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Diversity and Ecology of Orthoptera of Some Agricultural Areas in Northern Algeria

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Abstract **– A study on the orthopterologic diversity was performed in three different agro-ecosystems in northern Algeria, located at Baba-Ali, Ain-Taya and Cap-Djinet. The first two stations are part of the plain of Mitidja. Inventories carried out were conducted over a period of 12 months; November-December 1996/1997 for Baba-Ali and Ain-Taya stations, and September-August 2010/2011 for Cap-Djinet station. The settlement of the identified orthopteric revealed a total of 25 species, 8 Ensifera and 17 Caelifera. Acrididae Family accounts only 15 species are spread over 6 subfamilies, 60% of the identified orthopterofauna. The highest total richness and the specific average richness per survey and station values were recorded in October 1997: 8 – 4, 2 Baba-Ali, 10-5,2 Ain-Taya; and in August 2011: 13 – 6,2 Cap-Djinet. According to the Shannon-Weaver diversity index, the surveyed areas have a diverse orthopterofauna particularly in spring and autumn when the number of individuals is equally distributed between species (0,62 < E < 0, 97).**

Keywords **- Northern Algeria, Agroecosystem, Orthopteric Diversity, Caelifera, Acrididae.**

I. INTRODUCTION

Orthoptera is one of the most widely used in studies on ecosystems taxonomic groups [1]. They form an important part of the terrestrial biomass and often the most important invertebrates; their role as primary consumers of plants make them sometimes very harmful to agriculture. Some species are pests mainly middle - east where migratory species occasionally devastate crops [2].The grasshoppers damages are frequently recorded each year in one or another area of the Sahel [3]. It is widespread and generally abundant insects, which are often distinguished by their fidelity to a specific habitat type and their sensitivity to changes in ecosystems [4]. In North Africa, the problem of harmful Orthoptera was always and remains a major concern for farmers; seventeen species of Caelifera (in Orthoptera order) are declared harmful to agriculture research center on pests of overseas [5]–[6]. In agroecosystems, crops perennial vegetation are radically different from annual crops in terms of the level and frequency of disturbances they experience. These environments are essential because they allow many organizations to realize their life cycle [7], and find their suitable conditions for their development and sustainability.

In Algeria, an interesting work on the study of orthopterocenosis was performed in Mitija [8]–[9]. North east of Algeria [10]. And in two biotopes, Biskra and Constantine eastern Algeria [11].

This work presents the main results of a study conducted in three agroecosystems, Baba-Ali, Ain-Taya and Cap-Djinet; located north of Algeria. They show the orthopteric biodiversity subservient to agricultural environments, and to assess the richness and composition of each biotope orthopterofauna prospected.

II. MATERIAL AND METHODS

A. Study Sites

The station is the area or the precise location at which the study area of the orthopteric inventory is made. The study surveyed stations are represented by three different agroecosystems. Two of them belong to the Mitija which is the largest of sublittoral Algerian plain, bordered by a range of mountains [12]. This is a plot fallow located in Baba-Ali (36° 42 '59" North, 3° 9' 00" East) and cultivated fields; mainly potatoes, peas and zucchini located in the region of Ain-Taya (36° 47 '00" North, 3 ° 14' 00" East). The third station is the pilot farm in the region of Cap-Djinet, daira Bordj Menail, wilaya of Boumerdes (36 ° 48 'north latitude and 3°42' east longitude); it is arboreal vocation where there are various varieties of olive trees and other fruit trees (Fig.1).

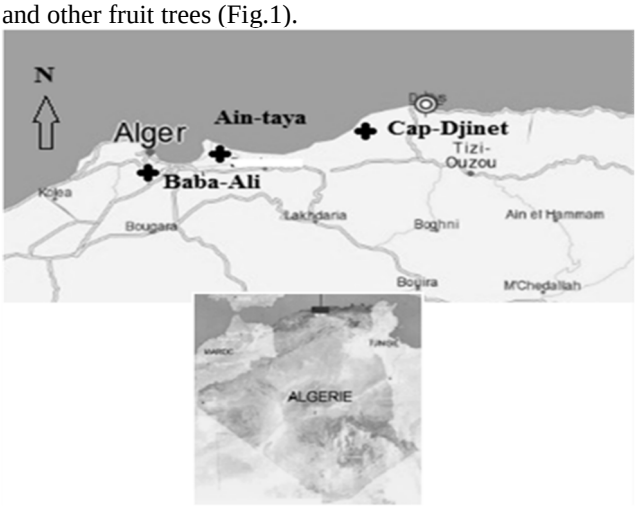

Fig.1. Location of the study area

B. Methodology

B.1. Sampling

Statements allow to know the specific composition of a stand of Orthoptera [13]. The most objective sampling method involves capturing all the wildlife that is on a given surface [14]. For this study we used the method of enumeration quadrat. Twelve readings for each study areas have been made regularly. From November 1996 to

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October 1997 respectively for Baba-Ali and Ain-Taya stations; and from September 2010 to August 2011 for the station Cap-Djinet. We first begin by choosing a definite location of 500 m^2 where conditions appear almost homogeneous. We then delimit five small areas of 9 m^2 called quadrats where we capture all these grasshoppers by hand or sweep net. Adults who move out quadrats are captured using a fine mesh swatter. Easily recognized species are determined *in situ* and released immediately; others are placed in plastic bags and transported to the laboratory for further identification using dichotomous keys to some authors [15]–[16]–[17].

B.2. Method of operating results

The results obtained are operated with the following diversity indices [18] – [19] :

- The total richness (S) is the total number of species that is contained in a population in a given habitat. The specific average richness (Sm) matches the average number of species present in a sample: Rs = ΣS / N where S is the total richness and N is the number of records.
- Diversity index of Shannon-Weaver (H) is the diversity index the most used and obtained by the following formula: H (bits) = - Σ qi $\log_2$qi where qi = ni / N is the probability of encountering the kind of rank i, ni is the number of each species in the sample and N is the sum of all species.
- Evenness index (E) or the equal distribution is the ratio of the observed diversity (H) has maximal diversity (Hmax) expressed in bits. The maximal diversity Hmax = $\log_2$S where S is the total richness. E tends to zero when almost all of the workforce is a single species of population, and E tends to 1 when each species is represented by the same number of individuals.

III. RESULTS

A. The Orthopterological species recorded.

Total of 32 surveys were conducted in three agroeco systems in northern Algeria. The results obtained showed the presence of 25 species of Orthoptera including 8 Ensifera and 17 Caelifera, included in five families and 13 different subfamilies. Acrididae Family account only 15 species that are spread over six (6) subfamilies: Acridinae, Oedipodinae, Eyprepocneminae, Catantopinae, Calliptaminae and Gomphocerinae; 60% of orthopterofauna identified. It is followed by Tettigoniidae (20%), Gryllidae (20%), Tetrigidae (4%) and Pamphagidae (4%). The Acrididae also predominate at the surveyed stations with percentages based on the number of species per station, which is 75%, 61.11% and 60% respectively for Baba-Ali, Ain-Taya and Cap-Djinet. Nine species are common between the three agroecosystems: *Odontura algerica*, *Acrida turrita*, *Acrotylus patruelis*, *Oedipoda caerulescens sulfurescens*, *Aiolopus strepens*, *Aiolopus thalassinus*, *Pezotettix giornai*, *Ochrilidia tibialis* and *Paratettix meridionalis*; they seem very characteristic of surveyed stations. The fallow middle Baba-Ali is the least populated in Orthoptera. We noted the total absence of the family Gryllidae and Pamphagidae; as well as the subfamilies: Conocephalinae, Decticinae, Eyprepocneminae and Calliptaminae. Two subfamilies are also absent in both stations, Ain-Taya and Cap-Djinet; they are respectively Eyprepocneminae and Trigonidinae. The Cap-Djinet has the highest species richness with a total of 20 species, five of them were recorded only at this station. This is *Decticus albifrans*, *Gryllulus sp*, *Eyprepocnemis plorans*, *Thisoicetrus annulosus* and *Calliptamus wattenwylianus* (Table I).

Table I: Inventory and systematic of othoptrologic species recorded in the study sites.

Family	Sub-family	Species	Baba-Ali	Ain-Taya	Cap-Djinet
Tettigoniidae	Conocephalinae	*Conocephalus conocephalus* (Linné, 1767)	-	+	+
	Phaneropterinae	*Odontura algerica* Brunner, 1878	+	+	+
		Odontura microptera Chopard, 1943	+	+	-
	Decticinae	*Decticus albifrans* Fabricius, 1775	-	-	+
		Rhacocleis sp Fieber, 1853	-	+	+
Gryllidae	Trigonidinae	*Trigonidium cicindeloides* Rambur, 1839	-	+	-
	Gryllinae	*Gryllus bimaculatus* De Geer, 1773	-	+	+
		Gryllulus sp.	-	-	+
Acrididae	Acridinae	*Acrida turrita* Linné, 1758	+	+	+
		Truxalis nasuta (Linné, 1758)	+	-	+
	Oedipodinae	*Oedipoda caerulescens sulfurescens* Saussure, 1884	+	+	+
		Acrotylus patruelis (Herrich-Schaffer, 1938)	+	+	+
		Aiolopus strepens (Latreille, 1804)	+	+	+
		Aiolopus thalassinus (Fabricius, 1781)	+	+	+
		Locusta migratoria(Linnaeus,1758)	+	-	-
	Eyprepocneminae	*Eyprepocnemis plorans* (Charpentier, 1825)	-	-	+
	Catantopinae	*Pezottetix giornai* (Rossi, 1794)	+	+	+
		Thisoicetrus annulosus Walker, 1870	-	-	+
	Calliptaminae	*Calliptamus barbarus* (Costa, 1836)	-	+	+
		Calliptamus wattenwylianus (Pantel, 1896)	-	-	+

	Gomphocerinae	*Ochrilidia tibialis* (Fieber, 1853)	+	+	+
		Dociostaurus jagoi jagoi Soltani, 1978	-	+	-
		Omocestus raymondi (Yersin, 1863)	-	+	-
Tetrigidae	Tetriginae	*Paratettix meridionalis* Rambur, 1839	+	+	+
Pamphagidae	Pamphaginae	*Pamphagus elephas* Linné, 1758	-	+	+
5	13	25	12	18	20

(+) Presence. (-) Absence.

B. The total richness of orthopteric study sites.

On all species counted, the total richness reached number 8, 10, 13 respectively at the station Baba-Ali in September-October, Ain-Taya in October 1997 and Cap-Djinet in August 2011. The weakest total richness is one species recorded in December and January for Ain-Taya and Baba-Ali stations (Fig. 2).

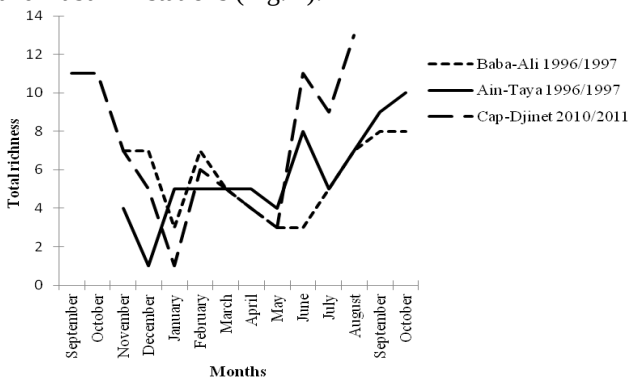

Fig.1. Monthly variations of the total richness

C. Specific average richness of study sites

The specific average richness per statement shows a value of 6,2 recorded in August 2011 in Cap-Djinet and 5,2 in October 1997 in Ain-Taya. These two agroecosystems manifested by a significant orthopteric diversity compared to that seen in Baba-Ali is 4,2. Other values range from 0,2 to 5,6 in Cap-Djinet; 1-5 in Ain-Taya and 2-3 to Bba-Ali (Fig.2).

This variation of the specific average richness over time is related to the conditions offered by the environment and phenology of each species orthopteric (Fig. 3).

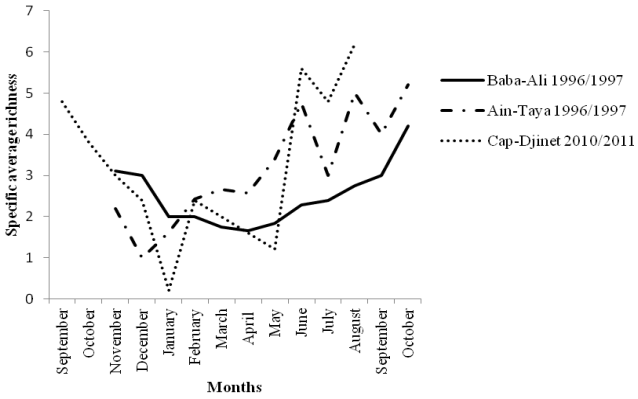

Fig.2. Monthly variatios of specific average richness

D. Diversity indices of Shannon-Weaver and evenness applied to listed species.

The diversity index of Shannon-Weaver is more than 2 bits for species collected in February-March in the three surveyed areas. Close to or greater than 2 bits values are also noted in late summer and autumn (Table 2). Therefore, the studied agroecosystems have a diversified orthopterofaua during these two time of year with a number of individuals equally distributed between species (0, 62 < E < 0,97).

Table II: Monthly variation indices of Shannon-Weaver and evenness of orthopteric species recorded.

	Baba-Ali		Ain-Taya		Cap-Djinet	
Months	H (bits)	E	H (bits)	E	H (bits)	E
- September	-	-	-	-	2,97	0,80
- October	-	-	-	-	2,68	0,75
- November	1,97	0,70	1,90	0,95	2,34	0,84
- December	1,73	0,62	0,00	-	1,94	0,75
- January	1,53	0,97	1,60	0,69	0,00	0,00
- February	2,28	0,81	2,22	0,95	2,55	0,91
- March	2,13	0,92	2,00	0,86	2,43	0,87
- April	0,76	0,48	1,52	0,76	1,83	0,91
- May	1,14	0,72	1,57	0,78	1,03	0,65
- June	1,38	0,59	1,02	0,34	2,87	0,80
- July	1,85	0,92	1,65	0,71	2,67	0,84
- August	2,47	0,88	2,40	0,85	3,24	0,88
- September	2,80	0,93	1,99	0,62	-	-
- October	2,43	0,86	2,41	0,80	-	-

IV. Discussion

The number of 25 species identified in the surveyed stations is therefore considered; because agroecosystems are specific ecosystems, intensively exploited and thus artificially regulated [20]. The orthopterologic composition between stations is relatively 12 species in Baba-Ali, 18 in Ain-Taya and 20 in Cap-Djinet. The subfamily Oedipodinae is best represented in our study sites. This observation is consistent with that reported by Benrima [21] and Hamadi [8] in Mitija. We noted that most species are fond of open environments characterized by particularly low herbaceous plants, except for *Pamphagus elephas* which sometimes requires some consistent plant species that serves as a perch, especially during the winter. The species distribution is different from one station to another; 5espèces were recorded only in Cap-Djinet: *Decticus albifrans*, *Gryllulus sp*, *Eyprepocnemis plorans*, *Thysoicetrus annulosus* and *Calliptamus barbarus*; and two species have been related only to Ain- Taya: *Docistaurus jagoin jagoi* and *Omocestus Raymondi*. At the Taza National Park (Wilaya of Jijel) *Dociostaurus jagoi jagoi* is considered among the most frequent Orthoptera [22]. The orthopterofauna inventoried in regions Meftah, Reghaia and Baghalem Mitidja shows the absence of *Omocestus ventralis* (Zetterstedt, 1821), *Omocestus lucasi* (Bissout, 1850), *Acrotylus longipes* (Charpentier, 1845) and *Tropidopola cylindrica* (Marshall, 1835) [23].

We observed in the field that the number of Caelifera is much higher than Ensifera that are very scattered in the plots studied, as in *Odontura algerica*, *Conocephalus Conocephalus* and *Rhacocleis sp*. Total and specific richness recorded in our study sites show a remarkable seasonal variation. The differences are very significant between the months of August, September and October when the number of species of the three stations is high (Fig. 2 and 3). It decreases gradually and then rebound in late spring with the emergence of the adults. The adult phase of an Orthoptera species is a kind of bottleneck through which population numbers are passed [24]. During the months of March, April and May the highest percentage of the orthopterocenosis is formed with larvae, while adults of most species are rarely caught. With the exception of some bivoltine species or with continuous reproduction in the year. We identified *Aiolopus strepens* and *Acrotylus patruelis* in the studied sites throughout the year. Adult species have been captured in several locations in Algeria by several authors throughout their sampling period [25]–[26]–[8],and even reported in National Park of the Ahaggar, the largest mountain range in the extreme south of Algeria [27].

Diversity indices of Shannon-Weaver and evenness allowed us to describe and compare the state of the identified orthopterological in time of settlement. Indeed, the rules that determine faunal composition are simple and result from the combination of the diversity of backgrounds and age of the restoration [28]. We recorded differences in the calculated values for these indices that vary according to the season and are influenced by cultural practices. In this regard, the Shannon-Weaver diversity ranges from 0,76 – 2,80 in Baba-Ali, from 0,00 – 2,41 in Ain-Taya and 0.00 - 3.24 in Cap-Djinet. A variation that may be related to the degree of occurrence of species and depending on environmental conditions; knowing that the cycle of major species is offset by a few days to a month depending on the species and depending on the temperature [9]. At the El Harrach station, Hamadi reports that the values of the diversity index of Shannon-Weaver are high and closely spaced throughout the year of sampling, because this type of area has an important floristic composition with high humidity due to watering plants made during the summer [8]. However, we observe the values of the evenness index very close to 1 for most surveys. This means that each of the identified species is represented by the same number of individual [19]. The most distant of 1 values are recorded for effect January - December in Ain-Taya and Cap-Djinet and May-June in Baba-Ali and Cap-Djinet. Two periods that mark the low temperatures of winter and the breeding season of most orthopteric species.

V. Conclusion

The study of orthopteric diversity conducted in three agroecosystems in northern Algeria; Baba-Ali, Ain-Taya and Cap-Djinet allowed us to identify 5 families, 13 subfamilies and 25 species. Stational total richness is respectively 20 species for Cap-Djinet Station against 18 Ain-Taya and 12 Baba-Ali. Monitoring time of orthopterofauna revealed the presence of 9 species with a large distribution in our study area. They were listed in the three conducted agroecosystems, these are: *Odontura algerica* Brunner, 1878 *Acrida turrita* Linnaeus, 1758 *Oedipoda caerulescens sulfurescens* Saussure, 1884 *Acrotylus patruelis* (Herrich-Schaffer, 1938), *Aiolopus strepens* (Latreille, 1804) , *Aiolopus thalassinus* (Fabricius, 1781) *Pezottetix giornai* (Rossi, 1794), *Ochrilidia tibialis* (Fieber, 1853), *Paratettix meridionalis* Rambur, 1839. Diversity index of Shannon-Weaver is closely related to the degree of occurrence of species. The study sites have a significant diversification of species whose distribution is closely linked to the state of the agroecosystem.

References

[1] S. Jaulin et Y. Baillet, Identification et suivi des peuplements de Lépidoptères et d'Orthoptères sur l'ENS du Col du Coq – Pravouta. Rapport d'étude de l'OPIE – LR, Perpignan, 2007, 107p.

[2] S. ZAHRADNIK, Guide des insectes. Ed. Hatier, Trim.1, Tchécoslovaquie,1988, 318p.

[3] M. Lecoq et J. Mestre, La surveillance des sauteriaux du Sahel. Coll. Acri. opérat, n°2, CIRAD – PRIFAS, Montpellier, 1988, 62p.

[4] E. BOITIER, Caractérisation écologique et faunistique des peuplements d'Orthoptères en montagne auvergnate. Diplôme d'études et des recherches en Sciences de le Vie et de la Terre. Faculté des Sciences et Technologiques, Université Limoges, 2003, 87 p.

[5] R. Fellaouine, Bioécologie des Orthoptères de la région de Setif. Thèse magister, Inst. Nat. Agro., El Harrach, 1989, 127p.

[6] H. Hamdi, Contribution à l'étude bioécologique des peuplements orthoptérologiques de la région médioseptentrionale de l'Algérie et la région de Gabes (Tunisie). Thèse Ing. Agro., Inst. Nat. Agro., EL-Harrach, 1989, 127p.
[7] I. Badenhausser, Estimation d'abondance des criquets (Orthoptera : Acrididae) dans les écosystèmes prairiaux. Ann. Soc. Entomol. Fr. (n.s.), 2012, 48 (3-4) : 397-406.
[8] K. Hamadi, Bioécologie de la faune orthoptérologique en Mitidja. Etude de l'activité biologique d'extraits de plantes acridifuges sur *Aiolopus strepens* (Latreille, 1804) (Orthoptera, Acrididae). Thèse Magister sci.agro., Inst. Nat. Agro., El Harrach, 1998, 172p.
[9] A. Guendouz-Benrima, B. Doumandji-Mitiche et D. Petit, Effects of weak climatic variations on assemblages and life cycles of Orthoptera in North Algeria. Journal of Arid Environments, 2011, pp 1-8.
[10] M. Bounechada, S. Doumandji, B. Çiplak, Bioecology of the Orthoptera Species of the Setifian Plateau, North- East Algeria. Turk. J. Zool., 30 (2006), pp 245-253.
[11] A. Harrat et A. Moussi, Inventaire de la faune acridienne dans deux biotopes de l'est algérien. Sciences et Technologie, C – N°26, décembre (2007), pp. 99-105.
[12] G. Mutin, La Mitidja – Décolonisation et espace géographique. Ed. Off. Publ. Univ., Alger, 1977, 607 p.
[13] J.F. Voisin, Une méthode simple pour caractériser l'abondance des Orthoptères en milieu ouvert. L'entomologiste, Paris, 42, 1986, pp.113-119.
[14] Ph. Dreux, Recherche sur le terrain en autoécologie des Orthoptères. Acrida, n°1, 1972, pp 305-330.
[15] L. Chopard, Orthoptéroide de l'Afrique du nord. Librairie Larose, Coll. Faune de l'empire français, T.I, Paris, 1943, 450 p.
[16] J. Mestre, Les acridiens des formations herbeuses d'Afrique de l'ouest. Ed. CIRAD-PRIFAS, Montpellier, 1988, 330p.
[17] G.B. Popov, Les larves des criquets du Sahel. Ed. Chatham, Ourseas Development Natural, resources institut, V, 1989, 158p.
[18] J. BLONDEL, Biogéographie de l'avifaune algérienne et dynamique des communautés. Sem. Intern. Avif. Algérienne, 5-11 juin 1979, Inst. Nati. Agro., El Harrach, 1979, 1-15 p.
[19] F. RAMADE, Eléments d'écologie. Ecol. Fond., Ed. Mac. Graw-Hill, Paris, 1984, 397p.
[20] R. Barbault, Ecologie générale. Structure et fonctionnement de la biosphère. Ed. DUNOD, 6e éd., Paris, 2010, 390p.
[21] A. BENRIMA, Bioécologie et étude du régime alimentaire des espèces d'Orthoptères rencontrées dans deux stations d'étudesituées en Mitidja. Etude histologique et anatomique du tube digestif de *Dociostaurus jagoi jagoi* (soltani, 1978). Thèse Magister sci. agro., Inst.Nat.agro., El-Harrach, 1993, 192p.
[22] M. Rouibah, Bioécologie des peuplements orthoptérologiques dans trois stations du parc national de Taza (w. Jijel) – Cas particulier de *Calliptamus barbarus* (Costa, 1836) et de *Dociostaurus jagoi jagoi* Soltani, 1978. Thèse Magister Sci. Agro., Inst. Nat. agro., El Harrach, 1994, 129 p.
[23] N. Djenidi, Approche biosystématique des Caelifères de quelques stations en Mitidja et sur l'Atlas tellien, en particulier processus d'invasion de *Schistocerca gregaria* Forsk, 1775 dans la région. Mem. Ing. Agro., Inst. Nat. agro., El Harrach, 1989, 102p.
[24] S. Puissant, Les Orthoptères comme outil d'aide à la gestion des sites de reproduction du grand Tetras. Première contribution. Rapport préliminaire février 2003, OPIE – LR, Languedoc – Roussillon, 2003, 14p.
[25] Y. Zergoun, Contribution à l'étude bioécologie des peuplements orthoptérologiques dans la région de Ghardaia. Thèse Ing. Agro., Inst. Nat. agro., El Harrach, 1991, 71p.
[26] B. Douadi, Contribution à l'étude bioécologique des peuplements orthoptérologiques dans la région de guerrara (Ghardaia). Développement ovarien chez *Acrotylus patruelis* (Herrich-Schaeffer, 1838). Thèse Ing. Agro. Inst. Nat. El Harrach, 1992, 75p.
[27] ML. Kourim, B. Doumandji-Mitiche, S. Doumandji, A. Reggani, Biodiversité entomologique dans le parc national de l'Ahaggar (Tamanrasset, Sahara). Entomologie faunistique – Faunistic Entomology , 63 (3), 2011, 149-155.
[28] D. Petit, Richesse en Orthoptères et succession primaire en Haute – Vienne. Annales Scientifiques du Limousin, 2006, 17, pp. 10 – 19.

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