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AQUATIC FLORA AND FAUNA

Fauna of Free-Living Nematodes (Nematoda) of the Waterbodies and Watercourses of Northern Irkutsk Oblast, Russia

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Abstract—The species diversity of free-living nematodes has been studied in the fresh waterbodies and watercourses of the Lena River basin, northern Irkutsk oblast: in the Chuya, Mama, Yuhtinka, and Vitim rivers; in Lake Teterinskoe and Lake Krasnoyarskoe; and in an unnamed lake near the settlement of Mama. Twenty-eight species belonging to 16 families and 9 orders are registered, and 6 species of these 28 are identified at the genus level only. Twenty-two species have been identified with certainty; 11 of them are eurybiont, 2 species are characterized by Holarctic distribution, 5 species are found in Eurasia, 1 species is found in Eastern Siberia, and 3 species are found at one site each. The species composition of the studied waterbodies and watercourses is usual and is presented mostly by the widespread nematode species. The most interesting findings include *Tripyla dybowskii* Tsalolikhin, 1976, which was previously considered a subendemic species of Lake Baikal. Three species are common to the fauna of Lake Baikal (two of them inhabit the splash zone). An illustrated description of the female of the rare species *Aporcelaimellus samarcandicus* (Tulaganov, 1949) is given.

Keywords: free-living nematodes, species composition, zoogeographical characteristic, Irkutsk oblast, Lena River basin, *Aporcelaimellus samarcandicus* (Tulaganov, 1949)

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INTRODUCTION

Data on the fauna of the free-living nematodes of Eastern Siberia are quite scarce. Most publications refer to the fauna of Lake Baikal [16, 22, 24, 25]. There are also studies on the species composition of nematodes of the middle stream of the Angara River [14], the Yenisei River in the vicinity of Dudinka Port [10], Lake Taimyr, several waterbodies near the city of Norilsk [5, 8], three lakes belonging to the Lena Delta Wildlife Reserve [13], and four lakes of the Ivano-Arakhlei lake system [15].

The fist data on the nematode fauna of the waterbodies and watercourses of northern Irkutsk oblast were published earlier [21]; this study presents the species composition of nematodes of the mineral-water source in the vicinity of the settlement of Klyuchi (Kazachinsko-Lenskii raion), of the Mama and Muikan rivers (3 km from the city of Severomuisk), and of an ice-free river near Severomuisk. Particularly, these results include the first findings of *Koerneria mordax* Shoshin, 1989 and *Tobrilus incognitus* Tsalolikhin, 1972 at Lake Baikal; they were considered earlier endemic species of this lake. This evidences the necessity of further studies of nematode fauna in the other water objects of this region.

This study aims to describe the nematode fauna of particular waterbodies and watercourses of northern Irkutsk oblast with specific interest in the outstanding zoogeographical findings.

MATERIALS AND METHODS

The studies were performed in 2009 in the Vitim, Mama, Chuya, and Yukhtinka rivers; in Lake Teterinskoe and Lake Krasnoyarskoe; and in an unnamed lake in vicinity of the settlement of Mama (Mama-Chuiskii raion, Irkutsk oblast, North Baikal Highlands). The terrain is mountainous; the height difference between the peaks of bare mountains and valleys of the rivers reaches 800–900 m. The maximal peak height is 1500 m. The Vitim River (1837-km long) is the largest right-hand tributary of Lena River; it is characterized by a great number of large and small secondary tributaries along the whole stream, including the Mama River (more than 400-km long, together with Levaya Mama River). The Chuya River (512 km) is also a tributary of the Lena River; it is called the Bol'shaya Chuya before its confluence with the Malaya Chuya River [3, 27]. A detailed description of the hydrological and hydrochemical regimes of the studied area has been published earlier [3]. Since there are no descriptions of the lakes, they are characterized under the observations

Table 1. Characteristics of the sampling sites

Sample no.	Date of sampling	Sampling site	Geographical coordinates,	Depth, cm	Type of sediments	No. of the slides in collection
1	26.III	Chuya River, 5 km upstream Gorno-Chuiskii settlement	57°22′26″, 111°23′51″	75	Gravel, pebble, fine sand, some silt. Much detritus in the sludge.	186–187
2	30.III	Yukhtinka River, Ul'kan setllement	55°32′26″, 111°28′20″	50–60	Pebble, rounded stones.	188–192
3	31.V	Mama River, upstream the boat station (left-hand bank), 1.2 km upstream Mama settlement	58°08′08″, 113°06′43″	50	Silt, sand, detritus	193
4	1.VI	Lake Teterinskoe	58°8′8″, 112°33′36″	50	Sand, silt, the roots of vascular aquatic plants	194–195
5	2.VI	Lake nearby an airstrip in vicinity of Mama settlement	58°19′30″, 112°54′57″	50	Silt, sand, detritus	196
6	23.VI	Lake Krasnoyarskoe	57°39′14″, 111°46′42″	150	Detritus, sand, remains of algae	197–198
7	23.VI	Ibid.	57°39′14″, 111°46′42″	150	Sand, silt, detritus	199–201
8	23.VI	Chuya River, 2.8 km upstream Gornaya Chuya settlement	57°23′14″, 111°27′9″	50	Sand, detritus, the remains of the aquatic plants	202–203
9	23.VI	Ibid.	57°23′14″, 111°27′9″	50	Sand, the remains of the aquatic plants	204
10	2.VII	Left-hand bank of Mama River, 800 m upstream the estuary	58°17′47″, 112°55′20″	50	Rocky bottom covered with sand, silt, the remains of the aquatic plants	205
11	2.VII	Vitim River, opposite Lake Teterinskoe	58°11′01″, 112°33′36″	50	Sand, silt, detritus	206–207
12	2.VII	Lake Teterinskoe	58°11′01″, 112°33′36″	50	Ibid.	208
13	24.VII	Chuya River, 2.8 km upstream Gornaya Chuya settlement	57°23′14″, 111°27′9″	50	Stones, pebble	209

of S.M. Evstigneev, who collected the samples (personal communication).

Lake Teterinskoe is located on the right-hand river bank of the Vitim River, 3 km upstream the confluence with the Mama River. This is a lake in a series of long floodplain lakes located along the riverbed. They join with the Vitim River during the freshet. The lake is lotic and perennial. The bottom is covered by the aquatic plants. The water is dark and transparent and smells of hydrogen sulfide.

Lake Krasnoyarskoe is located on the left-hand bank of the Chuya River, 3–4 km upstream the settlement of Gornaya Chuya. The lake is 80- to 100-m long and 15-m wide; its maximal depth is 2–2.5 m. The lake is lotic and perennial. The water is turbid and yellowish.

The unnamed lake is located in the vicinity of an airstrip northwards the settlement of Mama, 1 km from the left-hand bank of the Vitim River. This is a lake in the series of long floodplain lakes located along the riverbed. The lake is 30-m-long and 10-m-wide; the maximal depth is 1 m.

The characteristics of the sampling sites are presented in Table 1.

The sampling was performed by scoops and scrapers. The material was fixed in 4% formaldehyde and then placed into 70% ethanol. The nematodes were sorted under an MBS-10 stereomicroscope (Russia) and mounted into the permanent glycerol-gelatin slides stained by trypan blue under the standard method [24]. The specimens were measured and identified under Olympus CX-21 (Japan) and MBB-1A (Russia) light microscopes. The microphotographs were taken by a ToupCam 5.1 MP microscope-designed digital camera (video-registering eyepiece). All the slides are stored in

the collection of Limnological Institute, Siberian Branch, Russian Academy of Sciences (Irkutsk, Russia). In total, more than 200 specimens of nematodes have been analyzed from 13 samples.

RESULTS

Twenty-eight nematode species belonging to 16 families and 9 orders have been registered in the studied waterbodies and watercourses; six species have been identified at the genus level, because the number of the specimens was not enough to perform identification to the species level. The species list and the sites of their findings are presented in Table 2.

Below, we present the zoogeographic characteristics of the species.

Ironus ignavus is an eurybiont species; it is found on all continents except for Antarctica [30]. It inhabits water, moss, and wet soil. It is registered in the Baltic Sea and the Black Sea. [32].

Tobrilus gracilis is an eurybiont species, widespread on all continents [30]. An ubiquist species inhabiting different types of water objects, it stands significant salinity. Common in Russia and adjacent countries [7]. Particularly, it was registered for the Lena River basin [10, 13] and in Zabaykalsky krai (Russia) in Lake Arakhlei, Lake Shaksha, and Lake Irgen' [15].

Epitobrilus allophysis is widespread in Europe, registered in Asia (Himalayas and China), Africa (Ethiopia), and North America (United States) [30, 34].

Semitobrilus closlongicaudatus inhabits Europe (Switzerland, Poland, Hungary, Spain, and Russia) [30]. Recently it was registered in water objects of Vietnam [26]. Our finding is the first case for the Asian part of Russia.

Tripyla glomerans inhabits wet soil, moss, and freshwater and brackish waterbodies and watercourses. It is registered in Europe, Asia, Africa, and North America [30, 34].

T. dybowskii was first known for the abyssal of the South and the Central Basins of Lake Baikal; it was considered an endemic species. Later, it was found in the Angara River [14] and Chuya River [17, 21]. Eastern Siberia is considered the geographic range of this species.

T. filicaudata is spread throughout Europe, Asia, and North America [30]. In Russia it was found in one of the lakes belonging to the basin of the Ob' River (middle stream) [20], in the Russian Far East [1], and in a splash zone of Lake Baikal [16]. It inhabits the soil, moss, ground waters, sandy beaches, lakes, and streams [34].

Dorylaimus popus has been found in the coastal zone of the Kayrakkum Reservoir (Tajikistan) [4] and in Spain [35].

Mesodorylaimus pseudosubtilus had been registered earlier only for South Africa [34]. In our study, it was found in Lake Krasnoyarskoe and the Vitim River.

Eudorylaimus carteri is an eurybiont species, inhabits wet soil, moss, and the coastal shallow zone of water objects [6]. It was registered in the middle stream of the Angara River [14].

Arctidorylaimus kurenkovi was known before only for Lake Kuril'skoe (Kamchatka, Russia) [11]. In our study, this is the second finding of this species.

Aporcelaimellus samarcandicus was described from the grassland soil in Uzbekistan; later it was found in the forest soil in Hungary [28].

Paravulvus hartingii is an eurybiont species, widespread in Europe and registered in Asia, South Africa, and North America [31, 34].

Paractinolaimus macrolaimus is an eurybiont species inhabiting both lacustrine and terrestrial biotopes. It was registered in many European countries and in Asia, Africa, and North America [31]. It is widespread in the waterbodies and watercourses of Russia [18, 19].

Mononchus truncatus is an eurybiont species inhabiting the coastal zone of the lakes [7], found occasionally in wet soil. It was registered on all continents except for Antarctica [34].

Paramononchus arcticus is known from Canada (rivers in the arctic climatic zone) [34]. In Russia, it was found in Lake Arakhlei (Zabaykalsky krai, Asian part) [15] and in the water objects of Vladimir oblast (European part) [33].

Monhystera stagnalis is an eurybiont species, widespread in Europe. It is found in Asia (Japan), Africa (Ethiopia and South Africa), and South America (Columbia) [29].

Plectus rhizophilus is an eurybiont species inhabiting the shallow coastal zone of freshwater and brackish water objects, moss, and wet soil [7]. Widespread in many European countries, it is known in Asia, Africa, North America, Australia, and Oceania [29]. It is found frequently in the waterbodies and watercourses of Russia [7] and registered in the bottom sediments of a waterbody located on an island in the Lena River Delta [9]; authors was found it in the splash zone of Lake Baikal.

Paraphanolaimus embryonophorus has been registered in Primorsky krai (Russia) in southeastern Lake Khasan [2].

Chromadorita leuckarti is an eurybiont species registered in Europe, Asia, Africa, North America, and South America. Widespread in freshwater and brackish waterbodies, it is found in the marine environment. It is found in the fouling communities of plants (epiphytone) [7, 29, 34] and registered in the middle stream of the Angara River [13, 14]. It was found in a mineral spring located in the Kazachinsko-Lenskii raion, Irkutsk oblast, Russia [21].

Table 2. Taxonomic composition and the number of nematodes in the samples of the water objects

Taxa	Rivers				Lakes		
	Chuya	Yukhtinka	Mama	Vitim	Mama settl., nearby	Teterinskoe	Krasnoyarskoe
Order Enoplida Filipjev, 1929							
Family Ironidaede Man, 1876							
Ironus ignavus Bastian, 1865	1♀	–	–	–	–	–	7♀♀, 6juv
Order Triplonchida Cobb, 1920							
Family Tobrilidae de Coninck, 1965							
Tobrilus gracilis (Bastian,1865)	1♂, 7♀♀, 1juv	–	–	–	–	–	–
Epitobrilus allophysis (Steiner, 1971)	1♀, 1juv	2♀♀	1♀	1♀	–	1♀	4♀♀
Semitobrilus closlongicaudatus (Gagarin, 1919)	3♀♀, 1juv	–	–	–	–	1♀	–
Family Triylidae de Man, 1876							
Tripyla glomerans Bastian, 1865	–	–	–	–	1♂	–	–
T. dybowskii Tsalolikhin, 1976	2♂♂, 6♀♀, 1juv	–	–	–	–	–	–
T. filicaudata de Man, 1880	–	–	1juv	1♂, 2♀♀	–	–	–
Order Dorylaimida Pearse, 1942							
Family Dorylaimidae de Man, 1876							
Dorylaimus popus Gagarin, 1981	1♀	–	–	–	–	5♀♀, 8 juv	1♂, 3♀♀, 1juv
Mesodorylaimus pseudosubtilus Basson et Heyns, 1974	–	–	–	2♂♂, 1♀	–	–	1♀
Chrysodorus sp.	–	–	–	–	–	1♀	–
Family Qudsianematidae Jairajpuri, 1963							
Eudorylaimus carteri (Bastian, 1865)	2♀♀	3♀♀, 2juv	2♀♀	–	–	–	–
E. sp.	1♀, 1juv	–	–	–	–	–	–
Epidorylaimus sp.	1♀	–	–	–	–	–	–
Labronema sp.	–	–	–	–	–	–	2♀♀
Arctidorylaimus kurenkovi Gagarin, 2002	1♂	–	1juv	2juv	–	–	–
Family Aporcelaimidae Heyns, 1965							
Aporcelaimellus samarcandicus (Tulaganov, 1949)	4♀♀	–	3♀♀, 1juv	8♀♀, 3juv	–	–	–
Family Tylencholaimidae Filipjev, 1934							
Tylencholaimus sp.	–	–	1	1♂	–	–	–

Table 2. (Contd.)

Taxa	Rivers				Lakes		
	Chuya	Yukhtinka	Mama	Vitim	Mama settl., nearby	Teterinskoe	Krasnoyarskoe
Family Nygolaimidae Thorne, 1935							
Paravulvus hartingii (de Man, 1880)	–	–	–	–	–	1♀	–
Family Actinolaimidae Thorne, 1939							
Paractinolaimus macrolaimus (de Man, 1880)	–	–	–	–	–	–	3♂♂, 5♀♀, 1juv
Order Mononchida Jairajpuri, 1969							
Family Mononchidae Chitwood, 1937							
Mononchus truncatus Bastian, 1865	1♀	–	–	–	–	–	–
Paramononchus arcticus Mulvey, 1978	2♀♀, 5juv	1♀, 1juv	1juv	–	–	–	2♀♀, 2juv
Order Monhysterida Filipjev, 1929							
Family Monhysteridae de Man, 1876							
Monhystera stagnalis Bastian, 1865	–	3♀♀	–	–	–	–	–
Order Plectida Malakhov, 1982							
Family Plectidae Oerley, 1880							
Plectus rhizophilus de Man, 1880	3♀♀	32♀♀, 3juv	1♀	1♀	–	3 juv	–
Family Aphanolaimidae Chitwood, 1936							
Paraphanolaimus embryonophorus (Alekseev, Naumova, 1977)	–	–	–	–	–	1♀	–
Order Chromadorida Chitwood, 1933							
Family Chromadoridae Filipjev, 1917							
Chromadorita leuckarti (de Man, 1876)	–	2♂♂, 7♀♀	–	–	–	–	–
Punctodora ratzemburgensis (Linstow, 1876)	–	1♂, 1♀	–	–	–	–	–
Order Diplogasterida Micoletzky, 1922							
Family Neodiplogasteridae Paramonov, 1952							
Koerneria ruricola (Gagarin, 1983)	–	2♂♂, 2♀♀	–	–	–	1♀	1♀
Order Tylenchida Thorne, 1949							
Family Criconematidae Taylor, 1936							
Macroposthonia sp.	–	1♀	–	–	–	–	–

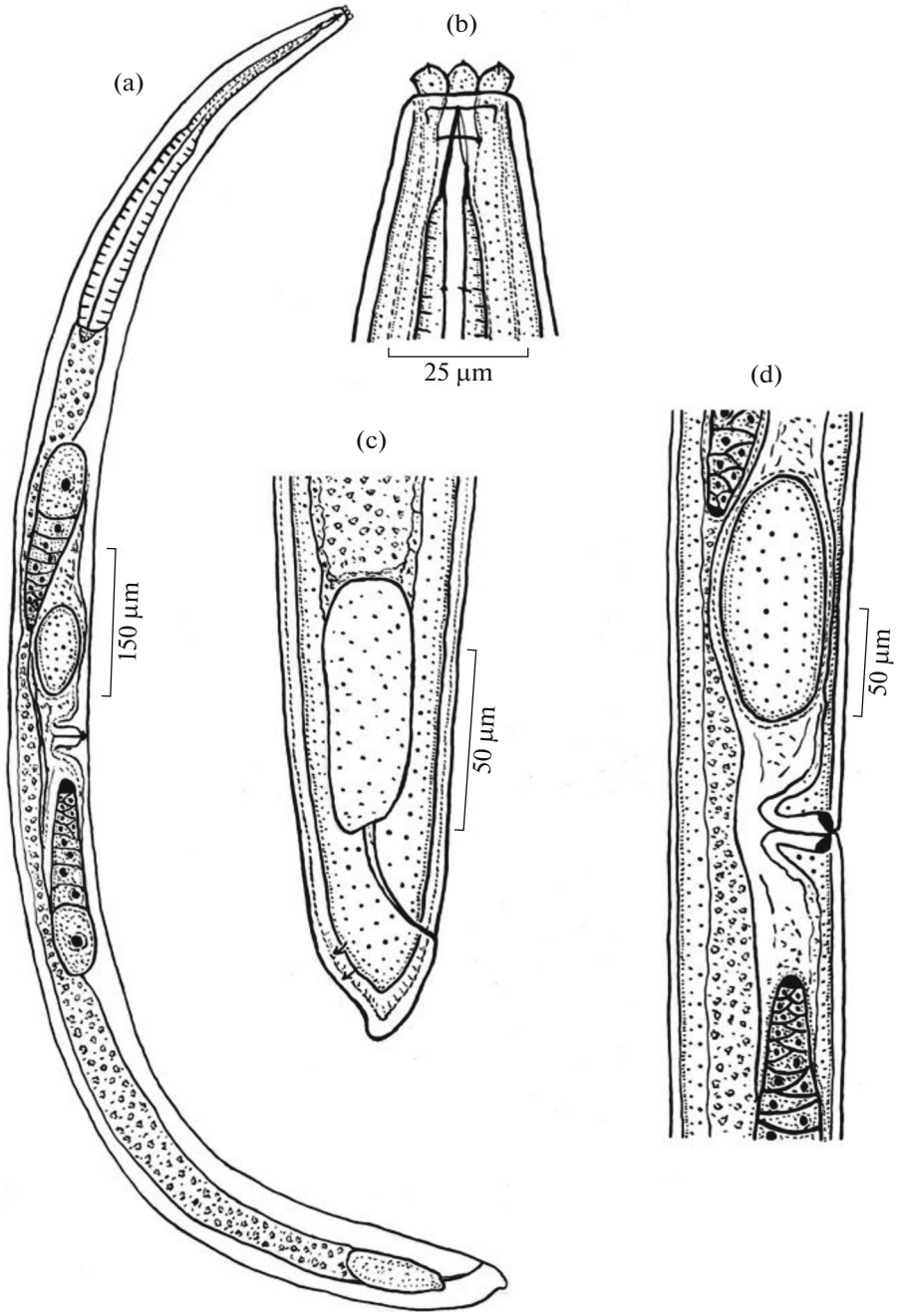

Fig. 1. Detailed view of the female of *Aporcelaimellus samarcandicus*: (a) general view, (b) head, (c) posterior end of the body, and (d) body at vulva area.

Punctodora ratzemburgensis usually inhabits the fouling communities of aquatic plants (epiphytobiont) [7]. It is found in the coastal brackish biotopes of the Baltic Sea and the Black Sea and in the marine biotopes in France, Spain, and in fresh waters of Europe [29, 34]. It was registered in the water objects of Novaya Zemlya archipelago and Vaygach Island [9].

Koerneria ruricola has been found in the water table in Tula oblast (European Russia) [12] and in the waterbodies of Taymyr Peninsula [5, 8].

Most of the species found during this study in the watercourses and waterbodies are widespread and described in detail. The description of the rare species *Aporcelaimellus samarcandicus* was scarce until now, so its detailed redescription is given below, including drawings and microphotographs.

***Aporcelaimellus samarcandicus* (Tulaganov, 1949) Baqri et Khera, 1975** (Figs. 1, 2; Table 3).

M a t e r i a l. 15♀♀, 4juv. The morphology of the ten mature females has been studied in detail; these specimens were measured.

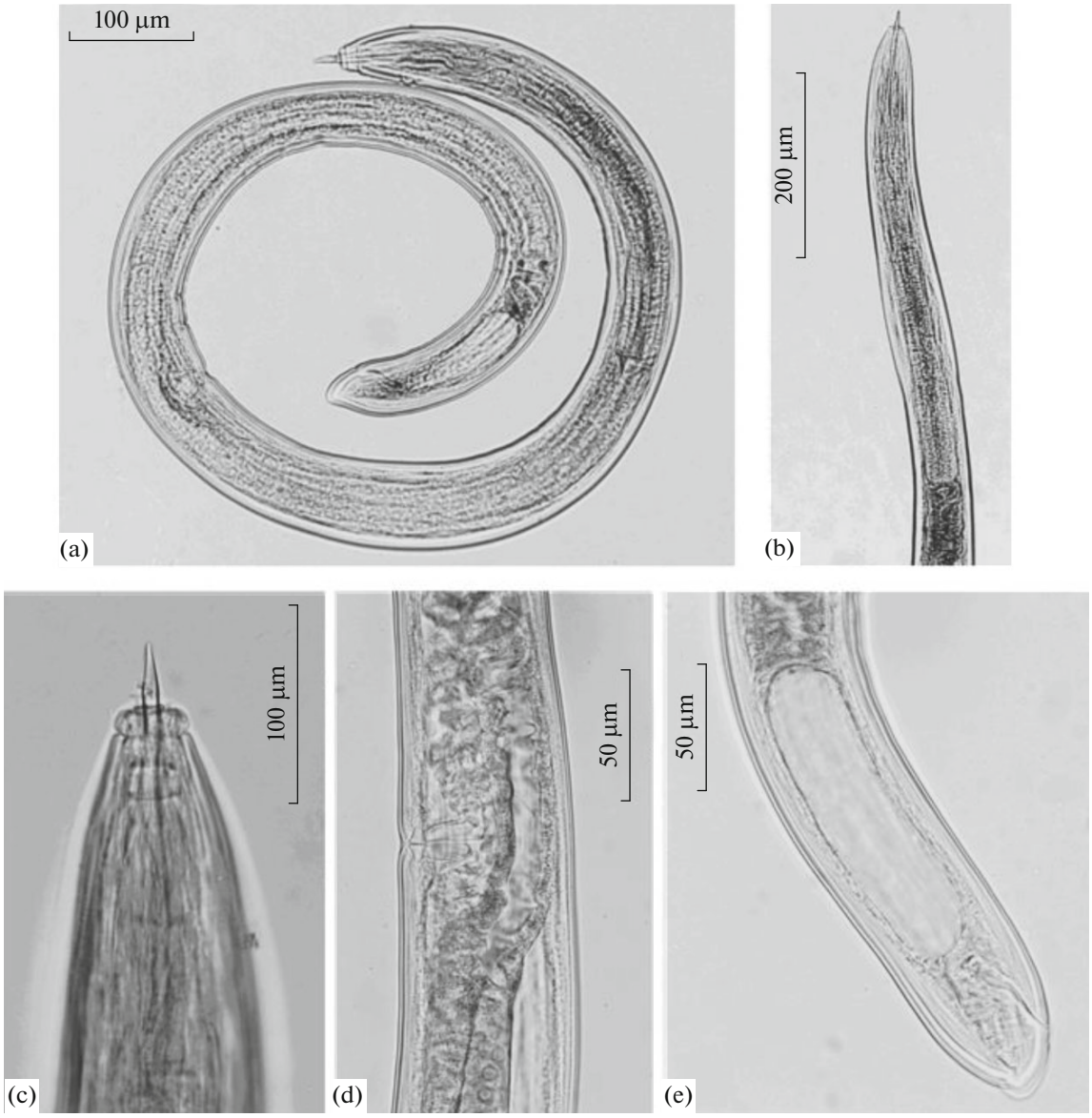

Fig. 2. Microphotographs of female *Aporcelaimellus samarcandicus*: (a) general view, (b) anterior end of the body, (c) head, (d) body at vulva area, and (e) posterior end of the body.

Locality. Russia, Eastern Siberia, the Vitim, Chuya, and Mama rivers; ravage; bottom sediments: sand and silt. June to July 2009.

Description of the female. The cuticle is smooth, without lengthwise lines and cuticle pores. The cuticle thickness in the middle part of the body is 3.0–3.5 μm on average, on the tail 7–8 μm, and on the head 4–5 μm. The cuticle is clearly split into two layers; this is most pronounced at the tail, where the cuticle is thickest. The anterior end of the body is narrowed. Labia are high and acuminate. The labial area is abruptly separated from the body. The spear is relatively short and thick. Its length is slightly smaller than the width of labial area. The spear aperture is 50–60% of the spear length. The elongation of the spear is a bit shorter than the spear length. The main valve is simple. The foveae of aphids are located in the basement of the labial area. Pharynx is muscular; it dilates in 40–45% of its length. The location of the pharynx nuclei was not visible. The cardium is triangle and muscular; it juts out the lumen of the middle intestine. The rectum length exceeds the body diameter at anus area 1.3–1.5 times; the prerectum length exceeds it 5–7 times.

The ovaries are paired and antidromous; both are located right to the middle intestine. Their bends are relatively long. The vulva is equatorial, of the transverse cleft shape. The noncuticulized labia of vulva do not protrude out of the body walls. The numerous oocytes are organized first in two rows, then in one

Table 3. Morphometric characteristics of *Aporcelaimellus samarcandicus*

Parameter	10♀♀	
	min–max	average
L, μm	1679–2073	1849
a	20–26	24
b	3.4–4.1	3.8
c	48–70	66
c'	0.6–0.7	0.7
V, %	49.2–56.9	53.2
Width of labial area, μm	17–20	19
Length, μm		
spear	21–23	22
pharynx	434–520	478
Distance, μm		
from the end of pharynx to vulva	405–608	498
from vulva to anus	675–1035	844
Length, μm		
prerectum	24–41	29
tail	82–130	93

row. One to two ripe eggs (115–130 × 50–56 μm) in the uterus. The vagina occupies approximately half of the body diameter at this area: *pars proximalis vaginae* is 33- to 37-μm-long; *pars refringens vaginae* consists of roundish and refractive sclerotia. *Pars distalis vaginae* is very short and nearly absent. The tail is short and semispherical and carries short dactylate apophysis; the tail is smaller than the body diameter at anus area.

Geographic range. The species is described from the grassland soil of Uzbekistan [23]. Later, in the forest soil, in Hungary [28]. This is the third finding of this species. In all cases, only the females and juveniles are found. Males of this species are unknown.

DISCUSSION

The nematode fauna of the studied waterbodies and watercourses of northern Irkutsk oblast comprises mostly widespread, well-known, and common freshwater species. Eleven species of 22 registered are characterized as eurybionts or, at least, they are found on most continents (*Ironus ignavus, Eudorylaimus carteri*, *Tobrilus gracilis*, *Epitobrilus allophysis*, *Tripyla glomerans*, *Paravulvus hartingii*, *Mononchus truncatus*, *Monhystera stagnalis*, *Plectus rhizophilus*, *Chromadorita leuckarti*, and *Paractinolaimus macrolaimus*), 2 species are found in the Holarctic (*Tripyla filicaudata* and *Paramononchus arcticus*), 5 species belong to the fauna of Eurasia (*Dorylaimus popus*, *Koerneria ruricola*, *Aporcelaimellus samarcandicus*, *Punctodora ratzemburgensis*, and *Semitobrilus closlongicaudatus*), and 1 species inhabits Eastern Siberia (*Tripyla dybowskii*). The species characterized by spotted distribution attract specific interest: *Mesodorylaimus pseudosubtilus* is known from South Africa, *Paraphanolaimus embryonophorus* has been registered in Primorye (Far Eastern Federal District, Russia), and *Arctidorylaimus kurenkovi* in Kamchatka (Russia). There are also three species common to the fauna of Lake Baikal (two of them inhabit the splash zone).

CONCLUSIONS

Twenty-eight species belonging to 16 families and 9 orders have been registered in the four studied rivers and three lakes of the Lena River basin (six species have been identified at the genus level only). Most species are widespread; three species are characterized by spotted distribution (one of these three species, *Mesodorylaimus pseudosubtilus,* is registered in Russia for the first time). A detailed illustrated description of the female of the rare species *Aporcelaimellus samarcandicus* is given.

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