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SPHAGNUM TENELLUM (SPHAGNACEAE, BRYOPHYTA) IN WEST SIBERIA

SPHAGNUM TENELLUM (SPHAGNACEAE, BRYOPHYTA) В ЗАПАДНОЙ СИБИРИ

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Abstract

The first finding of *Sphagnum tenellum*, a species with a well-defined oceanic distribution, on a ridge-hollow bog in the centre of the taiga zone of Western Siberia is reported. Its distribution in Russia is analyzed and re-assessed. The geobotanical descriptions of plant communities with *Sphagnum tenellum* from Western Siberia and South Siberian mountains are presented. It has been shown that communities with *Sphagnum tenellum* in montane mires in South Siberia are most similar in composition and environmental conditions to finds from the highlands of Scandinavia, while the new location of *Sphagnum tenellum* in the taiga zone of Western Siberia is fully consistent with the ecologo-cenotic amplitude of the species in the north of West European plains and North-West Russia.

Резюме

Сообщается о первой находке *Sphagnum tenellum* – вида с отчетливо выраженным океаническим распространением, на верховом грядово-мочажинном болоте в центре таежной зоны Западной Сибири. Проанализировано и уточнено его распространение в России. Приведены геоботанические описания растительных сообществ со *Sphagnum tenellum* из Западной Сибири и гор Южной Сибири. Показано, что сообщества с участием *Sphagnum tenellum* на горных болотах Южной Сибири по составу и экологическим условиям местообитаний наиболее близки находкам из горных районов Скандинавии. В то время как новое местонахождение *Sphagnum tenellum* в таежной зоне Западной Сибири полностью укладывается в эколого-ценотическую амплитуду вида на равнинных территориях севера Западной Европы и Северо-Западе Европейской части России.

KEYWORDS: *Sphagnum tenellum*, ecology, plant communities, distribution, Western Siberia, Russia

INTRODUCTION

Sphagnum mosses are one of the most distinctive and attractive groups of Bryophyta that play the leading role in the structure of the plant cover of peat bogs and taiga forests. They are common to the tundra zone and high mountains. However, the knowledge of *Sphagnum* mosses in Siberia, where these types of biomes are most common and diverse, is still rather poor. More and more new locations that increase our knowledge of the distribution pattern and ecology of the species are being found (Yurkovskaya & Maksimov, 2009). Most finds of new *Sphagnum* species unknown earlier in Russia have been reported from Siberia and Far Eastern Russia (Maksimov, 2013).

Sphagnum tenellum is a mesooligotrophic hygrohydrophyte closely related to oceanic regions [The nomenclature of mosses is presented after Ignatov, Afonina, Ignatova et al. (2006), that of liverworts after Konstantinova et al. (2009), that of lichens after Urbanavichus (2010) and that of vascular plants after Cherepanov (1995)]. It occurs on the American continent from maritime Greenland to Mexico and Brazil (Crum, 1984, 1986; McQueen & Andrus, 2007; Michaelis, 2011). In Eurasia, it has been reported from most parts of Europe from the Faeroes Islands to Portugal, the Kaliningrad region, the Baltic region, Ukraine, the Caucasus, Belorus, Japan, China and Far Eastern Russia (Savich, 1932, 1936; Savich-Lyubitskaya, 1952; Suzuki, 1972; Daniels & Eddy, 1985; Napreyenko & Razgulyaeva, 1999; Akatova, 2002; Ignatov & Ignatova, 2003; Ignatov, Afonina, Ignatova et al., 2006; Hill et al., 2006; Gao & Crosby, 1999; Séneca & Söderström, 2009; Chernyadyeva, 2012; Pisarenko et al., 2012) and North Pacific islands (Bakalin & Cherdantseva, 2006; Fedosov et al., 2012). *Sphagnum tenellum* occurs sporadically in western and northwestern European Russia, *e.g.*, the Pskov and Leningrad regions, Karelia and the Murmansk and Arkhangelsk regions (Savich, 1936; Shlyakov & Konstantinova, 1982; Botch & Kuzmina, 1985; Kuzmina, 1987; Maksimov, 1988; Botch & Vasilevich, 1992; Belkina & Likhachev, 1977; 2010; Boychuk, 2001; Churakova, 2002; Elina et al., 2005; Kuznetsov,

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2005; Kuznetsov & Maksimov, 2005) and is known from scarce finds in the Novgorod, Tver and Kaluga regions (Notov et al., 2002; Teleganova, 2008).

In European Russia, the species commonly grows in the hollows of ombrotrophic bog sites, where the degradation of the *Sphagnum* cover is about to begin or is already in progress in the phytocenoses of the associations *Rhynchospora alba – Sphagnum majus – Algae, Andromeda polifolia – Eriophorum vaginatum – S. balticum, Baeothryon caespitosum + Rhynchospora alba – Hepaticae*. Less commonly *Sphagnum tenellum* occurs in carpet cotton grass-*Sphagnum* communities at oligotrophic bog sites. *Sphagnum* moss degradation is induced by the erosion and denudation of the plant cover of bogs (Yurkovskaya, 1980). As *Sphagnum* mosses are poor edificators on such bogs, the bogs are colonized by liverworts and lichens. *S. tenellum* is a cenotically weak species. It forms small clean clumps or grows among other *Sphagnum* moss species such as *S. balticum, S. majus, S. lindbergii, S. compactum*, *S. papillosum, S. rubellum,* very seldom with *S. jensenii, S. subsecundum* and only once among *S. annulatum*. The shoots of *S. tenellum* are often permeated by the liverworts *Gymnocolea inflata* and *Cladopodiella fluitans.* In the north taiga subzone of western Karelia *Sphagnum tenellum* is occasionally encountered at mesotrophic bog sites and in the Murmansk region on small montane bogs, in hollows with unconnected *Sphagnum* cover formed of *S. compactum.* Liverworts are abundant on exposed peat between the clumps of *Sphagnum compactum* and *S. tenellum* (Kuznetsov & Maksimov, 2005; Boychuk & Kuznetsov, 2012).

In eastern Asian Russia, such as Sakhalin, Kamchatka, the North Kurile Islands and the Kommander Islands, *S. tenellum* is too scarce to describe its ecology, because there is practically no information on the growth conditions of the species on the labels.

In North America, *Sphagnum tenellum* occurs also in ombrotrophic and slightly minerotrophic habitats on blanket bogs and convex raised bogs in coastal areas. It grows together with *Sphagnum rubellum, S. pulchrum, S. papillosum, S. fuscum, S. cuspidatum.* In the mountains of New York State, it grows on siliceous moist rocks, often together with *Sphagnum pylaisii* Brid. and *S. compactum* (Andrus, 1980). In the North American Arctic, it has been found on permanently moistened soil near late snow-patches (Crum, 1986).

The goal of the present paper is to revise the finds, to analyze the distribution pattern of *Sphagnum tenellum* in continental Eurasia and to reveal the environmental and phytocenotic confinement of the species as compared to the main part of its distribution range in Russia.

Material and metods

Study of about 90 herbarium specimens in PTZ, LE, and partly in MW and Tomsk State University was conducted to reveal peculiarities of *Sphagnum tenellum* geographic distribution in Russia.

We used 156 published mire vegetation relevés containing *Sphagnum tenellum* from Western Europe (Ruuhijarvi, 1960; Eurola, 1962; Dierssen, 1982; B. & K. Dierssen, 1984) to clarify the phytocenotic confinement of this species in the main part of its range. Additionally 27 unpublished geobotanical relevés with *Sphagnum tenellum* from Karelia Republic and 2 relevés from Murmansk Province (Nature reserve "Pasvik") were included in a comparative analysis.

Comparison of the environmental conditions of mire habitats was made based on L.G. Ramenskiy method of ecological scales (Ramensky et al., 1956). Ecological indices (grades) of water supply and nutrient condition for each relevé were calculated.

The method for calculating average ecological grade value for a habitat is described by Korolyuk (2006) and is implemented in software package IBIS 6.0 (Zverev, 2007), which was used to calculate ecological grades. The ecological ordination of mire habitats was carried out using Ramensky' scales (Fig. 2) showing state values for mineral nutrition (Y-axis), and for water supply (wetness) (X-axis). The ecological grades of relevés were considered to be generalized characteristic of ecologic conditions in the habitats of *Sphagnum tenellum* noted in the relevé.

Results

A new site of *Sphagnum tenellum*, a species with a well-defined oceanic distribution, was recently found by E.D. Lapshina in the centre of the taiga zone of Western Siberia (upper Konda river basin, left tributary of the river Ob, Khanty-Mansiysk Autonomous District), where the climate is sharply continental (Fig. 1). The difference between January and July temperatures is about 40°C. The nearest sites are located 1610 km southeast, on the western macroslope of Kuznetskiy Alatau Mountains in Southern Siberia, and the distance to the nearest point in the west is about 1200 km.

The species was found on Bazovoe raised oligotrophic bog near the permanent study area in Kondinskie Lake Nature Park located 60 km south of Sovetskiy town, Khanty-Mansisk Autonomous District (60°51´N; 63°31´E).

The environmental conditions of this area are described in detail in the joint monograph "Kondinskie Lake Nature Park" (Kalinin, 2012). Mean annual air temperature measured by the Sovetskiy town Weather Station is not more than –0.8° C, the mean temperature of the coldest month (January) is –19.8 C and that of the warmest month (July) is +17.1°C. The length of the frostless period is 97-110 days. Total annual precipitation is 450-530 mm. The snow cover in the forest is 54 cm thick. The continental pattern of the climate and the considerable length of the winter season are due to the free transfer of the Arctic air to the area. The warm humid air transferred from the west and warm dry winds from the south have a warming effect.

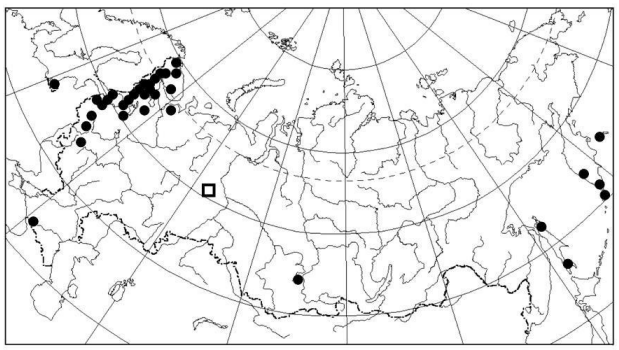

Fig. 1. Distribution of *Sphagnum tenellum* in Russia: open square – new location of the species in Western Siberia; solid circles – locations known earlier.

Of great importance for the warming of the local climate are bog complexes and lake-bog complexes that occupy up to 70% of the park area. As large, well-heated shallow lakes and bogs have a high heat-accumulating capacity, air humidity increases (dew, fog), while temperature maxima and the effect of droughts decrease.

The absolute dominance of sand soils in the park is responsible for the abundance of pine lichen and dwarf shrub-green moss forests and raised and transition bogs.

The main part of the site on the raised bog near the permanent study area where *Sphagnum tenellum* has been found consists of pine-dwarf shrub-*Sphagnum* (ryam) communities and ridge-small hollow complexes. Ryam communities and ridges are composed of the association ***Mylio-Sphagnetum fusci*** Lapshina 2010 which replaces the East European association ***Ledo-Sphagnetum fusci*** Du Rietz 1921 et Dierssen 1982 in the forest zone of Western Siberia. The cotton grass-*Sphagnum* communities of the association ***Eriophoro vaginati-Sphagnetum baltici*** Bogd.-Guihenéuf 1928, which make up as much as 30% of the complex area, are common to small round or irregular hollows (Lapshina, 2010).

Communities with *Sphagnum tenellum* have been described as a part of a ridge-pool-hollow complex, parts of which are small and are confined to poor ground water exposures near the foot of a high morainic hill.

The ridge-pool-hollow complex is formed of small secondary bog pools surrounded by large hollows of floating mat type combined with pine-dwarf shrub-*Sphagnum* ridges. The ratio of the complex constituents (bog pools, hollows and ridges) is 15:50:35.

The surface of low ridges with 1.0-2.5 m high pine stands growing on them are 20-30 cm above the hollow level. The dwarf shrub layer (20-30%) is formed of *Andromeda polifolia* and *Ledum palustre*. *Vaccinium uliginosum*, *Empetrum hermaphroditum, Oxycoccus palustris* and *O. microcarpus* are not very abundant. *Rubus chamaemorus* has the greatest cover area (10%) estimated for herbs, while *Eriophorum vaginatum* and *Drosera rotundifolia* are not abundant and are hardly noticeable. The ground cover is absolutely dominated by *Sphagnum fuscum*, while *Mylia anolala* and *Polytrichum strictum* are far less abundant. The ground lichens *Cladonia stydia, C. arbuscula, Cetraria islandica* and *C. laevigata* cover 5-10 to 15% of the area. *Cladonia cenotea, C. chlorophaea, C. deformis, C. crispata, C. cornuta, C. gracilis, C. grayi, C. sulphurina, C. crispata, C. botrytes* and *Icmadophylla ericetorum* commonly occur in microdepressions.

The communities differ in the elevated abundance of *Andromeda polifolia* and European cranberry from the typical association ***Mylio-Sphagnetum fusci*** Lapshina 2010.

There are two height levels occupied by various types of plant communities in the hollows. Beak-sedge–liverwort–*Sphagnum* communities, dominated by *Rhynchospora alba, Gymnocolea inflata, Sphagnum jensenii, S. lindbergii* and *S. majus*, occur on floating mats near the pools. The percent coverage of beak-sedge varies from 10-15 to 40-50%. *Drosera anglica* is also abundant (5-7%). The mosaic-structured moss cover is formed of alternating *Sphagnum* mosses, liverworts and patches of liquefied peat with scarce shoots of bryophytes. The bog water level is at a depth of 1-5 cm from the surface.

The upper level of the hollows in the form of flat carpets occupied by dwarf shrub-cotton grass-*Sphagnum* communities dominated by *Sphagnum tenellum*, adjoins the ridges. The 5-10 cm tall dwarf shrub layer (10-15%) consists of *Andromeda polifolia* with a small percentage of *Chamaedaphne calyculata*. The grass cover (10-15%) is composed of flat tussocks, 5-10 cm in height and 20-25 cm in diameter, covered by the cotton-grass *Eriophorum vaginatum*. *Drosera anglica, D. rotundifolia* and *Oxycoccus palustris* are not very abundant. The moss cover consists of the consolidated carpet of *Sphagnum tenellum* permeated by the individual stalks of *Gymnocolea inflata*. Pure carpets formed by *Sphagnum capillifolium* are scarce. The bog water level is at a depth of 10-12(-15) cm from the surface.

The plant cover of the hollows generally consists of fragments of the associations ***Sphagno baltici-Rhynchosporetum albae*** Bogd.-Guihenéuf 1928, ***Hepatico-Rhynchosporetum albae*** Bogd.-Guihenéuf 1928, ***Eriophoro vaginati-Sphagnetum baltici*** Bogd.-Guihenéuf 1928, ***Scheuchzerio palustris-Sphagnetum*** Osvald 1923 (Lapshina, 2010) and the community *Andromeda polifolia-Sphagnum tenellum*.

DISCUSSION

Sphagnum tenellum was first reported for continental Middle Siberia by Muldiyarov & Lapshina (1990). This species has been identified from the mosses collected in 1977 in the Podkamennaya-Nizhnyaya Tunguska interfluve. This area has been recently included into a review of the species diversity of bryophytes in Tungusskiy State Reserve established in 1995 in the area devastated by the Tunguska meteorite (Ignatov et al., 2004).

This location is essential for the understanding of the ecology and geographic distribution of the species be-

Table 1. Phytocoenotic table of vegetation relevés with *Sphagnum tenellum* from Siberia, Northwest of Russia and Western Europe. In synthetic lists of vegetation units (columns 6-12) only species with constancy of more than 20% were included.

Regions: WS – West Siberia, Khanty-Mansiysk Autonomous District; KA – South Siberia, Kuznetskiy Alatau Mountains (Lapshina 1996); KM – Karelia & Murmansk Province (unpublished relevés by Oleg Kuznetsov); FS – South Finland (Eurola, 1962); FN – North Finland (Ruuhijarvi, 1960); N1 – Norway (Dierssen, 1982; ass. Trichophoro cespitosi-Sphagnetum compacti Warén 1926 et Dierssen 1982); N2 – Norway (Dierssen, 1982; ass. Sphagno tenelli-Rhynchosporetum albae Osvald 1923 et Dierssen 1982); UK – British Isles (Dierssen, 1982); D – Germany, Schwarzwald (B. & K. Dierssen, 1984).

Region	WS	KA				KM	FS	FN	N1	N2	UK	D
Column	1	2	3	4	5	6	7	8	9	10	11	12
Number of relevés						29	14	39	30	23	11	39
Dwarf shrubs												
Andromeda polifolia	2					86	93	85	80	57	28	28
Betula nana						10		41	20			
Calluna vulgaris							15	28	17			49
Vaccinium uliginosum						3		21	17			16
Empetrum nigrum								21	23			
Erica tetralix									3	5	28	
Herbaceous plants												
Baeothryon cespitosum		**3**	**3**	**2**	**1**	72	29	82	**97**	44	9	64
Eriophorum vaginatum	2					69	72	72	27	74	9	44
Drosera rotundifolia	+			+	+	48	57	31	20	31	46	31
Rhynchospora alba	1					14	65	26		100	100	11
Oxycoccus palustris	1				+	66	86	75	3	13	9	49
Eriophorum angustifolium						10	7	3	40	9	91	5
Molinia caerulea						7	7	13	10	5	37	36
Drosera anglica	1					62	65	16	27	31	46	
Scheuchzeria palustris	+		+	2	2	79	15	49		9		21
Carex limosa				1	2	59	7	21	17	18		
Carex rostrata		+	+	1		17	7	34	10			8
Menyanthes trifoliata						14		16			18	
Carex pauciflora						45		62	7			31
Oxycoccus microcarpus	+					55		8	10	5		
Carex lasiocarpa		+						31				3
Narthecium ossifragum										13	46	
Bryophytes												
Sphagnum tenellum	**3**	**2**	**3**	**2**	**2**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Cladopodiella fluitans	2			+	+	59	29	8	30	35	9	3
Sphagnum papillosum	+			2	1	21	29	93	40	31	55	5
Sphagnum cuspidatum							29	8		35	91	18
Sphagnum magellanicum					+	3	15	54		13		44
Sphagnum rubellum							29	52		9		46
Sphagnum balticum	2					45	65	82	20	26		
Sphagnum majus	2					59		49	7	18		3
Sphagnum compactum		**4**	**2**	**2**	**4**	66		41	**90**	35	18	
Gymnocolea inflata									47	39	28	23
Sphagnum lindbergii						17		26	37	13		
Sphagnum angustifolium								26	7			28
Sphagnum fallax								28				
Mylia anomala						7					9	36
Warnstorfia fluitans		1	2	+	1	10		8	17	5		18
Polytrichum strictum							7	11				8
Sphagnum jensenii	2	+	2	3	2			13				

Note: In individual relevés from Siberia (columns 1 – 5) the Braun-Blanquet scale (+, 1, 2, 3, 4, 5) of abundance is used. For characterization of synthetic lists of vegetation units (columns 6 – 12) constancy values are indicated in percentage terms.

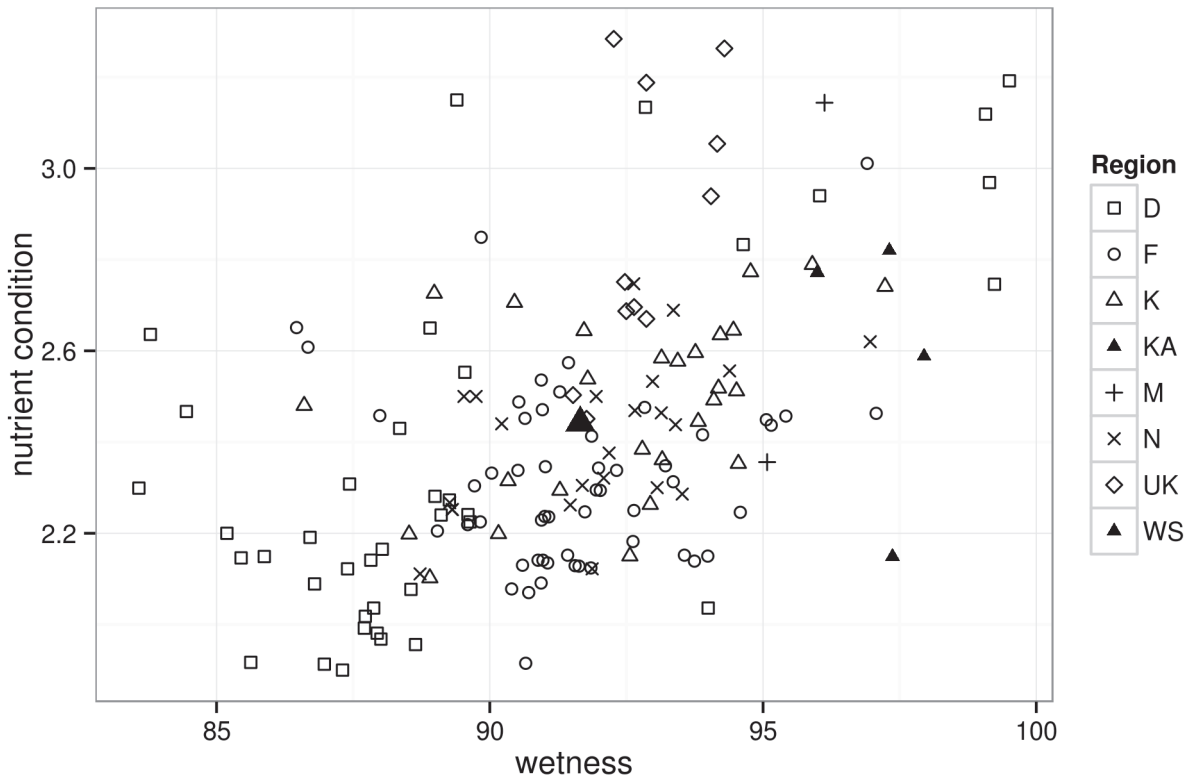

Fig. 2. Ordination of mire vegetation communities, where *Sphagnum tenellum* has been revealed, on Ramenskiy's scales. The legend follows the regions to Table 1.

cause Atlantic cyclones do not reach Middle Siberia, where the climate is sharply continental. Therefore, the authors have decided to re-identify and re-describe the species. While preparing the present paper, the sample was re-examined. The examination has shown that *Sphagnum tenellum* was reported for Middle Siberia by mistake. The point is that a poorly developed sample of *S. teres* was taken for *Sphagnum tenellum*.

In 1995, *Sphagnum tenellum* was found in South Siberian mountains, on the western macroslope of the Kuznetskiy Alatau mountains, a northern offshoot of the Altai-Sayany mountainous country (54° 41′ N; 88° 23′ E). Plant communities with *Sphagnum tenellum* have been described from Krestovskie Bogs located in a large intermontane basin at the boundary of the forest and lower subalpine belt, near the permanent study area by Mount Chemodan at an altitude of 850 to 950 m (Muldiyarov & Lapshina, 2000).

The environmental conditions of the Central Kuznetskiy Alatau have been described earlier (Pisarenko, 2004). The N-S orientation of Kuznetskiy Alatau mountains is responsible for considerable differences between the western and eastern macroslopes. As air masses are dominantly transferred in a western direction, the bulk of the moisture they carry is precipitated on the western macroslope and in the highland. Annual precipitation varies here from 2100 to 2500 mm, but in humid years it increases to at least 2700-3000 mm (Shpin, 1980), which is comparable with the sub-oceanic Atlantic climate of Western Europe. The snow cover in the upper part of the forest belt at an altitude of 800-900 m stays for 7-8 months a year. As the snow depth in the intermontane basin near the permanent study area varies from 200 to 400 cm, soils do not freeze throughout the entire winter season, although the mean annual temperature is about – 1°C.

During the geobotanical study of plants from montane bogs *Sphagnum tenellum* has been found repeatedly at a ridge-pool, slightly terraced oligotrophic bog site in the upper part of the intermontane basin slope.

The association ***Carici limosae-Sphagnetum compacti*** Lapshina 1996 has been described, based on the results of the study, and a special sub-association, ***C. l.-S. c. sphagnetosum tenelli***, represented by four descriptions, has been identified (Lapshina, 1996). The diagnostic species of the association are *Baeothryon caespitosum* and *Sphagnum compactum* and that of the subassociation is *Sphagnum tenellum*. The floristically poorly delineated communities of the association are well-defined and are readily recognized in the field. Their distinctive appearance is produced by the more or less dense root mat of *Trichophorum cespitosum* that grows on the compact peat, the surface of which is covered by the blackish crust of liverworts with yellow patches of the flat carpets of *Sphagnum compactum*.

The average percent coverage of the grass layer is about 40%. Other most permanent vascular plants, in addition to *Trichophorum cespitosum*, are *Carex limosa,*

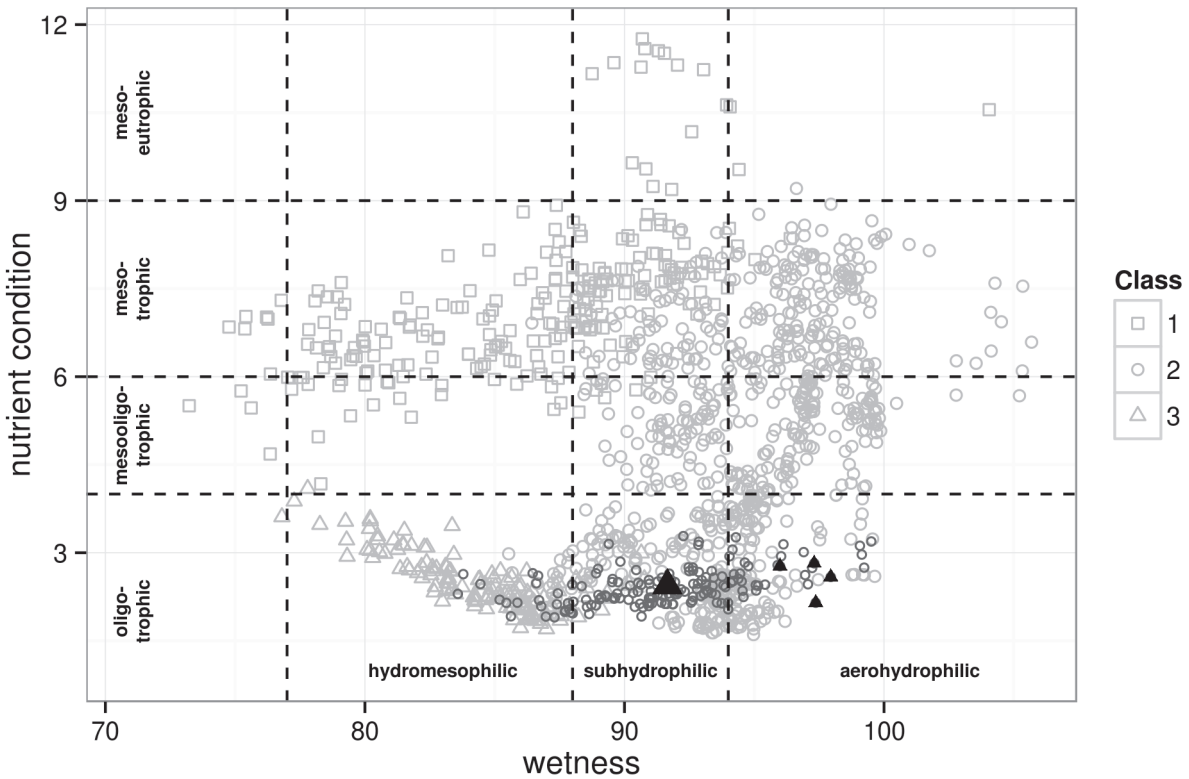

Fig. 3. Location of *Sphagnum tenellum* habitats (black symbols) shown against the ecological amplitude of the phytosociological classes of Braun-Blanquet approach (marked in grey) on Ramenskiy's scales.Phytosociological classes of mire vegetation: 1 – Alnetea glutinosa, 2 – Scheuchzerio-Caricetea, 3 – Oxycocco-Sphagnetea. Habitats of *S. tenellum*: in Western Europe and North West of Russia (black unfilled circles), in Kuznetskiy Alatau Mountains (small filled triangles), in the centre of West Siberian plain (large filled triangle).

C. rostrata and *Scheuchzetia palustris*. Other mosses, in addition to diagnostic species, that constitute the ground cover are *Warnstorfia fluitans, W. exannulata, Gymnocolea inflata, Cladopodiella fluitans, Sphagnum jensenii, S. papillosum* and *Scapania paludicola*.

The communities of the association develop under oligotrophic conditions on slightly to moderately inclined bog surfaces and are variably moistened. Communities with *Sphagnum tenellum*, in contrast to a typical subassociation developing in the large periodically drying fens of ridge-fen complexes, occupy relatively small areas at the best-moistened and, therefore, the most favourable sites along the ridges oriented across the bog surface slope.

The association with *Sphagnum tenellum* described from Kuznetskiy Alatau bogs is most similar to the association ***Trichophoro-Sphagnetum compacti*** Waren 1926 et Dierssen 1982 (Table 1, column 9). The latter is widespread in the boreal zone of Scandinavia, where it occurs dominantly on the oligotrophic hanging bogs of the subalpine belt. It differs from its Siberian analogue in the relatively well-defined species of the class ***Oxycocco-Sphagnetea*** Br.-Bl. et R.Tx. 1943 such as *Andromeda polifolia, Empetrum hermaphroditum, Oxycoccus microcarpus, Rubus chamaemorus* and *Eriophorum vaginatum*. Furthermore, northern sub-Atlantic and hypoarctic species, such as *Ochrolechia frigida, Siphula ceratites, Anthelia juratzkana, Cetrariella delisei, Carex rariflora, C. rotundata*, *etc*. make up a large share of the diagnostic and associated species of the Scandinavian association.

However, the finding of an oceanic species, *Sphagnum tenellum,* in the montane bogs of Southern Siberia under climatic conditions similar with sub-Atlantic areas of northern Western Europe and in similar plant communities, could be expected.

The environmental conditions of a particular habitat are of primary importance for the colonization of *Sphagnum tenellum* under the continental conditions of West Siberian plains, where annual precipitation is relatively small.

In the taiga zone of West Siberia, *Sphagnum tenellum* has been revealed in the hollows of an oligotrophic ridge-pool-hollow mire site, where initial stages of *Sphagnum* cover degradation indicated by the presence of liverworts and lichens in the plant cover, were observed. Favorable conditions for the growth of *Sphagnum tenellum* are provided here primarily by the distinctive hydrological conditions at this mire site, where poor groundwater contribute markedly to its nutrition. Thus, the emergence of *Sphagnum tenellum* in continental West Siberia is due to a stable humidification conditions, rather than

climate. A decrease in the vertical increment of the main dominant species of the *Sphagnum* cover, with which such a phytocenotically weak species as *Sphagnum tenellum* cannot compete, is also essential in ground water discharge areas.

Ecologically, communities with *Sphagnum tenellum* described from Kuznetskiy Alatau bogs tend to locate in noticeably wetted habitats (Fig. 2), which in Western Europe are usually covered by the most waterlogged communities with *Carex limosa, Scheuchzeria palustris* and dominance of *Sphagnum cuspidatum* and *S. majus*.

As it is shown in Fig. 2, the new habitat of *Sphagnum tenellum* in the taiga zone of Western Siberia is situated in the centre of ecologo-cenotic amplitude, which is typical for this species on West European plain areas (in Finland, Norway) and NW part of Russia. More significant eco-coenotic differences can be observed between West Siberian community of *Sphagnum tenellum* and communities located on blanket bogs in the British Isles and montane mires in the South of Germany.

The environmental and phytocenotic confinement of the plant communities with *Sphagnum tenellum* can be distinctly seen against the background of the ecological amplitude of the main phytosociological classes of mire vegetation selected in accordance with Braun-Blanquet approach. Based on Ramensky's scales, the ecological ordination of high vegetation units of West Siberia mire habitats was carried out (Lapshina & Filippov, 2012).

Figure 3 shows that as a whole the mire communities with *Sphagnum tenellum* occur within the broad limits of water supply conditions starting with relatively dry (hydromesophyllic) *Sphagnum* hummocks and ending with waterlogged (aerohydrophillic) hollows and quagmires (84-98 grades of wetness). At the same time, they are confined between 2.5 and 3.5 grades by their habitat nutrient conditions, displaying intermediate position between precipitations fed raised bog communities of Oxycocco-Sphagnetea and faintly minerotrophic Scheuchzerio-Caricetea communities fed by run-off and poor ground water.

Thus, a comparison of the composition and structure of the plant cover of the mire site where *Sphagnum tenellum* has been revealed, and the environmental conditions of its habitats in the taiga zone of West Siberia shows that they are very similar to the eco-coenotic characteristics of the mire habitats of this species in the North of Western Europe and NW Russia.

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APPENDIX 1

SPECIMENS EXAMINED**.** ***EUROPEAN RUSSIA:*** **Murmansk Province, *Pechenga District***, bottom of Karablek (69°14' 56" N, 29° 24' 51" E), 8.VIII.2011, #PTZ 4715, *M.A. Boychuk* (PTZ); Nature Strict Reserve "Pasvik", bottom of Kakyupya (69° 15'38" N, 29° 22'15" E), 7.VIII.2011, #PTZ 4743, *M.A. Boychuk* (PTZ); mire "Pechengskoe", 20.VII.1959, *A. Sventikhovskaya* (MW); the Pala Lip in Kola Bay, 27.VIII.1918, *L.I. Savicz* (LE); ***Kandalaksha District***, proposed Reserve "Kaita" (67° 08' 14'' N, 31° 23' 50'' E), 25.VII.2013, #PTZ 5588, *M.A. Boychuk* (PTZ);

Karelia Republic, *Louchi District,* bog Vypukloe, vicinity of the railway station Ambarny, 24.VIII.1957, #PTZ4731, *T.K. Yurkovskaya* (PTZ); mire Chkalovskoe, 14.VII.1987, #PTZ 4701, *N.V. Stoikina* (PTZ); mire Pirtishuo, 25.VII.1989, #PTZ 4709 c.fr., *N.V. Stoikina* (PTZ); White Sea, Keret Reserve, island Sidorov, 13.VIII.1998, #PTZ 4716 (Б-98/144-287) c.fr., *A.I. Maksimov* (PTZ); *Kem District*, mire Ozernoe, near road Kem-Kalevala (95 km), 14.VII.1990, #PTZ 4700, *O.L. Kuznetsov* (PTZ); raised bog Kuzhatshuo, 16.VII.1990, #PTZ 4702, *O.L. Kuznetsov* (PTZ); near village Gridino, island Belomorsky (65° 54' N, 34° 39' E), small mire among a lichen pine forest at island top, 5.VIII.2007, #PTZ 4713 (Гр/43-46(1), 4727 (Гр/43-65) c.fr., *A.I. Maksimov* (PTZ); mire near north bank of the lake Nizhnee Kuito, 2.VIII.1964, #PTZ 4735, *T.K. Yurkovskaya* (PTZ); *Kostomuksha District,* Kalevala National Park, environs Nizhnyaya Labuka, 7.VII.2000, #PTZ 4722, O.L. Kuznetsov (PTZ); North part of the Kostomuksha State Nature Reserve, surroundings lake Fenozero, 3.VIII.1995, #PTZ 4739, *M.A. Boychuk* (PTZ); ***Muezersky District***, neighborhood of the settlement of Rugozero, 5.VIII.1928, #421, *P. N. Nikolsky, I.I. Izotov* (LE); settlement Reboly, 15.VIII.1970, *L.A. Volkova* (LE); Vottovaara mountain (63° 04' N, 32° 36' E), 17.VIII.2008, #PTZ 4708 (Vo-08/102) c.fr., #PTZ 4712 (Vo-08/118), 4717 (Vo-08/88) c.fr., *A.I. Maksimov* (PTZ); Tuulos Landscape Reserve, vicinity Nemi lake (63° 30' 30.6'' N, 30° 14' 48.1'' E), 4.VII.2006, # PTZ 4726 (Ey-06/25), *A.I. Maksimov* (PTZ); in the same place, mire Kaskadnoe, 15.VI.1993, #PTZ 4732, *P.N. Tokarev* (PTZ); ***Segezha District***, mire serrounding railway station Sumerichi, 13.VIII.1962, #PTZ 4704 c.fr., *G.A. Elina* (PTZ); ***Belomorsky District***, vicinity of the village Virma, rised bog Virmovskoe, 22.VII.1988, #PTZ 4705, *A.I. Maksimov* (PTZ); bog in 1 km to east from Nyukhcha, 23.VII.1963, #PTZ 4728, *G.A. Elina* (PTZ); bog between Nyukhcha and hill Svyataya, 27.VII.1963, #PTZ 4729, *T.K. Yurkovskaya* (PTZ); bog Primirskoe in 5 km to north from Nyukhcha, 22.VII.1963, #PTZ 4730, *T.K. Yurkovskaya* (PTZ); bog Kamovoye in 2 km to south from the railway station Tegozero, 2.VIII.1963, #PTZ4733, *T.K. Yurkovskaya* (PTZ); ***Suoyarvsky District***, lake Hiisjyarvi vicinities (61° 44' N, 32° 03' E), bog Pallensuo, 2.VII.2002, #PTZ 4725 (H-02/3), *T.Yu. Dyachkova* (PTZ); Loymola forestry, bog Leyukisuo, 9.VI.1983, #PTZ 4740, *V.K. Antipin* (PTZ); ***Medvezhyegorsky District***, 4,5 km to east from the railway station Maselgskaya, a bog No. 6, 10.VII.1963, #PTZ 4738, *R.P. Kozlova* (PTZ); ***Kondopoga District***, east coast Kuyvalamby on the way Sandal lake to the Kivach Falls, 10.VIII.1920, #1150, *L.I. Savich* (LE); Kivach State Reserve, quarter 25, bog Sukhaya lamba, 13.VIII.2002, #PTZ 4711 (K-02/41), *T.A. Maksimova* (PTZ); ***Prionezhsky District***, bog Sambalskoe (61° 46' 6.68'' N, 34° 08' 11.65'' E), 10.IX.1985, #PTZ 4710, *A.I. Maksimov, O.L. Kuznetsov* (PTZ), #P TZ 4724, *A.I.Maksimov* (PTZ);

Lenigrad Province, rised bog Gladky Mokh, 11.VII.1927, *S.N. Tyuremnov* (MW), ***Kingisepp District***, Pyatnitsky Moss, 14.VIII.1926, *Solonitsyna* (MW), bog Porzolovskoe, 14.VI.1929, *E. Istomina* (MW); Moluzhinsky Mokh, 22.VI.1929, *E. Istomina* (MW); Kurovitskoe plateau,

Kurovitskoe bog, regressive complex, VIII.1926, #11 Ex. (#PTZ 4703), *I.D. Bogdanovskaya-Giyenef*, *G. K. Lipatova* (LE, PTZ); Klenisky bog, 22.VIII.1923, #189, *I. Giyenef, Z. Smirnova, O. Gaze* (LE); Klenisky bog, 13.VIII.1923, #188, *I. Giyenef, Z. Smirnova, O. Gaze* (LE); Kurovitsky plateau, Bolshoy Mokh, 15.VIII.1926, *G. Lepilova* (LE); Kurovitsky plateau, Kurovitsky bog, 23.VIII.1926, *G. Lepilova* (LE); Pyatnitsky Mokh, 29.VIII.1923, #191, *I. Giyenef, Z. Smirnova, O. Gaze* (LE); Klenisky bog, 28.VIII.1923, #190, *I. Giyenef, Z. Smirnova, O. Gaze* (LE); ***Vyborgsky District***, Reserve Lammin-suo, 1992, *E.O. Kuzmina* (LE); ***Podporozhsky District***, Nature Park Vepsky Les, Linsboloto, (60° 16' 34,8'' N 34° 50' 54.0'' E), 2005, #PTZ 4707, *V. Smagin* (PTZ); Leryanskoe bog, 10.X.1935, *S.N. Tyuremnov* (MW); **Pskov Province,** Pskov-Chudskaya lowland, Federal Reserve Remdovsky, 15.VI.2002, *E.N. Andreeva* (LE); **Tver Province, *Zharkovsky District,*** in 40 km to South from of the railway station Nelidovo, Zharkovsky Moss, 22.IX.1931, *S.N.Tyuremnov* (MW); **Kaluga Province, *Spas-Demensky District,*** Ignatovsky Mokh, in 2,5 km to south-west from the settlement the Ignatovsky Mokh, 25.VII.1965, *Peshkova* (MW); Ignatovsky Mokh, in 3 km from the railway station of Chiplyaevo, 25.VII.1965, *Peshkova* (MW); Ignatovsky Mokh, in 2,5 km to south-west from the settlement Ignatovsky Moss, 27.VII.1965, *Peshkova* (MW); **Kaliningrad Province, *Slavsky District,*** rised bog Bolshoe Mokhovoe, 25.VI.2010, *A.D. Potyomkin, M.G.Napreenko* (LE); **Archchangelsk Province,** Vetreny Poyas, bog Blik, 13.VII.1983, #PTZ 4706, *L.A. Volkova* (PTZ); 12.VII.1983, #PTZ 4736 c.fr., *G.A. Elina* (PTZ); 16.VII.1983, #PTZ 4737, c.fr., *O.L. Kuznetsov* (PTZ); bog Kamenny Mokh (63° 34' 41'' N, 36° 23' 06.24'' E), 15.VII.1983, #PTZ 4718 c.fr, 4742, *G.A. Elina* (PTZ); ***Mezensky District***, Belomoro-Kuloyskoye plateau, in 10 km on south-east from the settlement of Kepino, upper courses of Soyana river (65° 20' 11,4" N 41° 58' 04,3" E), ridge-pool-hollow site of bog, 21.VII.2012, *E.Yu. Churakova*; ***Primorsky District,*** Lodma river, 13.VI.2001, #2052, *E.Yu. Churakova* (MW).

WEST SIBERIA: **Khanty-Mansiysk Autonomous District**, ***Sovetskiy District,*** Nature Reserve Park "Kondinskie Lakes" (60° 51' 09.6'' N, 63° 31' 24.1'' E), pool-ridge-hollow complex, pure low carpets in hollows, 30.VII.2011, #PTZ 4714; 19.IX.2013, #PTZ 8201, 8202, *E.D. Lapshina* (PTZ).

SOUTH SIBERIA: **Kemerovo Province,** "Kuznetskiy Alatau" State Nature Reserve (54° 41' N; 88° 23' E), Krestovskie Bogs by Mount Chemodan (900 m a.s.l.), ologotrophic ridge-fen complex, in small patches along the ridges, 20.VII.1995, *E.D. Lapshina* (PTZ).

FAR EAST*: Sakhalin**, ***Dolinsky District, basin of the Naybumi river, bog "Takoe Pervoe", 12.IX.1952, *N.V. Vlastova* (LE); **Kamchatka,** the western coast, bog Mikoyanovskoe, VIII.1958, *Koreneva* (MW); Mysovskoye-1 bog, 11.VIII.1958, *Efimova* (MW); vicinity Yamburg, VI.1909, #78, *L.G. Ramensky* (LE); Ozerko on the road from Paratutka to Mikigrina, 5.VII.1908, #, *L.G. Ramensky* (LE); basin of the river the left Kikhchik (53° 25' N, 156° 40' E), 11.VIII.2001, #86, *I.V. Czernyadjeva* (LE); **Kommander Islands,** Bering Island, vicinities of a bay Poludennaya, bog in a valley of river Poludennaya, 16.VIII.2010, #10-3-57 (PTZ 8161), 10-3-399 (PTZ 8163), 10-3-933 (PTZ 8162) c.fr., *V.E. Fedosov* (MW, dupla PTZ).