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Biodiversity and distribution of the water mite fauna (Acari: Hydrachnidia) of Collo (Northeast Algeria)

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Abstract

In this work, we examined the biodiversity of water mites collected at the region of Collo (North-east Algeria). Sampling was carried out for a period of three years (2011/2012/2013). The species have been determined according to the keys of Soar & Williamson (1929), Viets (1930; 1936; 1956) and Marshall (1928). Five species belonging to three families (Eylaidae, Hydrachnidae, Hydryphantidae) and three genera (*Eylais*, *Hydrachna* and *Eupatra*), were revealed: two species belonging to the family of Eylaidae (*Eylais hamata* Koenike 1897, *Eylais galeata* Viets 1911), two species belonging to the family of Hydrachnidae (*Hydrachna Murati* Walter 1939, *Hydrachna globosa* De Geer 1778), and one species belonging to the family of Hydryphantidae (*Eupatra rotunda* Piersig 1906). However, The characterization of the structures of the water mite stand was performed using the ecological indices and showed a remarkable predominance of the species *Eylais hamata*, the other species are very rare.

Keywords: Algeria, collo, biodiversity, systematic, water mites, *Eylais*

1. Introduction

Mosquitoes are vectors of several pathogens such as protozoa, virus and nematodes, transmitted to humans and domestic animals^[1]. These insects are usually controlled by conventional insecticides that have in the long-term side effects. Biological control is an alternative to chemical control. Invertebrate and vertebrate organisms as well as entomopathogens have been used in biological control against mosquitoes^[2-4]. Among them, *Gambusia affinis* Baird & Girard 1853 (*Cyprinodontiformes: Poeciliidae*)^[5], is a larvivore fish the most known^[6-8]. As yet, there is within a natural population of aquatic insects, a multitude of other carnivores with interesting abilities (Coleoptera, Odonata and Hydrachnidae), which their preferential prey are most often the larvae of crustaceans and aquatic insects^[9-10]. In fresh waters, we found therefore the Hydrachnidae, that belong to the Cohort of Parasitengona and Subcohort of Hydrachnidia, Hydrachnida or Hydracarina (True water mites), predators of larvae and eggs of mosquitoes^[11-16] and parasites of insects semi-aquatic. Water mites are among the most abundant and systematically the most diversified of the aquatic mites. The most recent classification subdivides the mites in 4 groups: Prostigmata, Astigmat, Gribatida, Mesostigmata. The majority of water mites are Prostigmata, and Parasitengona^[17]. The identification of Hydrachnidia is a specialization that is strongly divergent. The classification of the groups is represented in majority by the similar characters of different chitinous structures of the adult and larvae body. Until now, there are more than 6000 species listed in the world, represented by 57 families, 81 sub-families and more than 400 genera^[18, 19]. But the studies on the water mites in Africa are very rare. In Algeria, the first work done on water mites^[20-23] have revealed the presence of larvae of water mites in different parts of the body of Insects with aquatic larval phase. Only 6 species belonging to this group have been reported at the time in North Africa^[24]. The description of the first four species collected in the surrounding area of Algiers has been made^[25]. However, the absence of certain details makes their identification unsafe^[24]. In this context, a research program has been established by our laboratory, in order to implement inventories at the East of Algeria, and proceed thereafter to the determination of their ability as antilicicide predators, to integrate them into the biological control^[26-29]. In this study, we have contributed to the systematic identification of species of water mites, harvested at Collo, located in the extreme

North-east of Algeria. These species have been determined according to the identification keys [30-34]. The characterization of the structures of the water mite stand was performed using the ecological parameters.

2. Materials and Methods

2.1 Presentation of the study area

Collo (37°00'21" N, 6°34'21 E, Altitude: 26 m), is located in the North-east of Algeria, at 71 km from the wilaya of Skikda. This area is about 228, 28 km². It is limited from the North and the North-east by the Mediterranean Sea, to the West by the Daira of Zitouna and to the South by the commune of Kerkeria (Figure 1). The climate of this region is the Mediterranean type with alternating of rainy and dry season, due to combined action of different climatic factors. The average annual precipitation varies between 800-1400 mm/year and the average annual temperature is about 20.2°C [35].



Fig 1: Geographical location of the sampling site (Collo) [36]

2.2 Biological material

Water mites are Arthropods, Chelicerata, belonging to the class of Arachnida and the order of Acarina. They are purely aquatic, and brightly coloured, often with orange, yellow and red colors, probably because of the harmful secretions from their dermal glands. They have a microscopic size from 0.5 mm to 5 mm. The body is of a one appearance, prosome and opisthosome being intimately fused and with inapparent segmentation. The buccal part consists of a pair of chelicerae and a pair of pedipalps [17].

2.3 Sampling method

The sampling of water mites was conducted for three consecutive years (2011, 2012, 2013). Specimens were collected at four stations, represented by temporary rainwater lodges. These last are located at 17 km from the commune of Collo. Samples were taken using a large dipper with 500 ml of the capacity. After that, specimens were placed in small containers with slodging water, to facilitate their transport to the laboratory and to preserve the living conditions [29].

2.4 Conservation and mounting of the specimens

Our samples were stored in eppendorf tubes containing 10% NaOH for 48 h, to make them transparent and to destroy the viscera. Then, they were rinsed with distilled water and preserved in Koenike's fluid (10% acetic acid, 50% glycerol and 40% distilled water) [37]. This fluid tends specimens soft, flexible, with some original colors, so facilitating the microscopic identification [38]. The species of water mites have been identified according to the identification keys [30-34].

2.5 Ecological index

The ecological indices retained for the analysis of the water mite population are the total and the average richness [39], Shannon-Weaver index [40], the equitability [41] and the centesimal frequency [42].

3. Result

3.1 Systematic position

Kingdom Animalia
Phylum Arthropoda
Subphylum Chelicerata
Class Arachnida
Subclass Acarina
Order Actinedida
Suborder Parasitengona
1- Family Hydryphantidae
<i>Eupatra rotunda</i> Piersig 1906
2- Family Eylaidae
<i>Eylais hamata</i> Koenike 1897
<i>Eylais galeata</i> Viets 1911
3- Family Hydrachnidae
<i>Hydrachna globosa</i> De Geer 1778
<i>Hydrachna murati</i> Muller 1776

3.2 Description

Eupatra rotunda Piersig 1906

It has a dark-red color, sometimes brown or even black (Fig. 2). The body is oval, elongated, and densely covered with papillae (Fig. 3). The eyes are fixed on each side of the body and separated from each other's by a dorsal plate. The pedipalps are short and very robust in their three basal articles, while the fourth is slender (Fig. 4). The coxae are arranged in four groups, covering almost two-fifths of the ventral. The fourth plate is relatively more long, and does not exceed the genital organ in the rear (Fig. 5). The first and the second pair of legs with large spines (Figs. 6, 7). Whereas, the two pairs of the rear legs are topped with swimming setae (Fig. 8).



Fig. 2. *Eupatra rotunda*; dorsal side of female (Agr. 38.51)

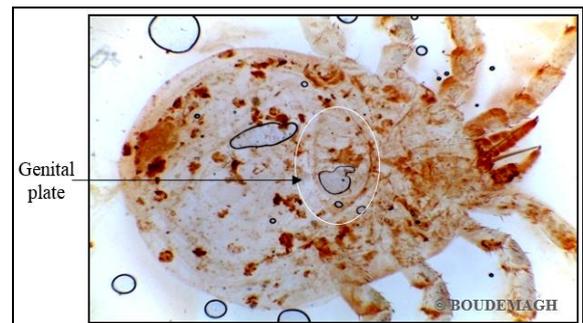


Fig. 3. *Eupatra rotunda*; ventral side of female (Agr. 18.24).



Fig. 4. Pedipalps of *Eupatra rotunda* (Agr. 22,09).

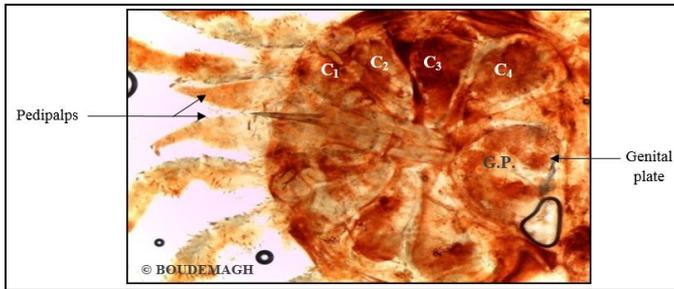


Fig. 5. *Eupatra rotunda*; ventral side of male; C: coxae (Agr. 38,66).



Fig. 6. *Eupatra rotunda* ; the 1st leg of female (Agr. 11,43x10).

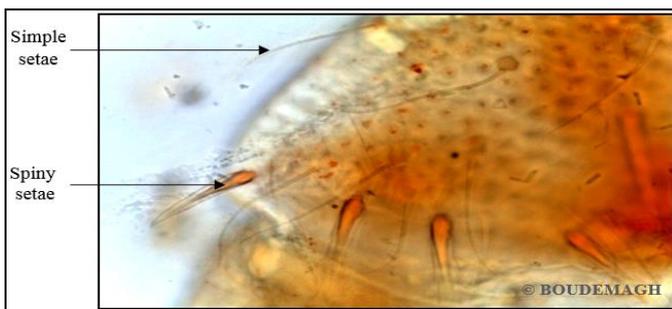


Fig. 7. *Eupatra rotunda* ; setae of the 1st leg of female (Agr. 2,44x102).

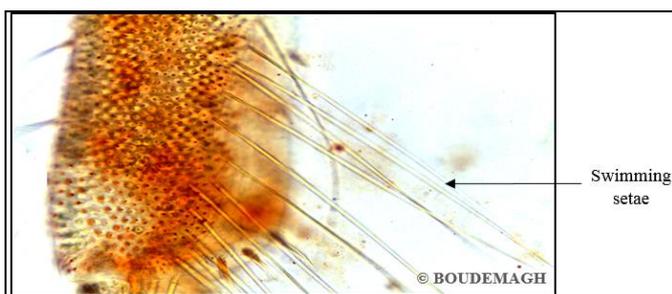


Fig. 8. *Eupatra rotunda*; swimming setae of the 3rd leg of female (Agr. 12,52x10).

***Eylais hamata* Koenike 1897**

It is one of the most large species, the length of the body varies between 4-7 mm, in the female. It is ovoid, has a bright red color and dorsoventrally flattened. The females are generally large compared to males (Fig. 9). The four eyes are worn on two capsules, connected between them by a keel transverse chitinous, very long and narrow as well called: eye bridge (Fig. 10). The length of the eye bridge in the male is relatively lower than that of the female. The coxae are in the form of plates long, narrow and arranged in four groups, which of the last two are closely related (Fig. 11). In the adult, the rostrum is bordered by a pair of pedipalps often long, articulated and gradually tapered in the end, and without claws (Fig. 12). As well as a pair of chelicerae very small and encourbés at the bottom (Fig. 13).



Fig 9: *Eylais hamata*; ventral side of the Male. L: leg; S.: Segment (Agr. 19,55)

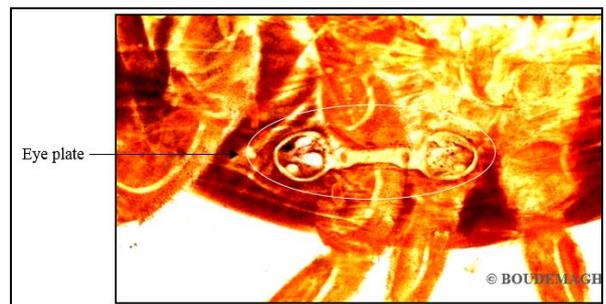


Fig 10: *Eylais hamata*; eye plate of female (Agr. 43,71)

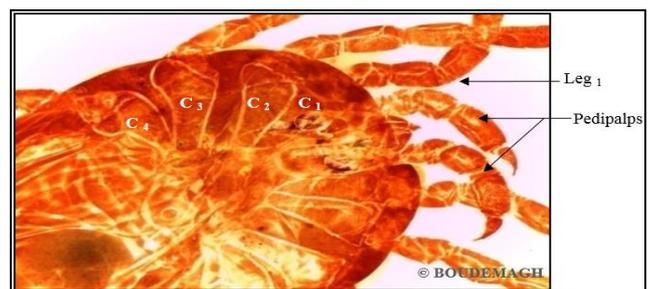


Fig 11: *Eylais hamata* ; ventral side of female C: coxae (Agr. 36,19)

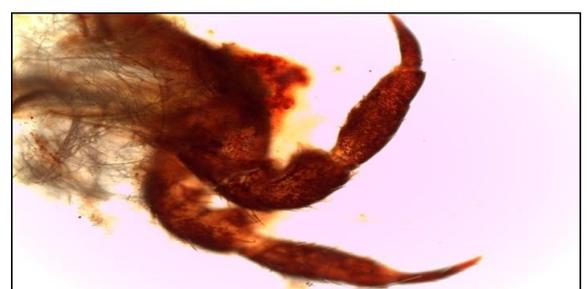


Fig 12: Pedipalps of *Eylais hamata*; S. : Segment (Agr. 34,60)



Fig 13: Chelicerae of *Eylais hamata* (Agr. 60,82)

***Eylais galeata* Viets 1911**

It is often rounded, and the third of the ventral is significantly inflated, with a bright red color. The length of the body varies between 2.6-3.8 mm. The two pairs of eyes, each enclosed in a capsule, are located in the rear of the front edge (Fig. 14). The pedipalps are relatively short (Fig. 15), as well, the chelicerae are quite short and bent slightly at the bottom (Fig. 17). However, the eye plate is a little greater, the eye bridge remains short, and the eye capsules are very close (Fig. 16). The coxae are long and narrow, arranged in four groups which of the last two are closely related.



Fig 14: *Eylais galeata*; ventral side (Agr. 12.2)

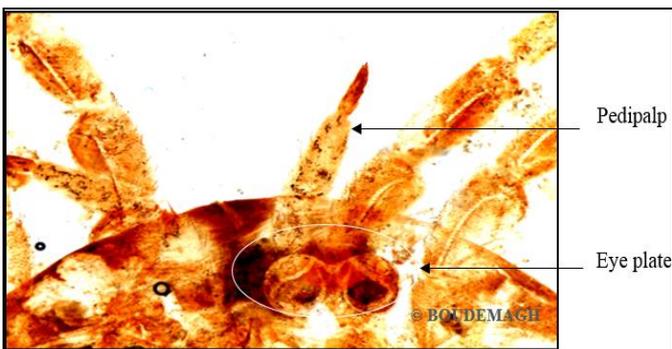


Fig 15: *Eylais galeata*; eye plate and pedipalps (Agr. 27.84)

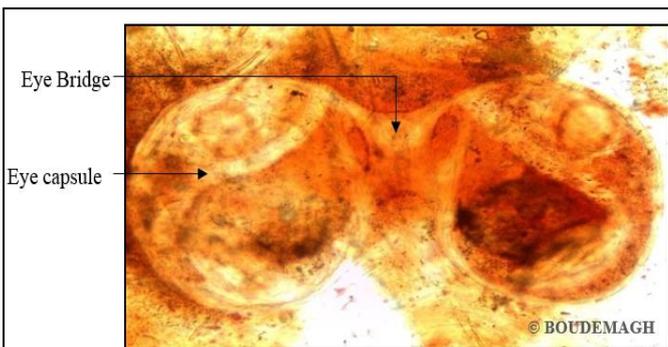


Fig 16: *Eylais galeata*; eye plate (Agr. 123,07)

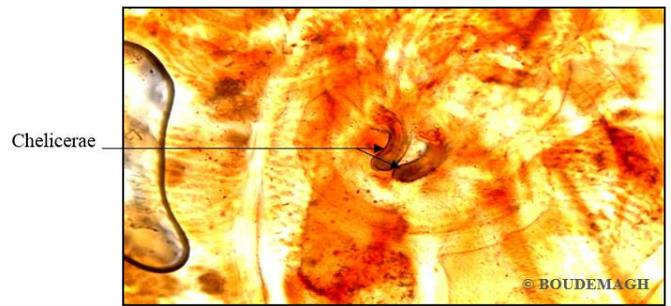


Fig 17: *Eylais galeata*; chelicerae (Agr. 92.78)

***Hydrachna globosa* De Geer 1778**

The color is red or sometimes black. The body is globular and broadly rounded, soft and covered with papillae of variable size and form. The length of the body tends to 3,3-4.0 mm long for females and 3.3 mm-2 mm long in males. The chelicerae and pedipalps are of the same length. The two pairs of eyes are located on the sides of the body and are enclosed in the chitin and the dorsal plate is located behind the eyes (Fig. 18). The coxae are typically arranged in four groups of two and the genital plate is located between the rear coxae, with a deep slot (Fig. 19).

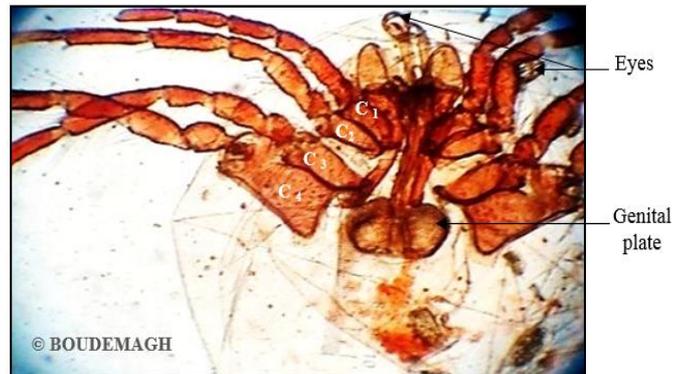


Fig 18: *Hydrachna globosa*; ventral side; C: Coxae (Agr. 15.05)

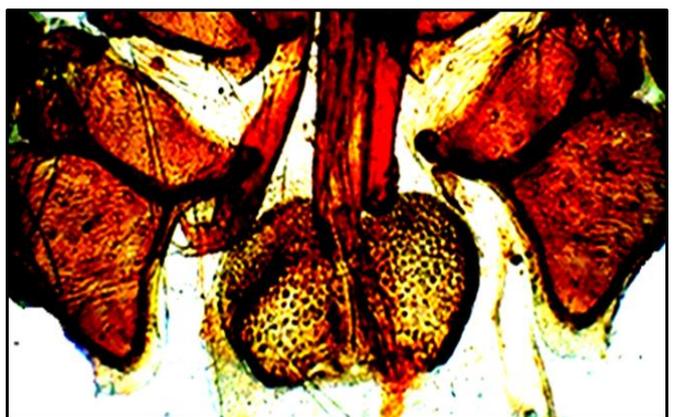


Fig 19: *Hydrachna globosa*: Genital plate (Agr. 33.70)

***Hydrachna Murati* Walter 1939**

Among the largest aquatic mites, with a spherical body, and red color, sometimes black. The two eyes located on each side are placed between the chitin. As well, the coxae are strongly developed (especially III pair), arranged in four groups, very close and merged into part (Fig. 20). The segments of the pedipalps remaining long and thin, and slightly more broad at the base (Fig. 21). The three pairs of legs rear are lined with swimming setae, which are more abundant than the other species (Fig. 22).

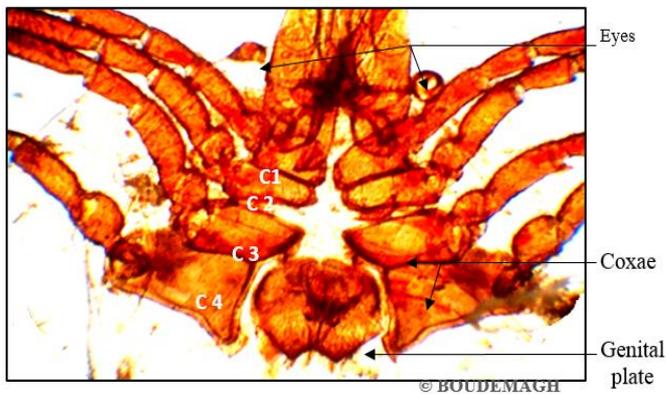


Fig 20: *Hydrachna Murati* ; ventral side of male; C: Coxae (Agr. 15.1)



Fig 22: *Hydrachna Murati*; segment of the 4th leg of the male (Agr. 49.48)



Fig 21: *Hydrachna Murati*; pedilpalps and Chelicerae (Agr. 31,03)

3.3 Water mite fauna composition

The systematic study of water mites realized in Collo (North east Algeria) allowed us to determine five species, according to the keys of identifications [30-34]. The list of species identified is addressed in the table 1. These species belong to three families: Eylaidae (*Eylais hamata* Koenike 1897; *Eylais galeata* Viets 1911); Hydrachnidae (*Hydrachna globosa* De Geer 1778 and *Hydrachna Murati* Walter 1939) and Hydryphantidae (*Eupatra rotunda* Piersig 1906), and to three genera (*Eylais*, *Hydrachna*, *Eupatra*). However, the period of emergence of water mites is limited to five months (January, February, March, April and May). The months of February, March and April marked the highest values. The species *Eylais hamata* is the most abundant, and persists during three years, as it is present in almost all stations (Fig. 23, 24, 25).

Table 1 : Monthly total richness of water mites in Collo (North east Algeria), for three consecutive years (2011 / 2012 / 2013)

Month species	Janvier	Février	Mars	Avril	Mai	Juin	Juillet	Août	Septembre	Octobre	Novembre	Décembre
<i>Eupatra rotunda</i> Piersig 1906	32	16	-	2	-	-	-	-	-	-	-	-
<i>Eylais hamata</i> Koenike 1897	287	130	85	92	8	-	-	-	-	-	-	-
<i>Eylais galeata</i> Viets 1911	-	7	-	2	-	-	-	-	-	-	-	-
<i>Hydrachna globosa</i> De Geer 1778	4	4	-	-	-	-	-	-	-	-	-	-
<i>Hydrachna murati</i> Walter 1939	1	-	1	-	-	-	-	-	-	-	-	-
Total	324	157	86	96	8	-	-	-	-	-	-	-

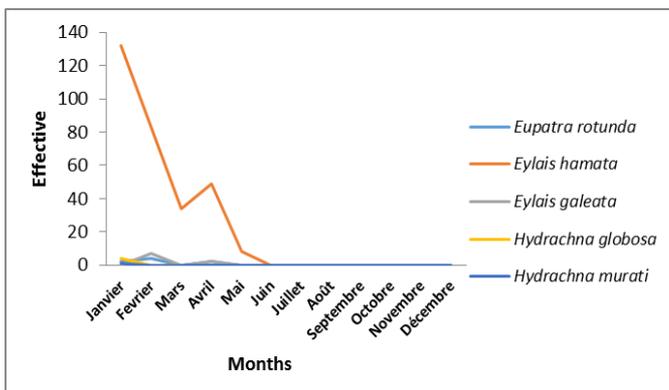


Fig 23: Monthly richness of water mites in Collo during the year 2011

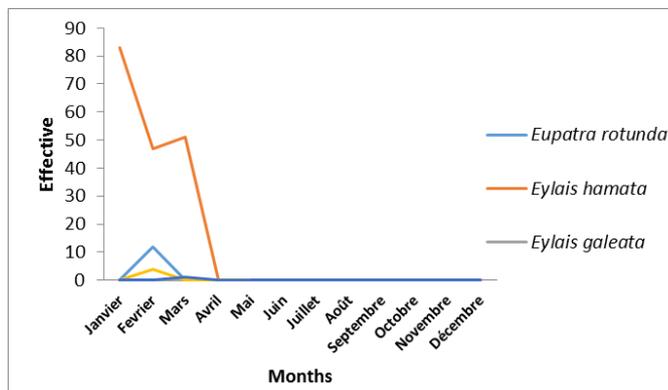


Fig 24: Monthly richness of water mites in Collo during the year 2012

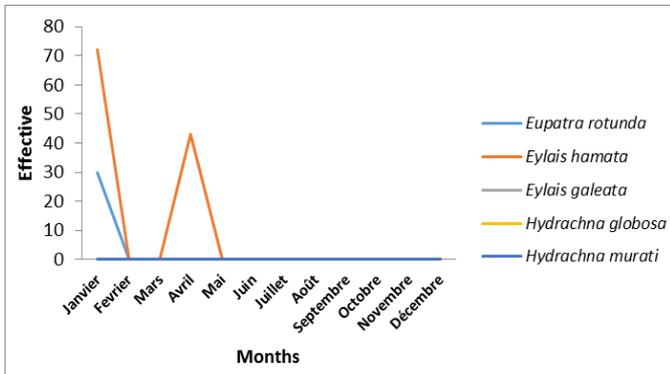


Fig 25: Monthly richness of water mites in Collo during the year 2013

3.3 Ecological indices

The results mentioned in the table (2) present the values of the total and the average richness, Shannon-Weaver (H') diversity index, maximal diversity index (H' max) and equitability (E). The total richness, is limited to five species, with an abundance of 671 individuals. However, the values of the Shannon -Weaver diversity index vary between 0.11 for the second station and 1.50 for the fourth station. The first value explains that the number of individuals is high and the number of species is low (2 species). The second value presents a rich population (4 species). Regarding the equitability, it presents a value of 0.11 at the second station, which explains that the populations are not balanced between them. But, it tends to 1 at the fourth station with a value of 0.94; indicating a balance between populations.

Table 2: Total and average richness, Schanon-Weaver (H') diversity index, maximal diversity index (H' max) and equitability (E) of the water mites in Collo (North east Algeria)

Species	Station			
	1	2	3	4
<i>Eupatra rotunda</i> Piersig 1906	25	-	21	4
<i>Eylais hamata</i> Koenike 1897	273	122	203	4
<i>Eylais galeata</i> Viets 1911	7	-	2	-
<i>Hydrachna globosa</i> De Geer 1778	4	2	-	2
<i>Hydrachna Murati</i> Walter 1939	2	-	-	-
Effective /station	311	124	226	10
H' / station	0.68	0.11	0.50	1.50
S/ station	05	02	02	03
H' max	2.32	1	1	1.58
E / station	0.29	0.11	0.50	0.94
Total effective	671			
Statments	16			
Total richness	05			
Average richness	37			

Centesimal frequency

The results recorded in Fig. 26 indicate that the relative abundance values vary from one species to another. Results indicate that *Eylais hamata* is the most frequent species in Collo (North east Algeria), since it is present in more than 50% of surveys. The other species are very rare because they are present in less than 25% of records.

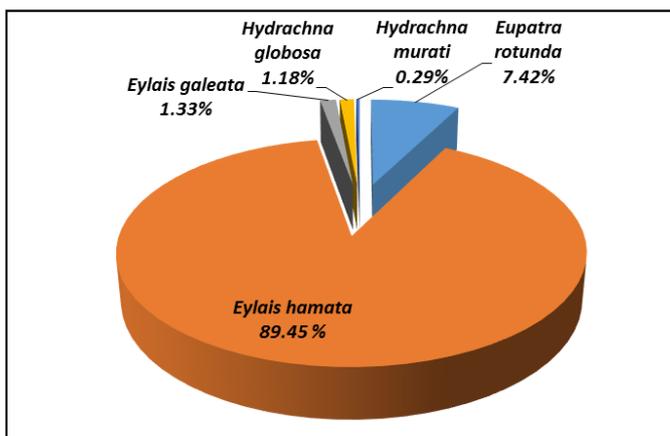


Fig 26: Centesimal frequency of water mites in Collo (2011/2012/2013)

4. Discussion

Water mites are Arachnids of the order of the Mites. They have the interest to be good indicators of a biocenosis quality, due to the requirements of their development cycle. Thus, they have the advantage of being present in

abundance when conditions are favorable, are easy to harvest and repellents for predators (insects and fish). They are also involved in the regulation of the populations of aquatic insects and their density reveals the trophic potentialities of their habitat. Several studies have been carried out on the classification of water mites in the world [14, 18, 37, 38, 43, 44]. In New Guiné, 75 species have been identified, 19 species of them are newly described as sub species [45]. In France, 420 species and 7 under species have been revealed [46]. In Turkey, 23 families, 55 genera and over 240 species of water mites are known [47]. For the roman fauna, 56 species of water mites have been identified, which of 40 are presented for the first time [48]. In Algeria, the first works were carried out in Algiers, El-Kala, Oran, Djurdjura and El-Hoggar [20- 25, 49,50]. Other works have determined the water mites as predators of insects. The Nearctic species of Arrenurinae [51-54], as well as other species Palearctic such as the Hydrachnidae, Limnocharinae, Eylaidae, Limnesiinae, Unionicolinae and Pioninae have been published [55]. In Collo (North east Algeria), five species have been detected. These species belong to three families: Eylaidae (*Eylais hamata* Koenike 1897, *Eylais galeata* Viets 1911); Hydrachnidae (*Hydrachna murati* Walter 1939 and *Hydrachna globosa* De Geer 1778) and Hydryphantidae (*Eupatra rotunda* Piersig 1906). The species *Eylais hamata* presents the highest density. This species has been reported in the key of the identification of Eylaidae [42]. *Eylais hamata* is the most abundant species in the Lake of birds, wilaya of El Taref [26] and it has been also found in the Lake Tonga [29], works have revealed the presence of six species: *Piona uncata*, *Forelia Onondaga*, *Eylais hamata*, *Arrenurus balladoniensis*, *Unionicola crassips*

and *Hydrachna cruenta*, including *P. uncata* is the most widespread and has already been the subject of a morphometric study of females [28]. However, the family of *Hydrachnidae* with the genus *Hydrachna* has also been reported in Lake Tonga [29, 56]. On the other hand, according to our results, the period of emergence of water mites is limited to five months (January, February, March, April and May). This could be due to the fact that the existing vegetation above the lodges, offers a favorable microclimate for the development of water mite during the rainy seasons. While the decrease in the water level during the dry period, which extends from June until December, leads to their disappearance.

5. Conclusion

The systematic and the ecological study of the water mites in Collo (Northeast Algeria) revealed the presence of five species belonging to three families: Eylais, Hydrachna, and Eupatra. The species *Eylais hamata* was the most abundant. This work is a complement to the data relating to the biodiversity of water mites in Algeria and their ecology. As a result, new research on its habitats would surely be involved, in order to list the species present in these plans of water.

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