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Phytophagous beetles of dunes fixed by perennial grasses from the Eastern region of Morocco

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Abstract

The present work deals with the faunistic study of the spatial distribution of the phytophagous beetles populations of the dunes fixed in the Eastern region of Morocco. Plants and insects are in constant interaction. Plants, lacking proper mobility, need insects, among other things, for their fertilization. Insects, on the other hand, use plants as a food source or shelter: place of mating, refuge or nesting.

This study is distributed from the dunes of Saïdia (North) to the great dunes of Figuig (Sahara), while passing through the intermediate dunes of the stations of Tendrara and Bouârfa. The entomological stand is dominated by the family Tenebrionidae which is the most represented and well adapted to this type of environment of extreme climatic conditions. The super family of Scarabaeoidea comes in second place and whose species are phytophages but for the majority of the coprophages attracted by the feces, also the presence of the species of the families Buprestidae, Cerambycidae, Curculionidae.. etc.

A great taxonomic richness is noted in Tendrara and Bouârfa. It is the same for the abundance whose high values are noted in the Saharan and desert stations of Figuig.

Keywords: Beetles a, fixed dunes, Eastern region, Morocco, Sahara.

Introduction

In Morocco, as in Algeria and Tunisia, the colopterological stand is the most representative entomofauna in the sandy environment. However, the majority of the work devoted to the study of this population was initially limited to establishing the systematic and geographical distribution of the various species cataloged: Antoine (1955 to 1963); Alluaude (1924); Bruneau de Mire (1958); Peyerimhoff (1943 to 1947); Pierre (1958); Kocher (1956 to 1969) and Raymond (1948).

The knowledge of the Moroccan fauna has made, for a hundred years, extraordinary progress. Its richness in beetles is remarkable because of the diversity of geographical and geological regions: Eastern Morocco, the Rifal massif which gave birth to many northern forms, the atlases, the coastal domain which extends for nearly fifteen hundred kilometers, the Atlantic steppe, the Sous and finally the Saharan and pre-Saharan regions.

Regarding the fauna of Beetles a in sandy formations and in a general way we can cite some bibliographic reference data: Bouraada and *al.* (2018), Bouraada and *al.* (2017), Bouraada and Essafi (2016), Bouraada (2016), Bouraada and *al.* (2016), Bouraada and *al.* (2015), Bouraada and *al.* (2014), Bouraada (2003), Bigot (1985), Chavanon and Bouraada (1996), Corre (1987), Greuter, Burdet and *al.* (1984-1989), Corre (1987), Jahadiez and Mayor (1931-1934), Mayor (1958-1977), Quezel and Santa (1962-1963).

Herbivorous or phytophagous insects are characterized by the fact that they feed on plants. All parts of the plant (stem, leaf, root, seed, fruit, sap, nectar, pollen) are likely to be consumed. This interaction is very profitable for the consumers because they find their energy in the tissues of the plant unlike the latter which loses energy and must find a way to compensate for these losses.

The present work constitutes the continuation of our research for a better knowledge of the entomological groupings of phytophagous beetles of the mobile dunes of Eastern Morocco (Bouraada, 1996). The surveys were concentrated on the spring period (April and May) and covered various stations in the eastern region of Morocco. This region has been chosen because it has not yet been the subject of a detailed entomological study.

I- SATATION OF STUDIES

Station S_1: Saïdia (35 ° 05 'Latitude N., 2 ° 13' Longitude W.)

Located on the Mediterranean coast 8 km east of the city of Saïdia, this station is under strong influence softening marine.

The dunes are 1 to 3 meters high and their northern slope, exposed to the sea breezes, is made of very mobile sand. Some are bright, others are partially fixed by the Oyat (*Ammophila arenaria* Link.).

Station S_2: Tendrara (33 ° 03 'Latitude N., 2 ° 13' Longitude W.)

It is located 28 km southeast of Tendrara at 1450 m altitude and is located on the northwestern edge of a vast depression limited to the north by a series of small hills and to the south by the eastern High Atlas. This large basin, with a silty substrate, undergoes, in its northwestern part, a silting due to the alteration of the underlying sandstones, sand which can locally form relatively large deposits. The dunes are usually 0.5 to 1 m high and rarely reach 2 m. Located on the hillside, they consist of mainly fixed sand with a certain proportion of silt (BOURAADA, 1996). Their summit is occupied by tufts of alfa (Stipa tenacissima L.) generally having a great development. This is more nebkhas than dunes.

Station S_3: Bouârfa (32 ° 04 'Latitude N., 1 ° 58' Longitude W.)

This station is located in the pre-Saharan zone 15 km east of Bouârfa at about 1000m altitude. As for station S2, the small dunes are rather nebkhas and are relatively few, isolated and a height not exceeding 1m. This small sandy formation is of Aeolian origin with a relatively coarser sand than that of the S2 station. It is directly exposed to the action of the wind. The summit of the nebkhas is occupied by tufts of spartum (*Lygeum spartum* L.) having a very limited development.

Station S_4: Figuig (33 ° 03 'Latitude N., 2 ° 13' Longitude W.)

This station is located a few kilometers northwest of Figuig, about 900 m above sea level. It is located at the edge of the Saharan zone, at the eastern end of a small elongated plain separating JbelsGrouz and Maïz. At its level, rocky outcrops led to the accumulation of

aeolian deposits of sand that, on their south and south-east flanks, form more or less powerful dunes from 1 to 10 m in height. Part of this sand is mobile, the other is fixed by tufts of "Drinn" (*Aristida pungens* Desf.) Which can form, in places, fairly dense stands covering even the greater part of certain dunes (especially those of small size). The studied dunes do not exceed 3 m of height and the population of Drinn is rather dense there.

For the establishment of the relationship between plants and beetles we have selected species that have a more or less close relationship with plants either for the purpose of food or shelter. At the dietary level, apart from the majority of carabids that are carnivorous entomophagous and a few rare carnivores more or less necrophagous (*Prionotheca coronata*), the majority of beetles harvested are phytophagous, scavengers, necrophages or coprophages.

Figure 1: Location of study stations
(Scale: 1/1500000)

II. Materials and Methods

Our faunistic study of beetles in eastern Morocco (Figure 1) was carried out in four sand formation stations (Figure 1b), spread over a trajectory of almost 1000 km. The first criterion of choice of stations is the fact that all these sandy formations are fixed, at least partially. We also considered geographic, climatic and accessibility parameters (Bouraada, 2003). The four stations have in common the presence of sandy formations fixed by perennial grasses having a height generally not exceeding 2 m.

For the harvest of phytophagous beetles we carried out the hunting by direct capture of beetles on the sand and on the vegetal species.

After making a general reconnaissance of the field to identify the plant groups, the samples were collected in each station in a qualitative way. Plant species recognized locally are noted, unrecognized species are harvested and returned to the laboratory and determined with the keys of Quezel and Santa (1962, 1963) and Maire (1958, 1959, 1961, 1962, 1963a, 1963b, 1964 , 1965, 1967, 1977). For some species, especially those that we could not determine, we called on botanists from the Scientific Institute of Rabat. The samples were kept in the form of a herbarium.

III. Results and Discussion

Table 1: Faunistic directory of phytophagous beetles species

Plant level / Plant species	Flower	Leaf	stem	Root
Ferula corssoniana (S2 and S3)	-	*Julodis aequinoctialis var. deserticola* (S3)	*Anthaxia nitidulaanatolica* (S2 and S3)	-
Onopordon algeriense (S2 and S3)	*Glaphyrus viridicollis, Larinus onopordi, L. cyanarae, L. ursus*	*Chitona sp., Cylindro pteruslexerii, Exochonus falviegata var. nigrepennis, Julodis onopordi.*	-	-
Aristida plumosa L. (S2)	*Exochonus falviegata var. nigripennis, Anisoplia pallidipennis.*	*Paracylindro mophuspinguis.*	*Heliotaurus quedenfeldti, H. gastrhaemoides*	-
Euphorbia guyonia(S4)	*Mordellistena parvula, Macrocoma setosa.*	-	-	-
Ononis polysperma (S1)	*Psylloides hospes, Erodius audouiniemondi*	-	-	-
Retama monosperma (S1)	*Apion hydrolapathi*	-	-	-
Lotus creticus(S1)	*Erodius audouiniemondi, Tentyria maroccana (consomateurs occasionnels)*	-	-	
Anthemis arvensis (S1)	*Tropinota squalida, Helitaurus plenifrons.*	-	-	
Senecio leucanthemifolius (S1)	*Psilotrix inflata*	-	-	-
Ononis variegata (S1)	*Tentyria maroccana (occasional consumer)*	-	-	-
Launea arboresens (S4)	*Mylabris circumflexa var. subangulata, M. wartmanni, M. litigiosa, M. sanguinolenta, M. fulgurita* and *M. menthae*	-	-	-
Pituranthes chloranthus (S4)	*Adonia variegata*	*Macroco mahenani*	-	
Echium pycnanthumtrygorrhizum (S4)	*Erodius zophosioides (occasional consumer)*	-	-	-

Most Tenebrionidae feed on dry plant debris (leaves, stems, glumes ...) or fresh. Scarabaeoidea are either coprophages or phytophagous. Adults of these are often florid and feed on flowers, stamens or seeds of plants. They are therefore installed at the top of the plants, at the end of the flowering or fruiting stems (*Anisoplia pallidipennis* on *Aristida plumosa*, *Dicronoplia deserticola* on *Aristida pungens*, *Hymenoplia* sp., On *Stipa tenacissima*, *Glaphyrus viridicollis* on *Carduaceae* ... etc.) (Figure 2 and Figure 3). This behavior is found in some species of occasionally granivorous Tenebrionidae (*Erodius zophosoides* observed on the ears of grass *Cutaudia dichotoma*). In addition, we list other phytophagous species for which we have collected data on their location on plants.

Figure 2, Some phytophagous beetles species

Several species can cohabit on the same plant and sometimes even on the same part of the plant and at the same time. Thus, both *Buprestidae Acmaeodera lanuginosa* and *Anthaxia nitidulaanatolicaferulae* Géné) and *Cerambycidae Agapanthia irrorata* all have "xylophagous" larvae that tunnel into the stems of the Umbellifera Ferula corsoniana, which are abundant in Tendrara and Bouârfa. . Their coexistence means that they do not occupy the same ecological niches in these stems (different development cycles, different position of the larvae inside the stem, different location of these larvae along the stem ... etc.).

Figure 3, Some dune plant species

Similarly, *Curculionidae Larinus cyanarae*, L. *onopordi* and *L. ursus*, all related to *Carduaceae Onopordon algeriensis*, are located on different parts of the plant and therefore do not compete.

Moreover, some with the same food spectrum, we can see that the rhythm of activity can be shifted during the diurnal cycle : some species are diurnal (eg*Pimilia*), others nocturnal (eg *Scaurus*) which allows their coexistence at the expense of the same food resource. In other cases, the life cycle is shifted to the seasonal level which is the case of *Alleculidae* and *Meloidae*. Pierre (1958) has shown that it is possible to meet on the grass *Aristida pungens* Dest., A more or less close connection between plant and insects.

We tried to establish the same thing with the grasses fixing our dunes and the fauna encountered on these plants. Thus on *Ammophila arenaria*, one can recognize as species most met *Meligetes elongatus* and *Nesocaedius pardoi* ... etc. For *Stipa tenaccissima*, we can recognize as the most plant-related species :*Exochonus falviegata* var. *nigripennis*, *Mylabris circumflexa*, *M. fulgurita*, *Stenaliastipae*, *Hymenoplia* sp., *Mylabris myrmidon* I, etc. On *Lygeum spartum* no beetles were found on the aerial parts of this plant. On *Aristida pungens*, *Mylabriswartmani*, *M. rubripes*, *Ammocleomushiero glyphicus*, *Paracylindromorphus pinguis* and *Exochonus falviegata* var. *nigripennis* and *Dicronoplis deserticola*. These faunistic elements do not seem to be for the most insects really harmful to the plant which shelters them.

In Saïdia many foreign species visiting the dunes episodically. They come from different places including the forest of Eucalyptus and they are mainly floricoles or scavengers that seek their food there but do not affect their life cycle.

The plant population contributes, by its density and by its composition, to create many micro habitats with varied ecological conditions and where many species can, without competing with each other, find living conditions that meet their biological requirements.

Plant-insect interactions are the various types of relationships between plants and insects. Thus in natural ecosystems, plants and insects are some of the living organisms that interact continuously in a complex way. Thus, the plants provide shelter, a nesting site and food for the insects, the latter participate in the pollination or the defense of the plants. Other insects feed directly on the sensitive organs of plants, reducing their ability to reproduce and their chances of survival.

Indeed, pollinating insects, moving from one flower to another, ensure the transport of pollen. It is therefore a relationship of mutualism between the insect and the plant where each participant makes a profit. As examples, there are phytophagous beetles (ladybugs, beetles ...), also several other types of pollinating insects such as *hymenoptera* (bees, wasps, bumble bees ...), *lepidoptera* (butterflies), or still the *Diptera* (flies, hoverflies ...). The plant provides the latter with food and in return, some insects contribute to the dispersion of the seeds of this plant. As far as host plants are concerned, insects do not interact with plants only for their food but also to take refuge, lay and reproduce. The vast majority of phytophagous insects are oligophagous and feed on a limited number of species belonging to one or more genus or family of plants. Monkeys, on the other hand, eat at the expense of a single botanical species and are by far the most selective, guided by the presence of allelochemicals in the plant.

Conclusion

The insect plant relationship shows a great dependence between the fauna and flora of the fixed dunes exploited either for the purpose of the search for food, shelter or nesting place which has highlighted the specificity of the link between the insect and the plant. Insects xylophagous living in galleries, in living or decomposing tree trunks can also be seen.

In addition to entomophilous pollination is the fertilization of plants through insects, in the presence of a mutualism relationship between the insect and the plant where each participant derives a benefit. The plants provide shelter, a nesting site and food for the insects, the latter participate in the pollination or defense of the plants. The basic knowledge of the ecology and biology of phytophagous insects is the foundation for the successful use of alternative control methods such as biological control, which is a key element of the concept of integrated plant pest management.

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