Water mites (Acariformes: Hydrachnidia, Halacaroidea) of bogs of Western Siberia (Russia)

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Abstract
Water mites (Acariformes, Hydrachnidia, Halacaroidea) were studied in 8 different bogs and fens of Western Siberia. 28 species of Hydrachnidia and 5 species of Halacaridae were found in them. The species composition in the bogs was very different. In the fens the abundance and species diversity were higher than in sphagnum bogs and the fauna were based on spring species. The representatives of the halacarid mites dominated in sphagnum bogs, which were not found in the fens. The specific similarity of the studied bogs was low. At the same time, the peculiarities of seasonal dynamics in bogs and fens were similar and resembled temporary water bodies: high numbers in the spring and an abruptly decline in the summer, with a slight increase in autumn.

Key words: Water mites, Hydrachnidia, Halacaroidea, bogs, fens, Western Siberia.

Introduction
Water mites are widespread in almost all types of fresh water bodies, including bogs of different types (Sokolow 1940; Di Sabatino et al. 2002). Mites can have high species diversity in bog habitats. For example, in Canada, of more than 500 species of water mites known in the country, about one hundred occur in different types of bogs (Smith 1987).

In Europe, where acarofauna as a whole has been studied most well, there are a large number of works on faunal composition of water mites inhabiting bogs and marshy water bodies (Biesiadka et al. 2005; Cichocka 1996b, 1998; Smit & Van der Hammen 2000; Stryjecki 2010). There is a number of large works devoted to the ecological characteristics of water mites inhabiting bogs (Tuzovskij 1974, 1996; Wiecek et al. 2013a). The fauna of water mites of the bogs is very specific, typical for a certain type of biotope and can be used for monitoring the state of bogs ecosystems (Wiecek et al. 2013b). However, even in Europe, not all types of wetland habitats and features of the ecology of water mites living in them have been studied (Wiecek et al. 2013a). In other regions the state of the water mite's study is much lower.

In Western Siberia (the Asian part of Russia), such studies have not previously been conducted. At the same time, the West Siberian Plain (one of the largest plains of the world) is most rich in bogs. Wetlands occupy more than 50% of its territory (Bogs of West Siberia 1976). Certainly, sphagnum bogs have a
tremendous impact on the climate of the region. In the territory of Western Siberia sphagnum bogs ecosystems are subject to increased anthropogenic pollution in connection with oil and gas production. Therefore, their conservation is an important task, the solution of which is impossible without studying all the components of bog ecosystems, one of which are water mites.

Material and Methods

Studies were conducted in 2016-2017 in the vicinity of Lake Kuchak (Nizhnetavdinsky district of the Tyumen region). The study area is located in the southwest of the West Siberian Plain. Eight different types of bogs were investigated, their description and location are shown in table 1. Sphagnum mesotrophic and eutrophic bogs, sedge and grassy fens were taken for the study, which differed in their characteristics: electrical conductivity, depth, pH.

Table 1. Characteristics of the studied bogs.

| №  | Name            | Coordinates            | Characteristics                             |
|----|-----------------|------------------------|---------------------------------------------|
| 1  | Chertankul’     | 57°19’27.4”N 66°02’23.4”E | Sedge-comarum-sphagnum mesotrophic bog       |
| 2  | fen near Torgili | 57°17’09.3”N 66°01’19.6”E | Sedge fen in open terrain                   |
| 3  | Lebyazhki       | 57°20’56.2”N 66°05’20.5”E | Eriophorum-sphagnum mesotrophic bog          |
| 4  | Far bog         | 57°21’38.7”N 66°00’32.8”E | Oligotrophic sphagnum bog                    |
| 5  | Mysukul’        | 57°21’51.5”N 66°04’51.2”E | Phragmites-sphagnum eutrophic bog            |
| 6  | Tangachi        | 57°21’05.5”N 66°03’03.8”E | Sedge-sphagnum eutrophic bog                 |
| 7  | fen near Ipkul’ | 57°20’56.2”N 66°05’20.5”E | Sedge-sphagnum eutrophic fen                 |
| 8  | Forest fen      | 57°21’51.5”N 66°04’51.2”E | Sedge forest eutrophic fen                   |

Samples were taken for studying the variety of mites and the hydrochemical characteristics of water at the end of June and the beginning of July 2016 and 2017, also examined the seasonal dynamics of mites during the entire season of 2017 from the thawing of bogs in early April to their freezing in late October.

A total of 47 samples were taken, of which 1501 specimens of water mites were extracted and studied. To collect samples in fens used hydrobiological net with mesh size 250 μm. Samples were taken from the same area equal to 2 m², raking the entire thickness of water from the surface to the bottom, capturing the upper part of the soil. In the sphagnum bogs, in areas where there were no open water patches, the method of trampling moss was used, creating a water-filled micro-depression in which mites was caught by a small net (Fillipov et al. 2017). In the sphagnum bogs, while milling, mosses were selected, which were then washed in a net.

To identify of water mites, the following keys and sources were used: Bartsch (2007, 2011), Davids et al. (2007), Gerecke et al. (2010, 2016), Sokolow (1940), Tuzovskij (1990, 2011, 2018), Viets (1936).

For the construction of a dendrogram of faunal similarity, the single-attachment method was used based on calculating the Jacquard coefficient in the PAST 3.01 program.

Results and discussion.

In total, 28 species of water mites from seven families, and five species of halacarid mites, were identified in 8 investigated bogs in the vicinity of Lake Kuchak (table 2).

Among the species of mites marked in the bogs, representatives of spring fauna characteristic of temporary water bodies prevailed, which was noted by other researchers (Smith 1987; Tuzovskij 1974, 1990, 1996). Euribiotic species were less, and they appeared only in the summer, if there was a lot of water left in the bog.
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Table 2. The occurrence (O) and dominance index (D) of water mites in the studied bogs.

| Taxon                                      | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|--------------------------------------------|---|---|---|---|---|---|---|---|
| **Hydrachnidia**                           |   |   |   |   |   |   |   |   |
| Family Hydrachnida                         |   |   |   |   |   |   |   |   |
| *Hydrachna comosa* Koenike, 1896           |   |   |   |   |   |   |   |   |
| *Hydrachna skorikowi* Piersig, 1900        |   |   |   |   |   |   |   |   |
| **Family Eyllidae**                        |   |   |   |   |   |   |   |   |
| *Eylais extendens* Muller, 1776            |   |   |   |   |   |   |   | 2.2|
| **Family Hydrachnidida**                   |   |   |   |   |   |   |   |   |
| *Hydrachna planus* Thon, 1899              |   |   |   |   |   |   |   |   |
| *Hydrachna varia* Thon, 1899               |   |   |   |   |   |   |   |   |
| **Family Arrenuridae**                     |   |   |   |   |   |   |   |   |
| *Arrenurus arenarius* Müller, 1776          |   |   |   |   |   |   |   |   |
| **Family Lymbodidae**                      |   |   |   |   |   |   |   |   |
| *Limbosa conata* Koenike, 1895             | 33| 2.4| 31| 4 | 37.5| – | 14.3| 8.7| – |
| **Family Pionidae**                        |   |   |   |   |   |   |   |   |
| *Piona alpica* Neuman, 1880                | – | – | 46| 4 | –   | – | –   | – | – |
| **Family Oxyidae**                         |   |   |   |   |   |   |   |   |
| *Oxus nivalis* Viets, 1900                  | – | – | 23| 0.8| –   | – | –   | – | 2.2|
| **Family Limnesiidae**                     |   |   |   |   |   |   |   |   |
| *Limnus conatus* Koenike, 1895             | – | – | 23| 8.5| –   | – | –   | – | – |
| **Family Arrenuridae**                     |   |   |   |   |   |   |   |   |
| *Arrenurus arenarius* Müller, 1776          | – | – | 15| 1.3| –   | – | –   | – | 100|
| *Arrenurus arenarius* Viets, 1900           | – | – | 38| 3.2| –   | – | –   | – | – |
| **Family Lymbodidae**                      |   |   |   |   |   |   |   |   |
| *Limbosa conata* Koenike, 1895             | 33| 1 | – | – | –   | – | 14.3| – | – |
| **Family Halacaridae**                     |   |   |   |   |   |   |   |   |
| *Halacaras Weberi* Romijn & Viets, 1924    | 50| 5.6| – | – | 12.5| – | –   | – | – |
| *Porohalacarus alpinus* Thor, 1910         | 50| 8.5| – | – | –   | – | 14.3| – | – |
| **Family Oxyidae**                         |   |   |   |   |   |   |   |   |
| *Oxus nivalis* Viets, 1900                  | 8 | 0.6| – | – | 12.5| 100| 28.6| 17.4| – |
| **Note. Without taking into account deutonymphs and females of the genus Arrenurus.**
In general, the number and occurrence of mites in different bogs varied greatly. So, only one specimen of mites was met in two bogs (No. 4 and 7). In general, in sphagnum bogs, especially those that lacked open water, the number and variety of mites were low, as was noted by other researchers in Europe (Cichocka 1998; Wiecek et al. 2013a). Indicators of abundance and species richness in them were usually significantly lower than in sedge and grass fens. In this case, they usually dominated one species. Number of species was significantly higher in fens and pronounced dominants were absent.

The species composition of the mites also varied: Hydrachnidia are noted mainly in fens, their abundance and species diversity were low in sphagnum bogs, they were absent in 30% of the samples. Only a few species of Hydrachnidia were found in both bogs and fens this is primarily *Limnesia connata* Koenike, 1895, which had the highest rates of occurrence from all mites (marked in 5 of 8 bogs).

Most of the species of Hydrachnidia, noted in sphagnum bogs, did not occur in fens. Thus, these species (*Tiphs scaurus* Koenike, 1892), *Acercopsis pistillifer* (Koenike, 1908), *Arrenurus stecki* Koenike, 1894) can be considered typical representatives of the semi-aquatic fauna of sphagnum bogs, as noted by other researchers in Europe (Besseling 1959; Cichocka 1996a; Wiecek et al. 2013a). At the same time, in our collections there were no species of water mites typical of sphagnum bogs in Europe – *Piersigia* spp., *Zschokkea oblonga* Koenike, 1892 (Besseling 1959; Wiecek et al. 2013a). Perhaps this is due to the insufficient study of the marshes of Western Siberia, the rarity of these species or the peculiarities of their distribution.

For sphagnum bogs, five species of halacarid mites were found, while in most samples they dominated in numbers. In this case, in the fens, the halacarid mites were not noted. Halacaridae often inhabit sphagnum bogs, and their numbers can be very high here (Bartsch 1989, 2007, 2008, 2009, 2011). As can be seen, in the bogs of Western Siberia, halacarid mites are numerous, often dominate in numbers and are represented not only by widespread species, but also rare enough, such as *Parasoldanellynx parviscutatus* (Walter, 1917).

The faunal similarity of the studied bogs was not high and did not exceed 60%. (Fig. 1). Mesotrophic sphagnum bogs differed in the greatest similarity with each other, in which there were practically no open water areas. Close to them was a bog near the lake Tangach (No. 6), in which there were also no open water areas, but there were grassy plants with a small share of sphagnum prevailed. Conversely, eutrophic sedge and grassy fens had low rates of similarity with sphagnum bogs, in both groups there were practically no common species. At the same time, the similarity of the two fens to each other was also low.

![Figure 1](image_url)

**Figure 1.** Dendrogram of faunal similarity of the studied bogs. Without taking into account bogs No. 4 and 7, in which one specimen of mites was indicated.
In two bogs, in which were noted the highest abundance and species diversity of water mites, we conducted studies of seasonal dynamics of abundance.

Two typical bogs were selected for the study of seasonal dynamics: the mesotrophic sphagnum bog Chertankul (No 1) and the eutrophic sedge fen in the vicinity of Torgili (No 2).

In the mesotrophic sphagnum bog of Chertankul (No 1) prevailed representatives of the halacarid mites, they also determined the features of seasonal dynamics (Fig. 2). *Porolohmannella violacea* (Kramer, 1879) prevailed in all terms of the collection, its share varied from 51 to 98% at different times, in the same year in 2017 this species had a 100% occurrence. Hydrachnidia, on the contrary, were few in species composition and in number, only *Tiphys scaurus* and *Limnesia connata* were regularly enough noted.

In contrast to the fen No 2, which already had high numbers of mites at the end of April, the sphagnum bog did not completely melt during these periods, and the mites were not marked in it. However, already since the beginning of May, the mites were numerous. The greatest abundance and species diversity were recorded from late May to early June, after which the number rapidly declined. In July-August, Hydrachnidia were not observed and mites were represented only by Halacaridae. After the maximum decrease in the number in August, in autumn the number and species richness of mites increased slightly, again the deutonymphs and females of *Tiphys* were again noted. Mites were found right up to the freezing of the swamp.

In the sedge fen near the village of Torgili (No. 2), the seasonal dynamics of abundance and species diversity of mites was also well pronounced (Fig. 3): already in late April, shortly after ice melt, mites were found in large quantities.

Deutonymphs of *Tiphys* and *Piona* were dominated, representatives of Hydryphantidae were numerous. In May, the highest indicators of species richness and abundance of water mites were revealed. All species diversity occurs in typical spring species of mites, but there were individual representatives of summer species – *Piona alpica* (Neuman, 1880), *Arrenurus globator* (Muller, 1776). Among the dominant

![Figure 2. Seasonal dynamics of numbers of water mites and proportion of dominating species in bog No. 1.](image)
representatives – *Hydryphantes ruber* (De Geer, 1778), adults *Tiphys*, the number of nymphs decreased. By the end of May, the number of mites decreased: the nymphs practically disappeared, *Hydryphantidae*, *Tiphys* and *Piona* were noted among the dominant species, among the *Piona*, many dead individuals, mostly males, were caught in the samples. On water plants, numerous egg layings of water mites have been recorded.

By the beginning of June, the number of water mites rapidly declined: only a few adult specimens were recorded, as well as a large number of dead *Piona nodata* (Muller, 1776) females. *Tiphys* and *Piona* predominated, *Hydryphantes* are marked by single representatives. At the end of June, a change in species composition occurs – summer species of the genus *Arrenurus* and *Piona alpicola* appear. There are also numerous egg laying. The number was low. In July and August, the numbers decreased even further due to a strong water level reduction in the bog. Summer species predominated, but their abundance and species diversity were small. In autumn a slight increase in the number of mites was observed due to two summer species of the genus *Arrenurus*. Also, in the samples of the end of September-October, the deutonymphs of the spring species of the genera *Tiphys* and *Piona* of the second generation are again marked.

Thus, despite the significant differences in the taxonomic composition, species richness and abundance of mites in different types of bogs, the features of seasonal dynamics in them were similar, which can be explained by similar conditions of existence. The features of seasonal dynamics in many respects resemble those in temporary water bodies (Tuzovskij 1974, 1996, Wiggins et al. 1980; Stryjecki 2006) and similar in many respects to the species composition of bog-inhabiting mites.

**References**

Bartsch, I. (1989) Marine mites (Halacaroidea: Acari): a geographical and ecological survey. *Hydrobiologia*, 178, 21–42.
Bartsch, I. (2007) Acari: Halacaroidea. In: Gerecke, R. (ed.), *Süßwasserfauna von Mitteleuropa*, Vol. 7/2-1 *Chelicerata: Araneae / Acari I*. Springer Spektrum, Berlin, Heidelberg, 113–157.

Bartsch, I. (2008) Global diversity of halacarid mites (Halacaridae: Acari) in freshwater. *Hydrobiologia*, 595, 317–322.

Bartsch, I. (2009) Checklist of marine and freshwater halacarid mite genera and species (Halacaridae: Acari) with notes on synonyms, habitats, distribution and descriptions of the taxa. *Zootaxa*, 37, 490–510.

Biesiadka, E., Cichocka, M., Moroz, M., Muchin, J. (2005) Aquatic mites (Acari: Hydracarina) of the „Olmany Wetlands” Landscape Reserve. *Entomologischeskoye Obozreniye*, 84, 226–233. (in Russian).

**Bogs of West Siberia, their structure and hydrological regime** (1976) Ivanov, K.E., Novikova, S.M. (eds.). Nauka Publishers, Leningrad, 447 pp. (in Russian).

Besseling, A.J. (1959) Watermijten uit voedelarm water. *De Levende Natuur*, 62, 228–229.

Cichocka, M. (1996a) Water mites (Hydracarina) of peatlands in Bagna Biebrzanskie. *Fragmenta Faunistica*, 39, 207–221.

Cichocka, M. (1996b) Water mites (Hydracarina) of the Zehlau peatbog. In: Diedkov, V.P. (ed.), *Flora i fauna bolota Celau*. Kaliningrad, 44–46.

Cichocka, M. (1998) Water mites (Hydracarina) of the peat-bogs in Mazurian Lakeland. Wyd. WSP w Olsztynie, 133, 1–128. (in Polish).

Di Sabatino, A., Martin, P., Gerecke, R., Cicolani, B. (2002) Hydrachnidia (water mites). In: Rundle, S.D., Robertson, A.L., Schmid-Araya, J.M. (eds.), *Freshwater meiofauna: biology and ecology*. Backhuys Publishers, Leiden, 105–133.

Davids, K., Di Sabatino, A., Gerecke, R., Gledhill, T., Smit, H., van der Hammen, H. (2007) *Acari: Hydrachnidia. In Gerecke R. (ed.) Süßwasserfauna von Mitteleuropa, 7/2-1*. Spektrum Akademischer Verlag, Munich, 241–376.

Gerecke, R., Di Sabatino, A., Gledhill, T., Smit, H. (2010) *Acari: Hydrachnidia II. In Gerecke R. (ed.) Süßwasserfauna von Mitteleuropa, 7/2-2*. Spektrum Akademischer Verlag, Munich, 235 pp.

Gerecke, R., Gledhill, T., Pešić, V., Smit, H. (2016) *Acari: Hydrachnidia III. In Gerecke R. (ed.) Süßwasserfauna von Mitteleuropa, 7/2-3*. Elsevier GmbH. Akademischer Verlag, Berlin Heidelberg, 429 pp.

Fillipov, D.A., Prokin, A.A., Przhiboro, A.A. (2017) *Methods of hydrobiological study of mires: a textbook*. TSU publ., Tyumen, 208 pp. (in Russian).

Smit, H. & Van der Hammen, H. (2000) *Atlas van de Nederlandse watermijten (Acari: Hydrachnida)*. Nederlandse Faunistische Mededelingen, 265 pp.

Smith, I.M. (1987) Water mites of peatlands and marshes in Canada. Memoirs of the *Entomological Society of Canada*, 140, 31–46.

Sokolow, I.I. (1940) *Hydracarina – vodyanye kleschi (Ch. 1, Hydrachnellae)* [Hydracarina – water mites (Part 1, Hydrachnellae)]. Fauna SSSR. Paukoobraznye, 5 (2). AN SSSR Publishers, Moscou–Leningrad, 511 pp. (In Russian).

Stryjecki, R. (2006) Roadside temporary water pool as a habitat for water mites (Acari, Hydrachnidia). *Teka Komisi Ochrony i Kształtowania Środowiska Przyrodniczego*, 3, 181–186.

Stryjecki, R. (2010) Water mites (Acari: Hydrachnidia) of water bodies in the carbonate peat bog Bagno Bubnow in Poleski National Park. Direction and dynamics of changes. *Teka Komisi Ochrony i Kształtowania Środowiska Przyrodniczego*, 7, 382–388.

Tuzovskij, P.V. (1974) Raspedelenie vodjaných klescej v zone vremennogo zatoplenija Rybinskogo vodochraniliska i prilegajucih vodoemach. [Verteilung der Wassermilben im Bereich der vorübergehenden Überschwemmung des Stausees von Rybinsk und in angrenzenden Wasserreservoiren]. *Institut Biologii Vnutrennikh Vod, Trudy*, 25(28), 202–229. (in Russian).

Tuzovskij, P.V. (1990) *Opredelitel’ deytonimf vodyanykh kleshchey* [Key to water mite deutonymphs]. Nauka Publishers, Moscow, 238 pp. (in Russian).

Tuzovskij, P.V. (1996) *Vodjanye kleschi verchenji Volgi* [Water mites of the upper Volga]. Institute of Ecology of the Volga Basin Publishers. Togliatti, 82 pp. (in Russian).

Tuzovsky, P.V. (2011) Water mites of the genus *Tiphys* Koch, 1836 (Acariformes: Pionidae) in Russia. *Acarina*, 19 (2), 113–212.
Tuzovskij, P. V. (2018) On the taxonomic status of the water mites *Piona inflata* Sokolow, 1927 (Acari, Hydrachnidia: Pionidae). *Ecologica Montenegrina*, 16, 42–47.

Viets K.H. (1936) *Wassermilben oder Hyclarcarina (Hydrachnellae und Halacaridae).* Gustav Fischer Verlag, Jena, 288 pp.

Wiecek, M., Martin, P., Gabka, M. (2013a) Distribution patterns and environmental correlates of water mites (Hydrachnidia, Acari) in peatland microhabitats. *Experimental and Applied Acarology*, 61, 147–160.

Wiecek, M., Martin, P., Lipinski, A. (2013b) Water mites as potential long-term bioindicators in formerly drained and rewetted raised bogs. *Ecological Indicators*, 34, 332–335.

Wiggins, G. Mackay, R., Smith, I. (1980) Evolutionary and ecological strategies of animals in annual temporary pools. *Archiv fur Hydrobiologie*, 1/2, 97–206.