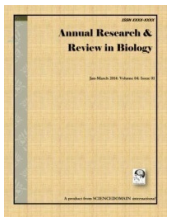

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Research on the Ecology of Water Mites (*Acari*: *Hydracarina*) in North-East of Algeria (Wetland Complex of El-Kala National Park)

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Authors' contributions

This work was carried out in collaboration between both authors. Author SM designed the study, wrote the protocol and interpreted the data. Authors SM and SB anchored the field study, gathered the initial data and performed preliminary data analysis, managed the literature searches and produced the initial draft. Both authors read and approved the final manuscript.

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ABSTRACT

An analysis of eight physical and chemical parameters was realized to determine the influence of species on the biodiversity of water mites. A total of 292 water mites belonging to 9 species were collected from the two lakes (Tonga and Oubeira), El-mellah lagoon, and Goureate pool from November 2007 to November 2009. Despite this importance, the *Hydracarina* have not been well investigated or documented in northern Algeria or elsewhere in Africa. To expand current knowledge of the *Hydracarina* in Algeria, we examined water mites biodiversity and physical and chemical characteristics of mites habitats in 4 locations of the wetland complex in the North-East of Algeria. We found 9 species belonging to 5 families The species dominants (dominance>5%) were *Eylais hamata* (24%), *Piona alpicola* (22%), *Arrenurus novus* (13%), *Eylais* sp.(12%), *Piona nodata* (10%), *Arrenurus batillifer* (10%) and (dominance<5%) were *Hydrochoreutes intermedius* (4.5%), *Diplodontus* sp.(3.5%), *Hydrachna globosa* (3.4%) distributed among our sample sites, and were able to determine significant differences in physical and chemical parameters among the sites as

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well. This research project can hopefully serve as a model for further studies on the distribution and habitat preferences of African *Hydracarina* especially in Algeria.

Keywords: Algeria; Hydracarina; small ponds; species diversity; water mites.

1. INTRODUCTION

The *Hydracarina* (water mites) represent the most important group of *Arachnida* in fresh waters. These animals have been grouped into 8 super families, 57 families, subfamilies and more than 400 genera, over 6.000 species [1,2]. Despite their importance, the *Hydracarina* of Algeria are poorly known, they have not been well investigated or documented in northern Algeria or elsewhere in Africa. To expand current knowledge of the *Hydracarina* in Algeria, only some information was given by Sergent and Sergent [3]. Later, Walter Gauthier and Jones [4-6] were published a list of all water mites from Africa, including Algeria, but Smit [7] conducted the most recent survey of African water mites with a new records of water mites from Morocco in 1995, mostly concentrating on their biogeography, though he did not include Algeria in his samples. Nonetheless, not much is known about the ecology of African *Hydracarina*. Habitat preferences, physical and chemical parameters, prey and host preferences are not evaluated here for many species of water mites in Africa, especially in Algeria. These water bodies are an important element of the surface water network and constitute a significant habitat for water mites. Our goal in this study is twofold. First, the aim of this study was to present faunistic and ecological data on the water mites inhabiting small permanent pools and lakes selected in El-Kala national park. So this study makes the research on the *Hydracarina* of the park more complete in this period. We wish to document the water mite species found in 4 locations in northern Algeria. Secondly, we wish to determine the physical (water temperature, air temperature, and humidity) and chemical (pH, conductivity, the concentrations of nitrate, ammonium, and phosphate) properties of the locations where we took our mite samples.

2. MATERIALS AND METHODS

2.1 Study Sites

Samples were taken from 4 stations situated in Wetland complex of El-Kala national park (Fig. 1).

Tonga lake (36°53' N and 08°31' E) is located in the extreme Northeast of Algeria 3 km far from the sea, it is 2.20 m height. It is a fresh water lake with an oval its length from Northeast to-Southwest is 7.1 km. Its width along an East-West axis through the center is 3.5 km on average. The perimeter is about 22 km. The area of open water is equal to 2300 ha, substantially reduced in summer due to evaporation. The exposed areas are located from the West to the whole of the south-Wilderness lake, Tonga is an area of international importance since 1992 including in the RAMSAR list.

Oubeira lake (30°50' N and 08°23' E) is located 3 km west of the city of El-Kala, between El-mellah lagoon and Tonga lake, at 25 m of altitude. It is an endorheic freshwater lake with a depth of 4 m and an area of 2200 ha and with a sub-circular form. It is the center of a basin slop of 9900 ha, and 4 Km far from the sea. It is supplied by 4 permanent shears flow, and it is usually low during the summer. Area of international importance, the site hosts over wintering birds in Europe, tens of thousands of ducks and coots [8].

El-mellah lagoon located at (36°53' N and 08°20' E), it is a lagoon of 860 ha which communicates with the sea by a channel 10 m wide running through the dunes of 700 m wide. It has an average salinity close to that of the sea. This site is subject to a traditional type of fish farm. It is frequented by fish-eating birds mainly composed of gulls, terns, grebes and cormorants. The pond sampled is located in the south of the lake. Covering an area of approximately 5 ha, it is 0.7 m depth and it is isolated from the lagoon with a clay bead along its northern shore. It is fed by rainfall in winter and a small resurgence of water during the dry season. It has undergone complete severe drying drought in 1991 and 1998.

Goureate pool is located at (36°51'18" N and 08°10'38" E), it is a pool with an altitude of 23 m. Located in an old dune formation covered with *Kermes Oak Bush, Lentisk* and *Calycotome*, it is in fact the water seeps from the dune water table. Covering an area of approximately 6 ha and a maximum depth of 0.6 m, this lake

depends entirely on the flow rate of the water table. It had known some total drying up in the past.

All of the physical and chemical parameters of the water were determine in period of study as follows in Table 1.

On the other hand, a correlation between water mites abundance and the 6 parameters of water with a factorial analysis was used (Fig. 2).

The analysis showed that a group of water mite species was associated with the parameter PO_4^-. This group included the following species: *Diplodontus* sp., *Arrenurus novus, Piona alpicola, Eylais* sp. and *Arrenurus batillifer*. And another group of species was associated with NH_4^+ which are *Piona nodata, Hydrachna globosa* and *Hydrochoreutes intermedius*. Finally we found *Eylais hamata* alone associated with NO_2^-, pH and conductivity. But the parameter of water temperature didn't associated any species.

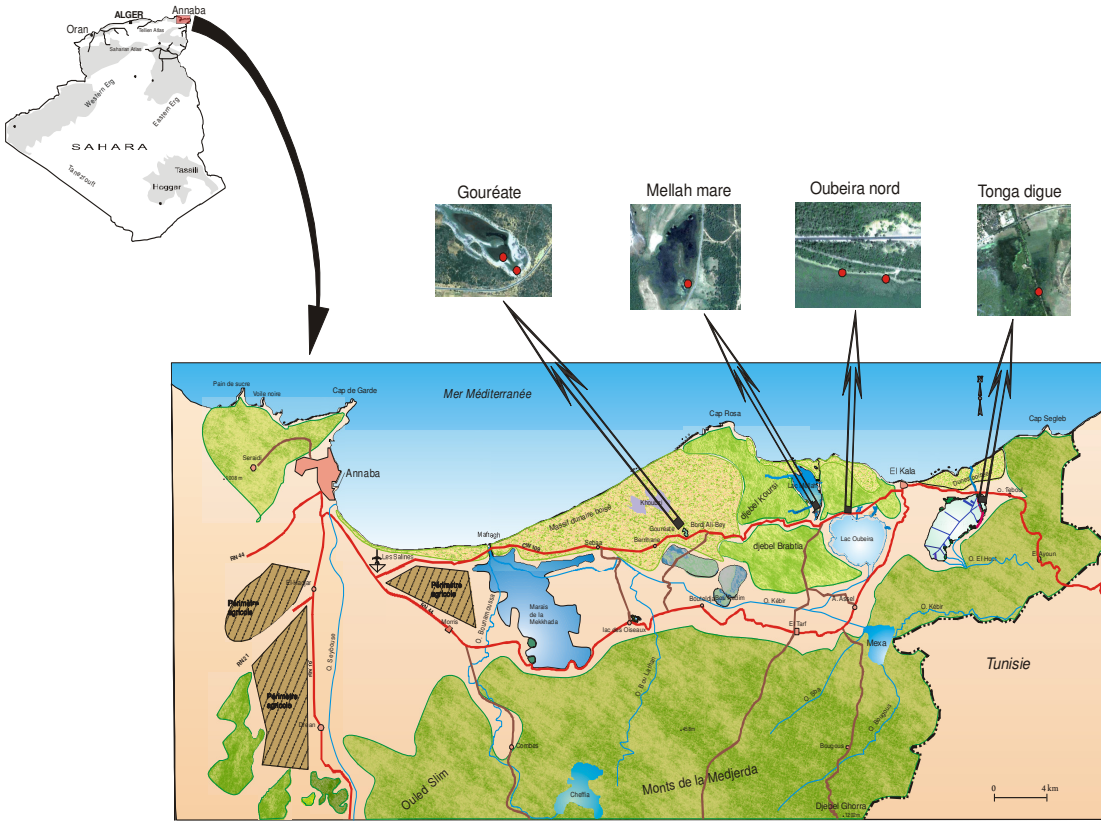

Fig. 1. Map of study area indicating sampling sites (Benyacoub, 1996)

Table 1. The physical and chemical parameters in 4 sites of El-Kala national park (2007-2009), (m±SD) with F and *p* values

Parameters	Goureate	El-mellah	Oubeira	Tonga	Fobs	*P*
Water temperature	19.34±6.98	17.25±5.57	19.88±6.71	20.07±6.28	0.83	0.483ns
Air temperature	21.88±6.59	21.42±6.40	23.90±6.38	24.30±7.19	0.97	0.412ns
Humidity	50.80±10.39	53.36±9.98	51.08±9.86	49.15±9.61	0.62	0.605ns
Conductivity	456±125	761±214	571.5±124.6	612.2±210.5	10.78	0.000***
PH	6.53±0.70	7.15±0.38	7.57±0.67	7.19±0.52	11.23	0.000***
NO_2^-	0.03±0.03	0.06±0.12	0.03±0.03	0.04±0.06	0.74	0.531ns
NH_4^+	0.88±1.23	0.28±0.64	0.11±0.03	0.10±0.00	5.85	0.001***
PO_4^-	0.48±0.66	1.42±1.43	0.44±0.37	0.5±0.71	6.00	0.001***

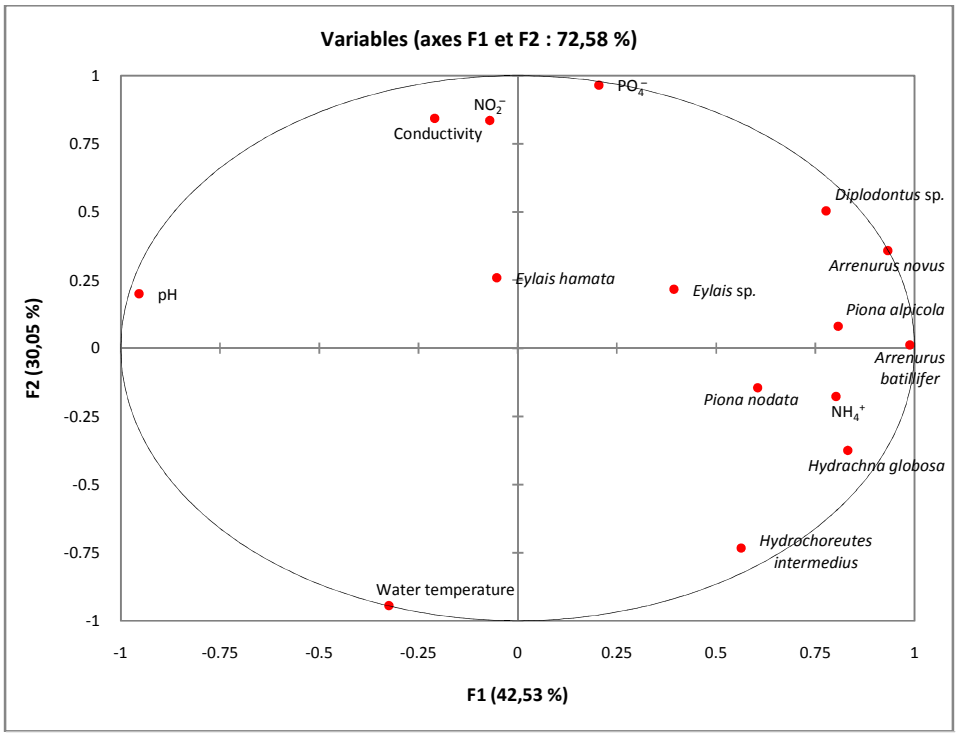

Fig. 2. The principal component analysis species-parameters

2.2 Sampling Method

Adult water mites were collected from the four stations, during one trip per month for two years. Samples too were taken from their shallower parts (at depths of up to 0.5 m). First we measured the chemical and physical parameters, where we using a multi-parameter devise (CONSORT 535). Water temperature, was measured with an accurate thermometer. Nutrients' test (NO_2^-, PO_4^-, NH_4^+), with visocolor ECO: (the Test kit). Finally the conductivity which is expressed in (µs/cm). At the same time we examined and checked carefully the water, here where many mites have a contrasting appearance, because of their bright coloration and movements. Also, it's important to know that they are free-swimming and crawling on aquatic plants and moss. After all, we picked up some mites quickly with a box size of 0.5 liters, later we transported to the laboratory, where we prepared them for study. PS: Test Kit for performing colorimetric tests on nitrite ions in surface water and sewage.

2.3 Conservation and Mounting Plates

Adult mites were be preserved in Modified Koenike's solution (or GAW), consisting of 5 parts glycerine, 4 parts water, and 1 part glacial acetic acid, by volume [9], so that they can be properly cleared and slide-mounted for identification and study. Adults must be cleared in either acetic corrosive or (10% KOH) and mounted in glycerine jelly. The observation was made with Microscope objective (10x and 40x). We used the keys [10-13] for identifying the families and species found.

2.4 Statistical Analyses

We calculated the basic statistical as means ± standard deviation (SD) of eight variables of the physical and chemical parameters for every station. The significance of results was tested by analysis of variance (ANOVA) followed by a Tukey's test. All statistical analyses were calculated using MINITAB Software (Version 16) and $p<0.05$ was considered to be a statistically significant difference. The Shannon index with a base 2 logarithm was used for analysis and we conducted the PCA factorial analysis type (pearson(n)) between species-parameters.

3. RESULTS

A total of 292 water mites belonging to 9 species of 5 families were collected from the 4 sites. The dominant family from all 4 sites was Pionidae

family (36.5%), followed by *Hydrodromidae* (3.5%, one sp.), *Eylaidae* (36%, one sp.), *Arrenuridae* (23%) and *Hydrachnidae* (3.4%) and the dominant species are shown in (Fig. 3).

With the significant differences in physical and chemical parameters *(P* < .05) among the sites as well in Table 1.

The highest number of mites collected were 107 individuals collected from pool in Goureate. The most abundant species in this pool were *Piona alpicola* (19%), *Eylais hamata* (23%), *Eylais* sp.(13%), *Arrenurus novus* (14%). Its most important families were *Eylaidae* (36%, one sp.), the second most abundant family was *Pionidae* (31.6%), next is the family *Arrenuridae* (23%), *Hydrodromidae* (4.5%, one sp.) and *Hydrachnidae* (3.7%). All its physical and chemical parameters were very close to the overall averages of all 4 sites, and in the Goureate pool, the total richness was important with 9 species, and abundance of 107 individuals. The Shannon-Wiener species diversity index was H'= 2.925. Concerning the equitability 0.923 in the Table 2.

In the pool of El-mellah, 87 *Hydracarina* individuals belonging to 8 species were collected. The most abundant were*: Piona alpicola* (24.13%), *Eylais hamata* (22.98%), *Eylais* sp.(11.49%), *Arrenurus batillifer* (18.39%), *Arrenurus novus* (17.24%). The most families on the pool were *Arrenuridae* (35.63%), the second most abundant family was *Eylaidae* (34.47%, one sp.), *Pionidae* (33.32%), next is the family of *Hydrodromidae* (5.74%, one sp.) and *Hydrachnidae* (2.29%). The highest average of electrolytic conductivity was observed in El-mellah (761 µs/cm) and the same with PO_4^- (1.42mg/l), but other physical and chemical parameters were very close to the overall averages of all 4 sites. The diversity index of Shannon-Wiener showed values 2.891. Concerning the equitability 0.963 shown in Table 2.

In Oubeira lake 36 individuals belonging to 2 species were collected. Most abundant were *Eylais hamata* (74.28%)*, Eylais* sp. (25.71%). The family of *Eylaidae* was clearly dominant in this lake constituting as much as (99.99%, one sp.). While abundant of other families were (0% species). All of its physical and chemical parameters were very close to the overall averages of all 4 sites. The diversity index of Shannon-Wiener showed values 0.822. Concerning the equitability 0.822 that shown in Table 2.

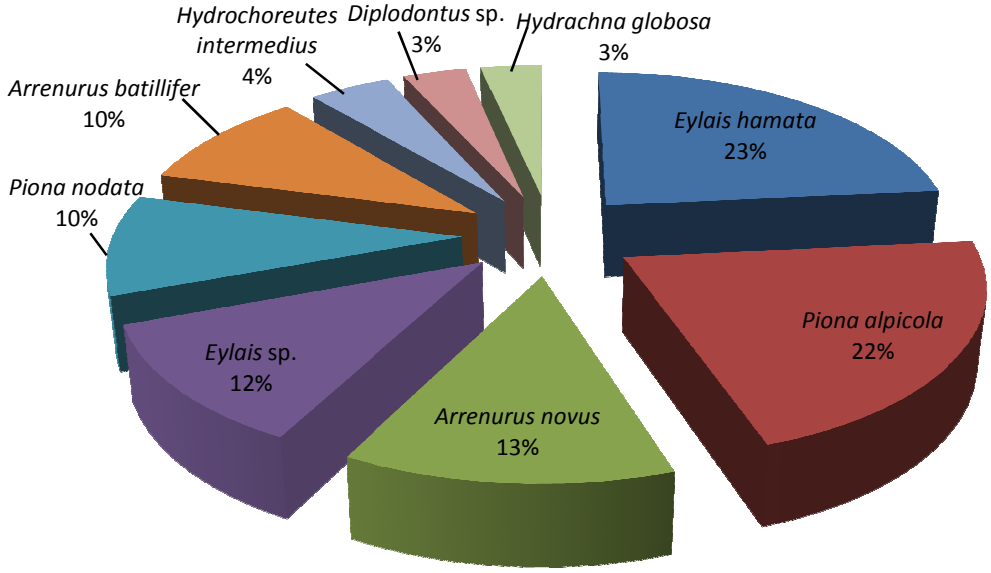

Fig. 3. Centesimal frequency of the total water mites species in 4 sites of El-Kala national park (2007-2009)

In Tonga lake, 63 individuals belonging to 7 species were collected. The most abundant species in this lake were *Piona alpicola* (38.09%), *Piona nodata* (22.22%), *Arrenurus novus* (12.69%), *Hydrochoreutes intermedius* (11.11%). The family of *Pionidae* was clearly dominant in this lake constituting as much as (71.42%) of the fauna collected, the second most abundant family was *Arrenuridae* (19.04%), next is the family *Hydrachnidae* (6.35%). *Eylaidae* (3.17%, one sp.) and *Hydrodromidae* (0%). The highest average water temperature is (20.07°C), but other physical and chemical parameters were very close to the overall averages of all 4 sites. The diversity index of Shannon-Wiener showed values 2.395. Concerning the equitability 0.853 given in the Table 2.

4. DISCUSSION

In our studies of the water mites of the northern Algerian Wetlands, we found 5 family a total of 9 species distributed among the 4 study sites. Later, with the significant differences of the physical and chemical parameters *(P* < .05) (which are in the Table 2), we found some informations to rich this study. The lake of Tonga had 7 species of 4 families of mites with the highest average water temperature. The site of Goureate (9 species) and El-mellah lagoon (8 species) had 5 families of mites, and all of its physical and chemical parameters were very close to the overall averages of all 4 sites. On the other hand, we found just 2 species of family *Eylaidae* in the site of Oubeira. From these data, we can make some statements regarding the habitat preferences, we will be able to find the most species when the conditions are favorable for their cycle of development and the environment is better, the presence of preferred prey such as crustaceans and aquatic insects (*Daphnia* and larvae of *Diptera*) as well as hosts such as *Odonata*, *Culicidae*, fish and shellfish. The water mites spend their larval stages as parasites on the hosts, in addition to the physical and chemical parameters that show the quality of fresh water, at low altitude and depth less than 50 cm with large and diverse aquatic vegetation. Only the family *Pionidae* was only found at site of Tonga with dominance (71.42%), all of sites. Tonga has the highest concentration of Ammonium ions and phosphate ions because the values of conductivity is high, suggesting that this species may only be found in sites that are rich in this particular nutrient. Species of families: *Hydrodromidae*, *Eylaida*e, *Hydrachnidae* and *Arrenuridae* were found in all the study sites, and in a variety of physical and chemical conditions, suggesting that they may be highly tolerant, somewhat generalist species, with very high dominance of small water body species was observed in most of the sites. However, there was a negative impact on useful aquatic organisms (predatory) like fish and birds, with the depths of the lake up to 4m, without forgetting the activity of human especially hunting, that's why in Oubeira lake we found just one family.

Table 2. Total and average richness (S, S'), the index of diversity (H ') and the maximum diversity (H' max), the index of equitability (E), with the (%) of species abundances in 4 sites of El-Kala national park (2007-2009)

Variables	Goureate	El-mellah	Oubeira	Tonga
Piona alpicola	18.69	24.13	00	38.09
Piona nodata	07.47	09.19	00	22.22
Hydrochoreutes intermedius	05.60	00	00	11.11
Diplodontus sp.	04.67	05.74	00	00
Eylais hamata	23.36	22.98	74.28	00
Eylais sp.	13.08	11.49	25.71	03.17
Arrenurus batillifer	9.34	06.89	00	06.34
Arrenurus novus	14.01	17.24	00	12.69
Hydrachna globosa	03.73	02.29	00	06.34
Effective/station	107	87	35	63
H'/station	2.925	2.891	0.822	2.395
S/station	09	08	02	07
H'max	3.169	03	01	2.807
E/station	0.923	0.963	0.822	0.853
Number of individuals (N)	292	292	292	292
Total wealth (S)	09	08	02	07
Average wealth (S')	26.75	21.75	8.75	15.75

5. CONCLUSION

All four sites in El-Kala national park were dominated by small water body species of water mites, that we considered an essential element of the surface water network. These ponds increase the species diversity of the water mites abundances in the park. Three water bodies situated here are inhabited by rich and diverse water mites fauna. Concerning the Shannon-Wiener species diversity index was average H'= 2.925, when the equitability was 0.923. About all of its physical and chemical parameters were very close to the overall averages of all four sites. In perspective, we wait to recommend that excessive nutrient with the equilibres doses which encourages mites, should be avoided in the water bodies, further intensive research on these habitats would surely lengthen, the list of species occurring in these water bodies where we can classify in further studies the water mites collected into three synecological groups: astatic ventral water body species, small water body species, tyrphobiontic and tyrphophilic species [14-16].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Di Sabatino A, Gerecke R, Martin P. The biology and ecology of lotic water mites (Hydrachnidia). Blackwell Science Ltd, Freshwater Biology 2000;44:47-62.
2. Di Sabatino A, Smit H, Gerecke R, Goldschmidt T, Matsumoto N, Cicolani B. Global diversity of water mites (*Acari*: *Hydrachnidia*; *Arachnida*) in fresh water 2008;595:303-315.
3. Sergent E, Sergent E. Note on the parasite mites of Anopheles. Report of the Biology Society. (french). 1904;56:100-102.
4. Walter C. Water mites of 'Algeria and Tunisia (collection M.H. GAUTHIER). First list. -Bull. Soc. Hist. natur. North Africa. (french). 1925;16:189-238.
5. Gauthier HC. Research on the fauna continental waters of Algeria and Tunisia.- Algiers Impr. Minerva, (french). 1928;420.
6. Jones RKH. Parasitism by Larvae of *Unionicola intermedia* KOENIKE, and another *Unionicola sp*. (*Acarina*, *Pionae*), on Chironomids. -Nature, Lond. 1965. 207: 317-318.
7. Smit H. New species of water mites from West Africa (*Acari*: *Hydrachnellae*), including a checklist of species recorded from Cameroon. –Storkia. 1994;3:5-11.
8. Van Dijk G, Ledant JP. Ornithological value of wetlands in eastern Algeria. Biological conservation. (french).1983;26:215-226.
9. Barr DW. Methods for the collection, preservation, and study of water mites (*Acari*: *parasitengona*). Life Science Miscellaneous Publications R. Ontario Museum. 1973;28.
10. Cook DR. Water mite genera and subgenera. Memoirs of the American Entomological Institute 1974;*2*1:860.
11. Smith IM. A study of the systematics of the water mite family *Pionidae* (*Prostigmata*: *Parasitengona*). Memoirs of the Entomological Society of Canada. 1976;98:1-249.
12. Smith IM, Cook DR. Water mites. Ecology and classification of North American freshwater invertebrates. Eds J. Thorp and A. covich. Academic Press, New York. 1991;523-592.
13. Proctor HC. Key to Aquatic mites known from Alberta. Agriculture Canada, Ottawa; 2006.
14. Stryjecki R. Water mites (*Acari*: *Hydrachnidia*) of water bodies in the carbonate peat bog Bagno Bubnów in Poleski National Park. Direction and dynamics of changes. Teka Kom. Ochr. Kszt. Środ. Przyr. –OLPAN. 2010a;7:382-388.
15. Stryjecki R. Faunistic and ecological characteristics of the water mites (*Acari*: *Hydrachnidia*) of small ponds in Polesie National Park. Teka Kom. Ochr. Kszt. Środ. Przyr .–OLPAN. 2011;8:202-209.

16. Stryjecki R. Faunistic and ecological characteristics of the water mites (*Acari*: *Hydrachnidia*) of astatic pools in Polesie National Park. Teka Kom. Ochr. Kszt. Środ. Przyr. –OLPAN. 2012;9:215-223.

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