Studia Universitatis "Vasile Goldiş", Seria Ştiinţele Vieţii
Vol. 32, issue 3, 2022, pp. 92 - 98

ASSESSMENT OF BIODIVERSITY IN HYMENOPTERA AND COLEOPTERA IN NORTHEASTERN OF SAHARA ALGERIA: A CASE STUDY OF OUED SOUF

Mehdi SELMANE[1*], Safa TLIBA[1], Iman BEN ATOUSS[1], Mohamed BENSLAMA[2]

[1]Department of Biology, Faculty of Life Sciences and Nature, El Oued University, Algeria
[2]Laboratory of Soil Development, Department of Biology, Faculty of Sciences, Annaba University, Algeria

Abstract: Our research paper on Coleoptera and Hymenoptera is to deepen our comprehension of quantitative and qualitative wildlife in the Oued Souf region. Oued Souf is situated in the northeast of Algerian Sahara. Sampling captures 71 species from the two analyzed orders Coleoptera and Hymenoptera. Our work contains 04 stations, the census allowed to have 1514 individuals divided into 25 families. The most dominant order is that of Coleoptera with 774 individuals, 44 species, and 14 families, followed by the order of Hymenoptera with 740 individuals distributed over 27 species and 11 families. The specific composition of the Coleoptera showed the dominance of Tenebrionidae by *Pimelia confusa*, *Pimelia interstitialis*, *Eleodes sp* and *Mesostena angustata*, and *Cicindelidae* by *Cicindela flexuosa*. The specific composition of the Hymenoptera showed the dominance of Formicidae by *Pheidole pallidula*, *Camponotus thoracicus*, and *Cataglyphis bombycinus*. The calculation of the diversity index gives a value of "4.07" bit following an equitability of 76.69% at Coleoptera and "2.80" bit following an equitability of 60.42% at Hymenoptera, these indices allow us to observe an important structure of environmental biodiversity. Calculate the degree of the Homogeneity index (T) to prove that shows that there is a relatively large heterogeneity between stations. This heterogeneity indicated a relative imbalance caused by the presence of low-density species.

Keywords: Coleoptera, Hymenoptera, Homogeneity index, diversity, Sahara, Oued Souf.

INTRODUCTION

The biodiversity is a major issue of the 21st century. Insects are among this diversity. They alone account for 70 to 80% of species (Martinez & Gauvrit, 1997). Insect populations also possess considerable genetic diversity and a great potential for adaptation to different or changing environments (Hoffmann & Frodsham, 1993). The microclimate oasis is a suitable habitat for Saharan agriculture, flora, and fauna (Daddi Bouhoun 2010). In deserts, insects are numerous despite adverse living conditions. They show often-remarkable adaptations (Dajoz, 2000). Insects are incalculably valuable to man. They are a fundamental part of our ecosystem. That would include a list of their roles in the pollination of many plants; the decomposition of organic materials, facilitating the recycling of carbon, nitrogen, and other essential nutrients; the direct production of certain foods; and the manufacture of useful products such as silk and shellac (Hickman, C.P. & L. S. Roberts, 1994). Globally, this work comes in the direction of completing the work of different authors such as those made by Benallal *et al*. (2013) in Entomological investigation, the inventory of arthropods has been the subject of a lot of studies including the work of Bekkari and Benzaoui (1991) at Ouargla and Djamaa, Alia and al (2008) and Bousbia (2010). In addition, Selmane *et al*. (2016) in the Oued Souf region have made the study on the biodiversity of fauna by an Inventory of arthropods. Based on previous work related to the study of insects and their diversity in the environment, we conducted a field study on the biological diversity of insects in two different environments, one of which is an olive farm and the other is a palm plantation in the southeastern region of Algeria in Oued Souf. In addition, we have studied quantitative and qualitative to contribute to the knowledge of this group of animals.

MATERIALS AND METHODS

Geographical location

Oued Souf is located in the Southeast of Algeria about 650 km from Algiers and in the North of the Eastern Erg about 350 km west of Gabes (Tunisia). It occupies an area of 80,000 km2 and gathers a set of palm groves growing in a deep crater. The region is limited by the area of the Chotts (Melghigh and Merouane) to the North, the extension of the eastern ERG to the South, the valley of Oued Righ to the West, and the Tunisian border to the East. Oued Souf is at latitude 33°33 N and longitude 6°30 E and has an altitude of 70 m above sea level (**Fig.1**).

Choice of stations

Sampling provides an accurate image of the entire stand from a given area, as small as possible (Lamotte & Bourliere, 1969). These stations are selected based on factors such as vegetation type, altitude and geographic exposure, and accessibility to the sampled stations. We have worked on four stations, which are Dhaouia palm (DP), Dhaouia olive (DO), Hameid palm (HP) and Hameid olive (HO).

***Correspondence**: Selmane Mehdi, El Oued University, Faculty of Life Sciences and Nature, Department of Biology, Algeria, Tel. +213-(782)90472, email: Selmane-mehdi@univ-eloued.dz*

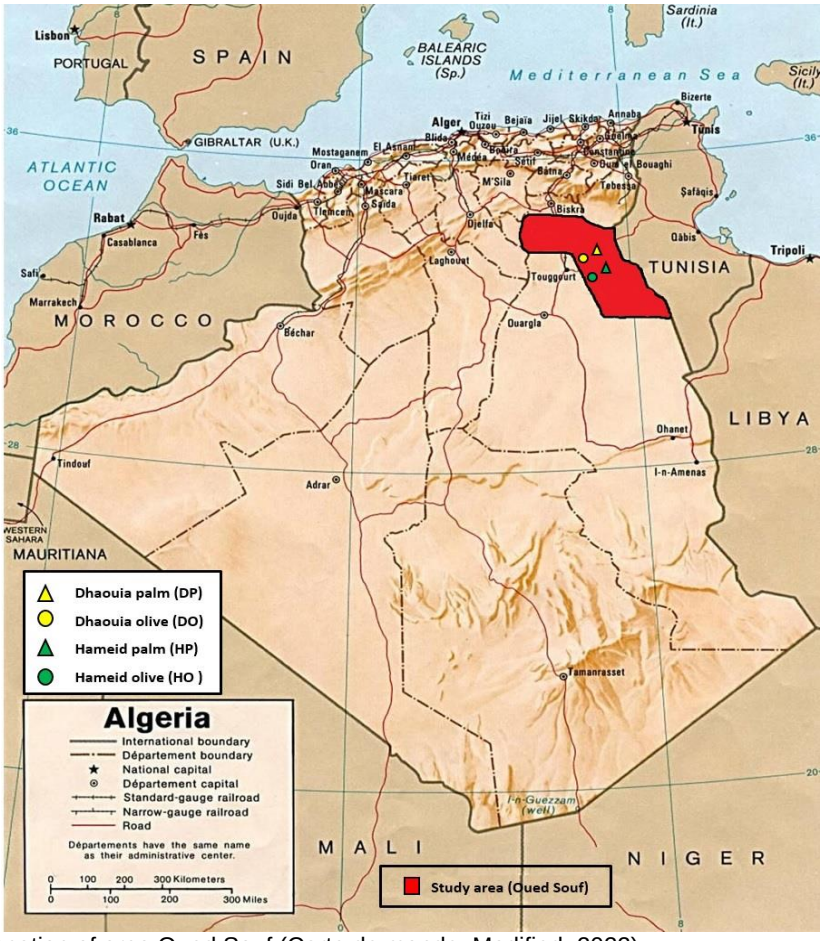

Fig.1. Geographical location of area Oued Souf (Carte de monde; Modified, 2022).

Equipment used in the field

Entomological sampling methods may be characterized according to several criteria allowing the choice, according to its objectives, of the method or methods to be used. (Brustel, 2004). To sample mobile epidemic insects, the most common method is the pitfall trap, or Barber trap (Barber, 1931). The Fauchoire net captured the low-mobility insects, billeted in the grass or bushes (Benkhelil, 1992).

Sampling and determination

We carried out our experiment over a period of 12 months, regularly doing two field trips a month and visiting the stations, which are divided, into two types of cultivation, two stations for olives and two stations for palm groves. Each outlet collects our samples to know the specific composition of the different stands. Species determination is performed at the laboratory using specialized manuals and identification keys (Carter & Hargreaves, 1988) (Chopard, 1943) and (Leraut, 2003).

Ecological Index

Our entomological matrix was valued by applying different ecological indices such as total and average richness, relative abundance of population, structural indices such as the Shannon Weaver diversity index (Vieira Da Silva, 1979), index J of Pielou (1966), and homogeneity index (Benyacoub & Chabi, 2000). Finally, we end with a qualitative parameter, the Factorial Analysis of Correspondences (AFC).

RESULTS AND DISCUSSION

The count of individuals trapped in the stations is 1514 individuals. The total abundance of captured insects is divided into two orders, the Coleoptera with 774 individuals and the Hymenoptera with 740 individuals. The identification showed that the order richest in species is the Coleoptera (44 species with an average richness of 20.75 per station) distributed over 14 families followed by the Hymenoptera (27 species with an average richness of 12.5 per station) distributed over 11 families (**Table 1**).

During the inventory of the Coleoptera, it was noted that the family Tenebrionidae is the most common with 16 species and 457 individuals, followed by Cicindelidae and Nitidulidae with five species and the individuals range between 56 and 99 individuals. The following families: Elateridae, Carabidae, Anthicidae, Ochodaeidae, Staphylinidae, Crypthophagidae, Scarabaeidae, Coccinillidae, Aphodiidae, Cerambycidae and Cetonidae are the least present depending on wealth and abundance (**Fig.2**).

Studia Universitatis "Vasile Goldiş", Seria Ştiinţele Vieţii
Vol. 32, issue 3, 2022, pp. 92 – 98

Table1.

Counting of insects distributed over families and species according to orders in Oued Souf

Orders	Population size (invidious)	Families number	Species richness	Species richness means
Coleoptera	774	14	44	20.75
Hymenoptera	740	11	27	12.5

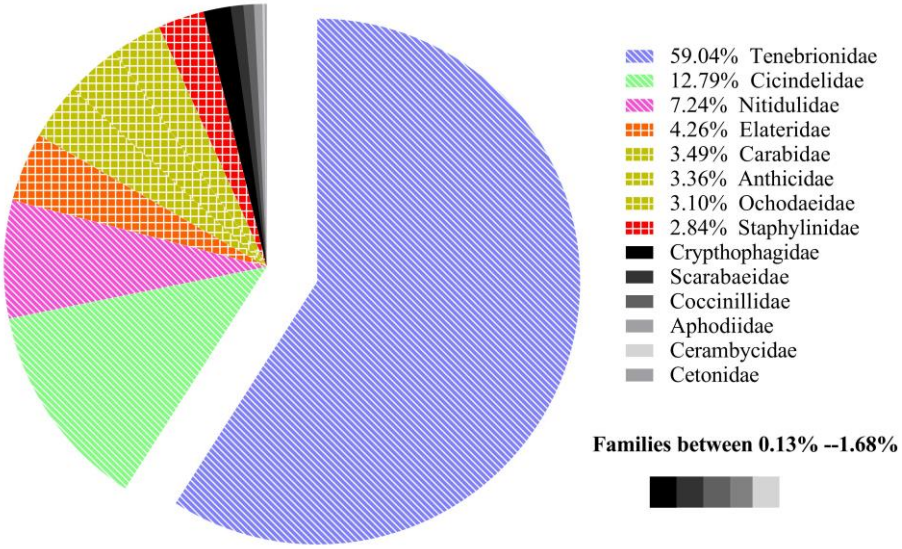

Fig.2. Number of individuals according to families of Coleoptera.

The species of the family Tenebrionidae are the most dominant of the order Coleoptera. It was noted that *Pimelia confusa* (Senac, 1884) dominates with 144 individuals (18.6%), followed by *Pimelia interstitialis* (Solier, 1836a) with 69 individuals (8.91%), *Eleodes sp* (Eschscholtz, 1829). with 64 individuals (8.27%) and *Mesostena angustata* (Fabricius, 1775) with 56 individuals (7.24%). Next, the family Cicindelidae is present in a single species *Cicindela flexuosa* (Linnaeus, 1758) with 99 individuals (12.79%) of the population of Coleoptera. Depending on the abundance, the latter species is ranked second after the Tenebrionidae. The remainders of the Coleoptera species catch list have low numbers ranging from 0.13% to 5% of the total Coleoptera population (**Fig.3**).

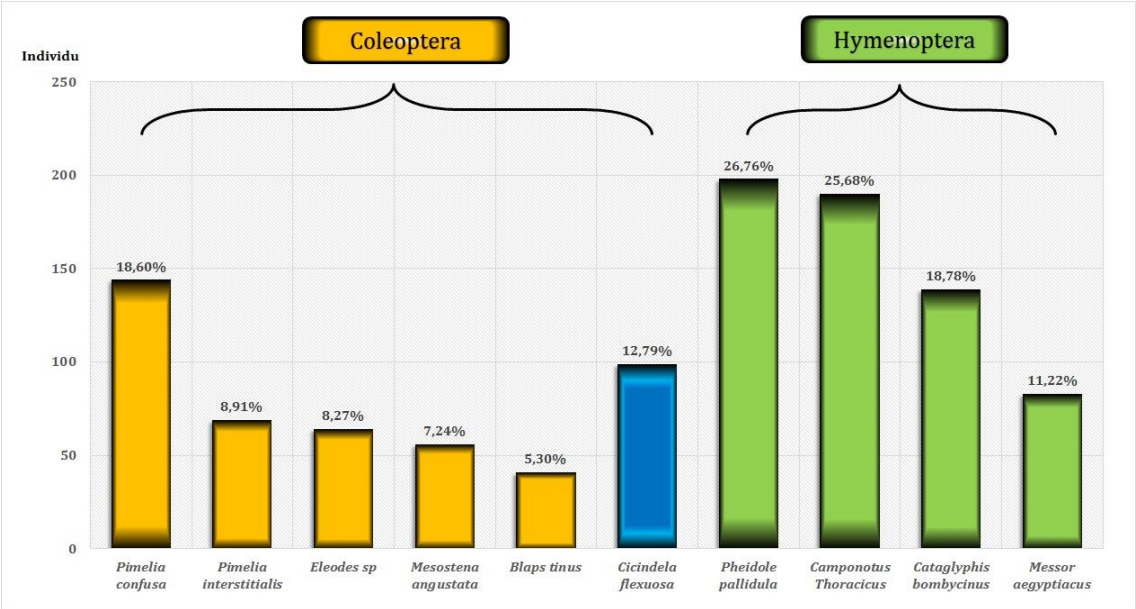

Fig.3. Number of individuals according to the most dominant species of Coleoptera and Hymenoptera.

During the Hymenoptera census, it was noted that the families Formicidae is the most dominant with 9 species and 662 individuals, followed by Pompilidae with four species and 32 individuals. The following families: Scoliidae, Sphecidae, Tiphiidae, Vespidae, Braconidae, Chalcidae, Crabronidae, Halictidae, and Pteromalidae are the least present depending on the

richness between 1 and 3 species and the abundance between 1 and 16 individuals (**Fig.4**).

The species of the family Formicidae are the most superior of the order Hymenoptera. Pheidole pallidula (Nylander, 1849) was found to dominate with 198 individuals (26.76%), followed by Camponotus thoracic (Fabricius, 1804) with 190 individuals (25.68%), Cataglyphis bombycinus (Roger, 1859) with 139 individuals (18.78%) and Messor aegyptiacus (Emery, 1878) with 83 individuals (11.22%). The remaining species have small numbers ranging from 0.14% to 5% of the Hymenoptera population (**Fig.3**).

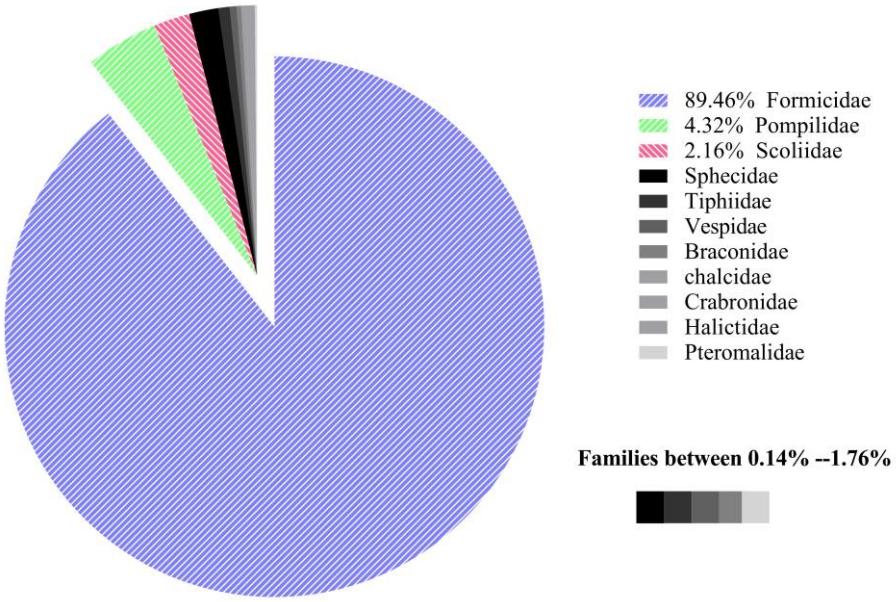

Fig.4. Number of individuals according to families of Hymenoptera.

In our sampling, the values of the diversity of the species-environment are presented in the table. The specific diversity of Coleoptera at the station level equals 4.07 bits with equitability equal to 76.69%. Next, the specific diversity of Hymenoptera at the station level equals 2.8 bits with equitability equal to 60.42%. All the values of equitability are close to 1, so we can say that a number of the species sampled tend to be in balance between them and also reveals that the diversity is good (**Table 2**).

The degree of homogeneity of the population of Coleoptera, measured by T is equal to 47.16%. Comparison of this value with the distribution of species shows that there is a relatively large heterogeneity between stations. This heterogeneity confirms the presence of many species with very low numbers. The homogeneity analysis of Hymenoptera is equal to 46.30%. This latter is close to that of the Coleoptera, indicating a relative imbalance caused by the presence of low-density species (**Table 2**).

Table 2.

Index values of the Shannon-Weaver diversity (H'), of the maximum diversity (H max), J Pielou index, and Homogeneity index (T) applied to insects trapped in Oued Souf.

Value	Shannon Weaver diversity index (H)	H max	J Pielou index (E)	Homogeneity index (T)
Coleoptera	4.07 bits	5.31 bits	76.69%	47.16%
Hymenoptera	2.80 bits	4.63 bits	60.42%	46.30%

The factor analysis of the correspondences applied to the species caught takes into account their presence or absence according to the stations. This parameter makes it possible to highlight the distribution of species according to stations. The graphical representation of Grids 1 and 2 showed that stations are in different quadrants because they have their own list of species sampled (**Fig.5**) (**Fig.6**).

The analysis of the distribution of captured species (**Table 3**) shows the existence of four groups (DP, DO, HP, and HO) specific to each medium. Then we have subgroups formed by the species common between the different stations. The subgroups are divided into two types, type A between each two stations and type B between each three stations. Finally, a group was assembled containing species common between all stations (**Table 3**).

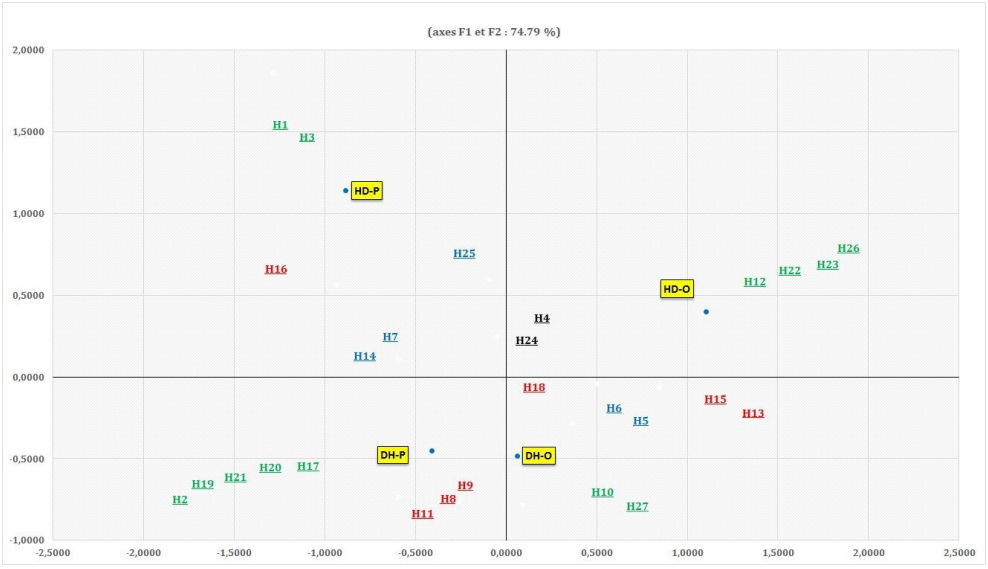

Fig.5. Factorial Analysis of Correspondence applied to species of Hymenoptera.

Fig.6. Factorial Analysis of Correspondence applied to species of Coleoptera.

Table3.

List of different groups of specific species listed and common in Oued Souf region.

Category	Station	Hymenoptera	Coleoptera
Specifies number for each type of station	DP	5	6
	DO	2	9
	HP	2	3
	HO	4	3
TYPE A Common species between two types of station	DO-HO	2	1
	DO-DP	3	8
	DO-HP	/	2
	HO-DP	1	3
	DP-HP	1	/
TYPE B Common species for the three types of station	DO-HO-DP	2	/
	HO-DP-HP	1	/
	DO-DP-HP	2	2
Common species for all types of station	DO-HO-DP-HP	2	7

DP: Dhaouia palm; **DO**: Dhaouia olive; **HP**: Hameid palm; **HO**: Hameid olive.

By viewing the results, we reported the Coleoptera that represents 14 families distributed over 44 species. According to Auber (1945) the diversity of the form and color and the facility of harvest of the Coleoptera, are all criteria sought by entomologists. Also, authors Hammond PM (1992), and Alex and Maurice (1993) confirm that Coleoptera is the richest in species because they represent between 350,000 and 400,000

species of insect in the world. Then, Hymenoptera counts 11 families and 27 species. Ants are undoubtedly among the most common insects and they meet in the majority of the terrestrial ecosystems (Passera & Aron, 2005). Their global biomass will go beyond even that of humans (Hölldobler & Wilson 1996; Passera & Aron 2005). With more than 12500 species described to date (Agosti and Johnson, 2005), this group of insects is of great interest as a biodiversity indicator (Alonso, 2000). On the other hand, Alia (2008) in the Oued Souf area (case of two Debila and Ghamra stations); we found 50 species of Coleoptera, Hymenoptera 20; Additionally, the author Aggab (2009) recorded order Coleoptera with 17 species in the Debila and Hassi Khalifa area, and Hymenoptera with 16 species. According to Selmane (2015), he collected 12 species of Coleoptera in the Oued Souf area and 5 species of Hymenoptera.

Through our results obtained, the factor analysis of the matches (F.A.C) and the degree of homogeneity are identical to the work of SELMANE (2015, 2016), by the presence of a specific difference and a low homogeneity for each station. Then, the comparison of the results with that of SELMANE (2015, 2016) confirmed the dominance of beetles according to the specific richness and the total abundance of insects that Hymenoptera. The ability of certain insect groups to adapt to all environmental conditions is among the factors that allow the dispersal of Coleoptera and Hymenoptera in the region studied. Then, the need for nutrients, the ecological role, and the presence of intra-action between individuals, such as the ant community are agents that control their presence.

CONCLUSIONS

At the end of this work, this study is a contribution to the study of insects in the region of Oued Souf. Several methods of capture were used for insect sampling. The sampling makes it possible to list 1514 individuals, divided into 02 orders and 25 families. In our study, we conclude that there is a minor difference between the stations studied according to specific richness. In the entomological contribution in the study area, it was also concluded that there is a relationship between the species and their effective distribution at the stations. The latter is confirmed by the calculated diversity and similarity indices where the simplicity of the ecosystem has been noted. The purpose of this study is to demonstrate the value of biodiversity for the two analyzed orders. They make up a considerable portion of the biomass in beetles and other Hymenoptera, especially in the area under study. They play a crucial role in food chains and have a significant impact as consumers and decomposers, among other things. Then, in some areas of semi-arid and arid zones, you might discover that both orders are very significant pollinators. By taking part in the soil's nutrient recycling process, beetles play a crucial ecological role from the perspective of agriculture. However, a number of beetle and hymenopteran species are used as crop auxiliary pest control agents, particularly to substitute phytosanitary chemicals in biological management due to their entomophagous activity as predators. These insects conceal many scientific miracles that must continue to be researched, studied, and exploited in various fields that concern man and his life. In light of this, we can say that it would be interesting to increase sampling efforts in the future and, in particular, that we need to think about using other trapping techniques in order to get results that are more accurate, i.e., create a faunal inventory that can account for the greatest number of species present in the environment. In order to have additional examples of the diversity of beetles and Hymenoptera in the region studied, it would also be interesting to expand the study to other stations in the region and to add various types of cultures and habitats.

AUTHOR CONTRIBUTION

Conceptualization, S.M. and B.A.I.; methodology, S.M.; data collection, B.A.I. and T.S.; data validation, S.M., B.A.I. and T.S.; data processing, S.M.; writing - review and editing, B.M.

FUNDING

This research received no external funding.

CONFLICT OF INTEREST

The author declares no conflict of interest.

REFERENCES

Aggab A. Caractérisation de la faune arthropodologique dans la région de Souf, Mémoire, ING, Université Ouargla, Algérie, P94,2009.

Agosti D, Johnson NF, Editors. Antbase. World Wide Web electronic publication. antbase.org, version,2005.

Alex OELOBEL et Maurice TRAN. Les Coléoptères des denrées alimentaires entreposées dans les régions chaudes, Faune tropicale XXXII. Ed, Orstom / CTA, paris. 1993.

Alia Z et Ferdjani B. Inventaire de l'entomofaune dans la région d'Oued Souf cas de deux stations (Dabadibe et Ghamra), Mémoire, ING, Université Ouargla, Algérie, 2008.

Alonso L. Ants as indicators of diversity. In: Agosti D, Majer J, Alonso L, Schultz T. Standard methods for measuring and monitoring biodiversity. Smithsonian Institution Press, Washington and London, P80-88, 2000.

Barber HS. Traps for cave-inhabiting insects. Journal of the Elisha Mitchell Scientific Society; 46: P259-266, 1931.

Bekkari A, Benzaoui S. Contribution à l'étude de la faune des palmerais de deux régions de sud-est algérien (Ouargla et djamaa). Mémoire, ING, Université Ouargla, Algérie, 1991

Benallal, K., B. Gassen, L. Bouiba, J. Depaquit and Z. Harrat. Entomological investigation following the resurgence of human visceral leishmaniasis in southern Algeria. Acta tropica 128(3): P518-521, 2013

Benkhelil ML. Les techniques de récolte et de piégeage utilisées en entomologie terrestre. Univ.Alger, P60, 1992.

Benyacoub Slim Et Chabi Yassine. Diagnose écologique de l'avifaune du parc national d'el Kala. Revue des sciences et technologie, synthèse ; université Annaba. N 7 : P16, 2000.

Bousbia R. Inventaire des arthropodes dans la région d'oued Souf. Mémoire, ING, Ouargla University, Algeria, 2010.

Brustel, H. "Polytrap™" a window flight trap for saproxylic beetles. 3rd Symposium and Workshop on the Conservation of Saproxylic Beetles. Riga / Latvia, 7th-11th July, Poster, 2004a.

Daddi Bouhoun M. Contribution à l'étude de l'impact de la nappe phréatique et des accumulations gypso-salines sur l'enracinement et la nutrition du palmier dattier dans la cuvette d'Ouargla. Thèse. Annaba University,2010.

Dajoz R. Précis d'écologie. Ed, dunod, paris, P112-442, 2000.

Carte de monde: http://www.carte-du-monde.net/ (accessed date: 1 April, 2020)

Carter DJ, Hargreaves B. les papillons d'Europe. Ed. Masson and Cie, Paris, P215, 1988.

Chopard L. Orthopteroides de l'Afrique du nord .Ed. Larousse library, paris, P447, 1943.

Hammond PM. Species inventory. Global Biodiversity. Status of the Earth's Living Resources. A Report Compiled by the World Conservation Monitoring Centre, ed Groombridge B (Chapman and Hall, London), P17–39, 1992.

Hickman, C.P. and L. S. Roberts. Animal Diversity. Wm. C. Brown, Dubuque, IA.)//(Brusca, R. C., and G. J. Brusca. Invertebrates. 1990. Sinauer Associates, Sunderland, MA.)//(Pearse, V., J. Pearse, M. Buchsbaum, and R. Buchsbaum. 1987. Living Invertebrates. Blackwell Scientific Publications, Palo Alto, Ca.). 1994

Hoffmann, M.P. and Frodsham, A.C. Natural Enemies of Vegetable Insect Pests. Cooperative Extension, Cornell University, Ithaca, NY. P63. 1993.

Hölldobler B, Wilson EO. Voyage chez les fourmis. Ed du Seuil, Paris. P247. 1996.

Lamotte M, Bourliere F. Problèmes d'écologie : l'échantillonnage des peuplements animaux des milieux terrestres. Ed. Masson and Cie, paris, P303. 1969.

Leraut P. Le guide entomologique. Ed. Delachaux and niestle, paris, P527, 2003.

Martinez M. & Gauvrit B. (1997). Combien y a-t-il d'espèces d'Insectes en France ? Bulletin de la Société entomologique de France, 102 (4) : P319-332.

Selmane M and Benslama M. Contribution to the study of soil macrofauna under Palm groves in the Northeast of the Algerian Sahara (Oued Souf area). Journal of Biodiversity and Environmental Sciences; 6(6): P203-213. 2015.

Selmane, M., I. Ben Atouss, S. Tliba, A. Farej and F. Marnich. Contribution to the study of insects in the northeast of the Sahara of Algeria (El Oued region). Journal of Entomology and Zoology Studies 4: P203-206. 2016.

Passera L, Aron S. Les fourmis: comportement, organisation sociale et évolution. Presses scientifiques du CNRC, Ottawa. P480. 2005

Pielou E. C. Species diversity and pattern diversity in the study of ecological succession. J. Thes. Biol.1: P370-383. 1966.

Vieira Da Silva. J. Introduction à la théorie écologique. Masson. P112. 1979.