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RESEARCH PAPER

New associations with *Eriophorum vaginatum* L. in the Russian Arctic

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ABSTRACT

We studied tussock communities with *Eriophorum vaginatum* attributed to the class *Oxycocco-Sphagnetea* Br.-Bl. et Tx. ex Westhoff et al. 1946 and predefined class *Carici arctisibiricae–Hylocomietea alaskani* class. prov. (Matveyeva & Lavrinenko 2021) Two new associations – *Ledo decumbentis–Eriophoretum vaginati* Lapshina **ass. nov.** (with 3 variants) and *Pleurozio schreberi–Eriophoretum vaginati* Lavrinenko et Lavrinenko **ass. nov.** (with subassociations *typicum*, *shagnetosum lenenses*, and *sphagnetosum russowii*) have been described in the bog class. The first association is confined to the southern tundra subzone of the West Siberian sector of the Arctic, while the second one to the East European sector of the Arctic, where the subassociations alternate along a gradient from the north of the typical tundra subzone to the south of the southern tundra subzone. The new association *Arctagrostio latifoliae–Eriophoretum vaginati* Lavrinenko O. et Lapshina **ass. nov.** has been categorized as zonal tundra vegetation. We compared these associations with syntaxa of the communities with *Eriophorum vaginatum* that were previously described in bog and zonal positions in the Siberian Arctic and Alaska.

Keywords: vegetation, cotton grass tussocks, *Eriophorum vaginatum*, Braun-Blanquet classification, bogs, zonal tundra communities, Arctic

РЕЗЮМЕ

Лавриненко О.В., Лапшина Е.Д., Лавриненко И.А. Новые ассоциации с *Eriophorum vaginatum* L. в Российской Арктике. Изучены кочкарные сообщества с пушицей *Eriophorum vaginatum*, отнесенные к классу *Oxycocco-Sphagnetea* Br.-Bl. et Tx. ex Westhoff et al. 1946 и предварительно выделенному Матвеевой и Лавриненко (2021) классу *Carici arctisibiricae–Hylocomietea alaskani* class. prov. В болотном классе описаны 2 новые ассоциации: *Ledo decumbentis–Eriophoretum vaginati* Lapshina **ass. nov.** (с 3 вариантами) и *Pleurozio schreberi–Eriophoretum vaginati* Lavrinenko et Lavrinenko **ass. nov.** с субассоциациями *typicum*, *shagnetosum lenenses* и *sphagnetosum russowii*. Ареал первой ассоциации находится в подзоне южных тундр западносибирского сектора Арктики, ареал второй – в восточноевропейском секторе Арктики, где субассоциации сменяют друг друга на градиенте от северной части подзоны типичных тундр до южной части южных. К классу зональной тундровой растительности отнесена новая асс. *Arctagrostio latifoliae–Eriophoretum vaginati* Lavrinenko O. et Lapshina **ass. nov.** Проведено сравнение этих ассоциаций с синтаксонами сообществ с пушицей *Eriophorum vaginatum*, описанными ранее на болотных и зональных позициях в арктической Сибири и на Аляске.

Ключевые слова: растительность, кочкарники, *Eriophorum vaginatum*, классификация по Браун-Бланке, болота, зональные тундровые сообщества, Арктика

Eriophorum vaginatum L. is a circumpolar hypoarctic (arctoboreal) species, a dense-turf tussock-forming granminoid plant widespread in forest and temperate parts of the tundra zone (Egorova et al. 1966, Sekretareva 2004). In the forest zone, it grows in intrazonal communities of raised (sphagna) bogs and transition mires; in the tundra zone, it occurs in intrazonal communities, such as on flat peat mounds and slopes of large peat mounds in frozen palsa bogs, as well as in zonal communities, such as in cottongrass tussock tundra and spotted sedge-dwarf shrub-moss tundra with frost boils with bare ground (mainly loamy).

Tussock tundras composed of *Eriophorum vaginatum* are common in upland locations in the tundra zone of Central and Eastern Siberia, with an optimum in Chukotka and Alaska where they occupy vast areas and form zonal vegetation of predominantly southern tundra (Gorodkov 1935, Matveyeva 1998). However, they are rare in typical tundra. The species is absent in the high Arctic, with its northernmost occurrences being in the south of Severnyi Island of the Novaya Zemlya Archipelago, Lake Taymyr, Bolshoi Lyakhovskii Island, and Wrangel Islands (Egorova et al. 1966).

Eriophorum vaginatum dominates in different types of communities – bogs, tundra and transitional, which was pointed out by Gorodkov (1935) nearly a century ago. He wrote that tussock tundras in the West Siberian Lowland and in Europe occured in slightly waterlogged hollows among moss tundra and were connected with them via transitional associations. Peat-forming species are sphagna (*Sphagnum balticum*, *S. girgensohnii*, *S. lenense*, *S. warnstorfii*) and green mosses (*Aulacomnium turgidum*, *Tomentypnum nitens*, *Dicranum elongatum*, *Hylocomium splendens*) as well as liverwort *Ptilidium ciliare* in equal numbers. Lichens (*Flavocetraria cucullata*,

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Cladonia arbuscula, *C. gracilis*, *C. rangiferina*) are few. Depth of the peat horizon of the gley soil does not exceed 15–20 cm, with the permafrost thawing to 50–60 cm. The upper layer are dominated by *Eriophorum vaginatum*, other abundant species are *Betula nana*, *Carex bigelowii* subsp. *arctisibirica*, *Eriophorum angustifolium*, *Rubus chamaemorus*, *Bistorta vivipara*, and *Vaccinium vitis-idaea* (Gorodkov 1935: 70–71).

The southern tundra subzone of the Siberian Arctic is dominated by tussock tundra types transitional to communities of the class *Oxycocco-Sphagnetea* Br.-Bl. et Tx. ex Westhoff et al. 1946; *Sphagnum* mosses and hypoarctic dwarf shrubs are abundant there. A different type of cottongrass and sedge-cottongrass tundra is common in the typical tundra subzone: sphagna mosses and hypoarctic dwarf shrubs are rare there, but arctic and arctoalpine forbs and dwarf shrubs *Dryas* spp., *Cassiope* spp., *Salix polaris*, as well as lichens are prevalent. Such tussock tundras occupy gently sloping, moderately drained clay and loam surfaces on watersheds (upland habitats), with moderate snow cover depths, forming zonal vegetation (Vasil'yev 1956, Perfil'yeva et al. 1991, Sinelnikova 2013). In a study of biological characteristics of *Eriophorum vaginatum* as a tussock former, Polozova (1970) described communities with similar species composition at the northern distribution limit of cottongrass tussock tundras on the Taymyr Peninsula (near the northern border of the typical tundra subzone). In these communities, the moss cover in the hollows between tussocks is dominated by *Hylocomium splendens* var. *alaskanum*, *Aulacomnium turgidum*, *Ptilidium ciliare*, and there are no sphagna mosses.

In the forest tundra belt in North Koryakia, the ecological phytocoenological classification system describes 3 associations of sedge-cottongrass (*Carex soczavaeana*, *Eriophorum vaginatum*) tussock wetlands that occur in intermountain depressions on permafrost loamy sands or loams, namely sphagna-cottongrass, dwarf shrub-cottongrass, and lichen-sedge-cottongrass associations. The communities within these associations occur on peat (seasonal thaw depth of 35 cm) or on peat-gley soil (Neshataeva & Neshataev 2021). The authors categorized them as the frozen sedge-cottongrass tussock bogs type. Having analyzed the species composition, it can be suggest that, in the floristic classification system, these communities undoubtedly belong to the class *Oxycocco–Sphagnetea*.

In East European tundras, *Eriophorum vaginatum* occurs in coenoses of the class *Oxycocco–Shagnetea* described on flat palsa bogs, and in those of the preliminary class *Carici arctisibiricae–Hylocomietea alaskani* (Matveyeva & Lavrinenko 2021) on spotted dwarf shrub-sedge-moss tundras on watersheds, but it has low constancy (I–III) and abundance (r–1) values in these communities (Lavrinenko & Lavrinenko 2015, 2018, 2020). At the same time, cottongrass-dominated communities form in transitional habitats between tundra and palsa bogs, where heavy clay loams underlie the 10–25 cm thick peat horizon. Cottongrass occupies particularly large expanses on Kolguev Island – nearly 28,000 ha or 5.9 % of the island's area (Lavrinenko & Lavrinenko 2014). Bogdanowskaya-Guihéneuf (1938), having described the island's vegetation in the tradition of physiognomic ecological (dominant) classification, identified a class of cottongrass tussock associations (*Eriophoreta vaginati salebrosa*) that she classified as bogs judging by their vegetation and peat depth. She highlighted that some of the cottongrass roots penetrate the clay horizon. *Eriophorum vaginatum* forms hemispherical tussocks, with sphagna mosses, green mosses, and lichens covering the ground between them.

In the floristic (= phytosociological, Braun-Blanquet) classification approach, several syntaxa with cotton grass tussocks were previously described in different sectors of the Arctic (Walker et al. 1994, Matveyeva 1998, Kholod 2007, Sinelnikova 2009, Telyatnikov & Pristyazhnyuk 2012, Telyatnikov et al. 2014, 2021). They are discussed in this paper.

We present the results of floristic classification of communities with *Eriophorum vaginatum* in East European tundras, on West Siberian Arctic plains near the Yanganape Mountain Range (spurs of the eastern macroslope of the Polar Urals), and in the south of the Taymyr Peninsula, as well as discusses syntaxonomic attribution of these to higher synthaxa.

MATERIAL AND METHODS

Study area

Relevés were made at 11 sites (Fig. 1, sites 1–11) in the typical and southern tundra subzones of the East European sector of the Arctic and in one and two locations in the West and Central Siberian sectors, respectively, both situated in the southern tundra subzone (Fig. 1, sites 12–14) (Aleksandrova et al. 1989). In accordance with the administrative division, studies were conducted in the Nenets Autonomous Area, Yamal-Nenets Autonomous Area and the Taymyr Dolgano-Nenets Autonomous Region (part of Krasnoyarsk Territory).

On Kolguev Island (area 5 000 km^2), relevés were made in the catchments of the Peschanka and Bugryanka Rivers (Fig. 1, sites 1–3). The island is formed by loose clay and sandy Quaternary deposits. Its central part that is elevated (100–140 m, up to 173 m above sea level) in relation to the waterlogged plain bordering the whole island comprises clusters of low (relative height 25–50 m) loamy hills.

In the east of Malozemelskaya tundra, plant communities have been described in the coastal area (near Tobseda Village) and on the Nenets Ridge Upland (Fig. 1, sites 4–5). The area adjacent to Kolokolkova Bay is lowland with elevations 10–40 m a.s.l. composed of sandy and loamy sediments of boreal marine transgression, almost ubiquitously overlain by a thin horizon of peat (up to 0.5 m deep). The Nenets Ridge is the terminal moraine (80–100 m a.s.l.) composed mainly of loam with inclusions of boulder and pebble material.

Surveys in the Bolshezemelskaya tundra have been carried out in areas with a gently rolling topography (Fig. 1, sites 6–11), where ridges and individual hills (50–150 m a.s.l.) stretching for tens of kilometres are mostly composed of loam. Vast hollows between them are occupied by palsa bogs and lake basins of residual glacial and thermokarst origin; peat layer depths reach 0.5–5.0 m (Makeev 2005).

The area around the Yanganape Mountain Range (Fig. 1, site 12) is a gently sloping plain that lies 60–90 m a.s.l. A rocky ridge some 3–5 km wide where elevated limestone plateaus alternate with outcrops of igneous mafic rocks crosses the plain in the sublatitudinal direction. The vast plains to

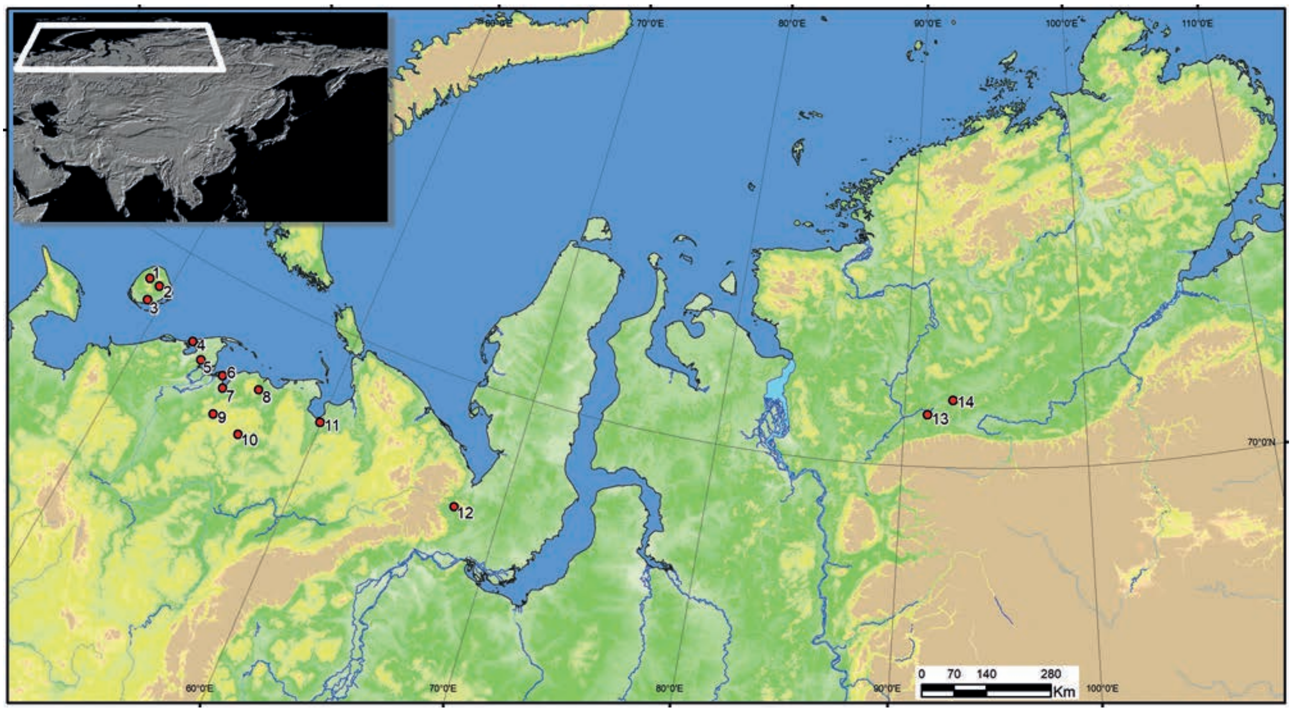

Figure 1 Study area. 1–14 – field sites by authors. 1–3 – Kolguev Isl. (1 – Peschanka River in the upstream, 2 – Peschanka River in the middlestream, 3 – Bugryanka River basin); 4–5 – the north-east part of Malozemelskaya tundra (4 – Tobseda settlement vicinity, Kolokolkova Bay; 5 – Nenets Ridge); 6–11 – the north-west part of Bolshezemelskaya tundra (6 – Bolvanskii Nose Cape environs; 7 – Yachey and Neruta Rivers interfluve, Bolvanskaya Bay; 8 – Vangureymusyur Upland, Bolshaya Khekheganyakha River middlestream; 9 – Vesnimusyur Upland, Shapkina River basin; 10 – Kharyaga River basin (Sredne-Kharyaga oil field); 11 – More-Yu River delta, Khaipudyrskaya Bay; 12 – plains adjacent to the Yanganape Mountain Range, Polar Ural; 13–14 – Taymyr Peninsula, Dudypta River basin (13 – the confluence of Kystyktakh River in Dudypta; 14 – the confluence of Bataika River in Dudypta)

the south and north of the mountain ridge carry numerous residual polygonal mires, thermokarst lakes, and waterlogged khasyreys (drained lakes) separated by low smoothed hills and ridges with tundra and bog communities. Mire vegetation of the class *Scheuchzerio palustris–Caricetea nigrae* Tx. 1937 has recently been described there (Lapshina et al. 2021).

In the south of the Taymyr Peninsula, relevés have been carried out in the Dudypta River catchment (Fig. 1, sites 13–14). The topography there is predominantly denudational, with a dense network of river valleys. There are lowland alluvial plains, lowland glaciolacustrine plains, and upland moraine plains with undulating, gently hilly, sometimes ridge-like topography (100–150 m a.s.l.).

The East European tundras have a maritime arctic climate, with long harsh winters, short summers, indistinct transitional seasons, and considerable cloudiness. Mean annual air temperature is -3°C on Kolguev Island, -5°C on the Barents Sea coast, and -6°C in the central part of the Bolshezemelskaya tundra. The mean air temperature in January varies from -19 to -11°C. The snow cover period lasts for 200–230 days. July is the warmest month, with the mean air temperature ranging from +8 to +12°C. The annual precipitation varies between 360 and 450 mm (Gulinova 1986).

The Yanganape Mountains area in Transuralia has a continental climate, with cold protracted winters and cool brief summers up to 68 days long. Mean annual air temperature is -7°C. July is the warmest month, with a mean temperature +14.6°C. The coldest month is January, with a mean temperature -24°C. Annual precipitation is 480 mm (Samoylova 2017).

The Taymyr Peninsula has a sharp continental climate. Mean annual air temperature in the Dudypta River catchment reaches -12°C, while the mean air temperature in January is -30°C. Snow cover holds for about 220–230 days. Summers are relatively warm, although short. The frost-free period lasts for 50 to 70 days. Mean temperature of the warmest month is +12°C. Annual precipitation averages 350 mm.

Sampling and data analysis

The syntaxonomic analysis is based on 60 relevés, of which 35 were sampled by O.V. Lavrinenko and I.A. Lavrinenko in 1999–2021 in the East European tundras, 17 by E.D. Lapshina in 2017 in the plains near the Yanganape Mountain Range, and 8 by O.V. Lavrinenko and E.D. Lapshina in 2021 in the south of the Taymyr Peninsula. We identified all species (vascular plants, mosses, and lichens) on 5×5 m plots and estimated the percentage cover (%) in total and for the major plant growth forms, as well as cover-abundance scores using the Braun-Blanquet scale (Becking 1957, Barkman et al. 1964): r – solitary plants; + – less than 1 %; 1 – 1–5 %; 2a – 6–12 %; 2b – 13–25 %; 3 – 26–50 %; 4 – 51–75 %; 5 – 76–100 %. Species abundance scores for the syntaxa used for comparison from Telyatnikov & Pristyazhnyuk (2012) and Telyatnikov et al. (2021) were brought to the same scale. We also adjusted the abundance scale from Bogdanowskaya-Guihéneuf (1938) who used the ecological-physiognomic (dominant) classification to the Braun-Blanquet scale: 1 (sol.) – +; 2 (sp.) – 1; 3 (cop. 1) – 2a; 4 (cop. 2) – 2b; 5 (cop. 3) – 3. In the cited paper by Bogdanowskaya-Guihéneuf (1928) we retained the authors'

5-point abundance scale: 1 – <8 %, 2 – 8–16 %; 3 – 16–32 %, 4 – 33–66 %, 5 – 66–100 %. The other authors cited used the 7- or 8-point Braun-Blanquet scale that we retained according to their publications.

Soil pits were dug to the depth of 25 cm. Plot coordinates were taken with the Garmin GPS device (see notes to Tables 1–3).

The vegetation classification was made according to the Braun-Blanquet sorted-table method (Westhoff & van der Maarel 1978). Species constancy in the tables is given using a percentage scale (%): I – > 0–20, II – 21–40, III – 41–60, IV – 61–80, V – 81–100. Species with constancy V and IV are considered highly constant. The median abundance values (if not stated, they are "+" or "r") were used for each species to characterise syntaxa. To calculate these, the Braun-Blanquet scale values were converted to a numerical 8-point scale.

When describing associations and subordinate syntaxa, we used the notion of a "differential species combination" (Beeftink 1965, Molenaar 1976) – a group of taxa that are characteristic of a syntaxon when they occur together, although each may not be individually. The term "characteristic species" was used for the higher syntaxonomic units (Braun-Blanquet 1932, Westhoff & van der Maarel 1978). Within the East European tundras, such species have been identified for major vegetation classes on watersheds (Lavrinenko & Lavrinenko 2020). For the higher zonal vegetation units, they are given in accordance with Matveyeva & Lavrinenko (2021).

The nomenclature of the species followed Sekretareva (2004) for vascular plants, *Carex bigelowii* subsp. *lugens*: Panarctic Flora [Online]; Ignatov et al. (2006) for mosses, Potemkin & Sofronova (2009) for liverworts and Santesson et al. (2004) for lichens.

The new syntaxonomic units have been named according to the International Code of Phytosociological Nomenclature, 4th edition (ICPN) (Theurillat et al. 2021). The nomenclature of the higher vegetation units is according to Mucina et al. (2016). The authors of the syntaxa are given in the text at first mention and in Prodromus.

RESULTS

On processing the relevé tables, *Eriophorum vaginatum* communities were assigned to 3 new associations (Tables 1–5) that are described below.

Ledo decumbentis–Eriophoretum vaginati Lapshina **ass. nov.** (Table 1, rel. 1–17, Fig. 2A, Table 4, syntaxa 3–5)

Holotypus: relevé 15 (author's number 114E17yp), West Siberian sector of the Arctic, plain adjacent to Yanganape Mountain Range – a spur of eastern macroslope of the Polar Urals, 26.07.2017, author E.D. Lapshina).

Composition. Differential species combination in the association: dwarf shrub *Ledum palustre* subsp. *decumbens* (preferential species, median abundance score 3) and mosses *Sphagnum lenense* (preferential species, 3) and *Aulacomnium turgidum*. Highly constant species are *Betula nana* (2a), *Empetrum hermaphroditum*, *Eriophorum vaginatum* (2b), *Rubus chamaemorus* (2a), *Vaccinium vitis-idaea* subsp. *minus*, mosses *Dicranum elongatum*, *D. laevidens*, *Polytrichum strictum*, *Sphagnum balticum* (2b) and *Orthocaulis binsteadii*.

Based on differences of the species composition in the moss cover that reflect community development stages, 3 variants were identified: *typica*, *Sphagnum capillifolium*, and *Sphagnum fuscum*. The communities of the variant *typica* are dominated by *Sphagnum lenense* with *S. balticum*. Var. *Sphagnum fuscum*, co-dominated by the above sphagna, can be distinguished by the occurrence of *Sphagnum fuscum* (2a) and its permanent companion *Mylia anomala* in the moss cover; *Andromeda polifolia* subsp. *pumila* and *Calypogeia sphagnicola* are constant species. The communities of the var. *Sphagnum capillifolium* represent an early stage of oligotrophization; *Carex bigelowii* subsp. *arctisibirica* (1) is highly constant, *Betula nana* (2b) is abundant, *S. angustifolium* (2b) and *S. capillifolium* (2a) are significant in the moss cover besides *Sphagnum lenense*.

The total number of taxa in the association is 57: 20 vascular plants (3 shrubs, 7 dwarf shrubs, and 10 herbs), 33 mosses, 4 lichens; 13 highly constant species (23 %), 29 species with constancy score I (51 %); 12–26 species in communities (20 on average).

Structure. Total plant cover in the communities is 100 %, with average cover of shrubs 10 %, dwarf shrubs 40 %, herbs 25 %, mosses 85 %, and virtually no lichens. Cottongrass tussocks are small and flat (20–30 cm across, 5 cm high). They are scattered over a continuous moss cover that is mainly composed of *Sphagnum lenense*, sometimes with noticeable participation of *S. balticum*, less frequently with *S. angustifolium*, *S. capillifolium* and *S. fuscum*. Green mosses – *Aulacomnium turgidum*, *Dicranum elongatum* (1), *D. laevidens*, *Polytrichum strictum* and the liverwort *Orthocaulis binsteadii* – accompany them in low abundance but with high constancy. In the hollows between tussocks, *Ledum palustre* subsp. *decumbens* and *Betula nana* dominate in a single shrub-dwarf shrub layer (up to 15 cm in height), while *Vaccinium vitis-idaea* and *Rubus chamaemorus* dominate in a lower dwarf shrub-herb layer. Nanotopography that varies from subdued undulate to pronounced hummocky is formed by cottongrass tussocks and *Sphagnum* moss turf.

Habitats. *Ledum*-cottongrass (*Eriophorum vaginatum*)–*Sphagnum* (*S. lenense*) communities develop on flat areas and gentle slopes of low hills (Fig. 2A). Soils are peaty, with a peat layer of 0.5 to 1.0 m deep. Permafrost occurred at a depth of 20–25 (in one case 30) cm in the first half of August.

Distribution. The association has been described in the southern tundra subzone of the West Siberian sector of the Arctic on the plains adjacent to the Yanganape Mountain Range (spurs of the eastern macroslope of the Polar Urals) (Fig. 1, site 12). Our field studies have shown that it is also widespread in the southern tundra of the Taymyr Peninsula.

Note. Communities of the association *Eriophoro vaginati–Sphagnetum lenenses* [name of ass. *Eriophoro vaginati–Sphagnetum lenensis* (Sinelnikova 2009) was corrected to conform to ICPN Annex I] (Table 4, syntaxon 2) that has a similar composition of dominant species and occurs on raised watershed cottongrass bogs in the upper reaches of the Kolyma River (Sinelnikova 2009) differ from West Siberian communities by the presence of *Polytrichum commune*, *Sphagnum aongstroemii*, *S. squarrosum*, and *S. warnstorfii* in the ground cover, which indicates richer water and mineral nutrition; high participation of the hypoarctic dwarf shrubs *Andromeda polifolia* s. l. and *Vaccinium uliginosum* s. l.; and, contrastingly, an absence or low constancy of *Rubus chamaemorus*, *Aulacomnium turgidum*, *Dicranum elongatum*, *Orthoculis binsteadii*, *Polytrichum strictum*, and *Sphagnum balticum*.

Pleurozio schreberi–Eriophoretum vaginati Lavrinenko et Lavrinenko **ass. nov.** (Table 2, rel. 1–35, Fig. 2B–J, Table 4, syntaxa 6–8)

Table 1. Association ***Ledo decumbentis–Eriophoretum vaginati*** in the plains adjacent to the Yanganape Mountain Range in the West Siberian sector of the Arctic

Variant	***Sphagnum capillifolium* (a)**						***Sphagnum fuscum* (b)**						***typica* (c)**								
Projective cover, %																					
total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100				
shrubs	30	20	15	5	10	25	5	<1	10	10	0	5	1	10	<5	<1	10				
dwarf shrubs	30	55	30	45	40	30	25	20	50	50	10	30	40	60	25	60	70				
herbs	25	20	25	20	20	40	20	50	20	30	30	20	40	25	25	20	25				
bryophytes	90	80	90	95	90	80	80	90	80	95	90	100	90	60	90	90	70				
lichens	0	0	0	0	0	0	<1	0	1	<1	0	0	0	0	0	0	0				
Number of species:																					
total	20	23	17	18	21	23	26	18	21	22	12	24	17	22	16	20	16				
shrubs	2	2	2	1	1	3	1	1	1	1	0	1	1	1	1	1	1				
dwarf shrubs	3	4	5	3	3	4	5	4	4	5	3	4	3	5	5	3	3				
herbs	5	5	3	4	4	4	3	2	3	3	2	2	2	3	3	2	4				
bryophytes	10	12	7	10	13	12	15	11	12	12	7	17	11	13	7	14	8				
lichens	0	0	0	0	0	0	2	0	1	1	0	0	0	0	0	0	0				
Date	27.07.2017	03.08.2017	26.07.2017	26.07.2017	26.07.2017	04.08.2017	28.07.2017	28.07.2017	28.07.2017	04.08.2017	28.07.2017	02.08.2017	28.07.2017	28.07.2017	26.07.2017	28.07.2017	03.08.2017				
Relevé nr.: by author	128E17yp	235E17yp	111E17yp	112E17yp	110E17yp	240E17yp	156E17yp	139E17yp	150E17yp	242E17yp	157E17yp	230E17yp	148E17yp	154E17yp	114E17yp	145E17yp	234E17yp	**Constancy and abundance**			
in the table	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15*	16	17	**a**	**b**	**c**	**ass.**
Differential species combination ass. *Ledo decumbentis–Eriophoretum vaginati*																					
Sphagnum lenense	3	3	5	5	3	2b	3	4	3	4	3	4	3	3	5	5	3	V^{3}	V^{4}	V^{3}	V^{3}
Ledum palustre subsp. *decumbens*	2b	3	2b	3	3	2b	1	2b	3	3	1	2b	3	3	2b	4	4	V^{3}	V^{2b}	V^{3}	V^{3}
Aulacomnium turgidum **C. a.–H. a.**	1	1	+	+	+	+	·	+	+	+	·	+	+	+	+	+	1	V^{+}	IV^{+}	V^{+}	V^{+}
Differential species combination var. *Sphagnum capillifolium*																					
Carex bigelowii subsp. *arctisibirica* **C. a.–H. a.**	1	+	+	1	+	1	·	·	·	·	·	·	·	·	+	·	+	V^{1}	·	II^{+}	III^{+}
Sphagnum capillifolium	2a	+	2a	1	1	2b	1	·	·	·	·	·	1	·	·	·	·	V^{2a}	I^{1}	I^{1}	III^{1}
Sphagnum angustifolium	2b	2b	+	1	2b	·	·	·	·	·	·	·	·	·	+	+	·	V^{2b}	·	II^{+}	III^{1}
Differential species combination var. *Sphagnum fuscum*																					
Sphagnum fuscum	·	·	·	·	·	·	2b	1	2b	1	1	2a	·	·	·	·	·	·	V^{2a}	·	II^{2a}
Mylia anomala	·	·	·	·	·	+	+	+	+	+	+	+	·	+	·	·	·	I^{+}	V^{+}	I^{+}	III^{+}
Calypogeia sphagnicola	·	·	·	·	·	·	+	+	+	·	·	+	·	·	·	+	·	·	IV^{+}	I^{+}	II^{+}
Characteristic species of *Oxycocco-Sphagnetea*, *Sphagnetalia medii*, *Oxycocco microcarpi–Empetrion hermaphroditi*																					
Andromeda polifolia subsp. *pumila*	·	·	+	·	·	·	1	+	+	+	1	+	+	1	+	·	·	I^{+}	V^{+}	III^{+}	III^{+}
Polytrichum strictum	+	+	·	·	+	+	1	+	·	1	1	1	1	1	·	+	+	IV^{+}	V^{1}	IV^{1}	IV^{+}
Vaccinium uliginosum subsp. *microphyllum*	·	+	+	·	·	+	2a	·	·	·	·	·	·	+	+	·	·	III^{+}	I^{2a}	II^{+}	II^{+}
Pinguicula villosa	·	·	·	+	·	·	·	·	+	+	·	·	·	·	·	·	·	I^{+}	II^{+}	·	I^{+}
Oxycoccus microcarpus	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	I^{1}	·	I^{1}
Oxycoccus palustris	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·	·	I^{1}	·	I^{1}
Characteristic species of *Rubo chamaemori–Dicranion elongati*																					
Rubus chamaemorus	1	2a	1	1	+	1	2a	2a	2a	2a	2b	2a	2b	2b	2a	+	1	V^{1}	V^{2a}	V^{2a}	V^{2a}
Dicranum elongatum	·	+	1	·	+	+	1	+	2a	2a	·	·	1	2b	+	1	1	IV^{+}	IV^{2a}	V^{1}	IV^{1}
Characteristic species of *Carici arctisibiricae–Hylocomietea alaskani* prov.																					
Hylocomium splendens	·	1	·	·	·	1	·	·	·	·	·	·	·	·	·	+	+	II^{1}	·	II^{+}	II^{1}
Ptilidium ciliare	1	·	·	·	·	1	+	·	+	1	·	·	+	+	·	·	·	II^{1}	III^{+}	II^{+}	III^{+}
Constant species																					
Eriophorum vaginatum	2b	2b	2b	2b	2b	3	2b	3	2a	2b	2b	2b	2a	2b	2b	2b	2b	V^{2b}	V^{2b}	V^{2b}	V^{2b}
Betula nana	3	2b	2b	1	2a	2b	1	+	2a	1	·	+	1	2a	1	+	2a	V^{2b}	V^{1}	V^{1}	V^{2a}
Empetrum hermaphroditum	+	1	2a	+	+	+	+	1	+	+	·	2b	·	+	1	+	1	V^{+}	V^{+}	IV^{1}	V^{+}
Vaccinium vitis-idaea subsp. *minus*	+	+	1	+	+	2a	1	1	2a	2b	+	·	1	1	1	1	1	V^{+}	V^{1}	V^{1}	V^{1}
Dicranum laevidens	+	1	+	+	+	2a	+	+	+	·	+	+	+	1	+	+	2b	V^{+}	V^{+}	V^{+}	V^{+}
Orthocaulis binsteadii	+	+	+	+	1	+	+	+	+	1	·	+	+	+	+	+	·	V^{+}	V^{+}	IV^{+}	V^{+}
Sphagnum balticum	·	·	·	·	2a	2b	2a	2a	1	3	3	2b	3	1	2a	1	·	II^{2b}	V^{2b}	IV^{2a}	IV^{2b}
Pleurozium schreberi	+	+	·	·	+	·	·	·	·	+	·	·	+	·	·	+	+	III^{+}	I^{+}	III^{+}	III^{+}
Salix pulchra	+	+	·	·	·	+	·	·	·	·	·	·	·	·	·	·	·	III^{+}	·	·	I^{+}
Pohlia nutans	·	+	·	+	+	·	·	·	·	·	·	+	·	·	·	·	·	III^{+}	I^{+}	·	II^{+}
Sphenolobus minutus	·	·	·	·	+	+	+	+	+	1	·	·	·	·	·	·	·	II^{+}	IV^{+}	·	II^{+}
Sphagnum alaskense	·	·	·	·	·	·	1	·	·	·	+	1	1	+	·	1	·	·	III^{1}	III^{1}	II^{1}
Other species																					
Aulacomnium palustre	+	+	·	·	·	·	+	·	·	·	·	·	·	·	·	·	+	II^{+}	I^{+}	I^{+}	II^{+}

Note. Species found in 1–2 relevés with an abundance of r or + (others are indicated in brackets): shrubs – *Salix glauca* 3, 6; herbs – *Festuca ovina* 5; *Calamagrostis neglecta* 1, 17; *Carex rotundata* 7, 14; *Minuartia stricta* 2; *Pedicularis labradorica* 1, 6; *Saussurea alpina* 2; mosses – *Bryum creberrimum* 4; *Ptilium crista-castrensis* 16; *Sanionia uncinata* 4; *Sphagnum girgensohnii* 5; *Straminergon stramineum* 12; *Tetraplodon mnioides* 4; *T. paradoxus*

Table 1. Continued.

7, 12; liverworts – *Cephalozia bicuspidata* 12; C. *connivens* 12, 14, 16; *C. loitlesbergeri* 14; *C. pleniceps* 10; *Cephaloziella* sp. 12; *Lophozia* sp. 12; *Riccardia latifrons* 9, 14; lichens – *Cladonia arbuscula* s. l. 7; *C.* sp. 9 (1); *Cetraria islandica* s. l. 10; *Flavocetraria cucullata* 7.

GPS coordinates (WGS 84) (N, E): **1** – 67.73863, 67.86489; **2** – 67.68760, 67.83558; **3** – 67.68192. 67.83288; **4** – 67.68125, 67.83397; **5** – 67.68251, 67.83170; **6** – 67.73325, 67.81574; **7** – 67.67796, 67.72906; **8** – 67.68754, 67.73101; **9** – 67.67939, 67.72964; **10** – 67.74702, 67.80978; **11** – 67.67533, 67.73219; **12** – 67.74042, 67.89428; **13** – 67.68118, 67.73221; **14** – 67.67796, 67.72906; **15** – 67.68188, 67.83679; **16** – 67.68578, 67.73135; **17** – 67.68697, 67.83407.

Author: **E. D. Lapshina**.

* – nomenclatural type (holotypus): rel. no. **15** (author's no. – 114E17yp), West Siberian sector of the Arctic, plains adjacent to the Yanganape Mountain Range (Eastern macroslope of the Polar Urals), 26.07.2017, author – E.D. Lapshina.

Holotypus: relevé 4 (author's number 5_13), Kolguev Island, Peschanka River, upper reaches, 31.07.2013, authors O.V. Lavrinenko, I.A. Lavrinenko).

Composition. Differential species combination in the association: *Eriophorum vaginatum* (preferential species, abundance score 3), mosses *Aulacomnium palustre*, *Pleurozium schreberi* (1), *Polytrichum jensenii* and lichens *Cetraria islandica* s. l., *Cladonia arbuscula* s. l. (1), *C. gracilis* subsp. *elongata*, *Ochrolechia frigida*, *Peltigera scabrosa*, *Sphaerophorus globosus*, *Thamnolia vermicularis*. Highly constant species are *Betula nana* (1), *Empetrum hermaphroditum* (2a), *Ledum palustre* subsp. *decumbens* (2a), *Vaccinium uliginosum* subsp. *microphyllum* (1), *V. vitis-idaea* subsp. *minus* (1), *Rubus chamaemorus* (2a); *Dicranum elongatum* (1), *D. laevidens* (1), *Sphagnum balticum* (2b), *Orthocaulis binsteadii* and *Sphenolobus minutus*; *Cetraria islandica* s. l, *Cladonia amaurocraea*, *C. rangiferina* (incl. *C. stygia*), *Flavocetraria cucullata*.

The total number of taxa in the association is 122: 30 vascular plants (4 shrubs, 8 dwarf shrubs, and 18 herbs), 37 mosses, 55 lichens; 22 highly constant species (18 %), 76 species with constancy score I (62 %); 19–58 species in communities (mean 34).

Structure. Total plant cover in the communities is 99 %, with average cover of shrubs 5 %, dwarf shrubs 20 %, herbs 55 %, mosses 50 %, and lichens 10 %. Cottongrass forms semispherical tussocks 25–40 cm across, 10–20 cm high, with dry and green vegetative (15–25 cm long) and generative (30–50 cm long) shoots sticking out evenly in all directions. The tussocks are evenly scattered across the surface, usually 30–70 cm apart. The space between them is filled with mosses (most commonly *Dicranum elongatum*, *D. laevidens*, *Polytrichum jensenii*, *P. strictum*, *Sphagnum balticum*, *S. lenense*, *S. russowii*) with flecks of lichens (fruticose and tubular *Cladonia* and *Flavocetraria*). Other mosses, such as *Aulacomnium turgidum* or *Pleurozium schreberi*, tend to grow either next to the tussocks or directly inside of them between the cottongrass shoots. Rising 2–5 cm above the lichen-moss turf surface are cloudberry leaves, shoots of dwarf shrubs, and the creeping *Betula nana*. Communities with a well-developed *Sphagnum* cover have a flat or slightly undulate surface between tussocks. But more often the nanotopography between them is gently hillocky, and, in this case, sphagna mosses with interspersed shoots of *Polytrichum jensenii* are confined to the lower elements, while dicranium mosses, *Polytrichum strictum*, and lichens to the elevations. The latter also grow on occasional small spots of frost-heaved loam (Figs 2B, C). Less common are communities with a patchy horizontal structure that can be clearly seen in UAV photographs: the cottongrass tussocks are not evenly dispersed across the plot's surface, but concentrated at the periphery of patches (about 1 m across) with lichen microgroups and and such modules alternate alternate with dwarf shrub-cloudberry-moss turf (Fig. 2D). Low (10–30 cm high) willows *Salix glauca*, some herbs, such as *Deschampsia glauca* and *Petasites frigidus*, and the moss *Racomitrium lanuginosum* can occasionally occupy these patches.

Habitats. Cottongrass tussock communities with a dwarf shrub-cloudberry-lichen-moss cover occur in strips (20–50 m wide) on gentle hillslopes in the transit zone between zonal spotted tundra and flat palsa bogs, along the edges of high river terraces, on foothills and in the lower gentle slopes of loamy hills where they change over to peatlands, as well as on peripheries of flat palsa bogs.

Soils are peat-gley criogenic, with a peat depth of 10–25 (up to 45) cm, underlain with wet blue clay loam. The peat depth varies in the presence of modules "cottongrass tussocks around lichen patches": the peat depth does not exceed 5 cm under lichens, with a mineral gleyed loam horizon approaching close to the surface, while the peat depth increases rapidly beyond the edge of the patch (Fig. 2E).

Distribution. The association is confined to the typical and southern tundra subzones in the Bolshezemelskaya and Malozemelskaya tundra as well as on Kolguev Island, mainly in areas of hill and ridge or hillocky topography, where loamy sediments come to the surface.

Note. The association *Empetro subholarctici–Eriophoretum vaginati* was recently described in the southern tundra on the Tazovskii Peninsula (Telyatnikov et al. 2021). Although the overall species composition is quite similar (see Tables 2, 4), we believe that the communities described by us cannot be attributed to this association for the following reasons: 1) fundamental differences from the holotypus of ass. *Empetro subholarctici–Eriophoretum vaginati*, where *Ledum palustre* subsp. *decumbens* and *Rubus chamaemorus* co-dominate in the herb-dwarf shrub tier (2b each), and *Eriophorum vaginatum* has low (2a) abundance, i.e. the communities cannot be physiognomically classified as tussock communities; the ground cover is dominated by lichens (90 % coverage), with *Cladonia amaurocraea* (3), *C. stygia* (3), and *Alectoria ochroleuca* (2b); the latter species, gravitating to mountainous terrain, is abundant in East European tundras only in wind-exposed habitats in *Loiseleurio procumbentis–Vaccinietea* Eggler ex Schubert 1960; 2) species identified as a differential combination of the ass. *Pleurozio schreberi–Eriophoretum vaginati* are absent or have low constancy in the ass. *Empetro subholarctici–Eriophoretum vaginati*; 3) the communities of the ass. *Empetro subholarctici–Eriophoretum vaginati* occupy other habitats, namely high-centered polygons (5 to 25 m in diameter, 20 to 40 cm high) in the polygonal tundra-mire complexes on the flat tops of watersheds; soil organic horison is peaty, 20 to 30 cm thick, underlain by sandy loam (Telyatnikov et al. 2021).

The new association differs significantly in composition and structure from the ass. *Eriophoro vaginati–Sphagnetum baltici* Bogdanowskaya-Guihéneuf 1928 first described on raised bogs in the Baltic States (Bogdanowskaya-Guihéneuf 1928), despite sharing the two major species in its name (see Table 4, syntaxon 1). These are oligotrophic cottongrass–*Sphagnum* communities dominated by *Sphagnum balticum*, which forms a continuous moss cover, against which flat tussocks of *Eriophorum vaginatum* are scattered. A sparse herb-dwarf shrub tier is formed by *Andromeda polifolia* s. l., *Calluna vulgaris*, *Chamaedaphne calyculata*, *Drosera rotundifolia*, and *Oxycoccus palustris*. The association is classified as *Scheuchzerio palustris–Caricetea nigrae* (Lapshina et al. 2022). It occurs in Finland, in the boreal zone of European Russia,

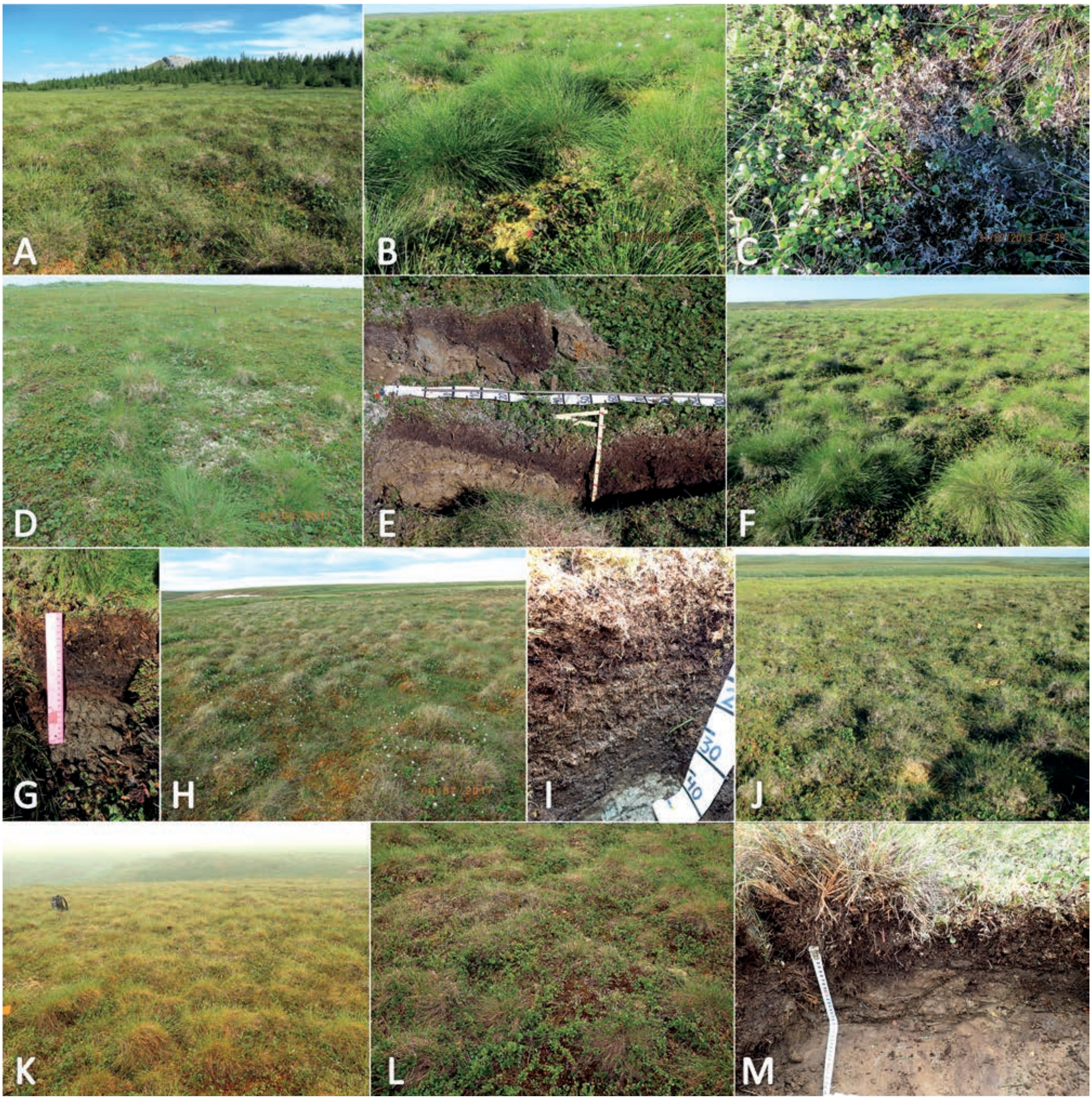

Figure 2 Views of communities and soil pits. A – cottongrass tussocks community of the *Ledo decumbentis–Eriophoretum vaginati* on plains adjacent to the Yanganape Mountain Range (Table 1); B – fragment of community of the *Pleurozio schreberi–Eriophoretum vaginati typicum* on the Kolguev Isl. – sphagnum cover with cloudberries (Table 2, rel. no. 4 (5_13)); C – Fragment of community of the *Pleurozio schreberi–Eriophoretum vaginati typicum* on the Kolguev Isl. – loamy patch with lichens (Table 2, rel. no. 4 (5_13)); D – modules "cottongrass tussocks around lichen patches" in community of the *Pleurozio schreberi–Eriophoretum vaginati sphagnetosum lenense* on Bolvanskii Nose Cape, Bolshezemelskaya tundra (Table 2, rel. no. 12 (M7_2017)); E – a trench through a lichen microgroup on a loamy patch and a shrub-cloudberry-moss microgroup between cottongrass tussocks on Bolvanskii Nose Cape, Bolshezemelskaya tundra (Table 2, rel. no. 12 (M7_2017); soil pits and photo was made by A.G. Shmatova in 2020); F – cottongrass tussocks community of the *Pleurozio schreberi–Eriophoretum vaginati typicum* on the Kolguev Isl. in the upstream of Peschanka River (Table 2, rel. no. 3 (47_13)); G – peat-gleyzem under the community of the *Pleurozio schreberi–Eriophoretum vaginati typicum* on the Kolguev Isl. (Table 2, rel. no. 1 (60_13)); H – cottongrass tussocks community of the *Pleurozio schreberi–Eriophoretum vaginati shagnetosum lenenses* on Vangureymusyur Upland, Bolshezemelskaya tundra (Table 2, rel. no. 9 (Ван25)); I – peat-gleyzem under the community of the *Pleurozio schreberi–Eriophoretum vaginati shagnetosum lenenses* on Bolvanskii Nose Cape, Bolshezemelskaya tundra (Table 2, rel. no. 26 (БН51_20); soil pit was made by A.G. Shmatova); J – cottongrass tussocks community of the *Pleurozio schreberi–Eriophoretum vaginati sphagnetosum russowii* on Vesnimusyur Upland, Bolshezemelskaya tundra (Table 2, rel. no. 24 (Шап5)); in the background is the community of the *Pleurozio schreberi–Caricetum globularis*, in which sedge creates a salad green aspect); K – cottongrass tussocks community of the *Arctagrostio latifoliae–Eriophoretum vaginati* on high riverbank edge of Kystyktakh River, Taymyr Peninsula (Table 3, rel. no. 2 (Ta76); poor visibility due to smog from the Yakutsk fires in the summer of 2021); L – fragment of community of the *Arctagrostio latifoliae–Eriophoretum vaginati* in Kystyktakh River basin, Taymyr Peninsula (Table 3, rel. no. 3 (Ta80)); M – gleyzem under the community of the *Arctagrostio latifoliae–Eriophoretum vaginati* in Kystyktakh River basin, Taymyr Peninsula (Table 3, rel. no. 2 (Ta76); soil pit was made by I.D. Makhatkov)

in northern Belarus, but is the most abundant in continental climate – in the raised bog complexes in the forest zone of West Siberia (Lapshina 2010), maintaining a remarkably constant composition and structure throughout its range.

Based on the floristic differences in the ass. *Pleurozio schreberi–Eriophoretum vaginati*, 3 subassociations have been identified that alternate along a latitudinal gradient.

Pleurozio schreberi–Eriophoretum vaginati typicum **subass. nov.** (Table 2, rel. 1–8, Table 4, syntaxon 7; Figs 2F, G)

Holotypus: relevé 4 (author's number 5_13), Kolguev Island, Peschanka River, upper reaches, 31.07.2013, authors O.V. Lavrinenko, I.A. Lavrinenko).

Composition. Differential species combination is the same as in the association. The subassociation is distinguished by the absence of *Ledum palustre* subsp. *decumbens* (taxon not found on the island) and the extremely rare occurrence of *Andromeda polifolia* subsp. *pumila*.

The total number of taxa in the subassociation is 63: 16 vascular plants (2 shrubs, 6 dwarf shrubs, and 8 herbs), 17 mosses, 30 lichens; 24 highly constant species (38 %), 21 species with constancy score I (33 %); 18–42 species in communities (mean 29).

Structure and Habitats. Same as in the association. The ground cover is predominantly mosses, with many species: *Aulacomnium palustre*, *Dicranum elongatum*, *D. laevidens*, *Pleurozium schreberi*, *Polytrichum jensenii*, *P. strictum*, *Sphagnum balticum*; lichens cover 1–2 %, with only one community having 10 % of lichen cover.

Distribution. The subassociation is confined to Kolguev Island in the southern part of the typical tundra subzone. The communities have been described in the upper and middle reaches of the Peschanka River and in the middle reaches of the Bugryanka River (Fig. 1, sites 1–3).

Note. Bogdanowskaya-Guihéneuf (1938) described 4 floristically close associations in the class *Eriophoreta vaginati salebrosa* (tussock cottongrass bogs) on Kolguev Island and gave more or less complete list of species for the two of them (ass. *Eriophorum vaginatum–Rubus hamaemorus–Empetrum hermaphroditum* and ass. *Betula nana–Eriophorum vaginatum*) in the text (p. 103) that we made to a table (Table 2). The ass. *Eriophorum vaginatum–Rubus hamaemorus–Empetrum hermaphroditum*, with communities dominated by green mosses (28 %) and a few sphagna (2 %), including *Sphagnum balticum* and *S. girgensohnii*, is certainly close to the newly described association, whereas the relevés of ass. *Betula nana–Eriophorum vaginatum* communities are less similar to those we have described, as they are transitional to birch-moss tundra.

Subass. ***Pleurozio schreberi–Eriophoretum vaginati sphagnetosum lenenses*** Lavrinenko et Lavrinenko **subass. nov.** (Table 2, rel. 9–28; Table 4, syntaxon 6; Fig. 2H, I)

Holotypus: relevé 14 (author's number НГ11), northeastern part of Malozemelskaya tundra, Nenets Ridge, 30.06.2021, authors O.V. Lavrinenko, I.A. Lavrinenko).

Composition. Present are all species of the differential combination of the association. The sedges *Carex rariflora* (abundance of 2a), *C. bigelowii* subsp. *arctisibirica*, and the mosses *Aulacomnium turgidum* and *Sphagnum lenense* (2b) complement it in commumities of the subassociation.

The total number of taxa in the subassociation is 95: 23 vascular plants (3 shrubs, 7 dwarf shrubs, and 13 herbs), 31 mosses, 41 lichens; 26 highly constant species (27 %), 51 species with constancy score I (54 %); 22–51 species in communities (mean 34).

Structure. The total projective cover in the communities of the subassociation is 100 %, with mean cover of shrubs 20 % (highly variable, 0 to 40 %), dwarf shrubs 25 %, herbs 50 %, mosses 60 %, and lichens 5 %. Horizontal and vertical structure is generally the same as in the association. The tussock communities described on the Vangureymusyur Upland (Table 2, no. rel. 9–11) have a well-developed cover of sphagna mosses (especially *Sphagnum lenense*) and a high abundance of *Betula nana* (2b).

Habitats. The communities occupy foothills and lower, gentle parts of loamy hillslopes where they change over to peatlands, edges of high river terraces, transitional areas between zonal communities, and flat palsa bogs on watersheds. Soils are peaty gley. In some cenoses with a well-developed sphagnum cover (especially of *Sphagnum lenense*), the peat horizon (first poorly, then well-decomposed) is succeeded by the blue-gley loam at greater depths – up to 45 cm (Fig. 2I). The loamy horizon is not detectable in early summer, as the peat is frozen to a depth of 25 cm.

Distribution. The communities were described in the Malozemelskaya (Tobseda settlement) and Bolshezemelskaya (Cape Bolvanskii Nos and Bolvanskaya Bay, Vangureymusyur Upland, Khaipudyrskaya Bay) tundras (Fig. 1, sites 4, 6–8, 11). The subassociation occurs in coastal areas on the mainland that are located in 2 subzones – typical (southern part) and southern (northern part) tundras.

Subass. ***Pleurozio schreberi–Eriophoretum vaginati shagnetosum russowii*** Lavrinenko et Lavrinenko **subass. nov.** (Table 2, rel. 29–35, Table 4, syntaxon 8; Fig. 2J)

Holotypus: relevé 31 (author's number Шап34), central part of Bolshezemelskaya tundra, Vesnimusyur Upland on the watershed of the Shapkina River and its tributary Vesniyu River, 23.07.2009, authors O.V. Lavrinenko, I.A. Lavrinenko).

Composition. Present are all species of the differential combination of the association. The grasses *Calamagrostis lapponica* and *Festuca ovina*, the moss *Sphagnum russowii* (abundance 2a), some lichens (*Cladonia cenotea*, *C. chlorophaea*, *C. cornuta* s. l., *C. uncialis*) complement it in communities of the subassociation. The subassociation has a great abundance of the drarf shrubs *Ledum palustre* subsp. *decumbens* (2b), moss *Pleurozium schreberi* and common lichens *Cladonia rangiferina* and *C. arbuscula* s. l. (each 2a).

The total number of taxa in the subassociation is 88: 20 vascular plants (3 shrubs, 7 dwarf shrubs, and 10 herbs), 25 mosses, 43 lichens; 26 highly constant species (30 %), 24 species with constancy score I (27 %); 35–58 species in communities (mean 42).

Structure. The total projective cover in the communities of the subassociation is 97 %, with mean cover of shrubs 20 % (highly variable, <1 до 30 %), dwarf shrubs 30 %, herbs 40 %, mosses 40 %, and lichens 25 %. Horizontal and vertical structure is generally the same as in the association. They differ by a well-developed dwarf shrub layer, predominantly of *Ledum palustre* subsp. *decumbens*, 10–15 cm high, and a greater participation of lichens in the ground cover in the hollows between tussocks. The lichen-moss cover is co-dominated by *Sphagnum balticum*, *S. russowii*, *Pleurozium schreberi* (growing not only on cottongrass tussocks, but also between them), *Dicranum elongatum*, *Cladonia arbuscula* s. l., *C. rangiferina* and *C. amaurocraea*.

Habitats. The communities occur in the middle and lower slopes of gentle hills, as well as on slightly convex tops

Table 2. Association ***Pleurozio schreberi–Eriophoretum vaginati*** in East European tundras and comparison with close syntaxa

Subassociation	***typicum* (a)**								***shagnetosum lenenses* (b)**																				***sphagnetosum russowii* (c)**							**Constancy and abundance**							
Projective cover, % total	100	100	100	100	100	100	100	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	90	100	90	99	100	100	100								
shrubs	0	10	<1	5	<1	0	1	<1	10	25	40	1	3	3	30	3	<1	<1	<1	3	<1	<1	0	<1	<1	<1	<1	<1	25	<1	3	<1	<1	15	30								
dwarf shrubs	1	5	15	5	5	40	30	10	5	10	10	30	20	20	25	20	35	60	40	25	30	15	10	15	10	30	10	20	25	30	40	40	20	30	10								
herbs	70	60	60	70	70	60	50	70	30	50	40	60	65	80	50	80	50	50	50	80	60	60	60	60	60	45	50	60	10	40	30	40	40	50	50								
bryophytes	25	30	30	30	30	70	60	30	80	80	70	60	35	40	50	50	50	80	45	60	50	40	50	50	50	80	40	40	30	20	40	50	40	30	60								
lichens	2	10	2	1	1	1	2	1	<1	1	3	12	25	15	1	2	5	5	15	<1	2	5	<1	<1	1	1	5	5	10	40	10	30	40	20	20								
Number of species: total	18	30	27	23	25	31	42	34	25	35	36	51	42	36	39	29	46	37	41	24	35	30	31	22	27	30	25	25	58	35	51	55	34	35	24								
shrubs	0	1	2	1	1	0	1	2	1	1	1	3	3	2	2	1	2	1	1	1	1	1	0	1	2	1	1	1	3	1	2	2	2	1	1								
dwarf shrubs	2	3	4	2	3	3	4	5	4	4	3	6	5	4	4	3	5	6	6	5	5	6	6	5	4	6	5	3	5	4	5	5	5	5	6								
herbs	3	2	2	2	2	3	2	7	5	5	4	5	6	6	4	3	6	6	6	3	4	5	4	3	3	4	3	4	8	3	7	5	3	2	2								
bryophytes	5	7	8	7	7	8	13	9	7	13	14	16	12	9	16	9	10	9	13	10	10	9	10	8	9	12	8	6	12	8	13	15	10	11	9								
lichens	8	17	11	11	12	17	22	11	8	12	14	21	16	15	13	13	23	15	15	5	15	9	11	5	9	7	8	11	30	19	24	28	14	16	6								
Date	08.08.2013	28.08.2013	05.08.2013	31.07.2013	18.08.2013	04.08.2012	17.08.2012	10.08.2013	12.07.2017	19.07.2017	11.07.2017	02.08.2017	30.06.2021	01.07.2021	08.07.2017	30.06.2021	18.07.1999	26.07.2014	26.07.2014	08.07.2021	06.08.2015	27.07.2014	12.08.2015	09.08.2015	10.07.2021	01.08.2020	08.07.2011	24.07.2015	10.07.2010	22.07.2009	23.07.2009	23.07.2009	20.07.2009	08.08.2017	23.07.2011								
Tundra subzone	typical, Kolguev Isl.								typical and south, coast of the Barents Sea																				south, mainland														
Locality	K1	K2	K1	K1	K1	K3	K3	K1	Vn	Vn	Vn	BN	NR	NR	Vn	NR	BN	BN	BN	NR	M	BN	M	M	NR	BN	T	YN	Kh	Sh	Sh	Sh	Sh	Sh	Kh								
Relevé nr. by author	60_13	147_13	47_13	5_13	104_13	12_12	80_12	74_13	Ван25	Ван53	Ван18	М7_17	НГ12	НГ19	Ван6	НГ11	БН25_99	БН25_14	БН27_14	НГ58	ХГ110	БН32_14	ХГ150	ХГ131	НГ68	БН51_20	Т121	БГ38	SrH F1.1	Шап32	Шап34	Шап33	Шап31	Шап5	СрХ_2								
Relevé nr. in the table	1	2	3	4*	5	6	7	8	9	10	11	12	13	14	15	16*	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31*	32	33	34	35	**a**	**b**	**c**	***Pleurozio schreberi–Eriophoretum vaginati***	***Eriophorum vaginatum–Rubus hamaemorus–Empetrum hermaphroditum***	***Betula nana–Eriophorum vaginatum*** (Bogdanovskaya-Giyenef, 1938)	***Empetro subholarctici–Eriophoretum vaginati*** Khitun in Telyatnikov et al. 2021	rel. no. 27 (**holotypus**) (Telyatnikov et al. 2021)
Differential species combination of the *Pleurozio schreberi–Eriophoretum vaginati*																																											
Eriophorum vaginatum	3	4	3	4	4	3	3	3	2b	2b	3	2b	3	3	3	4	3	2a	3	3	3	3	3	3	3	3	3	3	2a	3	3	3	2b	3	3	**V³**	**V³**	**V³**	**V³**	3	3	V²ᵇ	2a
Pleurozium schreberi	·	+	+	2a	+	2a	+	1	+	+	+	1	1	1	1	2a	2a	·	+	r	r	+	1	+	+	1	1	1	+	2a	2a	2a	2b	+	+	V⁺	V¹	V²ᵃ	V¹	2a	1	II¹	·
Cladonia arbuscula s. l.	1	1	1	+	1	1	1	+	+	+	+	1	2a	2a	+	+	+	+	2a	·	+	1	+	+	+	+	1	+	1	2b	1	2a	2b	2b	2a	V¹	V⁺	V²ᵃ	V¹	2b	1	III⁺	·
Cladonia gracilis subsp. *elongata*	+	+	+	·	+	+	+	·	+	+	+	+	+	+	+	+	+	+	+	r	+	+	r	r	+	·	1	+	+	1	1	2a	1	+	+	IV⁺	V⁺	V¹	V⁺	1	+	II⁺	·
Polytrichum jensenii	+	1	+	+	+	1	+	+	1	1	+	+	·	·	1	+	·	·	+	1	+	·	1	·	1	1	+	·	·	·	·	+	+	·	+	V⁺	IV¹	III⁺	IV⁺	·	·	II¹	·
Aulacomnium palustre	·	+	1	2a	+	·	+	+	·	+	+	1	·	1	+	+	1	·	+	·	2a	r	2a	·	+	1	1	+	·	·	+	+	+	·	r	IV⁺	IV⁺	III⁺	IV⁺	2a	1	·	·
Peltigera scabrosa	·	·	r	r	r	·	·	+	·	·	+	+	+	+	r	+	+	1	1	·	1	·	r	·	·	r	+	1	+	+	+	+	1	·	·	IIIʳ	IV⁺	IV⁺	IV⁺	·	·	·	·
Thamnolia vermicularis	r	r	r	·	r	·	·	·	+	+	+	1	1	+	+	+	+	+	+	·	r	+	r	·	+	+	·	·	+	·	·	+	·	r	·	IIIʳ	IV⁺	III⁺	IV⁺	·	·	·	·
Ochrolechia frigida	+	1	+	+	+	+	+	+	r	·	+	·	+	·	+	r	+	·	·	·	r	·	·	·	·	·	·	·	+	+	+	+	r	r	·	V⁺	II⁺	V⁺	III⁺	1	·	I⁺	·
Sphaerophorus globosus	·	+	·	r	·	+	·	+	·	+	+	·	+	+	+	r	r	·	·	·	r	·	·	·	·	·	·	·	+	r	+	+	·	·	·	III⁺	II⁺	III⁺	III⁺	+	1	·	·
Differential species combination of the *Pleurozio schreberi–Eriophoretum vaginati shagnetosum lenenses*																																											
Sphagnum lenense	·	·	·	·	·	·	·	·	4	4	4	2a	+	2b	·	2b	2b	2b	2a	3	·	2a	2a	1	3	3	·	·	·	·	·	·	·	·	·	·	IV²ᵇ	·	III²ᵇ	·	·	IV²ᵇ	2a
Aulacomnium turgidum **C. a.–H. a.**	·	·	r	·	·	·	·	·	+	r	+	1	1	+	r	+	·	2b	2a	r	2b	r	+	1	·	·	·	·	+	·	r	·	·	·	·	Iʳ	IV⁺	II⁺	III⁺	·	·	II⁺	·
Carex bigelowii subsp. *arctisibirica* **C. a.–H. a.**	·	·	·	·	·	·	·	·	r	r	+	+	2b	2a	2a	+	+	+	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	III⁺	·	II⁺	·	·	II¹	1
Carex rariflora	·	·	·	·	·	+	·	·	+	·	·	·	·	·	·	·	·	2a	2a	2a	2a	1	+	+	2a	2a	1	+	·	·	·	·	·	·	·	I⁺	III²ᵃ	·	II¹	·	2a	·	·
Differential species combination of the *Pleurozio schreberi–Eriophoretum vaginati sphagnetosum russowii*																																											
Sphagnum russowii **O.-S.**	·	·	·	·	·	·	·	·	·	+	+	2a	+	·	1	·	·	·	·	2a	·	1	·	·	+	1	·	·	2a	2a	2b	2b	2a	2a	3	·	III¹	V²ᵃ	III²ᵃ	1	·	·	·
Cladonia chlorophaea	·	·	·	·	·	·	r	r	·	·	·	r	·	·	·	·	·	r	·	·	r	·	r	·	·	·	·	·	r	r	r	r	r	r	·	IIʳ	Iʳ	Vʳ	IIʳ	·	·	II⁺	·
Cladonia cornuta s. l.	·	r	·	·	r	·	·	·	·	·	·	r	·	·	·	r	·	·	r	·	·	·	·	·	·	·	·	·	+	+	r	+	+	·	·	IIʳ	Iʳ	IV⁺	IIʳ	·	·	II⁺	·
Cladonia uncialis	·	+	·	·	·	+	r	·	·	·	·	r	·	r	·	·	r	·	·	·	·	·	·	·	·	·	r	·	r	1	+	+	·	·	+	II⁺	Iʳ	IV⁺	II⁺	·	·	·	·
Calamagrostis lapponica	·	·	·	·	·	·	·	·	·	r	·	·	+	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·	1	+	r	·	r	·	·	·	I⁺	III⁺	I⁺	·	·	·	·
Festuca ovina	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·	·	·	+	·	+	r	·	·	·	·	I⁺	III⁺	I⁺	·	·	·	·
Cladonia cenotea	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	r	r	·	r	·	·	·	·	·	IIIʳ	Iʳ	·	·	II⁺	·
Differential species combination of the *Empetro subholarctici–Eriophoretum vaginati*																																											
Alectoria ochroleuca	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	r	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	Iʳ	·	Iʳ	·	·	V²ᵃ	**2b**
Cladonia stellaris	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·	·	·	·	r	·	·	·	·	I⁺	Iʳ	I⁺	·	·	V²ᵃ	+
Cetraria laevigata	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	V²ᵃ	+
Bryocaulon divergens	·	·	·	·	·	·	·	·	·	·	·	+	+	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·	·	·	r	·	·	I⁺	Iʳ	I⁺	·	·	III⁺	·
Characteristic species of the *Oxycocco-Sphagnetea*, *Sphagnetalia medii* and *Oxycocco microcarpi–Empetrion hermaphroditi*																																											
Vaccinium uliginosum subsp. *microphyllum*	·	·	r	·	+	2a	2b	1	r	+	·	+	+	+	+	·	·	r	+	+	r	+	r	+	·	1	2a	·	2a	1	+	+	+	+	r	IV¹	IV⁺	V⁺	IV⁺	·	1	V¹	+
Polytrichum strictum	·	·	·	+	1	+	+	+	·	+	r	+	·	·	+	·	·	+	·	r	·	+	·	+	·	·	+	·	2a	·	+	·	·	r	1	IV⁺	III⁺	III¹	III⁺	2b		I²ᵃ	2a
Ledum palustre subsp. *decumbens*	·	·	·	·	·	·	·	·	r	r	r	2a	+	1	r	2a	2a	2b	2a	+	1	2a	1	1	1	1	+	+	2b	2b	2b	2b	2a	2a	2b	·	V¹	V²ᵇ	IV¹	·	·	V²ᵇ	2b
Andromeda polifolia subsp. *pumila*	·	·	·	·	·	·	r	·	·	·	·	r	·	·	·	·	+	+	+	1	2a	+	+	1	r	2a	+	·	·	·	·	·	+	r	+	Iʳ	III⁺	III⁺	III⁺	·	·	III⁺	+
Pinguicula villosa	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	r	r	·	·	+	r	·	·	r	·	·	·	·	·	·	·	·	·	·	IIʳ	·	Iʳ	·	·	·	·
Oxycoccus microcarpus	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	r	r	·	·	2a	·	·	·	·	·	·	·	·	+	·	I⁺	I⁺	I⁺	·	·	·	·

Table 2. Continued.

Subassociation	*typicum* (a)								*shagnetosum lenenses* (b)																				*sphagnetosum russowii* (c)							Constancy and abundance							
Relevé nr. in the table	1	2	3	4*	5	6	7	8	9	10	11	12	13	14	15	16*	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31*	32	33	34	35	**a**	**b**	**c**					
Characteristic species of the *Rubo chamaemori–Dicranion elongati*																																											
Rubus chamaemorus	2a	1	2a	2a	2a	2b	1	2b	2a	2b	2a	3	2a	2b	1	2b	2b	3	2b	3	2a	2a	2a	2a	3	2a	2a	2a	+	2a	2a	1	2b	2a	2b	V^{2a}	V^{2a}	V^{2a}	V^{2a}	2b	3	V^{2b}	2b
Dicranum elongatum	2a	2a	1	+	1	2a	1	1	+	+	.	1	2a	+	+	.	1	1	+	.	.	.	+	+	1	.	+	.	2a	1	+	+	1	1	+	V^{1}	IV^{+}	V^{1}	IV^{1}	1	1	V^{2a}	+
Characteristic species of the *Carici arctisibiricae–Hylocomietea alaskani* class. prov.																																											
Hylocomium splendens	·	·	·	·	·	·	·	·	·	r	·	1	+	+	·	1	+	1	1	·	+	·	·	·	·	·	·	2a	·	r	+	r	·	·	·	·	III^{1}	III^{r}	II^{+}	·	1	I^{+}	·
Ptilidium ciliare	·	·	·	·	·	+	·	·	·	r	r	·	r	·	r	·	+	·	·	·	·	·	·	·	·	·	·	·	+	·	+	1	·	r	·	I^{+}	II^{r}	III^{+}	II^{+}	·	·	II^{+}	·
Salix glauca	·	·	r	·	·	·	·	r	·	·	·	+	+	r	+	·	+	·	·	·	·	·	·	·	r	·	·	·	1	·	r	r	r	·	·	II^{r}	II^{+}	III^{r}	II^{r}	·	·	·	·
Pedicularis lapponica	·	·	·	·	·	·	·	·	·	r	+	·	+	r	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	r	r	·	·	·	·	I^{+}	II^{r}	I^{r}	·	·	·	·
Petasites frigidus	·	·	·	·	·	·	·	r	·	·	·	·	·	·	r	·	+	·	·	·	·	·	·	·	·	·	·	·	+	·	·	+	·	·	·	I^{r}	I^{+}	II^{+}	I^{+}	·	1	·	·
Deschampsia glauca	·	·	·	·	·	·	·	r	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	r	·	+	·	·	·	·	I^{r}	·	II^{+}	I^{r}	·	1	·	·
Constant species of syntaxa																																											
Sphagnum balticum	2a	2a	2a	2a	2a	3	3	2a	·	·	+	2b	2a	+	2b	·	2b	2b	2b	2a	2b	2b	2b	3	2a	3	3	+	2a	1	1	1	2b	2a	2a	V^{2a}	V^{2b}	V^{2a}	V^{2a}	+	·	**IV^{3}**	**3**
Empetrum hermaphroditum	1	1	2a	1	+	2b	2a	1	+	1	1	2b	2a	2a	1	2a	2a	3	2b	2a	2b	2a	2a	2a	2a	2b	2a	2b	2b	2a	2a	2a	2a	2b	2a	V^{1}	V^{2a}	V^{2a}	V^{2a}	3	+	·	·
Empetrum subholarcticum	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	V^{+}	+
Vaccinium vitis-idaea subsp. *minus*	+	1	1	+	1	2a	1	1	1	2a	2a	2a	2a	2a	2b	1	2a	2a	2a	2a	1	+	1	+	+	+	1	1	1	+	1	1	1	2a	+	V^{1}	V^{2a}	V^{1}	V^{1}	2a	2a	V^{1}	+
Dicranum laevidens	1	·	2a	+	2a	1	1	1	1	1	1	·	1	1	2a	1	+	·	+	1	1	+	·	+	1	1	2b	2b	1	+	+	+	+	·	+	V^{1}	V^{1}	V^{+}	V^{1}	1	1	III^{2a}	2a
Betula nana	·	2a	+	1	+	·	1	r	2a	2b	3	1	1	1	3	1	1	+	+	1	+	+	·	r	+	r	+	r	2a	+	1	1	+	1	2a	IV^{1}	V^{1}	V^{1}	V^{1}	·	3	IV^{2a}	·
Cetraria islandica s. l.	·	+	+	+	r	+	+	+	r	+	+	+	+	1	+	+	+	+	+	·	+	+	r	+	·	+	1	r	+	+	+	+	+	r	·	V^{+}	V^{+}	V^{+}	V^{+}	1	·	IV^{1}	+
Cladonia amaurocraea	+	+	+	+	+	+	+	+	+	+	+	1	1	+	+	+	1	+	+	r	+	·	r	+	+	+	·	1	+	+	1	2a	1	1	2a	V^{+}	V^{+}	V^{1}	V^{+}	·	·	V^{2a}	**3**
Cladonia rangiferina (incl. *C. stygia*)	1	+	1	+	1	+	1	+	+	+	+	1	+	2a	+	1	1	+	2a	r	r	+	r	+	+	+	1	1	1	2a	1	2a	2b	+	2a	V^{1}	V^{+}	V^{2a}	V^{+}	1	·	**V^{3}**	**3**
Flavocetraria cucullata	+	+	+	+	+	r	+	+	·	+	+	1	+	1	r	+	+	1	+	·	r	+	·	·	+	r	·	+	+	1	+	+	1	+	+	V^{+}	IV^{+}	V^{+}	V^{+}	·	·	V^{1}	·
Sphenolobus minutus	+	+	+	·	·	+	+	+	·	+	+	+	1	+	+	+	+	·	+	1	·	·	+	+	+	+	1	·	·	+	+	+	+	+	+	IV^{+}	IV^{+}	V^{+}	IV^{+}	·	·	III^{+}	+
Flavocetraria nivalis	+	·	+	·	r	r	+	·	·	·	·	+	r	·	·	·	r	·	r	·	·	+	·	·	r	·	·	·	+	1	·	·	1	+	·	IV^{+}	II^{r}	III^{1}	III^{+}	1	·	II^{1}	2a
Orthocaulis binsteadii	1	+	+	+	1	·	1	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·	+	+	·	·	·	V^{+}	I^{+}	II^{+}	II^{+}	·	·	·	·
Cladonia pleurota	·	r	·	r	·	r	+	·	·	·	r	·	·	·	r	r	·	·	·	·	·	·	·	·	·	·	·	·	r	r	r	r	·	r	·	III^{r}	I^{r}	IV^{r}	II^{r}	·	·	II^{+}	·
Cladonia bellidiflora	·	+	·	r	·	r	+	r	·	r	·	·	·	·	·	·	r	·	·	·	·	·	·	·	·	·	·	·	·	·	·	r	·	r	·	IV^{r}	I^{r}	II^{r}	II^{r}	1	·	·	·
Peltigera aphthosa	·	·	·	·	·	·	·	·	·	·	1	1	·	+	+	·	+	+	+	+	·	·	r	·	r	·	·	+	+	+	1	+	1	·	·	·	III^{+}	IV^{+}	III^{+}	·	·	II^{+}	·
Arctous alpina	·	r	r	·	·	·	·	+	·	·	·	+	+	·	·	·	+	·	r	·	·	·	·	·	·	·	·	·	1	·	1	+	·	·	·	II^{r}	I^{+}	III^{1}	II^{+}	·	·	·	·
Cladonia sulphurina	·	+	·	·	·	·	r	·	·	r	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	r	r	r	·	·	·	·	II^{+}	I^{r}	III^{r}	I^{r}	·	·	II^{+}	·
Cladonia subfurcata	·	·	·	·	·	+	+	·	·	·	·	·	·	r	·	·	·	·	·	·	·	·	·	·	·	·	r	·	·	·	+	+	·	+	·	II^{+}	I^{r}	III^{+}	I^{+}	·	·	III^{+}	·
Ochrolechia androgyna	·	+	·	·	+	·	r	·	·	·	·	·	·	·	·	·	r	r	·	·	·	·	·	·	·	·	·	·	·	+	r	+	·	·	·	II^{+}	I^{r}	III^{+}	II^{+}	·	·	·	·
Cladonia cyanipes	·	·	·	·	·	·	·	r	·	·	·	·	·	·	·	·	r	·	r	·	·	·	r	·	·	·	r	·	r	·	·	r	·	·	+	I^{r}	I^{r}	III^{r}	II^{r}	·	·	II^{2a}	·
Peltigera polydactylon	·	·	r	·	·	·	·	·	r	r	·	·	+	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	+	·	+	+	+	·	·	I^{r}	I^{+}	III^{+}	II^{+}	·	·	·	·
Cladonia coccifera (incl. *C. borealis*)	·	·	·	r	·	·	·	·	·	·	·	·	r	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	r	+	·	·	·	I^{r}	I^{r}	III^{+}	I^{r}	+	·	·	·
Liverworts	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	2a	1	·	·
Other species																																											
Equisetum arvense	·	·	·	·	·	·	·	·	·	·	·	·	r	r	·	·	+	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·	I^{r}	I^{1}	I^{+}	·	·	·	·
Luzula wahlenbergii	+	·	·	·	·	·	·	+	r	·	·	r	·	·	·	·	·	·	·	·	·	r	·	·	·	·	·	r	·	·	·	·	·	·	·	II^{+}	I^{r}	·	I^{r}	1	1	·	·
Pedicularis labradorica	·	·	·	·	·	·	·	·	·	·	·	r	·	·	·	·	·	·	r	·	r	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	I^{r}	·	I^{r}	·	·	·	·
Dicranum flexicaule	·	·	·	·	·	·	+	·	·	·	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	+	·	·	I^{+}	I^{+}	II^{+}	I^{+}	·	·	·	·
Dicranum groenlandicum	·	·	·	·	·	·	·	·	·	·	·	r	·	·	·	·	·	r	·	·	·	·	r	·	·	·	·	·	·	·	·	·	·	+	·	·	I^{r}	I^{+}	I^{r}	·	·	·	·
Dicranum majus	·	+	·	·	·	·	·	+	·	·	·	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	II^{+}	I^{+}	I^{+}	I^{+}	·	·	·	·
Pohlia nutans	·	·	·	·	·	·	+	·	·	·	·	·	+	·	·	+	·	·	·	r	+	·	·	·	·	·	·	·	·	·	r	r	·	·	·	I^{+}	I^{+}	II^{r}	I^{+}	·	·	·	·
Polytrichum hyperboreum	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·	+	+	·	·	·	·	·	·	I^{+}	II^{+}	I^{+}	·	·	·	·
Racomitrium lanuginosum	·	·	·	·	·	·	·	·	·	·	r	·	r	·	r	·	+	·	·	·	·	·	·	·	·	·	·	·	r	·	+	·	·	·	·	·	I^{r}	II^{+}	I^{r}	·	·	·	·
Sphagnum angustifolium ***O.-S.***	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	1	+	·	·	·	I^{+}	II^{1}	I^{+}	·	·	I^{+}	·
Sphagnum aongstroemii	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	1	·	·	1	·	·	+	·	·	·	·	·	·	·	·	·	·	·	I^{1}	·	I^{1}	·	·	·	·
Sphagnum fimbriatum	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	1	·	·	+	·	·	·	+	·	·	·	·	·	·	·	·	·	·	·	I^{+}	·	I^{+}	+	·	·	·
Sphagnum girgensohnii	·	·	·	·	·	·	·	·	1	1	1	2a	·	·	1	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	II^{1}	·	I^{1}	1	2a	·	·
Straminergon stramineum	·	·	·	·	·	·	+	·	·	·	·	·	·	·	+	·	·	+	·	·	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·	I^{+}	I^{+}	·	I^{+}	·	·	·	·
Cladonia crispata s. l.	·	·	·	·	·	·	·	·	·	·	·	+	·	r	·	·	r	·	·	·	·	r	·	·	·	·	·	·	r	·	·	·	·	·	·	·	I^{r}	I^{r}	I^{r}	·	·	·	·
Cladonia deformis	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·	r	·	·	·	·	·	r	·	·	·	·	·	r	·	·	·	·	·	·	I^{+}	I^{r}	I^{r}	I^{r}	·	·	I^{+}	·
Cladonia maxima	·	·	·	·	·	·	r	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	+	·	·	·	I^{r}	I^{+}	I^{+}	I^{+}	·	·	·	·
Cladonia squamosa	·	r	·	·	·	r	r	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	r	r	·	·	·	II^{r}	·	II^{r}	I^{r}	·	·	·	·
Hypogymnia physodes	·	·	·	·	·	·	·	·	·	r	·	·	·	·	·	·	r	·	·	·	r	·	·	·	·	·	·	·	r	·	·	·	·	r	·	·	I^{r}	II^{r}	I^{r}	·	·	·	·
Nephroma arcticum	·	·	·	·	·	·	·	·	·	·	·	+	r	·	·	·	+	·	r	·	1	·	·	·	·	·	·	1	·	·	·	+	·	·	·	·	II^{+}	I^{+}	I^{+}	·	·	·	·
Omphalina umbellifera	·	·	·	·	·	r	r	·	·	·	r	r	·	·	·	·	·	·	·	r	·	·	·	·	·	·	·	·	r	·	·	·	·	·	·	II^{r}	I^{r}	I^{r}	I^{r}	·	·	·	·
Peltigera canina	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	+	+	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	I^{+}	·	I^{+}	·	+	·	·
Peltigera scabrosella	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	r	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	r	r	·	·	·	I^{r}	II^{r}	I^{r}	·	·	·	·
Pertusaria dactylina	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	r	·	·	·	·	·	·	·	·	·	·	·	r	·	r	·	·	·	·	·	I^{r}	II^{r}	I^{r}	·	·	I^{+}	·
Psoroma hypnorum	·	·	·	·	·	·	·	·	·	·	·	·	r	·	·	·	r	·	·	·	·	·	·	·	·	·	·	·	r	·	·	·	·	·	·	·	I^{r}	I^{r}	I^{r}	·	·	·	·
Stereocaulon alpinum	·	·	·	·	·	·	·	·	·	·	+	+	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	I^{+}	·	I^{+}	·	1	I^{2a}	·
Tuckermannopsis inermis	·	·	·	·	·	r	r	·	·	·	·	·	·	r	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	II^{r}	I^{r}	·	I^{r}	·	·	·	·
Sphagnum fuscum ***O.-S.***	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	1	·	·	·	II^{1}	I^{1}	·	·	II^{2b}	·

Note. Species found in 1–2 relevés with an abundance of r or + (others are indicated in brackets): shrubs – *Salix phylicifolia* 29; *S. lanata* s. l. 12, 13; dwarf shrubs – *Salix herbacea* 8; herbs – *Chamaenerion angustifolium* 29; *Festuca richardsonii* 8; *Juncus biglumis* 31; *Pinguicula vulgaris* 18; *Polemonium acutiflorum* 8; mosses – *Drepanocladus sendtneri* 34; *Polytrichum commune* 29; *Rhytidium rugosum* 12(1); *Sanionia uncinata* 26, 32; *Sphagnum capillifolium* 19, 34; *S. teres* 28; *Splachnum sphaericum* 15; *Stereodon bambergeri* 13; *Tetraplodon mnioides* 15; *Warnstorfia fluitans* 7; *W. sarmentosa* 7; lichens

Table 2. Continued.

– *Alectoria nigricans* 21; *Baeomyces carneus* 29, 31; *Bryoria nitidula* 12, 18; *Cetrariella fastigiata* 7; *Cladonia macrophylla* 29; *C. scabriuscula* 6, 7; *Dactylina arctica* 14, 21; *Omphalina hudsoniana* 2; *Nephroma expallidum* 12; *Ochrolechia inaequatula* 15, 30; *Peltigera neckeri* 28; *Pertusaria panyrga* 29; *Protopannaria pezizioides* 31, 32; *Solorina crocea* 31.

GPS coordinates (WGS 84) (N, E): **1** – 69.21944, 48.87306; **2** – 69.19306, 49.45444; **3** – 69.25417, 48.88167; **4** – 69.22528, 48.83000; **5** – 69.23222, 48.82694; **6** – 68.86528, 49.23111; **7** – 68.86194, 49.28472; **8** – 69.26556, 48.89139; **9** – 68.33597, 56.49056; **10** – 68.35275, 56.46089; **11** – 68.35286, 56.46075; **12** – 68.29403, 54.49994; **13** – 68.36389, 53.14389; **14** – 68.36461, 53.10658; **15** – 68.34531, 56.40725; **16** – 68.36361, 53.14678; **17** – 68.24403, 54.46303; **18** – 68.29336, 54.49678; **19** – 68.29281, 54.49644; **20**– 68.36725, 53.15089; **21** – 68.29686, 59.90944; **22** – 68.28975, 54.47347; **23** – 68.28150, 59.95361; **24** – 68.28261, 59.89294; **25** – 68.36336, 53.13886; **26** – 68.29294, 54.49486; **27** – no data; **28** – 68.08622, 54.78431; **29** – 67.43583, 56.48575; **30** – 67.56694, 54.92583; **31** – 67.56778, 54.93556; **32** – 67.56861, 54.93694; **33** – 67.56556, 54.97500; **34** – 67.52425, 55.08403.

Authors. **O.V. Lavrinenko, I.A. Lavrinenko**.

Abbreviations. Locality: **K** – Kolguev Isl.: **K1** – Peschanka River in the upstream, **K2** – Peschanka River in the middlestream, **K3** – Bugryanka River basin; **BN** – Bolvanskii Nose Cape environs; **Vn** – Vangureymusyur Upland, Bolshaya Khekheganyakha River middlestream; **M** – More-Yu River delta, Khaipudyrskaya Bay; **NR** – Nenets Ridge; **Kh** – Kharyaga River basin (Sredne-Kharyaga oil field); **T** – Tobseda settlement vicinity, Kolokolkova Bay; **Sh** – Vesnimusyur Upland, Shapkina River basin; **YN** – Yachey and Neruta Rivers interfluve, Bolvanskaya Bay.

Characteristic species (next to the name of the taxon): ***C. a.–H. a.*** – ***Carici arctisibiricae–Hylocomietea alaskani*** class. prov.; ***O.-S.*** – ***Oxycocco-Sphagnetea***.

Here and in Tables 3–5 blue shading indicates the absence or low constancy of significant species, bold type indicates high abundance.

* – nomenclatural types (holotypus): rel. no. **4** (author's no. – 5_13), Kolguev Isl., Peschanka River in the upstream, 31.07.2013, authors – O.V. Lavrinenko, I.A. Lavrinenko; rel. no. **14** (author's no. – НГ11), northeastern part of Malozemelskaya tundra, Nenets Ridge, 30.06.2021, authors – O.V. Lavrinenko, I.A. Lavrinenko; rel. no. **31** (author's no. – Шап34), Vesnimusyur Upland, on the watershed Shapkina River its tributary Vesniyu River, 23.07.2009, authors – O.V. Lavrinenko, I.A. Lavrinenko.

(where mineral soil is close to the surface) of stoloniferous peat mounds, drained by runoff troughs with willow stands. Soils are peaty-gley, with occasional small (up to 0.5 m in diameter) patches of loam between closely spaced cottongrass tussocks.

Distribution. The described communities occur in the central part of Bolshezemelskaya tundra at the watershed of the Shapkina River and its tributary the Vesniyu River (Vesnimusyur Upland) as well as at the watershed of the Laya and Kharayakha Rivers (Sredne-Kharyaga oil field) at the altitudes of 120–150 m a.s.l. (Fig. 1, sites 9, 10). The subassociation is widespread on uplands in the southern part of the southern tundra subzone.

Note. Tussock communities of the subassociation occur in habitats similar to those in the previously described ass. *Pleurozio schreberi–Caricetum globularis* Lavrinenko et Lavrinenko 2015 **nom. invers. hoc loco** that also fringe zonal tundras. The association was originally described under the name *Carici globularis–Pleurozietum schreberi* (Lavrinenko & Lavrinenko 2015); here, we put sedge in second place in the name, because, in the holotypus, it belongs to the upper layer and has a higher abundance than moss (2b and 2a, respectively) (Arts 10b, 29b, 42 ICPN). Often the cottongrass tussock and sedge cenoses alternate in bands and adjoin each other (Fig. 2J), but the latter occupy better drained areas on the hillsides and their ground cover is dominated by lichens rather than mosses.

Ass. ***Arctagrostio latifoliae–Eriophoretum vaginati*** Lavrinenko O. et Lapshina **ass. nov.** (Table 3, rel. 1–8, Table 5, syntaxon 9; Fig. 2K–M)

Holotypus: relevé 4 (author's number Ta83), Taymyr Peninsula, Kystyktakh River at the confluence with the Dudypta River, high riverbank edge, 06.08.2021, author O.V. Lavrinenko).

Composition. Differential species combination of the association: grasses and herbs *Arctagrostis latifolia*, *Calamagrostis holmii*, *Pedicularis labradorica*, *Stellaria peduncularis*, dwarf shrub *Arctous alpina*, shrub *Salix glauca*, mosses *Sphagnum balticum* (abundance 2a), *S. lenense* (2a), *S. warnstorfii* (1), *Ptilidium ciliare* (2a), *Racomitrium lanuginosum*, *Orthocaulis binsteadii*, and lichens *Cladonia uncialis*, *Flavocetraria nivalis*, and *Sphaerophorus globosus*.

Some of these are characteristic species of the provisional class *Carici arctisibiricae–Hylocomietea alaskani*, order *Eriophoretalia vaginati* and alliance *Cassiopo tetragonae–Eriophorion vaginati* (Matveyeva & Lavrinenko 2021) (see Table 3). Other highly constant characteristic species of these higher zonal vegetation units are *Eriophorum vaginatum* (preferential species, 4), *Carex bigelowii* subsp. *arctisibirica*, *Cassiope tetragona*, *Salix pulchra* (1), *Aulacomnium turgidum* (1), *Hylocomium splendens*, and *Dactylina arctica*, while *Dryas punctata*, *Pedicularis lapponica*, *Poa arctica*, and *Tomentypnum nitens* occur only occasionally.

Several characteristic species of the class *Oxycocco–Sphagnetea* and its two member alliances – *Ledum palustre* subsp. *decumbens* (2b), *Vaccinium uliginosum* subsp. *microphyllum* (1), *Polytrichum strictum* (1), *Dicranum elongatum* (1), are highly constant here, but, unlike the above associations, this one does not contain *Andromeda polifolia* subsp. *pumila* and *Rubus chamaemorus* occurs rarely and in low abundance.

Constant are the shrub *Betula nana* (2b), dwarf shrubs *Empetrum subholarcticum* (1) and *Vaccinium vitis-idaea* subsp. *minus* (2a), bryophytes *Dicranum laevidens* (2a) and *Sphenolobus minutus*, lichens *Cladonia arbuscula* s. l. (2a), *C. rangiferina* (incl. *C. stygia*) (1), *Flavocetraria cucullata* (1) and other low abundance species (see Table 3).

The total number of taxa in the subassociation is 94: 30 vascular plants (5 shrubs, 8 dwarf shrubs, and 17 herbs), 34 mosses, 30 lichens; 39 highly constant species (41 %), 50 species with constancy score I (53 %); 40–55 species in communities (mean 48).

Structure. The total cover in the communities is 100 %, with mean cover of shrubs 20 %, dwarf shrubs 25 %, herbs 60 %, mosses 40 %, and lichens 10 %.

Cottongrass tussocks are hemispherical, 10–15 cm high, 20–30 cm wide, with protruding dry and green vegetative (15 cm long) and sparse generative (20–25 cm long) shoots. The tussocks are evenly and fairly densely scattered over the surface, usually 10–50 cm apart.

Not exceeding cottongrass in height, shrubs (*Betula nana* и *Salix pulchra*) and dwarf shrubs (*Ledum palustre* subsp. *decumbens*, *Vaccinium vitis-idaea* subsp. *minus*) are abundant in hollows between the tussocks (Fig. 2L). The low-abundance dwarf shrubs *Cassiope tetragona*, *Empetrum subholarcticum*, *Vaccinium uliginosum* subsp. *microphyllum* and herbs *Carex bigelowii*

Table 3. Association ***Arctagrostio latifoliae–Eriophoretum vaginati*** in the southern tundra on Taymyr Peninsula

Relevé nr. in the table	1	2	3	4*	5	6	7	8	Constancy and abundance
Projective cover, %									
total	100	100	100	100	100	100	100	100	
shrubs	30	15	15	15	10	20	20	20	
dwarf shrubs	10	20	15	20	40	30	30	35	
herbs	60	70	60	70	50	50	50	50	
bryophytes	50	25	30	30	30	30	40	50	
lichens	5	5	15	5	30	10	20	10	
Number of species:									
total	50	50	55	46	50	46	45	40	
shrubs	3	2	3	2	3	3	3	3	
dwarf shrubs	4	7	6	7	5	6	5	5	
herbs	10	4	7	7	9	7	9	9	
bryophytes	21	16	14	17	15	14	14	14	
lichens	12	21	25	13	18	16	14	9	
Date	02.08.2021	05.08.2021	05.08.2021	06.08.2021	08.08.2021	05.08.2021	06.08.2021	05.08.2021	
Locality	B	K	K	K	K	K	K	K	
Authors	Lav	Lav	Lav	Lav	Lav	Lap	Lap	Lap	
Relevé nr. by author	**Ta65**	**Ta76**	**Ta80**	**Ta83**	**Ta96**	**276**	**299**	**275**	
Differential species combination of the *Arctagrostio latifoliae–Eriophoretum vaginati*									
Eriophorum vaginatum	4	4	4	4	3	3	3	3	**V^{4}**
Arctagrostis latifolia **C.a.–H.a.**	r	·	+	+	+	1	1	1	V^{+}
Calamagrostis holmii ***E.v.***	+	·	r	+	r	+	+	+	V^{+}
Pedicularis labradorica	r	r	+	r	r	r	r	·	V^{r}
Sphagnum balticum	+	+	+	+	2a	2a	2a	3	V^{2a}
Sphagnum warnstorfii ***E.v.***	+	1	r	+	1	1	1	1	V^{1}
Sphagnum lenense	·	+	·	+	2a	2a	2a	3	IV^{2a}
Ptilidium ciliare **C.a.–H.a.**	1	+	2a	2b	2a	+	2b	+	V^{2a}
Orthocaulis binsteadii	+	+	+	+	+	1	+	·	V^{+}
Stellaria peduncularis **C.a.–H.a.**	+	·	·	r	+	+	r	+	IV^{+}
Arctous alpina	·	+	r	+	r	+	·	·	IV^{+}
Racomitrium lanuginosum ***C.a.–H.a.***	·	·	+	+	+	+	+	r	IV^{+}
Sphaerophorus globosus	·	r	+	+	1	·	+	·	IV^{+}
Cladonia uncialis	·	+	+	·	+	+	+	+	IV^{+}
Flavocetraria nivalis	·	r	r	r	r	r	·	·	IV^{r}
Salix glauca **C.a.–H.a.**	2a	·	+	·	·	+	·	+	III^{+}
Characteristic species of the *Carici arctisibiricae–Hylocomietea alaskani*, *Eriophoretalia vaginati* and *Cassiopo tetragonae–Eriophorion vaginati* (Matveeva & Lavrinenko 2021)									
Salix pulchra	+	1	1	1	1	2a	1	2a	V^{1}
Aulacomnium turgidum	2b	1	1	1	+	1	1	1	V^{1}
Hylocomium splendens	2a	+	+	+	+	+	1	+	V^{+}
Carex bigelowii subsp. *arctisibirica*	+	r	+	+	+	1	2a	+	V^{+}
Dactylina arctica	+	+	+	+	r	+	+	+	V^{+}
Cassiope tetragona	·	r	·	+	r	+	1	+	IV^{+}
Tomentypnum nitens	2a	+	·	·	·	·	·	·	II^{1}
Pedicularis lapponica	·	+	r	·	·	·	·	·	II^{+}
Poa arctica	r	·	·	·	·	·	r	·	II^{r}
Dryas punctata	·	r	r	·	·	·	·	·	II^{r}
Characteristic species of the *Oxycocco-Sphagnetea*, *Sphagnetalia medii*, *Oxycocco microcarpi–Empetrion hermaphroditi*									
Ledum palustre subsp. *decumbens*	+	2a	1	2b	3	2b	2a	3	V^{2b}
Polytrichum strictum	1	+	1	+	·	1	1	+	V^{1}
Vaccinium uliginosum subsp. *microphyllum*	2a	1	1	+	+	+	1	1	V^{1}
Characteristic species of the *Rubo chamaemori–Dicranion elongati*									
Dicranum elongatum	+	+	+	1	+	1	2a	1	V^{1}
Rubus chamaemorus	r	·	·	·	1	·	·	+	II^{+}
Constant species of syntaxa									
Betula nana	2b	2a	2a	2a	2a	2b	2b	2b	V^{2b}
Dicranum laevidens	2a	1	2a	2a	2a	2a	1	1	V^{2a}
Vaccinium vitis-idaea subsp. *minus*	+	+	1	1	2b	2a	2b	2a	V^{2a}
Cladonia arbuscula s. l.	r	+	1	+	2a	2a	2a	2a	V^{2a}
Cladonia rangiferina	+	+	+	+	2a	1	2a	1	V^{1}
Empetrum subholarcticum	+	1	1	+	·	1	+	1	V^{1}
Flavocetraria cucullata	1	+	1	1	2a	2a	2a	1	V^{1}

Table 3. Continued.

Relevé nr. in the table	1	2	3	4*	5	6	7	8	
Sphenolobus minutus	+	+	+	1	+	+	+	+	V^{+}
Thamnolia vermicularis	+	+	+	+	+	+	+	+	V^{+}
Cetraria islandica s· l·	+	+	+	+	+	+	2a	+	V^{+}
Cladonia amaurocraea	+	+	1	+	+	+	1	+	V^{+}
Cladonia gracilis subsp· *elongata*	+	+	+	+	+	+	+	+	V^{+}
Cladonia coccifera (incl· *C· borealis*)	·	r	r	r	r	r	·	·	IV^{r}
Cetraria laevigata	r	+	r	·	+	r	r	·	IV^{r}
Ochrolechia frigida	·	+	+	+	r	·	·	·	III^{+}
Cladonia chlorophaea	·	r	r	·	r	r	·	·	III^{r}
Other species									
Pedicularis capitata	·	·	+	r	·	·	·	r	II^{r}
Polytrichum hyperboreum	·	r	1	·	·	1	·	·	II^{1}
Pleurozium schreberi	·	+	·	r	r	·	·	·	II^{r}
Sphagnum aongstroemii	·	·	·	r	r	·	·	+	II^{r}
Sanionia uncinata	·	·	r	r	·	·	·	r	II^{r}
Peltigera polydactylon	+	·	r	·	·	·	r	·	II^{r}
Cladonia cyanipes	r	·	r	·	·	·	+	·	II^{r}
Cladonia pleurota	·	r	·	r	·	+	·	·	II^{r}
Cladonia sulphurina	r	r	·	·	·	r	·	·	IIr

Note. Species found in 1–2 relevés with an abundance of r or +: shrubs – *Salix phylicifolia* 7; *S. recurvigemis* 5; dwarf shrubs – *Salix polaris* 4; herbs – *Eriophorum angustifolium* 7; *Juncus castaneus* 6, 8; *Luzula nivalis* 1; *Petasites sibiricus* 5; *Pyrola rotundifolia* (incl. *P. grandiflora*) 1; *Ranunculus lapponicus* 7, 8; *Saxifraga nelsoniana* 5; mosses – *Aulacomnium palustre* 1; *Bryum pseudotriquetrum* 1; *Dicranum acutifolium* 5; *Ditrichum gracile* 1; *Loeskypnum badium* 1; *Oncophorus demetrii* 1; *Plagiothecium berggrenianum* 1, 2; *Pohlia nutans* 1; *Scorpidium revolvens* 1; *Sphagnum beringiense* 1; *S. compactum* 4; *Stereodon holmenii* 3 7; *S. plicatulus* 2, 4; *Tetraplodon mnioides* 5; *Warnstorfia sarmentosa* 1; liverworts – *Blepharostoma trichophyllum* 7; *Lophozia* sp. 6, 8; lichens – *Alectoria nigricans* 3; *A. ochroleuca* 3, 5; *Bryocaulon divergens* 5 6; *Cladonia cenotea* 2, 3; *C. cornuta* s. l. 3; *C. crispata* s. l. 2; *C. squamosa* 2, 3; *C. subfurcata* 3, 7; *Ochrolechia androgyna* 2, 3; *Peltigera scabrosa* 3; *Pertusaria panyrga* 5.

GPS coordinates (WGS 84) (N, E): **1** – 71.22303, 92.64342; **2** – 70.94553, 91.24822; **3** – 70.94572, 91.25206; **4** – 70.94697, 91.25747; **5** – 70.94794, 91.24064; **6** – 70.95229, 91.25443; **7** – 70.96851, 91.29947; **8** – 70.95215, 91.25641.

Abbreviations. Authors: **Lav** – O.V. Lavrinenko, **Lap** – E.D. Lapshina.

Locality: Taymyr Peninsula, Dudypta River basin: **B** – the confluence of Bataika River in Dudypta, **K** – the confluence of Kystyktakh River in Dudypta.

Characteristic species (next to the name of the taxon): ***C.a.–H.a.*** – ***Carici arctisibiricae–Hylocomietea alaskani*** class. prov.; ***E.v.*** – ***Eriophoretalia vaginati*** ord. prov.

* – nomenclatural types (holotypus): rel. no. 4 (author's no. – Ta83), Taymyr Peninsula, Kystyktakh River at the confluence with the Dudypta River, high riverbank edge, 06.08.2021, author – O.V. Lavrinenko.

subsp. *arctisibirica*, *Pedicularis labradorica*, *Stellaria peduncularis* form a lower tier (5–10 cm high). Occasional generative shoots of the grasses *Arctagrostis latifolia* and *Calamagrostis holmii* rise above the cottongrass tussocks. The ground cover is mosaic and multispecies. The wettest hollows between tussocks are filled with turf-forming sphagna (*Sphagnum balticum*, *S. lenense*, *S. warnstorfii*), while drier and flatter locations are occupied by green mosses (*Aulacomnium turgidum*, *Dicranum elongatum*, *D. laevidens*, *Hylocomium splendens*, *Polytrichum strictum*) and liverwort *Ptilidium ciliare*. They are interrupted by raised convex patches of loam that are sometimes bare, but more often covered with lichens (*Cladonia arbuscula* s. l., *C. rangiferina*, *Flavocetraria cucullata*) and the moss *Racomitrium lanuginosum*. Elevation differences between nanotopography elements are 10–20 cm.

Habitats. Cottongrass tussocks communities occupy poorly drained flat or slightly concave loam surfaces on watersheds, where they border with zonal spotted sedge-dwarf shrub-moss tundras on gently sloping surfaces. They often develop along the edges of flat high river terraces and are also associated with tundra-marsh complexes where they form on slightly elevated mineral mounds. The soil is gley, with the organic horizon of about 5 cm deep (Fig. 2M).

Distribution. The association was described in the Dudepta River basin on Taymyr Peninsula, in the southern part of the southern tundra subzone.

Note. We compared the new association with the ass. *Sphagno–Eriophoretum vaginati* described for Arctic Alaska (subzone E) (Walker et al. 1994) (Table 5). It is widespread on mesic, acidic soils of the upland tundra, covering gentle, poorly drained slopes. Although occurring on uplands, this association includes some hygrophytic species due to the high water-holding capacity of the Sphagnum mosses. The tussock-forming *Eriophorum vaginatum* is a conspicuous dominant in most stands. The association was originally categorized to the class *Oxycocco–Sphagnetea* (Walker et al. 1994) but later placed in "tundra" *Loiseleurio–Vaccinietea* Eggler 1952 class (Kade et al. 2005). At the same time, the authors used different methods for studying vegetation. In Walker's et al. studies most vegetation plots were ca. 80 m^2. In Kade's et al. studies homogeneous vegetation that was representative of the major plant communities was described on small plots (1 m^2), therefore, plant microgroups within cottongrass tussock communities were described as different syntaxa. So the vegetation on the often inactive nonsorted circles and earth hummocks has been described as the ass. *Cladino–Vaccinietum vitis-idaeae* Kade, Walker et Raynolds 2005 and vegetation on the slightly wetter small and barren active nonsorted circles as *Anthelia juratzkana–Juncus biglumis* community.

Initially 2 subassociations, *typicum* and *betuletosum nanae*, have been described in ass. *Sphagno–Eriophoretum vaginati*. The latter one, in which *Eriophorum vaginatum* is almost absent ($III^{r,+}$), is a well-defined low-shrub community dominated by *Betula nana* subsp. *exilis* that is common along the margins of water tracks and on palsas and high-centered polygons in colluvial basins. We doubt that such communities that have floristic and physiognomic differences and occupy different habitats should be combined into one association.

On a latitudinal and longitudinal gradient within the ass. *Sphagno–Eriophoretum vaginati* in the Russian Arctic, 2 more subassociations, 4 variants and 2 vicariants (with 2 variants) have been proposed (Matveyeva 1998, Kholod 2007, Telyatnikov & Pristyazhnyuk 2012, Telyatnikov et al. 2014), so the association now has a very complex structure (see Tables 4 and 5). The name of the association is invalid, as it is not obvious which *Sphagnum* species it is derived from, and this cannot be ascertained from the diagnosis and tables (ICPN, Art. 3g). Since the association is invalid, all the subsyntaxa are also invalid (Art. 4a ICPN).

Therefore, we decided to describe a new ass. *Arctagrostio latifoliae–Eriophoretum vaginati*, which differs floristically from the ass. *Sphagno–Eriophoretum vaginati*, despite a large group of common constant species that are characteristic species of the provisional class *Carici arctisibiricae–Hylocomietea alaskani* and subordinate higher syntaxa, or common tundra plants widespread in many tundra syntaxa (Table 5).

DISCUSSION

Despite some physiognomic similarities, the new associations *Ledo decumbentis–Eriophoretum vaginati* and *Pleurozio schreberi–Eriophoretum vaginati* placed in the class *Oxycocco–Sphagnetea* and described in various (West Siberian and East European) sectors of the Arctic differ by their species composition and habitats. In communities of the ass. *Ledo decumbentis–Eriophoretum vaginati*, the ground cover consists mainly of the East Siberian–North American species *Sphagnum lenense* (abundance 3–5) that is almost always accompanied by the Eurasian species *S. balticum* (1–3) and other oligotrophic sphagna species *Sphagnum angustifolium*, *S. capillifolium*, and *S. fuscum*. The abundance of other constant mosses (*Aulacomnium turgidum*, *Dicranum elongatum*, *D. laevidens*, *Polytrichum strictum*) is low (+ – 2a), and lichens are almost absent. The *Ledum*–cottongrass–*Sphagnum* (*S. lenense*) communities form on peat soils on flat foothills and gentle low hillslopes on the plains adjacent to the eastern macroslope of the Polar Urals. In general, they are widespread in the West Siberian and Central Siberian sectors of the Arctic.

The ground cover in the cenoses of the ass. *Pleurozio schreberi–Eriophoretum vaginati* contains many lichens (a total of 55 species), although their total abundance is low (usually not exceeding 10 %, but may rise to 50 % in the more "southerly" subass. *P. s.–E. v. shagnetosum russowii*). The moss cover is multi-species and oligodominant, with *Sphagnum balticum* (+ – 3) and green mosses of similar abundance (*Aulacomnium palustre*, *Dicranum elongatum*, *D. laevidens*, *Pleurozium schreberi*, *Polytrichum jensenii*, *P. strictum*) always present; subassociations can also contain other oligotrophic sphagna *Sphagnum lenense*, *S. girgensohnii* and *S. russowii*. *Sphagnum lenense* that is common in communities east of the Urals, is not widespread in East European tundras and penetrates westward, apparetly occurring on the coastal uplands only. Communities with *S. lenense* are in the rank of the subass. *P. s.–E. v. shagnetosum lenenses* and floristically they are most similar to the ass. *Ledo decumbentis–Eriophoretum vaginati*. In East European tundras, cottongrass tussock lichen-dwarf shrub-moss communities are found on gentle hillslopes where they occupy the transition zone between tundra and flat palsa bogs, on the edges of high river terraces, and on the periphery of flat palsa bogs in locations where the peat horizon underlain by heavy loam usually does not exceed a depth of 25 cm. The loam horizon is close to the surface in some locations and occasionally breaks through the dwarf shrub-moss turf, pouring out to form small patches.

We placed both associations in the bog vegetation class *Oxycocco–Sphagnetea* and the *Oxycocco microcarpi–Empetrion hermaphroditi* alliance based on the large group of characteristic species: *Andromeda polifolia* subsp. *pumila*, *Ledum palustre* subsp. *decumbens*, *Oxycoccus microcarpus*, *Pinguicula villosa*, *Rubus chamaemorus*, *Vaccinium uliginosum* subsp. *microphyllum*, *Calypogeia sphagnicola*, *Mylia anomala*, *Polytrichum strictum*, *Sphagnum angustifolium*, *S. capillifolium*, *S. fuscum*, *S. lenense*, *S. russowii* (species according to: Ermakov 2012; Mucina et al. 2016: Electronic Appendix S6: List of diagnostic species of classes of plant communities dominated by vascular plants). Although *Rubus chamaemorus* and *Dicranum elongatum*, characteristic species of the alliance *Rubo chamaemori–Dicranion elongati* (see Tables 1 and 2), are significant in the new associations, they should be placed in the *Oxycocco microcarpi–Empetrion hermaphroditi* alliance, as *Sphagnum* mosses are common in communities of the both associations and the abundance of lichens is low. The alliance *Rubo chamaemori–Dicranion elongati* has been described

Table 4. Synoptic table of syntaxa of bog communities with *Eriophorum vaginatum*

Class	*S.p.–C.n.*	***Oxycocco-Sphagnetea***											
Order	*S.p.*	***Sphagnetalia medii***											
Alliance	*S.p.*	***Oxycocco microcarpi–Empetrion hermaphroditi***											
Association	*E.v.–S.b.*	*E.v.–S.l.*	***Ledo decumbentis–Eriophoretum vaginati***			***Pleurozio schreberi–Eriophoretum vaginati***			*E.s.–E.v.*	***? Sphagno–Eriophoretum vaginati***			
Subassociation		*typicum*				*sphagnetosum lenenses*	*typicum*	*sphagnetosum russowii*		*typicum*			
Variant			*Sphagnum capillifolium*	*Sphagnum fuscum*	*typica*					*Alectoria nigricans*	*inops*	*Sphagnum aongstroemii*	*Pedicularis labradorica*
Number of relevés	21	9	6	6	5	20	8	7	9	12	7	7	8
Syntaxon number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Differential species combination of the *Eriophoro vaginati–Sphagnetum baltici* Bogdanowskaya-Guihéneuf 1928													
Oxycoccus palustris	IV$^{+,1}$	·	·	I^{1}	·	·	·	·	·	·	·	·	·
Sphagnum magellanicum	IV^{+-2}	·	·	·	·	·	·	·	·	·	·	·	·
Drosera rotundifolia	III$^{+,1}$	·	·	·	·	·	·	·	·	·	·	·	·
Chamaedaphne calyculata **O.-S.**	IV^{+-2}	·	·	·	·	·	·	·	·	·	·	·	·
Calluna vulgaris	II$^{+,1}$	·	·	·	·	·	·	·	·	·	·	·	·
Differential species combination of the *Eriophoro vaginati–Sphagnetum lenenses* Sinelnikova 2009													
Sphagnum warnstorfii	·	IV^{+-2}	·	·	·	·	·	·	·	I^{+}	·	·	II^{2b}
Sphagnum squarrosum	·	III^{1,2}	·	·	·	·	·	·	·	·	·	·	II^{1}
Polytrichum commune	·	III$^{+,1}$	·	·	·	·	·	I^{+}	I^{2a}	·	·	·	I^{+}
Differential species combination of the *Ledo decumbentis–Eriophoretum vaginati* Lapshina ass. nov.													
Sphagnum lenense	·	V^{+-5}	**V^{3}**	**V^{4}**	**V^{3}**	IV^{2b}	·	·	IV^{2b}	III^{2a}	III^{3}	III^{2b}	III^{2a}
Aulacomnium turgidum **C.a.–H.a.**	·	I^{+}	V^{+}	IV^{+}	V^{+}	IV^{+}	I^{r}	II^{+}	II^{+}	V^{1}	V^{+}	III^{+}	V^{+}
Differential species combination of the *Ledo decumbentis–Eriophoretum vaginati* var. *Sphagnum capillifolium*													
Sphagnum angustifolium **O.-S.**	·	·	V^{2b}	·	II^{+}	I^{+}	·	II^{1}	·	·	·	·	·
Sphagnum capillifolium **O.-S.**	·	·	V^{2a}	I^{1}	I^{1}	I^{+}	·	I^{+}	I^{2a}	·	·	·	·
Carex bigelowii subsp. *arctisibirica* **C.a.–H.a.**	·	·	V^{1}	·	II^{+}	III^{+}	·	·	II^{1}	III^{1}	II^{2a}	·	II^{+}
Differential species combination of the *Ledo decumbentis–Eriophoretum vaginati* var. *Sphagnum fuscum*													
Sphagnum fuscum **O.-S., O.-E.h.**	·	III$^{1-4}$	·	V^{2a}	·	·	·	II^{1}	II^{2b}	·	·	·	·
Mylia anomala **O.-E.h.**	II$^{+,1}$	·	I^{+}	V^{+}	I^{+}	·	·	·	·	·	·	·	·
Calypogeia sphagnicola **O.-S.**	·	·	·	IV^{+}	I^{+}	·	·	·	·	·	·	·	·
Differential species combination of the *Pleurozio schreberi–Eriophoretum vaginati* Lavrinenko et Lavrinenko ass. nov.													
Pleurozium schreberi	·	·	III^{+}	I^{+}	III^{+}	V^{1}	V^{+}	V^{2a}	II^{1}	I^{1}	III^{+}	III^{+}	IV^{+}
Cladonia arbuscula s. l.	I^{+}	II^{+}	·	I^{+}	·	V^{+}	V^{1}	V^{2a}	III^{+}	II^{+}	IV^{+}	III^{+}	II^{+}
Cladonia gracilis subsp. *elongata*	·	I$^{+,1}$	·	·	·	V^{+}	IV^{+}	V^{1}	II^{+}	V^{+}	V^{+}	III^{+}	I^{+}
Polytrichum jensenii	·	·	·	·	·	IV^{1}	V^{+}	III^{+}	II^{1}	I^{1}	·	III^{2a}	II^{2a}
Aulacomnium palustre	·	IV^{+-3}	II^{+}	I^{+}	I^{+}	IV^{+}	IV^{+}	III^{+}	·	II^{+}	I^{+}	III^{+}	V^{1}
Peltigera scabrosa	·	·	·	·	·	IV^{+}	III^{r}	IV^{+}	·	·	·	·	II^{+}
Thamnolia vermicularis	·	·	·	·	·	IV^{+}	III^{r}	III^{+}	·	IV^{+}	III^{+}	III^{+}	·
Ochrolechia frigida	·	·	·	·	·	II^{+}	V^{+}	V^{+}	I^{+}	I^{+}	I^{+}	·	·
Sphaerophorus globosus	·	·	·	·	·	II^{+}	III^{+}	III^{+}		I^{+}	·	·	I^{+}
Differential species combination of the *Pleurozio schreberi–Eriophoretum vaginati shagnetosum lenenses* Lavrinenko et Lavrinenko subass. nov.													
Carex rariflora	·	·	·	·	·	III^{2a}	I^{+}	·	·	II^{+}	·	III^{2a}	II^{2a}
Differential species combination of the *Pleurozio schreberi–Eriophoretum vaginati sphagnetosum russowii* Lavrinenko et Lavrinenko subass. nov.													
Sphagnum russowii **O.-S.**	·	·	·	·	·	III^{1}	·	V^{2a}	·	I^{2b}	·	I^{+}	II^{1}
Cladonia chlorophaea	·	·	·	·	·	I^{r}	II^{r}	V^{r}	II^{+}	III^{+}	I^{+}	·	I^{+}
Cladonia cornuta s. l.	·	·	·	·	·	I^{r}	II^{r}	IV^{+}	II^{+}	III^{+}	·	·	II^{+}
Cladonia uncialis	·	·	·	·	·	I^{r}	II^{+}	IV^{+}	·	II^{+}	·	II^{+}	·
Cladonia cenotea	·	·	·	·	·	·	·	III^{r}	II^{+}	II^{+}	II^{+}	·	I^{+}
Calamagrostis lapponica	·	·	·	·	·	I^{+}	·	III^{+}	·	·	·	·	·
Festuca ovina	·	·	I^{r}	·	·	I^{+}	·	III^{+}	·	I^{+}	·	·	II^{+}
Differential species combination of the *Empetro subholarctici–Eriophoretum vaginati* Khitun in Telyatnikov et al. 2021													
Alectoria ochroleuca	·	·	·	·	·	I^{r}	·	·	**V^{2b}**	V^{2a}	III^{1}	·	·
Cetraria laevigata	·	II$^{+,1}$	·	·	·	·	·	·	V^{2a}	V^{2a}	II^{+}	·	I^{+}

Table 4. Continued.

Number of relevés	21	9	6	6	5	20	8	7	9	12	7	7	8
Syntaxon number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Bryocaulon divergens	·	·	·	·	·	I^{+}	·	I^{r}	III^{+}	V^{1}	·	I^{+}	·
Cladonia stellaris	·	II$^{+,1}$	·	·	·	I^{+}	·	I^{r}	V^{2a}	·	·	·	·
Differential species combination of the variants by Telyatnikov et al. (2021), related to the *Sphagno–Eriophoretum vaginati*													
Polytrichum juniperinum	·	·	·	·	·	·	·	·	II^{1}	V^{2a}	V^{2a}	II^{1}	IV^{2a}
Eriophorum angustifolium	·	·	·	·	·	·	·	·	I^{+}	IV^{+}	II^{2a}	III^{2a}	IV^{2a}
Dactylina arctica ***C.a.–H.a.***	·	·	·	·	·	I^{r}	·	·	·	IV^{+}	IV^{+}	III^{+}	I^{+}
Alectoria nigricans	·	·	·	·	·	I^{r}	·	·	I^{+}	V^{1}	I^{+}	I^{+}	·
Flavocetraria nivalis	·	I^{1}	·	·	·	II^{r}	IV^{+}	III^{1}	II^{1}	IV^{1}	I^{+}	·	·
Calamagrostis holmii	·	·	·	·	·	·	·	·	·	IV^{+}	I^{1}	·	IV^{+}
Arctagrostis latifolia ***C.a.–H.a.***	·	·	·	·	·	·	·	·	·	III^{+}	·	·	II^{+}
Carex rotundata	·	·	·	I^{+}	I^{+}	·	·	·	I^{+}	II^{+}	V^{2a}	V^{2b}	I^{2a}
Sphagnum aongstroemii	·	III$^{1\text{-}4}$	·	·	·	I^{1}	·	·	·	·	·	V^{2a}	I^{2a}
Sphagnum compactum	·	·	·	·	·	·	·	·	·	II^{2b}	·	III^{2b}	·
Eriophorum russeolum	·	·	·	·	·	·	·	·	·	·	II^{1}	III^{1}	I^{3}
Salix glauca ***C.a.–H.a.***	·	·	II^{+}	·	·	II^{+}	II^{r}	III^{r}	·	I^{+}	I^{+}	IV^{+}	IV^{1}
Sphagnum rubellum	·	·	·	·	·	·	·	·	·	I^{3}	·	III^{2a}	IV^{2a}
Sphagnum girgensohnii	·	II^{1}	I^{r}	·	·	II^{1}	·	·	·	·	I^{3}	·	IV^{2b}
Pedicularis labradorica	·	I^{+}	II^{+}	·	·	I^{r}	·	·	·	II^{+}	II^{+}	·	III^{1}
Characteristic species of the *Oxycocco-Sphagnetea*, *Sphagnetalia medii* and *Oxycocco microcarpi–Empetrion hermaphroditi*													
Ledum palustre subsp. *decumbens*	·	IV$^{+\text{-}2}$	**V^{3}**	**V^{2b}**	**V^{3}**	V^{1}	·	V^{2b}	V^{2b}	V^{2b}	V^{2a}	V^{2a}	V^{1}
Vaccinium uliginosum s. l.	·	V$^{+\text{-}3}$	III^{+}	I^{2a}	II^{+}	IV^{+}	IV^{1}	V^{+}	V^{1}	IV^{+}	III^{+}	V^{+}	III^{1}
Andromeda polifolia s. l.	V$^{+\text{-}2}$	V$^{+,1}$	I^{+}	V^{+}	III^{+}	III^{+}	I^{r}	III^{+}	III^{+}	IV^{1}	I^{+}	V^{+}	III^{+}
Polytrichum strictum	·	·	IV^{+}	V^{1}	IV^{1}	III^{+}	IV^{+}	III^{1}	I^{2a}	·	·	·	I^{3}
Pinguicula villosa	·	I^{+}	I^{+}	II^{+}	·	II^{r}	·	·	·	·	·	·	·
Oxycoccus microcarpus	I^{+}	I$^{+,1}$	·	I^{1}	·	I^{+}	·	I^{+}	·	·	·	·	·
Characteristic species of the *Rubo chamaemori–Dicranion elongati*													
Rubus chamaemorus	·	II$^{+\text{-}2}$	V^{1}	V^{2a}	V^{2a}	V^{2a}	V^{2a}	V^{2a}	V^{2b}	V^{2b}	V^{2a}	V^{1}	V^{2a}
Dicranum elongatum	·	I^{4}	IV^{+}	IV^{2a}	V^{1}	IV^{+}	V^{1}	V^{1}	V^{2a}	V^{3}	V^{2b}	III^{2b}	II^{2a}
Constant species of syntaxa													
Eriophorum vaginatum	**V^{2,3}**	**V^{4}**	V^{2b}	V^{2b}	V^{2b}	**V^{3}**	**V^{3}**	**V^{3}**	V^{2b}	V^{2a}	V^{3}	V^{3}	III^{1}
Sphagnum balticum	**V$^{3\text{-}5}$**	·	II^{2b}	V^{2b}	IV^{2a}	V^{2b}	V^{2a}	V^{2a}	IV^{3}	V^{2b}	II^{2b}	V^{2b}	V^{2a}
Betula nana / B. exilis	·	III^{1,2}	V^{2b}	V^{1}	V^{1}	V^{1}	IV^{1}	V^{1}	IV^{2a}	V^{2a}	V^{2a}	V^{2a}	**IV^{4}**
Vaccinium vitis-idaea s. l.	·	IV$^{+,1}$	V^{+}	V^{1}	V^{1}	V^{2a}	V^{1}	V^{1}	V^{1}	V^{2a}	IV^{1}	V^{+}	IV^{2a}
Dicranum laevidens	·	·	V^{+}	V^{+}	V^{+}	V^{1}	V^{1}	V^{+}	III^{2a}	III^{2b}	IV^{3}	I^{2a}	IV^{2a}
Sphenolobus minutus	·	I^{1}	II^{+}	IV^{+}	·	IV^{+}	IV^{+}	V^{+}	III^{+}	V^{+}	II^{1}	II^{+}	·
Empetrum subholarcticum *	·	II$^{+,1}$	·	·	·	·	·	·	V^{+}	I^{+}	I^{+}	II^{+}	II^{+}
Empetrum hermaphroditum	·	·	V^{+}	V^{+}	IV^{1}	V^{2a}	V^{1}	V^{2a}	·	·	·	·	·
Orthocaulis binsteadii	·	·	V^{+}	V^{+}	IV^{+}	I^{+}	V^{+}	II^{+}	·	·	·	·	·
Ptilidium ciliare ***C.a.–H.a.***	·	I$^{+,1}$	II^{1}	III^{+}	II^{+}	II^{r}	I^{+}	III^{+}	II^{+}	III^{+}	III^{+}	II^{+}	V^{+}
Salix pulchra	·	I^{+}	III^{+}	·	·	·		·	I^{+}	III^{+}	II^{1}	I^{+}	III^{1}
Pohlia nutans	·	·	III^{+}	I^{+}	·	I^{+}	I^{+}	II^{r}	·	·	I^{+}	·	·
Sphagnum alaskense	·	III$^{1\text{-}4}$	·	III^{1}	III^{1}	·	·	·	·	·	·	·	·
Cladonia rangiferina (incl. C. *stygia*)	I^{+}	IV$^{+,1}$	·	·	·	V^{+}	V^{1}	V^{2a}	**V^{3}**	V^{1}	V^{1}	IV^{+}	II^{1}
Cladonia amaurocraea	·	I$^{+,1}$	·	·	·	V^{+}	V^{+}	V^{1}	**V^{2a}**	V^{+}	III^{1}	IV^{+}	II^{+}
Flavocetraria cucullata	·	IV$^{+,1}$	·	I^{+}	·	IV^{+}	V^{+}	V^{+}	V^{1}	V^{1}	V^{1}	IV^{+}	II^{+}
Cetraria islandica s. l.	·	I^{1}	·	I^{r}	·	V^{+}	V^{+}	V^{+}	IV^{1}	V^{+}	V^{1}	III^{+}	II^{1}
Hylocomium splendens ***C.a.–H.a.***	·	·	II^{1}	·	II^{+}	III^{1}	·	III^{r}	I^{+}	II^{+}	III^{+}	I^{2a}	II^{+}
Peltigera aphthosa	·	·	·	·	·	III^{+}	·	IV^{+}	II^{+}	·	·	·	·
Cladonia bellidiflora	·	·	·	·	·	I^{r}	IV^{r}	II^{r}	·	·	·	·	II^{+}
Cladonia pleurota	·	·	·	·	·	I^{r}	III^{r}	IV^{r}	II^{+}	II^{+}	III^{+}	III^{+}	I^{+}
Cladonia subfurcata	·	·	·	·	·	I^{r}	II^{+}	III^{+}	III^{+}	III^{+}	IV^{+}	II^{+}	I^{+}
Cladonia cyanipes	·	·	·	·	·	I^{r}	I^{r}	III^{r}	II^{2a}	II^{+}	·	·	·
Cladonia sulphurina	·	·	·	·	·	I^{r}	II^{+}	III^{r}	II^{+}	I^{+}	I^{+}	·	I^{+}
Arctous alpina	·	·	·	·	·	I^{+}	II^{r}	III^{1}	·	·	·	·	I^{2a}
Ochrolechia androgyna	·	·	·	·	·	I^{r}	II^{+}	III^{+}	·	·	·	·	·
Peltigera polydactylon	·	·	·	·	·	I^{+}	I^{r}	III^{+}	·	·	II^{+}	·	·

Note. Species with constancy only I and II are not included in the table.

* In Sinelnikova (2009), *Empetrum subholarcticum* is given as *E. nigrum*.

Relevé authors and sampling geography: syntaxon 1 – Bogdanowskaya-Guihéneuf in Baltics, syntaxon 2 – Sinelnikova in Kolyma River Basin, syntaxa 3–5 – Lapshina in Yanganape, West Siberia, syntaxa 6–8 – Lavrinenko & Lavrinenko in the East European tundras, syntaxon 9 – Khitin in Tazovskii Peninsula, syntaxa 10–12 – Khitin in Gydanskii Peninsula.

Syntaxa: ***S.p.–C.n.*** – ***Scheuchzerio palustris–Caricetea nigrae***, ***S.p.*** – ***Scheuchzerietalia palustris*** and ***Scheuchzerion palustris***. ***E.v.–S.b.*** – ***Eriophoro vaginati–Sphagnetum baltici*** Bogdanowskaya-Guihéneuf 1928; ***E.v.–S.l.*** – ***Eriophoro vaginati–Sphagnetum lenenses*** Sinelnikova 2009; ***E.s.–E.v.*** – ***Empetro subholarctici–Eriophoretum vaginati*** Khitun in Telytnikov et al. 2021.

Characteristic species (next to the name of the taxon): ***O.-S.*** – ***Oxycocco-Sphagnetea***; ***O.–E.h.*** – ***Oxycocco-Empetrion hermaphroditi***; ***C.a.–H.a.*** – ***Carici arctisibiricae–Hylocomietea alaskani*** class. prov.

for dwarf shrub–cloudberry–moss–lichen communities on dry, frozen peat mounds of palsa bogs with *Dicranum elongatum*, *Polytrichum strictum* and fruticose lichens of the genera *Cladonia* and *Flavocetraria* dominating in the ground cover, with an almost complete absence of sphagna (Lavrinenko & Lavrinenko 2015).

Cluster analysis of syntaxa in the class *Oxycocco–Sphagnetea* has shown that oligotrophic dwarf shrub–cottongrass–*Sphagnum* communities dominated by *Sphagnum lenense* from the West Siberian Arctic, namely the ass. *Ledo decumbentis–Eriophoretum vaginati* with 3 variants (*typica*, *Sphagnum capillifolium* and *Sphagnum fuscum*), form an independent cluster (Fig. 3, syntaxa 3–5). At a higher level, it clusters with other similar wetland communities from the Baltic (ass. *Eriophoro vaginati–Sphagnetum baltici*) and from the Kolyma River basin, North-East Russia (ass. *Eriophoro vaginati–Sphagnetum lenenses*).

Cottongrass tussock communities with a multi-species ground cover of various *Sphagnum*, *Dicranium* and *Polytrichum* mosses with inclusion of lichens from the East European Arctic – ass. *Pleurozio schreberi–Eriophoretum vaginati* with 3 subassociations (*typicum*, *shagnetosum lenenses* and *sphagnetosum russowii*) also form an independent cluster (Fig. 3, syntaxa 6–8). At a higher level, they cluster with similar communities from the West Siberian Arctic – the Tazovskii Peninsula (ass. *Empetro subholarctici–Eriophoretum vaginati*) and the Gidanskii Peninsula. The latter have unreasonably been attributed by the authors (Telyatnikov et al. 2021) to ass. *Sphagno–Eriophoretum vaginati*, with 4 variants (*Alectoria nigricans*, *inops*, *Sphagnum aongstroemii*, *Pedicularis labradorica*), as they lack the differential species of this association and the characteristic species of higher syntaxa of zonal vegetation (see Tables 4 and 5). These communities should be placed with the class *Oxycocco–Sphagnetea*. Furthermore, var. *Alectoria nigricans* bears an undeniable floristic resemblance to ass. *Empetro subholarctici–Eriophoretum vaginati* that was added in this 'bog' class by the authors (Fig. 3, syntaxa 9 and 10); the swam-

Table 5. Synoptic table of syntaxa of zonal communities with *Eriophorum vaginatum*

Class	***Carici arctisibiricae–Hylocomietea alaskani* class. prov.**								
Order	***Eriophoretalia vaginati* ord. prov.**								
Alliance	***Cassiopo tetragonae–Eriophorion vaginati* all. prov.**								
Association	***Sphagno–Eriophoretum vaginati***								***A.l.–E.v.***
Subassociation		***typicum***	***betuletosum nanae***		***peltigeretosum polydactyli***	***alectorietosum nigricantis***	***typicum***		
Vicariant	***Polytrichastrum alpinum***						***Salix lanata***		
Variant							***Dicranum angustum***	***Pedicularis capitata***	
Number of relevés	5	26	7	10	10	10	17	7	8
Syntaxon number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Differential species combination of the *Sphagno–Eriophoretum vaginati* Walker M., Walker D. et Auerbach 1994									
Petasites frigidus	IV^{1,2a}	V^{+-2}	V^{r-1}	V$^{+,1}$	III^{+}	.	.	.	.
Sphagnum warnstorfii ***E.v.****	III^{1-2b}	V^{+-3}	V^{+-2}	V^{+-2}	.	.	III^{1}	.	V^{1}
Sphagnum angustifolium+*S. balticum* *****	.	IV^{+-3}	III^{+-3}	IV^{+-2}	.	.	.	.	.
Bistorta plumosa / *B. elliptica* ***C.a.–H.a.***	.	IV$^{+,1}$	IV$^{+,1}$	V^{+-2}	.	.	.	I^{+}	.
Aulacomnium palustre	II^{1,2b}	IV^{+-2}	V$^{1-3}$	II$^{+,1}$	I^{2a}	.	I^{+}	.	I^{+}
Tomentypnum nitens ***C.a.–H.a.***	I^{1}	IV^{r-1}	III^{+}	IV$^{r,+}$	.	.	.	.	II^{1}
Pedicularis lapponica ***C.a.–H.a.***	.	III^{+}	IV^{r-1}	IV^{+}	.	I^{+}	I^{+}	V^{+}	II^{+}
Blepharostoma trichophyllum ***C.a.–H.a.***	IV^{1-2b}	III$^{+,1}$	III^{+}	III$^{+,1}$	.	.	.	.	I^{r}
Sphagnum girgensohnii ***E.v.***	I^{2b}	III^{+-3}	IV$^{1-3}$	IV^{+-2}	.	.	.	.	.
Tephroseris atropurpurea (incl. *T. a.* subsp. *frigidus*) ***E.v.***	.	II^{+}	.	IV^{+}	.	II^{1}	.	.	.
Pohlia nutans	.	II^{+}	III^{+}	.	.	.	.	.	I^{+}
Differential species combination of the *Sphagno–Eriophoretum vaginati* vicariant *Polytrichastrum alpinum* Kholod 2007									
Polytrichastrum alpinum	V^{+-2a}	.	I$^{+,1}$	.	.	.	.	.	.
Salix polaris ***C.a.–H.a.***	IV^{1,2a}	.	.	.	.	I^{1}	.	.	I^{r}
Saxifraga foliolosa	IV^{+}	.	.	.	.	.	.	.	.
Alopecurus alpinus s. l.	III$^{+,2a}$	.	.	.	.	.	.	.	.
Cirriphyllum cirrosum	III^{1}	.	.	.	.	.	.	.	.
Ditrichum flexicaule ***C.a.–H.a.***	III$^{+,1}$	.	.	II^{+}	.	.	.	.	.
Differential species combination of the *Sphagno–Eriophoretum vaginati typicum*									
Cassiope tetragona ***E.v.***	.	IV^{r-2}	I^{1}	V^{1,2}	.	.	V^{+}	III^{1}	IV^{+}
Pyrola rotundifolia (incl. *P. grandiflora*)	.	III$^{+,1}$	I^{+}	.	.	.	I^{+}	III^{+}	I^{+}
Differential species combination of the *Sphagno–Eriophoretum vaginati betuletosum nanae* Walker M., Walker D. et Auerbach 1994									
Sphagnum teres	.	II$^{1-3}$	V^{+-3}	.	.	.	.	.	.
Differential species combination of the *Sphagno–Eriophoretum vaginati peltigeretosum polydactyli* Telyatnikov et Pristyazhnyuk 2012									
Sphagnum rubellum+*S. lenense*	.	.	.	.	**V^{3}**	I^{3}	.	.	.
Peltigera polydactylon	.	I^{+}	I^{+}	.	IV^{1}	.	II^{+}	.	II^{r}
P. leucophlebia	.	.	.	.	III^{1}	.	.	.	.
Differential species combination of the *Sphagno–Eriophoretum vaginati alectorietosum nigricantis* Telyatnikov et Pristyazhnyuk 2012									
Bryocaulon divergens	.	I^{+}	I^{+}	I^{+}	I^{1}	V^{2a}	.	.	II^{r}
Alectoria nigricans	.	I^{+}	I$^{r,+}$	I^{+}	.	V^{1}	.	.	I^{r}
Alectoria ochroleuca	.	I$^{r,+}$	.	I^{+}	.	III^{1}	.	.	II^{r}
Differential species combination of the *Sphagno–Eriophoretum vaginati typicum* vicariant *Salix lanata* (Matveyeva 1994)									
Sphagnum squarrosum ***E.v.***	.	.	.	.	.	.	**V^{2}**	**V^{3}**	.
Sphagnum fimbriatum ***E.v.***	II^{1,2b}	I^{1,2}	.	.	.	.	**V^{2}**	**V^{2}**	.
Polytrichum juniperinum	I^{1}	.	.	.	.	.	V^{1}	V^{+}	.
Salix lanata s. l. ***C.a.–H.a.***	.	.	.	.	I^{1}	I^{+}	V^{+}	V^{+}	.
Eriophorum angustifolium (incl. *E. a.* subsp. *subarcticum*) ***E.v.***	II^{1,2a}	II^{+-3}	III$^{r,+}$	.	.	IV^{1}	IV^{+}	V^{+}	I^{r}

Table 5. Continued.

Syntaxon number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Hierochloë alpina	.	.	.	.	.	II^{1}	IV^{+}	IV^{+}	.
Poa arctica **C.a.–H.a.**	.	I^{+}	.	.	I^{+}	I^{1}	IV^{+}	III^{+}	II^{r}
Juncus biglumis **C.a.–H.a.**	I^{1}	.	.	.	.	.	III^{+}	V^{+}	.
Differential species combination of the *Sphagno–Eriophoretum vaginati typicum* vicariant *Salix lanata* var. *Dicranum angustum* (Matveyeva 1994)									
Brachythecium turgidum	.	.	.	.	.	.	IV^{+}	.	.
Baeomyces carneus	.	.	.	.	.	.	IV^{+}	.	.
Oncophorus wahlenbergii	IV$^{+,1}$	.	.	.	.	.	V^{+}	I^{2}	.
Differential species combination of the *Sphagno–Eriophoretum vaginati typicum* vicariant *Salix lanata* var. *Pedicularis capitata* (Matveyeva 1994)									
Dryas punctata **C.a.–H.a.**	.	.	.	.	.	.	I^{+}	V^{1}	II^{+}
Pedicularis capitata	.	.	.	.	.	.	I^{+}	V^{+}	II^{r}
Luzula nivalis **C.a.–H.a.**	III^{1}	.	.	.	.	.	II^{+}	V^{+}	I^{r}
Bistorta vivipara	II^{+}	I$^{+,2}$	I^{r}	.	II^{+}	.	I^{r}	V^{+}	.
Valeriana capitata **C.a.–H.a.**	.	.	.	.	II^{+}	I^{+}	I^{+}	V^{+}	.
Salix reptans	.	.	.	.	.	.	I^{+}	V^{+}	.
Saxifraga nelsoniana **C.a.–H.a.**	II$^{+,1}$	II^{+}	II^{+}	III^{+}	.	.	II^{+}	V^{+}	I^{r}
Parrya nudicaulis **C.a.–H.a.**	.	.	.	.	.	.	.	IV^{+}	.
Rhytidium rugosum	.	I^{r}	.	I^{+}	.	.	I^{+}	III^{+}	.
Petasites sibiricus	.	.	.	.	.	.	.	III^{+}	I^{r}
Luzula confusa **C.a.–H.a.**	.	.	.	.	.	II^{1}	II^{+}	III^{+}	.
Festuca brachyphylla **C.a.–H.a.**	.	.	.	.	.	.	I^{+}	III^{+}	.
Differential species combination of the *Arctagrostio latifoliae–Eriophoretum vaginati* Lavrinenko O. et Lapshina ass. nov.									
Ptilidium ciliare **C.a.–H.a.**	I^{1}	III^{+-2}	II$^{+,1}$	IV$^{+,1}$	.	.	.	.	V^{2a}
Sphagnum balticum	II^{2a,3}	.	.	.	.	.	.	.	V^{2a}
S. lenense	I^{2b}	II^{+-4}	I^{+}	.	.	.	.	.	IV^{2a}
Orthocaulis binsteadii	.	I^{+}	.	.	.	.	.	.	V^{+}
Flavocetraria nivalis	.	II$^{+,2}$	I^{+}	I^{+}	.	II^{1}	II^{+}	.	IV^{r}
Salix glauca **C.a.–H.a.**	.	.	.	.	II^{1}	I^{1}	.	.	III^{+}
Constant species in syntaxa on the Taymyr Peninsula									
Arctagrostis latifolia (incl. *A. l.* subsp. *latifolia*) **C.a.–H.a.**	II$^{+,1}$	I$^{r,+}$	I^{+}	II^{+}	II^{+}	I^{1}	V^{+}	V^{1}	V^{+}
Racomitrium lanuginosum **C.a.–H.a.**	I^{1}	.	I^{+}	.	I^{+}	.	V^{+}	IV^{1}	IV^{+}
Stellaria longipes coll. **C.a.–H.a.** *	.	I^{+}	.	.	II^{1}	I	IV^{+}	V^{+}	IV^{+}
Calamagrostis holmii ***E.v.***	.	.	.	.	II^{1}	II^{1}	IV^{+}	III^{+}	V^{+}
Pedicularis labradorica	.	I$^{r,+}$	II$^{r,+}$	II^{+}	III^{1}	.	III^{+}	IV^{+}	V^{r}
Arctous alpina	.	I^{+}	I^{r}	.	I^{+}	.	II^{+}	III^{+}	IV^{+}
Sphaerophorus globosus	.	.	I^{+}	I^{+}	I^{+}	IV^{1}	V^{+}	III^{+}	IV^{+}
Cladonia uncialis	.	I^{+}	.	I^{+}	I^{1}	V^{1}	V^{+}	IV^{+}	IV^{+}
Characteristic species of the *Carici arctisibiricae–Hylocomietea alaskani* class. prov., *Eriophoretalia vaginati* ord. prov., *Cassiopo tetragonae–Eriophorion vaginati* all. prov.									
Eriophorum vaginatum	**V^{2a-4}**	V^{+-4}	III$^{r,+}$	**V^{3}**	V^{2b}	V^{2b}	**V^{4}**	**V^{3}**	**V^{4}**
Carex bigelowii subsp. *lugens* *	III^{1,2a}	V^{r-3}	V^{r-2}	III$^{+,1}$	.	.	.	.	.
Carex bigelowii subsp. *arctisibirica*	.	.	.	.	IV^{1}	IV^{1}	IV^{+}	V^{1}	V^{+}
Aulacomnium turgidum	IV^{1}	V^{+-3}	V^{1,2}	V^{+-2}	IV^{2a}	IV^{2a}	V^{2}	V^{2}	V^{1}
Hylocomium splendens (incl. *H. s.* var. *alaskanum*)	III^{1}	V^{+-3}	V^{+-4}	V$^{1-3}$	IV^{2a}	II^{2b}	V^{1}	V^{+}	V^{+}
Salix pulchra	IV^{1,2b}	V$^{1-4}$	V^{+-2}	V^{1,2}	III^{1}	II^{1}	V^{1}	V^{1}	V^{1}
Dactylina arctica	.	V$^{+,1}$	III$^{r,+}$	V$^{+,1}$	II^{+}	V^{1}	V^{+}	III^{+}	V^{+}
Characteristic species of the *Oxycocco-Sphagnetea*, *Sphagnetalia medii*, *Oxycocco microcarpi–Empetrion hermaphroditi*									
Ledum palustre subsp. *decumbens*	.	V^{r-3}	V$^{+,1}$	V^{1,2}	IV^{2a}	III^{1}	V^{2}	V^{1}	V^{2b}
Polytrichum strictum	II$^{+,1}$	V^{r-2}	V^{+-2}	I^{+}	IV^{2a}	V^{2b}	II^{+}	I^{+}	V^{1}
Vaccinium uliginosum subsp. *microphyllum*	.	IV^{+-2}	II^{r,1}	II$^{+,1}$	IV^{2a}	III^{1}	V^{1}	V^{1}	V^{1}
Andromeda polifolia subsp. *pumila*	.	II$^{r,+}$	I^{+}	I^{r}	I^{1}	I^{1}	I^{+}	.	.
Characteristic species of the *Rubo chamaemori–Dicranion elongati*									
Rubus chamaemorus	.	V^{+-3}	V^{+-4}	.	V^{1}	IV^{1}	III^{+}	I^{+}	II^{+}
Dicranum elongatum *	I^{1}	IV^{+-3}	III$^{+,1}$	IV$^{+,2}$	IV^{1}	V^{3}	V^{2}	V^{2}	V^{1}
Constant species of syntaxa									
Betula nana (incl. *B. n.* subsp. *exilis*)	.	V^{+-3}	**V$^{3-5}$**	V^{2,3}	V^{2b}	V^{2b}	V^{2}	V^{2}	V^{2b}
Vaccinium vitis-idaea subsp. *minus*	.	V^{r-3}	V^{+-3}	V^{1,2}	V^{1}	IV^{2b}	V^{3}	V^{2}	V^{2a}
Cladonia amaurocraea	.	IV^{+-2}	IV^{+}	IV^{+}	V^{1}	III^{1}	V^{+}	III^{+}	V^{+}
Cladonia arbuscula s. l.	.	V^{+-2}	II$^{r,+}$	III^{+}	V^{1}	V^{1}	V^{1}	V^{+}	V^{2a}
Cladonia rangiferina (incl. C. *stygia*)	I^{r}	V^{+-2}	III^{+}	V$^{+,1}$	V^{1}	V^{2a}	V^{1}	V^{+}	V^{1}
Cladonia gracilis subsp. *elongata*	II^{+}	IV$^{+,1}$	IV$^{r,+}$	II^{+}	IV^{1}	III^{1}	IV^{+}	.	V^{+}
Flavocetraria cucullata	.	V^{+-2}	V^{r-1}	V$^{+,1}$	V^{1}	V^{1}	V^{1}	V^{+}	V^{1}
Cetraria islandica s. l.	III^{1}	V$^{+,1}$	III^{+}	III^{+}	IV^{1}	III^{1}	V^{+}	III^{+}	V^{+}
Dicranum laevidens *	.	V^{+-2}	V^{1,2}	III$^{+,2}$	.	.	V^{2}	III^{+}	V^{2a}
Empetrum subholarcticum *	.	III^{r-2}	I^{+}	IV^{+-2}	IV^{2a}	I^{1}	V^{1}	IV^{+}	V^{1}
Thamnolia vermicularis (incl. *T. subuliformis*)	II$^{+,1}$	III$^{r,+}$	I^{+}	.	I^{+}	V^{1}	V^{+}	III^{+}	V^{+}
Sphenolobus minutus	I^{1}	III$^{+,1}$	II$^{+,1}$	IV^{+-2}	.	.	V^{+}	V^{+}	V^{+}

py communities of var. *inops* and var. *Sphagnum aongstroemii* share a highly constant, significant species, *Carex rotundata* (see Table 4, syntaxa 11 and 12), and should be clustered; the communities of the var. *Pedicularis labradorica* cannot be classified as cottongrass tussock communities, because they are dominated by *Betula nana* (IV^{4}), and *Eriophorum vaginatum* is rare (III^{1}), i.e. they are dwarf birch communities (see Table 4, syntaxon 13). We believe the authors would want to correct their syntaxonomic decisions.

Zonal cenoses of the ass. *Arctagrostio latifoliae–Eriophoretum vaginati*, like other syntaxa of the provisional class *Carici arctisibiricae–Hylocomietea alaskani*, occupy mineral-rich habitats, i.e., slightly convex loamy surfaces on watersheds. They differ from the 'bog' cottongrass tussocks communities primarily in the well-developed cover of green mosses *Aulacomnium turgidum*, *Hylocomium splendens*, liverwort *Ptilidium ciliare*, and sphagna mosses; high constancy of sedge *Carex bigelowii* subsp. *arctisibirica*, *Cassiope tetragona*, and other characteristic species of higher zonal vegetation syntaxa; absence or scarsity of *Andromeda polifolia* subsp. *pumila* and *Rubus chamaemorus*. Patches of clay earth that can be exposed or covered with lichens, mosses (*Racomitrium lanuginosum*), and liverworts are a required and regular component of the horizontal structure in zonal cottongrass communities.

Based on the results of cluster analysis, two subassociations of the ass. *Sphagno–Eriophoretum vaginati* described in Alaska have been combined into one cluster with the vicariant *S.–E. polytrichastrum alpinum* from Wrangel Island (Kholod 2007) (Fig. 4). The syntaxa described in the Siberian Arctic form the second large cluster. It also divides into two lower-level clusters: the first one comprises markedly floristic different syntaxa from the Taymyr Peninsula described as two variants of vicariant *S.–E.* v. *Salix lanata* (Matveyeva 1998), while the other is the new ass. *Arctagrostio latifoliae–Eriophoretum vaginati* and two syntaxa earlier described as the subassociations *Sphagno–Eriophoretum vaginati peltigeretosum polydactyli* and *S.–E. alectorietosum nigricantis* from the Yamal Peninsula (Telyatnikov & Pristyazh-

Table 5. Continued.

Syntaxon number	1	2	3	4	5	6	7	8	9
Peltigera scabrosa	I^{r}	III^{+}	II^{+}	III^{+}	III^{1}	I^{1}	.	.	I^{r}
Peltigera aphthosa	II$^{+,1}$	III^{+}	III^{+}	II$^{+,1}$	.	II^{1}	II^{+}	III^{+}	.
Tritomaria quinquedentata	.	II^{+}	III^{+}	II^{+}	.	.	.	.	.
Sphagnum aongstroemii	I^{2a}	II^{+}	III^{+}	.	.	.	.	.	II^{r}
Dicranum acutifolium	.	I$^{+,2}$	.	III^{+-2}	.	.	.	.	I^{+}
Pleurozium schreberi	.	I^{+}	.	III$^{+,1}$	I^{2a}	.	.	.	II^{r}
Cetraria laevigata	.	.	.	III$^{r,+}$	IV^{1}	II^{1}	.	.	IV^{r}
Cladonia chlorophaea	.	.	I^{+}	.	III^{1}	II^{1}	.	.	III^{r}
Ochrolechia androgyna	.	.	.	.	I^{+}	III^{1}	.	.	II^{+}
Ochrolechia frigida	.	.	.	.	.	IV^{2a}	IV^{+}	.	III^{+}
Cladonia coccifera (incl. *C. borealis*)	.	I^{+}	.	I^{+}	I^{+}	III^{1}	V^{+}	.	IV^{r}
Cladonia bellidiflora	.	.	.	.	.	III^{1}	.	.	.
Cladonia pleurota	.	I^{+}	.	.	I^{+}	II^{1}	.	III^{+}	II^{r}
Sanionia uncinata	II$^{+,1}$	II$^{+,1}$	II$^{+,1}$	.	.	.	I^{+}	III^{+}	II^{r}
Juncus castaneus	.	.	.	.	.	.	II^{+}	III^{+}	II^{r}

Note. Species with constancy only I and II are not included in the table.

* In M. Walker et al. (1994) *Carex bigelowii* subsp. *lugens* given as *C. bigelowii*; *Empetrum subholarcticum* – as *E. hermaphroditum*; *Dicranum laevidens* – as *D. angustum*; *Dicranum elongatum* – in mixed with *D. groenlandicum*; *Sphagnum warnstorfii* – in mixed with *S. rubellum*; in A. Kade et al. (2005) *Sphagnum angustifolium*+*S. balticum* – as *S. angustifolium*; *Stellaria longipes* coll. aggregate *S. peduncularis*, *S. ciliatosepala*, *S. longipes*.

Relevé authors and sampling geography: syntaxon 1 – Kholod in Wrangel Island, syntaxa 2, 3 – Walker et al. in Alaska Low Arctic, syntaxon 4 – Kade et al. in Alaska Low Arctic, syntaxon 5 – Telyatnikov & Pristyazhnyuk in Yamal Peninsula, syntaxon 6 – Telyatnikov & Pristyazhnyuk in Polar Urals and Yamal Peninsula, syntaxa 7, 8 – Matveeva in Taymyr (Kresty), syntaxon 9 – O.V. Lavrinenko & Lapshina Taymyr and Dudypta.

Syntaxa: Association: ***A.l.–E.v.*** – ***Arctagrostio latifoliae–Eriophoretum vaginati***.

Characteristic species (next to the name of the taxon): ***C.a.–H.a.*** – ***Carici arctisibiricae–Hylocomietea alaskani*** class. prov.; ***E.v.*** – ***Eriophoretalia vaginati*** ord. prov.

nyuk 2012). The results of the analysis indicate that if the vicariant *S.–E. v. Polytrichastrum alpinum* described on Wrangel Island can be assigned to the ass. *Sphagno–Eriophoretum vaginati*, then new associations should be proposed for zonal cottongrass tussock communities in the West and Central Siberian Arctic.

A species with wide ecological amplitude, *Eriophorum vaginatum* grows in the tundra zone both in flat palsa bogs and in zonal communities. Cottongrass forms large hemispherical tussocks and has the highest viability in good mineral nutrition conditions on loam compared to oligotrophic habitats on peat. The species richness within the communities increases consistently from oligotrophic bogs to zonal eutrophic communities. On average, the community of the ass. *Ledo decumbentis–Eriophoretum vaginati* comprises 20 species, ass. *Pleurozio schreberi–Eriophoretum vaginati* – 34 species, and ass. *Arctagrostio latifoliae–Eriophoretum vaginati* – 48 species.

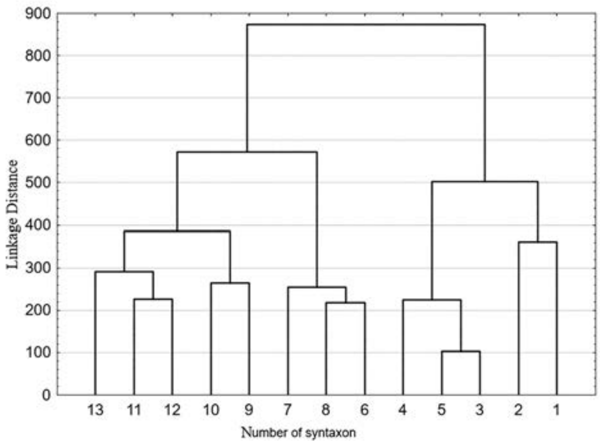

Figure 3 The similarity of syntaxa of bog communities with *Eriophorum vaginatum* from different sectors of the Arctic, established by the Complete-linkage clustering (Squared Euclidean distances). Syntaxa (the numbers correspond to the numbers of syntaxa in Table 4): 1 – ass. *Eriophoro vaginati–Sphagnetum baltici* Bogdanowskaya-Guihéneuf 1928; 2 – subass. *Eriophoro vaginati–Sphagnetum lenenses typicum* Sinelnikova 2009; 3–5 – ass. *Ledo decumbentis–Eriophoretum vaginati* Lapshina ass. nov.: 3 – var. *Sphagnum capillifolium*, 4 – var. *Sphagnum fuscum*, 5 – var. *typica*; 6–8 – ass. *Pleurozio schreberi–Eriophoretum vaginati* Lavrinenko et Lavrinenko ass. nov.: 6 – subass. *shagnetosum lenenses*, 7 – subass. *typicum*, 8 – subass. *sphagnetosum russowii*; 9 – ass. *Empetro subholarctici–Eriophoretum vaginati* Khitun in Telyatnikov et al. 2021; 10–13 – ass. ? *Sphagno–Eriophoretum vaginati* (Telyatnikov et al. 2021): 10 – var. *Alectoria nigricans*, 11 – var. *inops*, 12 – var. *Sphagnum aongstroemii*, 13 – var. *Pedicularis labradorica*

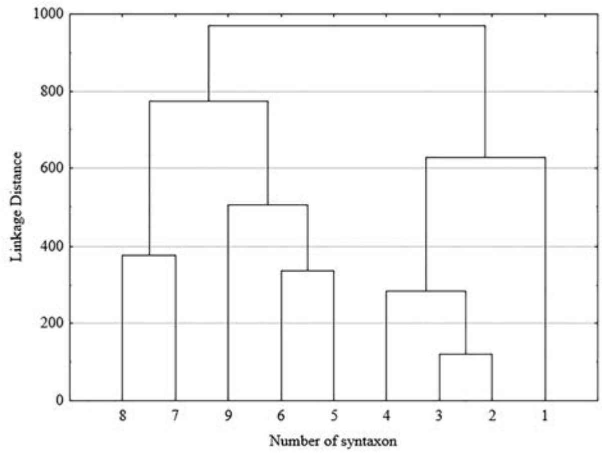

Figure 4 The similarity of syntaxa of zonal communities with *Eriophorum vaginatum* from different sectors of the Arctic, established by the Complete-linkage clustering (Squared Euclidean distances). Syntaxa (the numbers correspond to the numbers of syntaxa in Table 5): 1–4 – ass. *Sphagno–Eriophoretum vaginati* Walker M., Walker D. et Auerbach 1994: 1 – vicariant *Polytrichastrum alpinum* (Kholod 2007); 2 – subass. *typicum* Walker M., Walker D. et Auerbach 1994; 3 – subass. *betuletosum nanae* Walker M., Walker D. et Auerbach 1994; 4 – ass. *Sphagno–Eriophoretum vaginati* (Kade et al. 2005); 5 – subass. *S.–E. v. peltigeretosum polydactyli* Telyatnikov et Pristyazhnyuk 2012; 6 – subass. *S.–E. v. alectorietosum nigricantis* Telyatnikov et Pristyazhnyuk 2012; 7 – subass. *S.–E. v. typicum* vicariant *Salix lanata* var. *Dicranum angustum* (Matveyeva 1998); 8 – subass. *S.–E. v. typicum* vicariant *Salix lanata* var. *Pedicularis capitata* (Matveyeva 1998); 9 – ass. *Arctagrostio latifoliae–Eriophoretum vaginati* O. Lavrinenko et Lapshina ass. nov.

Prodromus of *Eriophorum vaginatum* communities

Class
Order
Alliance
Association
Subassociation
Variant

Oxycocco–Sphagnetea Br.-Bl. et R. Tx. 1943
Sphagnetalia medii Kästner et Flössner 1933
Oxycocco microcarpi–Empetrion hermaphroditi Nordhagen ex Du Rietz 1954
Ledo decumbentis–Eriophoretum vaginati Lapshina **ass. nov. hoc loco**
typica
Sphagnum capillifolium
Sphagnum fuscum
Pleurozio schreberi–Eriophoretum vaginati Lavrinenko et Lavrinenko **ass. nov. hoc loco**
typicum **subass. nov. hoc loco**
shagnetosum lenenses Lavrinenko et Lavrinenko **subass. nov. hoc loco**
shagnetosum russowii Lavrinenko et Lavrinenko **subass. nov. hoc loco**

Carici arctisibiricae–Hylocomietea alaskani class. prov. (Matveyeva & Lavrinenko 2021)
Eriophoretalia vaginati ord. prov. (Matveyeva & Lavrinenko 2021)
Cassiopo tetragonae–Eriophorion vaginati all. prov. (Matveyeva & Lavrinenko 2021)
Arctagrostio latifoliae–Eriophoretum vaginati Lavrinenko O. et Lapshina **ass. nov. hoc loco**

CONCLUSION

We described 3 new associations of cottongrass tussock vegetation using the Braun-Blanquet classification. While their physiognomy is similar due to the dominance of the tussock-forming *Eriophorum vaginatum* and the formation of mostly dwarf shrub-moss cover between the tussocks, these communities can belong to different vegetation classes depending on the habitat: the bog class *Oxycocco–Sphagnetea* and the zonal tundra provisional class *Carici arctisibiricae–Hylocomietea alaskani*.

We regard the oligotrophic dwarf shrub–cottongrass–*Sphagnum* communities on peat dominated by *Sphagnum lenense* and *S. balticum* as typically bog communities and classify them as *Oxycocco–Sphagnetea*. Many characteristic species of this class and the alliance *Oxycocco microcarpi–Empetrion hermaphroditi* occur in the communities of the new ass. *Ledo decumbentis–Eriophoretum vaginati* described on the plains adjacent to the spurs of the eastern Polar Urals macroslope.

In contrast to bog communities, zonal cottograss tussock communities develop in conditions of good mineral nutrition on loamy soils (gley soil) and have a multi-species ground cover of sphagna, green mosses, and liverworts with lichens. Such communities occupying upland habitats are widespread over large areas in the southern, less often typical tundra subzone of the Siberian sector of the Russian Arctic, and particularly in Chukotka. They were first described in Alaska in the rank of the ass. *Sphagno–Eriophoretum vaginati* subass. *typicum* (Walker et al. 1994). Communities of physiognomically similar appearance, but markedly different floristic composition have been described in the rank of variants and subassociations of this association on Taymyr Peninsula (Matveyeva 1998), Wrangel Island (Kholod 2007), and Yamal Peninsula (Telyatnikov & Pristyazhnyuk 2012). The common species in these communities, in addition to *Eriophorum vaginatum*, are only the characteristic species of the *Carici arctisibiricae–Hylocomietea alaskani* class. prov., namely *Carex bigelowii* subsp. *arctisibirica*, *C. bigelowii* subsp. *lugens*, *Salix pulchra*, *Aulacomnium turgidum*, *Hylocomium splendens*, *Dactylina arctica*, as well as widespread species of high constancy in many syntaxa of tundra communities, such as *Betula nana* (*B. exilis*), *Empetrum subholarcticum*, *Ledum palustre* subsp. *decumbens*, *Vaccinium uliginosum* subsp. *microphylla*, *V. vitis-idaea* subsp. *minus*, *Dicranum elongatum*, and common tundra lichens (*Cladonia amaurocraea*, *C. arbuscula* s. l, *C. rangiferina*, *C. gracilis* subsp. *elongata*, *Flavocetraria cucullata*, etc.). This diagnostic combination of species does not really suggest that they belong to the same association, but rather that the zonal cottongrass communities should be specified as higher rank syntaxa (*Eriophoretalea vaginati* ord. prov., *Cassiopo tetragonae–Eriophorion vaginati* all. prov.) with a circumpolar range based on their ecological and physiognomic similarities and a common group of characteristic species (Matveyeva & Lavrinenko 2021). We described a new association *Arctagrostio latifoliae–Eriophoretum vaginati* occurring in the south of the southern tundra subzone on Taymyr Peninsula that differs floristically from the earlier described ass. *Sphagno–Eriophoretum vaginati* with subsyntaxa, the names of which do not meet the ICPN requirements (Arts. 3g, 4a).

The composition of cottongrass tussocks communities in East European tundras formed on peat-gley soil differs considerably from those in the Siberian and American Arctic. They comprise only some characteristic species of the *Carici arctisibiricae–Hylocomietea alaskani* class. prov., such as *Carex bigelowii* subsp. *arctisibirica*, *Aulacomnium turgidum*, *Hylocomium splendens*, and *Ptilidium ciliare*, which are uncommon and have low abundance. These communities have been described as a new ass. *Pleurozio schreberi–Eriophoretum vaginati*. They often occupy transition habitats between zonal tundra and flat palsa bogs, where the depth of peat underlain by loam does not exceed 25 cm. In rare cases, the peat depth measures 40 cm, but even then the cottongrass roots penetrate the mineral horizon, while other species in hollows between the tussocks grow predominantly on peat. In terms of floristic composition and characteristic species, these communities belong in the class *Oxycocco–Sphagnetea*, which is in line with the decision of Bogdanowskaya-Guihéneuf (1938) to classify the cottongrass tussock communities on Kolguev Island as bogs.

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