

Diversity Of Coleoptera Associated With “*Retama Reatam Webb.*”, Planted For The Fixation El Mesrane Dune Cordon (Djelfa-Algeria)

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Received: 08-02-2025

Accepted: 10-09-2025

Abstract

The study of beetles associated with retame "*Retama reatam Webb*" was conducted in the plantation in El Mesrane (wilaya of Djelfa, Algeria), carried out 31 years earlier as a means of fixation, this region is characterized by an arid climate with cool winters. The research work was carried out in 2022 in two stations, using Barber pots to trap the beetles. A total of 527 individuals were recorded, representing 38 species of beetles: 15 species of Tenebrionidae, 14 species of Carabidae, 4 species of Chrysomilidae, 3 species of Curculionidae and 2 species of Scarabaeidea.

Keywords: Coleoptera, Retame, Diversity, Barber pots, El Mesrane, Djelfa, Algeria.

INTRODUCTION

The Algerian steppe represents an environment of significant natural wealth, yet, it has undergone intense degradation for several decades, this necessitates the study of its genetic resources, both plant and animal, to ensure the protection and conservation of these ecosystems. *Retames* species are shrubby legumes, with pharmacological and ecological interests. They have a diverse geographical distribution ranging from the Mediterranean coast to semi-arid and arid regions, and are natural means of combating desertification. According to Guerrache (2010), in the region of El Mesrane, *Rétames* plantations have given very important results in fixing inter-dunes, mid- and lower slopes and regeneration by stump shoots. It resists wind erosion well with a success rate of 90%. While research has focused on the anatomy, histology and biochemistry of stems, leaves and branches, limited studies have explored its role in supporting arthropod diversity, particularly coleoptera. This study investigates the beetle fauna associates with *Retama reatam Webb* planted as part of the El Mesrane dune fixation project.

MATERIAL AND METHODS

Study Region

This study was conducted in the Zahrez Gharbi plain which is presented in the form in the El Mesrane region, Djelfa. This area was the subject of a dune fixation test project of the I.N.R. F. (Forestry Research Institutes, Djelfa station). The El Mesrane site is located in the commune of Hassi-Bahbah, approximately 30 km north of Djelfa, and 20 km south of Hassi-Bahbah. It is bordered; to the north by the Sebkhah; to the south by the Ouled-Nail mountains; to the east by the dune cordon; to the west by national road no. 01. The stations chosen for our study must be homogeneous from a pedological and floristic point of view. The study was extended over a period when all the factors (insect, vegetation, climate) were combined. The study region is characterized by a dry period of nine months. The climagram of Emberger (1955), places the region of El Mesrane in the arid bioclimatic stage with a thermal variant Cool Winter.

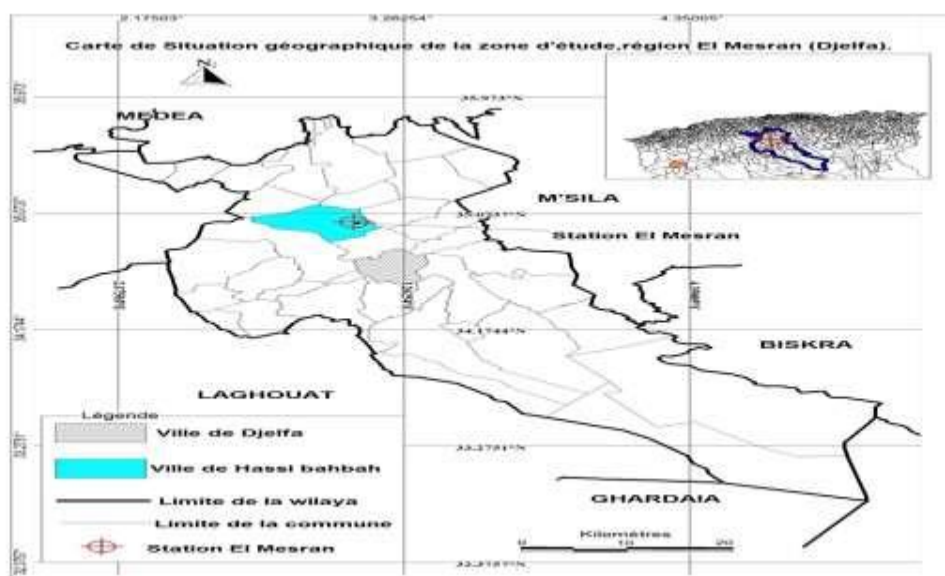


Figure 1 : Geographic location of the study area, El Mesrane region (Djelfa, Algeria). (HCDS, 2013)

Sampling sites

Two stations were selected :

Station 1: Located 38 km from Djelfa, this site is near the Hassi Bahbah-Djelfa national road. It features dune relief and is dominated by *Retama*. The altitude is 876.1 m.

Station 2: this site, located 1.5 km from station 1, is also dominated by *Retama* plantations and has an average altitude of 879.5 m.

Sampling method

The most effective trapping method adopted to study soil insects is the Barber pot trap. This type of trap is a tool for the study of medium and large-sized arthropods. It mainly allows the capture of various walking arthropods: beetles, springtail larvae, spiders, diplopods as well as species carried by the wind (Allan et al., 1996).

The lower part of the pot is sunk into the ground with its opening on its surface so that the beetles fall randomly during their movement. The principle of the buried pot is to place a bait or a toxic substance in order to kill the invertebrates that fall into it. We used formalin (methanol polymerized in water) titrated at 4% as a toxic substance (Khelil, 1992). The observation of the individuals was done with a binocular microscope. Species determination was based on Perrier's key (1961) and Baraud's key (1987) for Scaraboidae.

For the bionumerical analysis, we calculated ecological indices (richness, dominance, Shannon index, Simpson index and evenness). In order to understand the distribution of species in the study stations, we used DCA (Detrended Correspondence Analysis) and Euclidean distance, performed by Past.1.81 software (Hammer et al., 2001)

RESULTS

Inventory.

The results of the inventory of beetles associated with *Retama reatam* Webb carried out during the year 2022 in the Zahrez Gharbi plain (Djelfa) are reported in the following table 1.

Table 1 - List of beetle species listed on Retam in the El-Mesrane region (Djelfa).

Entomological family	Species
	<i>Adesmia</i> sp.
	<i>Adesmia metallica</i> (Klug, 1830)
	<i>Adesmia microcephalla</i> (Solier, 1835)
	<i>Blaps</i> sp.
	<i>Blaps gigas</i> (Linné, 1767)

Tenebrionidae	<i>Erodius zophoides</i> (Llard),
	<i>Erodius</i> sp.,
	<i>Sepidium multispinosum</i> (Solier, 1843),
	<i>Pimelia</i> sp.
	<i>Pimelia mauritanica</i> (Solier, 1836)
	<i>Pimelia simplexe</i> (Solier, 1836)
	<i>Pimelia pilifera</i> (Reitter)
	<i>Scaurus sancti amandi</i> (Solier, 1838).
	<i>Gonocephalum perplexum</i> (Lucas, 1849)
	<i>Zophosis</i> sp.
Carabidae	<i>Amara rufescens</i> (Dejean, 1829)
	<i>Calathus mollis</i> (Marshan,1802)
	<i>Calathus encaustus</i> (Fairmaire, 1868)
	<i>Calathus</i> sp.
	<i>Microlestes luctuosus</i> (Holdhaus, 1904)
	<i>Microlestes levipennis</i> (Lucas, 1846)
	<i>Scarites striatus</i> (Dejean, 1825)
	<i>Pristonychnus</i> sp.
	<i>Cymindis setifensis</i> (Lucas, 1842).
	<i>Anthia sexmaculata</i> (Linné, 1758)
	<i>Sphodrus leucophtamus</i> (Fabricius, 1787)
	<i>Zabrusdistinctus</i> (Lucas, 1842)
	<i>Graphipteruserrator</i> (Forsk, 1775)
Curculionidae	<i>Tentyria thunbergi</i> (Stevens, 1829)
	<i>Othiorrhynchus cribricollis</i> (Gyllenhal, 1834)
	<i>Brachycerus pradiieri</i> (Fairmaire,1856)
	<i>Hypera variabilis</i> (Herbst, 1795)
Chrysomelidae	<i>Sitona longulus</i> (Gyllinhal,1834).
	<i>Chrysomella</i> sp.
	<i>Chaetocnema</i> sp.
Scarabaeidae	<i>Adimonia cicumdata</i> (Obert, 1874).
	<i>Aphodius erraticus</i> (Panzer, 1798)
	<i>Rhizotrogus pallidipennis</i> (Blanchard, 1850).

A total of 527 insect individuals were counted. This Coleopteroid entomological diversity represents 38 species and five families. That of the Tenebrionidae predominates with 15 species or 39.47% of the total number, it is followed by the Carabidae with 14 taxa (36.84%). The Curculionidae come in third position with 04 species (10.53%). The Chrysomelidae group three species (7.89%) and the Scarabaeidae two taxa (5.26%)(Fig.2).

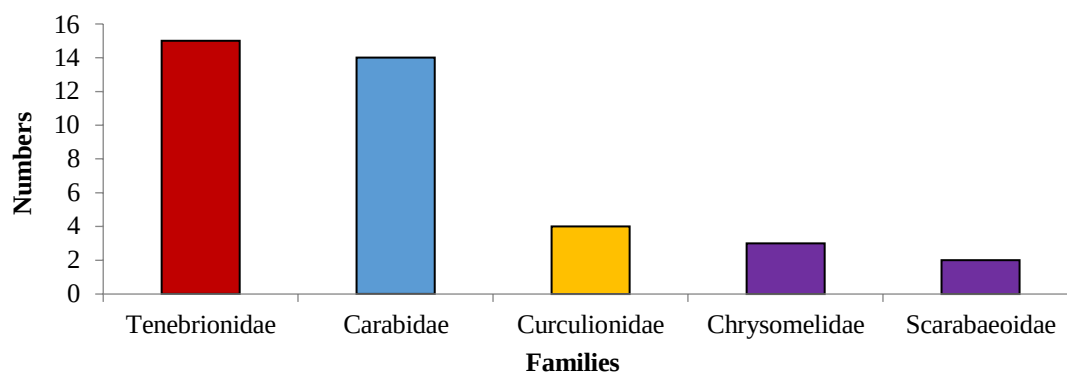


Figure 2 - Importance and distribution of beetles listed by taxonomic family

Relative abundance of Coleoptera by study site

The results of the abundance of Coleoptera illustrated in Figure 2 show that at station 1, the Tenebrionidae predominate and show intense activity. They display a rate of 47%. They are followed by the Carabidae with 28%, then come the Curculionidae with 13%. Finally, the Chrysomelidae and the Scarabaeidae are less represented in the station and record a rate of 6% for each family. For the case of station 2, almost the same proportions were recorded. It is still the Tenebrionidae that predominate with 48% of the total population. The Carabidae occupy the second position with 22%, they are followed by the Chrysomelidae and the Scarabaeidae which record 11% for each family. In last position come the Curculionidae with a rate of 8%.

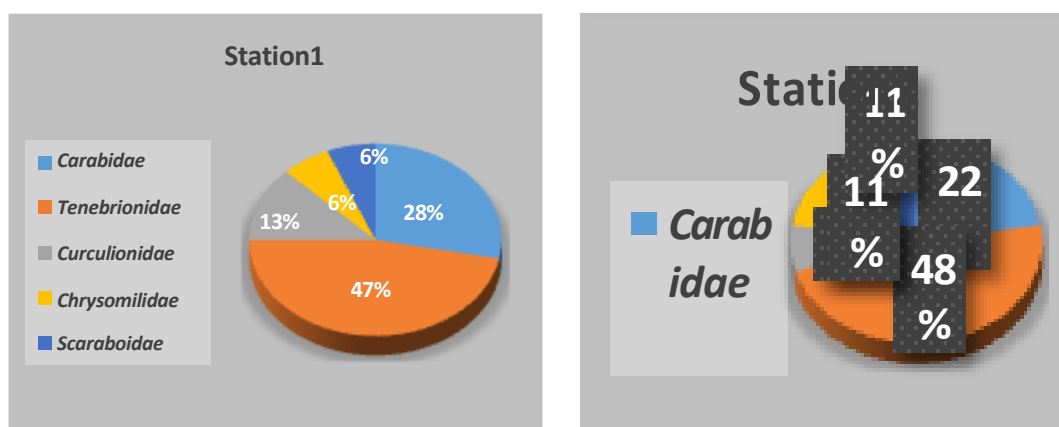


Figure 3 - Proportions of the different families of Coleoptera associated with Retama reatam in the two study stations at El-Mesrane (Djelfa)

Statistical analysis

In order to characterize the specific diversity of the beetle populations listed in the two study sites, we calculated several ecological parameters: specific richness, dominance, Simpson index, Shannon index (H') and equitability index (E). The results are reported in Table 2.

Table 2 – Measurements of diversity indices of beetle species in the two stations of El – Mesrane (Djelfa)

Ecological index	Station1	Station2	Average
Richness_(S)	28	26	27
Dominance (D)	0.063	0.095	0.079
Simpson index(1-D)	0.936	0.904	0.920
Shannon index_(H)	2.977	2.673	2.825
Equity (E)	0.893	0.820	0.857

The dominance is presented by an average of 0.079, the average Shannon index for the order of Coleoptera is 2.825 bits, The values found reflect a more or less faithful image of the reality of the study area (El-Mesrane) prospected.

For all species, the Shannon diversity index in each station varies between 2.673 bits at station 2 and 2.977 bits for the first station. These values are generally acceptable, because they are greater than 2 bits. When the diversity index is less than 2, the diversity is considered low. We speak of average diversity, when the index is between 2 and 3 bits, and high diversity when the Shannon index is between 4 and 5

The Simpson index is the probability that two randomly selected individuals belong to the same species in a population. The closer it is to 1, the more homogeneous the population. For the case of our work, we noted an average of 0.936 bits for station 1 and the value of 0.904 bits for station 2. The value of station 1 is the highest. Both values are close to 1 so the population of beetles of the two stations is homogeneous.

In general, the equitability is 0.890 for station 1 and 0.820 for station 2, both values tend towards 1. In this case, we say that the population is represented by a number of close individuals, for all species and that there is no species that dominates in the study sites

Bio-numerical analysis of the results for the collected species

Figure 3, obtained by the analysis (DCA) represents the distribution of all the collected species of the order Coleoptera in the two stations of El -Mesrane (38 species):

Axis 2 shows a contribution of 29.33%. In the positive part of this axis, we have the species of station 1: *Sitona* sp. with 2 individuals, *Pristonychnus* sp with 3 individuals, *Adimonia* sp, *Cymindis setifensis*; *Othiorrhynchus cribricollis* and *Graphipterus serretor*. The species of station.2 are in its negative part.

Axis 3 has a contribution of 30.38%. We noted that station.2 is placed in its negative part which is characterized by the presence of the following species; *Erodus* sp with 9 individuals, *Calathus* sp3 with 12 individuals, *Chaetocnema* sp with 4 individuals and finally *Aphodius* sp. with 7 individuals and *Zophosis* sp. with only one individual.

The dendrogram shows that the Euclidean distance between species for Coleoptera (Fig. 4), opposes two classes; each class is divided into two large groups with a similarity of 95%. These two groups are, subsequently, distributed; one in 5 lots and the other in 3 lots. 7 species are side by side with a similarity of 50%, while the other, forms 27 species. The two groups are attached with a total similarity of 30%

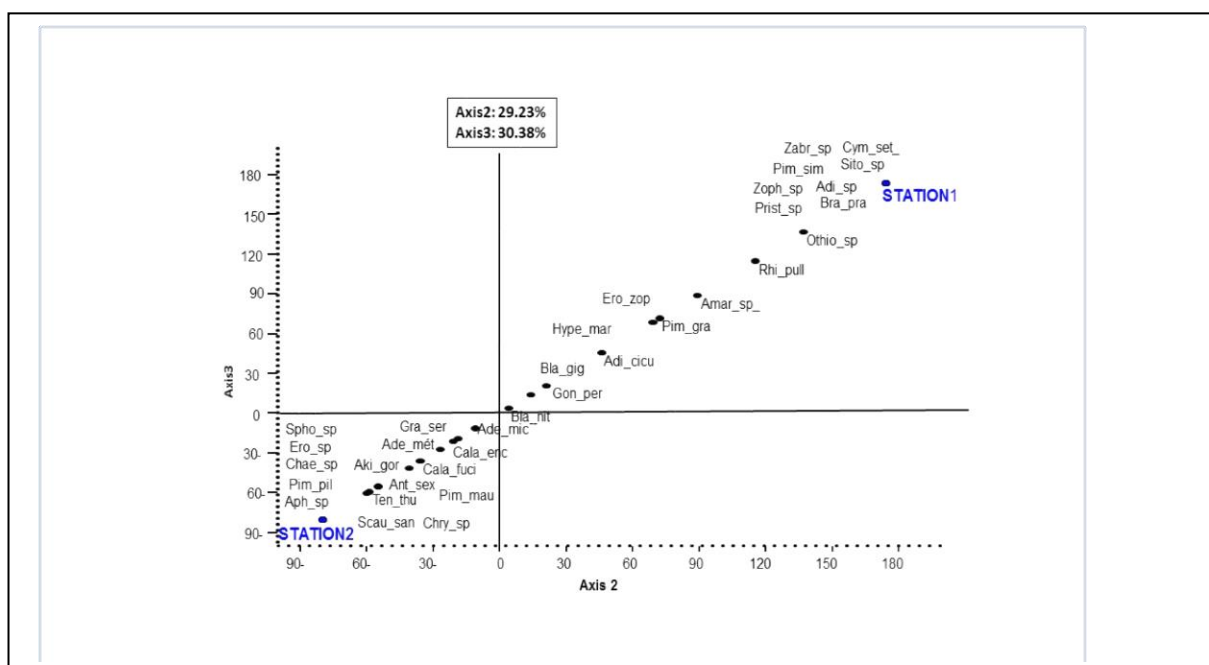


Figure 3 - Ordination of all Coleoptera species along axes 2 and 3 in the two stations from DCA (Past .1.81 software).

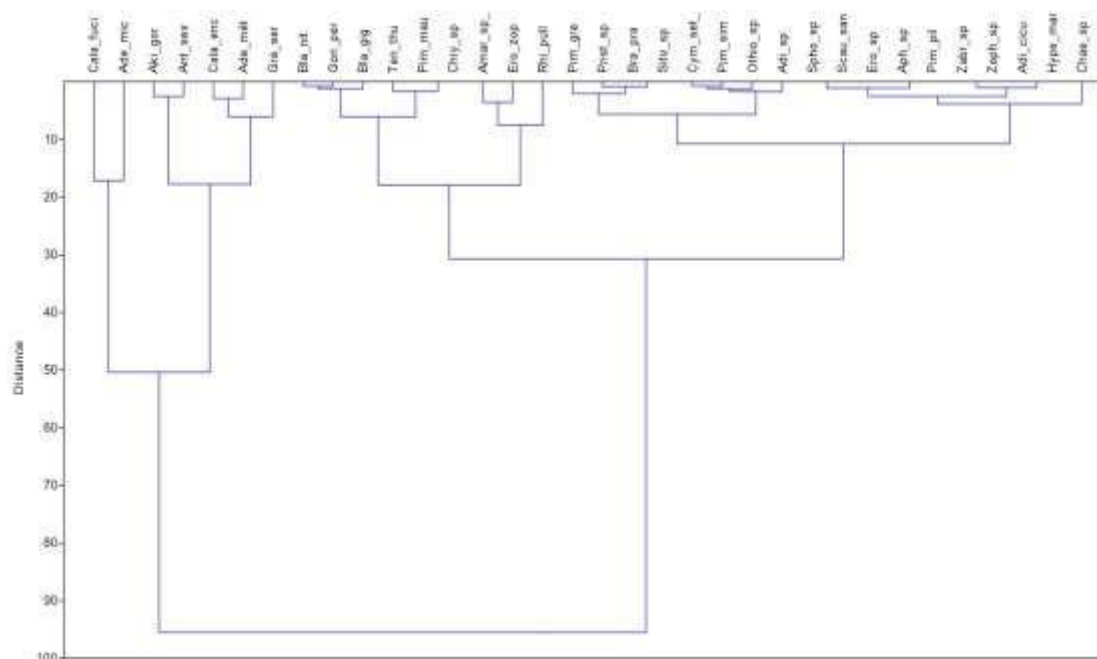


Figure 4 - The hierarchical Euclidean distance classification of all Coleoptera species collected in the two El Mesrane study stations.

DISCUSSIONS

For more than 40 years, the steppe landscape in Algeria has changed considerably and affected the floristic composition and functioning of ecosystems (Aidoud et al., 2006 ; Nedjraoui and Bédrani, 2008). There are specificities in the case of sand dunes, due to soil instability and poor organic matter. The key point for restoring this ecosystem is to limit the speed of the prevailing winds by the presence of shrubs or artificial fences. The latter must be dug to avoid the appearance of whirlwinds. As a result, sand mobility is reduced and vegetation can settle. In semi-arid areas, the succession process lasts for decades in the event of anthropogenic disturbances, but is faster in the presence of fences (Zhang et al., 2005). The beneficial effects of shrubs can be enhanced if the surface is covered with a protective layer of artificial or plant origin (Li et al., 2006).

Each area has its microclimatic characteristics, varied niches and a spectrum of animal prey. During our study, we sought to delimit the ecological factors following the establishment of *Retame* to stabilize the dunes in the Djelfa region. These factors limit the distribution of beetle species and the formation of ecological niches for this group of insects.

The Coleoptera is the largest in the insect class, with more than 300,000 species currently known in the world of Shredders with very variable general appearance and size. Some forms nevertheless like light and live actively on the sand in full sun. They mainly characterize warm regions, but can be numerous in other environments (Perrier, 1961). The Coleoptera population is the most representative entomofauna in sandy environments. These biotopes have attracted the interest of many scientists in order to highlight the biodiversity of these environments. (Chavanon & Bouraada, 1996)

In semi-arid steppes, the various species of *Tenebrionidae* often show a preference for specific plant associations. These preferences are attributed to two factors: the search for suitable food plants and the search for particular microclimates and shelters that are provided by certain types of vegetation (Dajoz, 2002). Most Carabidae actively search for food on the soil surface. The essential role of Carabidae in regulating populations and in trophic networks is due to their predatory activity and their existence in many environments. Many species can take turns all year round or almost (Dajoz, 2002). The genus *Gonocephalum* is mainly attracted to cultivated cucurbits. In the *Blaptini* tribe, various species of the genus *Blaps* have a non-selective diet consisting of decomposed plants and organic debris, but they can also attack cultivated plants. The genus *Adesmia* present in both stations, has a phytophagous and detritivorous diet, it plays an important role in the recycling of organic matter. In station 1, we recorded 48 individuals of this species; which explains the richness in organic matter of this station. Among the two Scarabaeoidea species that were captured during our sampling, we cite a phytophagous species, *Rhizotrogus pallipennis* (Baraud, 1987). *Pimelia* are a characteristic element of the fauna of the arid regions of North Africa. These are insects that consume a large number of plants, this genus is common in

the Djelfa region.

The species *Anthia sexmaculata* is a North African ground beetle that presented a significant number of individuals of 38 individuals. It is a species characteristic of the desert region (sanding and temperature).

We noted that the two stations are similar both in the number of species (28 species in station 1 and 26 in station 2) and in the total number of individuals (respectively 168, 359). This similarity is due to the type of vegetation; both stations are characterized by the presence of grasses and legumes, especially the *Retames*. We compared our results with those of Bencherif (2000), who worked in the same area and recorded the presence of 16 species of Coleoptera divided into 9 families and 1409 individuals. Lahrach & Raouane (2013), noted the Arthropods associated with *Tamarix* plantations in the same region with a beetle population of 120 individuals belonging to 10 species and 7 families. This difference is explained by the type of vegetation that characterizes each station and the evolution of the vegetation of *Retam* since their plantations with the aim of fixing the dunes in the steppe region. This has allowed the diversity of the beetle population. The vegetation cover intervenes in the distribution of Carabidae and Tenebrionidae. Clere and Bretagnolle (2001), noted that the captures of Caraboidea depend on the type of vegetation cover. The same observations were noted by Bouragba (2007). According to Guerrache et al. (2014), the plant species characteristic of mobile sand showed decreasing abundances of *Tamarix* and *Retam* plantations. The *Retam* plantation showed better values, in terms of richness and abundance. The better performance of *Retam* compared to *Tamarix* as a shrub species for dune restoration is not surprising, considering the results observed in Algeria (Akkouche et al., 2014; Adamou et al., 2015). In semi-arid coastal dunes of Spain, Muñoz-Vallés et al. (2014) showed that the presence of *Retama monosperma* (close to *R. raetam*) increased carbon and nitrogen and other mineral nutrients in the soil, as well as the diversity of the flora, but to the detriment of several dune-specific plant species.

As part of the assessment of steppe ecosystems, our work is devoted to the study of the population of Coleoptera associated with *Retam* (*Retama reatam* webb.), which is among the fixing species used to combat desertification. Two stations were chosen, the harvest duration was spread over a period of one year. Ground trapping was the only method we used, it allows us to collect the largest number of individuals and species. Our research found 527 individuals belonging to 38 species. Among the Coleoptera collected, the two families with the most species are the Tenebrionidae with 15 species followed by the Caraboidae families, the Chrysomelidae and Curculionidae families and finally the Scaraboida. The comparison of specific richness does not show a difference between the two stations, they have practically the same specific richness. This study is part of the assessment of ecosystems, installed for more than ten years to combat desertification, the diachronic comparison with the 2000 work allowed us to conclude that the *Rétame* plantations have favored the increase of populations in abundance and specific richness. This underlines the ecological importance of the dune cordon as a favorable and sufficient environment for the installation of fauna and flora.

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- 22- **Acknowledgment:** My sincere thanks to all those who contributed to the completion of this work, in particular the forest management of the wilaya of Djelfa in Algeria.