

Overview of the arthropod fauna in the extreme southeastern Algeria: species richness in Tassili N'Ajjer National Park (Djanet, Algeria)

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ABSTRACT

The present study concerns arthropod populations in two different environments, cultivated and natural regions of Djanet. We conducted qualitative and quantitative surveys over two seasons (summer and winter). Three sampling methods were used: pitfall traps, sweep nets, and yellow pan traps. Overall, 4480 individual arthropods were captured representing 191 species, 4 classes, 21 orders and 106 families, distributed across four study sites, namely: Lokmane and El Mihane stations for the cultivated environment and Teghargharte and Iffoutten stations for the natural environment. A total of 112 species of arthropod species were captured by pitfall traps, with Hymenoptera accounting for 69% of the species. Sweep netting generated 65 species of arthropods, with Orthoptera accounting for 36% of the captures. Yellow pan traps led to the capture of 82 species of arthropods, with dipterans most attracted by this type of trap with a rate of 38%. The 17 species of Orthoptera that we captured in the region of Djanet belonged to 7 families and 2 orders, in which the species *Tridactylus variegatus* was the most abundant.

KEY WORDS

Arthropod species richness; Djanet, Cultivated and natural environment; traps.

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INTRODUCTION

The Tassili region of Algeria was elevated to national park status in July 1972, and was classified as a World Heritage Site by UNESCO in 1982. The cultural richness and diversity of its natural ecosystems allowed it to become a preserve for Man and the Biosphere in 1986 (O.P.N.T, 2006). In general, the diversity of fauna found in the Tassili is the result of climatic variation, which began at the end of the last glacial period (O.P.N.T, 2006).

For their place in the Saharan and oasis ecosystems, the arthropods constitute a good biological indicator; they form a large part of essential elements for nutrition availability for numerous animal species (Beddiaf et al., 2014).

Published studies concerning the entomofauna are numerous. For example, there have been studies of the Ghardaïa region (Chouihet & Doumandji-Mitiche, 2012), the region of Adrar (Sid Amar et al., 2012), the region of Tamenrasset (Kourim et al., 2011; Reggani, 2010), the Djelfa region (Souttou et al., 2011), and the region of Biskra (Achoura & Bel-

hamra, 2010). However, the Djanet region has been relatively understudied given its size and ecological diversity (but see (Beddiaf et al., 2014; Chopard, 1943; Le Berre, 1989 & Dubief, 1999)).

The present study consists of both qualitative and quantitative surveys of arthropods that exist in the Djanet region of Algeria over a two-season period during 2012/2013 (summer and winter). This study was designed to comprehensively assess the arthropod biodiversity of this important area by examining both natural and human disturbed habitats using three sampling methods: pitfall traps, sweep nets and yellow pan traps.

MATERIALS AND METHODS

Sampling sites

The city of Djanet is situated in the far Southeast of Algeria (Fig. 1). It is distant 420 km to the county-city Illizi and 2.200 km of the capital city Algiers. It is located in the region of Tassili N'Ajjer at 24°33' N, and 9°29' E at an altitude of 1094 m. Because of its remoteness and proximity to Libya and Nigeria, this region has not been well studied.

The region of Djanet is demarked by the Libyan border on the east, the Nigerian border along the south, the Tamenrasset Province on the southeast and by the townships of Bordj El-Houas and Illizi to the north. According to Dubief (1999), Djanet is situated on a geological anomaly that forms a cliff of sandstone that is along the occidental side of Edjeriou River. A 15 km long granitic upland separates the valley from the Tassili region. The intact sandstones of the area preserve the marks of past geological and climatic events (orogenesis, glaciation, volcanism, sea recession, sedimentation, fluvial and Aeolian soil erosion) (O.P.N.T, 2006).

Four study sites were chosen, two of them in a cultivated environment: Lokmane station, situated at 30 km South-West of Djanet with a surface area of 30 ha (Fig. 2). The second station, El Mihane, was located in the town center of Djanet with a surface area of 1 ha (Fig. 3).

Two sites located in natural environments were also selected. The first was Teghargharte station, located alongside the Teghargharte River. This station is a flood zone of Edjeriou river of Djanet. This station is found 30 km to the south of Djanet (Fig. 4).

The second natural study site (Iffoutten station) was located about 4 km from the town center of Djanet, alongside the bed-river of the Edjeriou River (Fig. 5).

We used three sampling methods for arthropod sampling: pitfall traps, sweep nets and yellow pan traps.

Analyses

Species identifications were conducted using conventional taxonomical keys, including Perrier (1927, 1940, 1980) for the Hymenoptera, Coleoptera, Hemiptera and Diptera orders and Chopard (1943) for the Orthoptera.

For this study, we used two ecological indices of composition. We calculated Total Richness and Relative Abundance for the ecological indices of composition.

Total Richness (S) corresponded to the number of species found in a given sampling area (Ramade, 1984; Blondel, 1979). The relative abundance R.A% of a species was calculated by the formula:

$$R.A \% = n_i / N \times 100$$

Where n_i is the percentage of a given species, and N is the total number of individuals at a given site (Dajoz, 1971; Blondel, 1979).

RESULTS

The global survey of arthropods' populations captured during two seasons of the year (summer and winter) made use of three sampling methods: pitfall traps, yellow pan traps and sweep net in the four studied stations show the presence of 191 representing 106 families, 21 orders and four classes (Table 1).

Total Richness

A total of 112 arthropods species were captured by the pitfall traps in the two environments (four stations). The two natural stations, Teghargharte and Iffoutten, were less rich with 18 and 38 species, respectively, compared to the other two cultivated stations, Lokmane and El Mihane, with 57 and 51 species, respectively.

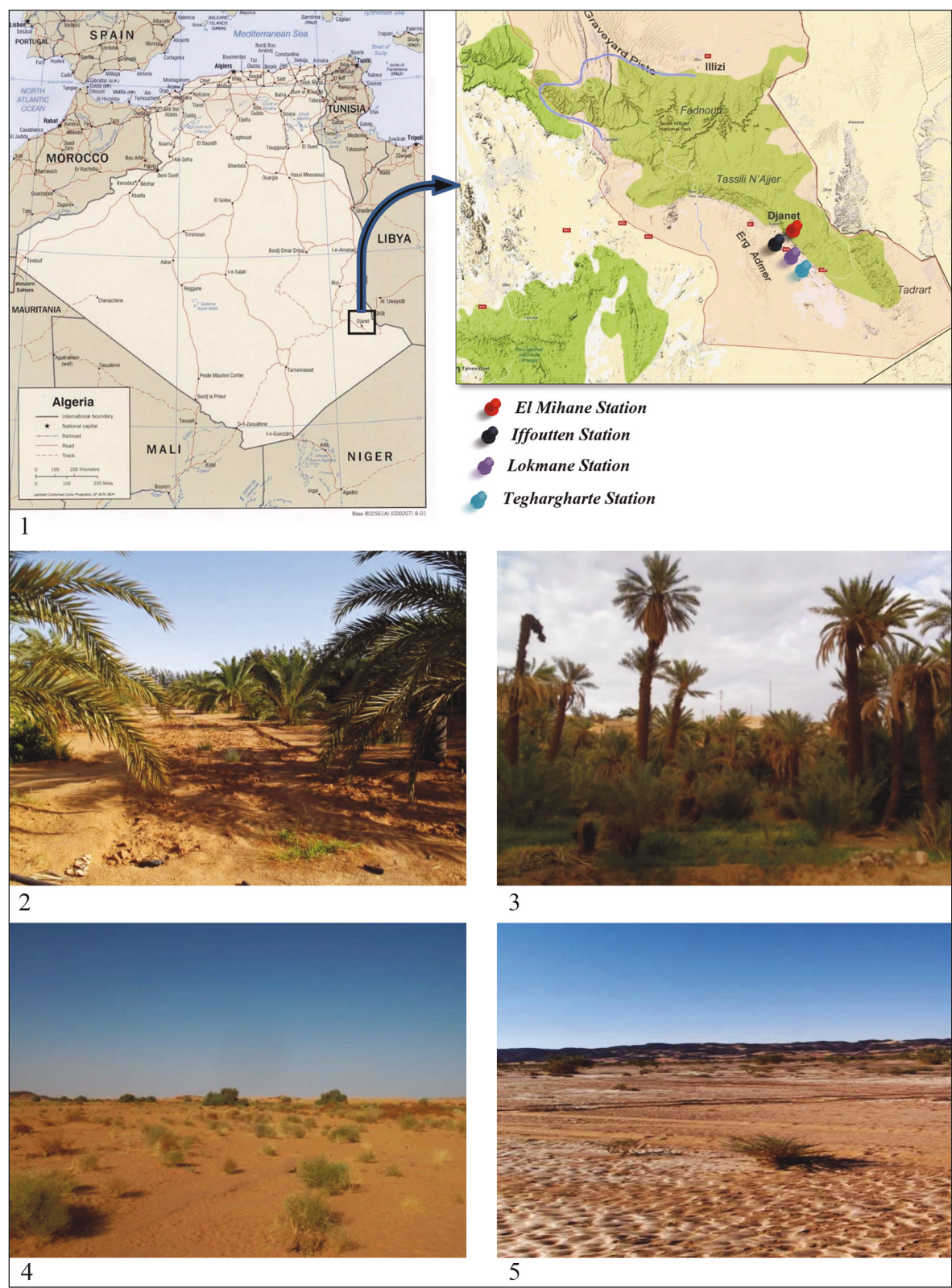


Figure 1. Geographic situation of Djanet and localization of sampling stations. Figure 2. Lokmane Station. Figure 3. El Mihane station. Figure 4. Teghargharte station. Figure 5. Iffoutten station.

Orders	Number of families	Number of species
ARACHNIDA		
Scorpiones	1	1
Araneae	6	6
Acarida	3	3
CHILOPODA		
Scolopendromorpha	1	1
COLLOMBOLA		
Entomobryomorpha	1	1
Symphyleona	1	1
INSECTA		
Odonatoptera	1	1
Blattaria	1	1
Mantodea	1	1
Isoptera	2	2
Dermaptera	1	1
Thysanoptera	1	1
Orthoptera	7	17
Hemiptera	9	14
Homoptera	5	12
Coleoptera	11	25
Hymenoptera	18	43
Nevroptera	1	1
Lepidoptera	6	9
Diptera	28	49
Aphaniptera	1	1
21	106	191

Table 1. Global survey of arthropod species captured during two seasons (summer and winter) using pitfall traps, yellow pan traps and sweep net.

The total number of arthropods species captured by the yellow pan traps was 82 species in the cultivated environment, within the two stations. We captured 39 species at the Lokmane station and 63 species at the El Mihane station.

The total number of arthropods species collected by the sweep net technique was 65 species in the cultivated environment, from both stations. These stations were similar to each other with respect to the number of species present, with 34 species for Lokmane station and 38 for El Mihane station.

Relative Abundance

Relative Abundance of Arthropod orders captured by pitfall traps during two seasons of the year is shown in figure 6.

Relative Abundance of Arthropod orders captured by pitfall traps by each station during two seasons of the year is shown in Table 2.

Relative Abundance of Arthropod orders captured by sweep net during two seasons of the year in two station is shown in figure 7.

Relative Abundance of Arthropod orders captured by sweep net during two seasons of the year in each station is shown in Table 3.

Relative Abundance of Arthropod orders captured using the yellow pan traps during the two seasons of the year is shown in figure 8.

Relative Abundance of Arthropod orders captured by the yellow pan traps during two seasons of the year in each station is shown in Table 4.

DISCUSSION

We collected a total of 112 species at the four study sites during two seasons of the year, with 57 species from Lokmane station, 51 species from El Mihane station, 18 from Taghrarte station and 38 species from Iffoutten. We note that Lokmane station is the richest in the cultivated environment and Iffoutten is the richest in the natural one. Also, we note that the cultivated habitats are more species rich than the natural environments. This may be related to denser vegetation, the availability of water, and a more moderate temperature, which may have created a less stressful environment compared to the harsher conditions in the natural environment. The natural environment is xeric, with little vegetation and is dominated by a single plant species, *Calotropis procera*, a giant milkweed.

A previous study of the Laghouat region found a total richness of 55 species in an apple orchard and 45 species along the riverbed of M’zi (Saoudi & Thelidji, 2007). These results are similar to those reported here. In contrast, our findings are higher than those found by Reggani (2010) in two cultivated environments in Tamenrasset where only eight species were collected using the same techniques.

Our results show that Hymenoptera are the most abundant order in the four studied stations. We

Stations	Cultivated Stations				Natural Stations			
	Lokmane		El Mihane		Teghargharte		Iffoutten	
Orders	Ni	AR%	Ni	AR%	Ni	AR%	Ni	AR%
Scorpiones	1	0.06	0	0	0	0	1	0.17
Araneae	14	0.88	12	3.38	0	0	3	0.53
Sarcoptiformes	0	0	2	0.56	1	0.11	0	0
Scolopendromorpha	1	0.06	0	0	0	0	0	0
Entomobryomorpha	748	46.96	22	6.2	0	0	1	0.17
Symphyleona	1	0.06	0	0	0	0	0	0
Blattaria	0	0	1	0.28	0	0	0	0
Mantodea	0	0	2	0.56	0	0	0	0
Isoptera	3	0.19	3	0.85	0	0	1	0.17
Dermaptera	2	0.13	0	0	0	0	0	0
Orthoptera	32	2.01	22	6.2	0	0	1	0.17
Hemiptera	7	0.44	5	1.41	1	0.11	0	0
Homoptera	79	4.96	24	6.76	2	0.23	4	0.67
Coleoptera	12	0.75	10	2.82	25	2.85	164	27.66
Hymenoptera	675	42.37	239	67.32	849	96.7	405	68.3
Nevroptera	1	0.06	0	0	0	0	0	0
Lepidoptera	0	0	4	1.13	0	0	7	1.18
Diptera	17	1.07	9	2.54	0	0	5	0.85
Aphaniptera	0	0	0	0	0	0	1	0.17
Total	1593	100	355	100	878	100	593	100

Table 2. Relative Abundance of Arthropod orders captured by pitfall traps by each station during two seasons of the year. Ni: number of individuals. AR%: Relative abundances.

found that 67.3% and 42.4% of captured organisms were Hymenoptera at El Mihane and Lokmane stations, respectively. In the study by Chouihet & Doumandji-mitiche (2012) in the region of Ghardaïa, the arthropod communities were composed of 30.4%, 55.1%, and 41.1% Hymenoptera at the Al-Atteuf, Beni Izguen, and Dayah stations, respectively, which was similar to our findings. Additionally, Sid Amar et al. (2012) found very similar patterns to ours, where they noted a rate of 61% Hymenoptera in the palm grove of Mahdia in the region of Adrar. Our results confirm those found by Chennouf (2008) who noted values of Relative abundance for the Hymenoptera order equal to 35% in a palm grove. The order of Entomobryomorpha

is in the second most abundant group with a rate of 46.96% at the Lokmane station, and 6.2% at the El Mihane station.

However, studies by Chennouf (2008) in the Ouargla region, and Chouihet & Doumandji-mitiche (2012) in the Ghardaïa region, showed coleoptera to be the second most abundant group. Conversely, Dipterans are relatively rare with a rate of 2.54% at El Mihane station, and 1.07% at Lokmane station.

CONCLUSIONS

The current Arthropodofauna study was con-

Orders	Cultivated stations			
	Lokmane		El Mihane	
	Ni	A.R %	Ni	A.R %
Araneae	2	1.48	3	2.04
Sarcoptiformes	0	0	1	0.68
Mantodea	0	0	2	1.31
Odonatoptera	0	0	1	0.68
Orthoptera	10	7.24	95	62.5
Hemiptera	34	25.19	14	9.52
Homoptera	17	12.23	2	1.36
Coleoptera	55	40.74	4	2.72
Hymenoptera	4	2.96	6	4.08
Lepidoptera	3	2.22	9	5.92
Diptera	13	9.63	15	10.2
Total	138	100	152	100

Table 3. Relative Abundance of Arthropod orders captured by sweep net during two seasons of the year in each station. Ni: number of individuals. AR%: Relative abundances.

Orders	Cultivated stations			
	Lokmane		El Mihane	
	Ni	A.R %	Ni	A.R %
Araneae	1	0.38	5	1
Entomobryomorpha	137	51.5	34	6.8
Blattaria	0	0	1	0.2
Thysanoptera	0	0	2	0.4
Orthoptera	18	6.77	53	10.6
Hemiptera	6	2.26	3	0.6
Homoptera	51	19.17	82	16.4
Coleoptera	0	0	3	0.6
Hymenoptera	12	4.51	63	12.6
Lepidoptera	0	0	4	0.8
Diptera	41	15.41	250	50
Total	266	100	500	100

Table 4. Relative Abundance orders captured by the yellow pan traps during two seasons of the year in each station. Ni: number of individuals. AR%: Relative abundances.

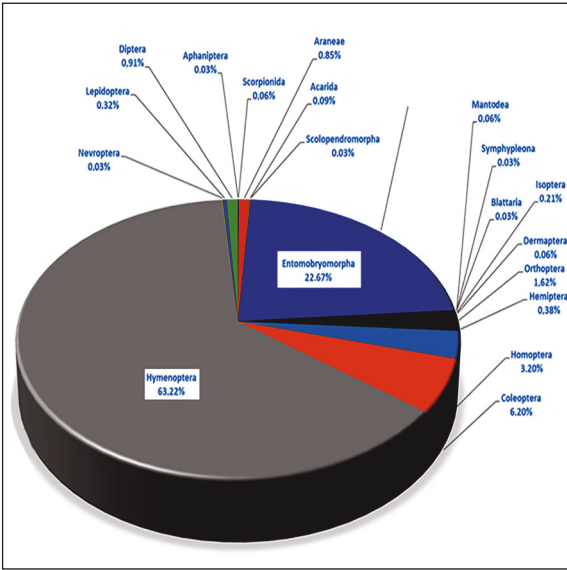


Figure 6. Relative abundances of orders of arthropods captured using pitfall traps in the four study stations.

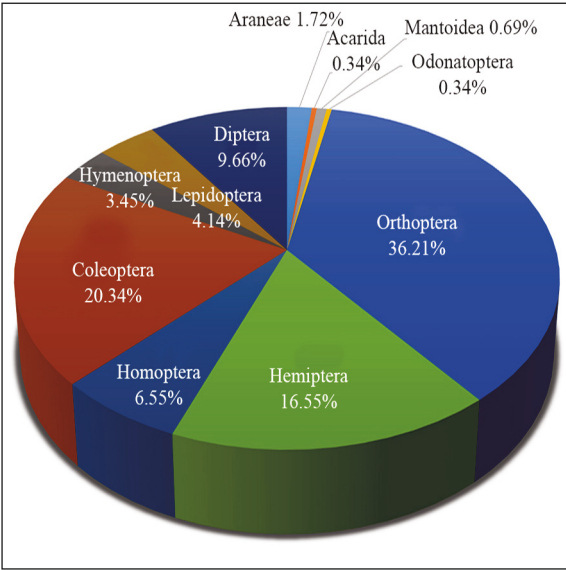


Figure 7. Relative Abundance of Arthropods species' orders captured through sweep net in two stations.

ducted in the region of Djanet in two different environments (cultivated and natural), at a total of four stations (two stations for each environment): Lokmane and El Mihane stations for the cultivated environment, and Teghargharte and Iffoutten stations for the natural environment. This study was conducted over two seasons, summer and winter. Three sampling methods were used during the two

seasons, namely: pitfall traps, sweep nets and yellow pan traps.

The pitfall trap method generated a collection of 112 arthropod species for the region. The Insecta class was the most abundant at the four stations with 10 species represented, including: *Cataglyphis bombycina* and *Anthicidae* sp. which were the most frequently captured species using this method. A

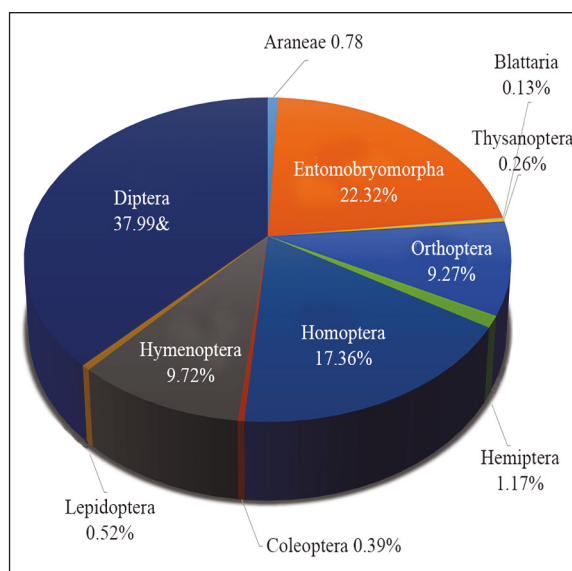


Figure 8. Relative Abundance of Arthropods species' orders captured by the yellow pan traps in two stations.

total of 2726 individuals were captured with pitfall traps during the summer and 694 individuals were captured during winter. Lokman station was ranked first with respect to the number of individuals captured by pitfall traps compared to the other stations. Hymenoptera and Entomobryomorpha orders were the most captured in the four stations using this method with relative abundance rates of 68.67% and 13.33% respectively.

The yellow pan trap method generated a total of 82 arthropod species. This method was used only in the two cultivated stations of Lokman and El Mihane. Dipterans were the most frequently captured group using this method with a rate of 40%. It is noteworthy that most of the individuals captured using this method were at El Mihane station.

The sweep net method was only used at the two cultivated stations. This sampling method allowed us to collect a large number of Orthoptera species (e.g. *Ochrilidia gracilis*), Coleoptera species (e.g., *Adonia variegata*) and Hemiptera species (e.g. *Nysius* sp.).

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