Contribution to the flora of mosses and liverworts of Yuzhny, Vaygach and Matveev islands (Barents Sea, European Russian Arctic)

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Abstract. The paper provides data on mosses and liverworts of the islands of south-eastean of the Barents Sea: Yuzhny Island of Novaya Zemlya, Vaygach and Matveev islands based on 700 identifications of mosses and 200 identifications of liverworts. The annotated list includes 173 species and one variety of mosses and 52 species and nine infraspecific taxa of liverworts, including insufficiently known *Blepharostoma trichophyllum* hybrid 1, *Barbilophozia rubescens*, *Saccobasis polita* var. *arctica*, *Trilophozia quinquedentata* var. *grandiretis*. Among them, 17 species and one variety of mosses and 13 species, two varieties and two forms of liverworts are reported for the first time for Novaya Zemlya, 66 species of mosses, and 16 species and one variety of liverworts for the first time for Yuzhny Island, 14 species of mosses, and six species, two varieties and one form of liverworts are reported for the first time for Vaygach Island. The first data of bryophytes of Matveev Island are obtained: 44 species of mosses, and 11 species and one variety of liverworts are recorded. For every species, data on localities, frequency, and habitats are provided. New combinations are published for *Mesoptychia gillmanii* f. *orbiculata* (R. M. Schust.) Potemkin, comb. nov., and *Trilophozia quinquedentata* var. *grandiretis* (H. Buch et S. W. Arnell) Potemkin, comb. nov.

Keywords: bryophytes, flora, hepatics, Marchantiophyta, Arctic, Barents Sea islands, Russia.

К флоре мхов и печеночников островов Южный, Вайгач и Матвеев (Баренцево море, Европейская российская Арктика)

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Резюме. В статье приведены данные о мхах и печеночниках островов юго-восточной части Баренцева моря: Южного острова Новой Земли, островов Вайгач и Матвеев, полученные в результате 700 определений мхов и 200 определений печеночников. В аннотированный список вошли 17 вида мхов, 52 вида и девять внутривидовых таксонов печеночников, в том числе малоизученные *Blepharostoma trichophyllum* hybrid 1, *Barbilophozia rubescens*, *Saccobasis polita* var. *arctica*, *Trilophozia quinquedentata* var. *grandiretis*. Из них впервые для Новой Земли приводятся 17 видов и одна разновидность мхов и 14 видов, две разновидности и две формы печеночников, для Южного острова — 66 видов мхов и 16 видов и одна разновидность печеночников, для о-ва Вайгач впервые отмечены 14 видов мхов и шесть видов, две разновидности и одна форма печеночников. Получены первые данные о мохообразных острова Матвеев: 44 вида мхов, 11 видов и одна разновидность печеночников. Для каждого вида приводятся данные о местонахождени-

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ях, числе находок и местообитаниях. Опубликованы новые комбинации для *Mesoptychia gillmanii* f. *orbiculata* (R. M. Schust.) Potemkin, comb. nov. и *Trilophozia quinquedentata* var. *grandiretis* (H. Buch et S. W. Arnell) Potemkin, comb. nov.

Ключевые слова: мхи, печеночники, мохообразные, флора, Арктика, острова Баренцева моря, Россия.

Historical background. Scandinavian researchers made the first studies of bryophytes of Novaya Zemlya and Vaygach Island. The first information on the bryophytes of Novaya Zemlya was published by A. Blytt (1872), who reported 17 species of mosses collected along Matochkin Shar Strait during the Arctic Ocean sailing in 1870–71. M. Th. Heuglin (1874) listed 19 moss species with references to Blytt (1872), adding two new species. C. Jensen (1885) published five species of liverworts and 46 species of mosses collected in 1882–83 in Yuzhny (southern) Island by Dijmpha-Expedition headed by Th. Holm. In 1897, O. Ekstam generalized previously published data and published 8 species of liverworts and 65 taxa of mosses collected by him in Yuzhny Island mainly and identified by Dr. Erik Nyman. In 1901, E. Jäderholm (1901) published 47 moss species for Yuzhny Island based on collections in areas of Karmakul Bay and Matochkin Shar Strait. The detailed history of these studies was described by H. W. Arnell (1917), who listed 14 species of liverworts and 105 species of mosses for Novaya Zemlya and Vaygach Island, without segregation of data for every island. This report was based on a revison of the earlier identified collection of Aage Aagaard kept in Kristiania (Oslo) and available publications of Nordic researchers (Blytt, 1872; Jensen, 1885; Jäderholm, 1901). In 1947, S. W. Arnell, based on kept in Riksmuseum, Stockholm, collection of Ekstam made in 1901–1902, reported 53 liverwort species for Yuzhny Island and for Matochkin Shar (Matochkin Strait) area without definitions of the islands. Russian botanist I. V. Palibin (1903–1906) reported 35 species of mosses for Severny Island. R. R. Pohle (1915) listed 58 moss species and four liverwort species based on his own collection from Yuzhny Island. J. Lid (1924), based on identified by E. Jørgensen collection of Norway expedition, reported 19 moss species, including 3 species of *Sphagnum* L. In 1930, the geobotanist A. I. Zubkov worked on the Gusinaya Zemlya Peninsula of Yuzhny Island. He reported 24 species of mosses and one liverwort species (Zubkov, 1932). In 1935, L. I. Savicz-Lubitskaya [originally spelled as Savicz-Ljubitzkaja] visited Novaya Zemlya and published a description of her trip with the list of widespread species (Savicz-Lubitskaya, 1936). She reported 37 species of mosses and six species of liverworts for Severny Island and 35 species of mosses and two species of liverworts for Yuzhny Island. Unfortunately, the main part of this collection kept in LE remained unidentified by Savicz-Lubitskaya. Later, the geobotanist V. D. Aleksandrova worked in Novaya Zemlya and reported 30 species of mosses for Mezhdusharsky Island and 37 species of mosses and one species of liverworts for Yuzhny Island (Aleksandrova, 1946, 1956). In 1995, N. V. Vekhov, A. N. Kuliev, worked in the polar deserts of Severny Island. They reported 62 species of mosses and three species of liverworts (Vekhov, Kuliev, 1998). N. A. Konstantinova and Potemkin (1997), based on reports of H. W. Arnell (1917) and S. W. Arnell

(1947), listed 61 liverwort species for Novaya Zemlya and Vaygach Island. K. I. Flatberg (2007) reported *Sphagnum concinnum* (Berggr.) Flatberg for the first time for Novaya Zemlya. In July 2017, E. Yu. Churakova examined the swampy habitats of the Bezymyannaya Bay of Yuzhny Island and reported 29 species of mosses (Churakova, 2019). In 2018, an examination of the northernmost tip of Novaya Zemlya, Cape Zhelania of Severny Island, resulted in a report of 135 species of mosses and 24 species of liverworts (Fedosov *et al*., 2019). Yu. A. Makukha and S. Yu. Popov (2021) reported *Sphagnum squarrosum* Crome, *S. concinnum*, *S. mirum* for Yuzhny Island based on collections made by S. Krylenko and A. Lukinykh in 2019. O. M. Afonina, based on collection of Palibin from the Krestovaya Bay of Severny Island, reported *Tortella spitsbergensis* (Ellis *et al*., 2019). Noteworthy, that 172 species of mosses were published in the "The Handbook of the mosses of the Arctic of the USSR" (Abramova *et al*., 1961), 110 species in the "The Handbook of the mosses of the USSR..." (Savicz-Ljubitzkaja, Smirnova, 1970), and 110 species were published in the issued volumes of the "Moss flora of Russia" (Flora Mkhov Rossii, 2017, 2018, 2020, 2022). All these reports were made just for Novaya Zemlya, without definite species locations. In general, 254 species of mosses and 69 species of liverworts were known for Novaya Zemlaya as a whole, and 128 species of mosses and 48 liverwort species were reported for Yuzhny Island.

The first information about the mosses of Vaygach Island (six species) was published by Blytt (1872), based on collections during the Arctic Ocean sailing in 1870–71. In 1897, Ekstam (1897) reported 13 moss species and four liverwort species new for the island. In 1947, S. W. Arnell, based on collection of Ekstam made in 1901–1902 and kept in Riksmuseum, Stockholm, reported 21 liverwort species for Vaygach (Waigatsch) Island. In 1935, the island was visited by Savicz-Lubitskaya, who reported 24 widespread species (Savicz-Lubitskaya, 1936). In the "Hand book of the mosses of the Arctic of the USSR" (Abramova *et al*., 1961), 83 species of mosses listed for Vaygach Island. In August 1978, in the southwest of Vaygach Island, in the vicinity of the Lake Paikhato and at the Krasnaya River mouth worked G. V. Zheleznova. Identification of this collection resulted in list of 165 mosses and 32 liverworts (Zeleznova *et al*., 2007). List of mosses in the subsequent publication was extended to 168 species (Zheleznova, Shubina, 2008). In 2004, on the islands of the Bay of Lamchin, including Bolshoi Tsinkovyi Island, the bryophyte collections were made by O. V. Lavrinenko. Their identification resulted in a report of 99 moss species by Afonina *et al.* (2007). Potemkin (2014) reported six liverwort species for Vaygach Island. In 2014, the monograph "Vaygach Island: nature, climate and man" with a list of 110 moss species was published (Aleinikov *et al*., 2014). Thus, before our study, 213 species of mosses and 39 liverwort species were known for Vaygach Island, including Bolshoi Tsinkovyi Island.

Study area. Novaya Zemlya belongs to the Arkhangelsk Region. Yuzhny Island is washed from the West by the Barents Sea, from the east by the Kara Sea. The narrow strait Matochkin Shar washed Yuzhny Island from the North and separates it from Severny Island. Yuzhny Island from the south is washed by the Kara Strait or Kara

Gate (Karskie vorota) that separates it from Vaygach Island. The area of Yuzhny Island is 33275 km2. The relief of its central part is mountainous, the highest point is Mt. Pervousmotrennaya, 1291 m a. s. l. The area adjacent to the shores is a plain strip, 2 to 20 km wide, gradually stepped-up from the sea into the island (Fig 1A, B). The archipelago is mainly formed by crystalline solids (granites, sandstones, shales, limestones, etc.) of the Paleozoic age, which are covered by a cover of loose glacier deposits with a thickness of up to 1.5–2.5 m. Carbonate deposits of various genesis and composition are widespread, whereas grounds of sandy gravel with boulders and a pebble smoothed by the sea are sporadic (Semenkov, 2020). The climate of Yuzhny Island is characterized by strong winds and relatively warm winters. In the area of the Malye Karmakuly village, located at the central part of the west shore of Yuzhny Island, the average annual air temperature is –4.6 °C, the average temperatures of March, the coldest month, is –15.5 °C, of August, the warmest month, is +7.0 °C. The absolute minimum is –37.3 °C, maximum +23 °C. Annual average precipitation is 238 mm (Aleksandrova, Zubkov, 1937).

Vaygach Island belongs to the Nenets Autonomous Area. It is located between the Barents and Kara Seas, south of Novaya Zemlya. It is separated from the mainland by the Yugorsky Shar Strait. The length of the island is 105 km, width is 44 km, and the total territory is about 3380 km^2. Vaygach is situated in the area of the continental shelf and is a typical shelf. The territory is composed mainly of rocks of the Paleozoic age, limestone, shale and sandstone; the relief is gently undulating having heights up to 157 m a. s. l. (Mt. Bolvanskaya). In winter, the western coast of the island is strongly influenced by the cyclonic circulation and North Cape Current entering the Barents Sea. The average annual air temperature is –6.4 °C, the average August temperature is +5.8 °C, and average winter temperatures is –17°C (Doronina, Zhadrinskaya, 1970; Aleinikov *et al*., 2014).

Matveev Island is a small rocky uninhabited island with coast indented by bays. It is located ca. 45 km to the SW of Vaygach and spreading 4 km from West to East and 3 km from North to South, maximal altitude is 11 m a. s. l.

The study area is located chiefly in the arctic tundra subzone (Aleksandrova, 1980). Bolshoi Tsinkovyi and Matveev islands are located between the arctic and northern hypoarctic tundra subzones (Yurtsev *et al*., 1978: Fig. 2). Lichen-moss tundra dominated by *Cetraria islandica*, *Cladonia mitis*, *C. rangiferina*, *Sphaerophorus globosus*, *Dicranum elongatum, Polytrichastrum alpinum, Racomitrium lanuginosum*, which are the most common in the plains; *Luzula nivalis*, *Poa alpigena*, *Salix polaris* are abundant too (Fig. 2A). Extensive areas are occupied by hummock dwarf shrub-lichen-moss tundra (Fig. 2B). Significant areas are occupied by dwarf shrub willow tundra with *Salix myrsinites*, *S. lanata*, *S. reptans* mainly. On rocky gravelly soils, lichen tundras with predominance of *Cetraria hiascens*, *C. nivalis*, *Cladonia mitis*, *Sphaerophorus globosus* are common. On the south faced slopes and the upper parts of the ridges, dwarf shrub tundras with the dominance of *Dryas octopetala* and *Salix polaris*, and abundant *Saxifraga oppositifolia*, *Silena acaulis* and mosses *Polytrichastrum alpinum,*



Fig. 1. Landscapes of Yuzhny Island.
A — Yuzhny Island shore; B — creek in the desintegration of hills.
Photo by S. V. Sidorenko.

Racomitrium lanuginosum, occur. On gentle slopes, spotty moss tundras with predominance of *Hylocomium splendens*, *Sanionia uncinata*, *Tomentypnum* spp., and co-dominating *Aulacomnium turgidum*, *Dicranum majus*, are common. Among the vascular plants, *Carex hyperborea*, *Deschampsia arctica*, *Polygonum viviparum* occur there in significant quantities. In the lower parts of the slopes, often on heavy loams, herb-moss tundras develop with a predominance of *Deschampsia arctica* and *Nardosmia frigida*. Among mosses, *Sanionia uncinata* and *Sarmentypnum sarmentosum* are the most abundant there (Fig. 3A). Poorly drained areas of depressions, lake basins, valleys of glacial and river origin are occupied by low-lying and flat-hilly swampy tundras (Fig. 3B) dominated by *Carex stans*, *Dupontia fischeri*, *Eriophorum angustifolium*, and mosses *Sarmentypnum exannulatum*, *S. sarmentosum*, *Scorpidium revolvens*, *Sphagnum squarrosum*, etc. (Aleksandrova, 1956).

Material and Methods

This work is based on the patchy gatherings made in August 2020 by S. V. Sidorenko and author Czernyadjeva in Yuzhny (Yuzhnyi) Island and on adjacent Tsvetnoi Islands of Novaya Zemlya Archipelago, in Vaygach Island together with adjacent Bolshoy Tsinkovyi Island, and on Matveev Island (Fig. 4). Besides above mentioned materials, unidentified collections of L. I. Savicz-Lubitskaya made in 1935 and A. I. Zubkov, made in 1930, 1947, as well as individual specimens of R. F. Niemann (1908), P. Ushakov (1925), and V. P. Savicz (1930) gathered in Yuzhny Island were identified and involved in our study. In total, the study is based on 700 identifications of mosses and 200 identifications of liverworts.

Collecting sites (from North to South), collectors' data

1. Yuzhny (southern) Island and adjacent Tsvetnoi Island:
   1a. Northwest coast, Pankova Zemlya Peninsula, ~73°09′N, 53°22′E; 1947, *A. I. Zubkov*.
   1b. Möller Bay, 72°23′N, 52°45′E, vicinity station Malye Karmakuly; 1908, *R. F. Niemann*; 1935, *L. I. Savicz* (used label name for L. I. Savicz-Lubitskaya); 20–21 VIII, 2020, *S. V. Sidorenko, Czernyadjeva 1-20 — 8-20*.
   1c. Gusinaya Zemlya Peninsula, ~71°50′N, 51°27′E; 1930, *A. I. Zubkov*.
   1d. Belushya Guba, vicinity Belushya Guba Settlement, ~71°32′N, 52°20′E; 1908, *R. F. Niemann*; 1930, *V. P. Savicz*; 1935, *L. I. Savicz*.
   1e. Chernaya Guba, vicinity of the non-residential village of Krasino, ~70°51′N, 54°18′E; 1925, *P. Ushakov*; 1935, *L. I. Savicz*.
   1f. Southwest coast, Rusanov Peninsula, Petukhovsky Shar strait, vicinity of the non-residential village of Rusanovo, 70°34′N, 56°21′E; 1935, *L. I. Savicz*; 23 VIII 2020, *S. V. Sidorenko, Czernyadjeva 12-20 — 13-20*.
   1g. Southwest coast, Rusanov Peninsula, Vnutrenyaya Bay, vicinity of Baranov Cape, 70°39′N, 56°21′E; 24 VIII 2020, *S. V. Sidorenko, Czernyadjeva 14-20 — 16-20*.
   1h. Southwest coast, Rusanov Peninsula, Gulf of Reineke: Shaposhnikov Bay, vicinity of Kambalny Cape, 70°36′N, 56°29′E; 24 VIII 2020, *S. V. Sidorenko, Czernyadjeva 17-20 – 20-20*.
   1i. Tsvetnoi Island, 70°34′05″N, 56°20′37″E; 23 VIII 2020, *S. V. Sidorenko, Czernyadjeva 9-20 — 11-20*.
2a. West coast of Vaygach Island, Utinaya Bay, Dyrovaty Peninsula, Dyrovataya Guba village, 70°13′N, 58°31′E, 25–26 VIII 2020, *S. V. Sidorenko, Czernyadjeva 21-20 – 26-20*.



Fig. 2. Tundra communities of Yuzhny Island.
A — lichen-moss tundra; B — hummock dwarf shrub-lichen-moss tundra.
Photo by S. V. Sidorenko.



Fig. 3. Tundra communities of Yuzhny Island.
A — herb-moss tundra; B — swampy sedge tundra.
Photo by S. V. Sidorenko.

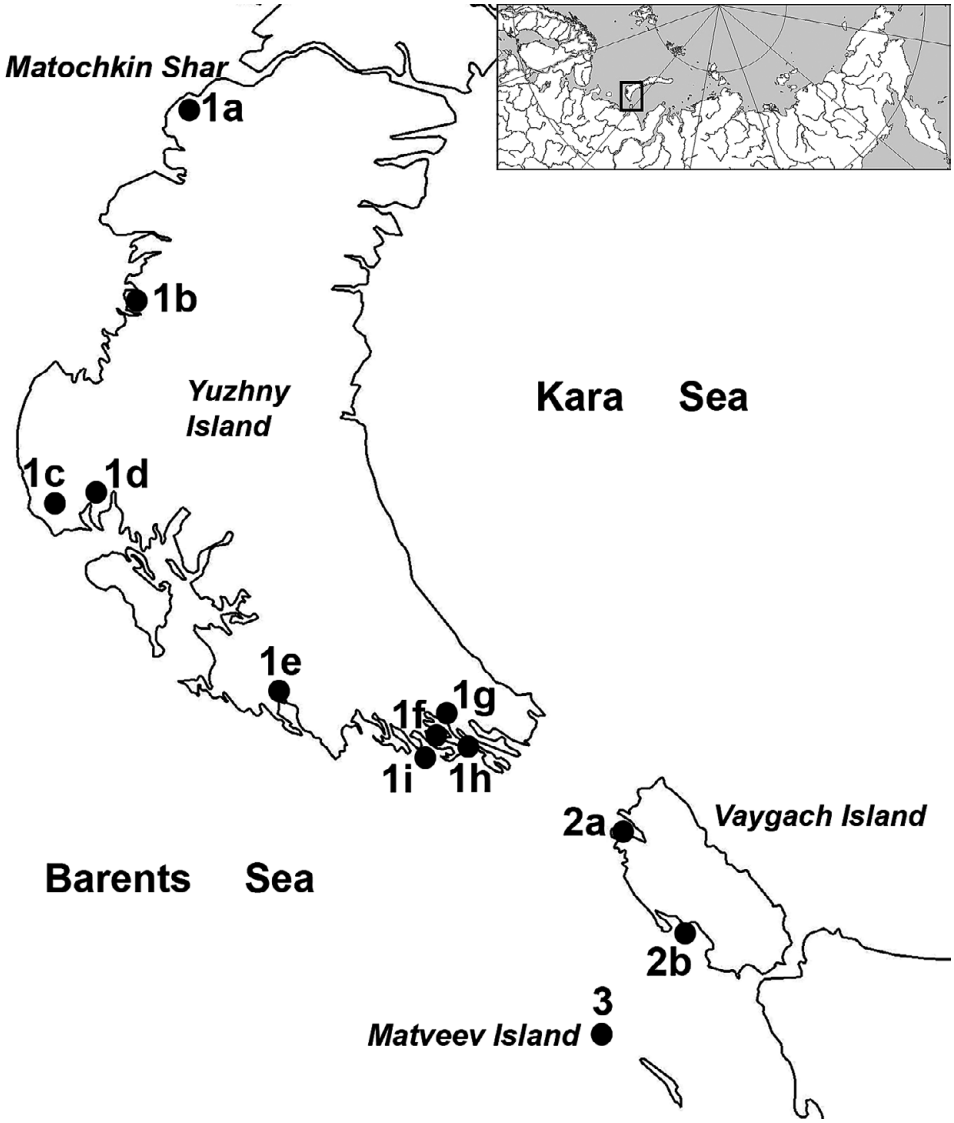


Fig. 4. Study area and its location.
Collecting sites are described in the text.

2b. West part of Vaygach Island, Lyamchina Bay, Bolshoi Tsinkovyi Island, 69°51′24″N, 59°25′01″E; 27 VIII 2020, *S. V. Sidorenko, Czernyadjeva 27-20 – 31-20*.

3. Barents Sea, Matveev Island, 69°28′N, 58°30′E, 27 VIII 2020, *S. V. Sidorenko, Czernyadjeva 32-20 — 35-20*.

The reliability of morphological identification of some liverworts specimens with a combination of features specified for different taxa was supported from DNA sequence data in course of recently described approach — integrative floristics (Fedosov *et al.*,

2022). This method was successfully implemented in the study of the liverwort flora of the Ziegler Island (Konstantinova *et al.*, 2020a) and Alexandra Land from Franz Josef Land (Konstantinova *et al.*, 2023), and North Ossetia (North Caucasus) (Konstantinova *et al.*, 2021). In arctic and alpine regions, the widespread species may have a specific morphology that obstacles their identification from positions of traditional taxonomy. The presence of poorly known taxa could be registered as well. The combination of morphological and molecular methods allows to robust estimate liverwort species diversity in the region and supplements the morphological description of critical species.

The six specimens with putative morphology were selected for integrative study. Two markers widely used in liverworts molecular systematic were obtained – ITS1-2 nrDNA and *trn*L-F cpDNA. DNA was extracted from dried shoots with a DNeasy Plant Mini Kit (Qiagen, Germany). The pairs of primers suggested by White *et al.* (1990) and Taberlet *et al.* (1991) were used to amplification and sequencing of ITS1-2 and *trn*L-F loci consequently. PCR was carried out in 20 μl volumes with the following amplification cycles: 3 min at 94 °C, 30 cycles (30 s 94 °C, 40 s 56 °C, 60 s 72 °C) and 2 min of final extension at 72 °C. Amplified fragments were visualized on 1% agarose TAE gels by EthBr staining, purified using the Cleanup Mini Kit (Evrogen, Russia), and used as a template in sequencing reactions with the ABI Prism BigDye Terminator Cycle Sequencing Ready Reaction Kit (Applied Biosystems, USA) following the standard protocol provided for the 3100 Avant Genetic Analyzer (Applied Biosystems, USA). Newly obtained nucleotide sequence data were assembled and tested with previously published datasets with the program BioEdit 7.0.1 (Hall, 1999). The infraspecific sequence variability was estimated as the average pairwise *p*-distances in Mega 11 (Tamura *et al.,* 2021), using the pairwise deletion option for counting gaps. Newly obtained 11 nucleotide sequences (five ITS1-2 and six *trn*L-F) were deposited into GenBank, accession numbers are provided with discussion of appropriate specimens.

The nomenclature of the annotated list follows "Flora mkhov Rossii" (2017, 2018, 2020, 2022), Hodgetts, Lockhart (2020) and Fedosov *et al.* (2020), for mosses and "Liverworts and hornworts of Russia" (Potemkin, Sofronova, 2009) for liverworts with selected updates from the recent literature. Annotation of each species includes mentioned above numbers of collection places, habitats, associated species, the number of the records, presence of structure associated with reproduction (S+ — moss sporophytes, gem. — gemmae, per. — perianths, fr. — mature liverwort capsules). The collectors' names and the field numbers italicised. The field numbers of Sidorenko and Czernyadjeva are listed without collector names, e. g., *20-20*. Collection name of L. I. Savicz-Lubitskaya (in the labels as L. I. Savicz) in the annotated list is *Savicz*, whereas collections of V. P. Savicz, Zubkov, Niemann, Ushakov have numbers or specimen collecting dates, and surname of collector. Respective herbarium numbers follow field numbers. Selected representative specimens are listed for widespread species. Names of taxa new for Novaya Zemlya are preceded by asterics "*", new for Yuzhny Island by two asterics "**", new for Vaygach by an exclamation mark "!", and new for Matveev Island by a circumflex accent "^". All specimens are deposited in LE.

Division Marchantiophyta — liverworts

Barbilophozia hatcheri (A. Evans) Loeske — 1b, 1g, 1h: on soil in dwarf shrub-herb-moss and polygonal gravelly herb tundras, and in rocky communities. 7 records: *3–20* LE B-0028135, *14-20* LE B-0028136, *18-20* LE B-0028137, *18-20* LE B-0028138, *21-20* LE B-0028139, etc.; gem.

Barbilophozia hatcheri is morphologically quite variable in our collections. Together with typical morphotypes, mod. *parvifolia-egemmipara* was mentioned in *14-20* LE B-0028136, *18-20* LE B-0028137 (ITS1-2: OR536583, *trn*L-F: OR540408). The attribution of the last specimen to *B. hatcheri* was confirmed by 99.6–100% similarity with *Barbilophozia hatcheri* in ITS 1-2 and 100% identity in *trn*L-F compared with accessions published in Vilnet *et al.* (2012). Morphotype in *3-20* LE B-0028135 (ITS1-2: OR536582, *trn*L-F: OR540407) as well demonstrates 99.5-99.9% similarity in ITS 1-2 and 100% identity in *trn*L-F with aforementioned accessions of *Barbilophozia hatcheri*. The ITS1-2 regions between both sequenced here morphotypes differ in 0.1%, whereas *trn*L-F loci are stable that corresponds with previously suggested level of infraspecies variability in *B. hatcheri* (Vilnet *et al.*, 2012). The morphotype *3-20* LE B-0028135 has leaf cells 25 μm wide with ± bulging trigones, leaf lobes without apiculi and long ciliate underleaves.

!B. lycopodioides (Wallr.) Loeske — 2a: on soil over stone in arctic tundra, with *Trilophozia quinquedentata* f. *gracilis*. 1 record: *21-20* LE B-0028140.

B. rubescens (R. M. Schust. et Damsh.) Kartt. et L. Söderstr. (≡ *Barbilophozia hatcheri* var. *grandiretis* H. Buch ex Lammes) — 1b, 2a: on rocky ridge near the lake, and stony placer. 2 records: *6-20* LE B-0028141, *6-20* LE B-0028142 (incl. trans. ad *Orthocaulis atlanticus*), *25-20* LE B-0028143. This species was listed and briefly described by Arnell (1947: 213) as a large-celled *Barbilophozia hatcheri* that H. Buch denominated as var. *grandiretis*.

^Blepharostoma trichophyllum (L.) Dumort. s. l. — 1b, 1g, 1i, 2a, 2b, 3: on soil in varios tundra communities and over rocks. 27 records: *3-20* LE B-0028144, *9-20* LE B-0028145, *10-20* LE B-0028146, *12-20* LE B-0028176, *17-20* LE B-0028147, *32-20* LE B-0028211, etc.

The species is represented by *B. brevirete* (Bryhn et Kaal.) Vilnet et Bakalin phenotypes, which are morphologically indistinguishable from hybrid taxon 1 of *B. trichophyllum* (Bakalin *et al.*, 2020). The DNA sequence analyses attend specimen *9-20* LE B-0028145 (mod. *parvifolia-compressa*) (ITS1-2: OR536579, *trn*L-F: OR540404) to *B. trichophyllum* "hybrid taxon 1" with differences in ITS1-2 till 1.3% and in *trn*L-F till 0.3% compared with dataset of *B. trichophyllum* "hybrid taxon 1" (Bakalin *et al.*, 2020).

Cephalozia ambigua C. Massal. — 1h: on soil in herb-moss tudra with *Silene acaulis, Papaver* sp. 2 records: *17-20* LE B-0028150.

C. bicuspidata (L.) Dumort. — 1b, 1h: on soil in dwarf shrub-moss tundra with *Salix polaris, Dryas* sp., and on brook bank. 2 records: *20-20* LE B-0028149 (sub *Fuscocephaloziopsis albescens*).

^Cephaloziella divaricata (Sm.) Schiffn. — 1h, 3: on soil in polygonal gravel herb tundra with *Salix polaris, Silene acaulis, Saxifraga* sp., dwarf shrub-sedge-moss tundra and rocky outcrop. 2 records: *18-20* LE B-0028152 (gem.), *18-20* LE B-0028162 (sub *Lophoziopsis* cf. *excisa*), *32-20* LE B-0028172 (*Lophozia wenzelii* s. l.).

^C. grimsulana (J. B. Jack ex Gottsche et Rabenh.) Lacout. — 3: in dwarf shrub-sedge-moss tundra. 2 records: *32-20* LE B-0028212 among *Myurella julacea* and *32-20* LE B-0028213 among *Drepanocladus polygamus*.

C. varians Steph. (= *C. alpina* Douin) — 1b, 1f, 1i: on soil and among bryophytes in various types of tundra. 11 records: *3-20* LE B-0028153, *34-20* LE B-0028154, etc.

Diplophyllum taxifolium (Wahlenb.) Dumort. — 1b, 1h: on soil in rocky outcrops. 5 records: *6-20* LE B0019514 (sub *Plagiothecium denticulatum*), 18-*20* LE B-0028155.

***Fuscocephaloziopsis albescens** (Hook.) Váňa et L. Söderstr. (≡ *Pleurocladula albescens* (Hook.) Grolle) — 1h: on soil in herb-moss tudra with *Silene acaulis, Papaver* sp., and on brook bank. 2 records: *17-20* LE B-0028170, *20-20* LE B-0028149.

***F. leucantha** (Spruce) Váňa et L. Söderstr. (≡ *Cephalozia leucantha* Spruce) — 1h: on soil in herb-moss tundra with *Silene acaulis, Papaver* sp., and on brook bank. 2 records: *17-20* LE B-0028150 (sub *Cephalozia ambigua*), *20-20* LE B-0028151 (per.).

F. lunulifolia (Dumort.) Váňa et L. Söderstr. (≡ *Cephalozia lunulifoia* Spruce, = *Cephalozia media* Lindb.) — 1h: on soil on brook bank. 1 record: *20-20* LE B-0028151 (sub *Fuscocephaloziopsis leucantha*).

Gymnocolea inflata (Huds.) Dumort. — 1h: on soil on brook bank. 3 records: *20-20* LE B-0028149 (sub *Fuscocephaloziopsis albescens*), LE B-0028151 (sub *Fuscocephaloziopsis leucantha*), LE B-0028185 (sub *Odontoschisma elongatum*).

Gymnomitrion concinnatum (Lightf.) Corda — 1h: on soil over rocks. 1 record: *18-20* LE B-0028167 (sub *Lophozia wenzelii* s. l.).

****G. corallioides** Nees — 1b, 1g, 1h: on soil in dwarf shrub-moss tundras and in rocky communitites. 6 records: *4-20* LE B-0028156; fr.

***Jungermannia eucordifolia** Schljakov — 1b: on rocks in water. 2 records: *2-20* LE B-0028157 (per.), *7-20* LE B-0028158.

J. polaris Lindb. — 1f, 1h, 1i: on bare soil in scree and rocky outcrops. 5 records: *9-20* LE B-0028163 (sub *Lophozia polaris*), *18-20* LE B-0028159, etc.; per., fr.

****J. pumila** With. — 1b, 1i: on rocks in water. 1 records: *7-20* 0028160; per.

***Lophozia savicziae** Schljakov — 1h: in herb-moss tundras with *Silene acaulis*, *Papaver* sp., among *Gymnomitrion corallioides*, etc. 2 records: *14-20* (sub *Barbilophozia hatcheri*), *17-20* LE B-0028173 (sub *Marsupella boeckii*); gem.

^L. wenzelii (Nees) Steph. s. l. — 1b, 1g, 1h, 3: on soil in rocky outcrops and tundra communities. 13 records: *3-20* LE B-0028164, *3-20* LE B-0028165, *3-20* LE B-0028166, *16-20* LE B-0028171, *17-20* LE B-0028169, *18-20* LE B-0028167, *18-20* LE B-0028168, *32-20* LE B-0028172, etc.; mostly with gemmae.

The species is quite variable as it was shown by Bakalin (2005). Several morphotypes from the list below [*3-20* LE B-0028164 (*trn*L-F: OR540409), *3-20* LE B-0028165, *3-20* LE B-0028166, 18-20 LE B-0028167] resemble *Pseudolophozia sudetica* but have larger cells and green to occasionally brownish gemmae. The *trn*L-F sequence similarity up to 99.5% allow us to attribute the specimen *3-20* LE B-0028164 to *Lophozia wenzelii* s. l. (Konstantinova *et al*., 2020), but species differentiation in the genus *Lophozia* from molecular evidence stays questionable due to absence of sequences from the type material.

Lophoziopsis excisa (Dicks.) Konstant. et Vilnet — 1b, 1h, 2a: among *Dicranum* in rocky community, associated with *Blepharostoma trichophyllum* s. l., *Lophozia wenzelii* s. l., *Cephaloziella divaricata, Scapania ligulifolia*, *Mesoptychia heterocolpos*, *Mnium lycopodioides*, etc. 3 records: *9-20* LE B-0028216 (sub *Scapania ligulifolia*, gem.), *18-20* LE B-0028162 (cf., no gemmae seen, leaf margin purplish, mod. *parvifolia*), *25-20* LE B-28217 (sub *Scapania gymnostomophila*).

***L. longidens** (Lindb.) Konstant. et Vilnet — 2a: in stony placer, associated with *Barbilophozia rubescens*. 1 record: *25-20* LE B-0028161; gem.

****L. polaris** (R. M. Schust.) R. M. Schust. et Damsh. — 1i: on bare soil in scree together with *Blepharostoma trichophyllum* s. l., *Tritomaria scitula*, *Mesoptychia collaris*, *Jungermannia polaris*, etc. 1 record: *9-20* LE B-0028163; gem.

Marchantia quadrata Scop. — 1f: on soil in herb-moss tundra with *Salix reticulata, Silene acaulis*, associated with *Blepharostoma trichophyllum* s. l., *Mesoptychia badensis*, etc. 1 record: *12-20* LE B-0028174.

***Marsupella boeckii** (Austin) Lindb. ex Kaal. — 1h: in herb-moss tundra with *Silene acaulis*, *Papaver* sp., among *Gymnomitrion corallioides*, etc. 1 record: *17-20* LE B-0028173.

***^Mesoptychia badensis** (Gottsche ex Rabenh.) L. Söderstr. et Váňa — 1f, 2a, 3: on soil in herb-moss tundra with *Salix reticulata, Silene acaulis*, associated with *Blepharostoma trichophyllum* s. l., *Marchantia quadrata*, in stony place and in wet sedge-moss tundra. 4 records: *12-20* LE B-0028174 (sub *Marchantia quadrata*), *25-20* LE B-0028177, *33-20* LE B-0028208 (among *Amphidium lapponicum*), *33-20* LE B-0028209 (among *Catascopium nigritum*).

***!M. collaris** (Nees) L. Söderstr. et Váňa — 1i, 2a: — on bare soil in scree and stony placer. 2 records: *9-20* LE B-0028178, *25-20* LE B-0028179.

M. gillmanii (Austin) L. Söderstr. et Váňa (= *Leiocolea kaurinii* (Limpr.) Jørg.) — 1h, 2a: in herb-moss tundra with *Silene acaulis*, *Papaver* sp., among *Gymnomitrion corallioides*, near brook and on bare soil. 3 records: *17-20* LE B-0028173 (sub *Marsupella boeckii*); *26-20* LE B-0028181 (sub *Riccardia* cf. *latifrons*)

***Mesoptychia gillmanii** f. **orbiculata** (R. M. Schust.) Potemkin, **comb. nov.** (≡ *Lophozia gillmanii* fo. *orbiculata* R. M. Schust., 1969, Hepat. Anthocerotae N. Amer. 2: 385) — 1h: on bare soil on slope to the sea. 1 record: *19-20* LE B-0028180.

M. heterocolpos (Thed. ex Hartm.) L. Söderstr. et Váňa — 1b, 1i: in herb-lichen tundra, on scree, associated with *Orthocaulis qudrilobus* var. *glareosa*, *Blepharostoma trichophyllum*, *Cephaloziella varians*. 2 records: *10-20* LE B-0028182 (gem.).

!M. heterocolpos var. **arctica** (S. W. Arnell) L. Söderstr. et Váňa — 1b, 1i, 2a, 2b: on soil in rocky ridge, scree and over log of destroyed building. 8 records: *6-20* LE B-0028184, *9-20* LE B-0028163 (sub *Lophoziopsis polaris*), *25-20* LE B-0028195, *28-20* LE B-0028183.

****M. heterocolpos** var. **harpanthoides** (Bryhn et Kaal.) L. Söderstr. et Váňa — 1b: on bare soil of scree among *Blepharostoma trichophylum* s. l., etc. 1 record: *9-20* LE B-0028218.

***Odontoschisma elongatum** (Lindb.) A. Evans — 1h: on soil near brook, associated with *Gymnocolea inflata*, *Fuscocephaloziopsis leucantha*, etc. 1 record: *20-20* LE B-0028185.

^Orthocaulis binstadii (Kaal.) H. Buch — 1h, 3: on soil in rocky outcrops among *Lophozia wenzelii* s. l. and in wet sedge-moss tundra. 2 records: *17-20* LE B-0028169 (sub *Lophozia wenzelii*); *33-20* LE B-0028210 (cf., among *Sphagnum fimbriatum*, mod. *meso-* vel *subleptoderma-latifolia*, sub *Schistochilopsis incisa*).

^O. kunzeanus (Huebener) H. Buch — 1b, 1g, 3: on soil in dwarf shrub-herb, moss, and polygonal herb tundras. 4 records: *5-20* LE B-0028186, *32-20* LE B-0019543 (un., sub *Bryum cryophilum*).

^O. quadrilobus (Lindb.) H. Buch — 1b, 1f, 1h, 1i, 2a, 3: on soil and among mosses in rocky outcrops and various types of tundra, associated with *Blepharostoma trichophyllum* s. l., *Cephaloziella varians*, *Mesoptychia heterocolpos* var. *arctica*, etc. 12 records incl. *f. *cephalozielloides* (R. M. Schust.) Potemkin — 1h: *18-20* LE B-0028187.

***!^O. quadrilobus** var. **glareosus** (Jørg.) S. W. Arnell — 1i, 2a, 3: *9-20* LE B-0028163 (sub *Lophoziopsis polaris*), *24-20* LE B-0028188, *32-20* LE B-0028172 (*Lophozia wenzelii* s. l.).

!Plagiochila porelloides (Torr. ex Nees) Lindenb. — 2b: on soil in dwarf shrub moss tundra. 1 record: *27-20* LE B-0028189.

***Prasanthus suecicus** (Gottsche) Lindb. — 1h: in herb-moss tundra with *Silene acaulis*, *Papaver* sp., among *Gymnomitrion corallioides*, etc. 1 record: *17–20* LE B-0028173 (sub *Marsupella boeckii*).

Ptilidium ciliare (L.) Hampe — 1b, 1g, 1 h: on soil and rocks in various types of moss tundras and rocky outcrops. 7 records: *18-20* LE B-0028190.

!Riccardia cf. **latifrons** (Lindb.) Lindb. — 2a: near brook among mosses and *Blepharostoma trichophyllum*. 1 record: *26–20* LE B-0028181.

!Saccobasis polita (Nees) H. Buch var**. arctica** Konstant. et al. — 1h, 2a: on soil in rocky outcrops. 2 records: LE B-0026973 (Potemkin *et al*., 2022), *25-20* LE B-0028179 (un., sub *Mesoptychia collaris*).

Scapania cf. **curta** (Mart.) Dumort. — 1b: on soil in dwarf shrub-herb-moss tundra with *Salix polaris*, *Silene acaulis*, *Dryas* sp., *Saxifraga* sp. 1 record: *3-20* LE B-0028191.

S. cuspiduligera (Nees) Müll. Frib. — 2a: in arctic tundra and rocky placer, associated with *Blepharostoma trichophyllum* s. l., *Tritomatomaria scitula*, etc. 3 records: *21-20* LE B-0028140 (males, gem.) (sub *Barbilophozia lycopodioides*), *25-20* LE B-0028192, mod. *parvifolia-densifolia*.

S. gymnostomophila Kaal. — 2a: on bare soil of scree among *Blepharostoma trichophyllum* s. l. 1 record: *25-20* LE B-28217.

S. cf. **irrigua** (Nees) Nees — 1b: over rock in water of brook. 1 record: *7-20* LE B-0028193 (ITS1-2: OR536581, *trn*L-F: OR540406). This specimen resembles *Scapania hyperborea* Jørg. by morphology, but sequence similarity achieved 99.5% in ITS1-2 and 99.7% in *trn*L-F with multiplied sampled *S. irrigua* (Vilnet *et al*., 2010) that lies in the level of infraspecific variability and attend tested specimen to *S. irrigua*.

!S. ligulifolia R. M. Schust. — 2a: on soil in rocky placer, among *Blepharostoma trichophyllum* s. l., *Tritomaria scitula*, etc. 2 records: *25-20* LE B-0028194.

***S. obcordata** (Berggr.) S. W. Arnell — 1b: among mosses in dwarf shrub-moss tundra with *Salix polaris*, *Dryas* sp. 1 record: *8-20* LE B-0028196, gem.

***S. scandica** (Arnell et H. Buch) Macvicar f. **argutedentata** (H. Buch) Damsh. — 1h: among *Dicranum* in rocky community, associated with *Lophozia wenzelii* s. l., *Cephaloziella divaricata, Blepharostoma trichophyllum*. 1 record: *18-20* LE B-0028162 (un., sub *Lophoziopsis excisa*).

***S. scandica** (Arnell et H. Buch) Macvicar var. **grandiretis** (Schljakov) Schljakov — 1h: in herb-moss tundra with *Silene acaulis*, *Papaver* sp., among *Gymnomitrion corallioides*, etc. 1 record: *17-20* LE B-0028173 (sub *Marsupella boeckii*).

S. tundrae (Arnell) H. Buch — 1h: on brook bank. 1 record: *20-20* LE B-0028151 (sub *Fuscocephaloziopsis leucantha*).

^Schistochilopsis incisa (Schrad.) Konstant. (= *S. opacifolia* (Culm.) Konstant.) — 1f, 1h, 3: in herb-moss tundras with *Silene acaulis* and in sedge-moss wet tundra. 3 records: *12-20* LE B-0028175 — *Schistochilopsis incisa* phenotype, associated with *Lophozia wenzelii* s. l., *Fuscocephaloziopsis lunulifolia*; *17-20* LE B-0028150 (sub *Cephalozia ambigua*) — *Schistochilopsis opacifolia* phenotype, among *Gymnomitrion corallioides*, etc; *33-20* LE B-0028210 — among *Sphagnum fimbriatum*.

^Sphenolobus minutus (Schreb.) Berggr. — 1b, 1g, 1h, 1i, 3: usually among mosses in various types of tundra and rocky outcrops. 11 records: *15-20* LE B-0028197; *32-20* LE B-0028172 (*Lophozia wenzelii* s. l.).

Tetralophozia setiformis (Ehrh.) Schljakov —1h: over rocks in rocky outcrops. 2 records: *18-20* LE B-0028198.

Trilophozia quinquedentata (Huds.) Bakalin — 1b: in dwarf shrub-moss tundras. 2 records: 2 records: *3-20* LE B-0028166 (sub *Lophozia wenzelii* s. l.), *4-20* LE B-0028199.

***!T. quinquedentata** f. **gracilis** (R. M. Schust.) Konstant. — 1b, 1g, 1h, 1i, 2a: on soil in rocky outcrops, twice in tundras. 8 records: *4-20* LE B-0028200.

Trilophozia quinquedentata var. **grandiretis** (H. Buch et S. W. Arnell) Potemkin, **comb. nov.** ≡ *Tritomaria quinquedentata* (Huds.) H. Buch var. *grandiretis* H. Buch et S. W. Arnell, 1950, Svensk Bot. Tidskr. 44(1): 84. = *Tritomaria quinquedentata* var. *dentata* S. W. Arnell, 1956, Moss Flora of Fennoscandia. I. Hepaticae: 148, nom. invalid. — 1b, 1g: in wet moss tundra with *Salix polaris, Artemisia* sp. and polygonal gravel herb tundra with *Salix polaris*, *Silene acaulis*, *Saxifraga* sp. 3 records: *5-20* LE B-0028202, *14-20* LE B-0028201, *16-20* LE B-0028203.

In our collections, there are phenotypes with morphology of var. *grandiretis* and with some dentate leaves like in var. *dentata*, which were found in *5-20* LE B-0028202 (ITS1-2: OR536580, *trn*L-F: OR540405). K. Damsholt (2002) opinion on their identity is supported by this study. Sporadic development of leaf dentititon may result from polyploid origin of var. *grandiretis*. This variety is distinct from var. *turgida* in often acuminate and occasionally dentate leaf lobes vs. often blunt to rounded lobes. Published molecular data have suggested diversity within *T. quinquedentata*-complex, thus careful study should be implemented in course of infraspecific diversity and reliability of previously described infraspecific taxa (Vilnet *et al*., 2010). The similarity of specimen *5-20* LE B-0028202 counts up to 99.8% in ITS1-2 and *trn*L-F (Vilnet *et al*., 2010, Konstantinova *et al*., 2020b) and 100% in *trn*L-F with *T. quinquedentata* accessions AY463592 from Finland (He-Nygren *et al*., 2004).

T. quinquedentata var. **turgida** (Lindb.) Konstant. — 1g: in polygonal gravel herb tundra with *Salix polaris*, *Silene acaulis*, *Saxifraga* sp., associated with *Sphenolobus minutus*, 1 record: *14-20*.

***Tritomaria scitula** (Taylor) Jørg. — 1i, 2a, 2b, 3: on soil in scree, arctic tundra, rocky placer, dwarf shrub (*Dryas* sp.)-moss arctic tundra, among *Blepharostoma trichophyllum* s. l., *Tritomaria scitula*, *Bryum* sp., *Flexitrichum flexicaule*, etc. 7 records: *9-20* LE B-0028163 (sub *Lophozia polaris*), *21-20* LE B-0028205, *25-20* LE B-0028206, *27-20* LE B-0028206, *32-20* LE B-0028215, etc.

Division Bryophyta — Mosses

****^Amblystegium serpens** (Hedw.) Schimp. — 1f, 1i, 2a, 2b, 3: on soil in forb-lichen and forb-moss tundra, on rocks. 5 records: *10-20* LE B-0021008, *21-20* LE B-0021007, etc.

^Amphidium lapponicum (Hedw.) Schimp. — 3: on soil in sedge-moss swampy tundra. 1 record, *33-20* LE B-0038794.

Andreaea papillosa Lindb. — 1a, 1b, 1h: on stones in swampy moss tundra and on rocks, S+. 3 records: *5-20* LE B-0038797, *18-20* LE B-0038795, *Zubkov 52* LE B-0038796, etc.

Aongstroemia longipes (Sommerf.) Bruch et Schimp. — 1f, 1h: on stones in forb-moss tundra, on rocks, on descent to the sea, associated with *Bryum* sp., *Pohlia cruda*, *Schistidium* sp., *Tayloria lingulata*, etc. 3 records: *12-20* LE B-0021946, *18-20* LE B-0021944, *19-20* LE B-0021945.

***Arctoa fulvella** (Dicks.) Bruch et Schimp. (≡ *Kiaeria glacialis* (Berrgr.) J. I. Hagen) — 1b: on bare spot in dwarf shrub-moss spotty tundra, S+. 1 record: *4-20* LE B-0038799.

****A. glacialis** (Berggr.) Fedosov et al. — 1f: on soil in sedge-cotton grass swampy tundra in the lowland. 1 record: *Savicz 96* LE B-0038919.

^Aulacomnium palustre (Hedw.) Schwägr. — 1b, 1c, 1f, 2b, 3: on soil in different tundra, S+. 11 records: *8-20* LE B-0021015, etc.

^A. turgidum (Wahlenb.) Schwägr. — 1b, 1c, 1e, 2b, 3: on soil in different tundra. 11 records: *3-20* LE B-0021022, etc.

Bartramia ithyphylla Brid. — 1c, 1d, 1g: on stones in forb-moss tundra and on rocky outcrops, associated with *Aulacomnium palustre, Bryum arcticum, Sanionia uncinata, Tomentypnum involutum*, S+. 3 records: *16-20* LE B-0038802, *Zubkov* LE B-0038803, etc.

****Brachythecium albicans** (Hedw.) Schimp. — 1b: on soil in stony-gravelly tundra among *Sanionia uncinata*. 1 record: *Savicz 130* LE B-0038804. Det. M. S. Ignatov.

^B. cirrosum (Schwägr.) Schimp. — 1a, 1f, 1i, 2b, 3: on soil in forb-lichen and dwarf shrub-herb-moss tundra, on stones of rocky outcrops, associated with *Distichium capillaceum, Pseudoleskeella catenulata, Tomentypnum involutum,* etc. 6 records: *10-20* LE B-0038805, *28-20* LE B-0038808, etc.

****B. mildeanum** (Schimp.) Schimp. ex Milde — 1b: between stones on lake bank. 1 record: *6-20* LE B-0038810.

!B. tauriscorum Molendo et Lorentz — 2a: on stone in stony area. 1 record: *25-20* LE B-0038811. Det. M. S. Ignatov.

^B. turgidum (Hartm.) Kindb. — 1c, 1i, 2a, 2b, 3: on soil in forb-moss spotty and dwarf shrub-herb-moss tundra, on stones of rocky outcrops, associated with *Bryum* sp., *Drepanocladus aduncus*, *Tomentypnum involutum,* etc. 6 records: *21-20* LE B-0038814, *32-20* LE B-0038813, etc.

B. udum I. Hagen — 1i: on soil on stream bank. 1 record: *11-20* LE B-0021951.

***Brideliella demetrii** (Renauld et Cardot) Fedosov et al. (≡ *Oncophorus demetrii* (Renauld et Cardot) Hedenäs) — 1b, 1e: on soil in dwarf shrub-herb-moss, dwarf shrub-moss spotty and sedge-cotton grass swampy tundra, S+. 6 records: *3-20* LE B-0021772, *4-20* LE B-0021766, *Savicz 133* LE B-0039581, etc.

B. wahlenbergii (Brid.) Fedosov et al. (≡ *Oncophorus wahlenbergii* Brid.) — 1b: on stream bank, associated with *Platyhypnum alpestre*. 1 record: *7-20*. Det. O. M. Afonina.

Bryoerythrophyllum recurvirostrum (Hedw.) P. C. Chen — 1b, 1i, 2a, 2b: on stones and in the crevices of rocky outcrops and stony areas, associated with *Distichium capillaceum, Encalypta rhaptocarpa,* etc, S+. 4 records: *25-20* LE B-0038816, *28-20* LE B-0038817, etc.

Bryum arcticum (R. Br.) Bruch et Schimp. — 1d: in arctic tundra, associated with *Pohlia* sp., *Sanionia uncinata,* S+. 1 record: 11 VII 1908, *Niemann*.

****B. creberrimum** Taylor — 1e: fine gravelly tundra, associated with *Bryum* sp., *Flexitrichum flexicaule*, S+. 1 record: *Savicz 99* LE B-0040218.

^B. cryophilum Mårtensson — 1b, 1f, 3: on stones on streams banks and on lakes banks, on soil in dwarf shrub-herb-moss tundra, associated with *Brachythecium turgidum*, *Bryum* sp. 5 records: *7-20* LE B-0019542, *12-20* LE B-0019539, *35-20* LE B-0019540, etc.

B. neodamense Itzigs. — 1b, 1f, 1h, 1i: on wet soil in forb-lichen, forb-moss and swampy moss tundra, on streams banks, associated with *Bryum* sp., *Pohlia wahlenbergii*. 6 records: *5-20* LE B-0038818, *17-20* LE B-0019556, etc.

B. pseudotriquetrum (Hedw.) P. Gaertn et al. — 1b, 1f: on streams banks, on soil in dwarf shrub-herb-moss tundra, associated with *Bryum* sp., *Pohlia wahlenbergii*, S+. 4 records: *3-20* LE B-0019560, *7-20* LE B-0038823, etc.

B. teres Lindb. — 1a, 1f, 1i, 2b: between stones in stony area, rocky outcrops, on soil in forb-moss tundra, on lake bank, associated with *Bryum* sp., *Drepanocladus arcticus, D. polygamus, Scorpidium cossonii,* etc. 5 records: *9-20* LE B-0021002, *30-20* LE B-0038825, etc.

****!Buckia vaucheri** (Lesq.) D. Rios et al. (≡ *Stereodon vaucheri* (Lesq.) Lindb. et Broth.) — 1e, 2a, 2b: on stones of rocky outcrops, on fine gravelly and forb-moss tundra. 4 records: *23-20* LE B-0039013, *28-20* LE B-0039032, etc.

Calliergon cordifolium (Hedw.) Kindb. — 2b: in water on lake bank. 1 record: *31-20* LE B-0038826.

C. giganteum (Schimp.) Kindb. — 2a: along stream bank. 1 record: *26-20* LE B-0017637.

***C. giganteum** (Schimp.) Kindb. subsp. **sibiricum** Ignatova et Czernyadjeva — 1f: in water on lake bank, associated with *Sarmentypnum sarmentosum*. 1 record: *Savicz 82* LE B-0025815.

C. richardsonii (Mitt.) Kindb. — 1b, 1c, 1f: along streams banks, in wet soil in forb-moss tundra, associated with *Bryum pseudotriquetrum*, *Pohlia wahlenbergii, Scorpidium cossonii*. 4 records: *2-20* LE B-0019290, *12-20* LE B-0019292, etc.

****Calliergonella cuspidata** (Hedw.) Loeske — 1e: in arctic tundra. 1 record: *Ushakov 411* LE B-0038827.

C. lindbergii (Mitt.) Hedenäs — 1c, 2b: on soil in *Dryas*-moss and spotty with *Deschampsia alpina* tundra, associated with *Campylium stellatum, Plagiomnium curvatulum, Scorpidium revolvens, Tomentypnum involutum,* etc. 2 records: *27-20* LE B-0039038; 14 VIII 1930, *Zubkov* LE B-0038828.

****^Campylium bambergeri** (Schimp.) Hedenäs et al. (≡ *Stereodon bambergeri* (Schimp.) Lindb.) — 1a, 2a, 3: on stone in stony areas, on soil on dwarf shrub-herb-moss tundra, associated with *Flexitrichum gracile*, *Distichium capillaceum, Drepanocladus sordidus,* etc. 4 records: *21-20* LE B-0039040, *32-20* LE B-0039042, etc.

^C. stellatum (Hedw.) C. E. O. Jensen — 1a, 1h, 1i, 2a, 2b, 3: on soil in different tundra, between stones in stony areas, associated with *Flexitrichum gracile, Distichium capillaceum, Polytrichastrum septentrionale,* etc. 8 records: *10-20* LE B-0038830, *32-20* LE B-0038850, etc.

***Campylophyllopsis sommerfeltii** (Myrin) Ochyra — 1i: between stones in stony area. 1 record: *9-20* LE B-0038829.

^Catoscopium nigritum (Hedw.) Brid. — 1a, 1f, 1h, 1i, 2a, 2b, 3: on soil in different tundra, on stones of rocky outcrops, along lake bank. 9 records: *17-20* LE B-0025071, *34-20* LE B-0025075, etc.

Ceratodon purpureus (Hedw.) Brid. — 1b, 1e, 1f, 2a, 3: on soil in different tundra, on stones and between stones of rocky outcrops, along lake bank, S+. 8 records: *3-20* LE B-0038835, *25-20* LE B-0038839, etc.

Cinclidium arcticum (Bruch et Schimp.) Schimp. — 1b: on soil in sedge-cotton grass swampy tundra in the lowland. 1 record: *Savicz 134* LE B-0038840.

^C. stygium Sw. — 3: on sand along lake, associated with *Bryum cryophilum*. 1 record: *34-20* LE B-0038841.

C. subrotundum Lindb. — 1b, 1f: along lakes, associated with *Sarmentypnum sarmentosum*. 2 records: *Savicz 81* LE B-0038842; 19 VII 1908, *Niemann* LE B-0038843.

Cnestrum alpestre (Wahlenb. ex Huebener) Nyholm ex Mogensen — 1b: on spot in dwarf shrub-moss spotty tundra. 1 record: *4-20* LE B-0038844.

Conostomum tetragonum (Hedw.) Lindb. — 1b: on spot in dwarf shrub-moss spotty tundra, on soil in stony dwarf shrub-moss tundra, S+. 2 records: *4-20* LE B-0038845, *8-20* LE B-0038846.

!Cratoneuron curvicaule (Jur.) G. Roth — 2a: on stone in stony area, with *Distichium capillaceum*. 1 record: *25-20* LE B-0040372.

Cratoneuron filicinum (Hedw.) Spruce — 1e: on soil in fine gravelly tundra, associated with *Bryum* sp., S+. 1 record: *Savicz 99* LE B-0038847. Det. M. S. Ignatov.

****Cyrtomnium hymenophyllum** (Bruch et Schimp.) Holmen — 1f: on soil in sedge-cotton grass swampy tundra in the lowland, associated with *Hylocomium splendens, Sanionia uncinata*. 1 record: *Savicz 80* LE B-0038848.

****!Dichodontium pellucidum** (Hedw.) Schimp. — 1f, 1g, 1i, 2a: on soil in forb-lichen and forb-moss tundra, on bare soil on descent to the sea, on stone in stony area, associated with

Bryum sp., *Distichium capillaceum*, etc. 4 records: *10-20* LE B-0038852, *15-20* LE B-0038851, *25-20* LE B-0038854, etc.

Dicranella cf. **crispa** (Hedw.) Schimp. — 2b: on stone of rocky outcrops, S+. 1 record: *28-20* LE B-0038849.

****Dicranum acutifolium** (Lindb. et Arnell) C. E. O. Jensen — 1c, 1h: on stone of rocky outcrops, on soil in *Dupontia ficheri*-moss swampy tundra, associated with *Rhizomnium andrewsianum*. 2 records: *18-20* LE B-0040220; 5 VIII 1930, *Zubkov* LE B-0038855.

^D. elongatum Schleich. ex Schwägr. — 1b, 1c, 1f, 1g, 1h, 1i, 2b, 3: on soil in different tundra, on rocky outcrops and stony area. 17 records: *5-20* LE B-0025007, *32-20* LE B-0025009, etc.

D. fuscescens Turner — 1b, 1g, 1h: on soil in polygonal gravelly forb and stony-gravelly tundra, between stones of rocky outcrops, associated with *Dicranum majus*. 3 records: *14-20* LE B-0038857, *18-20* LE B-0038856, *Savicz 130* LE B-0038858.

****^D. laevidens** R. S. Williams — 1b, 1c, 1f, 1g, 1h, 2a, 2b, 3: on soil in different tundra, associated with *Aulacomnium palustre, Dicranum spadiceum*, etc. 10 records: *14-20* LE B-0025033, *23-20* LE B-0025031, etc.

^D. majus Turner — 1b, 1g, 3: on soil in dwarf shrub-moss spotty, swampy moss, polygonal gravelly forb and dwarf shrub-herb-moss tundra, in stony areas, associated with *Dicranum fuscescens, Sanionia uncinata*, *Lophozia wenzelii***,** etc. 7 records: *5-20* LE B-0038862, *32-20* LE B-0038861, etc.

^D. spadiceum J. E. Zetterst. — 1b, 1c, 1d, 1g, 1h, 1i, 2a, 3: on soil in different tundra, on stones of rocky outcrops, associated with *Dicranum laevidens*, *Sanionia uncinata*, *Barbilophozia hatcheri*, etc. 12 records: *3-20* LE B-0025039, *23-20* LE B-0025801, etc.

****Didymodon asperifolius** (Mitt.) H. A. Crum et al. — 1a, 1f: on soil in stony-gravelly tundra, associated with *Flexitrichum flexicaule, Scorpidium cossonii, Tomentypnum involutum*. 4 records: *Zubkov 23* LE B-0039022, *Savicz 101* LE B-0039024, etc. Det. M. S. Ignatov.

****D. validus** Limpr. — 1a, 1e: on soil in stony-gravelly tundra. 3 records: *Savicz 101* LE B-0039027, *Zubkov 32* LE B-0039026, *Zubkov 48* LE B-0039025. Det. M. S. Ignatov.

^Distichium capillaceum (Hedw.) Bruch et Schimp. — 1a, 1e, 1i, 2a, 2b, 3: on stones and gravelly on rocky outcrops and stony-gravelly area, on soil, stones and gravelly in fine gravelly, forb-lichen and forb-moss tundra, S+. 12 records: *10-20* LE B-0038869, *33-20* LE B-0038866, etc.

D. inclinatum (Hedw.) Bruch et Schimp. — 1f, 2a, 2b: on stones in forb-moss tundra and on stony-gravelly areas, associated with *Bryum* sp., *Flexitrichum flexicaule*, etc, S+. 3 records: *12-20* LE B-0038870, *25-20* LE B-0038871, etc.

^Drepanocladus aduncus (Hedw.) Warnst. — 1e, 1i, 2a, 2b, 3: on soil in dwarf shrub-herb-moss, *Dryas*-moss and forb-moss tundra, on stones of rocky outcrops, along stream bank, associated with *Brachythecium turgidum, Campylium stellatum, Scorpidium cossonii*, etc. 7 records: *9-20* LE B-0038872, *27-20* LE B-0021864, etc.

****D. arcticus** (Williams) Hedenäs — 1b, 1e, 1f: on soil in sedge-cotton grass swampy and fine gravelly tundra, along stream bank. 3 records: *13-20* LE B-0038874, *Savicz 95* LE B-0038875, etc.

^D. brevifolius (Lindb.) Warnst. — 1b, 3: on soil in sedge-cotton grass swampy and dwarf shrub-herb-moss tundra, along lakes banks, associated with *Amblystegium serpens, Scorpidium scorpioides*. 4 records: *32-20* LE B-0039498, *34-20* LE B-0039499, etc.

^D. polygamus (Schimp.) Hedenäs — 1f, 1i, 2b, 3: on soil in forb-lichen, forb-moss and dwarf shrub-herb-moss tundra, along lake bank, associated with *Bryum* sp., *Flexitrichum flexicaule, Scorpidium cossonii*, etc. 4 records: *10-20* LE B-0038879, *30-20* LE B-003886, etc.

^D. sendtneri (Schimp. ex Müll. Hal.) Warnst. — 1e, 3: along lake banks, associated with *Sarmentypnum exannulatum*. 3 records: *35-20* LE B-0039028, *Ushakov 1166* LE B-0038885, etc.

****!D. sordidus** (Müll. Hal.) Hedenäs — 1b, 2a: on stones of rocky outcrops, on soil in sedge-cotton grass swampy tundra in the lowland, along stream bank, associated with *Campylium bambergeri, Distichium capillaceum*. 3 records: *7-20* LE B-0038882, *25-20* LE B-0038881, *Savicz 133* LE B-0038883.

^D. turgescens (T. Jensen) Broth. — 1a, 1b, 1e, 1f, 1i, 2a, 2b, 3: on wet soil in different tundra, along streams and lake banks, associated with *Campylium stellatum, Scorpidium cossonii*, etc. 12 records: *11-20* LE B-0025021, *27-20* LE B-0025015, etc.

Encalypta alpina Sm. — 1a, 1h, 1i, 2b: on stones in forb-lichen tundra, on rocks, on descent to the sea, in stony area, associated with *Bryum* sp., *Distichium capillaceum*, S+. 4 records: *19-20* LE B-0038888, *28-20* LE B-0038886, etc.

E. procera Bruch — 2a: on stone in stony area, associated with *Encalypta rhaptocarpa*, S+. 1 record: *25-20* LE B-0039030.

E. rhaptocarpa Schwägr. — 2a, 2b: on stones in stony area and rocky outcrops, associated with *Encalypta procera*, S+. 2 records: *25-20* LE B-0039031, *28-20* LE B-0038890.

****Eurhynchiastrum pulchellum** (Hedw.) Ignatov et Huttunen — 1b: on spot in dwarf shrub-moss spotty tundra. 1 record: *4-20* LE B-0038891.

****^Fissidens osmundoides** Hedw. — 1b, 2b, 3: on soil and spots in dwarf shrub-moss spotty and dwarf shrub-herb-moss tundra, associated with *Mnium stellare, Pohlia cruda,* etc. 3 records: *4-20* LE B-0038892, etc.

^Flexitrichum flexicaule (Schwägr.) Ignatov et Fedosov — 1a, 1b, 1e, 1g, 1f, 1i, 2a, 2b, 3: on soil, on stones and in the crevice of stones in different tundra, on rocky outcrops, on stony-gravelly areas, along lake bank. 17 records: *16-20* LE B-0025047, *27-20* LE B-0025049, etc.

****^!F. gracile** (Mitt.) Ignatov et Fedosov — 1a, 1i, 2a, 3: on soil in forb-lichen and sedge-moss swampy tundra, on stone on stony-gravelly area, associated with *Bryum* sp., *Hypnum cupressiforme, Sanionia uncinata,* etc. 5 records: *10-20* LE B-0038894, *21-20* LE B-0038896, *25-20* LE B-0038895, etc.

****Grimmia incurva** Schwägr. — 1a: on stone in arctic tundra, associated with *Flexitrichum flexicaule*. 1 record: *Zubkov 52* LE B-0039029.

***Hygrohypnella ochracea** (Turner ex Wilson) Ignatov et Ignatova — 1b: along stream bank. 1 record: *2-20*.

H. polare (Lindb.) Ignatov et Ignatova — 1a: on wet soil, S+. 1 record: *Zubkov 51* LE B-0025079.

Hygrohypnum luridum (Hedw.) Jenn. — 2a: on wet stone on rock, associated with *Schistidium platyphyllum*, S+. 1 record: *25-20* LE B-0038900.

Hylocomium splendens (Hedw.) Schimp. — 1b, 1c, 1d, 1f, 2a, 3: on soil in different tundra. 11 records: *3-20* LE B-0039504, *30-20* LE B-0039505, etc.

Hymenoloma crispulum (Hedw.) Ochyra — 1b, 1d, 1h: on stones on rocky outcrops, in stony-gravelly and forb-moss tundra, on stones along stream banks, S+. 6 records: *2-20* LE B-0038906, *17-20* LE B-0038904, etc.

H. mulahaceni (Höhn.) Ochyra — 2a: on stone in stony area, S+. 1 record: *25-20* LE B-0038913.

Hypnum cupressiforme Hedw. — 1a: on soil in tundra, S+. 4 records: *Zubkov 32* LE B-0038915, *Zubkov 51* LE B-0038916, etc.

****Isopterygiella pulchella** (Hedw.) Ignatov et Ignatova — 1e, 2a: on soil in sedge-cotton grass swampy tundra in the lowland, on stone on rocky outcrops, associated with

Distichium capillaceum. *Flexitrichum flexicaule*. 2 records: *25-20* LE B-0038917, *Savicz 96* LE B-0038918.

Leptobryum pyriforme (Hedw.) Wilson — 1i: on soil in forb-lichen tundra, among *Bryum neodamense*. 1 record: *10-20* LE B-0040221.

***Lescuraea saxicola** (Schimp.) Molendo — 1b: on stone on lake bank. 1 record: *6-20* LE B-0038920.

!Lewinskya cf. **pylaisii** (Brid.) F. Lara — 2b: on stone of rocky outcrops, S+. 1 record: *28-20* LE B-0038921.

Loeskypnum badium (C. C. Hartm.) Paul. — 1a, 1b, 1d, 1f: on soil in dwarf shrub-herb-moss tundra and sedge-cotton grass swampy tundra in the lowland, associated with *Paludella squarrosa, Sarmentypnum sarmentosum, Scorpidium cossonii*. 5 records: *3-20* LE B-0038906, *Savicz 109* LE B-0038924, etc.

Meesia triquetra (Jolycl.) Ångstr. — 1b, 1d, 1f, 2a: along stream and lake banks, on wet soil in sedge-cotton grass swampy tundra in the lowland, associated with *Sarmentypnum sarmentosum, Scorpidium cossonii, S. revolvens*. 5 records: *26-20* LE B-0038926, *Savicz 134* LE B-0038928, etc.

****!Mnium lycopodioides** Schwägr. — 1b, 1i, 2a: on stones in stony areas, on soil in forb-lichen tundra, associated with *Blepharostoma trichophyllum,* etc. 4 records: *9-20* LE B-0038932, *25-20* LE B-0038930, etc.

M. stellare Hedw. — 2b: on soil in *Dryas*-moss tundra among *Pohlia cruda*. 1 record: *27-20* LE B-0038933.

***M. thomsonii** Schimp. — 1b: in the crevices of stones along lake bank. 1 record: *6-20* LE B-0038934.

^Myurella julacea (Schwägr.) Schimp. — 1b, 1e, 1f, 2b, 3: on shallow earth in dwarf shrub-herb-moss and fine gravelly tundra, on stony-gravelly area, associated with *Distichium capillaceum, Flexitrichum flexicaule, Tomentypnum involutum, Tortella fragilis,* etc. 5 records: *29-20* LE B-0038963, *32-20* LE B-0038962, etc.

****Niphotrichum canescens** (Hedw.) Bednarek-Ochyra et Ochyra — 1b: on soil in dwarf shrub-herb-moss tundra. 1 record: *3-20* LE B-0040222.

***N. elongatum** (Frisvoll) Bednarek-Ochyra et Ochyra — 1d: in arctic tundra, among *Hylocomium splendens*. 1 record: *V. P. Savicz 105* LE B-0040223.

****N. ericoides** (Brid.) Bednarek-Ochyra et Ochyra — 1a: in arctic tundra. 1 record: 9 IX 1947, *Zubkov* LE B-0040224.

Oncophorus integerrimus Hedenäs — 1b, 1f, 1i: along streams banks, on wet soil in dwarf shrub-herb-moss tundra, in the crevice of stones in stony area. 4 records: *3-20* LE B-0021834, *7-20* LE B-0021835, *9-20* LE B-0021770, *13-20* LE B-0021836.

Orthothecium chryseon (Schwägr.) Schimp. — 1a, 2a: in stony areas. 3 records: *25-20* LE B-0024975, *Zubkov 14* LE B-0024981, *Zubkov 43* LE B-0024980.

****O. retroflexum** Ignatov et Ignatova — 1e: in fine gravelly tundra, associated with *Scorpidium cossonii,* etc. 2 records: *Savicz 93* LE B-0024985, *Savicz 95* LE B-0039518.

****O. strictum** Lorentz — 1a, 1b, 1i, 1h, 2a, 2b: in the crevice of stone and on stones of rocky outcrops, in forb-moss tundra, along lake bank, associated with *Distichium capillaceum, Flexigtrichum flexicaule, Tortella fragilis,* etc. 7 records: *6-20* LE B-0039516, *18-20* LE B-0039513, *28-20* LE B-0039517, etc.

Paludella squarrosa (Hedw.) Brid. — 1a, 1f: on wet soil in forb-moss and sedge-cotton grass swampy tundra, along stream bank, associated with *Sarmentypnum sarmentosum, Loeskypnum badius*. 4 records: *12-20* LE B-0039034, *Zubkov 56* LE B-0039033, etc.

Philonotis fontana (Hedw.) Brid. — 1b, 1f: on wet soil in forb-moss tundra, along stream banks, associated with *Pohlia wahlenbergii*. 2 records: *7-20* LE B-0040251, *12-20* LE B-0040225.

P. tomentella Molendo — 1b, 2a: along stream banks, associated with *Pohlia wahlenbergii, Sarmentypnum tundrae*. 3 records: *2-20* LE B-0039001, *7-20* LE B-0039577, *26-20* LE B-0039578. Det. E. A. Ignatova.

Plagiomnium curvatulum (Lindb.) Schljakov — 2b: on soil in *Dryas*-moss tundra, associated with *Calliergonella lindbergii, Campyium stellatum, Sanionia uncinata*. 1 record: *27-20* LE B-0019478.

P. ellipticum (Brid.) T. J. Kop. — 1b, 1d, 1h: along streams banks, associated with *Pohlia wahlenbergii, Scorpidium scorpioides, Sphagnum squarrosum,* etc. 4 records: *7-20* LE B-0019495, *20-20* LE B-0019494, etc.

****Plagiothecium berggrenianum** Frisvoll — 1f: sedge-cotton grass swampy tundra in the lowland, among *Dicranum laevidens, Hylocomium splendens*, *Sanionia uncinata,* etc. 1 record: *Savicz 80* LE B-0040226.

****P. denticulatum** (Hedw.) Schimp. — 1b, 1h: in the crevices of stones on lake bank, on stone of rocky outcrops, associated with *Buckia revoluta*, *Blepharostoma trichophyllum, Trilophozia quinquedentata*, *Bryum* sp., etc. 2 records: *6-20* LE B-0019514, *18-20* LE B-0019515.

***Platydictya jungermannioides** (Brid.) H. A. Crum — 1b: in the crevices of stones on lake bank. 1 record: *6-20* LE B-0040227.

****Platyhypnum alpestre** (Hedw.) Ochyra — 1b: along streams banks, associated with *Bryum pseudotriquetrum, Pohlia wahlenbergii, Sarmentypnum sarmentosum* etc. 2 records: *2-20* LE B-0021871, *7-20* LE B-0021870.

****Pogonatum dentatum** (Brid.) Brid. — 1a, 1h: on stones of rocky outcrops, S+. 2 records: *18-20* LE B-0040229, *Zubkov 51* LE B-0040228.

****P. urnigerum** (Hedw.) P. Beauv — 1b: on spots in dwarf shrub-herb-moss and dwarf shrub-moss spotty tundra, in the crevices of stones on lake bank. 3 records: *3-20* LE B-0039574, *4-20* LE B-0039575, *6-20* LE B-0039576.

***Pohlia beringiensis** A. J. Shaw — 1b, 2a: on stones with soil in stony areas and stony-gravelly tundra, gem. 2 records: *25-20* LE B-0040230, *Savicz 128* LE B-0040231.

***^P. bulbifera** (Warnst.) Warnst. — 3: on soil in dwarf shrub-herb-moss tundra, among *Bryum cryophyllum*, gem. 1 record: *32-20* LE B-0040232.

^P. cruda (Hedw.) Lindb. — 1f, 1h, 2a, 2b, 3: on soil in forb-moss, dwarf shrub-herb-moss and *Dryas*-moss tundra, on stone in stony areas, associated with *Bryum* sp., *Mnium stellare, Orthothecium chryseon,* etc. 5 records: *19-20* LE B-0039036, etc.

****P. crudoides** (Sull. et Lesq.) Broth. — 1f: in soil in sedge-cotton grass swampy tundra in the lowland, associated with *Pohlia nutans,* etc. 1 record: *Savicz 105* LE B-0039037.

P. drummondii (Müll. Hal.) A. L. Andrews — 1b, 1f, 2a: on soil and stones with soil in swampy moss and forb-moss tundra, in stony areas, along lake and stream banks, associated with *Bryum neodamense, Distichium capillaceum,* etc., gem. 6 records: *1-20* LE B-0025805, *12-20* LE B-0025808, *25-20* LE B-0025804, etc.

***P.** cf. **longicollis** (Hedw.) Lindb. — 1b: in stony areas. 1 record: *1-20* LE B-0040233.

^P. nutans (Hedw.) Lindb. — 1b, 1g, 1f, 2b, 3: on soil in swampy moss, polygonal gravelly forb, *Dryas*-moss, dwarf shrub-herb-moss and sedge-cotton grass swampy tundra, associated with *Polytrichastrum septententrionale, Polytrichum piliferum, Sanionia uncinata,* etc., S+. 5 records: *14-20* LE B-0039583, *27-20* LE B-0039584, etc.

****^Pohlia wahlenbergii** (F. Weber et D. Mohr) A. L. Andrews — 1b, 1f, 1h, 1i, 2a, 3: along lakes and steram banks, associated with *Bryum pseudotriquetrum, Philonotis tomentella, Scorpidium cossonii,* etc. 8 records: *2-20* LE B-0039039, *26-20* LE B-0038967, etc.

^Polytrichastrum alpinum (Hedw.) G. L. Sm. — 1a, 1b, 1d, 2a, 2b, 3: on soil in *Dryas*-moss, stony-gravelly lichen-moss and dwarf shrub-herb-moss tundra, in stony areas, associated with *Orthothecium chryseon*, *Plagiomnium curvatulum, Sanionia uncinata*, etc., S+. 6 records: *1-20* LE B-0017797, etc.

!P. septentrionale (Brid.) E. I. Ivanova et al. — 1b, 1g, 1f, 2a: on soil in swampy moss, dwarf shrub-herb-moss, polygonal gravelly forb and sedge-cotton grass swampy tundra, in stony area, associated with *Distichium capillaceum*, *Pohlia nutans, Sanionia uncinata*, etc. 5 records: *3-20* LE B-0017837, *25-20* LE B-0017835, etc.

P. sexangulare (Floerke ex Brid.) G. L. Sm. — 1b: on soil in swampy moss tundra, associated with *Pohlia drummondii*. 1 record: *5-20* LE B-0040235.

Polytrichum hyperboreum R. Br. — 1b, 1g, 2b: on soil in dwarf shrub-herb-moss, dwarf shrub-moss spotty, polygonal gravelly forb and *Dryas*-moss tundra. 4 records: *3-20* LE B-0017811, *27-20* LE B-0017813, etc.

P. piliferum Hedw. — 1b: on spot in dwarf shrub-moss spotty tundra, on bare soil in swampy moss tundra, associated with *Pohlia nutans, Sanionia uncinata*. 2 records: *4-20* LE B-0017830, *5-20* LE B-0017829.

P. strictum Brid. — 1b, 1h: on soil in stony dwarf shrub-moss, forb-moss and stony-gravelly tundra. 3 records: *17-20* LE B-0039521, etc.

Pseudobryum cinclidioides (Huebener) T. J. Kop. — 1b: along stream bank, among *Bryum pseudotriquetrum*. 1 record: *2-20* LE B-0040234.

***Pseudoleskeella catenulata** (Brid. ex Schrad.) Kindb. — 1e, 1f, 1i, 2a: on rubble and stones in forb-moss, forb-lichen and fine gravelly tundras, in stony areas, associated with *Brachythecium cirrosum, Flexitrichum flexicaule, Roaldia revoluta, Syntrichia ruralis,* etc. 6 records: *10-20* LE B-0039006, *21-20* LE B-0039007, etc.

****P. rupestris** (Berggr.) Hedenäs et L. Söderstr. — 1b: on stone in swampy moss tundra, in the crevice of stone on lake bank. 2 records: *5-20* LE B-0039523, *6-20* LE B-0019474.

***P. tectorum** (Funck ex Brid.) Kindb. ex Broth. — 1f, 2b: on stones on rocks and stony-gravelly areas, associated with *Distichium capillaceum,* etc. 3 records: *28-20* LE B-0019476, *29-20* LE B-0019475, *Savicz 74* LE B-0039524.

****Pseudostereodon procerrimus** (Molendo) M. Fleisch. — 1a, 1e: in soil in arctic tundra, associated with *Flexitrichum flexicaule, Scorpidium revolvens, Tomentypnum involutum,* etc. 2 records: *Savicz 93* LE B-0040238, *Zubkov 35* LE B-0040236.

Psilopilum cavifolium (Wilson) I. Hagen — 1b: on spot in dwarf shrub-moss spotty tundra. 1 record: *4-20* LE B-0040237.

Racomitrium lanuginosum (Hedw.) Brid. — 1b, 1c, 1g: on soil in dwarf shrub-herb-moss, dwarf shrub-moss spotty and polygonal gravelly forb tundra. 4 records: *3-20* LE B-0039532, *14-20* LE B-0039533, etc.

****Rhizomnium andrewsianum** (Steere) T. J. Kop. — 1c: on soil in *Dupontia ficheri*-moss swampy tundra, associated with *Dicranum acutifolium*. 1 record: 5 VIII 1930, *Zubkov* LE B-0040239.

Rhytidium rugosum (Hedw.) Kindb. — 1h: on stone of rocky outcrops, associated with *Dicranum elongatum*. 1 record: *18-20* LE B-0040240.

^Roaldia revoluta (Mitt.) P. E. A. S. Câmara et Carv.-Silva — 1a, 1b, 1e, 1g, 1h, 1i, 2a, 2b, 3: on stones and soil in different tundra, on stony-gravelly areas, on rocky outcrops, along lake bank. 11 records: *6-20* LE B-0025065, *21-20* LE B-0025067, etc.

****Sanionia nivalis** Hedenäs — 1a, 1b, 1f, 1h, 1i: on soil in swampy moss tundra, in the crevices of stones and on stones of rocky outcrops, and stony areas, associated with *Dicranum elongatum, Stereodon revolutus, Bryum* sp., S+. 5 records: *5-20* LE B-0021024*, 18-20* LE B-0021026, etc.

****S. orthothecioides** (Lindb.) Loeske — 1b: on soil in dwarf shrub-moss spotty tundra. 1 record: *4-20* LE B-0021028.

^S. uncinata (Hedw.) Loeske — 1b, 1d, 1f, 1g, 1i, 2a, 2b, 3: on soil in different tundra, on stones on stony-gravelly areas, along lake bank, S+. 19 records: *10-20* LE B-0021033*, 32-20* LE B-0021035, etc.

Sarmentypnum exannulatum (Schimp.) Hedenäs — 1e, 1f: on wet soil in forb-moss tundra. 3 records: *12-20* LE B-0039540, etc.

^S. sarmentosum (Wahlenb.) Tuom. et T. J. Kop. — 1a, 1b, 1d, 1f, 3: on wet soil in sedge-cotton grass swampy tundra in the lowland, along streams and lake banks. 14 records: *2-20* LE B-0038989, *13-20* LE B-0038991, etc.

!S. tundrae (Arnell) Hedenäs — 1a, 1b, 1e, 1f, 1h, 2a, 2b: along streams and lake banks, associated with *Calliergon cordifolium, Philonotis tomentella, Pohlia wahlenbergii*, etc. 7 records: *2-20* LE B-0021947,*20-20* LE B-0021948, etc.

****!Schistidium abrupticostatum** (Bryhn) Ignatova et H. H. Blom — 1b, 2a: on stones of rocky outcrops and lake bank, S+. 2 records: *7-20* LE B-0039541*, 25-20* LE B-0038936.

S. frahmianum Ochyra et Afonina — 1b: on stone on lake bank. 1 record: *7-20* LE B-0040242.

****S. frigidum** H. H. Blom — 1a, 1b: on stones on arctic tundra and stream bank, associated with *Flexitrichum flexicaule*, S+. 2 records: *2-20* LE B-0039542*, Zubkov 46* LE B-0039543. Det. E. A. Ignatova.

***S. frisvollianum** H. H. Blom — 1e: in fine gravelly tundra, associated with *Flexitrichum flexicaule*. 1 record: *Savicz 99* LE B-0040243.

****S. papillosum** Culm. — 1b: on stone on lake bank, S+. 1 record: *6-20* LE B-0039544.

****!S. platyphyllum** (Mitt.) H. Perss. — 1b, 2a: on stones in stony areas, associated with *Dichodontium pellucidum*, S+. 2 records: *2-20* LE B-0040244*, 25-20* LE B-0040245.

****S. sordidum** I. Hagen — 1e, 1i: on stones in fine gravelly tundra and in stony area, associated with *Syntrichia ruralis*, S+. 2 records: *9-20* LE B-0040246*, Savicz 94* LE B-0040247.

****S. submuticum** Broth. ex H. H. Blom — 1a: in arctic tundra. 1 record: *Zubkov 32* LE B-0040248. Det. E. A. Ignatova.

S. tenuinerve Ignatova et H. H. Blom — 1i: on stone in forb-lichen tundra, associated with *Pseudoleskeella catenulata, Roaldia revoluta*, S+. 1 record: *10-20* LE B-0040249.

Scorpidium cossonii (Schimp.) Hedenäs — 1a, 1b, 1d, 1e, 1f, 1h, 1i, 2a, 2b, 3: on soil in different tundra, along stream banks. 17 records*: 2-20* LE B-0025053*, 13-20* LE B-0025056*, 27-20* LE B-0025061, etc.

S. revolvens (Sw. ex anon.) Rubers — 1b, 1c, 1d, 1e, 1f: on wet soil in sedge-cotton grass swampy tundra and along stream banks. 10 records: *7-20* LE B-0025820, etc.

^S. scorpioides (Hedw.) Limpr. — 1e, 1f, 3: on wet soil in sedge-cotton grass swampy tundra in the lowland, along lake banks, associated with *Drepanocladus brevifolius, Sarmentypnum tundrae*. 4 records: *Savicz 82* LE B-0039550, *Savicz 97* LE B-0039549, etc.

Sphagnum capillifolium (Ehrh.) Hedw. — 1b: on soil in dwarf shrub-herb-moss tundra, associated with *Aulacomnium palustre, Sphagnum* sp. 1 record: *3-20* LE B-0040267.

S. concinnum (Berggr.) Flatberg — 1a, 1b, 1c, 1f: on wet soil in sedge-cotton grass swampy tundra in the lowland and in dwarf shrub-moss tundra. 5 records: *8-20* LE B-0039592, *Savicz 84* LE B-0040268, etc.

^Sphagnum fimbriatum Wilson — 3: on soil in sedge-moss swampy tundra. 1 record: *33-20* LE B-0040269.

^S. squarrosum Crome — 1b, 1f, 1h, 3: on wet soil in dwarf shrub-herb-moss, swampy moss, forb-moss and sedge-moss swampy tundra, along stream bank. 6 records: *5-20* LE B-0039551, *20-20* LE B-0039553, etc.

S. teres (Schimp.) Ångstr. — 1b: on wet soil in dwarf shrub-herb-moss and swampy moss tundra. 3 records: *3-20* LE B-0040271, *5-20* LE B-0040270, etc.

S. warnstorfii Russow — 1a: in swampy moss tundra. 2 records: 25 IX 1947, *Zubkov* LE B-0040274, etc.

****Stereodon holmenii** (Ando) Ignatov et Ignatova — 1b: on soil in dwarf shrub-herb-moss, dwarf shrub-moss spotty and swampy moss tundra, associated with *Aulacomnium turgidum, Dicranum majus, Hylocomium splendens, Sanionia uncinata,* etc. 3 records: *3-20* LE B-0039586, *4-20* LE B-0039587, *5-20* LE B-0039585.

^Straminergon stramineum (Dicks. ex Brid.) Hedenäs — 1b, 1c, 1f, 3: on soil in dwarf shrub-herb-moss, dwarf shrub-moss spotty and swampy *Dupontia ficheri*-moss tundra, associated with *Aulacomnium palustre, A. turgidum, Symblepharis elongata,* etc. 7 records: *4-20* LE B-0025028, *13-20* LE B-0025024, etc.

***Symblepharis elongata** (I. Hagen) Fedosov et al. (≡ *Oncophorus elongatus* (I. Hagen) Hedenäs) — 1b, 1c, 1d, 1f, 1g: on soil in dwarf shrub-moss spotty, stony dwarf shrub-moss, polygonal gravelly forb, stony-gravelly lichen-moss and *Lusula*-moss swampy tundra, associated with *Dicranum laevidens*, *Sanionia uncinata, Straminergon stramineum*, etc., S+. 7 records: *4-20* LE B-0021776, *8-20* LE B-0021777, *14-20* LE B-0021771, etc.

Syntrichia norvegica F. Weber — 2a: on stone in stony area. 1 record: *25-20* LE B-0039561.

^S. ruralis (Hedw.) F. Weber et D. Mohr — 1e, 1i, 2a, 2b, 3: on stones, rubble and in the crevices of stones on rocky outcrops, stony areas, in fine gravelly and dwarf shrub-herb-moss tundra, associated with *Brachythecium turgidum, Bryum* sp., *Dicranum elongatum*, etc. 7 records: *10-20* LE B-0038975, *28-20* LE B-0038977, etc.

****Tayloria lingulata** (Dicks.) Lindb. — 1b, 1f, 1h: on soil in forb-moss tundra, along stream banks, associated with *Aongstroemia longipes, Pohlia drummondii, Tortella fragalis*, S+. 3 records: *7-20* LE B-0039568, *12-20* LE B-0039567, *17-20* LE B-0039566.

Tetraplodon mnioides (Hedw.) Bruch et Schimp. — 1a, 1d, 1f, 2a, 2b: on bones on rocky outcrops and stony areas, S+. 6 records: *25-20* LE B-0038974, *29-20* LE B-0038972, etc.

!T. urceolatus (Hedw.) Bruch et Schimp. — 2b: on bones in stony area. 1 record: *29-20* LE B-0040276.

Timmia austriaca Hedw. — 2a, 2b: on stones of rocky outcrops and stony area, associated with *Distichium capillaceum, Hylocomium splendens,* etc. 2 records: *25-20* LE B-0025828, *28-20* LE B-0025827.

T. comata Lindb. et Arnell — 2a: on stone in stony area, among *Distichium capillaceum, Mesoptychya heterocolpos* var. *arctica,* etc. 1 record: *25-20* LE B-0039569.

***T. megapolitana** Hedw. — 1f: on soil in forb-moss tundra and in sedge-cotton grass swampy tundra in the lowland, among *Bryum* sp., *Distichium capillaceum,* etc. 2 records: *12-20* LE B-0039588, *Savicz 80* LE B-0039589.

****T. norvegica** J. E. Zetterst. — 1a, 1i: on soil in forb-lichen tundra, among *Catoscopium nigritum*. 2 records: *10-20* LE B-0039590, *Zubkov 25* LE B-0039591.

****T. sibirica** Lindb. et Arnell — 1i: in the crevices of stones in stony area, associated with *Distichium capillaceum, Oncophorus integerrimus, Blepharostoma trichophyllum,* etc. 1 record: *9-20* LE B-0040278.

^!Tomentypnum involutum (Limpr.) Hedenäs et Ignatov — 1a, 1b, 1c, 1f, 1g, 1i, 2b, 3: on soil in different tundra, on rocky outcrops and stony areas, S+. 12 records: *4-20* LE B-0021467, *32-20* LE B-0021468, etc.

T. nitens (Hedw.) Loeske — 2a: on soil in arctic tundra, associated with *Brachythecium turgidum*. 1 record: *21-20* LE B-0021469.

****^Tortella fragilis** (Hook. et Wilson) Limpr. — 1a, 1h, 2a, 2b, 3: on soil in forb-moss and dwarf shrub-herb-moss tundra, on stones of rocky outcrops and stony areas, associated with *Bryum* sp., *Distichium capillaceum,* etc. 7 records: *17-20* LE B-0021467, *25-20* LE B-0038984, etc.

****T. spitsbergensis** (Bizot et Thér) O. Werner et al. — 1a: in arctic tundra, associated with *Flexitrichum flexicaule, Scorpidium cossonii,* etc. 2 records*: Zubkov 13* LE B-0040279*, Zubkov 35* LE B-00402780.

^T. tortuosa (Hedw.) Limpr. — 1a, 1e, 2b, 3: on soil and rubble in fine gravelly and dwarf shrub-herb-moss tundra, on stony-gravelly areas, associated with *Tortella fragilis*, etc. 5 records: *29-20* LE B-0040281*, 32-20* LE B-0040282, etc.

Tortula leucostoma (R. Br.) Hook. — 2b: on stone of rocky outcrops, associated with *Bryoerythrophyllum recurvirostrum, Encalypta rhaptocarpa*, S+. 1 record: *28-20* LE B-0040286.

T. mucronifolia Schwägr. — 1e: in fine gravelly tundra, associated with *Bryum* sp., *Syntrichia ruralis*, S+. 3 records: *Savicz 99* LE B-0025836, *Savicz 100* LE B-0025835, *Savicz 101* LE B-0025834.

Our study resulted in finds of 173 species and one variety of mosses and 52 species and 9 infraspecific taxa of liverworts: 153 species of mosses and 50 species, five varieties and three forms of liverworts from Novaya Zemlya Archipelago (including Tsvetnoi Island), 73 species of mosses and 17 species of liverworts from Vaygach Island (including Bolshoy Tsinkovyi Island), and 44 species of mosses and 11 species and one variety of liverworts from Matveev Island. Among them, 17 species and one varieties of mosses and 13 species, two varieties and two forms of liverworts are reported for the first time for Novaya Zemlya, 66 species of mosses and 16 species and one variety of liverworts for the first time for Yuzhny Island, 14 species of mosses and seven species, two varieties and one form of liverworts are reported for the first time for Vaygach Island. Five moss species have already been reported in the "New records" papers for Novaya Zemlya and one for Vaygach Island (Ellis *et al*., 2021, 2022a, 2022b; Sofronova *et al*., 2022; Kotkova *et al*., 2022). Information on the bryoflora of Matveev Island has not been previously reported, and all records are new to this lonesome island.

The identification of mosses revealed a number of relatively recently described species, which distribution has not yet been sufficiently known. The findings of these species expand the understanding of their distribution.

Orthothecium retroflexum was described from Yakutia, now it is known from the Arctic and subarctic regions of Russia, permafrost areas of the mountainous regions of Siberia, on Sakhalin Island and Alaska (Ignatov *et al*., 2020).

Plagiothecium berggrenianum is an arctomountain species, fairly common in permafrost areas of arctic and subarctic of Asiatic Russia (Yamal Peninsula, Taimyr Peninsula and its adjacent territories, Yakutia, Magadan Region and Chukotka); it is known

from several localities of the mountainous regions of Siberia (Ust-Maysky District of Yakutia, Kamchatka Peninsula). In North America, it occurs in Alaska, the Northwest Territories, and Greenland. In Europe, before our find single localities were known from Svalbard, the Nenets Autonomous Area and Franz Josef Land (Czernyadjeva, 2001; Ignatov, Ignatova, 2020).

Pohlia beringiensis is an arctomountain species. It is known from Alaska, Yukon, arctic and subarctic regions of Siberia and Far East, and from permafrost areas of the mountainous regions of Siberia (Altai, Trans-Baikal Territory). In Europe, before our finds in Novaya Zemlya and Vaygach, single localities were known in the Nenets Autonomous Area and Franz Josef Land (Czernyadjeva, 2018; Czernyadjeva *et al.*, 2020).

Schistidium frahmianum was recently described from Chukotka (Ochyra, Afonina, 2010). This species is known from several localities in Chukotka and western Alaska, also found in one locality in Yakutia, northern part of the Verkhoyansky Range (Ignatova, Blom, 2017). The find of *S. frahmianum* in the Novaya Zemlya Archipelago is the westernmost and the first record in Europe.

Schistidium frisvollianum is a circumpolar arctic and subarctic species. In Russia, it is comparatively frequent in the Taimyr Peninsula and Anabar Plateau (southwards to ca. 70°N), arctic Yakutia and Chukotka; also found in the Severnaya Zemlya Archipelago, Novosibirsk Islands (Kotelny Island), in the mountains in the middle course of the Lena River in Yakutia (ca. 61°N). In North America, it occurs in the Northwest Territories, Nunavut, Yukon, Alaska. In Europe, in addition to Novaya Zemlya, single localities are known from Iceland, Sweden, Svalbard and the Nenets Autonomous Area (Russia) (McIntosh, 2007; Hodgetts, Lockhart, 2020; Ignatova, Blom, 2017). Our record is the northernmost in the Western Europe.

Several rare and interesting for European Arctic moss species are phytogeographically remarkable.

Aongstroemia longipes occurs sporadically in arctic, subarctic, and mountainous regions of the Holarctic. The nearest localities are known in the Nenets Autonomous Area (Afonina *et al.*, 2019) and Kolguev Island (Afonina *et al.*, 2007). The finds of *Aongstroemia longipes* on Novaya Zemlya are the northernmost in European Russia.

Hymenoloma mulahaceni is a rare species, sporadically occurring in the Arctic and mountain regions of the Holarctic. It was found in Alaska, northern Canada and Greenland in North America; in Spanish Sierra Nevada, Swiss western Bernese Alps and Iceland in Europe; in Armenia, Georgia in the Caucasus, and in Uzbekistan, Kazakhstan, Tajikistan, Kyrgyzstan, China, and Mongolia in Asia (Werner *et al.*, 2013). In Russia, *H. mulahaceni* was reported from the northern Far East from Chukotka, Kamchatka Peninsula, Wrangel Island. Its isolated finds are known from the Karachaevo-Cherkesskaya Republic, eastern slope of the Polar Ural, the Taimyr Peninsula, and Altai Mts. (Ignatova, Fedosov, 2017). The find of *H. mulahaceni* on Vaygach Island is the northernmost in Europe and the first record in the European Russia outside the Caucasus.

Tomentypnum involutum has long been considered within *T. nitens*. Its recent studies confirmed its independence at the species level (Hedenäs *et al*., 2020). Now, it is known in the high mountains in Scandinavia and in Svalbard, from the Rocky Mountains of Canada, Alaska, and from Greenland (Hedenäs *et al*., 2020). In Russia, it was found in the islands of the Arctic Ocean (Franz Josef Land and New Siberian Islands archipelagos, Wrangel Island); in the continental part of Siberia and the Russian Far East; it occurs mainly in the permafrost regions (Taimyr Peninsula, Yakutia, Magadan Province, Chukotka), as well as in the mountains of Southern Siberia in areas with low rainfall (Altai, Buryatia, Transbaikalia, Amur Province); single specimens are known from Sakhalin Island (Hedenäs, Ignatov, 2022). A significant number of finds of this species in Novaya Zemlya confirms its wide distribution in the Arctic.

Lewinskya pylaisii is an amphi-atlantic species. It is known from the northern Europe (Fennoscandia, Iceland, Greenland, Svalbard) and North America (along the western coast, in Canadian Atlantic Provinces, Yukon, subarctic Alaska). In Russia, this species has a bicentric distribution: in the Murmansk Region and Karelia in the west and in the Kamchatka Peninsula and Bering Island (Commander Islands) in the east (Fedosov, Doroshina, 2018). The find of *Lewinskya pylaisii* in Vaygach Island is the northernmost in Russia.

The list of revealed liverworts is predictable for this sector of the Arctic. Special attention deserve earlier published *Saccobasis polita* var. *arctica* (Potemkin *et al*., 2023) and deserving further study poorly known *Trilophozia quinquedentata* var. *grandiretis*.

Eight species of mosses (*Catoscopium nigritum, Distichium inclinatum, Drepanocladus sendtneri, Loeskypnum badium, Plagiothecium berggrenianum, Platydictya jungermannioides, Stereodon holmenii, Tetraplodon mnioides*) were included in the Red Book of the Arkhangelsk Region (*Krasnaya kniga Arkhangel'skoi oblasti*, 2020) and *Pohlia beringiensis* was included in the Red Book of the Nenets Autonomous Okrug (*Krasnaya kniga Nenetzkogo Avtonomnogo Okruga,* 2020). No protected liverwort species have been found in the studied collection.

As a result, at the moment, including all published data and a partial revision of herbarium specimens, 278 species of mosses and 82 species, two varieties and two forms of liverworts are known for the Novaya Zemlya Archipelago, 201 moss species and 64 liverwort species for Yuzhny Island, 224 species of mosses and 45 species, two varieties and one form of liverworts are known for Vaygach Island (including Bolshoi Zinkovyi Island), and 44 species of mosses, and 11 species and one variety of liverworts for Matveev Island.

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