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Endogenous fauna of Beetles in sand and organic matter in the dunes of Eastern Morocco

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Abstract

The present work relates to a continuation of the studies of the abiotic factors which influence the spatial distribution of the stand of the beetles of the mobile dunes and in particular the organic matter of the surface at the depth of these sands at the level of the dunes of eastern Morocco from the dunes of Saïdia (North) to the large dunes of Figuig (Sahara), while passing by the dunes of the following stations: Tendrara and Erfoud on a trajectory of almost 400km. We noted in general, an increasing gradient from surface to depth and related mainly to the vegetation of the dunes, contribution of leaves and branches from reforestation bordering and faeces of the many herds that roam these dunes. The variation of the organic matter goes in the same direction as the variation of the density of the endogenousfauna of the sands, more than one sinks in the sand read that the organic matter decreases and the density of the beetles decreases also. In Saïdia, the dunes are distinguished from sands by their high content of organic matter linked to the contributions already mentioned, but also to the presence of plant fragments from sea leashes, waste and detritus left behind by the many summer visitors, however the lower densities of the endogenous species noted in this station of Saïdia are linked mainly to the presence of larvae and strictly sabuli cultural species.

Keywords: Beetles, organic matter, Eastern of Morocco, sands, density, endogenous fauna.

Introduction

In terms of sandy formations, the beetle stand is the most representative entomofauna in the sandy environment. However, the majority of the work devoted to the study of this settlement was limited at the beginning to establishing the systematics and the geographic distribution of the different cataloged species (Antoine, 1955, 1957, 1959, 1961, 1962, 1943; Alluaude, 1924, Bernard , 1964; Bruneau de mire¸ 1958; Cassola, 1973, Chessel and *al*., 1975; Espanol, 1951; Joly and *al*., 1951; P. de Mire, 1947; Peyerimhoff, 1923, 1925a, 1925b, 1943, 1947a, 1947b, Pierre, 1958, 1950, 1954;… ..etc.). Chavanon and *al*., 1995, Bouraada, 1996; Bouraada and *al*.; 2015; Dubief, 1943; Reymond, 1950;… . etc.

Then, these works were supplemented progressively by numerous researchers, amateurs or professionals, who worked since on the various families of this order. Very few of these works have concerned an in-depth ecological study specific to Sabulicoles. In Europe, several research works have attempted to solve the ecological problems of this faunistic group and among them: Chavanon and *al*. (1995), Bouraada (1996), Chavanon (2001), Maachi and Radouani (1993), Bouraada and *al*. (2016a), Bouraada and Essafi (2016b), Bouraada and *al*. (2015), Brun (1968), Bruneau de mire P. (1958), Cassola, (1973), Chavanon and *al*. (1995), Chessel and *al*. (1975), Dubief (1943), Joly and *al*. (1951), Peyerimhoff (1923,1925a, 1925b, 1943, 1947a, 1947b, 1950).

The formation of these dunes is a consequence of the desertification of the environment. This is above all linked to an irreversible reduction of the plant cover leading to the denudation of the soil (Fig. 1). Bare soil is prey to wind erosion. This desertification ultimately manifests itself in a new distribution of the soil. The loose part is carried away by deflation and accumulated elsewhere in the form of dunes for the sandy fractions, and in the form of loess for the silty and clayy fraction. On the ground thus stripped comes then accumulates, under the combined action of the relief, the wind,…., Sandy deposits of exogenous origin which, gradually, constitute mobile dunes. The best sandy fixers of exogenous origin which, gradually, constitute mobile dunes. The best fixers seem to be local grasses like Drinn (*Aristida pungens*) and very locally, alfa (*Stipa tenacissima*) as well as various shrubs or bushes. The dunes of the Sahara are only the result of the accumulation of sands torn away by river and wind erosion, the trampling of herds and excessive clearing.

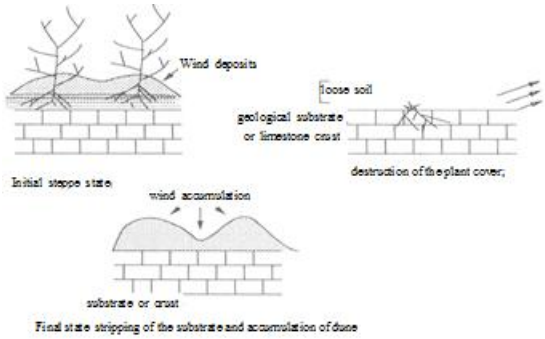

Figure 1, Desertification and dune formation process

This present work constitutes the continuation of our research for a better understanding of the entomological groupings of beetles in the dunes of eastern Morocco from the coast to the Sahara (Saïdia, Tendrara, Bouârfa and Figuig). It thus extends our previous study (Bouraada, 1996).

In this work, we will limit ourselves to treating and deepening the points which seem interesting and on which general data are necessary.

I) Description of the stations studied

Distributed over a trajectory of almost 400km, for the choice of our 4 stations we took into account various criteria. The first is the fact that all of these sandy formations are at least partially mobile. We also chose these stations according to geographic, climatic and accessibility parameters.

The present work concerns the faunistic study of the spatial distribution of the population of beetles in the mobile dunes of the northern fringe and the Eastern region of Morocco from the dunes of Saïsia (North) to the large dunes of Figuig (Sahara), while passing by the dunes of the following stations: Tendrara and Erfoud (Bouraada, 2003). (Figure 2).

I-1) Station S_1: Saïdia

The station of Saïdia is located on the Mediterranean coast 8 km east of the city of Saïdia, this station is under strong softening marine influence with Lambert coordinates of 35 ° 05 'Latitude N. and 2 ° 13' Longitude W (Figure2). The dunes are 1 to 3 m high and their northern slope, exposed to sea breezes, consists of very mobile sand. Some are alive, others are partially fixed by the Oyat (*Ammophila arenaria* Link.)

I-2) Station S_2: Tendrara

With Lambert coordinates of 33 ° 03 'Latitude N.; 2 ° 13 'Longitude W. Altitude 1460m this station is located in the pre-Saharan area 35 km north-west of Bouârfa. The small dunes which form this station are rather Nebkhas and have a height not exceeding 1m.

These sandy formations consist mainly of sand resulting from the degradation of the underlying sandstone formations and relatively less coarse than that of the Bouârfa station. They are relatively little exposed to the action of the wind. The top of the Nebkhas is occupied by tufts of alfa (*Stipa tenacissima* L.) with very limited development.

I-3) Station S_3: Bouârfa

This station is located in the pre-Saharan area 20 km east of Bouârfa. The small dunes, rather nebkhas, are relatively few, isolated and their height does not exceed 1m. With Lambert coordinates of 32 04 'Latitude N., 1 ° 58' Longitude W. Altitude: 1000 m. This small sandy formation consists mainly of relatively coarse Aeolian sand. It is directly exposed to the action of the wind. Vegetation is represented by a few feet of *Lygeum spartum*.

II-4) Station S_4: Figuig

This station is located 2 or 3 kilometers north-west of Figuig, at an altitude of around 900M. It is located on the edge of the Saharan zone, at the eastern end of a small elongated plain separating Jbels Grouz and Maïz. With Lambert coordinates of 32 ° 07 'Latitude N.; 2 ° 14 'Longitude W. Altitude: 900m. At its level, rock outcrops have allowed the accumulation of aeolian deposits of sand which, on their south and south-east flanks form more or less powerful dunes of 1 to 2 md height covered with a fairly dense formation of *Aristida pungens*.

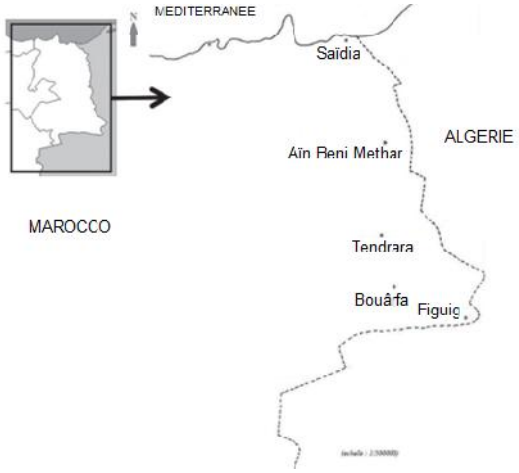

Figure 2 : Location of study stations
(Scale: 1/1500000)
(Bouraada, 1996)

II. Materials and Methods

For organic matter, the sand samples were taken at the four stations on the surface of the dunes and at a depth of 15 cm and 30 cm. They dried in the laboratory at 45 ° C for 48 hours. The organic matter was evaluated by calcination in an oven at a temperature of 600 °C. for 2 hours. The results are expressed as a percentage of the weight of organic matter relative to the initial weight of dry sand. Three samples were assayed for each depth (Bouraada, 1996).

For the fauna in question the sampling method consists of sieving, this harvesting technique is mainly intended for the study of burrowing beetles, especially larvae, and consists in sieving a determined volume of sand (50 dm3 in general, Bouraada, 1996) with a 2 mm mesh screen to let through only the grains of sand. We used this method for two purposes: Collecting larvae and locating buried fauna and Determining the density of harvested burrowing species. We practiced sight hunting by direct capture of beetles inside the sand.

III. Results and Discussion

The organic matter contents for all the stations are always lower than 3%, in general of the order of 2% to 3% in all the stations (Figure 3). This parameter has lower values, this is certainly due to the low abundance of the plant cover.

The organic matter content increases slightly with the depth in all stations, while it is constant beyond 15 cm and remains constant at Figuig. From the start in Saïdia, the dunes are distinguished from sands of other stations by their high organic matter content (30%) between 2.5% and 3%. This great wealth is linked to various contributions: plant fragments from sea leashes (Gehu and al. 1987), dune vegetation, contribution of leaves and branches from reforestation bordering the south of these dunes but also waste and detritus left behind by the many summer visitors and faeces from the many herds that roam these dunes.

In the entomological inventory, we inventoried 199 taxa represented by 5207 individuals and distributed in 34 families of unequal importance (Bouraada, 1996). The capture of *Tentyrialongicollis* luca at Figuig confirms the presence of this species on Moroccan territory. On the other hand, many other species are new to the region or have their regional range enlarged.

The entomological population is dominated by the family of Tenebrionidae which is the best represented and well adapted to this type of environment of extreme climatic conditions. The super family of Scarabaeoidea comes in second position and whose species are mostly coprophages attracted by faeces. The great taxonomic richness is noted in Tendrara, Figuig and Bouârfa. The evolution of this wealth follows a growing North-South geographic gradient. The same is true for abundance, the high values of which are noted in the Saharan and desert stations: Figuig and Tendrara. In addition, the highest densities of endogenous fauna are recorded in Figuig, Tendrara and Bouârfa, which more or less goes hand in hand with the evolution of the high abundance of beetles noted in these stations. Conversely, the lowest densities are obtained in Saïdia. The diversity and fairness show that it is a poorly diversified, moderately structured, unbalanced and unstable population. These settlements, like the environment which hosts them, are therefore specialized (Bouraada, 1996). Regarding *Scarabaeinae*: *Scarabaeus (Scarabaeus) sacer* Linnaeus, 1758; *Scarabaeus (Ateuchetus) semipunctatus* Fabricius, 1792; *Scarabaeus (Mesoscarabaeus) bannuensis* Janssens, 1940; *Bubasbubaloides Janssens*, 1938; *Onthophagus (Euonthophagus) bede* liReitter, 1891; *Pentodonalgerinumalgerinum* Herbst, 1789; Regarding *Tenebrionidae*: *Erodius (Dirosis) brevicollis* Kraatz, 1865; *Erodius (Zophoserodius) zophosoides* Allard, 1865 (lat.); *Erodius (Dimeriseis) bicostatusbicostatus* Solier, 1834; *Erodius (Dimeriseis) exilipes* Lucas, 1858; *Zophosis (Septentriophosis) bicarinatamagistrettii* Koch, 1941; *Zophosis (Hologenosis) nigroaenea*Deyrolle, 1867; *Mesostena (Mesostena) angustata* Fabricius, 1775 (s.lat.); *Tentyrinalongicollis* Lucas, 1855; *Tentyrinasenegalensis* Solier, 1835; *Scaurus sanctiamandi*Solier, 1838; *Scaurus vicinus* Solier, 1838; *Pimelia (Pimelia) angulatalesnei* Peyerimhoff, 1911; *Pimelia (Pimelia) subquadratavaldanii*Guérin-Méneville, 1859(Figure 4).

This organic matter is an important factor conditioning the population of beetles. Thus in Saïdia, Tendrara and Bouârfa, its high value can encourage the installation of living in the sand, detritivores, coprophages ... etc.

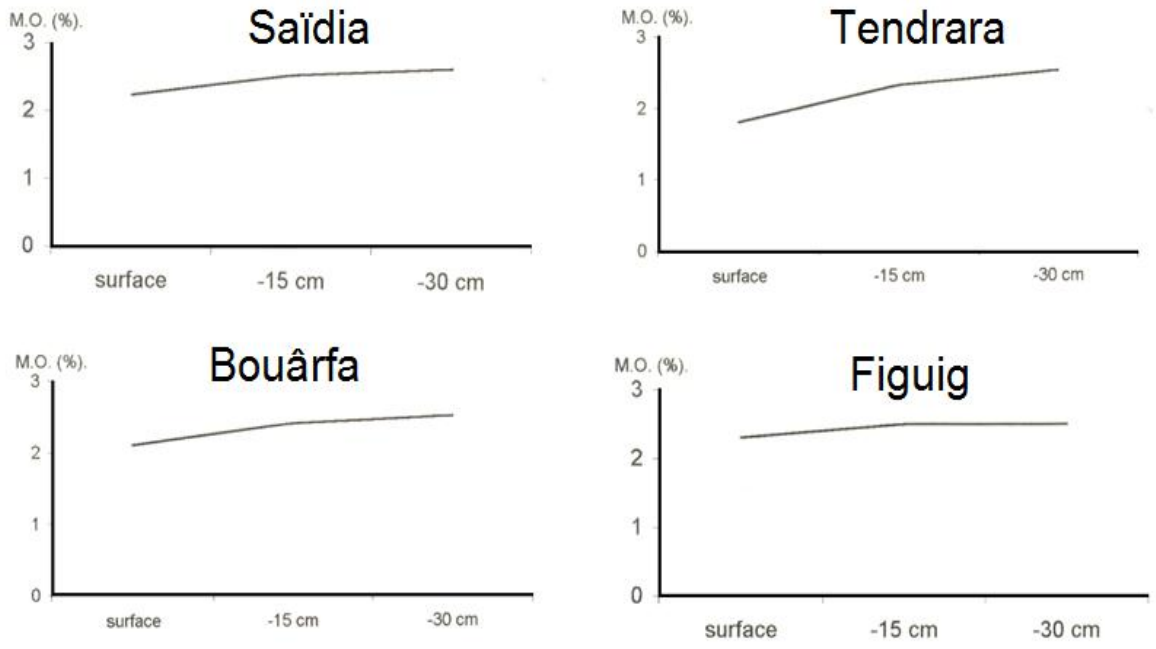

Figure 3, percentage of organic matter at different levels of the sands studied

The highest densities of endemic fauna are recorded in Tendrara and Bouârfa. However, the lowest values are obtained in Saïdia. Between these two extremes are the Figuig stations (Figure 3).

Figure 4 :*Tentyrina senegalensis* Solier

The values of this parameter are relatively low, this has to do with the small size of the mobile dunes, the existence of impermeable loamy soil, the low frequency of surveys, the low cover vegetation, etc.

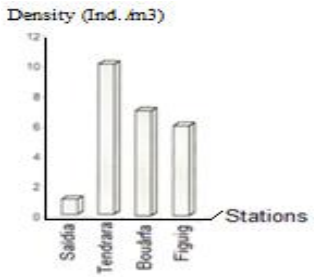

Figure 5: spatial variation of the density of species.

In addition, the values of this parameter although lower remain nonetheless non-negligible in particular in Tendrara. Spatial variations in the density of sand fauna go in parallel with the variation in the parameter of taxonomic richness (Bouraada, 1996). In fact, the majority of the aboveground fauna is represented by insect larvae, notably beetles. The rise of these larvae which, for the rest of the year, would be deeper, can be linked to several causes such as the increase in soil moisture linked to spring rains, the appearance, at shallow depth, of roots of annual plants, rise in surface temperature, etc. In addition, the presence of significant endogenous fauna during hot days is partly linked to the presence of epigeous individuals which sink into the ground in search of a more temperate micro-climate (Figure 4), the larvae themselves -same being buried deeper in search of humidity (Bouraada, 1996).

The present study has shown us that the entomological settlement of dunes is formed by species unequally distributed in the different families that group them.

In the stations surveyed, the entomological population is dominated by the family of Tenebrionidae which is the best represented and well adapted to this type of environment with extreme climatic conditions. The super family Scarabaeoidea comes in second position and whose species are mostly coprophages attracted by faeces (Bouraada, 1996).

Constant species proliferate in very abundant populations. The least abundant and least frequent species are the accidental and exogenous species. The great taxonomic richness of the Tendrara, Figuig and Bouârfa stations in these groups of taxa is mainly linked to the presence of favorable conditions (temperature, humidity, organic matter, etc.) where they find a more favorable environment for their development.

The highest densities of endogenous fauna are recorded in Figuig, Tendrara and Bouârfa, which more or less goes hand in hand with the evolution of abundance. Conversely, the lowest densities are obtained in Saïdia and this is due to the presence of the endogenous species consists mainly of larvae and strictly sabulicultural species, it is relatively low (between 1 and 10 ind./m3). Indeed, the variation in organic matter goes in the same direction as the variation in the density of the endogenous fauna of the sands, the more we sink into the sand when the organic matter decreases and the density of the beetles also decreases. These groups of taxa are mainly linked to the presence of favorable conditions (temperature, humidity, trophic sources, etc.) which allow them to flourish well (Figure 5). These stands, poorly structured, are under the direct dependence of extremely rigorous environmental factors.

Conclusion

This study allowed us to distinguish that organic matter as an abiotic element has a relatively important influence on the distribution and presence of burrowing beetle species in the sand. Indeed, we have noted in general, an increasing gradient from surface to depth and linked mainly to the presence of favorable conditions (temperature, humidity, trophic sources, etc.) allowing them to flourish well. The variation of the organic matter goes in the same direction as the variation of the density of the endogenous fauna of the sands, more that one sinks in the sand read that the organic matter decreases and the density of the beetles decreases too. In Saïdia, the dunes are distinguished from sands of other stations by their high content of organic matter linked to various contributions: plant fragments from sea leashes, dune vegetation, contribution of leaves and branches from reforestation bordering the South of these dunes but also waste and detritus left behind by the many summer visitors and faeces of the numerous herds that roam these dunes, however the lower densities of the endogenous species noted in this station of Saïdia are mainly linked to the presence of larvae and strictly living in the sand species.

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