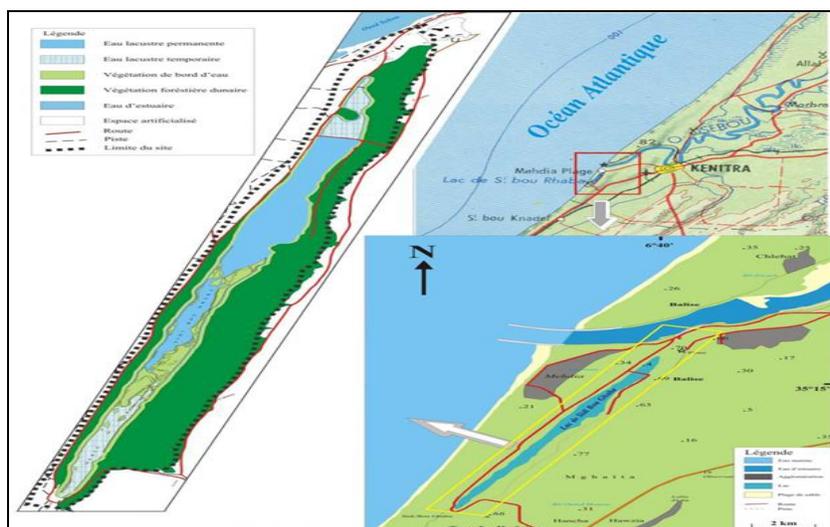


Fig 1: Geographical location of the biological reserve of Sidi Boughaba [15]

**Sampling**

The study is limited to the period of adults' activity, between the late month of May and September. Five days of prospecting were realized at one month apart: 25th May, 24th June, 30th July, 31th August and 21th September, 2014. In so far as we have studied five areas of the reserve, we have realized a total of five quadrats for each day of prospecting. Five prospecting days have been realized, the results of this study are based on a total of 25 performed

quadrats. The individuals are identified "on sight" or captured in entomological net if needed, then released immediately after capture. Some individuals, whose identification needs further examination, were collected and identified under binocular microscope in the Laboratory of Nutrition, Health and Environment.

**Results**

Floristic and granulometrical data

Table 1: Floristic and granulometric characteristics of each study area

Parameters		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	
Abundance vegetation	Fabaceae	<i>Retama monosperma</i>	x	x	x	x	x
		<i>Acacia cyanopnylla</i>					x
	Iridaceae	<i>Iris pseudacorus</i>		x	x	x	
	Salicaceae	<i>Populus alba</i>				x	
	Polypodiaceae	<i>Pteridium aquilinum</i>				x	
	Cyperaceae	<i>Cladium mariscus</i>		x	x	x	
	Lythraceae	<i>Lythrum salicaria</i>	x	x	x	x	
	Cactaceae	<i>Opuntia ficus-indica</i>	x				
	Thymelaeaceae	<i>Thymelaea lythroides</i>				x	
	Oléaceae	<i>Phillyrea angustifolia</i>		x		x	
		<i>Olea europaea</i>				x	
	Cupressaceae	<i>Juniperus phoenicea</i>		x	x	x	x
	Poaceae	<i>Hordeum murinum</i>		x		x	
Asteraceae	<i>Centaurea aspera</i>	x			x	x	
Granulo Aquatic areas		=	Daya	Small Merja	Great Merja	Beach	
Granulo metry	Clayish and sandy			x	x	x	
	sandy		x			x	x
	calcite		x				

(x): Presence of the floristic species and the naturally granulometry of each study zone.

Table 1 shows the floristic characteristics and granulometry of each study zone.

Zone (1): This zone is located near the agglomerated area of Mehdia. It is characterized by a calcareous soil which is generated by the outcrop of bedrock. The species of vegetables that dominates this zone is: *Retama monosperma* (Fabaceae), with such Asteraceae (*Centaurea aspera*), Cactaceae such as (*Optinsia ficus indica*) and *Lythrum salicaria* (Lythraceae).

Zone (2): This field includes a permanent lagoon. From a bioclimatic perspective, the studied areas are part of sub-humid bioclimate and a mild winter [16]. The plant species that dominate the zone (2) are: *Retama monosperma* (Fabaceae), *Hordeum murinum* (Poaceae), *Cladium mariscus* (Cyperaceae), *Lythrum salicaria* (Lythraceae), *Iris pseudacorus* (Iridaceae). We found in this zone other species like *Centaurea aspera* (Asteraceae) with some *Phillyrea angustifolia* (Oleaceae).

Zone (3): this zone is characterized by the presence of a body of water, the small Merja, the dominant plant species like *Cladium mariscus* (Cyperaceae), some Fabaceae (*Retama monosperma*), *Iris pseudacorus* (Iridaceae) and *Lythrum salicaria* (Lythraceae).

Zone (4): contains the large Merja. The plant species that dominate the 4<sup>th</sup> zone : *Juniperus Phoenica* (Cupressaceae), *Retama monosperma* (Fabaceae), *Iris pseudacorus* (Iridaceae), *Cladium mariscus* (Cyperaceae), *Lythrum salicaria* (Lythraceae) *Olea europaea*, *Phillyrea angustifolia* (Oleaceae), *Centaurea aspera* (Asteraceae), *Populus alba* (Salicaceae), *Hordeum murinum* (Poaceae), *Pteridium aquilinum* (Polypodiaceae) and *Thymelaea lythroides* (Thymelaeaceae).

Zone (5): near the beach, the plant species that dominate this zone are: *Juniperus phoenicea* (Cupressaceae), *Retama monosperma* and *Acacia cyanophylla* (Fabaceae), with a Asteraceae of (*Centaurea aspera*).

**Faunal aspects**

**Inventory and frequency of species**

A total of 15 species were studied which correspond to three families:

*Acrididae* with (11) species, *Gryllidae* with (1) species, Mantidae with (3) species

The table 2 presents the systematic list of species and the distribution of the specific richness of the surveys in the five prospected areas. The frequency of species, also postponed in this table, is represented graphically and in descending order on the histogram of the figure 2.

**Table 2:** Systematic list and distribution of the surveyed species in the five prospected areas during the study period

Family	Sub-family	Genre and species	Zone1	Zone 2	Zone 3	Zone 4	Zone 5	Frequency %
Acrididae	Gomphocerinae	<i>Euchorthippus albolineatus</i>	+		+			13.33
		<i>Dociostaurus maroccanus</i>	+	+	+	+	+	33.33
		<i>Dociostaurus jagoi</i>	+	+	+	+	+	33.33
		<i>Chorthippus jucundus</i>		+				6.66
		<i>Stenobothrus stigmaticus</i>			+			6.66
	Calliptaminae	<i>Calliptamus barbarus</i>	+		+	+	+	26.26
		<i>Oedipoda caerulescens</i>			+		+	13.33
	Oedipodinae	<i>Paracinema tricolor</i>			+			6.66
		<i>Aiolopus puissanti</i>			+	+	+	20
		<i>Aiolopus strepens</i>			+	+	+	20
	Eyperepocnemidinae	<i>Heteracris lieutaghii</i>		+	+		+	20
Gryllidae	Nemobiinae	<i>Nemobius sylvestris</i>	+	+				13.33
Mantidae	Mantinae	<i>Mantis religiosa</i>		+				6.66
		<i>Sphodromantis viridis</i>		+				6.66
	Angelinae	<i>Euchomenella</i> sp		+				6.66
3	7	15	5	8	10	5	7	

(+) presence of species, (-) absence of species, Area (1) = outside the reserve polluted area, Area (2) = bordering the small Merja, Area (3) = bordering the great Merja, Area (4) = bordering the ditch, Area (5) = near the Sea.

The three common species in the five surveyed areas are *Dociostaurus maroccanus*, *Dociostaurus jagoi* and *Calliptamus barbarus*. *Dociostaurus maroccanus* and *Dociostaurus jagoi* are represented by a frequency of 33.33%, before *Calliptamus barbarus* with 26.66%. Overall,

these three species are common and also appear dominant (or co-dominant) in numerous surveyed areas. The high frequency of *Dociostaurus maroccanus* and *Dociostaurus jagoi* is explained before everything else by its *euryece* character, that is to say a large ecological amplitude. To the contrary, many species are poorly represented in the surveys, for reasons that can be quite varied. And in this case they are considered rare since their frequency (relative abundance) is comprised between 5% <AR% <25%.

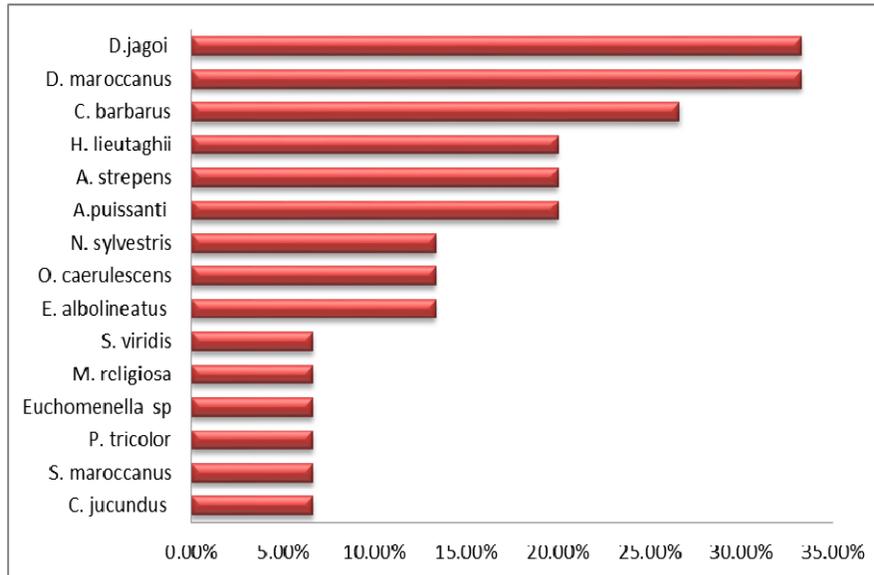


Fig 2: Histogram of the frequencies of different species of counted Orthoptera

**Diversity of harvested species in the reserve of Sidi Boughaba**

**Distribution of different Orthoptera families in the five study areas**

The distribution of different families of harvested Orthoptera in each study area, is mentioned in figure 3, we distinguish many sorts: \_

-The family of Acrididae: the most represented in the studied stations with 10 species in area 3. These species are: *Euchorthippus albolineatus*, *Dociostaurus maroccanus*, *Dociostaurus jagoi*, *Stenobothrus stigmaticus*, *Calliptamus barbarus*, *Oedipoda caerulescens*, *Paracinema tricolor*, *Aiolopus puissanti*, *Aiolopus strepens* and *Heteracris*

*lieutaghii*. This number decreases in the other stations until 4 species met in the areas 1 and 2. We have concluded that *Dociostaurus maroccanus* and *Dociostaurus jagoi* are common to all stations.

-The family of Gryllidae: represented by a single species that is *Nemobius sylvestris*\_which has met only in both areas 1 and 2.

-The family of Mantidae: is represented by three species: *Mantis religiosa*, *Sphodromantis viridis* and *Euchomenella* sp.

We have nicely noted that the family of Acrididae remains the most diverse and the richest in species in all the areas studied (Figure 3).

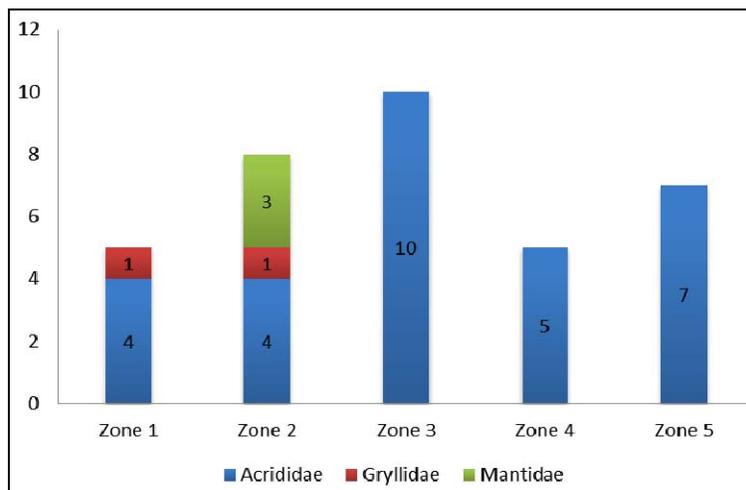


Fig 3: Specific richness of families in the function of the five stations

**Distribution of Acrididae sub-families on five areas**

In the studied areas, the family of Acrididae counts four sub-families (Figure 4), which are:

-The sub-family of Gomphocerinae: this is the most diverse with 5 species that are: *Euchorthippus albolineatus*, *Dociostaurus maroccanus*, *Dociostaurus jagoi*, *Chorthippus jucundus* and *Stenobothrus stigmaticus*. These two last species seem to be specific respectively to areas 2 and 3.

-The sub-family of Calliptaminae: is represented by a single species *Calliptamus barbarus* which it met in the areas 1, 3,

4 and 5.

-The family of Oedipodinae: is represented by 4 species: *Oedipoda caerulescens*, *Paracinema tricolor*, *Aiolopus puissanti* and *Aiolopus strepens*. We have nicely observed that *Paracinema tricolor* is subservient to the area 3.

-The sub-family of Eypreocnemidinae: that has only a single species *Heteracris lieutaghii*. We have noted that the locusts colonize very varied habitats, so their diversity depends on the nature of the environment.

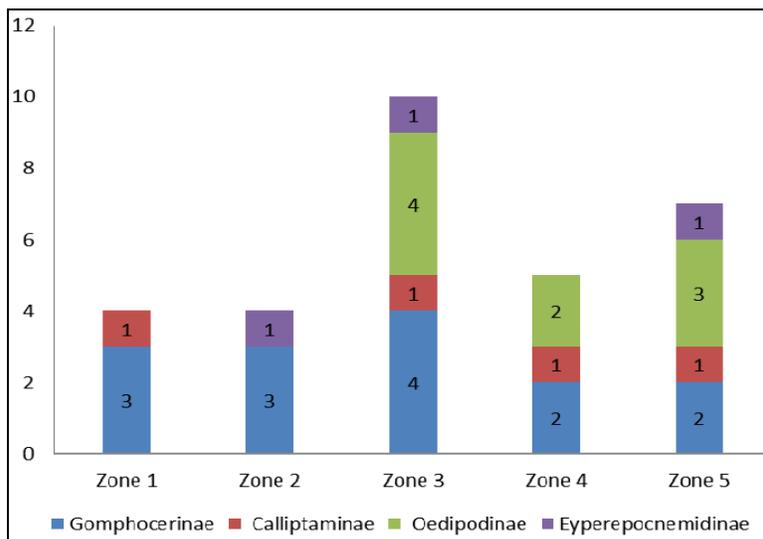


Fig 4: Distribution of species of the family Acrididae in the five study areas

**Coenotic affinity**

The dendrogram represented in the figure 5 shows three groups of species.

The first group is constituted by *Chorthippus jucundus* and *Nemobius sylvestris* whose affinity is 0.33.

The second group is composed by *Euchomenella* sp, *Sphodromantis viridis* and *Mantis religiosa*. The first two species in this group have a 1 affinity and they are connected with *Mantis religiosa* by an affinity of 0.67.

The third group is divided into three sub-groups. The first

sub-group is formed by species *Heteracris lieutaghii*, *Oedipoda caerulescens*, *Aiolopus puissanti*, *Aiolopus strepens*; the second sub-group by *Stenobothrus stigmaticus* and *Paracinema tricolor* while the third sub-group by *Calliptamus barbarus*, *Dociostaurus maroccanus*, *Dociostaurus jagoi* and *Euchorthippus albolineatus*. On the plan synecological, we have nicely remarked that *Aiolopus puissanti* and *Aiolopus strepens* are well associated between them, the same for *Calliptamus barbarus* and *Dociostaurus jagoi*.

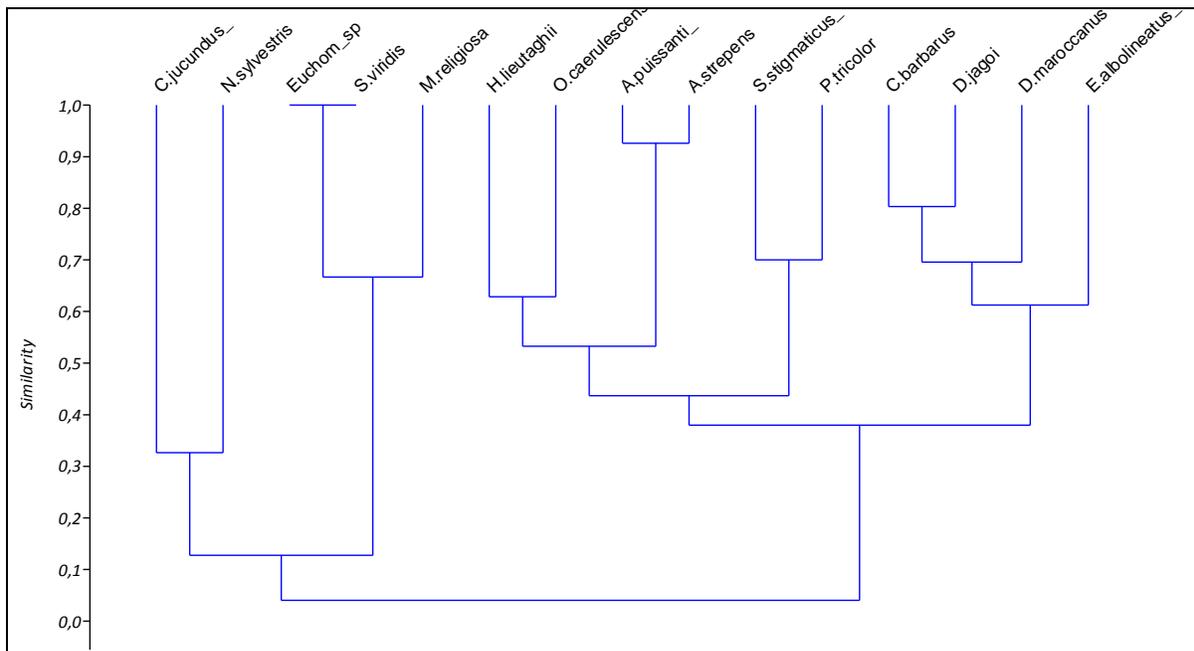


Fig 5: Dendrogram inter-species of the biological reserve of Sidi Boughaba

**Discussion**

During the harvests performed in the five areas of the reserve of Sidi Boughaba, 15 species row in 13 genera and three families (*Acrididae*, *Gryllidae* and *Mantidae*), and 7 sub-families were captured. From a rich point of view, the Gomphocerinae and the Oedipodinae come to mind with respectively 5 and 4 identified species. The latter species Gomphocerinae (*Euchorthippus albolineatus*, *Dociostaurus*

*maroccanus*, *Dociostaurus jagoi*, *Chorthippus jucundus* and *Stenobothrus stigmaticus*) and that of Oedipodinae (*Oedipoda caerulescens*, *Paracinema tricolor*, *Aiolopus puissanti* and *Aiolopus strepens*) are distributed differently across the five surveyed areas.

Their distribution shows influenced by a certain number of external factors including principally the nature of vegetation. This is in agreement with the works of Allen *et*

al.,<sup>[7]</sup> and Whitman<sup>[8]</sup> who were shown that the distribution of locusts is largely influenced by the abiotic factors (temperature, humidity, the light, the soil) and biotic (the nature of the vegetation).

According to the species, the *Orthoptera* present the ecological preferences very diverse. The species presenting a very extensive ecological habitat and therefore capable of adapting to changes in large amplitudes of environmental factors. It is the case of the *Dociostaurus maroccanus*, *Dociostaurus jagoi* and *Calliptamus barbarus* which with the exception of the area 2 share the same habitat therefore they behave like *euryece* species. By contrast, other species present a narrow ecological niche and a low adaptive capacity when the variations of ecological factors proper to its habitat, so incapable to develop only in some very specific areas<sup>[17-20]</sup>. It is the case especially the *Stenobothrus stigmaticus*, the *Chorthippus jucundus* and the *Paracinema tricolor* which behaved as the *stenoece* species.

The locusts colonize very varied habitats: from low altitude to high altitude, the tropical zones to deserts, the cultivated areas, the bare soils, the woody lands, etc. The density and the diversity of species vary depending on the type of environment<sup>[21]</sup>.

### Conclusion

At term of this study, it appears that the biological reserve of Sidi Boughaba harbors, on the weak superficies, a fauna in Orthoptera and Mantoptera relatively rich and diverse, largely related to the heterogeneity of the environment such as the soil nature of substrate, the qualitative variation in vegetation cover.

The analysis of the community as a whole has allowed us to inventory a total of fifteen species belonging to the order of Orthoptera, which should be added three species of Mantoptera (*Mantis religiosa*, *Sphodromantis viridis* and *Euchomenella* sp).

On the plan ecologic, *Dociostaurus maroccanus* and *Dociostaurus jagoi* behave as the eurytopic insects, *Stenobothrus stigmaticus*, *Chorthippus jucundus* and *Paracinema tricolor*, are the stenotopic insects.

This study, realized for the first time in the biological reserve of Sidi Boughaba, has allowed us to establish a first list of the Orthopteric biodiversity presents in the study area. This basic list can also serve a reference for the complementary studies which will subsequently be performed to study the evolution of biodiversity and know the real impact of the modifications made to the landscape on the Entomofauna.

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