

Article

Phoenicicole habitats' Entomofauna of Algerian South

Nacima Deghiche-Diab^{1*}, Tesnim Deghiche²

1 Scientific and Technical Research Center on Arid Region (CRSTRA). P.O Box 1682 RP. 07000. Biskra, Algeria.

2 Biological Sciences Department. Mohamed Khider University. Biskra. P.O Box 145 RP. 07000. Biskra, Algeria.

*Correspondence: diab_nassima@yahoo.fr

Abstract: Due to its geographic location and its specific climate, Biskra region hosts a large number of natural and artificial habitats. In order to study structural and functional variability of entomofauna in palm grove, a periodic sampling at Ain Ben Noui from 2018 until 2019 was carried out while being based on ecological indices and statistical analyzes. In total, Palm grove habitat presents the greatest wealth with 10 orders grouping 148. Coleoptera order being the most dominant with 41 species. Pests' group characterizes palm grove ecosystem with 48species (32.43%) against predators 42species (28.38%). Results of the ecological indices ; diversity of Shannon ($H_p = 3.33$), of equitability ($E_p = 0.80$) and of Margalef ($I_p = 9.30$), calculated indicate a significant diversity of insects species present in balance with each other. Those results were confirmed by statistical analyzes.

Keywords: entomofauna, palm grove, Ziban, ecosystem, Diversity, satat.

Received: 23 January 2023

Accepted: 17 May 2023

Citation : Deghiche-Diab, N.; Deghiche, T. Phoenicicole habitats' Entomofauna of Algerian South . *Journal Algérien des Régions Arides*. 2023, 16 (1) :38–45.

Publisher's Note: ASJP is an electronic publishing platform for Algerian scientific journals managed by CERIST, that is not responsible for the quality of content posted on ASJP.



Copyright: © 2022 by the CRSTRA. Algerian Journal of Arid Regions is licensed under a Creative Commons Attribution NonCommercial 4.0 (CC BY NC) license.

1. Introduction

The large number of insects [1] makes them the basis of the animal and plant world, without insects no life would be possible [2]. The diet of insects is rich and diverse, some species are phytophagous, others are zoophagous or even polyphagous [3]. They are equally important agents for the fertilization of millions of plants but are also the basis of food webs [4]. This is why knowledge of the diet is one of the essential elements for defining ecological niches and understanding the spatio-temporal use of trophic resources by species [5]. The trophic relationships that characterize the Ziban oasis ecosystem was studied.

2. Materials and Methods

2.1. Study area and sampling sites

Covering an area of 2 035.978 km², Biskra region (34°, 48' N and 5°, 44' E) is one of the wilayats of southern Algeria. It is located at the south east of Algeria, limited by the province of Batna in the north, to the North-West by M'Sila and Ouled Djellal, to the North east by Khenchela, to the south by El Oued and Ouargla [6]. Its' vast expanse, combined with geological and geographic characteristics as well as climatic factors, show a series of ecosystems, sheltering a diversity of forests, mountains, plateau, steppes and oasis habitats, offering a diversity of animal and plant species (Figure 1).

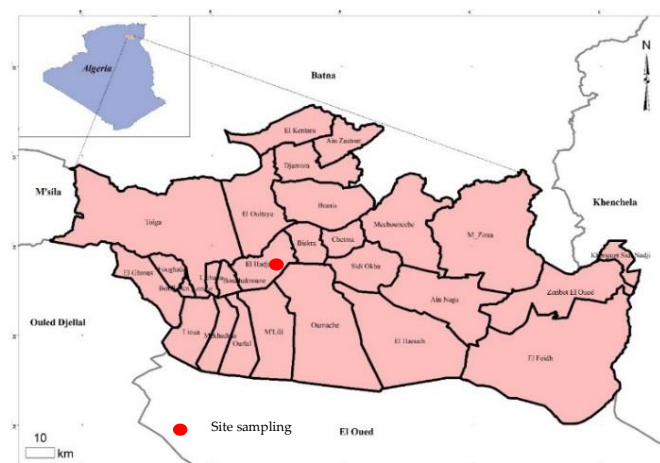


Figure 1. Location of study area

2.2. Sampling methods and identification

In order to collect insects species, pitfall traps are often the most widely used sampling technics [7, 8, 9, 10]. For this, three (3) transparent cylindrical pots of 15 cm deep and 20 cm diameter was filled with 2/3 water containing a detergent were installed in three plots chosen in an area of 1 ha (Figure 1) spaced 3 to 5m between pots and 10-30m between plots. The traps were continuously visisted (4 times/month). The collected specimens were kept in tubes containing 75% alcohol to be further identifiacted using keys [11, 12, 13,14] and guides [15, 16, 17, 18, 19, 20, 21, 22] in laboratory under magnifier binocular.

2.3. Data treatment

The obtained results of the sampling insects specimens from palm grove ecosystem during 2018-2019 were treated using a statistical processing with [23] XLSTAT software (2016.V.3.1).

2.4. Principal Component Analysis (PCA)

Principal Component Analysis (PCA) is one of the most widely used multivariate data analysis methods. It makes better plane representations of individuals and variables [24, 25]. Its objective is to represent in a simplified graphical form, the maximum information of the data and the variables (variables in reduced number contained in a table of quantitative data) resulting from a sampling procedure [26]. This reduction in the number of variables causes a loss of information; the PCA proceeds that this loss is as low as possible [27].

Principal Component Analysis provides both optimal visualization of variables and data, and biplots mixing the two [28]. These representations are reliable only if the sum of the percentages of variability associated with the axes of the representation space is sufficiently high. If the percentage is low, it is advisable to make representations on several pairs of axes in order to consolidate the interpretation made on the first two factorial axes.

2.5. Interpretation of graphs

The graphical representation of the variables in the k-factor space makes it possible to visually interpret the correlations between the variables on the one hand, and between the variables and the factors on the other hand. Observations and variables are represented in factor space as two distant points in k-dimensional space but which may appear close in 2-dimensional space depending on the direction used for the projection. We can consider that the cosine as an indicator of the proximity of a point to an axis in a plane, that is to say the closest to 1. The squared cosines are displayed in the results proposed by XLSTAT in order to avoid any misinterpretation. It is interesting to study the relative contribution expressed in percentage or in proportion of the different variables to the construction of each of the factorial axes [23].

2.6. Ascending Hierarchical Classification (AHC)

The Ascending Hierarchical Classification (AHC) consists in gradually aggregating individuals according to their resemblance, it produces a series of nested partitions of the objects to be classified, measured using an index of similarity or dis-similarity (a measure of distance). The AHC produces a binary classification tree (dendrogram), the root of which corresponds to the class by grouping together all the individuals [23].

3. Results

3.1. Insect Systematics

The trapping system set up at Ain Ben Noui palm grove during the study period indicated the identification of 148 species divided into 61 families and 11 orders. Beetles group was the best represented with 41 species covering 10 different families. The Hymenoptera order was represented by 35 species and 15 families, Lepidoptera and Hemiptera are in the third position with 13 species. The less represented order was from Embidae family. The Hymenoptera order represent a very important group under palm grove where it group together visiting species of flowers feeding on nectar and fertilizing crops [26] some others are important agent (parasitoids) for maintaining crops pests in balance. From September until June, the number of species under palm grove varies from one month to another and from a season to another, it fluctuates between 15 and 55 species. it is noted that this period favors the proliferation of plants, thus providing a site for egg-laying for certain groups of insects, or shelter or more food for other groups of phytophagous. The diversity of plant resources in the palm grove is a very important ecological factor [29] if present in low densities can have an effect on the number of insects species. These results thus demonstrate the beneficial effect of spring climatic conditions on the resumption of insect stand activity in the oasis.

Seasonal variation is also significant for both total wealth and average wealth. During December and January we recorded the lowest values 0.16 and 0.24, however the highest value is obtained during June (7.58) through March (4.49), April (6.78), May (8.64). This variation is related to the environmental conditions and the presence of cultivated crops. The height presence of weedy plants provide more nesting and refuge habitats for insects.

By using the ecological indices it is noted that the highest densities and the most abundance species were *Musca domestica* (3.37%), *Coccinella septempunctata* (3.20%), *Orthoptera Acrida pellucida algeriana* (2.68%) and Hymenoptera *Polistes dominula* (2.60%). Among the 148 insect species retained, only 7 are constant species (51.11% $\pm$ 66.67%). Sporadic species were the most represented with 71 species of which 43 are qualified as rare to very rare species. The obtained values for species caught during the study period in the palm grove are characterized by a moderately high value (3.33 bits) of the Shannon-Weaver diversity index this value indicates that the species caught are diverse. This diversity is clearly variable from month to another, with distinct peaks in September (3.8bits) and October (3.0bits). A considerable decrease from November was observed, almost cancelling out in December and the diversity begins to increase again from March until it reaches a maximum in April (4.29bits), May (4.32bits), and June (4.29bits). The evenness average value obtained is equal to $E=0.80$ and shows that the numbers of the different species caught are in equilibrium between them. Their distributions as a function of the months show that the month of December presents the least diversified month in terms of species (0.91), which is explained by the presence of only one species dominating the others [30]. The results of the Margalef diversity index of collected species indicated an average index of 9.30, that is clearly variable from month to another. The highest value was recorded during May (15.43), June (14.78) and April (14.68), from November to February the biocenosis decreases considerably.

The monthly variation in insects' species was probably related to the diversity of crops planted in each period, this conditions promotes the presence of an effective number of predators and parasites for maintaining a low diversity of insect species over the periods of the year [31]. Because insects are poikilotherms whose climatic conditions of the environment determine the level of their body temperatures [32] and forces them to spend the bad season as nymphs or adults in the soil or in plant debris (hibernation). The Migration is another phenomenon that explains the low diversity in habitat that offers a favorable condition [33, 34]. Whereas the dominant species plays a major role in the functioning of ecosystems [35] and is involved in maintaining their equilibrium [36, 37].

Three large groups have been identified under the oasis ecosystem. The largest group was of phytophagous with 77 species (49%), followed by the zoophagous group that was represented by 56 species (36%) and polyphagous by 17 species (15%). The phytophagous were species that feed on spontaneous or cultivated plant which can have economic problems (*Tuta absoluta*, *Sesamia nonagrioides*, *Aphis fabae*, *Frankiniella occidentalis*, *Bactrocera oleae*, *Apate monachus*, ... [38, 39, 40, 41].

An important number of pollinators was collected under oasis ecosystem (29 species), the best known were *Bombus terrestris*, *Xylocopa violacea*, *Andrena afrensis*... these species are the subject of studies concentrated in eastern Algeria [42, 43, 44].

The predatory group includes 42 species that are almost equivalent to the category of pest species (48 species) that keep an ecological balance in the habitat. Predation in the oasis environment characterizes species, *Psyllobara viantiduo-punctata*, *Coccinella algerica*, *Polistes gallicus*, *Megascolia maculata*, ...

As reported [45 coleo], a new recorded species *Diomus* sp and *Scymnus frontalis* were added to the list of predator species of the white date palm scale, those species were not included before in the list established by [15, 16], it was first described in Iran but never in Algeria. Some Parasitoids species were also collected, that provide control of existing pests; *Bracon hebetor*, *Dinocampus* sp, *Ophion luteus*, *Arachnospila* sp., *Orius laevigatus*, *Systoechus vulgaris*, *Cryptocheilus notatus*, *Caliadurgus fasciatellus*, ... were also collected.

The polyphagia concerns species that can present a varied diet (phytophagous and zoophagous) under different conditions (stage of development, mouthparts, availability of food...), they are represented by 11% against 2% for each of the saprophagous and coprophagous.

The large number of phytophagous groups under oasis ecosystem can be explained by the diversity of intercrops (vegetable crops, gardening, fruit trees and fodder) as well as the presence of a large number of weeds plant especially during the spring period that are used by insects as shelters [46]. The importance of the phytophagous group has always been pointed out by the authors having worked under oasis system, [47, 48, 49, 50].

The study conducted by [51], in both natural and cultivated environments in Ghardaia region indicates a richness of 15 species of parasitoid and hyper-parasitoid from Hymenoptera order belonging mainly to Braconidae, Megaspilidae, Encyrtidae, Pteromalidae, Alloxystidae families. [52, 53], adds that species of *Lysiphlebus* genus have a great capacity of adaptation to different climatic conditions which explains their presence in the cultivated as well as natural environment. Beetles that play an important ecological role [54] are the most represented order in the world and are characterized by a diversified way of life [49].

In order to highlight the distribution of collected species from palm groves habitat. The observation to the contribution of these species to the total inertia that is greater than 80% until the 5th axis was done. For the determination of the closest observations, the squared cosine of each point on the plane of the factorial map is used to obtain indications of the values corresponding to each of the observations (highest value) [55].

By reading figures 2a,b the F1 axis explains a cumulative information of 29.12% of the overall information of our sample that is related to December, January, February and

May. This relationship are explained by the climatic conditions of the months characterized by the lowest temperatures that induces a decrease in the biocenosis and a low rate of insect activity. The F2 axis explains 18.97% of the overall information of our sample most contributed by April characterized by a significant diversity of insect species. The F3 axis explains 14.05% of the overall information of our sample by the contribution of June that represents an optimum activity in the habitat. The F4 explains 11.27% of the overall information of our sample by the contribution of July where a gradual decline in species activity is observed corresponding to harvest crops planted under palm trees where the floral fauna decreases. The F5 axis explains only 7.78% of the overall information of our sample.

According to the reading of figure 2c,d the F1 axis explains a cumulative information of 29.12% of the overall information of our sample and which relates to the months of December, January, February and May. This relationship explains the climatic conditions of the months characterized by the lowest temperatures and which induces a decrease in the biocenosis in the environment and which reflects a low rate of insect activity. In addition, the F2 axis explains 18.97% of the overall information of our sample (Figure 53a), of which the month of April is the most contributory, this month reflects a significant diversity of species following the diversity of resources for the feeding, multiplication and refuge with no chemical treatment. The F3 axis explains 14.05% (Figure 2b) of the overall information of our sample by the sole contribution of the month of June, which represents the optimum of activity in the habitat.

By using the projection on a Factorial map of variables (2e,f,g,h), the first axis F1 that explains 29.12% of the overall information is well correlated with 51 different species (*Erodium emondi*, *Cicindela flexuosa*, *Colias crocea*, *Tapinoma nigerrimum*, *Ischnura pumilio*, *Aeolothrips intermedius*..... The F2 axis (18.97%) is correlated with 29 species; *Adalia bipunctata*, *Thrips tabaci*, *Psilothrix viridicoerulea*, *Danaus chrysippus*, *Megascolia maculate*, *Aphis craccivora*,..... Similarly, the F3 axis (14.05%) is correlated to 23 different species including *Aspidapion aeneum*, *Cleonis pigra*, *Zabrus tenebrioides*, *Camponotus aethiops*, *Sympetrum sanguineum*, *Ischnura pumilio*, ... Only 11.27% of the overall information is explained by the F4 axis correlated to the 13 species (*Chorthippus* sp., *Messor barbara*, *Arachnospila* sp., *Glauropsyche melanops*, *Scarabaeus sacer* ...

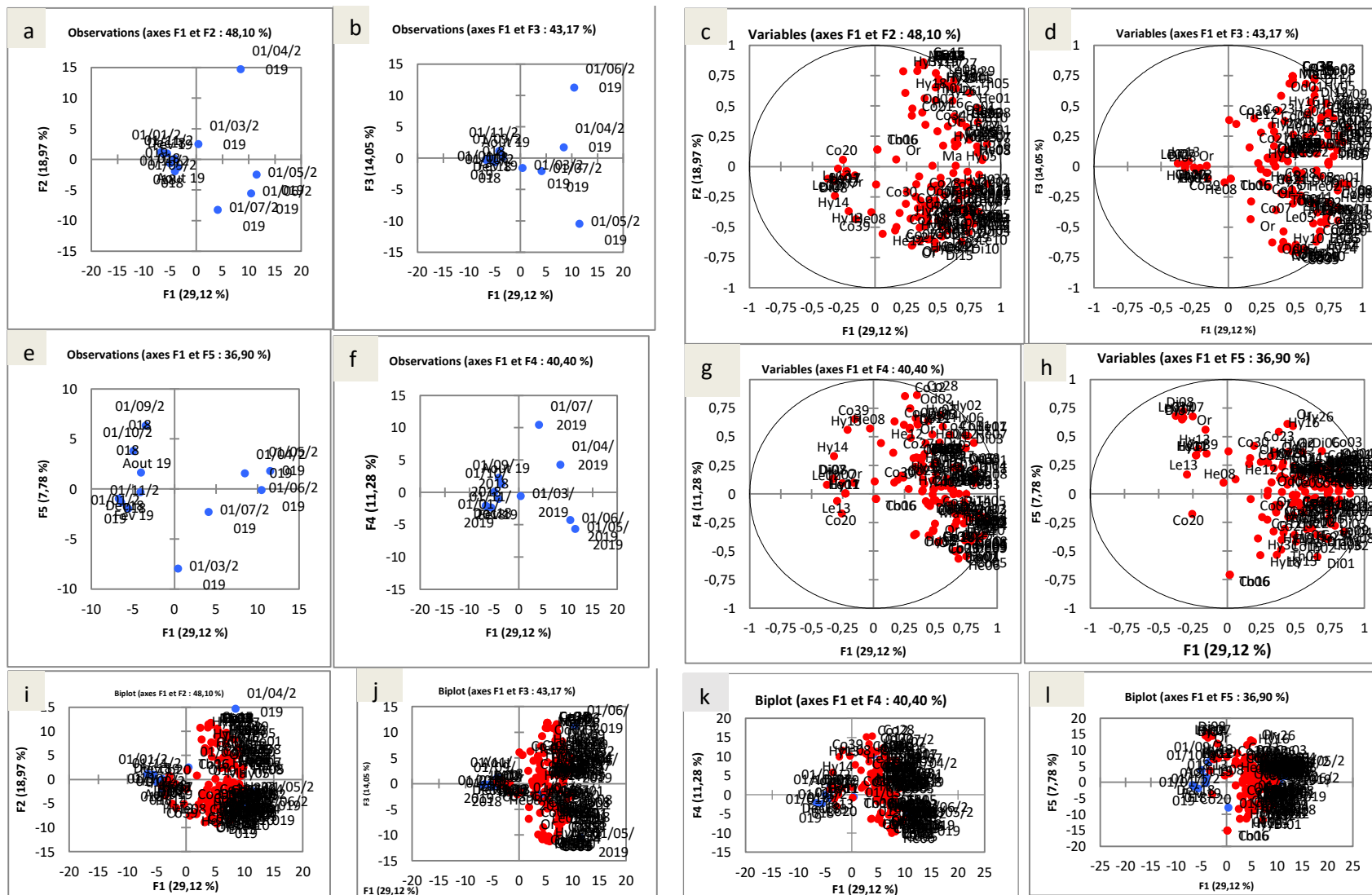


Figure 2a-d. Representation of the observations(months) on the factorial plan of a PCA. **e-h.** Representation on a factorial map of the variables (species). **i-l.** Simultaneous representation of variables and observations on a factor plane of a PCA.

The simultaneous representation of variables and observations on the plane of a PCA aims to bring out the most important groups (Figure 2i,j,k,l). A strong aggregation of species, *Cybocephalus Palmarum*, *Danaus chrysippus*, *Hylaeus affinis*, *Bracon hebetor*, *Aphidius ribis*, *Sphaerophoria scripta*, *Neoitamus* sp. Was observed around April that constitute the first group. Another group (*Stenotus binotatus*, *Aphis fabae*, *Frankliniella occidentalis*, *Syrphus vitripennis*, *Melanostoma mellinum*, *Pieris brassicae*, *Colias crocea*,... was observed around June which seems to oppose April. The third group that highlighted September, October, November, December, January and February that was correlated to *Sesamia nonagrioides*, *Venessa cardui*, *Camponotus forelli*, *Belonogaster juncea*, *Eumenidae* sp., *Sceliphron destillatorium*, *Bactrocera oleae*, *Dicranocephalus Albipes*, *Scymnus frontalis* sp.,...

5. Conclusions

Height biodiversity of fauna species from insecta class was observed during our study conducted under oasis ecosystem, The important presence of species during spring time was related to different biotic (host plants and predation) and abiotic (temperature, humidity, type of sol,...) conditions. Those results was also clearly indicated by using ecological indices and confirmed by statistical analysis.

References

- Hoffmann, B.S. and Vaughan, D.M.. Endangered insects. Dans : resh,V.H, et R.T carde (edir). The encyclopedia of insects . academic press, san diego, **2003**, p 363-368..
- Nowak, J. Histoire de la classification. Entomologic. L'entomologie à la portée de tous. P 1-10, **2011**.www.GdeFon.com.
- Aouissi, H.A., Deghiche-Diab, N., Farhi, Y.. *Etat actuel de la faune Algérienne, sauvage et domestique*. Edition Universitaires Européenne, **2021**, 149 p,
- Schoenly, K., Beaver, R. A. and Heumier, T. A. *On the Trophic Relations of Insects: A Food-Web Approach*. The American Naturalist, **1991**, 137(5), 597-638.
- Boukhemza, M., Etude bio-écologique de la cigogne blanche (*Ciconia ciconia* L. 1775) en Kabylie : analyse démographique, ethnobotanique et essai d'interprétation des stratégies trophiques. Thèse Doctorat. INA. El Harrache. **2000**, 188p.
- Deghiche-Diab, N., Deghiche T. New records and check list of arthropods from two oasis ecosystems in Algeria. *Studia Universitatis Babeş-Bolyai Biologia*, 67, 1, 89-105. doi:10.24193/subbbiol. **2022**.1.05.
- Hertz, M. Huomioita petokuoiraisten olinpaikoista. *Luonnon Ystävä*, **1927**, 31 (218-222).
- Barber, H.S.. Traps for cave inhabiting insects. *Journal of the Elisha Mitchell Scientific Society*. **1931**, 46 :259-266..
- Benkhelil, M.L. *Les techniques de récolte et de piégeage utilisées en entomologie terrestre*. Ed. OPU, Alger, **1991**. 66 p.
- Deghiche-Diab, N. Inventory of insects in the oases of Ziban, Biskra- Algeria. Master Thesis of Science, IAM, Bari, Italy. **2009**, 70p.
- Chopard, L. *Orthopteroïdes de l'Afrique du Nord*. Larose, Paris, **1943**. 450 p.
- Villiers, A. *Coléoptères Cérambycides de l'Afrique du Nord*, Faune de l'Empire Français, ORSC Paris, **1946**. 5: 152p.
- Blackman, R.L., Eastop, V.F. *Aphids on the World's Trees: an Identification and Information guide*. Ed. C.A.B. International, Wallingford, **1994**. 987 p,
- Blackman, R.L and Eastop, V.F. *Aphids on the World's Crops , An identification and information guide*. Ltd JWS (ed.), The Natural History Museum, London, **2000**. 466 p.
- Chinery, M. *Collins guide insects of Britain and Northern Europe*. 3rd ed of (1973). Harper Collins publishers. London, **1993**.
- Didier, B., Guyot, H. *Guide pratique des plantes et leurs insectes*.Quuae. Opie. **2011**. 192p.
- Saharaoui, L., Hemptinne, J.L., Magro, A. Biogéographie des coccinelles (Coleoptera: Coccinellidae) d'Algérie. *Entomologie Faunistique*. **2014**, 67 , 147-164.
- Saharaoui, L., Les coccinelles algériennes (Coleoptera, Coccinellidae) : analyse faunistique et structure des communautés. Biodiversité. Thèse Doctorat. Université Paul Sabatier, **2017**.Toulouse. 195p.
- Hampt, H., Hampt, J. *Guide des mouches et des moustiques l'identification des espèces européennes Allemmenggne.de la chaux et Nustlé*. 350 p. **1998**.
- La Planches, G., Gorge A. *Papillons de méditerranée*. Edition Sud., **2008**, 203 p.
- Brague-Bouragb, N. *Guide de quelques artropodes en région semis arides*. MADR, INRF, **2010**, 100 p.
- Dozière, A., Valarcher, J., Clément, Z. *Papillons des jardins, des prairies et des champs. Guide de terrain pour les observatoires de sciences participatives*. Escourbiac, **2017**, 133.
- XLSTAT. <https://www.xlstat.com/fr/solutions/fonctionnalites/analyse-en-composantes-principales-acp>

24. Dufour, A.B., Lobry J.R. Initiation à l'analyse en composantes principales Logiciel R version 2.11.1. **2010**, 18p. <http://pbil.univ-lyon1.fr/R/pdf/tdr601.pdf>.
25. Rakotomalala R. Analyse de corrélation. Étude des dépendances-Variables quantitatives Version 1.1. Université Lumière Lyon. **2015**.
26. Bardgett, R.D., Van der Putten, W.H. Belowground biodiversity and ecosystem functioning. *Nature*. **2014**, 515, 05-11. <https://doi.org/10.1038/nature13855>.
27. Legendre, L., Legendre P. *Ecologie numérique: la structure des données écologiques*. Tome 2. Ed. Masson. Paris. **1979**, 255p.
28. Champely, S. Introduction à l'analyse multivariée (factorielle) sous R. **2005**, 57p.
29. Dajoz R. *Précis d'écologie*. Ed. Dunod, Paris, **1970**, 434 p.
30. Grall J., Coïc N. Synthèse des méthodes d'évaluation de la qualité du benthos en milieu côtier. Institut Universitaire européen de la Mer. Université de Bretagne Occidentale Laboratoire des sciences de l'Environnement Marin, **2006**, 86p.
31. Barbault, R. *Ecologie des populations et des peuplements*. Ed. Masson et Cie, Paris. **1981**, 200 p.
32. Feiled, P.G. Contrôle des insectes en post-récolte : basses températures. In: Vincent Ch., Panneton B. et Fleurat-Lessard F. (Eds.), *La lutte physique en phytoprotection*. Ed. INRA, Paris. **2000**, 95-110.
33. Appert J., Deuse, J. *Pests of crops and vegetables in the tropics*. Ed. Maisonneuve et Larose. Paris. **1982**, 420p.
34. Dajoz, R. *Précis d'écologie*. 7ème édition, Ed. Dunod, Paris, **2003**, 615 p.
35. Rmade F. *Eléments d'écologie. Ecologie fondamentale*. 3ème Ed. Dunod, Paris, **2003**, 690 p.
36. Deghiche Diab, N.; Belhamra, M.; Deghiche, L. Study of spontaneous plants and their associated arthropods in Ziban oases agroecosystem, Biskra-Algeria. Commission for IP and Biocontrol in North-African Countries IOBC-WPRS Bulletin, **2020**, 151: 127-134.
37. Deghiche-Diab, N. ; Deghiche L. : Belhamra, M. ; Boultif, M. Cartography and distribution of insects species according to habitats diversity in ziban Biskra-Algeria. *Munis entomology and zoology journal*. **2020**, 15(2): 412-419.
38. Deghiche-Diab, N., Entomofaune des habitats humides, steppiques et phoenicicoles des Ziban : Approche stucturale et fonctionnelle. Thèse Doctorat, Université de Biskra. **2020**, 179p.
39. Razi, S. Etude éco-biologique des thrips de la région de Biskra. Thèse Doctorat. Université de Biskra. **2017**, 145p.
40. Menzer, N., Aroua, K., Mokabli, A., Benzehra A., Biche M. Biological data on *Pollinia pollini* (Coccoidea: Asterolecaniidae) on Olive tree in Mitidja (Algeria). *Wulfenia*. **2016**. V23(3),162-169.
41. Deghiche-Diab, N., Deghiche L., Belhamra, Y.I. New record of *Phloeotribus scarabaeoides* (bernard, 1788) on introduced olive trees in Biskra region–Algeria. 2021. *Munis Entomology & Zoology*. **2021**. 16 (2): 1093-1102.
42. Louadi, K., Terzo, M., Benachour, K., Berchi, S., Aguib, S., Maghni, N., Benarfa, N., Les Hyménoptères Apoidea de l'Algérie oriental avec une liste d'espèces et comparaison avec les faunes Ouest-Paléarctiques. *Bulletin de la Société entomologique de France*. **2008**, 113(4) : 459–472.
43. Chinchoune, H., Benachour, K., Louadi, K. OrtizSánchez, F.J. Premières données sur les Halictidae (Hymenoptera : Apoidea) de la région de Batna (Est algérien), *Annales de la Société entomologique de France* (N.S.), **2018**. (NS), 447-463. DOI: 10.1080/00379271.2018.1507686.
44. Deghiche-Diab, N., Deghiche L., Belhamra, Y.I. The First Record of Insect Species from Wetland Ziban Habitat, Biskra (Algeria). *Bull. Nat. Hist. Mus. Plovdiv*, **2021**, 6: 47-50.
45. Deghiche-Diab, N., Deghiche T. New records and check list of arthropods from two oasis ecosystems in Algeria. *Studia Universitatis Babeş-Bolyai Biologia*. **2022**, 67, 1: 89-105. doi:10.24193/subbbiol.2022.1.05.
46. Coutin R. Le monde extraordinaire des insectes. *Biologie des insectes. Insectes*. **1988**. 69 :5-8.
47. Ben Ameur-Saggou H. La faune des palmeraies de Ouargla: Interactions entre les principaux écosystèmes. Thèse Magister. Université Kasdi Merbah Ouargla. **2009**.184P.
48. Achoura A., Belhamra M. Aperçu sur la faune Arthropodologique des palmeraies d'El-Kantara université Mohamed Khider Biskra. *Courrier de Savoir*. **2010**, 10 :93-101.
49. Deghiche-Diab, N. Biodiversité des arthropodes et des plantes spontanées dans un agroécosystème oasien. Biskra.Algérie. Thèse Magister. Université de Biskra. **2015**, 98p.
50. Deghiche-Diab, N., Belhamra, M. Diversity of Coleoptera in Ziban Palm Groves, Biskra, Algeria. *Centre for Entomological Studies Ankara, Miscellaneous Papers*. **2019**. 201, 1-9.
51. Chehma, S. Etude bio-écologique des Hyménoptères parasitoïdes des pucerons associés au milieu naturel et cultivé dans la région de Ghardaïa. Thèse magister. Université de Ouargla. **2013**. 76p.
52. Rakhshani, E., Talebil A.A., Star P., Tamanovic Z. et Manzari S. Aphid- parasitoid (Hymenoptera, Braconidae, Aphidiidae) associations on willows and poplars in Iran. *Acta Zoologica Academiae Scientiarum Hungaricae*. **2007**, 53 (3): 281-292.
53. Sary, P., Remaudiere, G. et Lyon, J.P. Les Aphidiidae (Hymenoptera) et aphides (Hom) de Corse. *Annls. Soc. Ent. Fr*. **1975**, 11 (4) :745- 762.
54. Leraut P. *Le guide entomologique*. Ed. Delachaux et Niestlé SA. Paris. **2003**,527 p.
55. Deghiche-Diab, N., Abbabsa M., Deghiche T. Steppe Habitats' Entomofauna At Ouled Djellal-Algeria. *Entomologia Hellenica* **2022**, 31: 1–18.