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Water mites (Acariformes, Hydrachnidia, Halacaroidea) of the Southern Trans-Urals (Kurgan Oblast)

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Abstract. The article presents the results of a study of water mites in Kurgan Oblast (Southern Trans-Urals). A total of 52 species of Hydrachnidia and 2 species of Halacaridae were found in various water bodies in Kurgan Oblast. The greatest species diversity of mites was observed in floodplain ponds, and the highest abundance was found in lakes. The most common and abundant species were *Hydrodroma pilosa* Besseling, 1940, *Limnesia undulatoides* Davids, 1997, *Piona neumani* (Koenike, 1883), and *Arrenurus tricuspikator* (Müller, 1776). COI sequences were obtained for seven water mite species. For the two species (*H. bucharicus* and *E. tullgreni*) COI sequences were received for the first time. *Hygrobatas bucharicus* Sokolow, 1928 was first recorded in Russia.

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Keywords: water mites, new records, DNA barcoding, Siberia, fauna, ecology

Водяные клещи (Acariformes, Hydrachnidia, Halacaroida) Южного Зауралья (Курганская область)

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Аннотация. В статье представлены результаты исследований водяных клещей в Курганской области (Южное Зауралье). В различных водоемах Курганской области было обнаружено в общей сложности 52 вида Hydrachnidia и 2 вида Halacaridae. Наибольшее видовое разнообразие клещей отмечено в пойменных водоемах, наибольшие показатели численности — в озерах. По встречаемости и численности преобладали такие виды, как *Hydrodroma pilosa* Besseling, 1940, *Limnesia undulatoidea* Davids, 1997, *Piona neumani* (Koenike, 1883) и *Arrenurus tricuspidator* (Müller, 1776). Для семи видов водяных клещей были получены последовательности гена COI, в том числе впервые для двух видов (*H. bucharicus*, *E. tullgreni*). *Hygrobatas bucharicus* Sokolow, 1928 был впервые зарегистрирован на территории России.

Ключевые слова: водяные клещи, новые находки, ДНК-штрихкодирование, Сибирь, фауна, экология

Introduction

Water mites in Western Siberia are still a poorly studied group. Previous studies of water mites have focused mainly on the northern and central parts of the region, or on mountainous areas. At the same time, the southern part of the West Siberian Plain, which is located in a subarid region, has hardly been studied. The only exception is a study of Omsk Oblast (Yakimenko et al. 1997), in which the main objective was to investigate water mites as possible reservoirs of arboviral infections.

Previously, water mites had not been specifically studied in Kurgan Oblast. The only reference to water mites from Kurgan Oblast is found in Musselius (Musselius 1913), which mentions *Hydrachna inermis* (= *Hydrachna sibirica* Musselius, 1913 (Sokolow 1940)), currently considered as species incerta (Davids et al. 2005; 2006).

This article presents the results of many years of research on water mites in various types of water bodies in Kurgan Oblast.

Materials and methods

Water mite samples were collected in Kurgan Oblast of Russia. The Kurgan Oblast is located in the southwestern part of Western Siberia and is traditionally considered part of the Southern Trans-Urals (Naumenko 2008).

Kurgan Oblast has a subarid climate, and most of it is in the West Siberian forest-steppe zone. The main river is the Tobol (Ob-Irtysh basin), and its major left tributaries, the Iset and the Uy Rivers, also flow through the region. The hydrographic network is poorly developed, as small rivers are relatively short in length and have insignificant flow rates (Naumenko 2008). The Southern Trans-Urals is characterized by numerous lakes, which are mostly small in size, and fens. Many lakes have increased mineralization (Naumenko et al. 2019).

The mites were collected in 2017 and throughout 2021–2025. A total of 46 water bodies were studied, which we considered possible to divide into the following four groups (Fig. 1).

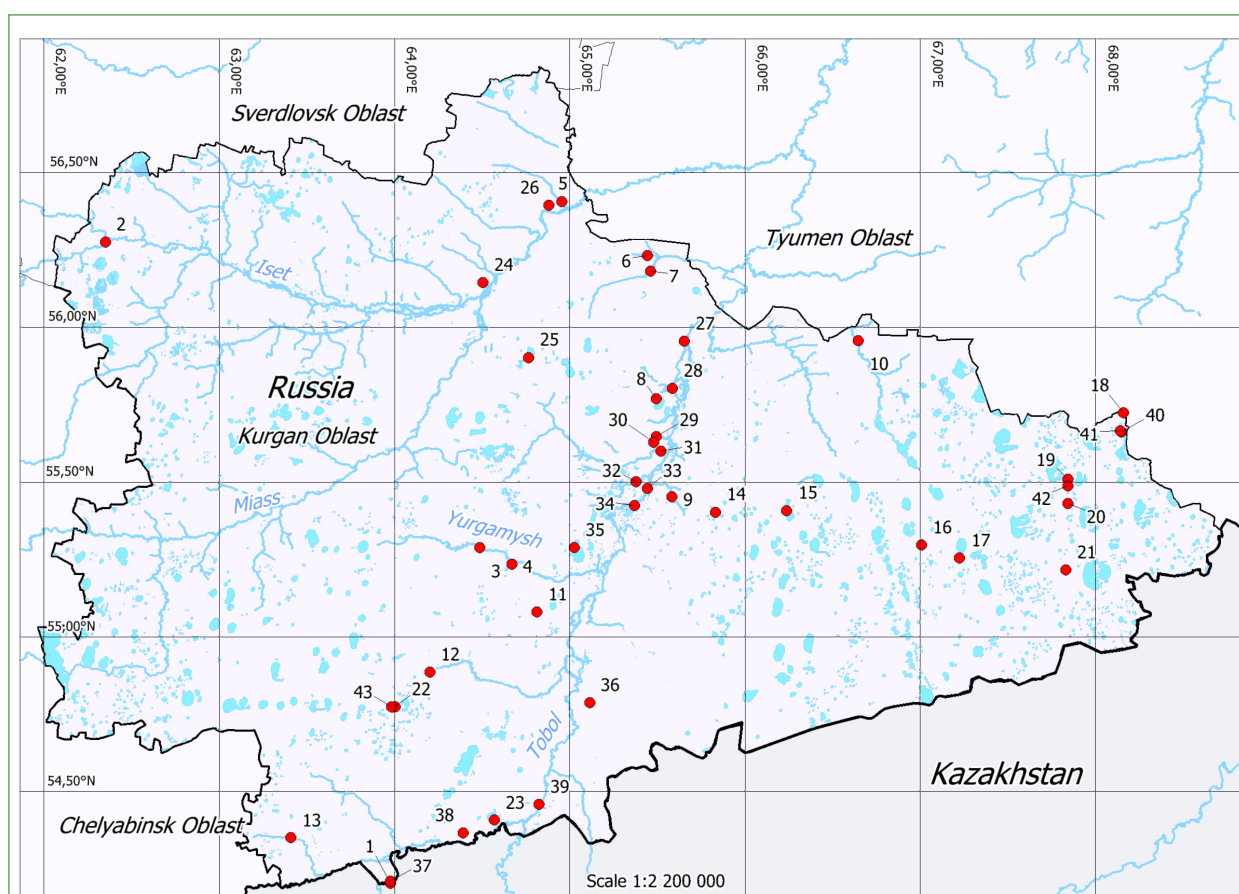


Fig. 1. Studied water bodies of Kurgan Oblast. 1 — Tobol River; 2 — Sinara River; 3 — Yurgamysh River; 4 — Klepechikha Stream; 5 — Mostovka River; 6 — Brodovka River; 7 — Niyap River; 8 — Kurya River; 9 — Sredniy Utyak River; 10 — Kizak River; 11 — Stepnaya River; 12 — Berezovka River; 13 — Chernaya River; 14 — Lake Kotlik II; 15 — Lake Kamyshnoe; 16 — Lake Glubokoe; 17 — Lake Penkovatoe; 18 — Lake Penkovo; 19 — lake near Chastoozerye vil.; 20 — lake near Vostochnoe vil.; 21 — Lake Shtyrovo; 22 — lake near Kosulino vil.; 23 — Lake Gorkoe; 24 — Berezovka River pond; 25 — oxbow of the Sosnovka River; 26 — oxbows of the Iset River; 27–34 — floodplain ponds of the Tobol River and its tributaries (environs of the city of Kurgan); 35 — artificial pond (Novokomogorovka vil.); 36 — Pond (Yalym vil.); 37 — oxbow of the Tobol River (Ust-Uyskoe vil.); 38 — oxbow lake Ostrovnaya (Proryvnoe vil.); 39 — oxbow of the Tobol River (Zverinogolovskoe vil.); 40 — sedge fen (Belyakovskoe vil.); 41 — sphagnum bog (Belyakovskoe vil.); 42 — reed fen (Okunevka vil.); 43 — sphagnum bog (Kosulino vil.)

Рис. 1. Изученные водоемы Курганской области: 1 — р. Тобол; 2 — р. Синара; 3 — р. Юргамыш; 4 — р. Клепечиха; 5 — р. Мостовка; 6 — р. Бродовка; 7 — р. Нияп; 8 — р. Курья; 9 — р. Средний Утяк; 10 — р. Кизак; 11 — р. Степная; 12 — р. Березовка; 13 — р. Черная; 14 — оз. Котлик второй; 15 — оз. Камышное; 16 — оз. Глубокое; 17 — оз. Пеньковатое; 18 — оз. Пеньково; 19 — озеро у с. Частоозерье; 20 — озеро у с. Восточное; 21 — оз. Штырово; 22 — озеро у с. Косулино; 23 — оз. Горькое; 24 — запруда на р. Березовка; 25 — старица р. Сосновка; 26 — старицы р. Исеть; 27–34 — пойменные водоемы р. Тобол и ее притоков (окр. г. Курган); 35 — пруд (д. Новокомогоровка); 36 — пруд (д. Ялым); 37 — старица р. Тобол (с. Усть-Уйское); 38 — старица Островная (с. Прорывное); 39 — старица р. Тобол (с. Звериноголовское); 40 — осоковое болото (окр. с. Беляковское); 41 — сфагновое болото (окр. с. Беляковское); 42 — тростниковое болото (окр. д. Окуневка); 43 — сфагновое болото (окр. с. Косулино)

1. Rivers (n=13). The large Tobol River, the medium-sized Sinara River, and 11 small rivers in the Tobol, Uy, and Iset river basins were studied. The small rivers studied differed in their characteristics. This includes typical low-land rivers with low water flow velocity. The rivers flowing through the forest (Brodovka, Berezovka) were heavily shaded and had no macrophytes. Banks of rivers flowing through the steppe are covered with reed beds. In a number of rivers (Niyap, Kizak, Sinara), the higher aquatic vegetation was found, including *Elodea canadensis* Michx., *Potamogeton* spp., and *Sparganium* spp. Some of the rivers studied (Klepechikha, Kurya) had no mite population.

2. Lakes (n=10). This group includes numerous lakes, usually small in size, predominantly of suffosion origin. Some of the lakes studied have shallow waters, abundantly overgrown with higher aquatic vegetation, and have a belt of reed beds along the shore. Eight of the ten lakes studied are classified as freshwater (mineralization up to 1 g/L), while subsaline Lake Kamyshnoe (1.6 g/L) and hyposaline Lake Gorkoe (4.6 g/L) were also studied.

3. Ponds (n=18). Numerous small flood-plain water bodies are located in the flood-plains of the Tobol and Iset rivers and their tributaries. This also includes small artificial ponds on small rivers. All water bodies in this group have sandy or silty soils, are abundantly overgrown with higher aquatic vegetation, and warm up well in summer.

4. Mires — bogs and fens (n=5). Two small flat mesotrophic sedge-Sphagnum bogs of lacustrine origin near the villages of Belyakovskoe and Kosulino were studied. We also studied sedge and reed fens of lacustrine origin located near sphagnum bogs.

A hydrobiological net was used for sampling. Mites were collected from an area approximately equal to 1 square meter, by combing the water column from the surface to the bottom. The mites were fixed in 95 % ethanol and mounted on slides in Hoyer's medium. Modern identification guides were used to identify mites (Bartsch 2006; Davids et al. 2006; Di Sabatino et al. 2010; Gerecke et al. 2016).

DNA extraction, PCR and sequencing

Mitochondrial cytochrome c oxidase subunit 1 (COI) DNA barcodes were obtained for several specimens. DNA was extracted using the BiolabMix D-Tissues kit (50 columns) (BiolabMix, Novosibirsk, Russia) following a spin column-based protocol. We used whole mite specimens for lysis, preserving the exoskeletons after the incubation step for subsequent morphological identification. The incubation period was extended to an overnight exposure to ensure complete lysis. To increase DNA yield, the eluate was reapplied to the center of the column during the elution step.

PCR amplifications were performed using the BiolabMix PCR kit (BiolabMix, Novosibirsk, Russia) with HS-Taq polymerase (+MgCl₂). Each 25 µl reaction contained: 2.5 µl of DNA template, 1.25 µl each of primers LCO1490 and HCO2198 (Folmer et al. 1994), 5 µl of PCR buffer, 0.5 µl of dNTPs, 0.5 µl of HS-Taq polymerase, 14 µl of sterile distilled water. The PCR cycling conditions were as follows: initial denaturation at 94 °C for 15 min; 5 cycles of 94 °C for 30 s, 47 °C for 40 s, and 72 °C for 1 min; followed by 30 cycles of 94 °C for 30 s, 52 °C for 40 s, and 72 °C for 1 min; with a final extension at 72 °C for 7 min (Geisler et al. 2024). PCR products were visualized in a 1 % agarose gel by electrophoresis. In cases of weak or absent bands on the agarose gel, a second round of PCR (re-PCR) was performed using the initial PCR product as a template.

PCR products showing a single clear band of approximately 700 bp were purified using the BiolabMix DR-micro kit (BiolabMix, Novosibirsk, Russia). For samples with multiple bands, purification was performed using the BiolabMix N-Gel kit (BiolabMix, Novosibirsk, Russia) by excising the target band from the agarose gel.

Sanger sequencing was performed by Evrogen (Moscow, Russia). The COI barcode for each sample was sequenced in both forward and reverse directions. The resulting chromatograms were inspected and edited using FinchTV 1.4.0 (Geospiza Inc., Seattle, USA) and MEGA 12 (Kumar et al. 2024).

Results and discussion

A total of 52 species of Hydrachnidia from 14 families and 2 species of Halacaridae were identified (Table 1). In terms of species numbers, representatives of the families Pionidae (10), Arrenuridae (8), Hygrobatidae (6), and Limnesiidae (5) predominated.

COI sequences were obtained for seven water mite species, the first time for the Southern Trans-Urals.

Eylais infundibulifera, is widespread in standing waters of the region, both fresh and mineralized. Morphologically, our specimen UTMN.KR24427 corresponds to the description given by Davids et al. (Davids

Table 1
Taxonomic composition, number, and occurrence (O, %) of water mites in the studied water bodies

Таблица 1
Таксономический состав, численность и встречаемость (O, %) водяных клещей в изученных водоемах

Species	Number of specimens	Rivers, O	Lakes, O	Ponds, O	Mires, O
1	2	3	4	5	6
Hydrachnidia					
Family Limnocharidae					
<i>Limnochara aquatica</i> (Linnaeus, 1758)	29		9		
Family Eylaidae					
<i>Eylais discreta</i> Koenike, 1897			9		
<i>Eylais extendens</i> (Müller, 1776)	5	8		6	
<i>Eylais infundibulifera</i> Koenike, 1897	15		18	6	
<i>Eylais tullgreni</i> Thor, 1899	11			12	
Family Hydryphantidae					
<i>Hydryphantes crassipalpis</i> Koenike, 1914	4				29
<i>Hydryphantes dispar</i> (Schaub, 1888)	33		9	6	
<i>Hydryphantes octoporus</i> Koenike, 1896	6		18		14
<i>Thyopsis cancellata</i> (Protz, 1896)	2	8		6	
Family Hydrodromidae					
<i>Hydrodroma pilosa</i> Besseling, 1940	55	15	18	35	
<i>Hydrodroma torrenticola</i> (Walter, 1908)	1	8			
Family Hydrachnidae					
<i>Hydrachna conjecta</i> Koenike, 1895	2			12	
<i>Hydrachna cruenta</i> Müller, 1776	1			6	
<i>Hydrachna skorikowi</i> (Piersig, 1900)	6		9		
Family Lebertiidae					
<i>Lebertia inaequalis</i> (Koch, 1837)	14	15			
<i>Lebertia insignis</i> Neuman, 1880	11	8			
Family Oxidae					
<i>Oxus longisetus</i> (Berlese, 1885)	3		9		
<i>Oxus nodigerus</i> Koenike, 1898	1				14
Family Limnesiidae					
<i>Limnesia connata</i> Koenike, 1895	2				29
<i>Limnesia fulgida</i> Koch, 1836	6		9	6	
<i>Limnesia maculata</i> (Müller, 1776)	1			6	
<i>Limnesia undulata</i> (Müller, 1776)	3	8	9		
<i>Limnesia undulatooides</i> Davids, 1997	29	15	18	47	

Таблица 1. Окончание

Table 1. End

1	2	3	4	5	6
Family Hygrobatidae					
<i>Atractides nodipalpis</i> Thor, 1899	1	8			
<i>Hygrobates bucharicus</i> Sokolow, 1928	37	8			
<i>Hygrobates fluviatilis</i> (Ström, 1768)	33	15			
<i>Hygrobates nigromaculatus</i> Lebert, 1879	2	8			
<i>Hygrobates prosiliens</i> Koenike, 1915	52	38			
<i>Hygrobates trigonicus</i> Koenike, 1895	1	8			
Family Unionicolidae					
<i>Unionicola crassipes</i> (Müller, 1776)	4		9	12	
<i>Unionicola minor</i> (Soar, 1900)	2			6	
<i>Unionicola parvipora</i> Lundblad, 1920	3			6	
Family Pionidae					
<i>Piona alpicola</i> (Neuman, 1880)	10			24	
<i>Piona carnea</i> (Koch, 1836)	1		9		
<i>Piona clavicornis</i> (Müller, 1776)	12				14
<i>Piona conglobata</i> (Koch, 1836)	2			12	
<i>Piona longipalpis</i> (Krendowskij, 1878)	4		9		
<i>Piona neumani</i> (Koenike, 1883)	261	8	27	24	
<i>Piona pusilla</i> (Neumann, 1875)	1			6	
<i>Piona stjordalensis</i> (Thor, 1897)	6		27	12	
<i>Tiphys latipes</i> (Müller, 1776)	1				14
<i>Tiphys ornatus</i> Koch, 1836	1035		9		
Family Mideidae					
<i>Midea orbiculata</i> (Müller, 1776)	1				14
Family Mideopsidae					
<i>Mideopsis orbicularis</i> (Müller, 1776)	1		9		
Family Arrenuridae					
<i>Arrenurus affinis</i> Koenike, 1887	1			6	
<i>Arrenurus batillifer</i> Koenike, 1896	18			6	
<i>Arrenurus bicuspidator</i> Berlese, 1885	7			12	
<i>Arrenurus papillator</i> (Müller, 1776)	1				14
<i>Arrenurus tricuspidator</i> (Müller, 1776)	61	8	9	12	
<i>Arrenurus perforatus</i> George, 1881	1	8			
<i>Arrenurus sinuator</i> (Müller, 1776)	1		9		
<i>Arrenurus stecki</i> Koenike, 1894	1			6	
<i>Arrenurus</i> females indet.	124	23	27	18	14
Deutonymphs indet.	66	8	45	12	14
Halacaroidea					
Family Halacaridae					
<i>Porohalacarus alpinus</i> (Thor, 1910)	5				14
<i>Porolohmannella violacea</i> (Kramer, 1879)	1				14
Total number	1998	192	1609	163	34

et al. 2006). However, the BOLD Barcode ID analysis revealed a maximum of 87.80 % sequence identity with the *E. infundibulifera*

BIN BOLD:ACS0089, which comprises samples from the Netherlands and Norway. This is possibly a cryptic species.

Eylais tullgreni was collected in two flood-plain ponds of the Tobol River. Currently, COI barcodes for this species are represented in neither BOLD nor GenBank. Specimens from the BIN BOLD:AFP3591 (which includes morphologically close species *E. tantilla* from Portugal) were suggested by BOLD Barcode ID as the closest matches to our specimen UTMN.KR24428 (maximum identity of 94.98 %).

Hygrobates bucharicus Sokolow, 1928 (Fig. 2) was first recorded in Russia. This is also the northernmost record of this species. It was first described from Uzbekistan (Sokolow 1928; 1940), and was later also found in Iran (Pesic 2004), Turkey (Esen et al. 2014), and Kyrgyzstan (Pešić, Smit 2021). In the

Southern Trans-Urals, *H. bucharicus* was collected in the Chernaya River (a tributary of the Uy River) in the vicinity of Belozerk village in the Tselinny District (54°21'03.3" N 63°24'33.3" E). The COI barcode for this species was obtained for the first time. Using the BOLD Barcode ID, the highest match for our specimen UTMN.KR24437 was a *Hygrobates* specimen (HYDAB1484-23) with only 80.92 % identity.

Piona clavicornis was collected in a sedge fen. The species is widespread in Siberia. BOLD Barcode ID confirmed the identification of specimen UTMN.KR21299 as *P. clavicornis* (BIN BOLD:AAL3980, including specimens from the Netherlands and Canada) with 98.94 % identity.

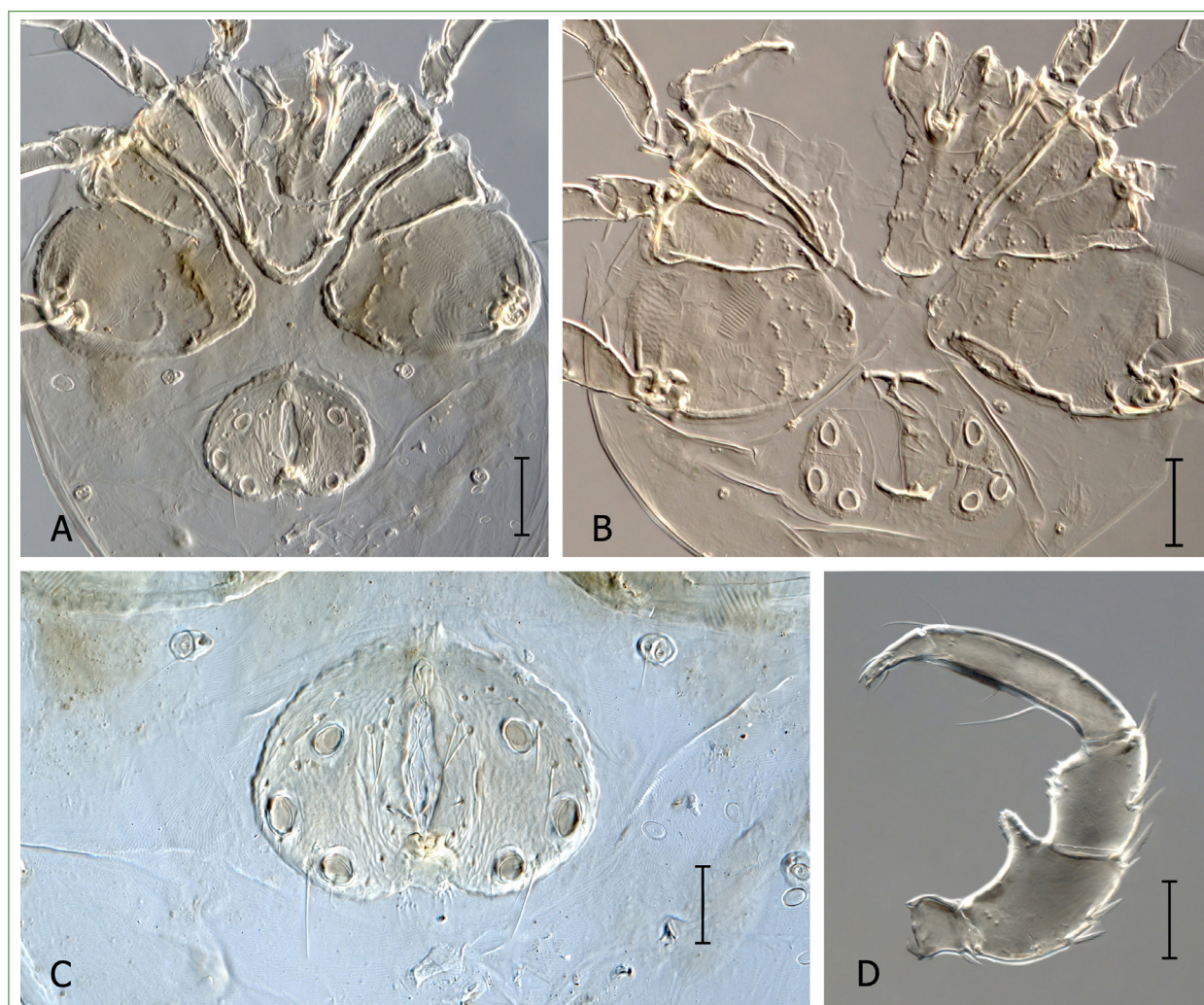


Fig. 2. *Hygrobates bucharicus* Sokolow, 1928 (A, C — male; B, D — female): A, B — coxal and genital field; C — genital field; D — palp. Scale bars: A, B — 100 µm, C, D — 50 µm

Рис. 2. *Hygrobates bucharicus* Sokolow, 1928 (A, C — самец; B, D — самка): A, B — коксальное и генитальное поле; C — генитальное поле; D — пальпа. Шкалы: A, B — 100 µm; C, D — 50 µm

Unionicola minor has been recorded for the first time in Siberia. Previously, this species was found in Russia only in the European part of the country, in Yaroslavl and Samara Oblasts (Tuzovskij, Semenchenko 2015). Two specimens of this species were collected in an oxbow of the Iset River in the Shatrovsky District. Genetically, this species represents a species aggregate consisting of six clusters (Gerecke et al. 2025). BOLD Barcode ID identified our specimen UTMN.KR25450 as *U. minor* (99.85 % identity). It belongs to BIN BOLD:ACS0643, which includes specimens from the Netherlands.

Arrenurus affinis was collected as a single specimen in an oxbow lake of the Tobol River. Our specimen UTMN.KR24429 matched *A. affinis* samples from the Netherlands (BIN BOLD:ADF7911) with 99.22–99.53 % identity. *Arrenurus batillifer*, also a common species in Siberia, was found in an oxbow lake of the Iset River. *A. batillifer* is represented in BOLD by two BINs (BOLD:AGB3614 and BOLD:ACR9712) with a 3.25 % distance between them. Using BOLD Barcode ID, our specimen UTMN.KR25451 showed the highest match to specimens from the Netherlands (BIN BOLD:ACR9712) with 99.39–99.84 % identity.

Most of the identified species of water mites in the Southern Trans-Urals are common species widely distributed in Siberia and inhabiting various types of water bodies. The ecological structure was dominated by eurybiontic species, which were found not only in stagnant water bodies, but also in rivers, which in the studied region are characterized by low flow velocity, high organic content, and, often, massive development of riparian and submerged vegetation.

The distribution and abundance of mites in different water bodies varied greatly. Perhaps because Kurgan Oblast is located in a zone with an arid climate, the number and occurrence of mites in water bodies were usually low. In several water bodies (mainly small rivers), mites were not found at all.

The highest occurrence rates were observed in eurybiontic species such as *H. pilo-*

sa, *L. undulatoides*, *P. neumani* and *A. tricuspidator*, which were found in large numbers in various types of stagnant and slow-flowing water bodies.

The number of mites in most water bodies was low, but in some cases, high numbers of certain species were observed. Thus, in spring, more than a thousand specimens of *Tiphys ornatus* were collected in a single sample from Lake Kamyshnoe (used for fish farming). However, this species was not encountered in other water bodies during the study.

The greatest species diversity of water mites was found in numerous floodplain ponds of the Tobol and Iset rivers. At the same time, the number of mites and the occurrence of certain species in these water bodies were low.

The number of mites varied greatly between lakes, but was, on average, higher than in floodplain water bodies. The occurrence of certain species was also low. The mites were found in both freshwater lakes and lakes with higher mineralization. At the same time, the highest numbers were recorded in the subsaline Lake Kamyshnoe, which has a low degree of mineralization, where eight taxa of mites were found, while in the hyposaline Lake Gorkoe, with a mineralization of 4.6 g/l, only one species was recorded (*Eylais infundibulifera*).

The rivers were also dominated by eurybiont species in terms of the number of species. Only eurybiont species have been recorded in the backwaters of large rivers (Tobol). Small rivers are inhabited by mixed fauna, including both eurybiont and rheobiont species, but in most rivers the former predominate in terms of both species diversity and number. Among rheophilic species, only species of the genus *Hygrobates*, in particular *H. prosiliens*, which prefers stagnant water bodies, had high numbers and occurrence, but in Kurgan Oblast, it was found exclusively in rivers. Only in the Sinara River, which flows in the northwestern part of Kurgan Oblast in proximity to the Ural Mountains, rheobiont species were observed, but their diversity was limited (*Atractides nodipalpis*, *Hygrobates fluviatilis*).

The most specific was the fauna of mires. Only four species of mites have been found in

the sphagnum bogs, which are few in number in the region. Halacarid species (*Porolohmannella violacea* and *Porohalacarus alpinus*) are found only in sphagnum bogs. At the same time, in lowland reed and sedge fens, which are widespread throughout the study area, a rich and diverse fauna of Hydrachnidia has been recorded. Specific species typical of marshes and temporary water bodies predominated in these areas. The fauna of the mires differed most significantly from other types of water bodies, with only one species being common to all (*Hydryphantes octoporus*), which was also found in the reed-covered shallows of lakes, including those with higher mineralization.

In Omsk Oblast, which neighbors Kurgan Oblast and is also located mainly in the forest-steppe zone, 47 species of water mites are known (Yakimenko et al. 1997). However, the species composition differs greatly from that of Kurgan Oblast. The families Eylaidae, Hydrachnidae, and Hydryphantidae were predominant in Omsk Oblast. This may be due to the specific characteristics of the water bodies studied. The study in Omsk Oblast focused primarily on floodplain ponds and temporary

water bodies. However, what they had in common was that the species composition varied greatly in the different water bodies studied. The occurrence of various species of mites was low. This may be because in the south of the West Siberian Plain, in arid climatic conditions, the regime and area of water bodies fluctuate greatly from year to year (Naumenko et al. 2019), and this may have a strong impact on the acarofauna of these water bodies.

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