

Additions to the springtail fauna (Hexapoda: Collembola) of the Malozemelskaya tundra, Kolguev and Vaygach islands

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ABSTRACT. The article provides data about new records of springtails in the East European tundra. The species *Hypogastrura distincta* is registered for the first time in European North-East of Russia. The springtail fauna of the Malozemelskaya tundra is added with 16 species (112 species, totally); Kolguev — 4 (65 species, totally) and Vaygach — 7 (82 species, totally).

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KEY WORDS: Collembola, fauna, new records, tundra, northeastern Europe.

Дополнения к фауне ногохвосток (Hexapoda: Collembola) Малоземельской тундры, островов Колгуев и Вайгач

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РЕЗЮМЕ. В статье представлены данные о новых находках коллембол в восточно-европейских тундрах. Вид *Hypogastrura distincta* впервые зарегистрирован для европейского Северо-Востока России. Фауна ногохвосток Малоземельской тундры дополнена 16 видами (всего 112), о. Колгуев — 4 (всего 65) и о. Вайгач — 7 (всего 82 вида).

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КЛЮЧЕВЫЕ СЛОВА: коллемболы, фауна, новые находки, тундра, Северо-Восточная Европа.

Introduction

The collembolan fauna of the tundra zone of the European part of Russia has been intensively studied during recent years (Babenko *et al.*, 2017; Taskaeva *et al.*, 2020; Taskaeva, 2022 a, b). There is information about the local

faunas of springtails in the Malozemelskaya (Taskaeva, Nakul, 2016; Taskaeva *et al.*, 2020; Taskaeva, 2022a), Bolshezemelskaya (Taskaeva *et al.*, 2015; Konakova *et al.*, 2017; Taskaeva, Nakul, 2017; Kuznetsova, 2019; Taskaeva, 2020, 2022a), and Karskaya (Taskaeva, 2022b) tundras, as well as the Kanin Peninsula, the

Kolguev, Dolgii, and Vaygach Islands (Babenko, 2012; Babenko *et al.*, 2017). According to the published data (Taskaeva, Nakul, 2016; Babenko *et al.*, 2017; Taskaeva *et al.*, 2020) 106 species are known for the Malozemelskaya tundra and the Pechora Delta river, but ten of them (*Mesaphorura krausbaueri*, *M. yosii*, *Megaphorura arctica*, *Choreutinula inermis*, *Xenylla humicola*, *Anurida denisi*, *A. komi*, *Pseudachorutes dubius*, *Folsomia dovrensis*, *Lepidocyrtus violaceus*) need confirmation. Two more species of the genus *Protaphorura*, listed as sp.1 and sp.2 (Taskaeva, Nakul, 2016), were identified to the species *P. jacutica* and *P. tundricola*, previously noted for plant communities in this region. Thus, as a result of the revision in the Malozemelskaya tundra and the Pechora Delta river, 96 species are registered. For the Kolguev and Vaygach Islands, 61 and 75 species were identified, respectively (Babenko *et al.*, 2017). Despite the fairly good knowledge of the East European tundra fauna of some regions is poorly studied and still need attention.

Material

The material underlying the present study was collected in 2000s in the Malozemelskaya tundra: Indiga river basin (67°25' N, 49°10' W), the Nenets Ridge (68°08' N, 53°30' W), Russkii Zavorot (68°31' N, 53°51' W), and in 2009–2010 in previously studied Kolguev (68°46' N, 49°18' W) and Vaygach (70°13' N, 59°11' W) Islands. The plant communities of the Indiga river basin and Russkii Zavorot are represented by moss-lichen tundra, while ecosystems of Nenets ridge are presented by dwarf tundra. Kolguev Island (5030 km²) is a bogged plain raised in its central part. It is situated in the typical tundra subzone of the tundra belt (Lavrinenko, Lavrinenko, 2018). The next different habitats such as zonal tundra, meadows, sedge bogs were studied. Vaygach Island (3400 km²) is located in the area of the continental shelf on the border of the Barents and Kara seas. The vegetation of most of the island is represented by willow shrubs (*Salix myrsinities*, *S. lanata*, *S. reptans*), dwarf shrubs (*Dryas octopetala* and *Salix polaris*), sedge, meadow tundra, and swampy complexes within the southern zone of the Arctic tundra (Vaygach Island..., 2014).

In all sites, excluding Kolguev Island, soil samples were collected in August and transported to Institute of Biology (Komi Republic). Extraction of *Collembola* was performed in the laboratory using Tullgren's funnels at approximately 25 °C into 70% alcohol for 7–10 days until the cores were completely dry. On Kolguev Island only pitfall traps were used, which

were installed at the end of August and removed 10 days later in the first decade of September.

Most of specimens, which are in good condition, were mounted on slides according to a standard procedure (Potapov, Kuznetsova, 2011). The material includes 5830 individuals of 62 species from three localities of the Malozemelskaya tundra, 1068 specimens of 16 species and 2561 individuals of 37 species from Kolguev and Vaygach Islands, respectively. They were collected by O. Gazizova, N. Mazura, O. Mineev, N. Zubrii and B. Filippov and identified by the author of this article. Both modern taxonomic papers and keys (Fjellberg, 1998, 2007; Potapov, 2001; Thibaud *et al.*, 2004; Kaprus *et al.*, 2016 and others) for the taxonomic determination of *Collembola* were used. Scientific names were checked using the GBIF species matching tool. All specimens are kept in the department of animal ecology (IB FRC Komi SC UB RAS).

This paper presents species not previously found in the aforementioned areas.

Results

Tullbergiidae

Mesaphorura jirii Rusek, 1982

MATERIAL: 6 ♀♀, Malozemelskaya tundra, Kolokolkovskaya Guba, moss tundra, 10.07.2003, G.L. Nakul leg.

REMARK: This common and abundant species previously was mentioned in the region as *M. yosii* [Taskaeva, Nakul, 2016]. It is a widespread parthenogenetic species throughout Europe.

Onychiuridae

Hymenaphorura inopinata Babenko, 2017

MATERIAL: 9 ♀♀, Malozemelskaya tundra, Pechorskaya Bay, Russkii Zavorot, moss tundra, 9.08.1996, O.Yu. Mineev leg.

REMARK: It was described from Bolvanskaya Bay (Babenko *et al.*, 2017). This is the third record of this species in European part of Russia.

Protaphorura borealis (Martynova, 1973)

MATERIAL: 14 ♀♀, Malozemelskaya tundra, Pechorskaya Bay, Russkii Zavorot, moss tundra, 9.08.1996, O.Yu. Mineev leg.

REMARK: This is the second record in East European tundra. Previously it was mentioned only in Vorkuta region (Babenko *et al.*, 2017).

Protaphorura pjasinae (Martynova, 1976)

MATERIAL: 2 ♀♀, Malozemelskaya tundra, Pechorskaya Bay, Russkii Zavorot, moss tundra, 9.08.1996, O.Yu. Mineev leg.

REMARK: It is a rather widespread species in the Bolshezemelskaya tundra.

Protaphorura taimyrica (Martynova, 1976)

MATERIAL: 2 ♀♀, Malozemelskaya tundra, Pechorskaya Bay, Russkii Zavorot, moss tundra, 9.08.1996, O.Yu. Mineev leg.

REMARK: Rare species in East European tundra. Previously it was observed only on Vaygach Island (Babenko *et al.*, 2017).

Protaphorura tschernovi (Martynova, 1976)

MATERIAL: 1 specimen, Malozemelskaya tundra, Pechorskaya Bay, Russkii Zavorot, moss tundra, 9.08.1996, O.Yu. Mineev leg.

REMARK: On the territory of European North-East of Russia it was previously registered in forest tundra ecosystems of the Sula and Bolshaya Rogovaya rivers (Taskaeva, 2022).

Hypogastruridae

Ceratophysella czelnokovi Martynova, 1978

MATERIAL: 5 specimens, Malozemelskaya tundra, Pechorskaya Bay, Russkii Zavorot, moss tundra, 9.08.1996, O.Yu. Mineev leg.

REMARK: Very rare species in East European tundra. It was previously observed on Vaygach Island and Yugorskii Peninsula (Babenko *et al.*, 2017).

Hypogastrura distincta (Axelson, 1902)

MATERIAL: 1 specimen, Malozemelskaya tundra, Nenets Ridge, moss-lichen tundra near bird nests, 22.08.1998, N.V. Mazura leg.

REMARK: It is a new species for European North-East of Russia. In Nordic countries it was noted in garden soil, flower pots, composts and disturbed habitats (Fjellberg, 1998).

Schaefferia czernovi (Martynova, 1978)

MATERIAL: 132 specimens, Malozemelskaya tundra, Nenets Ridge, moss-lichen tundra, 22.08.1998, N.V. Mazura leg.; 2 specimens, Vaygach Island, dwarf shrub tundra, 24.08.2010, N.A. Zubrii, B.Yu. Filippov leg.

REMARK: It is a common species in East European tundra. It was previously mentioned in the Bolshezemelskaya tundra, Kolguev and Dolgii islands (Babenko *et al.*, 2017).

Willemia anophthalma Börner, 1901

MATERIAL: 4 specimens, Vaygach Island, dwarf shrub tundra near Talatinskoye village, 24.08.2010, N.A. Zubrii, B.Yu. Filippov leg.

REMARK: The most numerous and common species of the genus in East European tundra (Babenko *et al.*, 2017).

Willemia scandinavica Stach, 1949

MATERIAL: 1 ♀♀, Malozemelskaya tundra, Pechorskaya Bay, Russkii Zavorot, moss tundra, 9.08.1996, O.Yu. Mineev leg.

REMARK: Probably widespread in the East European tundra.

Willemia similis Mills, 1934

MATERIAL: Malozemelskaya tundra, Nenets Ridge: 34 specimens, dwarf shrub moss-lichen tundra; 20 specimens moss-lichen tundra, 22.08.1998, N.V. Mazura leg.

REMARK: Holarctic species with a clear preference to the northern parts of the region.

Neanuridae

Endonura reticulata (Axelson, 1905)

MATERIAL: 3 specimens, Vaygach Island, dwarf shrub tundra near Talatinskoye village, 24.08.2010, N.A. Zubrii, B.Yu. Filippov leg.

REMARK: It is wide distributed species all over the East European tundra.

Friesea quinquespinosa (Wahlgren, 1900)

MATERIAL: 12 specimens, Malozemelskaya tundra, Pechorskaya Bay, Russkii Zavorot, moss tundra, 9.08.1996, O.Yu. Mineev leg.

REMARK: It is a rare species, previously it was found in the Bolshezemelskaya tundra, Vaygach and Dolgii Islands (Babenko *et al.*, 2017).

Isotomidae

Desoria olivacea (Tullberg, 1871)

MATERIAL: 5 specimens, Malozemelskaya tundra, Nenets Ridge, dwarf shrub moss-lichen tundra; 22.08.1998, N.V. Mazura leg.

REMARK: It was noted in different types of dwarf shrub tundra, but in East European tundra it is not common.

Desoria tshernovi (Martynova, 1974)

MATERIAL: 32 specimens totally, Vaygach Island, 24.08.2010, N.A. Zubrii, B.Yu. Filippov leg. 1 specimen, dwarf shrub tundra; 6 specimens, bogs; 24 specimens, meadows; 1 specimen, dwarf shrub moss tundra near Talatinskoye village.

REMARK: It is a common and frequent species in different habitats of East European tundra.

Desoria violacea (Tullberg, 1876)

MATERIAL: 64 specimens totally, Vaygach Island, 24.08.2010, N.A. Zubrii, B.Yu. Filippov leg. 60 specimens, bogs; 4 specimens dwarf shrub moss tundra near Talatinskoye village.

REMARK: It is a common and widespread species in East European tundra.

Folsomia diplophthalma (Axelson, 1902)

MATERIAL: 2 specimens, Malozemelskaya tundra, Pechorskaya Bay, Russkii Zavorot, moss tundra, 9.08.1996, O.Yu. Mineev leg.

REMARK: It is a widespread all over the East European tundra.

Folsomia taimyrica Martynova, 1973

MATERIAL: 3 specimens, Vaygach Island, dwarf shrub moss tundra near Talatinskoye village, 24.08.2010, N.A. Zubrii, B.Yu. Filippov leg.

REMARK: It is a high Arctic species known from Arctic Ocean coast (Potapov, Babenko, 2000). Previously it was found in the northern part of the Bolshezemelskaya tundra, Yugorskii Peninsula and Dolgii Island (Babenko *et al.*, 2017).

Isotomurus fucicola (Schött, 1893)

MATERIAL: 49 specimens totally, Kolguev Island, pitfall traps, 30.08–8.09.2010, N.A. Zubrii, B.Yu. Filippov leg. 2 specimens, bogs, 47 specimens, meadows.

REMARK: Probably it is a wide distributed in East European tundra.

Parisotoma longa (Potapov, 1991)

MATERIAL: 108 specimens, Malozemelskaya tundra, Nenets Ridge, moss-lichen tundra, 22.08.1998, N.V. Mazura leg.; 1 specimen, Vaygach Island, meadow, 24.08.2010, N.A. Zubrii, B.Yu. Filippov leg.

REMARK: Rare species, it was found previously in the Bolshezemelskaya tundra and Dolgii Island (Babenko *et al.*, 2017).

Entomobryidae

Lepidocyrtus violaceus (Geoffroy, 1762)

MATERIAL: 1 specimen, Kolguev Island, valley slope on the sites of the meadow, pitfall traps, 30.08–8.09.2010, N.A. Zubrii, B.Yu. Filippov leg.

REMARK: Holarctic species, but it is a rare in East European tundra.

Tomoceridae

Tomocerus sibiricus Reuter, 1841

MATERIAL: 1 juv., Malozemelskaya tundra, Nenets Ridge, moss-lichen tundra, 22.08.1998, N.V. Mazura leg.

REMARK: This Siberian species is rare in East European tundra.

Bourletiellidae

Heterosminthurus bilineatus (Bourlet, 1842)

MATERIAL: 3 ♀♀, 1 ♂♂, Kolguev Island, meadow tundra, pitfall traps, 30.08–8.09.2010, N.A. Zubrii, B.Yu. Filippov leg.

REMARK: It was previously mentioned in the Bolshezemelskaya tundra (Babenko *et al.*, 2017).

Heterosminthurus insignis (Reuter, 1876)

MATERIAL: 1 ♀♀, Kolguev Island, meadow tundra, pitfall traps, 30.08–8.09.2010, N.A. Zubrii, B.Yu. Filippov leg.

REMARK: Previously it was met only in the southern part of the Bolshezemelskaya tundra (Babenko *et al.*, 2017; Taskaeva, 2020).

Discussion

The collection of springtails of the Malozemelskaya tundra, Kolguev and Vaygach islands during 2000s and 2009–2010, coupled with an analysis of published data, has yielded the identification of 16, 4 and 7 new species, respectively, to be added to the existing species list of these regions. As a consequence of these findings, the checklist for the aforementioned regions now includes 112, 65 и 82 species, respectively. These outcomes strongly indicate the potential for future investigations in the Malozemelskaya tundra, particularly within its northern part (typical tundra), as well as on Vaygach Island. The Malozemelskaya tundra notably remains the least studied in relation to various groups of invertebrates. There are only limited data on gamasid mites (Makarova, 2012), ground beetles (Kolesnikova *et al.*, 2017), rove beetles (Kolesnikova, Uzhakina, 2005) and spiders (Mazura, Esyunin, 2001), which is apparently due to the inaccessibility of this area. For comparison, when considering springtail species, the combined total for the Bolshezemelskaya tundra and even the islands (Kolguev, Dolgii, Vaygach), along with the Kanin Peninsula, surpasses that of the Malozemelskaya tundra by 1.7 and 1.3 times, tallying 194 and 151 species, respectively.

The level of springtail diversity documented on Vaygach Island can be classified as high for the subarctic tundra. Nonetheless, this is less than on Dolgii Island, where 105 species have been registered (Babenko, 2012; Babenko *et al.*, 2017), but higher than on Kolguev Island, where 65 species are known. Concomitantly, it is

noteworthy that the diversity of other invertebrate groups, i.e. gamasid mites, spiders, bumblebees and butterflies, in this area is relatively decreased compared to Kolguev Island (Makarova, 2012; Vlasova *et al.*, 2014; Potapov *et al.*, 2017; Tanasevich, 2017). Given the array of habitats characterized by diverse soil types, rugged topography, and the occurrence of carbonate rocks (Vaygach Island..., 2014), the likelihood of discovering new springtail species remains substantial. The enrichment of Vaygach Island's springtail fauna may potentially arise from species typifying the taiga and tundra zones of the European Northeast. These species could migrate via the Novaya Zemlya arc (Ural – Pai-Khoi – Vaygach), a region divided into distinct sections by sublatitudinal troughs. A similar hypothesis has previously been posited in relation to mosses (Zheleznova, Shubina, 2007).

The species diversity observed within the studied habitats of Kolguev Island is notably limited, rendering the prospect of discovering new forms unique to the region of marginal significance. This trend is also evidenced by data obtained for other groups of invertebrates, including mites (Makarova, 2012), spiders (Nekhaeva, 2020), bumblebees (Kolossova, Potapov, 2010) and butterflies (Bolotov, 2011). It is assumed that the geographical isolation from the mainland (75 km) has exerted a pivotal influence on the formation of the species composition of various invertebrate groups present on Kolguev Island. Evidently, the fauna appears to have formed during the late Pleistocene, a period marked by extensive marine regression, which consequently united the island with the mainland (Evolution of European..., 2008).

Springtails species associated with anthropogenic organic substances (e.g. compost heaps) were hardly expected within East European tundra. However particularly surprising was the record of *Hypogastrura distincta*. This species inhabits wood fragments, compost heaps and disturbed areas. Notably, the sole specimen encountered within the Malozemelskaya tundra was located near to the nest, an unexpected habitat for this species.

Our list of springtails of the East European tundra is now based on more than 11000 geo-referenced species records from 43 localities, which represent all types of habitats occurring in the study region and includes 229 species.

The comparison of springtail communities with northern Norway and treeless expanse of Taimyr, now documented 172 and 181 species, respectively (Fjellberg, 1998, 2007; Babenko, 2003, 2013), has clearly demonstrated that our list is quite complete. However, based on an analysis of springtail populations across landscape types ranging from boreal vegetation to the Arctic tundra subzone of the region, leads us to postulate that the actual richness of Collembola fauna within the region may conceivably exceed our current checklist.

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