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INVENTORY OF THE INVERTEBRATE FAUNA ASSOCIATED WITH THE PERIMETER OF THE K'SOB DAM, EAST OF THE ALGERIAN STEPPE, IN THE WILAYA OF M'SILA

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Abstract

The study was conducted, on the arthropodological fauna, in the perimeter of the dam of K'sob, in the wilaya of M'sila, which is located in a semi-arid bioclimatic area. An inventory of arthropods was carried out using Barber traps. The results showed the dominance of species from the class Insecta (75.29 %). The total species richness consisted of 96 species corresponding to 35 families of which the family Formicidae (Hymenoptera) was the most represented (46.77%). The most abundant order is Hymenoptera with a representation of 49.05%.

Key words: K'sob area, arthropod fauna, Barber traps

INTRODUCTION

Wetlands, are among the most important ecosystems of our planet (Kadid, 1999).

They comprise areas of marshes, fens, peat bogs, natural or artificial waters, permanent or temporary, where the water is stagnant or flowing, fresh, brackish or salty, including areas of marine waters whose depth at low tide does not exceed 6 meters (Ramsar Convention).

They are essential from the point of view of the ecological processes that take place there but also for their richness in species of fauna and flora. In fact, they play an important role in the vital processes, maintaining hydrological cycles and hosting fish and migratory birds (Skinner et al., 1994).

Algeria, contains a great diversity of wetlands, these environments are among the most valuable resources in terms of biological diversity and natural productivity. Today, we know that wetlands play an important role in life processes, maintaining hydrological cycles and hosting an important flora, fish and migratory birds. On the other hand, due to numerous threats, wetlands are being destroyed at an unprecedented rate (Boumezbeur, 2001).

There are hundreds of thousands of dams in the world, built either for irrigation, as a reserve of drinking water or for energy production, or are considered environmentally important as artificial wetlands playing the role of staging areas, delivery or feeding for different species (Chadi and Ladgham-Chikouche, 2010).

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MATERIAL AND METHOD

1. The study site

The present work, which consists in carrying out an inventory of arthropods, in the perimeter of the K'sob dam, one of the sub-basins of the great Hodna basin located in the northern part of the wilaya of M'Sila, extends over an area of 1456 km², and a perimeter of 202 km. It is limited to the North and the North-West by the Bibans Mountains, to the South and the South-West by the Hodna mountains and to the East by the high plains of Sétif (Fig. 1).

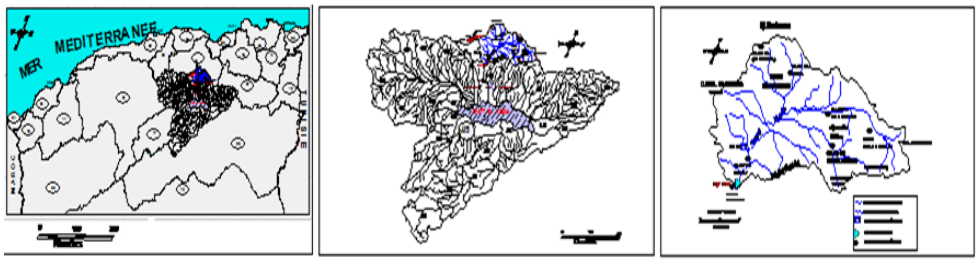

Fig. 1. (a) Hodna watershed, (b) Hodna watershed and K'Sob sub-basin, (c) K'Sob sub-basin

It is located in an area limited by longitudes (4°30'- 5°17' East) and latitudes (35°45' - 36°9' North). The climate of the basin is semi-arid, characterized by a cold winter and a dry and hot summer. The rainfall is irregular, characterized by short and intense showers, varying between 150-600 mm over the entire basin with an interannual average of 330 mm, with a coefficient of variation Cv = 0.27 for 66 hydrological years (1943/1944 - 2009/2010).

2. Sampling methods

For the realization of the present study, during the years 2015 and 2016, the sampling method consisted in placing an array of Barber traps. Traps are placed according to the transect method. It is a line materialized by a string along which a dozen traps are installed at intervals of 5 meters (Benkhelil, 1992).

In this case, the trap jars used are empty cylindrical cans, 15 cm in diameter and 18 cm high, with a volume of one liter. Each interception trap is filled to two thirds of its height with water and detergent to intercept the arthropod species. A total of 20 Barber traps were placed each month in the study site. After 48 h, the content of each trapis collected separately in a Petri dish, mentioning the date.

3. Method of conservation and identification of the arthropod species

After collecting the invertebrate species intercepted in Barber traps, they were identified in the laboratory using a binocular magnifying glass. It is based on the systematic study using different identification keys of Bernard, 2014; Chinery, 1988; Delvare and Aberlenc, 1989; Piham, 1986; Perrier, 1927, 1932, 1961; Sergent, 1909; Seguy, 1923, 1924.

4. Data analysis

For the interpretation of the results, different indices were used:

- The total species richness is calculated for each sampling site. It is the total number of species in an ecosystem (Ramade, 2003).
- The relative abundance of each species (expressed as proportion) Fc (%) was also evaluated; it is calculated as the percentage of individuals of a species Ni relative to the total number of individuals N (Faurie et al., 2003).

$$Fc\ \% = (Ni \times 100)/N ; \quad (1)$$

- The frequency of occurrence is the ratio expressed as a percentage of the number of records containing the species (Pi) under consideration to the total number of records (P) (Dajoz, 1982). It is defined as follows:

$$Fo\ \% = (Pi \times 100)/P ; \quad (2)$$

- According to Barbault (1981), Species diversity is measured by various indexes; the most used is the Shannon-Weaver. It is calculated by the following formula:

$$H' = -\Sigma qi \log 2\ qi ; \quad (3)$$

Where:

H'**:** diversity index expressed in bits units;

qi: the probability of encountering the species i or its' relative frequency;

- The equitability index is the ratio of observed diversity H' to the maximum diversity' max**:** E = H'/H' max (Blondel, 1979). Knowing that H' max corresponds to the highest possible theoretical value of the stand (Muller, 1985). It is calculated using the following formula:

$$H'\ max = Log2\ S ; \quad (4)$$

S: total wealth;

Where: H'max is expressed in bits.

The constancy classes of the species captured in the Barber pots, determined in relation to the frequency of occurrence, according to Sturge's rule are 7.53; it is rounded by default to 8 constancy classes such as:

A species is very rare if $0 \leq$ F.O. ≤ 12.5 %.

A species is rare if $12.5\ \% \leq$ F.O. ≤ 25 %.

A species is accidental if $25\ \% \leq$ F.O. ≤ 37.5 %.

A species is very iccidental if $37.5\ \% \leq$ F.O. ≤ 50 %.

A species is incidental if $50 \leq$ F.O.≤ 62.5.

A species is frequent if $62.5 \leq F.O. \leq 75$ %.
A species is regular if $75\% \leq F.O. \leq 87.5$ %.
A species is ubiquitous if $87.5\ \% \leq F.O. \leq 100$ %.

RESULTS AND DISCUSSION

1. Structure and organization of invertebrate communities

We start with the observation that sampling completeness was low giving incomplete survey results (Table 1). According to Ramade, 2003, the quality of the sampling is related to the number of species recorded as well as the number of surveys.

Table 1

Values of sampling completeness, total richness (S) and mean richness calculated for the species identified

Parameters	(a)	R	Sampling completeness (a/R)	Total species richness(S)	Average species richness
Results	53	20	2.95	59	4.45

R: Total number of surveys performed, (a): Total number of species found once (S): Total number of species.

The total species richness of arthropods sampled in the study area is 59 species; the average richness of the sampling sites is 4.8 (Table 1). Ziane, 2011, in the forest of El Haourane, reported 30 species for the total richness and an average richness of 3.75, while Kara and Chetioui, 2013, in Chott elHodna, reported 194 species for the total richness and 6.46 for the average richness.

By using the Barber traps method, our results are close to those of Ponel, 1983, obtained during the study of the littoral dunes in France, who found a total richness of 55 species. Also, Souttou et al., 2011, reported 64 species in a reforestation area with Aleppo pine in Sehary Guebly in Djelfa. In an olive grove, in Kabylia, Boukrout-Bentamer, 1998, showed the highest value of total richness fluctuating between 50 and 79 species in the Sebaou valley.

2. The inventory of classes and orders of captured arthropods

At the end of our work, we were able to count a total of 263 species with a total number of 2654 individuals. This inventory includes 5 classes, 16 orders and 35 families. The class Insecta was the most dominant with a percentage of 75.29 %, followed by *Arachnida* with a percentage of 12.55 %. In terms of orders, the Hymenoptera were the most represented with a number of 129 individuals with a percentage of 49.05 %, followed by the *Diptera* with 24 individuals, with a percentage of 9.13 %, the remaining orders covered percentages between 0.38 % and 7.98 % (Fig. 2).

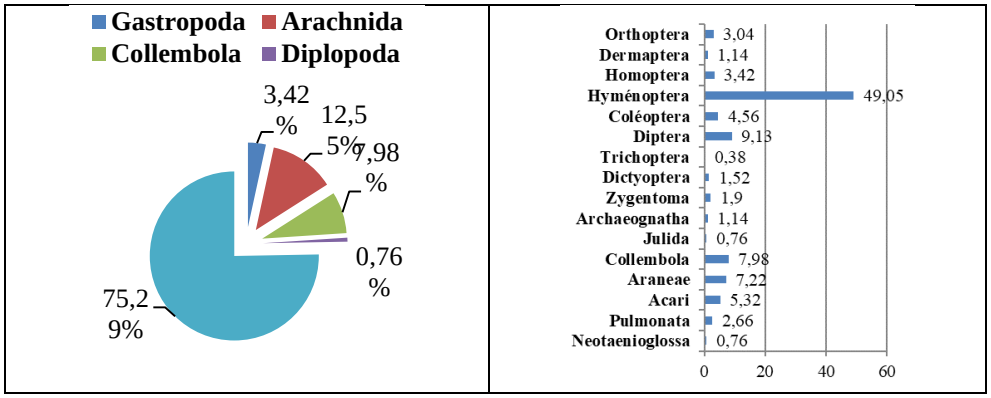

Fig. 2. Percentage representation of different taxa of invertebrates captured in the K'Sob-M'Sila area

Our results were similar to those reported in the paper of Chebouti - Meziou et al., 2011, who indicated the order *Hymenoptera* being dominant with a relative abundance of 55 %, corresponding to 136 individuals followed by *Coleoptera* with a percentage of 29 %, corresponding to 70 individuals.

Similarly, Souttou et al., 2011, using the same sampling technique, were able to capture 632 individuals belonging to the order *Hymenoptera* which dominated the other orders with a relative abundance ranging from 27.9 % to 90.2 % during the six months study.

According to Figure 3, the highest frequencies of occurrence are recorded for the orders *Hymenoptera* (F.O. = 85 %), *Diptera* and *Collembola* with a frequency of occurrence of 65 % each. The frequencies of occurrence at order level of the other trapped individuals vary from 5 % to 45 %. These results are similar to those of Yakoubi, 2013, who found in an olive grove at the Nouara station, that the dominant orders were: *Hymenoptera* with a frequency of 84.1 %, followed by Diptera with a frequency of 6.46 %.

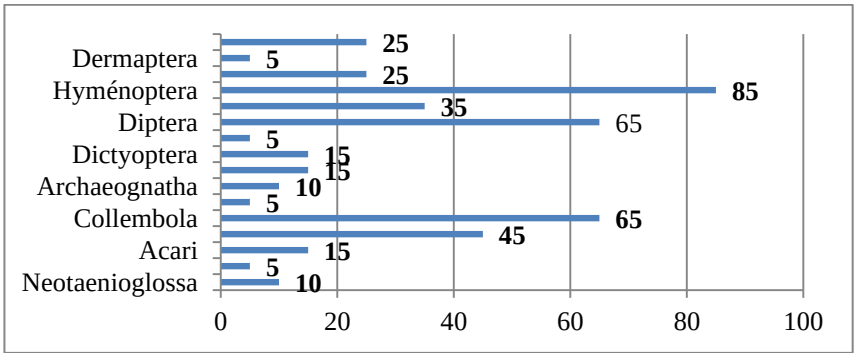

Fig. 3. Frequency of occurrence (%) of arthropod taxa inventoried in the study area

3. Occurrence frequencies, constancy and rarity of the intercepted arthropods

The classes of constancy of the species captured in the Barber traps, determined in relation to the frequency of occurrence, according to the Sturge rule are 7.53; it is rounded by default to 8 classes of constancy (Very rare, Rare, very accidental, accidental, frequent (Table 2).

According to Table 2, the frequencies of occurrence and Constancy of the species identified in the K'Sob perimeter vary from 1.5 % to 80 %; one species is accidental with an occurrence frequency of 28.67 % (*Camponotus micans*); one species is very accidental with an occurrence frequency of 40.75 % (*Camponotus erigens*); one species is frequent with an occurrence frequency of 80 % (*Messor barbarus*).

Table 2

Percentages and frequencies of occurrence and the constancy class of the captured invertebrates species in the K'Sob-M'Sila area

Famillies	**Species**	**F.C %**	**F.O %**	**categories**
Hydrobiidae	*Hydrobia acuta*	0,38	1.50	Very rare
Pleuroceridae	*Pleurocera acuta*	0,38	1.50	Very rare
Sphincterochilidae	*Sphincterochilacandidissima*	1,90	7.55	Very rare
	Sphincterochilatunetana	0,76	3.01	Very rare
Trombidiiae	*Allothrombiumfuliginosum*	1,52	6.04	Very rare
Caeculidae	*Caeculusechinipes*	1,14	4.53	Very rare
	*Caeculussp*ind.	1,14	4.53	Very rare
Gamasidae	*Phytoseiulus persimilis*	1,52	6.04	Very rare
Gnaphosidae	*Scotophaeusblackwalli*	0,38	1.50	Very rare
	Drassodeslapidosus	1,14	4.53	Very rare
	Callilepisnocturna	0,76	3.01	Very rare
Lycosidae	*Alopecosaaccentuata*	0,76	3.01	Very rare
	Lycosidae ind.	0,38	1.50	Very rare
Linyphiidae	*Linyphia triangularis*	1,14	4.53	Very rare
	Tenuiphantes sp.	0,38	1.50	Very rare
Phalangiidae	*Leptobunusparvulus*	1,14	4.53	Very rare
	Podura sp.	1,14	4.53	Very rare
Poduridae	*Podura sp.*	1,14	4.53	Very rare
Isotomidae	*Desoriasaltans*	1,52	6.04	Very rare
	Cryptopygusantarcticus	1,14	4.53	Very rare
Entomobryidae	*Orchesela sp.*	1,90	7.55	Very rare
	Orcheselavillosa	1,14	4.53	Very rare
	Entomobryaunostrigata	1,14	4.53	Very rare
Julidae	*Ommatoiulussabulosus*	0,76	3.01	Very rare
Machilidae	*Machilidaesp*	1,14	4.53	Very rare
Lepismatidae	*Lepisma saccarina*	1,14	4.53	Very rare
	Lepismiumbolivianum	0,76	3.01	Very rare
Blattidae	*Blattaorientalis*	1,14	4.53	Very rare
Ectobiidae	*Lobopteradecipiens*	0,38	1.50	Very rare
Phryganeidae	*Phryganea grandis*	0,38	1.50	Very rare

Mycetophilidae	*Macrocerasp*	0,38	1.50	Very rare
	Mycetophilidaesp	0,38	1.50	Very rare
Muscidae	*Musca domestica*	4,18	16.60	Very rare
	Hydrotaea sp.	1,14	4.53	Very rare
	Stomoxyscalcitrans	1,52	6.04	Very rare
Fanniidae	*Fanniacanicularis*	1,14	4.53	Very rare
	Fanniascalaris	0,38	1.50	Very rare
Carabidae	*Harpalusrufipes*	0,38	1.50	Very rare
	Harpalusrufipes	0,38	1.50	Very rare
Staphylinidae	*Staphylinussp*	1,14	4.53	Very rare
Scarabeidae	*Pterostichusdiligens*	0,76	3.01	Very rare
	Coprislunaris	0,38	1.50	Very rare
Curculionidae	*Sitophilus granarius*	1,14	4.53	Very rare
Coccinellidae	*Coccinelaseptempunctata*	0,38	1.50	Very rare
Formicidae	*Messorbarbarus*		80	Regular
	Camponotuserigens	20,15	40.75	Very
		10,27		accidental
	Camponotusmicans	7,22	28.67	accidental
	Aphaenogastertestaciopillosa	4,18	16.60	Rare
	Crematogasterscutellaris	4,94	19.62	Rare
Vespidae	*Vespula germanica*	1,52	6.04	Very rare
Braconidae	*Microplitiissp*	0,76	3.01	Very rare
Jassidae	*Cicadellaviridis*	1,90	7.55	Very rare
	Jacobiascalybica	0,76	3.01	Very rare
	Jassidae sp.	0,76	3.01	Very rare
Forficulidae	*Forficulaauricularia*	1,14	4.53	Very rare
Gryllidae	*Nemobius sylvestris*	0,76	3.01	Very rare
	Gryllusbimaculatus	0,38	1.50	Very rare
Miridae	*Miridae sp.*	0,76	3.01	Very rare
Acrididae	*Schistocerca sp.*	1,14	4.53	Very rare
35	**59**			

It should be noted, that 54 species are very rare, with a frequency of occurrence that fluctuates between 1.5 % and 10 %; 3 categories are rare with a frequency of occurrence that fluctuates between 16.6 % and 19.62 % (Fig. 3).

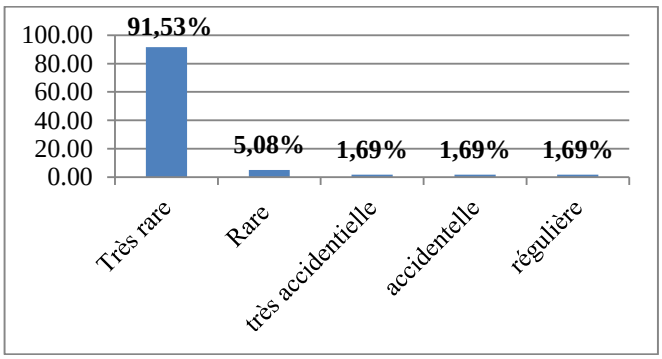

Fig. 4. Constancy classes of the captured invertebrates species in the K'Sob-M'Sila area

Souttou et al., 2011, in the reforested pine forest in Djelfa reported the dominance of *Camponotus sp.2* with 31.2 % representation followed by *Monomorium sp*. with 20.9 %. The dominance of ant species has been reported in a faunistic study, at the level of the cedar grove of the Mount Babor nature reserve, where the dominance of *Camponotus* sp. was 13.2 %.

4. Diversity of arthropod populations in the K'Sob area

As ecological indices of structure, we used the Shannon-Weaver diversity index (H') and the equitability index (E). The values of these indices are shown in Table 3.

Table 3

Values of Shannon diversity index (H'), maximum diversity (H' max) and equitability index calculated for the species.

Ecological indices	Shannon Diversity Index H' (bits)	Maximum diversity index H' max (bits)	Equitability Index (E)
Values	3.4	4.08	0.83

The Shannon diversity index value calculated for the recorded interceptions during the study period at the Ksob perimeter is 3.4 bits. According to Blondel, 1979, the greater the diversity index (H'), the more diverse the community.

The increase in the diversity of phytophagous and consequently of their predators and parasites is related to the increase in plant diversity (Tilman, 1997).

According to Souttou et al., 2011, the values of the Shannon-Weaver diversity index generally oscillate between 2.58 bits and 4.75 bits. These values are close to those found in our study. On the other hand, Brague-Bouragba et al., 2006, reported low diversity of invertebrates in El Mesrane (H' = 2.50 bits).

Equitability Index is 0.83. This index equals 1 when all species in a given sample have the same abundance and 0 when only one species is present in the sample (Cordonnier et al., 2012). Souttou et al., 2011, gives values of the equitability index between 0.44 and 0.89 for observed communities.

CONCLUSIONS

Our study, on the *arthropod fauna* of the perimeter of the dam of K'sob (Wilaya of M'sila), during the years 2015 and 2016, showed a total richness of 96 species, corresponding to 5 classes, 16 orders and 35 families; the calculated average richness was 4.8 species.

The classes of arthropods recorded are *Insecta*, *Arachnida*, *Diplopoda*, and *Collembola*. Among these, the class of *Insecta* dominates with a frequency of 75.29; regarding the percentages of families and orders intercepted in Barber traps, the family *Formicidae* is the most represented with 46.77 % and the order *Hymenoptera* is the most represented with 49.05 %.

The number of constancy classes calculated according to Sturge's rule indicates the presence of 8 constancy classes.

The study of the frequency of occurrence reveals the presence of 54 very rare species, 3 species are rare, one species is accidental with a frequency of occurrence of 28.67 % (*Camponotus micans*); one species is very accidental with a frequency of occurrence of 40.75 % (*Camponotus erigens*); one species is frequent with a frequency of occurrence of 80 % (*Messor barbarus*).

The Shannon-Weaver index calculated for the various species sampled is equal to 4.53 bits; this value allowed us to qualify the study area is moderately diverse in arthropods. The equitability is equal to 0.67, which reflects a balance between the numbers of species recorded.

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