

New data on collembolan fauna of the Karskaya tundra and Polar Urals

Новые данные о фауне коллембол (Collembola) Карской тундры и Полярного Урала

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КЛЮЧЕВЫЕ СЛОВА: ногохвостки, список видов, тундра, Северо-Восточная Европа.

ABSTRACT. The article provides data on the species composition of collembolans in ecosystems of the Polar Urals and Karskaya tundra (Russia: Komi Republic, Yamalo-Nenets and Nenets Autonomous Districts). In total, 65 species of 44 genera and 15 families of springtails have been recorded in this area.

РЕЗЮМЕ. В статье приводятся данные о видовом составе коллембол Полярного Урала и Карской тундры (Россия: Республика Коми, Ямало-Ненецкий и Ненецкий Автономные Округа). Всего в данном районе зарегистрировано 65 видов ногохвосток из 44 родов и 15 семейств.

Springtails of the East European tundra have been studied quite well [Babenko et al., 2017]. Most of the works on collembolans in this sector is based on materials collected on the Kanin Peninsula, in the Malozemel'skaya and Bolshezemel'skaya tundras (including the Kolguev, Dolgii and Vaigach Islands) [Babenko et al., 2017; Taskaeva, Nakul, 2017; Taskaeva et al., 2020]. According to these data, the list of springtails in the East European tundra is quite extensive and includes 198 species. However, there is practically no information on the composition and structure of the collembola fauna of the Karskaya tundra, adjacent to the Bolshezemel'skaya tundra from the east and the Polar Urals. It should be added that the extreme northeast of the Bolshezemel'skaya tundra and the Polar Urals is of great zoogeographical interest as an area of contact between Siberian and Eastern European, as well as Boreal and Arctic faunistic and floristic complexes [Savinov, 2018].

The first information about springtails of this area date back to the beginning of the 20th century. In the summer of 1909, the expedition under the leadership of O.O. Backlund organized by the Imperial Russian

Geographical Society and the Imperial Russian Academy of Sciences spent 4 months exploring the region of the Kara River, the Karskaya tundra, Bajdaratskaya Bay and the River Shchyuchya, in the Arctic tundra of the Yugorsky Peninsula (Polar Ural region) (Figs 1–2). It was financed by the Kuznetsov brothers, who were wealthy tea traders and who both agreed to participate in the expedition. The starting point was the city of Obdorsk (now Salekhard), where the participants of field research arrived on May 22, 1909. The expedition went to the upper reaches of the Khanema river (now River Khan-Mey, a tributary of the River Sob), along the main watershed and a longitudinal valley to the River Shchyuchya, through Lake Shchyuchya, the upper reaches of the River Pyderata (now River Baydarata) and the Minisey Mountain, across the tundra to a mouth of the River Kara, across the tundra along the coast of the Kara Sea, up the valley of the River Baydarata and back to Obdorsk (Salekhard) [Sorokina, Pont, 2014]. As one of the results of this expedition, a list of springtails including 34 species and varieties was published [Linnaniemi, 1919]. Among them a little more than dozen species were found in the Kara tundra and the Polar Urals although only a few of the latter are easily recognizable at present (Table 1). Later studies were carried out only in the Polar Urals, namely in the vicinity of Lake Pagaty located in the forest-tundra [Kolesnikova et al., 2007] and in the tundra zone of the Khrebtovy Preserve [The biological diversity..., 2010]. Based on the results of these works, a list of springtails including 46 species was compiled. Therefore, any information on soil springtails, especially from the extreme northeast of the European sector is of great interest.

We have processed a small collection of collembolas collected by A.I. Taskaev during the expedition

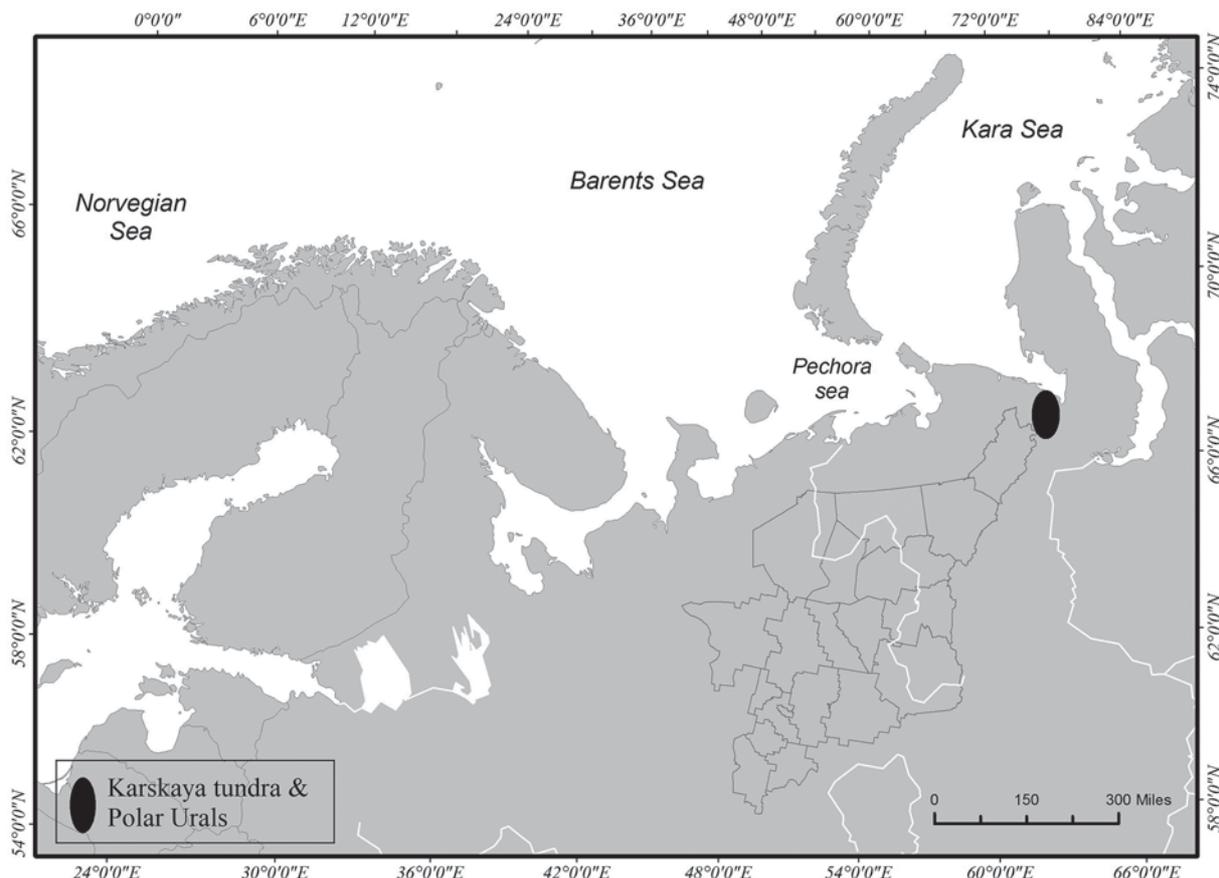


Fig. 1. Location of Karskaya tundra and Polar Urals.

Рис. 1. Расположение Карской тундры и Полярного Урала

along the Kara river in August 2003. The Kara river flows along the border of the Nenetsky and Yamalo-Nenetsky Autonomous districts and Komi Republic. The river is formed in North-Western slopes of the Polar Urals at the confluence of the rivers Bolshaya Kara and Malaya Kara. It flows mainly in a north-western direction along the Pai-Khoi ridge. The studied area is located on the eastern outskirts of the Zapolyarny District of the Ural mountainous country [Chibilyov, 2012] on the border of the southern and typical tundra subzones. From the mouth of Kara on the coast of the Kara sea the green moss and moss-lichen tundra are most widespread. To the south of the shores from the Kara mouth there are spotted and dwarf shrub tundra. On the banks of the river valleys the shrub, willow, meadow tundra is developed [Martynenko, 1999].

Unfortunately, due to the lost records, it is not possible to give more detailed information about the localities and biotopes where the material was collected. We are only basing ourselves on the labels, according to which five locations were examined. From the oral communication of V.I. Ponomarev, who was a member of the expedition in 2003, the Polar Urals became the starting point of the research (Lake Gnetty, 67°58' N, 65°35' E). The route passed along the Kara river to the Baydaratskaya Bay (68°53' N, 66°35' E) across the lake Komaty (68°07' N, 66°21' E), lake Big

Ngosaveito (68°39' N, 66°09' E) and ended near the mouth of the Gromashor river (68°52' N, 64°53' E). The route of the expedition is shown in Fig. 2. However, it was not possible to correlate certain samples with exact localities.

In total, 46 samples were studied and about 5 thousand specimens of collembolans were sorted. Extraction was carried out in the laboratory of the Institute of Biology in the Tullgren funnels at room temperature and natural light for 10 days. Fixator was 70% solution of ethyl alcohol with the addition of glycerin (3%). Identification of springtails was done using the keys [Fjellberg, 1998, 2007; Potapov, 2001; Kaprus et al., 2016 and others].

As a result of a study conducted in 2003, 37 species were found in the vicinity of the Polar Urals and the Karskaya tundra. Taking into account the literature data [Linnaniemi, 1919; Kolesnikova et al., 2007; The biological diversity..., 2010] 65 species from 44 genera and 15 families are known for this territory (Table 2). No new species have been registered for the European North-East of Russia. However, a number of species were noted only as a result of the 1909 expedition (Table 1). The first species is *Podura aquatica* preferring standing water in ponds and along the shores of lakes appears to be generally distributed all over this territory. But in our study it was not found, which is

Table 1. List of springtail species found in the Polar Urals and Karskaya tundra (according to the results of the expedition of the Kuznetsov brothers to the Polar Urals in 1909).
Таблица 1. Список видов коллембол, обнаруженных на Полярном Урале и Карской тундре (по результатам экспедиции братьев Кузнецовых на Полярный Урал в 1909 г.)

Species	Expedition stops, localities, number of specimens as given in [Linnantemi, 1919]	Expedition stops and localities as given in [Sorokina, Pont, 2015]
<i>Podura aquatica</i> L.	Ural: Charawa-Tal (7. VI), 1 Ex.	Valley of the of River Kharava [River Kharbey] (tributary of River Ob) [about 67°08' N, 66°15' E]
<i>Achorutes giganteus</i> (Tullberg)	in der Tundra am Ufer des Kara-Flusses (24. VII), 2 Ex.; in der Tundra unweit vom Ufer des Kara-Flusses (VII), 1 Ex.	Delta of the River Kara [about 69°07' N, 64°54' E]
<i>Onychiurus armatus</i> (Tullberg)	Fluss Niada-jaha, Tundra v. Pyderata (21. VIII), 1 Ex.	Right bank of the River Nyada-yaga, 65 m [tributary of the River Baydarata, 67°53' N, 67°55' E]
<i>Isotoma sensibilis</i> Tullberg	Ural: Chadata-Tal (19. VI), 6 Ex.	South bank of the River Khadata near the Khadata-yugan-lor lakes [67°37' N, 66°10' E]
<i>Isotoma violacea</i> Tullberg	Ural: Charawa-Tal (7. VI), 4 Ex.; Ural: Chadata-Tal (19. VI), 1 Ex.	Valley of the of River Kharava [River Kharbey] (tributary of River Ob) [about 67°08' N, 66°15' E]; South bank of the River Khadata near the Khadata-yugan-lor lakes [67°37' N, 66°10' E]
<i>Isotoma viridis</i> Bourlet, Schott	Ural: Chadata-Tal (19. VI), 4 Ex.; Karskaja Tundra: Samgy-Pe (13. VII), 9 Ex.; in der Tundra 7 km. vom Ufer des Kara-Flusses (29. VII), 2 Ex.	South bank of the River Khadata near the Khadata-yugan-lor lakes [67°37' N, 66°10' E]; Upper reaches of the River Kara [about 68°39' N, 65°52' E]; Left tributary of the River Lyubi-Yaga [now Labiyakha, about 69°09' N, 65°10' E]
<i>Isotoma viridis</i> var. <i>annulata</i> Nicolet	Ural: Charawa-Tal (9. VI), 1 Ex.	Upper reaches of River Kharava [River Kharbey] (tributary of River Ob) [about 67°13' N, 66°08' E]
<i>Isotoma viridis</i> var. <i>riparia</i> Nicolet	Karskaja Tundra: Samgy-Pe (13. VII), 4 Ex.; Karskaja Tundra: Kara-Tal (16. VII), 13 Ex.; Karskaja Tundra: Chara-Pe (14. VIII), 28 Ex.	Upper reaches of the River Kara [about 68°39' N, 65°52' E]; Right bank of the River Kara, 60 m [about 68°43' N, 65°27' E]; Right tributary of the River Pensigou-Yaga (or Pensingou), 60 m [about 68°18' N, 67°50' E]
<i>Isotomurus palustris</i> (Müller) f. <i>typica</i> (incl. var. <i>aquatilis</i>).	Karskaja Tundra: Pyderata-Tal (19. VIII), 1 Ex. in der Tundra, 7 km. vom Ufer des Kara-Flusses (29. VII), 2 Ex.; Karskaja Tundra: Pyderata-Tal (19. VIII), 1 Ex.	Right bank of the River Nyada-yaga, 65 m [tributary of the River Baydarata, 67°53' N, 67°55' E] Left tributary of the River Lyubi-Yaga [now Labiyakha, about 69°09' N, 65°10' E]; Right bank of the River Nyada-yaga, 65 m [tributary of the River Baydarata, 67°53' N, 67°55' E]
<i>Isotomurus palustris</i> var. <i>praxina</i> Reuter	Chadata-Tal, Ural (19. VI), 2 Ex.	South bank of of the River Khadata near the Khadata-yugan-lor lakes [67°37' N, 66°10' E]
<i>Corynothrix borealis</i> Tullberg	Fluss Niada-jaha (21. VIII), 18 Ex.	Right bank of the River Nyada-yaga, 65 m [tributary of the River Baydarata, 67°53' N, 67°55' E]
<i>Entomobrya zaitzewi</i> sp.nov.	Tundra von Pyderata, Fluss Niada-jaha (21. VIII), 1 Ex.	Right bank of the River Nyada-yaga, 65 m [tributary of the River Baydarata, 67°53' N, 67°55' E]
<i>Tomocerus sibiricus</i> (Reuter)	Karskaja Tundra: Kara-Tal (16. VII), 15 Ex.	Right bank of the River Kara, 60 m [about 68°43' N, 65°27' E]
<i>Sminthurus viridis</i> L. var. <i>picta</i> nov.	Karskaja Tundra: Pensingou-Fluss (14. VIII), 1 Ex.	Right tributary of the River Pensigou-Yaga (or Pensingou), 60 m [about 68°18' N, 67°50' E]
<i>Dicytoma fusca</i> (Luc. Lubb.)		

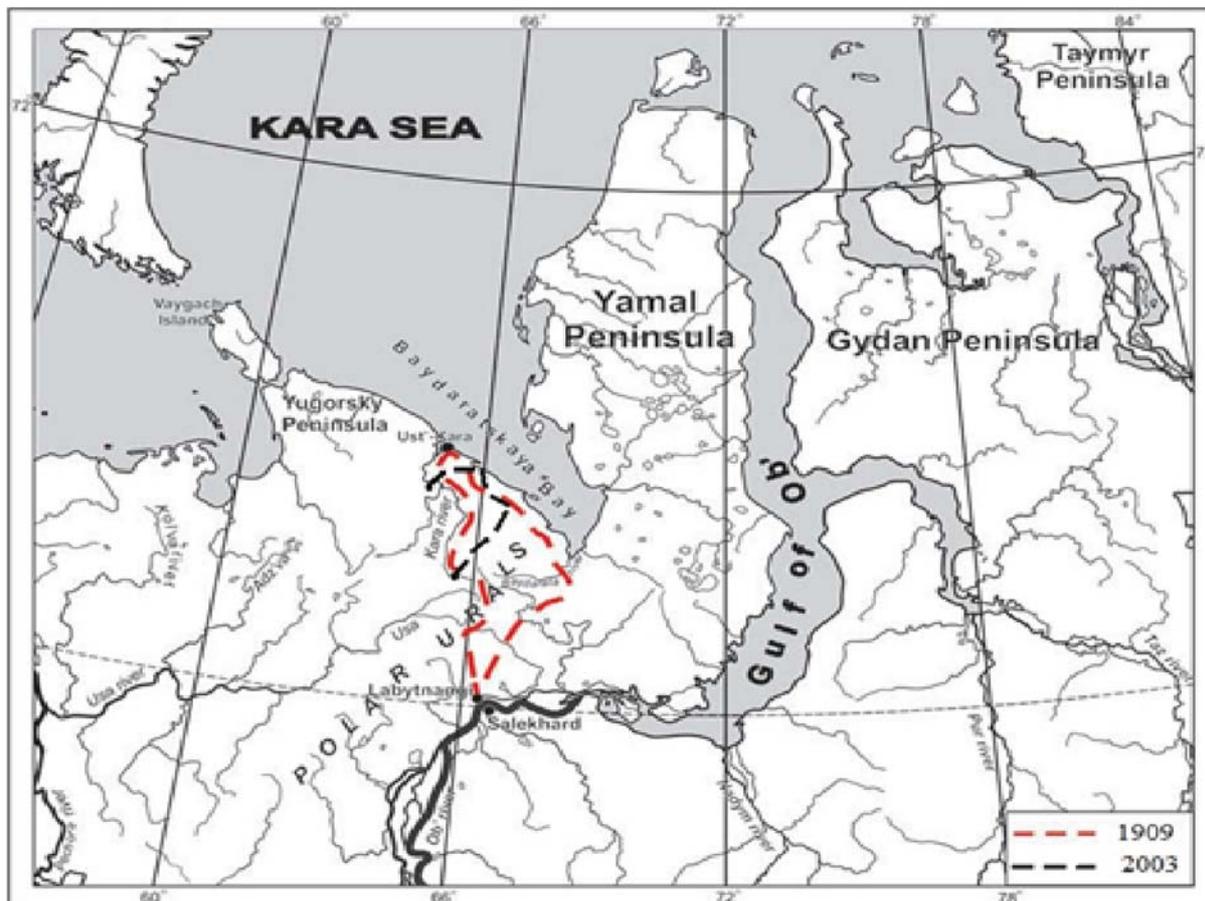


Fig. 2. The route of expeditions: red — an outline of the expedition itinerary by the Kuznetsov brothers to the Polar Urals in 1909; black — an outline of the expedition itinerary by A.I. Taskaev and V.I. Ponomarev along the Kara river in 2003 (the map was taken from: Sorokina, Pont, 2014).

Рис. 2. Маршруты экспедиций: красный — схема маршрута экспедиции братьев Кузнецовых на Полярный Урал в 1909 г.; чёрный — схема маршрута экспедиции А.И. Таскаев и В.И. Пономарева по реке Каре в 2003 г. [карта взята из: Sorokina, Pont, 2014].

possibly due to the lack of samples from such habitats. The other four Siberian species are *Morulina gigantea*, *Corynothrix borealis*, *Himalanura zaitsevi* and *Tomocerus sibiricus*. If the first one was previously recorded singly in East European tundra [Babenko et al., 2017], then the second is noted for Novaya Zemlya, Siberia, North-eastern and Middle Asia, Canada, Alaska and Colorado [Babenko, Fjellberg, 2006]. At the same time, in some “warm” habitats of Severnaya Zemlya, *C. borealis* reaches the level of subdominance [Babenko, 2018]. The species *Himalanura zaitsevi* is mainly distributed in West and Middle Siberia, recorded in Taymyr, Yakutia and the Magadan region [Babenko, Fjellberg, 2006]. The existence of *Tomocerus sibiricus* in the collembolan fauna of the researched territory is quite expected, as previously it was found in the tundra of Vorkuta region [Babenko et al., 2017]. The sixth species, *Isotomurus palustris* originally described from western Europe is a widespread hydrophile previously found in northeastern Europe only in tidal strips of the Pechora Delta [Taskaeva et al., 2020]. In two more species of Symphypleona, belonging to the genera *Sminturus* and *Dicyrtoma*, the species affiliation is doubtful, but the genera are most likely quite adequate. The rest of the species listed

in Table 1 obviously need to be confirmed due to radical changes in the group’s taxonomy. However, their identification cannot be confirmed as the slides appear to be missing.

The ranges of most of the found species are extensive in longitude (Holarctic, Palearctic, and Neomediterranean). An insignificant prevalence of species with the Eastern Palearctic range over the Western Palearctic forms was noted, which is quite natural. It has already been shown earlier that in springtails the “Siberian influence” is much stronger than the “European” one [Makarova et al., 2019]. In terms of latitudinal-zonal groups Boreal, Arctic-Boreal and Polyzoal species predominate. Only a few species with predominantly arctic (*Folsomia taimyrica* and *Morulina gigantea*) and arctic-alpine ranges (*Folsomia bisetosa* and *Corynothrix borealis*) have been noted. Apparently, such a composition of the fauna is not the prerogative of springtails alone. Thus, for the nearby Yugor Peninsula and Yamal, only one arctic species was recorded among the oribatid mites, while none in the Polar Urals [Melekhnina, 2020].

The collected material cannot be interpreted from an ecological point of view, which is due not only to the

Table 2. List of springtail species known for the Karskaya tundra and the Polar Urals.
Таблица 2. Список видов коллембол известных для Карской тундры и Полярного Урала.

Family, species	Occurrence		Range (Long./Lat.)	Literature data
	specimens	samples		
Tullbergiidae				
<i>Mesaphorura italica</i> (Rusek, 1971)	–	–	WP+G/B	+ ³
<i>Mesaphorura yosii</i> (Rusek, 1967)	54	7	C/B	–
Onychiuridae				
<i>Hymenaphorura anatolii</i> Pomorski, 2001	36	6	EP/AB?	–
<i>Oligaphorura absoloni</i> (Börner, 1901)	–	–	TH/B	+ ³
<i>Protaphorura bicampata</i> (Gisin, 1956)	385	8	TP/B	–
<i>Protaphorura boedvarssoni</i> Pomorski, 1993	1	1	WP/AB	+ ^{2,3}
<i>Protaphorura borealis</i> (Martynova, 1973)	55	6	EP+N/AB?	–
<i>Protaphorura jacutica</i> (Martynova, 1976)	151	9	EP/B	–
<i>Protaphorura pseudovanderdrifti</i> (Gisin, 1957)	–	–	WP+G/B	+ ³
<i>Protaphorura subarctica</i> (Martynova, 1976)	1	1	EP/AB	–
<i>Supraphorura furcifera</i> (Börner, 1901)	12	4	TP/B	+ ³
<i>Uralophorura schilovi</i> (Martynova, 1976)	134	6	WP/AB	+ ³
Poduridae				
<i>Podura aquatica</i> Linnaeus, 1758	–	–	C/P	+ ¹
Hypogastruridae				
<i>Ceratophysella denticulata</i> (Bagnall, 1941)	104	10	C/P	–
<i>Choreutinula inermis</i> (Tullberg, 1871)	1	1	TP/B	+ ³
<i>Hypogastrura lapponica</i> (Axelson, 1902)	1	1	TP/B	–
<i>Hypogastrura viatica</i> (Tullberg, 1872)	–	–	C/AB?	+ ²
<i>Willemia anophthalma</i> Börner, 1901	11	6	TH/B	+ ³
<i>Willemia denisi</i> Mills, 1932	–	–	TH/B	+ ³
<i>Xenylla</i> sp.	–	–	?	+ ²
Brachystomellidae				
<i>Brachystomella parvula</i> (Schäffer, 1896)	2	1	C/P	–
Neanuridae				
<i>Anurida ellipsoides</i> Stach, 1949	7	2	WP/B	+ ³
<i>Anurida komi</i> Babenko, 1998	–	–	?	+ ³
<i>Anurida papillosa</i> (Axelson, 1902)	2	2	?/AB	–
<i>Endonura reticulata</i> (Axelson, 1905)	–	–	TP/B	+ ²
<i>Friesea mirabilis</i> (Tullberg, 1871)	–	–	C/B	+ ³
<i>Friesea truncata</i> Cassagnau, 1958	54	11	TP/B	–
<i>Micranurida pygmaea</i> Börner, 1901	–	–	C/B	+ ³
<i>Morulina gigantea</i> (Tullberg, 1876)	–	–	EP+N/A?	+ ¹
<i>Neanura muscorum</i> (Templeton, 1835)	2	2	TH?/B	+ ^{2,3}
<i>Pseudachorutes dubius</i> Krausbauer, 1898	–	–	WP/B	+ ³
Odontellidae				
<i>Xenyllodes armatus</i> Axelson, 1903	61	12	TH/B	+ ²
Isotomidae				
<i>Agrenia riparia</i> Fjellberg, 1986	27	6	TH/B	+ ³
<i>Desoria alaskensis</i> (Fjellberg, 1978)	–	–	EP+N/B	+ ³
<i>Desoria</i> sp. gr. <i>multisetis</i>	–	–	?	+ ²
<i>Desoria violacea</i> (Tullberg, 1876)	23	10	EP+N/AB	–
<i>Desoria propinqua</i> (Axelson, 1902)	9	3	TH?/B	–
<i>Folsomia bisetosa</i> Gisin, 1953	331	10	TH/AA?	–
<i>Folsomia manolachei</i> Bagnall, 1939	7	1	TP/P	+ ³
<i>Folsomia palaeartica</i> Potapov et Babenko, 2000	204	5	TH/B	+ ³
<i>Folsomia quadrioculata</i> (Tullberg, 1871)	2514	25	TH/P	+ ^{2,3}
<i>Folsomia taimyrica</i> Martynova, 1973	55	7	TH?/A	–

Table 2. List of springtail species known for the Karskaya tundra and the Polar Urals (end).
Таблица 2. Список видов коллембол известных для Карской тундры и Полярного Урала (окончание).

<i>Isotoma anglicana</i> Lubbock, 1873	9	2	TP?/AB?	—
<i>Isotoma viridis</i> Bourlet, 1839	—	—	TH/P	+ ^{1,2,3}
<i>Isotomiella minor</i> (Schäffer, 1896)	1	1	C?/B	+ ³
<i>Isotomurus palustris</i> (Müller, 1776)	—	—	TH?/?	+ ¹
<i>Pachyotoma miserabilis</i> Potapov, 2017	3	2	EP/AB?	+ ^{2,3}
<i>Parisotoma ekmani</i> (Fjellberg, 1977)	2	1	TH/B	+ ³
<i>Parisotoma notabilis</i> (Schäffer, 1896)	399	22	C/P	+ ³
<i>Pseudisotoma sensibilis</i> (Tullberg, 1876)	45	7	TH/AB	+ ^{1,3}
<i>Tetracanthella wahlgreni</i> Axelson, 1907	610	14	WP/AB	+ ^{2,3}
Entomobryidae				
<i>Corynothrix borealis</i> (Tullberg, 1877)	—	—	EP+N/AA	+ ¹
<i>Entomobrya nivalis</i> (Linnaeus, 1758)	—	—	C?/B	+ ³
<i>Himalanura zaitzevi</i> (Linnaniemi, 1919)	—	—	EP/AB	+ ¹
<i>Lepidocyrtus lignorum</i> (Fabricius, 1793)	—	—	TH/P	+ ^{2,3}
Tomoceridae				
<i>Tomocerina minuta</i> (Tullberg, 1876)	1	1	TH/B	+ ³
<i>Tomocerus sibiricus</i> Reuter, 1891	—	—	EP/B	+ ¹
Neelidae				
<i>Megalothorax</i> sp. 1 sensu Babenko et al., 2017	1	1	?	—
Sminthuridae				
<i>Sphaeridia pumilis</i> (Krausbauer, 1898)	1	1	TH/P	—
Katiannidae				
<i>Sminthurinus aureus</i> (Lubbock, 1862)	1	1	TP/P	—
<i>Sminthurinus concolor</i> (Meinert, 1896)	—	—	WP+G/AB?	+ ³
Dicyrtomidae				
<i>Dicyrtoma</i> sp.	—	—	?	+ ¹
Sminthuridae				
<i>Allacma fusca</i> (Linnaeus, 1758)	—	—	TH/B	+ ²
<i>Lipothrix lubbocki</i> (Tullberg, 1872)	—	—	TP/B	+ ³
<i>Sminthurus</i> sp.	—	—	?	+ ¹
Total	5314	46		

NOTES: Long. — longitude: C — cosmopolite, TH — trans-Holarctic, TP — trans-Palaeartic, WP — West Palaeartic, EP — East Palaeartic, N — Nearctic, G — Greenlandic; Lat. — latitude: A — Arctic, AA — Arctic-Alpine, AB — Arctic-Boreal, B — Boreal, P — Polyzonal; Literature data according to: 1 — Linnaniemi [1919], 2 — Kolesnikova et al. [2007], 3 — The biological diversity... [2010]; dash means that species is absent, plus — the species is present.

ПРИМЕЧАНИЯ: Long. — долготные группы ареалов: C — космополитная, TH — трансголарктическая, TP — транспалеарктическая, WP — западно-палеарктическая, EP — восточно-палеарктическая, N — неарктическая, G — гренландская; Lat. — широтные группы ареалов: A — арктическая, AA — аркто-альпийская, AB — аркто-бореальная, B — бореальная, П — полизональная; литературные данные по: 1 — Линнаними [1919], 2 — Колесникова и др. [2007], 3 — Биологическое разнообразие..., [2010]; прочерк означает, что вид отсутствует, плюс — вид присутствует.

lack of data on biotopes and localities, but also to its small volume. It is only possible to single out a group of species recorded in all or almost all of the surveyed habitats: *Folsomia quadrioculata*, *Parisotoma notabilis*, *Tetracanthella wahlgreni*. All of these species are widespread in both forest and tundra ecosystems.

The total number of species (65) recorded in the Karskaya tundra and the Polar Urals is not high. Moreover, this is the fauna of a fairly large territory, which is obviously distinguished by more diverse landscapes, including both coastal and mountainous areas. Known local faunas within the tundra zone of the east of the Bolshezemelskaya tundra and the nearby Yugorsky Peninsula are much richer: 96 species were identified in the course of long-term work in the Vorkuta region [Konak-

ova et al., 2020], 66 species in the area of Cape Bely Nos [Babenko et al., 2017]. The fauna of Vaigach Island located on the border of the Barents and Kara Seas is almost identical in richness and includes 75 species [Babenko et al., 2017]. Based on this brief comparison with the very few available data, obviously, to conclude that such a low diversity of the surveyed area is most likely associated with a very low level of knowledge. At the same time, the number of springtail species recorded in the local faunas of the Zapolyarny district of the Urals (excluding the Vorkuta region) is quite comparable. For example, 37 species were identified in this study, 35 species were noted in the tundra ecosystems of the "Khrebtovy" Preserve [Kolesnikova et al., 2010], 33 species and 4 varieties are known for the tundra and forest-tundra of

the lower reaches of the Ob and the Yamal Peninsula [Stebaeva, 1976; Babenko, 1997].

Thus, the springtail communities of the Kara tundra and the Polar Urals are characterized by poor fauna, which is most likely due to the low level of knowledge of this area, as well as the predominance of boreal species.

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