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Ecological characteristics of dayas and their impact on edaphic wildlife in Algeria

Djelloul Ghezali, Hafsa Harkat, Karim Soutou and Hassiba Ghezal

Ecole Supérieure Nationale d'Agronomie, Département de Zoologie Agricole et Forestiere
16200, El-Harrach, Alger, Algérie.

Abstract

The station selected for this study is characterized by specific ecological conditions. The plant transect conducted in this Daya has identified two plant species with a recovery rate of 18.7%. *Ziziphus lotus* species dominated and represent a recovery rate of 16.3%. *Pistacia atlantica* as second species has only 9.4% of recovery rate. A fauna inventory has identified 904 individuals representing 175 species which are divided into 18 orders and 3 classes with that of Gastropoda, Arachnida and those of insecta. The latter occupies the first place with 865 individuals and 153 species. Arachnida class occupies the second place with 20 species and the third place goes to that of Gastropoda with 2 species. In the insecta class, the Order of the Coleoptera is the high population with 75 species, followed by that of the Hymenoptera with 32 species. In the 3rd place, we find the Diptera with 21 species. The orders of Actinedida, Solifugae, Neuroptera, Oribatida, Gamasida and Heteroptera are represented only by one or two individuals and one species for each. The richest family in terms of species is that of the Formicidae with 20 species followed by the Carabidae with 13 species. The collected population at the Daya of Bowden seen to be evolving with the increasing temperature, whereas the specific resources seen to act independently from the latter, but we note that number of the species is significant at the decrease of rainfall. The wind which has a constant speed during most of the year seems to have no direct effect on the soil fauna. The analysis of the acarofauna revealed the presence of only one species which is *Oppia bicarinata*. The Oribatida mites being as biological indicators in form us about the status of the soil at the Daya. In fact in spite of the favourable conditions for their development, the obtained results show that there are other factors which can influence their presence. Regarding the topography and the geomorphology characteristics, these Dayas constitute basins which are filled up with water in winter period. This state can significantly harm the evolution of the Oribatida mites. The second factor is that of the wind, the geographic situation of the Daya in desert region which constitutes large and open environment helps this factor to have a very important action especially in summer period. This action doesn't have a direct effect on the acarofauna but more much on the litter which constitute a very important nutritive factor of the Oribatida mites.

Key words: Daya, Ento-acarofauna, Oribatida, Ecological factors, Algeria.

Introduction

The fauna of the ground is a source of important biodiversity that it is advisable to preserve because these organizations have crucial roles for the maintenance of the quality of ground (Chapman *et al*., 1997). It takes part in the decomposition of the organic matter and the bio-disponibility of the nutrients for the plants and the micro-organisms of the ground and also plays a part in the creation and the conservation of the structure of the ground (Mayeux and Savanne, 1996). The specific richness and the complexity of the communities recall the historical events and bio-geographic medium as well as the ecological factors available Wood mites, as announced by Gergocs and Hufnagel (2009) showed extraordinary characteris-

tics which make it possible to indicate the various environmental changes. These characteristics are largely mentioned in work of Lebrun and Van Straalen (1995), Behan-Pelletier (1999) and Gulvik (2007).

These changes in the arid mediums are defined by an impoverishment of the soil. The latter begin with deterioration from the plants and a modification from the floristic composition. In parallel cover vegetable cleared up and the production of the biomass decrease. The capacities of reproduction and regeneration are reduced more and more. The ground more protected by the plant is subjected to the mechanical action (erosion) which causes a modification of surface qualities. It can even in the covered zones of vegetation cause modifications by the displacement of the litter which constitutes an essential nutritional support for the activity of the micro-arthropods.

The reduction in the biomass and its restitution on the ground involves progressive organic matter losses which constitute one of the crucial factors in the property of the ground. This decomposition of the organic matter involves the formation of biogenic salts which will feed the reserve of the ground (Toutain, 1987).

It requires processes controlled by climatic factors as well as nature and abundance of the organizations decomposers (Gallardo and Merino, 1993; Swift and Norton 1995; Cortez, 1998). The physical, chemical and biological properties of the ground also influence its operation (Toutain, 1987; Gobat *et al*., 1998; Lozet and Mathieu, 2002).

In the arid and semi-arid regions, this evolution results in a deterioration of the biotope thus creating an inadequate medium for the development of the faunistic and floristic. The arid regions do not have profits to date from all the intention necessary with regard to their safeguarding. The studies on edaphic fauna and its relation with the medium as well in the world as in Algeria remain however insufficient. In Algeria, in the arid mediums, with exception work of Bragues Bouragba *et al.* (2006). The aime of this study consists in studying the effect of wind erosion on the pedofauna (soil fauna) and their consequence on the development of these ecosystems.

Materials and Methods

A vegetable transect is carried out in May 2010. It corresponds to a 10 m broad rectangle on 50 m length is a surface of 500 m^2. It makes it possible to highlight, on the one hand, the structure of the vegetation and the occupation of the ground, and on the other hand, the aspect of the landscape. The chart is carried out according two figures. The first vertical projection that allows to specify the structure of plant and the recovery rate. The second is a representation of profile which gives indications on the aspect of the medium, showing if it is about an open, half-open or closed area.

The Daya which is a basin located in Hamada characterised by alluvial soil, which named “Bowden’s Daya” (3°30' E.; 33°59' N). It extends on a surface from 25 hectares. It is located at the level of the commune of Deldoul in the area of Djelfa which belongs to the Saharian Atlas. It is to approximately 30 km in the south of Messaâd. It is limited from the north by the road Messaâd and Touggourt, in the west by Oued El Ktaifa, the south by Oued El Saboune and the east by Oued El Harrath. The vegetation is made up mainly by *Ziziphus lotus*, *Pistacia atlantica*, *Eupharbia* sp. *Peganum harmala*, *Astericus pygmacus*, *Anabasis articulata*, *Helianthemum lippii*.

Figure (1): *Pistacia atlantica*

Figure (2): General sight of Daya Bowden (Djelfa)

Climatic data: Data analysis revealed that the hottest month is July with an average temperature of 34.3 °C. However the coldest month is January with an average temperature of 7.4 °C. The most rainy month is January with 53.6 mm While the driest month is August with 0.7 mm the annual average of precipitations is of 287.9 mm the maximum speed of the wind (5.3 m/s) was noted during April and January. However the minimal speed (2.8 m/s) was recorded at October and September.

Collecting of samples: A sampling procedure requires one or more techniques of data acquisition and the establishment of a sampling design according to a strategy (Riba and Silvy, 1989). Applied methods in the present study are the technique of the Barber pots and Berlese funnel which allows the extraction of the acari.

The Barber pots: The Barber pots or traps door is a tool which allows the study of the arthropods of average and big size (Benkhelil, 1992). This kind of trap help especially to capture a various arthropods walkers as well as a great number of flying insects which come to be posed on the surface of the trap (Le berre, 1969; Benkhelil and Doumandji, 1992). The material used is a container 15 cm in diameter and 18 cm height. Each pot trap is buried vertically, so that the opening coincides with the level of the ground that is to say with short-nap cloth of the ground. The ground is packed all around the opening in order to avoid the barrier effect that a small arthropods species can meet (Benkhelil, 1992). The Barber pots are filled with water to the third their height added with detergent, preventing the trapped invertebrates to escape. The traps are placed according to the method of transects. It is a line materialized by a string along which ten traps are installed with intervals of 5 m (Benkhelil, 1992). The trapped species are recovered in Petri boxes carrying the number of the pot traps and the date of the trapping. The Barber pots remain in place on the ground during 24 hours in order to avoid taking too large manpower of arthropods which would have an impact on the later taking away. The contents of 8 Barber pots are taken into account only. The samples are examined, determined and counted by a binocular magnifying glass. Taxonomic research is as far as possible thorough with the order, the family, the genus and if possible with species.

Our study spread out over 8 months since October 2009 until June 2010.

Test sample selections of the ground: Sampling consists in making six monthly taking away of ground, from October 2009 to June 2010. The latter are dug from 10 to 15 cm of depth and 15 cm as dimensions in a random way using a hoe According to Benkhelil (1992), the apparatus of Berlèse is effective to capture the acari. The principle of this apparatus rests on the negative phototactism of the acari (Basket maker, 1970). According to Coineau *et al*. (1997), it is a dynamic or selective method which uses the tactism of the individuals. The latter leave the sample by their own average under the influence of a thermodynamic stimulus. The samples of the ground are placed on sieves from 1 to 2 mm of mesh which are deposited on funnels. The latter supported by a support are overcome by a lamp directed towards the ground. The acari sensitive to the source of light flees in-depth, slip on the slopes of the funnel and are recovered in containers which contain alcohol with 70%. The duration of this extraction is from 3 to 4 days. The pedo-fauna thus collected starting from the samples of ground and the Barber pots, is counted and identified by Mr. Doumandji Salah-Eddine professor at the High National School of Agronomy in Algeria (E.N.S.A). The determination has then was made using a collection of Mr. Niedbala and Mr. Wauthy (Natural History Museum of Natural history of Brussels, Belgium).

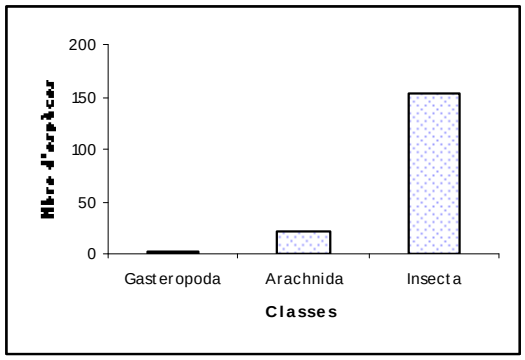
Results and Discussion

Inventory of the pedofauna collected on the level of Bowden's Daya: The vegetable transect carried out in the daya Bowden, made it possible to count two plant species with a rate of total covering of 18.7%. The species *Ziziphus lotus* was dominated with a rate of covering of 16.3%, followed by *Pistachia atlantica* with 2.4% . The geographic situation of the Daya in desert region which constitutes large and open environment help the factor to have a very important action especially in summer period The inventory showed the presence of 904 individuals representatives 175 species which are distributed in 18 orders and 3 classes. They are, by importance order, the class of insecta which counts 865 individuals and 153 species. Arachnida with 20 species and Gasteropoda with two species.

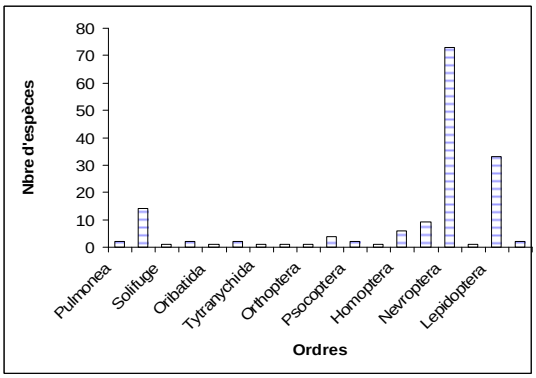
Table (1): Number of collected invertebrates individuals

					Months					
Orders	X	XI	XII	I	II	III	IV	V	VI	Total
Pulmonea	-	-	-	-	-	2	-	-	-	2
Aranea	1	1	7	1	-	5	4	3	7	29
Solifuge	-	-	-	-	-	-	-	-	1	1
Phalangida	1	3	7	1	1	-	1	-	-	14
Oribatida								1		1
Gamasida								1		1
Actinedida	-	-	-	1	-	-		-	-	1
Podurata	4	-	-	3	3	-	-	1	97	108
Orthoptera	2	-	-	-	-	1	-	3	2	8
Thysanoptera	2	-	-	-	-	-	1	-	-	3
Psocoptera	-	-	-	-	-	-	-	-	1	1
Heteroptera	-	-	-	-	-	-	-	1	7	8
Homoptera	-	3	7	1	1	2	17	-	3	34
Coleoptera	11	14	48	16	32	55	60	16	76	328
Nevroptera	-	-	-	-	-	-	-	-	1	1
Hymenoptera	5	1	-	1	3	47	51	137	46	291
Lepidoptera	-	2	-	-	1	-	-	-	-	3
Diptera	4	7	-	-	9	5	4	7	34	70
No. of individuals	30	31	69	24	50	117	138	170	275	904

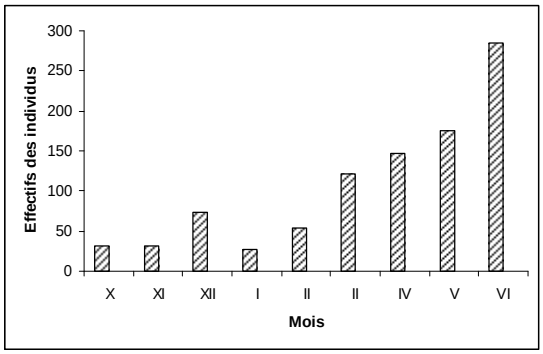
In the class of the insects, the Coleoptera in high population represented with 75 species, followed by Hymenoptera with 32 species. The dipterous was represented with 21 species. Actinedida, Solifugea, Nevroptera, Oribatida, Gamasida and Heteroptera are represented only by one to two individuals and a species each one. The family richest in species is that of Formicidae with 20 species, followed by Carabidae with 13 species.



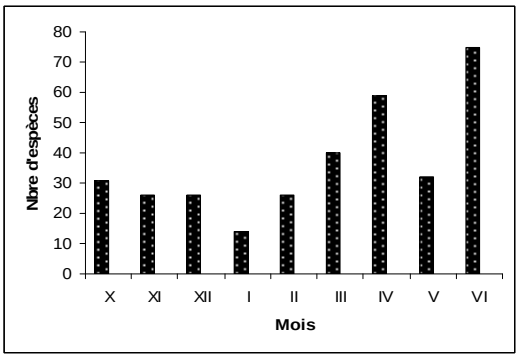
Figure(3): Various classes collected



Figure(4): Total richness collected



Figure(5): Monthly progress of manpower



Figure(6): Monthly progress of the species.

The Analysis of the two Figures (5 and 6) watch that manpower of the populations collected on the level of Bowden's Daya evolve/move considerably with the rise in the temperature. Indeed, it is noticed that as from April until June when the temperatures are raised, an increase in manpower on the other hand pluviometry seems to exert a contrary effect on the development of the pedo-fauna. The specific richness (Figure 6) seems to evolve/move independently of the temperature but it is noticed that the numbers of species are important when the pluviometry is in fall. The wind which has a constant speed lasting all the year almost does not seem to have any effect on the pedo-fauna.

Ecological indices:

Quality sampling applied to the pedo-fauna: The species seen only once are 88 species and the quality of sampling is good. The value was 1.22

Equitability: The equitability is higher than 0, 5 through out the months of this study. Of this fact manpower of various listed species tend to being in balance between them (Table 2).

Diversity Index of Shannon-Weaver: According to the values of the index of diversity of Shannon Weaver, diversity is low in May with a value of 2.48 bits, average in December and January with respective values of 3.63 and 3.45 bits and it is high in October (4.37 bits), in November (4.08 bits), in February (4.13 bits), in March (4.16 bits), April (4.69 bits) and June (4.16 bits).

The diversity during the period of sampling is high (5.44 bits). The maximum of diversity varies between 3.81 bits in January and 6.11 bits in June. (Table 2).

Total richness and monthly average: The monthly total richness varies between 14 species in January and 69 in June. As for the average richness (Sm) it varies between 2.88 at January and 12 at June (Table 2).

Analyzes in principal components applied to the fauna of the ground inventoried in Bowden's Daya: The principal analysis in components applied to the various orders of Arthropods listed in Bowden's Daya (Djelfa) between October 2009 and June 2010 has makes it possible to highlight certain mechanisms which determine the distribution of the orders and the four ecological parameters which are the temperature, pluviometry, the relative humidity, and the Wind according to the axes.

The sum of the percentages of the first two axes is of 58. This value is higher than 50%. The plan determined by axes 1 and 2 contains most of the information which is enough for interpretation to the results.

The values of the correlation between the various orders and the climatic factors are variable. The order of Orthoptera and the temperature is positively correlated (R^2 = 0.75). In the same way the order of Diptera (R^2 = 0.67), of Heteroptera (R^2 = 0.64), and of Hymenoptera (R^2 = 0.58) are positively correlated with the temperature. On the other hand Pulmonea and Phalangida are negatively correlated with this parameter. Humidity is negatively correlated with Heteroptera (R^2 = -0.74), Diptera (R^2 = -0.66), Orthoptera (R^2 = -0.64), Podurata (R^2 = -0.54), Aranea (R^2 = -0.52) and Hymenoptera (R^2 = -0.47).

The chart of the plan determined by axes 1 and 2 watch that the variables represented by the order of Orthoptera, Heteroptera, Hymenoptera, Aranea, Coleoptera, Thysanoptera and the two parameters climatic temperatures and relative humidity are very close to the circle of correlation and consequently are very well represented on the graph (Figure 8). On the basis of the origin, the angle rather closed that the variables such as the order of Podurata and the temperature form, indicates that these two variables are rather well correlated between them. It is the same for the two orders Heteroptera and Diptera which are rather well correlated. On the other hand the angle quasi-right between the relative humidity and the order of Orthoptera on a side and between the relative humidity and Podurata on the other side indicate that these variables are independent between them.

Table (2): Values of the various ecological indices

Indices	Months								
	X	XI	XII	I	II	III	IV	V	VI
Equitability	0.97	0.94	0.9	0.91	0.9	0.78	0.82	0.52	0.68
H' (bits)	4.37	4.08	3.6	3.45	4.1	4.16	4.69	2.48	4.16
Hmax	4.52	4.32	4.1	3.81	4.7	5.36	5.7	4.81	6.11
Q.	2.1	1.75	1.6	1.13	2.3	3.5	3.8	2.13	4.9
Sm	3.5	3.25	3.25	2.88	4.88	6.63	9	5.88	12

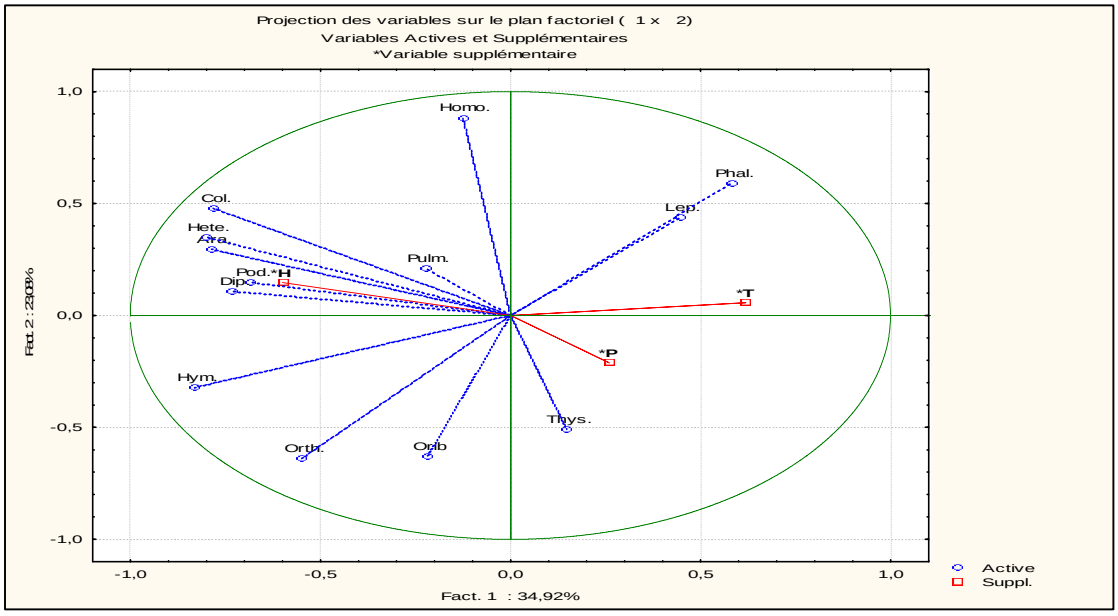


Figure (7): Factorial chart of the various orders of invertebrates and parameters climatic recorded on the level of Daya of Bowden (Djelfa).

Legends:

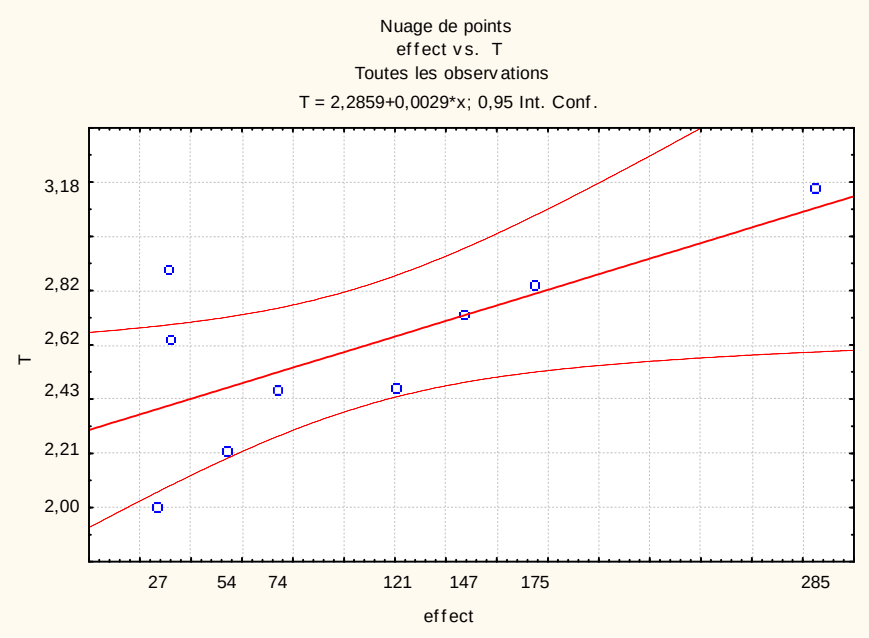
Ecological factors:
T: Temperature
P: Pluviometry
H: Moisture

Different orders:
Dip (Diptera)
Hete (Heteroptera)
Hym (Hymenoptera)
Pod (Podurata)
Col (Coleoptera)
Lep (Lepidoptera)
Homo (Homoptera)
Pul (Pulmonea)
Phal (Phalangida)
Orth (Orthoptera)
Ara (Aranea)
Thys (Thysanoptera)
Orib (Oribatida)

Linear regression applied between monthly manpower and the various ecological parameters

Temperature

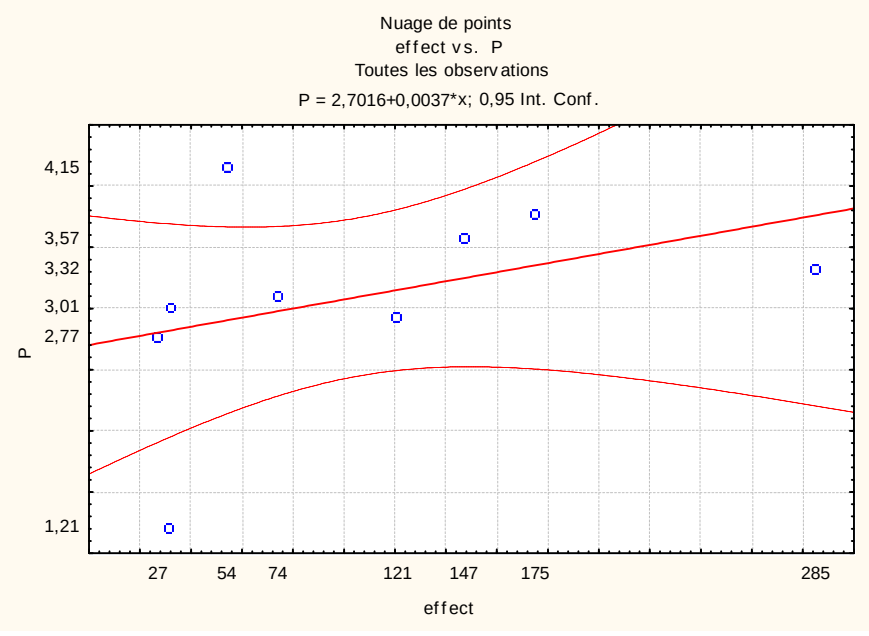
R^2= 0,47356212 p<0,04043



Figure(8): Linear regression enters the monthly manpower monthly of the Orders and the temperature

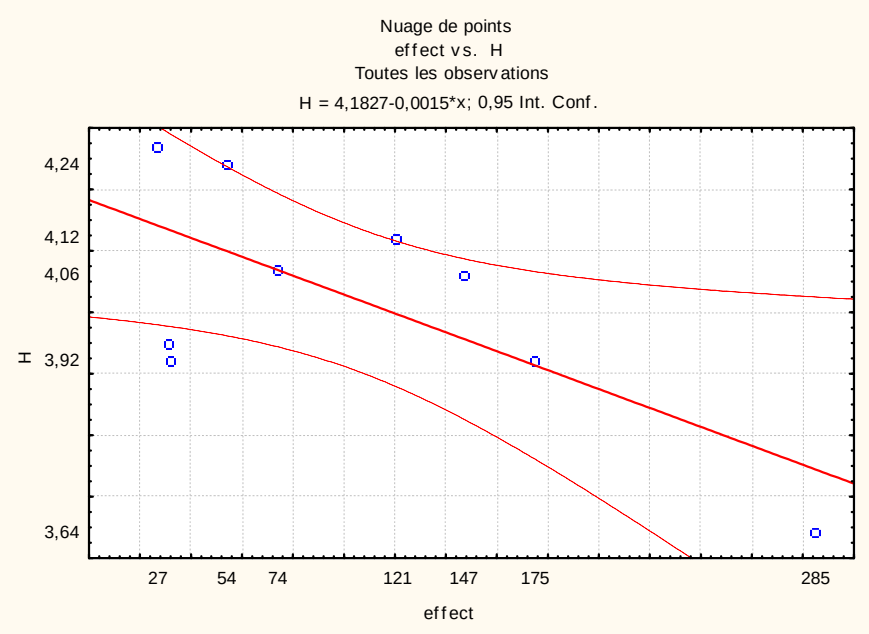
Pluviometry

R^2= 0,14908333 p<,30470



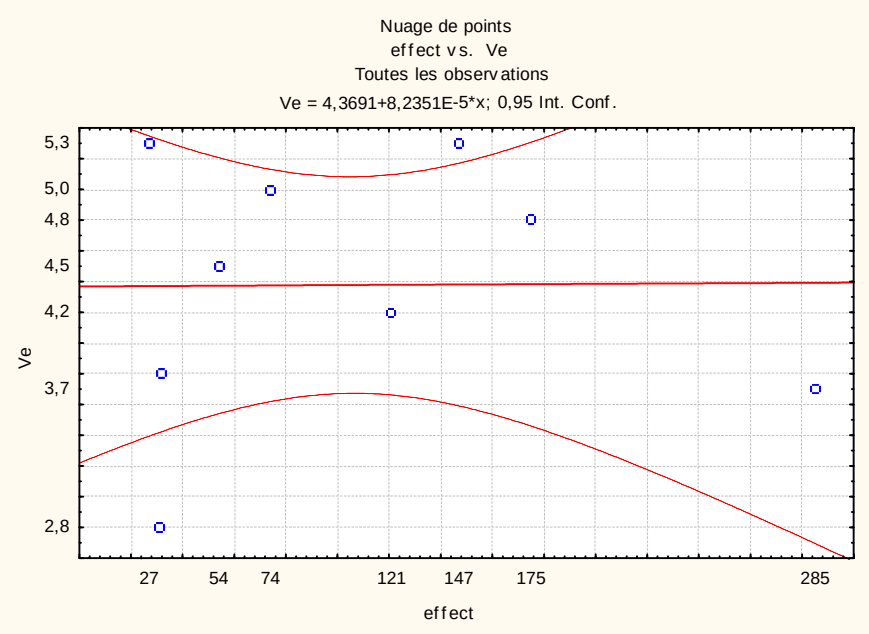
Figure(9): Linear regression enters the monthly manpower of the orders and pluviometry Appear

Moisture:
R^2=0,48025562 p<0,03848



Figure(10): Linear regression enters manpower of the Orders and moisture

Speed of the wind:
R^2= 0,00007244 p<,98266



Figure(11): Linear regression enters the monthly manpower of the orders and speed of the wind

The same observation is recorded between the relative humidity and the order of Diptera, Heteroptera and Hymenoptera. The fact that the order of Heteroptera (Cosine squares = 0.70), of Diptera (Cosine squares = 0.61), of Hymenoptera (Cosine squares = 0.59) and of Aranea (Cosine squares = 0.57) are close to axis 1 indicates that these variables are well represented by this axis. As they are very far away from axis 2, one can conclude that they are represented little by this axis. The temperature is very close to this axis (Cosine squares = 0.65). Concerning axis 2, only the order of Thysanoptera (Cosine squares = 0.65) is well correlated with this axis. The parameters wind and pluviometry being very far from the circle of correlation and consequently are represented very little on the graphs (Figures 9-11).

The analysis of the linear correlation shows that the ecological factors act deferments with the populations of arthropods fauna collected on the level of Bowden's Daya. Indeed the temperature and moisture present a correlation slightly significant with manpower of the orders. The recorded respective values are R2=0.47 and R2= 0.48. This correlation is, on the other hand insignificant between the wind, pluviometry and manpower. For the R2=0.98 wind and pluviometry R2= 0.39.

Analyzes in principal components applied to the various months of census of the pedo-fauna in Daya Bowden: The sum of the percentages of the first two axes is of 56.0%. This value is higher than 50%. The plan determined by axes 1 and 2 contains most of information. It is enough for interprétation to the results.

The chart determined by axes 1 and 2 watches that study months are in different quadrants (Fig. 13). The coldest months, represented per October, November, January, December and February appear in the negative part of the graph, while months which are characterized by a soft temperature are located in the positive part of the gradient. With the extreme left of axis 1, is January which is strongly related to this axis (Cosine squares = 0.59). While with the extreme right-hand side of this axis, is June which is strongly related to this axis (Cosine squares = 0.89). He is thus established left towards the line a seasonal gradient energy of the freshest months (January) about the hottest month (June).

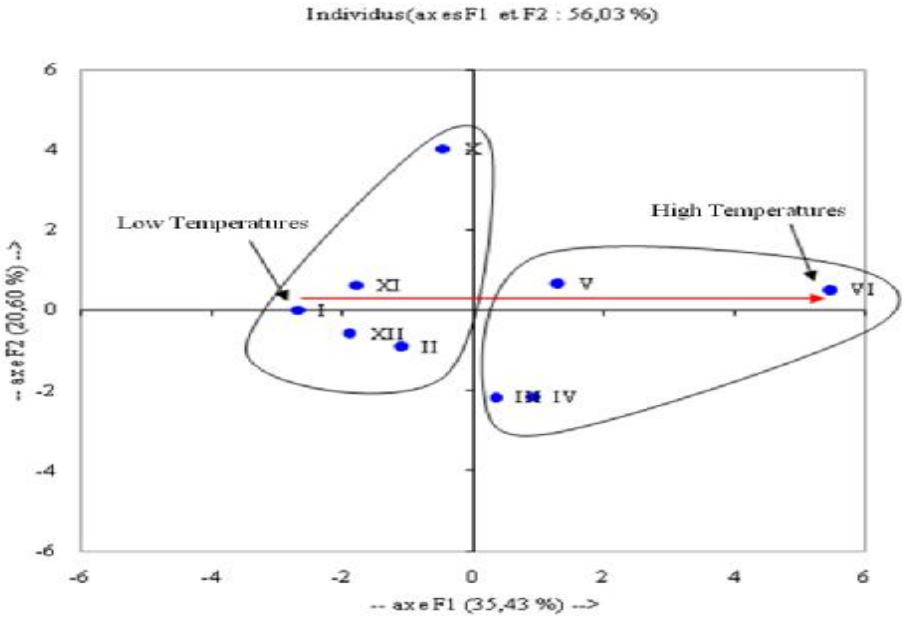
The factors of this area are not independent from to each other and their combined effects can determine the composition of the community (Asikidas and Stamou, 1991). This study carried out in a particular ecosystem (Daya) made it possible to count 904 individuals and 175 species distributed in 16 orders and 3 classes. By comparison with the work undertaken in the same area, one can note that the quantitative richness is less important in this study. Indeed, Brague-Bouragba *et al*. (2006) revealed that the structure of the faunistic richness associated with *Atriplex halimus* and *Atriplex canescens* in the area of Zahrez Gharbi (Djelfa) is of 2779 individuals. Soutou *et al.*, (2006) in the same objective noted in El- Mesrane (Djelfa) manpower of 1201 individuals

The qualitative richness seems, on the other hand, better. Indeed, 173 species were recorded. Guit (2006), noted 110 species in the course timbered by *Atriplex canescens* and 90 species in a station containing the indigenous species *Atriplex halimus*. Brague-Bouragba *et al.* (2006) listed in two stations containing the introduced species *Atriplex canescens* respectively 74 and 61 species. Yasri *et al*. (2006) recorded 50 species in the drill of Senalba (Djelfa). Soutou *et al* (2006) have identified 73 species in El-Mesrane (Djelfa).

The class of the insects with 865 individuals and 153 species occupies the first rank. All work quoted above confirms the predominance of this class. The class of Arachnida occupies the second place with 27 individuals gathering 20 species. Brague-Bouragba *et al* (2007) recorded 324 individuals of spiders divided into 28 species.

The third place returns to the gastropods with two species. The family of Formicidae occupies the first rank with 20 species. Brague-Bouragba *et al* (2006) noted 8 species on the other hand Soutou *et al*. (2006) recorded 20 species. Is this ecosystem more stable than it is diversified more? The answer is far from being affirmative. These Dayas, which is located in arid zones where the conditions are difficult, offer to the arthropods fauna a refuge in particular in summer period.

The analysis of the edaphic acari-fauna revealed the presence of only one family with only one species in fact *Oppia bicarinata*. These results are far from those evoked by many authors who note



Figure(12): Factorial map of various months of census of the invertebrates in Daya de Bowden (Deldoul, Djelfa) between 2009 and 2010.

that the wood mites represent the most important biomass on the level of the ground. Dudiche *et al.* (1952) give a value from 70 to 75 for -one hundred of wood mites compared to the micro-arthropods. Reeves (1969) announces that the wood mites many and are represented better in the mesofauna. Lebrun (1971) noted which the wood mites represent 60 to 80 percent of the acari. Andre (1984) estimates at 33.6% the wood mites compared to the fauna of the ground. Can these results reveal us that the grounds on the level of these Daya are far from being a favourable area for the development of the acari-fauna. The ecosystems are so complex and the factors which intervened are so numerous. It is thus very difficult to make a fragmented analysis of the individual effect of each factor, but as all the authors testify some, the operation of the ecosystems is conditioned by the whole of the biotic and abiotic factors which characterize them.

In nature, the organizations react narrowly with the abiotic factors of the medium which influences in a synergistic way their activity. Some of them react proportionally to the variat-ions rapid of the environment. It is however necessary to note that certain species can provide indices of deterioration and quality of the medium (Vikram, 1986).

The analysis of the linear correlation between manpower and the abiotic factors of the medium gives a value of R^2 (0.5) what means very weak correlation.

These results are contrary with those mentioned by various authors. According to Neave, (1998), moisture is as dominating as the temperature; it deeply influences the fauna of the ground by regulating the intensity, the localization of the activity of the individuals and intervenes in the numerical variations of the micro-fauna. Athias and Concela (1976) showed that pluviometry remains a paramount factor for the fauna of the ground.

Tousignat and Coderre (1992) showed that the abundance of the species and the structure of the community of the arthropods generally depend on the biotic and abiotic conditions on the area.

Webb *et al*. (1998) and Gergocs and Hufnagel (2009) showed that the temperature can induce a modification when with the structure of the com-

munity of the wood mites.

In the light of can these results, one suppose that other extrinsic factors intervene in these particular ecosystems? The answer lies partly in work of Adetola-Badejo *et al*. (2002) which showed that the absence or the scarcity of the litter and the dryness disturb the dynamics of the acari of the ground as well as the water excess as it was announced by Bachelier (1978).

Of geographical share them situation and their topography as well as the pedological structure, these mediums (Dayas) are subjected to several constraints:

1) Their ground being impermeable constituted for wintry time, a tank where a great quantity of water will be stagnated. This constraint can have a very important incidence on the pedo-fauna and particularly the wood mites.

2) For the summer period, one attends a draining complete of the ground what constitutes a second constraint for the development of the wood mites

3) In the arid and semi-arid regions the wind constitutes a determining factor by its mechanical action. To the level of Daya, its action is not limited solely to the displacement of the sand particles but it sweeps all the litter resulting from the vegetation in place. This litter being a determining factor, its absence blocks the development of the wood mites.

Usher (1976) Usher *et al*. (1982) and Vreeken-Buijs (1998) noted that the organic matter and moisture condition the distribution of the wood mites and their pullulating. As mentions it all these authors, the litter determines the faunistic richness and particularly the Wood mites. Pascual *et al*. (2000) noted that in the wide sectors of the Mediterranean regions, the vegetation is exposed to the difficult climatic conditions. Garcia *et al.* (2002) mentioned that many factors which are implied in the control of the biogeochemical cycles, microbiological have a particular importance in the semi-arid zones where the degradation of vegetable cover relates to the shortage of the organic matter which is regarded as the principal precursor of durability.

Gregor *et al.* (2004) watch that the gradient of distribution in sectors subjected to constraints potentially provide a powerful tool to interpret the relations between the biodiversity of the ground and the quality of the site.

This study showed the complexity of certain ecosystems in particular Dayas and made it possible to show that the ecological factors the temperature, pluviometry, moisture and the litter are not the only parameters which act on the space-time distribution of the fauna of the ground but of other factors can intervene. Their action cannot be direct but their incidence can be very important.

Conclusions

The faunistic study of Bowden's Daya showed that the area presents a very particular ecosystem. Indeed does the recorded specific richness which, compared to the various neighbouring areas, appears very important but this richness constitute a native fauna which really evolves/moves in these mediums? The answer is far from being easy.

The ecological factors such as temperature, pluviometry, moisture and litter which constitute the determining parameters in the space-time distribution of the species in the various ecosystems seem that their effects in Daya are influenced by other parameters particularly the flood and dewatering as well as the wind to which these zones are subjected permanently.

This parameter exerts an important mechanical action on the litter which constitutes the trophic source of most of the pedofauna.

In the arid and semi-arid areas where one generally allots the impoverishment of the soil like the resultant of the combined action of the dryness and the phenomenon of anthropisation, one forgets often the action of the wind which in this open area constitutes a determining factor.

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