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ALGAE IN SPHAGNUM EPIPHYTON FROM THE MIRES OF THE SUBPOLAR URALS

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Abstract

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Species diversity of algal communities of sphagnum epiphyton was studied in six mountain and plain mires of the Subpolar Urals (Russia). A total of 154 species and intraspecific taxa from six divisions were identified. The highest species richness was recorded for Bacillariophyta (96 taxa) and Charophyta (33) divisions. Species *Kobayasiella parasubtilissima*, *Tabellaria flocculosa* and *Eunotia lunaris* had high abundance. Dominant communities were often formed by *Eunotia lunaris*, *E. mucophila*, *Kobayasiella parasubtilissima* and *Pinnularia subcapitata*. CCA analysis showed that conductivity and altitude above the sea level are the main factors affecting the development of algae in the studied mires.

Keywords: algal flora, mountain mires, sphagnum epiphyton, Subpolar Urals.

INTRODUCTION

Mires are a characteristic component of the geographic landscape in the northern regions. Ecological and economic value of the mires is widely recognized. In 1971, mires were included in The Convention on Wetlands of International Importance (The Ramsar…, 2013) as one of the protected objects. Mires cover 3.2 mln ha, or 7.7% of the area of Komi Republic (in European Northeast of Russia).

Environmental conditions of various types of mire ecosystems are different, resulting in high diversity of their species composition, rare taxa content and specificity of the taxa in these habitats (Ština et al., 1981; Krivograd Klemenčič et al., 2010; Kulikovskiy et al., 2010; Zagirova & Shneider, 2016).

Mires are important ecosystems for the conservation of biodiversity, especially, in the North (Zagirova & Shneider, 2016). The biota of the mires is still poorly studied compared to other water ecosystems.

The algal communities of mires have been investigated for a long time, but irregularly. In the second half of the 20th century, there was little interest to investigate algae of these ecosystems (Ština et al., 1981). During the last decades, however, the number of publications devoted to the separate algal groups of mires (Genkal & Kulikovskij, 2006; Jakimavičiūtė et al., 2006; Luknickaja, 2010; Šovran et al., 2013) and their floras in different regions, including hydrophilic and soil habitats (Muñoz et al., 2003; Zakieva, 2007; Stenina, 2008a, b; Makarevič & Leško, 2009; Konižčuk, 2013), have increased. Researchers are still interested to study algal groups that are specific to different types of mires under distinct range of environmental conditions (Borics et al., 2003; Krivograd Klemenčič et al., 2010; Pivovarova & Blagodatnova, 2016).

The algae have been well investigated in the lakes, rivers and streams of the Subpolar Urals (Sterlyagova, 2008; Sterlyagova & Stenina, 2008; Patova et al., 2014, 2016; Stenina, 2016). Data on the algae of mires in the Polar and Northern Urals (Voronixin, 1930) are incomplete. However, algae of mountain mires on the western slope of the Subpolar Urals have not been investigated yet. The aim of this paper was to study algae in sphagnum epiphyton in the mires of the Subpolar Urals.

MATERIALS AND METHODS

The field sampling was conducted in six mires on the western slope of the Subpolar Urals in the basins of Schugor and Kosyu Rivers (Fig. 1) within the boundaries of Yugyd Va National Park in July–August (2015). The qualitative samples were squeezed out of sphagnum mosses using standard techniques (Morduhaj-Boltovskoj, 1975). Five samples were taken from each of the mire.

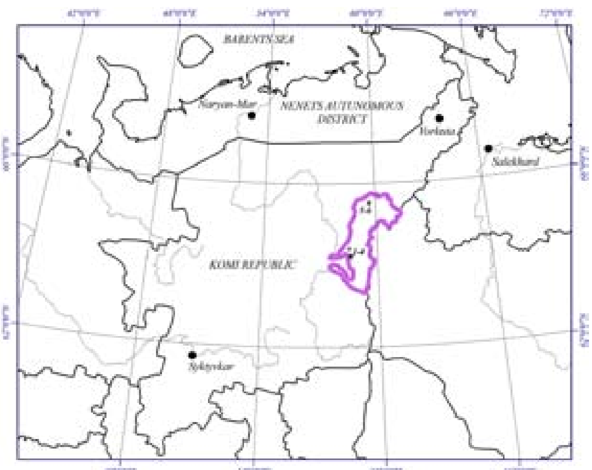

Fig. 1. Map of the study area: 1–4 mires in the basin of the Schugor River, 5–6 – mires in the basin of the Kosyu River; - - - - the border of Yugyd Va National Park

The basic parameters of water in all the mires were measured with portable digital water tester (Hanna instruments). The water sample analysis was carried out in the Ecoanalytical Laboratory of the Institute of Biology, Komi Scientific Centre, Ural Branch, Russian Academy of Sciences.

Diatom taxa were identified in permanent slides. Other algal groups were studied on live or fixed by 4% formaldehyde samples, the pure algal cultures were also used for the study. The living cultures are stored in the collection of microalgae strains at the Institute of Biology, Komi Scientific Centre (SykoA).

Samples were examined using light microscopes Nikon Eclipse 80i (with camera Nikon digital sight DS-2Mv) and XSZ-2101 (with camera Premiere HiROCAM MA88-300) (magnification ×640–1600). Abundance of the species in algal communities was estimated using the visual six-point scale (Vasil′eva & Remigajlo, 1982): 1 – single, less than 10 individuals in the slide; 2 – rare, 10 individuals in the slide; 3 – frequent, 1–10 individuals in the transect; 4 – often, 11–25 individuals in the in the transect; 5 – constant, 25–50 individuals in the transect; 6 – mass, more than 50 individuals in the transect. The dominant species (dominants and subdominants) had from four to six points of abundance. The evaluation was done by identifying all of the algae observed in successive transects of the cover glass (18 × 18 mm) under ×640 magnification (from 10 transects or more, depending on algal abundance in the sample).

To identify the taxa, we used guides and taxonomical overviews (Kosinskaja, 1952, 1960; Gollerbax et al., 1953; Koršikov, 1953; Matvienko, 1954, 1965; Popova, 1955; Dedusenko-Ščegoleva & Gollerbax, 1962; Kondrat'eva, 1968; Popova & Safonova, 1976; Ettl, 1978; Matvienko & Dogadina, 1978; Vinogradova et al., 1980; Palamar'-Mordvinceva, 1982, 1986; Coesel, 1982, 1983, 1985, 1994, 1997; Krammer & Lange-Bertalot, 1986, 1988, 1991a, b; Moškova & Gollerbax, 1987; Carenko, 1990; Lenzenweger, 1996, 1997, 1999, 2003; Komárek & Anagnostidis, 1998, 2005; Rundina, 1998; Krammer, 2000, 2003; Coesel & Meesters, 2013; Komárek, 2013). Up-to-date nomenclature changes were checked using AlgaeBase (Guiry & Guiry, 2016). Ecological and geographical analysis was performed using reviews on ecology and distribution of algae and cyanobacteria (Barinova et al., 2006; etc.).

Cluster analysis was performed using ExcelToR Excel addon (Novakovskij, 2016). Species lists with relative abundance and water ecological parameters were analysed using CCA approach in PC-ORD software (McCune et al., 2002).

RESULTS AND DISCUSSION

Descriptions of the mires are presented in Table 1. The results of physicochemical analysis showed low conductivity (from 170 to 325 µS cm^{-1}) and colour index (from 5 to 194° Pt/Co scale) of wa-

Table 1. Description of the studied mires of the Subpolar Urals

Localities / Parameters	Mire 1	Mire 2	Mire 3	Mire 4	Mire 5	Mire 6
	Basin of the River Schugor				Basin of the River Kosyu	
Type of mire	eriophorum-sphagnum	spring sedge-herb-hypnum-sphagnum	spring menyanthes-hypnum-sphagnum	herb-hypnum-sphagnum	herb-moss	sedge-sphagnum (slope)
Altitude, m	204	140	146	204	507	647
GPS coordinates	64°13'07.4" 58°34'30.9"	64°14'26.5" 58°32'56.0"	64°11'22.0" 58°33'17.2"	64°14'59.9" 58°31'54.0"	65°32'04.0" 59°36'25.1"	65°31'24.0" 59°39'19.2"
pH	4.36	6.22	7.79	5.81	6.72	7.53
Conductivity, µS cm^{-1}	170	325	225	304	195	254
T°C	10.4	10.2	12.0	9.9	10.9	11.4

ter in the investigated mires. BOD varied from 5 to 52 mg l^{-1}. Nutrient content was insignificant: total nitrogen – < 0.5 mg l^{-1}, concentration of ammonium – < 0.02 mg l^{-1}, total phosphorus – 0.041 mg l^{-1}, Si – from 0.85 to 29 mg l^{-1}, Fe – from 0.01 to 0.96 mg l^{-1}.

Analysis of the data on sphagnum epiphyton in the studied mires showed a high number of species in the water bodies of northern mountain. A total of 154 species were found in all mires, including intraspecific taxa (Table 2, Fig. 4–5). By the number of identified taxa, Bacillariophyta prevailed with 96 species and varieties (62% of the total number of species), followed by Charophyta with 33 species (21%). The similar pattern has been observed earlier by other authors for European mountain mires (Novakova, 2002; Muñoz et al., 2003; Krivograd Klemenčič et al., 2010). The number of species in other algal groups did not exceed 10% of all number of species. Most species were from *Bacillariophyceae* (87 taxa) and *Conjugatophyceae* (33) classes. The identified species belonged to 24 orders. *Naviculales*, *Desmidiales*, *Eunotiales* made up a significant part of all taxa (32, 26 and 20 taxa, respectively). The other orders consisted of 1–12 taxa. A total of 40 families were noted. The richest groups were the *Eunotiaceae* and *Desmidiaceae* (20 taxa in each), *Pinnulariaceae* (17) and *Bacillariaceae* (12). More than half of the families (21) and genera (39) were presented by single species. The genera with the highest richness of species were *Eunotia* (20 taxa), *Cosmarium* and *Pinnularia* (14 in each), *Nitzschia* (11).

Prevalence of diatoms often occurs in mesotrophic or, mostly, in oligotrophic mires (Ština et al., 1981; Krivograd Klemenčič et al., 2010; Naumenko & Ptuxina, 2012; Koniščuk, 2013; Sterljagova et al., 2016). The desmids and cyanoprokaryotes have been recorded indicating high richness of species in the mires (Ština et al., 1981).). The genera *Pinnularia*, *Eunotia*, *Frustulia, Cosmarium* and *Closterium* are considered as the most characteristic taxa of mires and other wetlands (Gecen, 1985; Kulikovskiy, 2008; Stenina, 2008a, b; Krivograd Klemenčič et al., 2010; Šovran et al., 2013). It is believed that the diversity ratio of Desmidiaceae species may be used as the index of geographical location of studied flora: the number of *Cosmarium* species over *Closterium* species grows towards the Arctic regions, (Gecen, 1985). In the studied mires, *Cosmarium* was presented by 14 species and *Closterium* – only by five species.

In different mires, from 20 to 47 species were found (Table 3). Bacillariophyta and Cyanobacteria occurred in all the studied mires, the fact is well known from the literature (Ština et al., 1981; Genkal & Kulikovskij, 2006; Stenina, 2008a, b; Koreivienė et al., 2015). Species from the Charophyta division that are a typical component of mire systems were found almost in all the investigated sites (Gecen, 1985; Kostkevičienė et al., 2003; Luknickaja, 2010; Šovran et al., 2013). Diatoms were prevalent in all of the mires and made up to 52.5–85% from all the species diversity found in the particular mires.

Various species from the genera *Pinnularia* and *Eunotia* were found at all the sites under study (in each mire 7–11 taxa). Taxa belonging to the genera *Cosmarium* (except for mire 4), *Kobayasiella* (except for mire 3) and *Tabellaria* (except for mire 5) were found in five mires. Algae of 29 genera appeared to be rare and were found in one sample. Typically, these genera were represented in the mires by single taxon except for the genus *Navicula*, three species of which were found only in mire 3.

Table 2. The list of algae found in the mires of the Subpolar Urals with relative abundance of species

Taxa	Label	Mire 1	Mire 2	Mire 3	Mire 4	Mire 5	Mire 6
Cyanobacteria							
Merismopediaceae							
Merismopedia elegans A.Br. ex Kütz.	Mer_ele	1					
Leptolyngbyaceae							
Leptolyngbya foveolara (Gom.) Anagn. et Kom.	Lep_fov			3			
Chroococcaceae							
Chroococcus turgidus (Kütz.) Näg.	Chr_tur					3	
Oscillatoriaceae							
Phormidium breve (Kütz. ex Gom.) Anagn. et Kom.	Pho_bre		1				
P. terebriforme (Ag. ex Gom.) Anagn. et Kom.	Pho_ter				1		
Rivulariaceae							
Microchaete tenera Thur. ex Born. et Flah.	Mic_ten					1	
Hapalosiphonaceae							
Hapalosiphon welwitschii W. et G.S.West	Hap_wel					3	
Aphanizomenonaceae							
Dolichospermum lemmermannii (Richter) Wacklin, Hoffmann et Kom.	Dol_lem					1	
Nostocaceae							
Anabaena minutissima Lemm.	Ana_min				1		
A. oscillarioides Bory ex Born. et Flah. f. *elliptica* (Kisselev) Elenk.	Ana_o_el					4	
Anabaena sp.	Ana_sp.		4				
Nostoc paludosum Kütz. ex Born. et Flah.	Nos_pal				1	1	2
Euglenophyta							
Euglenaceae							
Trachelomonas sp.	Tra_sp.	1					
Bacillariophyta							
Stephanodiscaceae							
Stephanodiscus cf. *hantzschii* Grun.	Ste_han					1	
Fragilariaceae							
Fragilaria mesolepta Rabenh.	Fra_mes				1		
F. nitzschioides Grun.	Fra_nit			2			
F. tenera (W.Sm.) Lange-Bert.	Fra_ten		1				
Fragilariforma virescens (Ralfs) Williams et Round	Fra_vir						3
Tabellariaceae							
Diatoma mesodon (Ehr.) Kütz.	Dia_mes			2			
Meridion circulare (Grev.) Ag.	Mer_cir	1		2	1		
Tabellaria fenestrata (Lyngb.) Kütz.	Tab_fen	1		2			
T. flocculosa (Roth) Kütz.	Tab_flo	1	2		2		3
Eunotiaceae							
Eunotia bigibba Kütz.	Eun_big					2	
E. crista-galli Cl.	Eun_cri					1	
E. denticulata (Bréb.) Rabenh.	Eun_den	3					
E. exigua (Bréb.) Rabenh.	Eun_exi	3				1	2
E. fallax Cl. var. *fallax*	Eun_fal						2
E. fallax var. *gracillima* Krasske	Eun_f_g						2
E. lapponica Grun. ex A. Cl.	Eun_lap	3					2
E. lunaris (Ehr.) Grun.	Eun_lun	5		2	3		3
E. microcephala Krasske	Eun_mic					3	
E. mucophila (Lange-Bert. et Nörpel-Schempp) Lange-Bert.	Eun_muc	5				3	
E. neocompacta Mayama	Eun_neo	3				1	1

Taxa	Label	Mire 1	Mire 2	Mire 3	Mire 4	Mire 5	Mire 6
E. nymanniana Grun.	Eun_nym			1			
E. paludosa Grun.	Eun_pal		3			2	
E. parallela Ehr.	Eun_par	2				1	
E. praerupta Ehr.	Eun_pra					2	
E. septentrionalis Øestr.	Eun_sep					2	3
E. suecica A.Cl.	Eun_sue						2
E. trinacria Krasske	Eun_tri					2	1
Eunotia sp. 1	Eun_sp.1		3				
Eunotia sp. 2	Eun_sp.2						1
Cymbellaceae							
Cymbella affinis Kütz.	Cym_aff			2			
C. falaisensis (Grun.) Krammer et Lange-Bert.	Cym_fal			4	3		
Encyonema gracilis Rabenh.	Enc_gra				2	2	
E. perpusillum (A.Cl.) Mann	Enc_per					4	2
E. silesiacum (Bleisch ex Rabenh.) Mann	Enc_sil					2	
Cymbopleura subaequalis (Grun.) Krammer	Cym_sub		3	1	1		
Gomphonemataceae							
Gomphonema angustatum (Kütz.) Rabenh.	Gom_ang			3			
G. clavatum Ehr.	Gom_cla		3	1	1		
G. parvulum (Kütz.) Kütz.	Gom_par		3				
Cocconeidaceae							
Cocconeis placentula Ehr. var. *lineata* (Ehr.) Van Heurck	Coc_p_l	1				1	
Achnanthidiaceae							
Achnanthidium minutissimum (Kütz.) Czarn.	Ach_min		2	1			
A. subatomoides (Hust.) Monnier, Lange-Bert. et Ector	Ach_sub			3			
Planothidium ellipticum (Cl.) Round et Bukht.	Pla_ell			2			
P. lanceolatum (Bréb. ex Kutz.) Lange-Bert.	Pla_lan		2	3		2	
Rossithidium linearis (W.Sm.) Round et Bukht.	Ros_lin			3			
Achnanthales sp. 1	Ach_sp.1		3				
Achnanthales sp. 2	Ach_sp.2						3
Amphipleuraceae							
Frustulia crassinervia (Bréb.) Lange-Bert. et Krammer	Fru_cra					2	
F. saxonica Rabenh.	Fru_sax	3		2			2
Brachysiraceae							
Brachysira brebissonii R.Ross	Bra_bre					4	
Neidiaceae							
Neidium ampliatum (Ehr.) Krammer	Nei_amp					3	
Sellaphoraceae							
Fallacia indifferens (Hust.) Mann	Fal_ind				2		
Pinnulariaceae							
Pinnularia appendiculata (Ag.) Schaarschm.	Pin_app						2
P. divergentissima (Grun.) Cl.	Pin_div					1	
P. major (Kütz.) Rabenh.	Pin_maj		2				
P. microstauron (Ehr.) Cl.	Pin_mic	2				3	2
P. cf. *notabilis* Krammer ex Krammer et Lange-Bert.	Pin_not				3		
P. persudetica Krammer	Pin_per		2				
P. pseudodivergentissima B. van de Vijver, Moravcová, Kusber et Neustupa	Pin_pse						1
P. rupestris Hantzsch	Pin_rup	2				3	3
P. stomatophora (Grun.) Cl.	Pin_sto					2	
P. subcapitata Greg.	Pin_subc	3				3	3
P. substreptoraphe Krammer	Pin_subs			1			

Taxa	Label	Mire 1	Mire 2	Mire 3	Mire 4	Mire 5	Mire 6
P. viridis (Nitzsch) Ehr.	Pin_vir					2	
Pinnularia sp. 1	Pin_sp.1	2					
Pinnularia sp. 2	Pin_sp.2					2	
Caloneis alpestris (Grun.) Cl.	Cal_alp		3	2			
C. bacillum (Grun.) Cl.	Cal_bac		4	2	2		
C. tenuis (Greg.) Krammer	Cal_ten			1	3		
Diploneidaceae							
Diploneis ovalis (Hilse) Cl.	Dip_ova		2	2			
Naviculaceae							
Adlafia bryophila (Petersen) Lange-Bert.	Adl_bry		1		1		
A. minuscula (Grun.) Lange-Bert.	Adl_min			1			
Chamaepinnularia hassiaca (Krasske) Cantonati et Lange-Bert.	Cha_has					3	
Eolimna minima (Grun.) Lange-Bert.	Eol_min		2				
Kobayasiella parasubtilissima (Kobayasi et Nagumo) Lange-Bert.	Kob_par	4	2		1	4	1
Navicula amphibola Cl.	Nav_amp			1			
N. oblonga (Kütz.) Kütz.	Nav_obl			1			
N. semen Ehr.	Nav_sem			1			
Naviculales sp.	Nav_sp.					5	
Catenulaceae							
Amphora sp.	Amp_sp.			1			
Bacillariaceae							
Hantzschia amphioxys (Ehr.) Grun.	Han_amp		1	1			
Nitzschia amphibia Grun.	Nit_amp		3				
N. dissipata (Kütz.) Rabenh.	Nit_dis			1			
N. holsatica Hust.	Nit_hol		3				
N. linearis (Ag.) W.Sm. var. *linearis*	Nit_l_li			1			
N. linearis var. *tenuis* (W.Sm.) Grun.	Nit_l_te		1				
N. paleacea (Grun.) Grun.	Nit_pal			3			
N. perminuta (Grun.) M.Peragallo	Nit_per					3	
Nitzschia sp. 1	Nit_sp.1		2				
Nitzschia sp. 2	Nit_sp.2		2				
Nitzschia sp. 3	Nit_sp.3			2			
Nitzschia sp. 4	Nit_sp.4				1		
Rhopalodiaceae							
Epithemia adnata (Kütz.) Bréb. var. *adnata*	Epi_a_ad		3				
E. adnata var. *saxonica* (Kütz.) Patrick	Epi_a_sa		3		1		
E. turgida (Ehr.) Kütz.	Epi_tur		1	3			
Rhopalodia gibba (Ehr.) Müll.	Rho_gib		3				
R. parallela (Grun.) Müll.	Rho_par				3		
Ochrophyta							
Hydruraceae							
Hydrurus foetidus (Villars) Trevisan	Hyd_foe					1	
Mallomonadaceae							
Mallomonas sp.	Mal_sp.	1					
Tribonemataceae							
Tribonema affine (Kütz.) G.S.West	Trib_aff			1			
T. minus (Wille) Hazen	Tri_min					1	
T. utriculosum (Kütz.) Hazen	Tri_utr					2	
T. viride Pascher	Tri_vir	1					
Vaucheriaceae							

Taxa	Label	Mire 1	Mire 2	Mire 3	Mire 4	Mire 5	Mire 6
Vaucheria sp.	Vau_sp.						1
Chlorophyta							
Chlamydomonadaceae							
Chlamidomonas sp.	Chl_sp.						1
Selenastraceae							
Ankistrodesmus spiralis (Turn.) Lemm.	Ank_spi					1	
Microthamniaceae							
Microthamnion kuetzingianum Näg. ex Kütz.	Mic_kue			1			
M. strictissimum Rabenh.	Mic_str		1				1
Trebouxiophyceae incertae sedis							
Crucigenia quadrata Morren	Cru_qua						1
Charophyta							
Mesotaeniaceae							
Cylindrocystis brebissonii (Ralfs) De Bary	Cyl_bre	1					1
Netrium digitus (Bréb. ex Ralfs) Itzigsohn et Rothe	Net_dig	1				6	
N. oblongum (De Bary) Lütkem.	Net_obl	1					
Roya anglica G.S.West	Roya_an						2
Zygnemataceae							
Mougeotia sp.	Mou_sp.						2
Spirogyra sp.	Spi_sp.	1	4				
Zygnema sp.	Zyg_sp.			1			
Gonatozygaceae							
Gonatozygon brebissonii De Bary	Gon_bre						1
Closteriaceae							
Closterium acutum Bréb.	Clo_acu	1		1			
C. cornu Ehr. ex Ralfs	Clo_cor	1		1		1	
C. navicula (Bréb.) Lütkem.	Clo_nav			1			
C. strigosum Bréb. var. *elegans* (G.S.West) Krieger	Clo_s_el	1					
Closterium sp.	Clo_sp.						4
Desmidiaceae							
Actinotaenium clevei (Lund.) Teil.	Act_cle					1	
A. cucurbita (Bréb. ex Ralfs) Teil.	Act_cuc		1				1
A. cucurbitinum (Bisset) Teil.	Act_cucm						1
Cosmarium botrytis Meneg. ex Ralfs	Cos_bot		3				
C. dickii Coesel	Cos_dic						1
C. hexalobum Nordst. var. *ornatum* Woronichin	Cos_h_or						1
C. laeve Rabenh.	Cos_lae						1
C. moniliforme Ralfs	Con_mon		1				
C. pachydermum Lund. var. *aethiopicum* (West et G.S.West) West et G.S.West	Cos_p_ae						1
C. pachydermum var. *minus* Nordst.	Cos_p_mi						1
C. pseudamoenum Wille	Cos_p_am			1			
C. pseudarctoum Nordst.	Cos_p_a	1					
C. punctulatum Bréb.	Cos_pun					1	
C. quadratum Ralfs ex Ralfs	Cos_qua	1					
C. simplicius (West et G.S.West) Grönblad	Cos_sim			1			
C. subcrenatum Hantzsch	Cos_subc		1				
C. subprotumidum Nordst.	Cos_subp						3
Euastrum binale Ehr. ex Ralfs var. *sectum* (Turn.) Kreiger	Eua_b_se					1	
E. montanum West et G.S.West	Eua_mon						1
Staurastrum margaritaceum Menegh. ex Ralfs	Sta_mar					1	

Table 3. Ratio of the divisions in the communities of sphagnum epiphyton in the mires of the Subpolar Urals

Divisions	Total	Mire 1	Mire 2	Mire 3	Mire 4	Mire 5	Mire 6
Cyanobacteria	12	1	2	1	3	6	1
Ochrophyta	7	2		1		3	1
Bacillariophyta	96	17	28	33	17	31	21
Chlorophyta	5		1	1		1	3
Charophyta	33	9	5	6		6	14
Euglenophyta	1	1					
Total	154	30	36	42	20	47	40

Only one species from Cyanobacteria *Nostoc paludosum* was found in three mires 4, 5 and 6. Among Chlorophyta, *Microthamnion strictissimum* occurred in mires 2 and 6. The Charophyta species found in more mires, were *Closterium cornu* (mires 1, 3 and 5), *Cylindrocystis brebissonii* (mires 1 and 6), *Netrium digitus* (mires 1 and 5), *Actinotaenium cucurbita* (mires 2 and 6) and *Closterium acutum* (mires 1 and 3). Other 35 species found in more mires, belong to Bacillariophyta: *Kobayasiella parasubtilissima* was found in all mires except for mire 3; *Tabellaria flocculosa* and *Eunotia lunaris* were found in four mires. Algae of 112 species were found once in the investigated water bodies. Most of the identified species (112 taxa) were found in one sample.

Cluster analysis based on the Sorensen-Czekanowski method of grouping by medium revealed low similarity of sphagnum epiphyton from different mires (Fig. 2).

Sphagnum epiphyton from different mires differed not only in the number of species, but also in the total algae abundance. The high relative abundance of some species was found in mires 1 and 5, where *Eunotia lunaris* and *E. mucophila* dominated with five points of abundance in mire 1, *Netrium digitus* (6 points) and *Naviculales* sp. (5 points) in mire 5. Dominant species in other mires were noted with abundance points 4 and 3.

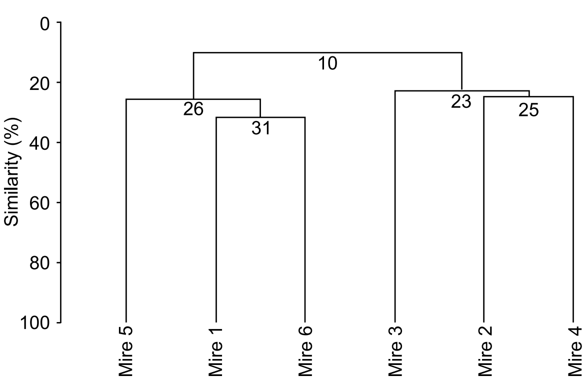

Fig. 2. Similarity of algae species composition in the studied mires, based on the Sorensen-Czekanowski coefficient

Prevailing complexes were mainly formed of diatoms. In mires 1 and 4, dominant species were presented only by diatoms. Dominants composition was the most diverse in the mire 5. There were Bacillariophyta, Cyanobacteria and Charophyta.

Eunotia lunaris (5 points in mire 1; 3 points in mires 4 and 6), *E. mucophila* (5 points in mire 1; 3 points in mire 5), *Kobayasiella parasubtilissima* (4 points in mires 1 and 5), *Pinnularia subcapitata* (3 points in mires 1, 5 and 6) were recorded with high abundance.

Among the ecological algal groups, leading positions were occupied by epiphytic and benthic forms (28–45% in different mires). The diversity of plankton forms was significantly lower (5–8%). Salinity-indifferent (30–53%) and halophobic (11–33%) indicator species were presented with high abundance, i.e. *Kobayasiella parasubtilissima*, *Cymbella falaisensis.* Most of the species were acidophilic (33–40%), including dominant species (*Netrium digitus*, *Eunotia lunaris*, *E. mucophila*). That is typical for mire ecosystems with low pH. Alkaliphilic and pH-indifferent species occupied the second position in the list (17.5 and 18.8%, respectively, from all the species found in the particular mires). Most species (32%), including all abundant species, were indicators of the absence of organic pollution (19–50% in certain mires). Species typical of reservoirs with a high content of organic matter comprised only 14% of the total list (5–30% in certain mires, such species were not found in the mires 1 and 6). Ecological structure of the studied algal flora reflects the features of water environment of the studied mires having low mineralization, neutral or slightly acidic pH. Geographical analysis showed that most of the species were cosmopolites (43−56%). A relatively large number of arctic-alpine (13.6%) and boreal species (10.4%) were typical of the northern mountainous areas (Gecen, 1985; Jarušina, 2004; Briškaitė et al., 2016; Patova et al., 2016; Stenina, 2016).

CCA analysis was used to assess how algal composition depends on four abiotic factors: altitude above sea level, water temperature, pH and conductivity. Algal composition in the mires under study was found to be affected by altitude and conductivity (Fig. 3). A large group of species clearly separated from the other by altitude. Almost all of the arctic-alpine species belonged to the group: *Encyonema gracilis*, *E. bigibba*, *E. crista-galli*, *E. denticulate*, *E. lapponica*, *E. septentrionalis*, *E. suecica*, *Fragilariforma virescens*, *Frustulia crassinervia*, *F. saxonica*, *Pinnularia divergentissima*, *P. pseudodivergentissima*, *P. rupestris*, *P. stomatophora*. Six species were the exception: *Achnanthidium subatomoides*, *Diatoma mesodon*, *Fragilaria tenera*, *Navicula apmhybola*, *Planothidium ellipticum*, *Rhopalodia parallela.*

Species affected by conductivity were species-indicators of water salinity: oligohalobic *Cosmarium moniliforme*, halophobic *Adlafia bryophila*, *Caloneis tenuis*, *Eunotia paludosa*, *Fallacia indifferens*, *Pinnularia persudetica* and *Tabellaria flocculosa*.

Thus, the first data on the algae of six mountain mires of the Subpolar Urals were received. Relatively high species richness of algae was recorded. The algal flora is typical for the mountainous northern mires with a high prevalence of Bacillariophyta and Charophyta groups, and high number of single-species families and genera. The ratio of ecological and geographical groups was also normal for the mires of the region. Further research is required on the mires of this area.

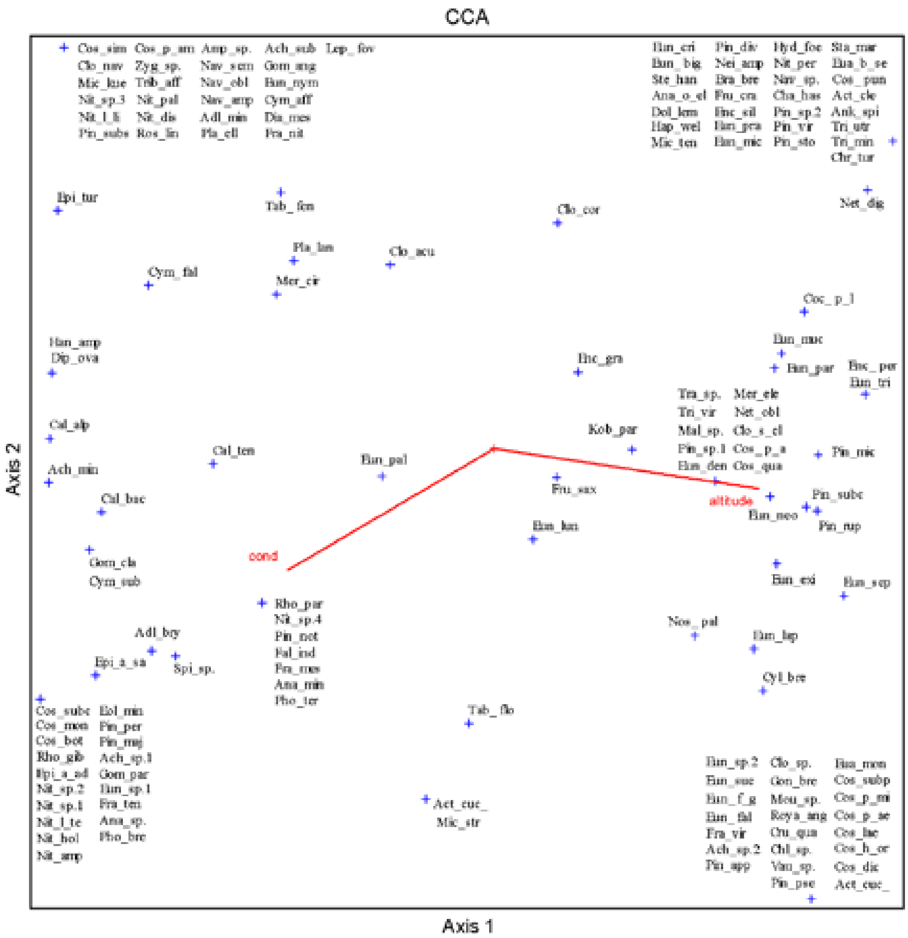

Fig. 3. Results of CCA analysis obtained using the PC-ORD software. Axes correlation coefficients: altitude − 0.804, conductivity − -0.638

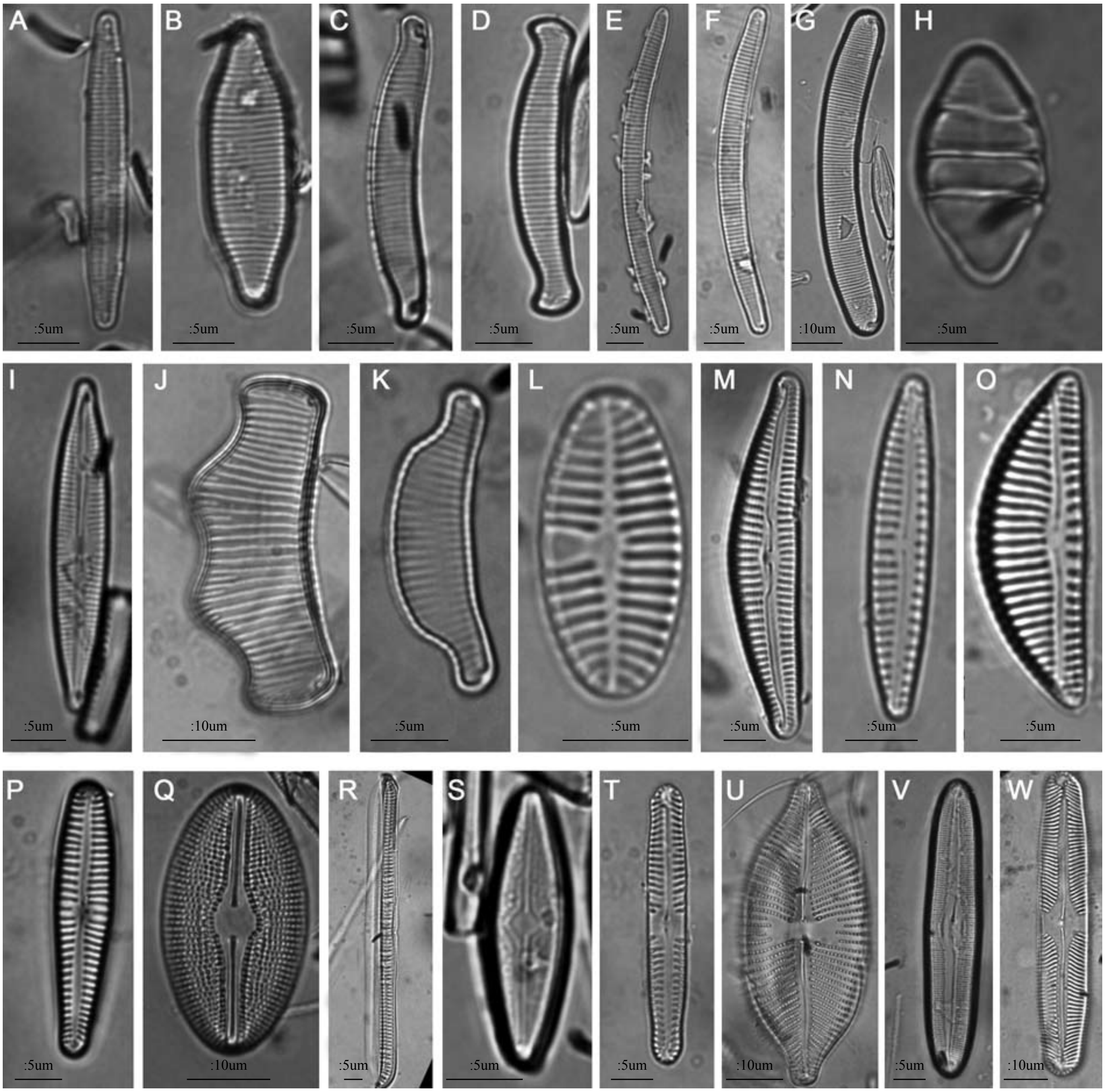

Fig. 4. Some species of diatoms from mires. A – *Fragilaria nitzschioides*, B – *Fragilariforma virescens*, C – *Eunotia denticulata*, D – *E. neocompacta*, E, F – *E. lunaris*, G – *E. parallela*, H – *Diatoma mesodon*, I – *Cymbella falaisensis*, J – *Eunotia bigibba*, K – *E. septentrionalis*, L – *Planothidium ellipticum*, M – *Cymbella affinis*, N – *Encyonema perpusillum*, O – *E. silesiacum*, P – *Gomphonema clavatum*, Q – *Diploneis ovalis*, R – *Rhopalodia parallela*, S – *Brachysira brebissonii*, T – *Pinnularia subcapitata*, U – *Navicula amphibola*, V – *Caloneis alpestris*, W – *Pinnularia microstauron* (G, J, Q, U, W – scale 10 μm, other figures – scale 5 μm)

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Fig. 5. Some species of desmids from mires. A – *Gonatozygon brebissonii*, B – *Roya anglica*, C – *Closterium navicula*, D – *Cosmarium simplicius*, E – *C. quadratum*, F – *C. laeve*

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KIMINŲ EPIFITONO DUMBLIAI SUBPOLIARINIO URALO PELKĖSE

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Santrauka

Dumblių rūšių įvairovė kiminų epifitono bendrijose buvo tirta šešiose Subpoliarinio Uralo (Rusija) kalnų ir lygumų pelkėse. Iš viso aptikta 154 rūšys ir vidurūšiniai taksonai, priklausantys šešiems dumblių skyriams. Titnagdumbliai (96 rūšys) ir charofitainiai (33) išsiskyrė didžiausia įvairove. Gausiai vystėsi *Kobayasiella parasubtilissima*, *Tabellaria flocculosa* ir *Eunotia lunaris* rūšys, o dominantų bendrijas dažnai formavo *Eunotia lunaris*, *E. mucophila*, *Kobayasiella parasubtilissima* ir *Pinnularia subcapitata*. Kanoninė atitikties analizė (CCA) parodė, kad savitasis elektrinis laidis ir altitudė buvo pagrindiniai veiksniai, įtakoję dumblių rūšių pasiskirstymą.