

Article de recherche

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Systematics and ecology of some insect groups in the steppe region (case of the reforestation of the Green Dam)

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ملخص

يُعد علم تصنيف الحشرات مجالاً واسعاً ومعقداً نظراً للتنوع الكبير في أنواعها والاكتشاف المستمر لأنواع جديدة في أنحاء العالم. في الجزائر، لا يزال عدد المتخصصين في علم الحشرات محدوداً. تهدف هذه الدراسة إلى جرد بعض مجموعات المفصليات ودراسة بيئتها السهبية في منطقة موحرة شرق الجلفة، ضمن غابات الصنوبر الحلي التي تُشكل جزءاً من السد الأخضر، وهو حزام نباتي أنشئ في سبعينيات القرن الماضي لمكافحة التصحر في السهوب الجزائرية. وقد أصبحت هذه الغابات أنظمتها بيئية جديدة تتطلب تقييماً علمياً. لهذا الغرض، أنشئت محطات مراقبة دائمة منذ أكثر من عشر سنوات من قبل المعهد الوطني للبحث الغابي. تعتمد الدراسة على جمع المفصليات بواسطة مصائد باربر خلال سنة كاملة في ثلاث محطات بمنطقة موحرة. أظهرت النتائج وجود 13023 فرداً ينتمون إلى 53 نوعاً، منها 15 نوعاً من غشائيات الأجنحة بنسبة 90.08%، و10 أنواع من ذوات الجناحين (6.10%)، و28 نوعاً من رتب مختلفة (3.82%). بلغ مؤشر التنوع لشانون معدلاً قدره 1.60 بت. التربة كلسية بنسبة كربونات متوسطة 13.01% ومحتوى مادة عضوية قدره 2.28%. كشفت تحليلات التشابه عن تقارب بين محطتي موحرة 1 و3 وتباعد محطة موحرة 2، ويُعزى ذلك على الأرجح إلى الطريق الوطني الذي يفصل بينها وبشكل حادراً بيئياً. الكلمات المفتاحية: المفصليات، ذوات الجناحين، البيئة، غشائيات الأجنحة، إعادة التشجير.

Abstract

Insect systematics is a vast and complex field, given their enormous diversity and the continuous discovery of new species worldwide. In Algeria, entomological specialists remain scarce. This study focuses on the inventory of some arthropod groups and their steppe ecology in the Moudjbara region, east of Djelfa, within Aleppo pine reforestation areas that form part of the Green Dam, a vegetative belt established in the 1970s to combat desertification in the Algerian steppe. These reforestation areas have become new ecosystems that now require ecological assessment. For this purpose, permanent monitoring stations have been established for over ten years by the National Institute of Forestry Research. The study is based on arthropod sampling using Barber traps over a one-year period at three stations in Moudjbara. Results revealed 13,023 individuals belonging to 53 species, including 15 species of Hymenoptera (90.08%), 10 species of Diptera (6.10%), and 28 species from various orders (3.82%). The Shannon diversity index averaged 1.60 bits. The soil is calcareous, with an average carbonate content of 13.01% and organic matter of 2.28% across the stations. Similarity analyses revealed a close relationship between stations Moudjbara 1 and 3, and a distance from station 2, likely due to the national road separating them, which may act as an ecological barrier.

Keywords: Arthropoda, Diptera, Ecology, Hymenoptera, Reforestation.

Résumé

La systématique des insectes est un domaine vaste et complexe, vu leur nombre considérable et la découverte continue de nouvelles espèces à travers le monde. En Algérie, les spécialistes en entomologie restent peu nombreux. Cette étude porte sur l'inventaire de quelques groupes d'arthropodes et leur écologie steppique dans la région de Moudjbara, à l'est de Djelfa, au sein des reboisements de pin d'Alep intégrés au barrage vert, ceinture végétale mise en place dans les années 1970 pour lutter contre la désertification. Ces reboisements constituent aujourd'hui de véritables écosystèmes dont l'évaluation s'impose. À cet effet, des stations permanentes de surveillance ont été installées depuis plus de dix ans par l'Institut National de Recherche Forestière. L'étude repose sur un échantillonnage des arthropodes à l'aide de pots Barber, durant une année, dans trois stations situées à Moudjbara. Les résultats font état de 13 023 individus appartenant à 53 espèces, dont 15 espèces d'Hyménoptères représentant 90,08 %, 10 espèces de Diptères (6,10 %) et 28 d'ordres divers (3,82 %). L'indice de diversité de Shannon affiche une moyenne de 1,60 bits. Le sol, de nature calcaire, présente une teneur moyenne en carbonate de 13,01 % et en matière organique de 2,28 %. Les analyses de similarité montrent un rapprochement entre les stations Moudjbara 1 et 3, et un éloignement de la station 2, probablement dû à la route nationale qui les sépare et agit comme barrière écologique.

Mots clés : Arthropoda, Diptera, Ecologie, Hymenoptera, Reboisement.

1. Introduction

Much effort has been made to restore degraded land, from simple land protection to forest and pastoral plantations and even biological dune fixation. These interventions, which often required significant human and material resources, were carried out on the basis of factors such as phytosociology, geology, pedology and climate, and have often given satisfaction from a technical point of view, including works by Djebaili (1978) and Pouget (1980).

The reforestation of Moudjbara located in the heart of the green dam, represents the first reforested area in 1969, as a means of combating desertification, it has given encouraging results. With its advantages and disadvantages, this achievement requires a scientific study on several levels. For the biodiversity component, entomofauna is a major asset in the ecological study of natural or artificial ecosystems. In order to approach this component, the key tool that the researcher must master or at least know is systematics and, which sees considerable progress from a technological point of view, through the use of modern means; Bioacoustique, Sueur & al (2002), immunochemical study Goyffon & Billiald (2002) and amino acid sequencing Kerdelhue & Rasplus (2002), nevertheless classical systematics, using dichotomous keys, remains essential and cannot be done without. Among the studies carried out in the Green Dam region, we can cite the study by Khelil (1995) concerning the entomological population of the esparto grass (*Stipa tenacissima*) steppes in western Algeria. For the central highlands, there are the works of Bosmans & Bouragba (1992); Bouragba et al. (2006); Bouragba et al. (2007); Brague-Bouragba (2007) and Bouragba et al. (2012).

As part of a study carried out on the biodiversity of Arthropods in the Moudjbara region, we present here part of the results and which concerns three groups namely Diptera, Hymenoptera and a group of various orders encountered in small numbers. These Arthropods, have they found in the reforestation a refuge for their installation, or on the contrary, this transformation created an imbalance which disturbed them.

2. Materials and Methods

2.1. Biotope Study and Site Selection

The Moudjbara reforestation area is located 4 km southeast of Djelfa, on the slopes of the Ouled Nails Mountains (Djellal Chergui), which form the northern backbone of the Saharan Atlas. The Djelfa-Moudjbara paved road, which crosses the reforestation area, constitutes the main route. The Moudjbara project is bordered to the south by the Djellal Chergui Mountains, to the north by the city of Djelfa, to the west by National Road No. 1, and to the east by significant alfalfa beds (D.G.F., 2009).

For this study, we selected three sites located within the Moudjbara reforestation area (Figure 1): the first with predominantly of *stipa tenacissima*, the second and the third dominated by *Artimisia herba alba*.

2.2. The first station Moudj.1

Located 6.33 km from Djelfa, and 3.33 km from the start of reforestation, it is to the left of the Djelfa-

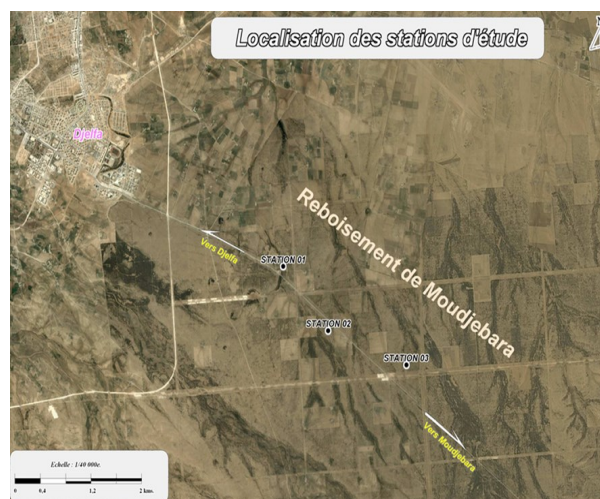


Figure 1. Aerial view showing the location of the three stations in the Moudjbara reforestation. (Google maps)

Table 1. Monthly average temperatures and monthly average precipitation during the period (1980-2010).

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Oct	Nov	Dec	sums	annual average
P(mm)	20.90	18.02	18.28	21.85	28.29	13.50	8.20	15.33	23.75	21.83	21.12	241.83	20.15
m(°C)	0.27	1.42	3.67	6.53	10.64	15.85	18.94	18.61	14.49	5.18	1.88	107.34	8.9
M(°C)	9.87	12.01	15.36	18.43	23.53	30.12	33.20	33.20	27.47	15.03	10.61	250.97	20.9
T(°C)	5.65	7.33	10.54	13.71	18.51	24.82	27.65	27.65	22.20	10.73	6.69	193	16

Source : O.N.M de Djelfa. (2011).

Moudjbara road, 100 m from the forestry center of the Moudjbara district, Djelfa Forest Conservation Area. The station is characterized by a flat, gently rolling terrain and an altitude of 1200 m.

2.3. The second station Moudj.2

Located 3 km from the first station, on the south-north firebreak trench No. 3, it is to the right of the Djelfa-Moudjbara road and has an altitude of 1210 m.

2.4. The third Station Moudj.3

Located to the east of the 2nd station in the direction of the settlement on flat ground, like the first station, it is to the left of the Djelfa-Moudjbara road, at an altitude of 1220 m.

2.5. Meteorological Data

The nearest meteorological station to the Moudjbara area is the one in the city of Djelfa, approximately 6 km from the study area. Climate data spanning a 30-year period (1973-2010) were provided by the meteorological station at an altitude of 1144 m (Table 1). The hottest month is July, with an average maximum temperature of 33.89°C and an average minimum temperature of 18.94°C; the coldest month is January, with an average maximum temperature of 9.87°C and an average minimum temperature of 0.27°C. The average annual precipitation during this period is 241.83 mm.

With a Q2 of 24.60, the Emberger climagram allows us to classify our study area in the upper semi-arid bioclimatic zone with a thermal variant and cool winters.

2.6. Soil Sampling

For our study, examining soil characteristics is essential. It provides us with information on certain physicochemical parameters necessary to determine the structure of a biocenosis. To complete the ecological study of our area, we conducted analyses of certain soil parameters at the H.C.D.S. laboratory.

2.7. Vegetation Sampling

All that is needed is a representative sample area that fairly accurately defines the area, i.e., where the fauna, flora, and physicochemical environment are likely to be found (Faurier et al., 1977). For the floristic survey in our study, we opted for the transect method, which consists of delineating a rectangular area on the ground measuring 10 m by 50 m, or 500 m², which is divided into ten corridors 1 m wide and 50 m long. Ten surveys are therefore carried out per station, and all species present are recorded during each season.

2.8. Soil Fauna Sampling

The study by Maelfait and Baert (1975) showed that the Barber trap method is effective for studying soil insects. This type of trap is a tool for studying medium- and large-sized arthropods; it particularly allows the capture of various walking arthropods: beetles, springtail larvae, spiders, millipedes, and wind-blown species (Khellil, 1992) (Figure 2). We used formalin (methanol polymerized in water) titrated at 4% as a toxic substance. Our sampling was carried out over a one-year period, from December 2009 to November 2010, with bimonthly samples. Sorting was done at the laboratory of the I.N.R.F. station. (National Institute of



Figure 2. Illustration of the Barber. **A:** Buried Barber pots. **B :** Above-ground trap. **C:** Retrieving trap contents.

Forestry Research) of Djelfa, the content of our material is separated into 3 groups: Hymenoptera, Diptera and Various orders. The preservation of arthropods is done in 75% ethyl alcohol.

3. Results

3.1. Soil Analyses

The results obtained (Table 2) show that the soils of the three study stations are characterized by a slightly alkaline pH and a sandy-silty texture. For limestone, the lowest percentage is noted at 1% in station I, followed by 5% in station II. The highest value recorded is at station 3, at 6.5%. For moisture content, the highest value is recorded at station Moudj.3, at 3.12%, followed by 1.37% for station I and 1.11% for station Moudj.2. The recorded values show that the soil is poor in organic matter, with the highest value, 2.99%, recorded at station Moudj.3. For station Moudj.2, 2.37% was recorded and 1.49% for the first station (Moudj.1).

3.2. Vegetation (floristic inventory of the three stations)

The vegetation emphasizes that the composition of the fauna of a given region is influenced by the nature of the plant species present in these regions. It

Table 2. Results of soil analyses in the three study stations.

Analysis physico-chimica	Moudj.1	Moudj.2	Moudj. 3
Total limestone (%)	1.94	12.7	24.40
Active limestone (%)	1.00	6.50	5.50
C.E (ms/cm ²)	0.15	0.18	0.29
pH	7.83	7.69	7.49
Humidity (%)	1.37	1.11	3.12
Organic matter	1.49	2.37	2.99
Sand	57.87	57.16	60.07
Silt	23.17	32.84	27.42
Clay	10.00	19.00	12.50
Soil nature	Sandy-loam	Sandy-loam	Sandy-loam
Texture	Balanced	Balanced	Balanced

is sufficient to focus on a representative sample area that defines it fairly accurately, that is, where the fauna, flora, and physicochemical environment are likely to be found (Faurier et al., 1977). The transect method consists of delineating a rectangular area on the ground measuring 10 m by 50 m, or 500 m², which is divided into ten corridors 1 m wide and 50 m long. Ten surveys are therefore carried out per station, and all species present are recorded during each season.

The reforestation of Aleppo pine of Moudjbara extends over a steppe environment forming small shrubs (4 to 6 m) and of the same age, we can see the presence of the following strata: The shrub layer is represented by the feet of Aleppo pine and which represents the only species of the shrub layer. The high herbaceous layer is represented by the species *Stipa tenacissima*, *S. parviflora* and *Artemisia herba alba*. The low herbaceous layer with a height of 0.1 to 0.5 m, it includes different species at different degrees of abundance depending on the stations Tables 3, 4 and 5.

Table 3. Floristic survey at the three stations during winter. (+) species present, (-) species absent. (M1: Moudj.1, M2: Moudj.2, M3: Moudj.3. *Tree-like forest species. ** Herbaceous species.)

The family	Species	M1	M2	M3
Pinaceae*	<i>Pinus halpensis</i> MILL.	+	+	+
	<i>Artemisia herba alba</i> L.	-	+	+
	<i>Calendula aegyptiaca</i> Desf.	-	+	+
Asteraceae**	<i>Carduncellus pinnatus</i> Desf.	-	+	+
	<i>Onopordum arenarium</i> Desf.	+	-	-
	<i>Atractylis humilis</i> L.	-	-	+
	<i>Launaea angustifolia</i> Desf.	+	-	-
	<i>Leontodon hispanicus</i> Poient	+	+	-
Liliaceae**	<i>Ornithogalum tenuifolium</i> Guss	+	-	+
Labiaceae**	<i>Teucrium poleum</i> L.	-	-	+
Labiaceae**	<i>Sideritis montana</i> L.	-	-	+
Plantaginaceae**	<i>Plantago albicans</i> L.	+	+	+
Papilionaceae**	<i>Visia sativa</i> L.	+	+	+
	<i>Onins natrrix</i> L.	-	+	-
	<i>Medicago arabica</i> L.	+	-	-
Poaceae**	<i>Bromus rubens</i> L.	-	+	+

Table 4. Floristic survey at the three stations during spring. (+) species present, (-) species absent. (*Tree-like forest species. ** Herbaceous species.)

The family	Species	Moudjbara 1	Moudjbara 2	Moudjbara 3
Pinaceae*	<i>Pinus halpensis</i> MILL.	+	+	+
	<i>Artemisia herba alba</i> L.	+	+	+
	<i>Atractylis prolifera</i> L.	+	+	+
Asteraceae**	<i>Carduncellus pinnatus</i> Desf.	+	+	+
	<i>Leontodon hispanicus</i> Poient	+	+	+
	<i>Atractylis serratoloides</i> L.	+	+	+
	<i>Sonchus oleracens</i> L.	+	+	+
	<i>Carduncellus plumasus</i> Pomel.	+	-	-
	<i>Mantsalca salmantica</i> L.	+	+	-
	<i>Xeranthemum hirtum</i> L.	+	-	-
	<i>Atractylis humilis</i> L.	+	+	+
	<i>Visia sativa</i> L.	+	+	+
Papilionaceae**	<i>Onins natrrix</i> L.	+	+	+
	<i>Cornilla scorpioides</i> Koch.	+	+	-
	<i>Medicago arabica</i> L.	+	+	+
	<i>Astragalys hamosus</i> L.	+	+	+
	<i>Stipa parviflora</i> Desf.	+	+	+
Poaceae**	<i>Stipa tenacissima</i> L.	+	+	+
	<i>Bromus rubens</i> L.	+	+	+
	<i>Hoedeum murinum</i> L.	+	-	-
	<i>Telephium imperati</i> L.	+	-	-
Caryophyllaceae*	<i>Paranchia arabica</i> L.	+	+	+
	<i>Noaea mucronata</i> Forssk.	+	+	-
	<i>Thymus ciliatus</i> Desf.	+	+	+
Labiaceae**	<i>Sideritis montana</i> L.	+	+	+
	<i>Teucrium poleum</i> L.	+	+	+
Umbellifera**	<i>Tapsia garganica</i> L.	+	+	+
Resedaceae**	<i>Resida alba</i> L.	+	-	-

Table 5. Floristic survey in the three stations, during summer and autumn. (M1: Moudj.1, M2: Moudj.2, M3: Moudj.3. *Tree-like forest species . ** Herbaceous species.)

The family	Species	M1	M2	M3
Pinacea*	<i>Pinus halpensis</i> MILL.	+	+	+
Asteracea**	<i>Artemisia herba alba</i> L.	-	+	+
	<i>Stipa parviflora</i> Desf.	+	+	-
Poacea**	<i>Stipa tenacissima</i> L.	+	-	+
	<i>Bromus rubens</i> L.	+	+	+

3.3. Soil Fauna

3.3.1. Hymenoptera

For Hymenoptera, we noted the presence of 15 species. The highest number of species is represented in the Formicidae family with 7 species, followed by the Ichenomeunidae family with 4 species, the Scoliidae with 2 species, the Pompilidae and the Andrenidae with a single species. Species richness is almost the same in both stations Moudj.1 and Moudj.3 (14 and 13 species), and for station Moudj.2, 8 species were recorded.

3.3.2. Diptera

Diptera are characterized by the presence of Brachycera with 9 species and a single species belonging to the suborder Nematocera. The number of species is comparable in all three stations.

3.3.3. Various orders

A total of 27 species belonging to 7 different orders were collected in the three stations during the collection period, among these orders we can mention the most numerous in species, the Hemiptera with 9 species, the Orthoptera with 5 species, the Myriapoda with 5 species, the Crustacea and Mantidae each with a single species. The highest species richness was recorded in station Moudj.1 with 20 species followed by station Moudj.2 with 15 species and Moudj.3 (14 species).

3.4. DECORANA or DCA (Detrended Correspondence Analysis) analysis

3.4.1. Species of the order Hymenoptera

The dominant Hymenoptera, with a population of 13023 individuals, are plotted in the graph in Figure 3. The arrangement of stations (2, 3) is in the positive part of axis 1. Station Moudj.2 is positioned at the positive end with the lowest number of species and individuals compared to the other stations. In its negative part, we find station Moudj.1, which is represented by the highest population of the species *Crematogaster laestrygon* with 1752 individuals, *Camponotus thoracicus* with 1128 individuals, and *Ichenomeunidae sp.* with 4 individuals (Figure 3).

Figure 4 shows that station Moudj.3, positioned on the positive end of axis 2, is encountered by the lowest number of individuals (3080) and the presence of the species *Anderena sp.* with a single individual.

Station Moudj.3 is located in the positive part of axis 3; in its negative part, we find the two stations Moudj.2 and 3, associating all the species except the species *Ichenomeunidae sp2* (Figure 2).

The SORESEN dendrogram: The two stations Moudj.1 and Moudj.3 form a group, the links are the species: *Ichenomeunidae sp.*, *Ichenomeunidae sp1*, *Ichenomeunidae sp.2*, *Elis villosa*, *Scoleasp* and *Xerides sp.*, which are present in these two stations. This subgroup is attached to the subgroup of Moudj.2, these are the species of the Formicidae family (Figure 5)

3.4.2. Species of the order Diptera

With a total population of 795 individuals, in the graph in Figure 6, we have the arrangement of stations (1, 2) in the positive part of axis 1. It is at station Moudj.1 that we find the highest population of the species *Drosophila sp.* with 168 individuals, *Pollenia sp.* with 72 individuals. In the negative part, we find station Moudj.3 with the species *Boletina sp.* (4 individuals).

According to Figure 6, the graph shows that stations (1, 3) are positioned in the negative part of axis 2 and linked to the presence of 6 species, including: *Drosophila sp.*, *Fannia sp.* and *Pollenia sp.*

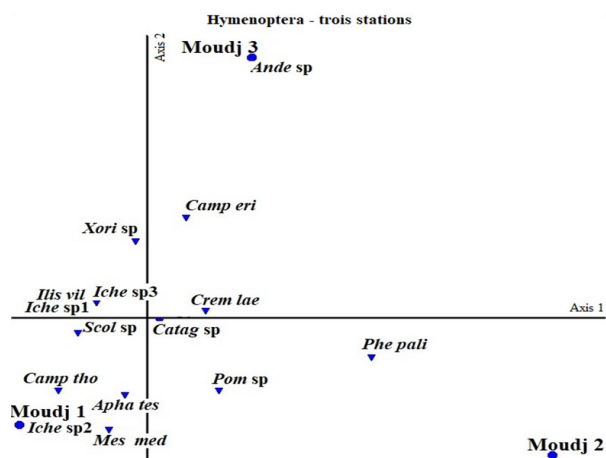


Figure 3. Ordination of all species of the order Hymenoptera, according to axes 1 and 2 in the three stations from DECORANA.

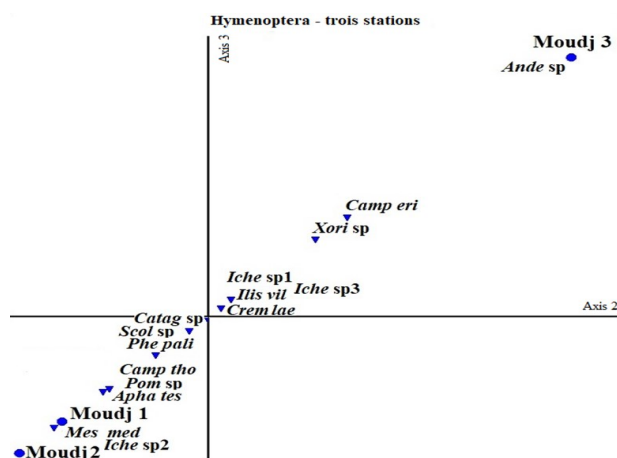


Figure 4. Ordination of all species of the order Hymenoptera along axes 2 and 3 in the three stations from DECORANA

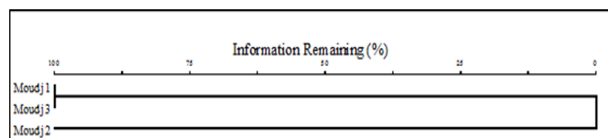


Figure 5. SORESENSE similarity dendrogram in the classification of species of the order Hymenoptera, collected in the three stations during the sampling period.

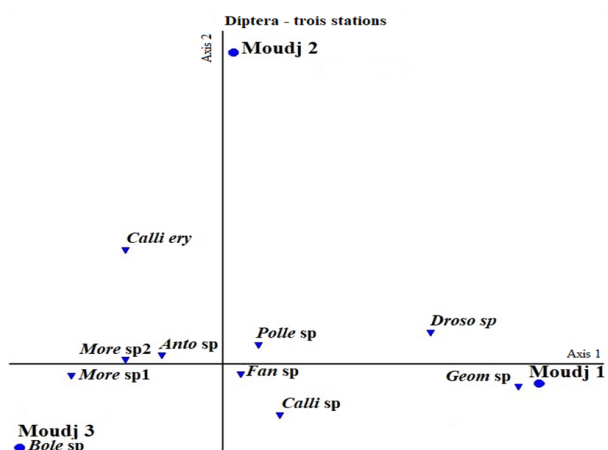


Figure 6. Ordination of all species of the order Diptera along axes 1 and 2 in the three stations from DECORANA.

while station Moudj.2 is positioned on the positive end of axis 2, which is encountered by the lowest number of individuals (139) compared to the other stations.

Stations Moudj.1 and 2 are grouped in the positive part of axis 3, the species *Calliphora erythrocephala* moves away from the center to link to station Moudj.2. In the negative part of axis 3, we find station Moudj.3, associated with the species *Boletina* sp (Figure 7).

The SORESENSE dendrogram: shows that the two stations Moudj.2 and Moudj.3 form a group, the links are the 8 species that are present in these two stations. This subgroup is attached to the subgroup of Moudj.1 the link is the common species (*Morellia* sp1, *Morellia* sp2., *Pollenia* sp, *Calliphora* sp, *Drosophila* sp, *Fannia* sp, *Geomyza* sp and *Fannia* sp) (Figure 8).

3.4.3. Species of various orders

In our sample, we have a total population of 469 individuals. In the graph in Figure 9, we have the arrangement of stations (1, 2) in the negative part of axis 1. It is at station Moudj.1 that we have the highest population of the species *Jassidae* sp. 1 with 73 individuals, *Jassidae* sp. 2 with 45 individuals. In the positive part, we find station Moudj.3 with the presence of the following species: *Plutelidae* sp.

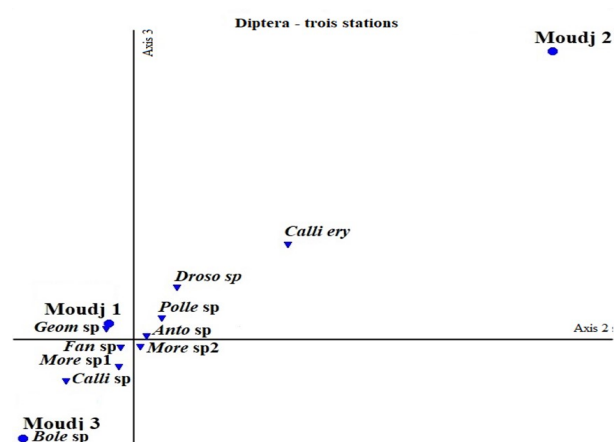


Figure 7. Ordination of all species of the order Diptera along axes 2 and 3 in the three stations from DECORANA.

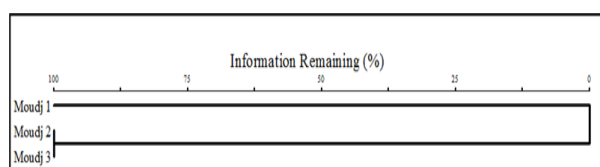


Figure 8. SORESENSE similarity dendrogram in the classification of species, of the order Diptera, collected in the three stations during the sampling period.

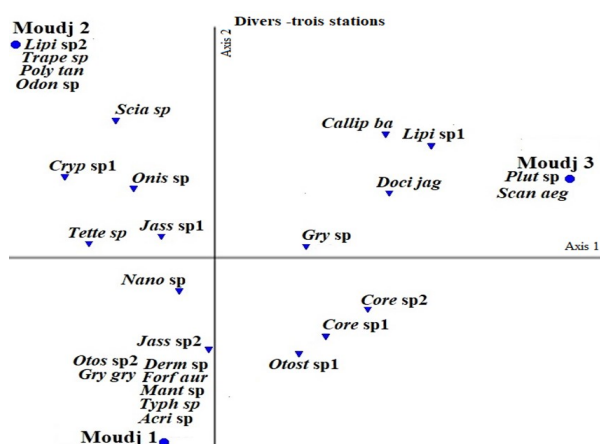


Figure 9. Ordination of all species of various orders along axes 1 and 2 in the three stations from DECORANA.

with 4 individuals, *Scantiusa egyptius* with a single individual.

The graph in Figure 9 shows that stations (1, 2) are positioned in the negative part of axis 2 and linked to the presence of 8 species, while station Moudj.3 is positioned on the positive end.

Stations Moudj.2 and Moudj.3 are grouped in the positive part of axis 3, among the species that are only found in station Moudj.2: *Polyporogaster tanetanum*, *Odontoscelis* sp., *Trapezonatus* sp., and *Lepidoptera* sp.2. In the negative part, station Moudj.1 is associated with the following species: *Gryllulus gryllulus*, *Forficula auricularia*, *Dermatopetra* sp., *Mantis* sp., and *Typhlocyba* sp. (Figure 10).

The SORESENSE dendrogram: shows that the two stations Moudj.1 and Moudj.2 form a group, the links are the species *Cryptops* sp1 and *Tetteigonidae* sp which are present in these two stations. This subgroup is attached with the subgroup of Moudj.3 the link is the common species (*Dociostaurus jagoijagoi*, *Gryllomorpha* sp, *Jassidae* sp.1, *Jassidae* sp.2, *Nanophilus* sp, *Oniscus* sp, *Sciacoris* sp.) (Figure 11).

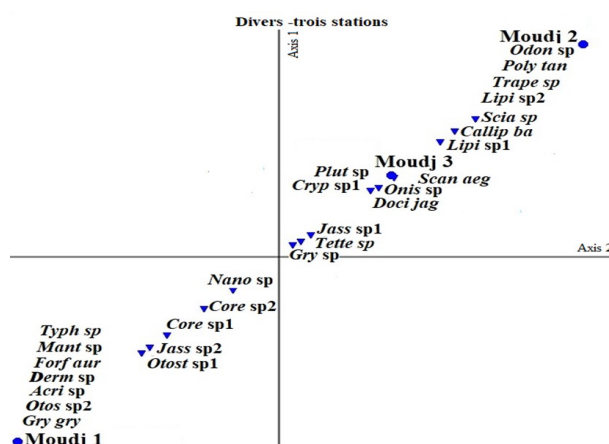


Figure 10. Ordination of all stations for species of Various orders along axes 2 and 3 in the three stations from DECORANA.

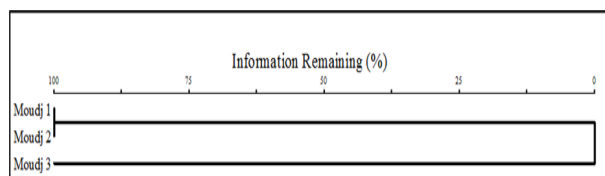


Figure 11. SORESEN similarity dendrogram in the classification of species of various orders collected during the sampling period.

4. Discussion

The order Hymenoptera is the most abundant in the Aleppo pine reforestation, containing 15 species and representing 69.76% of the total number of individuals of all harvested orders. The Formicidae family is the richest in species (7) and individuals (11686). The other families are represented by low richnesses varying between 1 and 2 and numbers between 1 and 14 individuals. The Formicidae are represented by the following species: *Crematogaster laestrygon*, *Aphaenogaster testaceo-pilosa*, *Camponotus thoracicus*, *Cataglyphis* sp., *Camponotus erigens*, *Messor medioruber*, and *Pheidole pallidolla*. According to Bouzekri (2010), sampling across transects and in different environments in the Djelfa region, for the reforestation of Moudjbara, she reported that in the reforested environment of the Aleppo pine the counting of individuals belonging to the species found reveals the abundance of *Crematogaster laestrygon* (42.55%) *Cataglyphis bicolor* is the least abundant with a percentage of 3.08%; in our study we find this species with 32.10% in third position after *Pheidole pallidolla* with 34.99% and *Aphaenogaster testaceo-pilosa* with 33.45%.

Bouzekri (2010) noted that both species: *Messor medioruber* and *Crematogaster laestrygon* build their nests near plants, the first species is present for the two dominant plant species (Mugwort and Alfa) and the second for the Aleppo pine only. *Cataglyphis bicolor* and *Monomorium salomonis* build their nests under stones. According to Cagniant (1973) *Messor medioruber* is distributed in Kairouan, southern Aurès, in the high plains and the Saharan Atlas, it mainly harvests grasses and licks insect juices. *Crematogaster laestrygon* is present in both reforested and forested environments. It clearly demonstrates its tendency to colonize Aleppo

pine trees. Its behavior is comparable to what Cagniant (1973) found. The author reported that this latter species climbs up to 1272m of the Saharan Atlas, it is dominant on the plateaus of the Aleppo pine and their nests are found distributed among the pine trees, it is a mainly arboreal species. The same description was attributed by Clark & Gorley (2001), who describes the genera *Crematogaster* as a mainly arboreal species in Mediterranean regions. The order of Diptera with that of Coleoptera are the most important numerically of the class of insects. The development is of the holometabolous type. The lifestyle of adults is terrestrial, while the larvae live in very varied environments according to the families and species considered (Elouard, 1967). The systematics and the study of Diptera in Algeria remain timid because of the lack of specialists, in our material 10 species were identified by Professor Doumandji of the E.N.S.A. (National School of Agronomic Sciences). For Diversity the average Shannon index for Hymenoptera is 1.34 bits, Diptera it is 1.64 bits and finally the Various orders record 1.81 bits. The values found reflect a more or less faithful image of the reality of the stations prospected which are moreover very close and homogeneous. The equitability for each order; Hymenoptera with 0.54, Diptera with 0.78 and finally Miscellaneous Orders with 0.66. These values are greater than 0.5 which implies that the regularity is high and the species are equitably distributed.

6. Conclusion

For our research, 53 species were collected and distributed across three groups (Hymenoptera, Diptera, and Miscellaneous Orders), of which Formicidae are quantitatively dominant and present with only 7 species. Among the Diptera, we recorded for the first time in our steppe region the dominance of Brachycera with 9 species; also for the Miscellaneous Orders, we can note the presence of Myriapoda with two orders and 5 species. Comparison of species richness shows a difference between the three Moudjara1 stations, which have the highest richness with 48 species, while stations 2 and 3 have practically the same species richness, 35 and 32 species respectively. Dendrograms of similarity between stations for the different orders

showed that for the Hymenoptera, the analysis of integration levels distinguishes, in all three cases, station Moudj.2 and stations Moudj.1 with Moudj.3 while for Diptera and Various groups it is the Moudj.1 and Moudj.2 stations which are attached together and detached from the Moudj.3 station. This situation could be explained by the fact that the national road separates the Moudj.1 and Moudj.3 stations from the Moudj.2 station, this ex-

planation is valid for walking Arthropods in this case the Hymenoptera (Formicidae), this is not the case for Diptera and the various orders which include Orthoptera, Heteroptera, Homoptera, Lepidoptera, Mantidae; which are mostly flying insects, the tarred road which is quite busy, would constitute a geographical barrier to the distribution of species in this ecosystem. This observation would be confirmed by long-term studies, which will demonstrate the negative effects of urbanization on natural ecosystems.

Appendix

Appendix 1. List of abbreviations of Hymenoptera species produced, used for numerical analyses.

Abbreviations	Species
<i>Ande sp</i>	<i>Anderna sp</i>
<i>Apha tes</i>	<i>Aphaenogaster testaceo-pilosa</i>
<i>Camp tho</i>	<i>Camponotus thoracicus</i>
<i>Catag sp</i>	<i>Cataglyphis sp</i>
<i>Camp eri</i>	<i>Camponotus erigens</i>
<i>Crem lae</i>	<i>Crematogaster laestrygon</i>
<i>Iche sp3</i>	<i>Ichenomeunidae sp3</i>
<i>Iche sp1</i>	<i>Ichenomeunidae sp1</i>
<i>Iche sp2</i>	<i>Ichenomeunidae sp2</i>
<i>Ilis vil</i>	<i>Ilis villosa</i>
<i>Mes med</i>	<i>Messor mediorober</i>
<i>Phe pali</i>	<i>Pheidole pallidolla</i>
<i>Pom sp</i>	<i>Pompilidae sp</i>
<i>Scol sp</i>	<i>Scolia sp</i>
<i>Xori sp</i>	<i>Xorides sp</i>

Appendix 2. List of abbreviations of Diptera species produced, used for numerical analyses.

Abbreviations	Espèce
<i>Anto sp</i>	<i>Antomyicinae sp</i>
<i>Bole sp</i>	<i>Boletina sp</i>
<i>Calli ery</i>	<i>Calliphora erythrocephala</i>
<i>Calli sp</i>	<i>Calliphora sp</i>
<i>Callip ba</i>	<i>Calliptamus barbarus</i>
<i>Droso sp</i>	<i>Drosophila sp</i>
<i>Geom sp</i>	<i>Geomyza sp</i>
<i>Polle sp</i>	<i>Pollenia sp</i>
<i>More sp1</i>	<i>Morellia sp1</i>
<i>More sp2</i>	<i>Morellia sp2</i>
<i>Fan sp</i>	<i>Fannia sp</i>

Appendix 3. List of abbreviations of various species produced, used for numerical analyses.

Abbreviations	Species
<i>Acri sp</i>	<i>Acridella sp</i>
<i>Callip ba</i>	<i>Calliptamus barbarus</i>
<i>Colle sp</i>	<i>Collembola sp</i>
<i>Core sp1</i>	<i>Coreomeris sp1</i>
<i>Core sp2</i>	<i>Coreomeris sp2</i>
<i>Cryp sp1</i>	<i>Cryptops sp1</i>
<i>Derm sp</i>	<i>Dermopetra sp</i>
<i>Doc jag</i>	<i>Dociostaurus jagoijagoi</i>
<i>Forfaur</i>	<i>Forfocula auricularia</i>
<i>Gry sp</i>	<i>Gryllomorpha sp</i>
<i>Gry gry</i>	<i>Gryllulus gryllulus</i>
<i>Jass sp1</i>	<i>Jassidae sp1</i>
<i>Jass sp2</i>	<i>Jassidae sp2</i>
<i>Lipi sp1</i>	<i>Lepidoptera sp1</i>
<i>Lipi sp2</i>	<i>Lepidoptera sp 2</i>
<i>Mant sp</i>	<i>Mantis sp</i>
<i>Nano sp</i>	<i>Nannophilus sp</i>
<i>Odon sp</i>	<i>Odontoscelis sp</i>
<i>Onis sp</i>	<i>Oniscus sp</i>
<i>Otost sp1</i>	<i>Otostigmus sp1</i>
<i>Otos sp2</i>	<i>Otostigmus sp2</i>
<i>Plut sp</i>	<i>Plutellidae sp</i>
<i>Polle sp</i>	<i>Pollenia sp</i>
<i>Poly tan</i>	<i>Polyporogaster tanetanum</i>
<i>Scan aeg</i>	<i>Scantius aegyptius</i>
<i>Scia sp</i>	<i>Sciacoris sp</i>
<i>Tette sp</i>	<i>Tetteigonidae sp</i>
<i>Typh sp</i>	<i>Typhlocybidae sp</i>
<i>Trape sp</i>	<i>Trapezonatus sp</i>

Appendix 4. Activity density of Hymenoptera species per trap, in the three stations, during the harvest period (2009-2010).

Station/ Traps Species	Moudj.1					Moudj.2					Moudj.3					TOT
	P1	P2	P3	P4	P5	P1	P2	P3	P4	P5	P1	P2	P3	P4	P5	
<i>Anderna</i> sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
<i>Aphaenogaster</i>	25	85	0	114	70	32	1	2	18	7	30	1	0	0	6	391
<i>tertestaceo-</i>																
<i>Camponotus</i>	323	411	112	2	280	2	0	29	6	2	32	39	16	2	33	1289
<i>thoracicus</i>																
<i>Cataglyphis</i> sp	107	389	168	29	284	32	40	107	22	25	168	53	47	7	231	1709
<i>Camponotus</i>	63	35	17	0	35	0	8	10	8	0	39	102	36	44	10	407
<i>erigens</i>																
<i>Crematogaster</i>	265	248	264	631	344	6	130	408	188	35	303	287	269	211	163	3752
<i>ter laestrygon</i>																
<i>Ichenomeuni-</i>	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	3
<i>dae</i> sp																
<i>Ichenomeuni-</i>	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	3
<i>dae</i> sp1																
<i>Ichenomeuni-</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
<i>dae</i> sp2																
<i>ilisvillosa</i>	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	3
<i>Messor</i> me-	22	18	0	0	0	0	8	0	0	0	0	0	0	0	0	48
<i>diorober</i>																
<i>Pheidole</i>	433	293	33	24	86	64	1000	366	114	736	165	196	85	275	220	4090
<i>palidolla</i>																
<i>Pompilidae</i> sp	10	0	2	0	2	0	1	2	2	3	3	0	0	0	0	25
<i>Scolia</i> sp	3	1	0	0	2	0	0	0	0	0	1	0	0	1	0	8
<i>Xorides</i> sp	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	2

Appendix 5. Activity density of Diptera species per trap, in the three stations, during the harvest period (2009-2010).

Stations/ Traps species	Moudj.1					Moudj.2					Moudj.3					TOT
	P1	P2	P3	P4	P5	P1	P2	P3	P4	P5	P1	P2	P3	P4	P5	
<i>Antomyiinae</i>	1	0	0	4	14	9	5	1	3	2	10	0	2	13	35	99
sp																
<i>Boletina</i> sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
<i>Calliphora</i>	0	0	0	0	0	0	0	0	0	2	0	0	0	1	1	4
<i>erythrocephala</i>																
<i>Calliphora</i> sp	1	1	0	0	0	0	0	0	0	0	1	0	0	0	1	4
<i>Morellia</i> sp1	0	0	0	0	1	0	1	0	5	0	2	16	0	8	1	34
<i>Morellia</i> sp2	2	1	2	0	6	1	1	0	1	15	1	6	13	4	37	90
<i>Drosophila</i> sp	40	48	22	33	25	6	7	19	8	1	5	2	1	5	12	234
<i>Fannia</i> sp	0	0	0	5	38	0	3	0	4	7	7	22	5	11	12	114
<i>Geomyza</i> sp	1	0	0	2	20	0	0	0	0	0	0	0	0	0	1	24
<i>Pollenia</i> sp	38	7	4	12	11	0	10	13	0	15	8	25	23	6	19	191

Appendix 6. Activity density of species Various orders per trap, in the three stations, during the harvest period (2009-2010).

Station/Traps	Moudj.1					Moudj.2					Moudj.3					TOT
	P1	P2	P3	P4	P5	P1	P2	P3	P4	P5	P1	P2	P3	P4	P5	
<i>species</i>																
<i>Acridella</i> sp	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
<i>Calliptamus barbarus</i>	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	3
<i>Colombola</i> sp	907	1080	1443	967	785	569	708	507	644	721	1395	1375	1365	1136	866	14468
<i>Coreomeris</i> sp1	0	3	0	0	0	0	0	0	0	0	2	0	0	0	0	5
<i>Coreomeris</i> sp2	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	2
<i>Cryptops</i> sp1	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	3
<i>Dermapetra</i> sp	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	3
<i>Dociostaurus jagoi jagoi</i>	0	0	0	2	1	0	3	1	0	0	4	0	5	1	2	19
<i>Forficula auricularia</i>	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2
<i>Gryllomorpha</i> sp	2	0	2	0	36	0	3	3	4	13	33	0	5	1	8	110
<i>Gryllulus gryllulus</i>	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
<i>Jassidae</i> sp1	21	10	14	25	3	2	47	4	16	2	1	8	13	3	0	169
<i>Lepidoptera</i> sp1	0	0	0	0	0	0	0	1	0	0	1	1	1	0	0	4
<i>Lepidoptera</i> sp2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
<i>Mantis</i> sp	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
<i>Meolemajalis</i>	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
<i>Nanophilus</i> sp	3	0	0	0	1	0	0	1	1	0	0	0	1	0	0	7
<i>Odontoscelis</i> sp	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2
<i>Oniscus</i> sp	0	0	1	1	13	14	4	2	4	2	1	0	0	2	3	47
<i>Otostigmus</i> sp1	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	3
<i>Otostigmus</i> sp2	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	3
<i>Plutellidae</i> sp	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4
<i>Pollenia</i> sp	38	7	4	12	11	0	10	13	0	15	8	25	23	6	19	191
<i>Scantius aegyptius</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
<i>Sciacoris</i> sp	0	0	0	1	0	4	0	1	0	0	0	0	0	0	1	7
<i>Tetteigonidae</i> sp	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2
<i>Trapezonatus</i> sp	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	4

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