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THE WATER MITE FAUNA (HYDRACHNIDIA) FROM THREE SPRINGS IN MACEDONIA

Abstract

The results of a faunistic survey of water mites from five spring areas in Macedonia are presented. Only in three investigated areas were water mites found. 13 species were identified, 2 of which (*Lebertia longiseta* and *Hygrobates setosus*) are reported as new for the Balkan Peninsula, and 1 (*Lebertia porosa*) as a new for Macedonia. The ecological significance of the researches is briefly discussed.

Keywords: water mites, crenobiotic species, cronophilus species

Introduction

The fauna of water mites found in springs is unique as a rule. The fauna of mountain springs is more characteristic than the fauna of lowland springs, while the fauna of helocrene and rheocrene springs is more characteristic than the fauna of limnocrene springs. Biesiadka and Kowalik (1999) proposed classification of crenobiotic and crenophilous species of water mites encountered in Polish springs. However, the status of these species may change in other geographical regions. The present study shows such a change in the status of two species, namely *Arrenurus conicus* and *A. cylindratus*, recorded in the springs of Macedonia.

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It focuses on the characteristics of water mites encountered in three Macedonian springs which has never been previously investigated with regard to water mites. However there are some other dates from the springs (Kunz 2006, Subaquatic Springs 2005–2008) The study has lead to a discovery of two new species for the Balkan Peninsula, namely *Lebertia longiseta* and *Hygrobates setosus*, and one new species for Macedonia, namely *Lebertia longiseta*.

Material and methods

The investigation of water mites from springs in Macedonia was carried out on 20–22 February and 19–30 June 2009. In shallow places (< 1 m) water mites were caught using a hydro-biological sampler with a triangular hoop, with the length of the side equalling 20 cm. Each time 20 sweeps were performed, each covering about 1 m, which allowed the area of ca. 0.2 m^2 in total to be covered. Water mites were identify by keys: Viets (1936), Sokolov (1940), Wainstain (1980), Zawal (2008) and Di Sabatino et. al. (2010).

Five spring system areas was investigated, but in two of them there was no water mites. The material was collected in three spring systems comprising: 1) springs in St. Naum; 2) Biljanini springs near the Hydrobiological Institute in Ohrid; 3) "Podgoricko Ezero". In the first of systems 12 samples were collected in 7 localities (5 in February and 7 in June), but water mites were encountered only in 5 localities. In the second system 3 samples in 3 localities (1 in February and 2 in June) were collected. In the third system 8 samples in 8 localities (in June), were collected but water mites were present only in 5 samples.

The collected material contained adult specimens as well as larvae (Table 1). While analysing the abundance and frequency of occurrence, only adult stages were taken into account, since the larvae were encountered in clusters and each egg cluster was probably laid by an individual female. Taking the larvae into account would artificially increase the abundance of some species.

Table 1. Water mites (Hydrachnidia) from springs in Macedonia

No.	Species	♀♀	♂♂	*larvae*	*total*	*adult abundance %*	*frequency %*	*St. Naum*		*Biljanini*		*Podgoricko Ezero*	
								n.s.	*%*	*n.s.*	*%*	*n.s.*	*%*
1	*Lebertia inaequalis* (Koch)	8	7	10	25	6.5	30.8	14	9.5			1	2.6
2	*L. porosa* (Thor)	2			2	0.9	7.7	2	1.4				
3	*L. longiseta* (Bader)		1		1	0.4	7.7	1	0.7				
4	*L. schechteli* (Thor)	1			1	0.4	7.7					1	2.6
5	*Oxus strigatus* (Müller)	1	3	10	14	1.7	7.7	4	2.7				
6	*Hygrobates fluviatilis* (Strom)	95	48	45	188	61.6	46.2	96	65.3	47	100		
7	*H. longipalpis* (Herm.)	9		148	157	3.9	38.5	9	6.1				
8	*H. setosus* (Bess.)	11		28	39	4.7	38.5	10	6.8			1	2.6
9	*Forelia variegator* (Koch)	1			1	0.4	7.7	1	0.7				
10	*Piona conglobata* (Koch)	9		61	70	3.9	23.1					9	23.7
11	*P. pusilla* (Neum.)	12	2	59	73	6.0	30.8					14	36.8
12	*Arrenurus conicus* (Piers)	12	4	67	83	6.9	23.1	4	2.7			12	31.6
13	*A. cylindratus* (Piers.)	6		3	9	2.6	15.4	6	4.1				
	Total	167	65	431	663			147		47		38	

Description of the area

The “Sini Virovi” spring system area, near village Belcista, about 30 km from Ohrid constitute a system rheocrenes and helocrens on the border of valley which flow-off into the floor of the valley. The valley is cover by meadows and pastures. The samples were collected from two limnocrenes, one rheocrenes and one helocrenes situated on pasture. There was no water mites.

The “Mera” spring system area, near village Izdeglavie, about 35 km from Ohrid. The valley covered by meadow and pasture with some limnocrenes and helocrenes. The samples were collected from one limnocren and one helocren. There was no water mites.

The springs at St. Naum constitute a system of limnocrenes with comparatively small rheocrenes situated on their borders and surrounded by an alder riparian forest. Water discharge is rapid and abundant in these springs, and has the form of a rushing river, about 5 m wide. The bottom is covered with sand and pebbles, with *Berula erecta* (Huds.) Coville and *Sparganium* sp. growing in some places. *Phragmites australis* (Cav.) Trin. Ex Steud., *Typha latifolia* L., *Sparganium* sp. and *Mentha aquatica* L. grow sparsely near the river banks. Localities of sample collection: 1 – interstitial (no water mites); 2 – three small rheocrenes with bottoms covered with pebbles and moss and a fast water flow (no water mites); 3 – *Berula erecta* on a silty bottom, slow water flow, depth ca. 0.5 m; 4 – the bottom covered with large stones and branches, slow water flow, depth ca. 1 m; 5 – a patch of *Sparganium* with *Lemna trisulca* L., depth ca. 0.5 – 1 m, sandy bottom; 6 – a patch of *Sparganium* and *Mentha aquatica* in a very fast water current, gravelly bottom, depth ca. 0.5 m; 7 – sparse reeds, sandy bottom, depth ca, 1 m. Hydrochemical parameters show Table 2.

Biljanini Springs – the system of springs near the Hydrobiological Institute consists of three rheocrene springs and streams flowing from them. The bottoms are covered with pebbles and gravel, with *Cladophora* sp., *Berula erecta*, *Sparganium* sp. and *Mentha aquatica* growing in some places. Depth: 0.2 –0.5 m. Localities of sample collection: 8 – a rheocrene with a slow water flow and a pebbly bottom with *Cladophora* sp. growing in some places, depth: ca. 0.2 m; 9 – a stream beyond a rheocrene covered by herbaceous plants, with a gravelly bottom, depth ca. 0.3 m; 10 – an outflow from a rheocrene to a wide channel, with a pebbly and gravelly bottom, covered by *Berula erecta*, depth ca. 0.3 m. Hydrochemical parameters show Table 2.

“Podgoricko Ezero” – Mountain Jablanica. This is a system consisting of two limnocrenes, a number of rheocrenes and streams flowing from them, situated at an altitude 1850 m. There is a large limnocrene spring covering the area of ca. 3 ha. Its lowest depth is ca. 15 m, while an average depth is 1.5 m. The bottom is covered with sand and pebbles, with large patches of *Potamogeton lucens* L. and *Carex acutiformis* Ehrh. A vast system of rheocrene springs situated at 1800 m. a. s. l. is characterised by a strong water discharge and a pebbly bottom covered by moss in some places; depth ca. 0.1 m. The other limnocrene spring is small (ca. 0.2 ha), situated at 1700 m. a. s. l., and ca. 0.6–0.7 m deep. Its bottom is pebbly and gravelly, covered with a thick layer of silt, with *Batrachium* and *P. lucens* growing in some places. Localities of sample collection: 11 – the large limnocrene spring, depth ca. 1 m, gravelly and pebbly bottom (no water mites); 12 – the large limnocrene spring, a large patch of Carex acutiformis, depth ca. 0.5 m, sandy and gravelly bottom; 13 – the large limnocrene spring, a large patch of *Potamogeton lucens*, sandy and gravelly bottom, depth ca. 1 m; 14 – the large limnocrene spring, depth ca. 0.7 m, sandy and gravelly bottom; 15 – a rheocrene spring with pebbly and gravelly bottom (no water mites); 16 – a rheocrene spring, moss on stones; 17 – the small limnocrene spring, depth ca. 0.5 m, a patch of *Batrachium* and *P. lucens*; 18 – the small limnocrene spring, depth ca. 0.7 m, pebbly bottom with a thick layer of silt.

Table 2. Hydrochemical parameters of investigated areas

Investigated parameters	Sampling places	
	St. Naum Springs	Biljanini Springs
Temperature (°C)	10.3	10.0 – 10.3
Conductivity µS/cm	208 – 233	191.8 – 235
pH	7.64 – 7.85	7.74 – 7.92
Dissolved oxygen (mg/l)	8.22	9.87
Free CO_2 (mg/l)	2.82	2.14
Organic matter (mg/l $KMnO_4$)	1.54	1.08
Total phosphorus (mg/l)	9.083	15.159
NH_4-N (mg/l)		
NO_2-N (mg/l)	0.891	0.445
NO_3-N (mg/l)	648.71	703.29
Total nitrogen Kjedahl (mg/l)	527.93	190.89

Results

In total, 663 specimens were collected (167 females, 65 males and 431 larvae), representing 13 species of water mites (Table 1). By far, the most abundant species were *Hygrobates fluviatilis* (61.6%), followed by: *Arrenurus conicus* (6.9%), *Lebertia inaequalis* (6.5%) and *Piona pusilla* (6%). The most frequent species included: *H. fluviatilis* (46.2%), *H. longipalpis* and *H. setosus* (38.5%), *Lebertia inaequalis* and *Piona pusilla* (30.8%) (Table 1), but none of these species was encountered in all three systems of springs.

Most species (10) and specimens (147) of water mites were recorded in the springs at St. Naum, while 6 species and 38 specimens were recorded in Ozero, and finally, only one species (*H. fluviatilis*), but present in large numbers, was recorded in the springs near the Hydrobiological Institute (Table 1).

The dominant species in St. Naum was *H fluviatilis*, followed by *Lebetria ineaqualis*, *H. setosus* and *H. longipalpis*. In Ezero, the dominant species included *Piona pusilla*, *Arrenurus conicus* and *P. conglobata* (Table 1).

List of species

The material is presented as follows: lc. – locality, females/males/larvae.

***Lebertia inaequalis* (Koch, 1837)**

Material examined: St. Naum Springs: lc. 4, 19.06.2009 (5/3/10); lc. 6, 19.06.2009 (3/4/0); "Podgoricko Ezero": lc. 12, 30.06.2009 (1/0/0).

***Lebertia porosa* (Thor, 1900)**

Material examined: St. Naum Springs: lc. 6, 19.06.2009 (2/0/0).

Lebertia longiseta

Material examined: St. Naum Springs: lc. 4, 19.06.2009 (0/1/0).

***Lebertia schechteli* (Thor, 1913)**

Material examined: "Podgoricko Ezero": lc. 16, 30.06.2009 (1/0/0).

***Oxus strigatus* (Müller, 1776)**

Material examined: St. Naum Springs: lc. 5, 19.06.2009 (1/3/10).

***Hygrabates fluviatilis* (Ström, 1768)**

Material examined: St. Naum Springs: lc. 5, 19.06.2009 (0/1/0); lc. 6, 22.02.2009 (1/0/0), 25.06.2009 (3/9/0); Biljanini Springs: lc. 8, 22.02.2009 (9/0/0), 19.06.2009 (5/0/45); lc. 9, 25.06.2009 (13/9/0); lc. 10, 25.06.2009 (0/11/0).

Hygrobates longipalpis **(Hermann, 1804)**

Material examined: St. Naum Springs: lc. 3, 22.02.2009 (3/0/0), 19.06.2009 (3/0/148); lc. 6, 22.02.2009 (1/0/0), 19.06.2009 (1/0/10); lc. 7, 19.06.2009 (1/0/0).

Hygrobates setosus **(Besseling, 1942)**

Material examined: St Naum Springs: lc. 6, 22.02.2009 (2/0/0), 19.06.2009 (2/0/21); lc. 7, 22.02.2009 (5/0/0), 19.06.2009 (1/0/7); "Podgoricko Ezero": lc. 17, 30.06.2009 (1/0/0).

Forelia variegator **(Koch, 1837)**

Material examined: St. Naum Springs: lc. 4, 19.06.2009 (1/0/0).

Piona conglobata **(Koch, 1836)**

Material examined: "Podgoricko Ezero": lc. 12, 30.06.2009 (4/0/27); lc. 13, 30.06.2009 (2/0/21), lc. 14, 30.06.2009 (1/0/0), lc. 17, 30.06.2009 (2/0/13).

Piona pusilla **(Neumann, 1875)**

Material examined: "Podgoricko Ezero": lc. 13, 30.06.2009 (4/0/55); lc. 14, 30.06.2009 (5/2/0), lc. 17, 30.06.2009 (3/0/4).

Arrenurus conicus **(Piersig, 1894)**

Material examined: St. Naum Springs: lc. 3, 22.02.2009 (2/0/0), 19.06.2009 (2/0/37); "Podgoricko Ezero": lc. 17, 30.06.2009 (6/4/20); lc. 18, 30.06.2009 (2/0/10).

Arrenurus cylindratus **(Piersig, 1896)**

Material examined: St. Naum Springs: lc. 5, 19.06.2009 (5/0/3); lc. 6, 22.02.2009 (1//0).

Discussion

It was discovered that the fauna of water mites in Macedonia is not unique, which was a surprise especially in the context of the high faunistic specificity which had previously been encountered in the springs in the proximity of St. Naum (Kunz 2006). Only one species was recorded (i.e. *Lebertia schechteli*) described as a rhitrobiontic or a rheophilous species, restricted to higher mountain ranges (Gerecke 2009, Pesic at al. 2010), which had previously been recorded in Macedonia by Schwoerbel, „*L. tuberosa*" (1963) and Gerecke (2009). Two species (*Arrenurus conicus* and *A. cylindratus*) were described by Biesiadka & Kowalik (1999) as stagnophilous xenophiles, i.e. species which are common and abundant in springs, but encountered in stagnant water as well. On the other hand, Pešic at al. (2010) characterised the species in question as ones which could be encountered in ponds, channels and the phyto-littoral of lakes. It is probable that in central and western Europe these species prefer springs, while in southern Europe they rather tend to inhabit stagnant waters. Another six species (*Lebertia ineaqualis*, *L. porosa*, *L. longiseta*, *Hygrobates fluviatilis*, *H. longipalpis* and *H. setosus*) are either rhitrobiontic or rheophilous ones Three of them (*L. inaequalis*, *L. porosa* andi *H. longipalpis*) can be encountered in stagnant waters, too (Pešic at al. 2010). Little is known about *L. longiseta*, because its taxonomic status is uncertain (Gerecke 2009). As for *H. setosus*, it was separated from *H. nigromaculatus* group (Martin at al. 2010). *H. nigromaculatus* had previously been believed to occur in both lenitic and lotic habitats, but recently Martin at al. (2010) discovered that the lentic populations belonged to *H. nigromaculatus*, while the lotic ones belonged to *H. setosus* Besseling 1942. As for *H. fluviatilis*, it is considered a pollution-resistant rhitrobiont (Gerecke, Schwoerbel 1992). However, from time to time it has been found in clean lakes, too (Jankovskaja 1965; Biesiadka 1972; Zawal, Szlauer-Łukaszewska, in press). This species is also abundant in Lake Orhid (Zawal, unpublished data). In the light of this data, the ecological status of the species ought to be changed into a rheophile encountered also in clean lakes. *Oxus strigatus* is a species inhabiting lakes and ditches, while *Forelia variegator*, *Piona conglobata* and *Piona pusilla* are eurytopic species encountered in stagnant and slow flowing waters (Pesic at al. 2010).

Lebertia porosa was recorded in Macedonia for the first time, and *L. longiseta* and *Hygrobates setosus* were recorded in the Balkan Peninsula for the first time.

Two of the spring systems (i.e. St. Naum Springs and Biljanini Springs) are very close to Ohrid Lake and thus heavily influenced by the lake. All water mite species recorded in these spring systems have also been encountered, most of them in large numbers, in the lake (Zawal, unpublished data), and seven of them (*Leberia inaequalis*, *Oxus strigatus*, *Hygrobates longipalpis*, *Forelia variegator*, *Piona conglobata*, *P. pusilla*, *Arrenurus cylindratus*) were mentioned in Ohrid Lake (Baker et al. 2008). What is more, the springs near the Institute in Ohrid are situated in a built-up area and a high level of human contamination has eliminated most water mite species except for the particularly resistant *H. fluviatilis* (Table 1). Both of the two spring systems are relatively strong charged by biogenics (Table 2) and it might be a reason of such not specific character of water mite fauna.

The low specificity of water mite fauna encountered in the "Podgoricko Ezero" system of springs is somewhat surprising. Only one species was recorded, namely *Lebertia schechteli*, which is typical of mountain springs, while all the remaining ones are species characterised by a wider environmental spectrum (Table 1). Authors of many earlier studies (Pešic 2004a, b, 2005; Pešic et al. 2010) had recorded in Macedonia and the Balkans many water mites species characteristic of mountain springs. Since the investigated spring system is a vast and diversified one, it is difficult to explain the low specificity and low species diversity of water mites encountered in it. However, the results obtained may be due to the time of year and the limited period of sampling.

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