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The Species Composition and Distribution of Diatom Algae in Sphagnum Bogs in European Russia: The Polistovo–Lovatskii Land Tract

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Abstract—The species composition of diatom algae in the Polistovo–Lovatskii sphagnum tract (Rdeiskoye bog, Novgorod oblast) \are studied. The systematic and ecological–geographical analyses of the flora are performed. A total of 256 species and intraspecific taxa differing in ecological specificities and frequencies of occurrence in samples are revealed. A considerable number of centric diatoms is found. It is shown that primary and secondary diatom communities are formed in large sphagnum tracts. The horizontal heterogeneity of diatom communities in sphagnum bog is revealed. The species diversities of diatom algae in different bogs are compared.

Key words: Polistovo–Lovatskii tract, Rdeiskoye bog, Bacillariophyta, flora.

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INTRODUCTION

In the first paper on the species composition and peculiarities of diatom algae distribution in the sphagnum bogs of European Russia, the flora of ten small ecosystems of the Privolzskaya Plateau (Penza oblast) situated in the forest zone was described [14]. The Polistovo–Lovatskii sphagnum tract (Europe's largest high bog) is situated within the zone of broad-leaf–coniferous forests [4] in the center of the Priil'menskaya lowland [3]. The Rdeiskii State Natural Reserve was established on the tract territory lying within Novgorod oblast. Studies on the formation and functioning of oligotrophic sphagnum bogs, vegetation, and hydrology were performed in the reserve [1, 3].

Studies on the algal flora of the Polistovo–Lovatskii sphagnum tract began as late as 2005 [13], although the algae are a necessary and important element for the functioning of bog ecosystems. The first data allowed for the general composition and morphology of centric diatoms to be described [9].

The goal of the present study is to reveal the composition, perform an ecological–geographical analysis of diatom algae, and to find the peculiarities of their distribution in the Polistovo–Lovatskii sphagnum tract.

MATERIAL AND METHODS

The material for the study was 41 samples collected in July 21–23, 2005 in the Polistovo–Lovatskii sphagnum tract on the territory of the Rdeiskii State Natural Reserve (Novgorod oblast). The studied waterbodies include lakes small in area that are highly colored, acidic, and have low water transparency (Table 1). The lakes' characteristics were obtained following the commonly accepted methods. The samples were collected in the following habitats: in the Red'ya River (in the sphagnum and detritus in the thickets of deep-bodied crevalle); in the water-logged periphery of the sphagnum tract (in the thickets of willows, deep-bodied crevalles, in sphagnum, and in the debris of sedges); in the peat under the debris of higher plants (deep-bodied crevalle, scheuchzeria, and sedge near the shores of Lake Domshinskoye and in the peat with sweet grasses and the debris of willows near Lake Rdeiskoye); in the depth under the peat with sphagnum quagmire (near lakes Chudskoye, Maloye Goretskoye, and Ostrovistoye); in the sphagnum cover (in the mound with cranberry, myrtle, and andromeda near Lake Kornilovskoye; sphagnum pad near Red'ya Brook; a mound with S*phagnum magellanicum* Brid. in the vicinity of Lake Bol'shoye Goretskoye; sphagnum near Lake Domshinskoye; lakes Rogovskoye and Rdeiskoye; in the depression near lakes Kornilovskoye, Bol'shoye Goretskpye, and Ostrovistoye; moss cover at a depth of 20 cm near Lake Chudskoye, and waterlogged sphagnum near Lake Domshinskoye) in the bordering zone of sphagnum cover and the shore lines of lakes Domshinskoye, Kornilovskoye, Ostrovistoye, Bol'shoye and Maloye Goretskoye, and Chudskoye; in the detritus from the deep parts of lakes Domshinskoye, Kornilovskoye, Ostrovistoye, and Bol'shoye and Maloye Goretskoye; and in the plankton of lakes Domshinskoye, Kornilovskoye, Ostrovistoye, Bol'shoye and

Table 1. Some morphometric and hydrochemical characteristics of the studied lakes

Lake	Area, km^2		Ratio of lake area to catchment area	River basin	Color, degrees	pH	Water transparency, m
	catchment area	water surface					
Rdeiskoye	25821.3	8926.4	0.35	Red'ya	260	4.9	0.6
Chudskoye	8494.2	1619.6	0.19	″	242	5.4	–
Domshinskoye	10113.8	610.6	0.06	Khlavitsa	265	5.9	0.6
Kornilovskoye	1261.0	148.4	0.12	″	310	5.0	0.2
Ostrovistoye	9459.0	397.0	0.04	″	290	5.7	0.5
Maloye Goretskoye	116.7	91.6	0.78	–	76	4.9	1.6
Bol'shoye Goretskoye	303.7	257.7	0.85	–	114	5.3	1.2
Rogovskoye	1337.8	563.6	0.42	Tupichinka	219	5.3	0.6

Maloye Goretskoye, Rdeiskoye, Rogovskoye, and Chudskoye.

The procedure of sample processing, the classification of diatoms used, and the taxonomic overviews used most often are give elsewhere [14]. The cluster analysis was performed using the Chekanovski–Sorensen index; and the variables were included by the method of nonweighted pairwise mean.

RESULTS

A total of 256 species and intraspecific taxa belonging to two classes, six orders, and 17 families were revealed in the Polistovo–Lovatskii sphagnum tract (Table 2). Centric diatoms include 43 taxa belonging to four orders and five families, or 16.8% of the whole flora. The remaining 213 taxa, or 83.2% of the flora, belong to the class Pennatophyceae, including two orders, twelve families, and 49 genera. The order of araphales diatoms is represented by 182 species and intraspecific taxa, or 71% of the flora. In the Polistovo–Lovatskii sphagnum tract flora, 197 taxa (77.1%) belong to five leading families: Naviculaceae, Eunotiaceae, Fragilariaceae, Stephanodiscaceae, and Aulacoseiraceae. The composition of leading genera (*Pinnularia*, *Eunotia*, *Aulacoseira*, *Navicula* s. str., *Cyclotella*, *Navicula* s. l., *Stephanodiscus*, *Staurosira*, *Frustulia*, *Stauroneis*, and *Encyonema*) consists of 163 species (63.5%).

Vast majority of diatoms found in the Polistovo–Lovatskii sphagnum tract are benthic algae (80.5%), while the rest are planktonic (19.5%). The halophobic and halophilic species are presented by similar numbers of species: 25.8% and 25%, respectively. Indifferents account for 8.2%. Only one species found, *Sceletonema potamos* (Weber) Hasle, is mesohalobic. There is no information on the halobity of the other (40.6%) taxa of studied flora. The difference between the numbers of alkaliphils and acidophils is insignificant: 21.1% and 20.3%, respectively. The indifferents account for 11.7% of taxa. Data on the preferable water pH of 46.6% of the revealed species are unavailable. Cosmopolites prevail (32%). The Boreal taxa account for 18%; Arcto–Alpine taxa account for 10.2%. The geographic characteristic of 39.8% of the flora is unknown.

DISCUSSION

Species diversity in the Polistovo–Lovatskii sphagnum tract is much higher that in other sphagnum bogs studied earlier (Table 3). Strong fluctuations of the total species diversities in the Penza oblast bogs were revealed earlier [14]. Presumably, this is determined by the specific character of biotopes in the studied bogs in regards to their areas and ages [8].

The diatom flora of the Polistovo–Lovatskii sphagnum tract of Novgorod oblast is quite unique compared to the flora of sphagnum bogs in Penza oblast as was assessed by a low Chekanovski–Sorensen similarity index (39.9%). The reason for the differences [13] is the presence of large acid lakes at the territory of the studied tract which facilitates an increase in the share of Centrophyceae in the whole pool of diatom algae. In the flora of this bog, among the species that dominate in number are gg. *Aulacoseira*, *Cyclotella*, and *Stephanodiscus*, which hold, respectively, third, sixth, and seventh places out of the top ten. The dominance of the representatives of the first genus is a characteristic of diatom floras in sphagnum bogs [8, 13, 27]. The composition of leading families and genera of pennate diatoms is similar in many aspects to that of other ecosystems [2, 5–7, 10–12, 15–24].

The large species diversity of centric diatoms, among which *Actinocyclus normanii* (Gregory) Hustedt, *Aulacoseira lacustris* (Grunow) Krammer, *A. nivalis* (W. Smith) Genkal et Kulikovskiy, *A. perglabra* var. *floriniae* (Camburn) Haworth, *A. rdeiskoensis* Genkal et Kulikovskiy, *A. tenella* (Nygaard) Simonsen, *A. valida* (Grunow) Krammer, etc., were noted, reflects an increase in the share of plankters in the total composition of diatoms in bogs.

Table 2. Systematic composition of diatom algae in the Polistovo–Lovatskii tract

Taxon	Number of species and intraspecific taxa	Share in flora, %
Class Centrophyceae	43	16.8
Order Thalassiosirales	23	9
Fam. Thalassiosiraceae Lebour emend. Hasle	5	2
Thalassiosira Cleve	3	1.2
Sceletonema Greville	2	0.8
Fam. Stephanodiscaceae Makarova	18	7
Stephanodiscus Ehrenberg	8	3.1
Cyclostephanos Round	1	0.4
Cyclotella Kützing	9	3.5
Order Melosirales	1	0.4
Fam. Melosiraceae Kützing	1	0.4
Melosira Agardh	1	0.4
Order Aulacoseirales	18	7
Fam. Aulacoseiraceae Moisseeva	18	7
Aulacoseira Thwaites	18	7
Order Coscinodiscales	1	0.4
Fam. Hemidiscaceae Hendey emend. Simonsen	1	0.4
Actinocyclus Ehrenberg	1	0.4
Class Pennatophyceae	213	83.2
Order Araphales	31	12.2
Fam. Fragilariaceae (Kützing) De Toni	24	9.4
Asterionella Hassall	3	1.2
Fragilaria Lyngbye	4	1.6
Fragilariforma Williams et Round	6	2.3
Hannaea Patrick	1	0.4
Pseudostaurosira Williams et Round	1	0.4
Stauroforma Flower, Jones, Round	1	0.4
Staurosira Ehrenberg	8	3.1
Fam. Diatomaceae Dumortier	4	1.6
Diatoma Bory	3	1.2
Meridion Agardh	1	0.4
Fam. Tabellariaceae Schutt	3	1.2
Oxyneis Round	1	0.4
Tabellaria Ehrenberg	2	0.8
Order Raphales	182	71
Fam. Naviculaceae Kützing	101	39.6
Aneumastus Mann et Stickle	1	0.4
Brachysira Kützing	1	0.4
Caloneis Cleve	1	0.4
Cavinula Stickle	1	0.4
Chamaepinnularia Lange-Bertalot et Krammer	1	0.4
Diploneis Ehrenberg	1	0.4
Fallacia Stickle	1	0.4
Frustulia Rabenhorst	8	3.1

Table 2. (Contd.)

Taxon	Number of species and intraspecific taxa	Share in flora, %
Gyrosigma Hassall	1	0.4
Hippodonta Lange-Bertalot, Metzeltin, Witkowski	1	0.4
Kobayasiella Lange-Bertalot	1	0.4
Luticola Mann	4	1.6
Mayamaea Lange-Bertalot	1	0.4
Navicula Bory s. str.	10	3.9
Navicula Bory s. l.	9	3.5
Pinnularia Ehrenberg	45	17.6
Placoneis Mereschkowsky	2	0.8
Sellaphora Mereschkowsky	5	2
Stauroneis Ehrenberg	7	2.7
Fam. Eunotiaceae (Kützing)	36	14.1
Actinella Lewis	2	0.8
Eunotia Ehrenberg	34	13.3
Fam. Epithemiaceae Grunow	1	0.4
Denticula Kutzing	1	0.4
Fam. Achnanthaceae (Kützing)	12	4.8
Achnanthidium Kützing	2	0.8
Cocconeis Ehrenberg	4	1.6
Rossithidium Round et Bukhtiyarova	1	0.4
Psammothidium Bukhtiyarova et Round	4	1.6
Nupela Vyverman et Compère	1	0.4
Fam. Cymbellaceae (Kützing) Grunow	15	5.9
Amphora Ehrenberg	1	0.4
Cymbella Agardh	2	0.8
Cymbopleura (Krammer) Krammer	5	2
Encyonema Kützing	7	2.7
Fam. Gomphonemataceae (Kützing) Grunow	4	1.6
Gomphonema Ehrenberg	4	1.6
Fam. Nitschiaceae Hassall	6	2.4
Hantzschia Grunow	1	0.4
Nitzschia Hassall	5	2
Fam. Rhopalodiaceae Topatschevskiy	1	0.4
Rhopalodia O. Müller	1	0.4
Fam. Surirellaceae Kützing	6	2.4
Cymatopleura W. Smith	1	0.4
Stenopterobia Brebisson	1	0.4
Surirella Turpin	4	1.6

There are only a few mesohalobic species. The halophobes are presented by rare centric diatoms A*ulacoseira nivalis*, *A. perglabra* var. *floriniae*, *A. tenella*, and *A. valida*. These species are typical for oligotrophic, oligosaprobic North–Alpine waterbodies with low water conductivity [26]. The considerable extent of development in the studied tract was revealed for representatives of g. *Cymbopleura* [28], which prefer oligotrophic North–Alpine waterbodies. The share of acidophilic diatoms of g. *Eunotia* taxa is also high.

Table 3. General species diversity of diatoms in sphagnum bogs of Russia and adjacent countries (given according to modern taxonomic modifications [13])

Bog	Region	Number of species and intraspecific taxa	Reference
Volkovskoye	Moskow oblast	64	[2, 16]
Sharapovskoye	same	35	[11]
Gladkoye	Leningrad oblast	20	[12]
no. 1	Belgorod oblast	45	[10]
no. 2	same	46	[10]
Bol'shoye Mokhovoye	Kaliningrad oblast	8	[23]
Bezymyannoye	Penza oblast	159	[13]
Chibirleiskoye	same	113	[13]
Ivanyrskoye	″	81	[13]
Pestrovskoye	″	39	[13]
Il'minskoye	″	47	[13]
Kachimskoye	″	60	[13]
Verkhozimskoye 1	″	44	[13]
Verkhozimskoye 2	″	65	[13]
Verkhozimskoye 3	″	51	[13]
Naskaftymskoye	″	28	[13]
Polistovo–Lovatskii tract	Novgorod oblast	256	author's data
In the vicinities of the town of Gus'–Khrustal'nyi	Vladimir oblast	6	[7]
In the vicinities of Petlyar village	Tyumen oblast	52	[15]
Shuyskaya Lowland bogs	Republic of Karelia	41	[24]
Bog near Yula–Lambina Lake	same	10	[6]
Pedroboloto	″	18	[6]
Urosozerskoye	″	21	[6]
Nikonovo	″	15	[6]
Mokhovatoye	Ukraine	56	[18]
Pervoye sfagnovoye	″	62	[20]
Chetvertoye sfagnovoye	″	61	[20]
Volisok	″	9	[19]
Sfagnovo–Osokovoye	″	63	[22]
no. 1	″	29	[21]
no. 2	″	27	[21]
no. 3	″	12	[21]
Near Vilkhova Station	″	38	[21]
Bezlyudovskoye	″	90	[17]
Oligotrofnoye	″	10	[5]
Lavasari	Estonia	65	[23]
Sindi	″	17	[23]
Nurme	″	32	[23]

Among the Boreal and Arcto–Alpine species, the following were revealed: *Cavinula pseudoscutiformis* (Hustedt) Mann et Stickle, *Cymbopleura anglica* (Lagerstedt) Krammer, *Encyonema hebridicum* Grunow, *Eunotia diodon* Ehrenberg, *Fragilariforma constricta* (Ehrenberg) Williams et Round, *F. virescens* (Ralfs) Williams et Round, *Gomphonema montanum* Schumann, *Nitzschia alpina* Hustedt, *Nupela impexifor-*

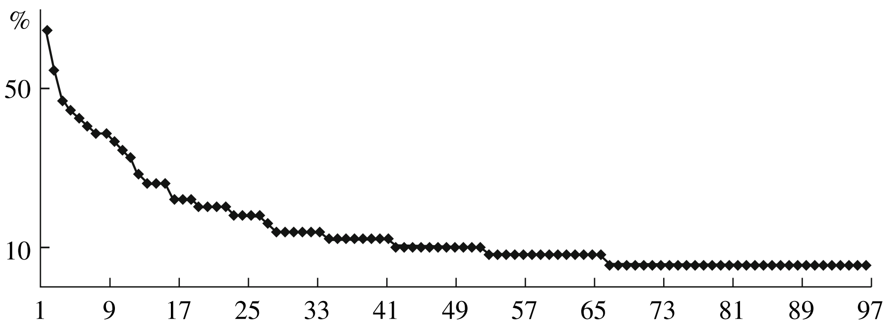

Fig. 1. Distribution of diatom species (%) by frequency occurrence above 5% in the Polistovo–Lovatskii tract. Species shown on the *X* axis: (1) *Tabellaria flocculosa* (Roth) Kützing, (2) *Aulacoseira ambigua* (Grunow) Simonsen, (3) *Frustulia krammeri* Lange-Bertalot et Metzeltin, (4) *Cyclostephanos dubius* (Fricke) Round, (5) *Aulacoseira subarctica* (O. Müller) Haworth, (6) *Cyclotella meneghiniana* Kützing, (7) *Aulacoseira tenella* (Nygaard) Simonsen, (8) *Stephanodiscus hantzschii* Grunow, (9) *Eunotia serra* Ehrenberg, (10) *Frustulia saxonica* Rabenhorst, (11) *Pinnularia subcapitata* var. *elongata* Krammer, (12) *Stephanodiscus minutulus* (Kützing) Cleve et Möller, (13) *Eunotia bilunaris* (Ehrenberg) Mills var. *bilunaris*, (14) *E. meisteri* Hustedt, (15) *Kobayasiella subtilissima* (Cleve) Lange-Bertalot, (16) *Aulacoseira granulate* (Ehrenberg) Simonsen, (17) *Stephanodiscus invisitatus* Hohn et Hellermann, (18) *S. makarovae* Genkal, (19) *Cyclotella atomus* Hustedt var. *atomus*, (20) *Eunotia microcephala* Krasske, (21) *E. paludosa* Grunow, (22) *Pinnularia macilenta* Ehrenberg, (23) *Cyclotella pseudostelligera* Cleve et Grunow, (24) *Asterionella Formosa* Hassall, (25) *Eunotia lapponica* Grunow, (26) *Pinnularia microstauron* var. *rostrata* Krammer, (27) *Staurosira pinnata* var. *trigona* (Krasske) Lange-Bertalot, (28) *Chamaepinnularia* sp., (29) *Encyonema perelginense* Krammer, (30) *Eunotia incise* Gregory, (31) *Fragilariforma* constricta (Ehrenberg) Williams et Round, (32) *Pinnularia bacilliformis* Krammer, (33) *P. brauniana* (Grunow) Mills, (34) *Aulacoseira islandica* (O. Müller) Simonsen, (35) *Sceletonema subsalsum* (Cleve-Euler) Bethge, (36) *Stephanodiscus neoastraea* (Håkansson et Hickel) emend. Casper, Scheffler et Augsten, (37) *Encyonema hebridicum* Grunow, (38) *Eunotia tetraodon* Ehrenberg, (39) *Fragilariforma* sp., (40) *Psammothidium helveticum* (Hustedt) Bukhtiyarova et Round, (41) *Stenopterobia delicatissima* (Lewis) Brébisson, (42) *Aulacoseira lacustris* (Grunow) Krammer, (43) *A. perglabra* var. *floriniae* (Camburn) Haworth, (44) *Stephanodiscus* cf. *alpinus* Hustedt, (45) *Eunotia rhomboidea* Hustedt, (46) *E. septentrionalis* Oestrup, (47) *Fragilariforma virescens* (Ralfs) Williams et Round, (48) *Navicula tripunctata* (O.F. Müller) Bory, (49) *Pinnularia subrupestris* Krammer, (50) *Staurosira elliptica* (Schumann) Williams et Round, (51) *S. mutabilis* (W. Smith) Grunow, (52) *Tabellaria stellata* Kulikovskiy, (53) *Aulacoseira* sp., (54) *Cyclotella atomus* var. *gracilis* Genkal et Kiss, (55) *Cocconeis placentula* var. *lineata* (Ehrenberg) Van Heurch, (56) *Eunotia michaelis* Metzeltin, Witkowski, Lange-Bertalot, (57) *E. pectinalis* var. ventralis (Ehrenberg) Hustedt, (58) *Eunotia* cf. *subarcuatoides* Alles, Nörpel, Lange-Bertalot, (59) *Fragilariforma constricta* f. *stricta* (Cleve) Poulin, (60) *Meridion circulare* (Greville) Agardh var. *circulare*, (61) *Navicula* cf. *vulpina* Kützing, (62) *N.* sp. 1, (63) *Pinnularia borealis* Ehrenberg var. *borealis*, (64) *P. microstauron* (Ehrenberg) Cleve var. *microstauron*, (65) *P. nobilis* var. *regularis* Krammer, (66) *Staurosira* sp., (67) *Aulacoseira alpigena* (Grunow) Krammer, (68) *A. nivalis* (W. Smith) Genkal et Kulikovskiy, (69) *A. rdeiskoensis* Genkal et Kulikovskiy, (70) *Melosira* varians *Agardh*, (71) *Thalassiosira guillardii* Hasle, (72) *Amphora libyca* Ehrenberg, (73) *Cocconeis placentula* var. *euglypta* (Ehrenberg) Grunow, (74) *Cymbopleura naviculiformis* (Auerswald) Krammer, (75) *Encyonema perpusillum* (Cleve) Mann, (76) *E. silesiacum* (Bleish) Mann, (77) *Eunotia diadema* Ehrenberg, (78) *E. diodon* Ehrenberg, (79) *E. steineckei* Petersen, (80) *Fragilaria ulna* var. *acus* (Kützing) Lange-Bertalot, (81) *Hantzchia amphioxys* (Ehrenberg) Grunow, (82) *Hippodonta capitata* (Ehrenberg) Lange-Bertalot, Metzeltin, Witkowski, (83) *Navicula capitatoradiata* Germain, (84) *N.* sp. 2, (85) *N.* sp. 3, (86) *Nitzschia wuellerstorfii* Lange-Bertalot, (87) *Oxyneis binalis* (Ehrenberg) Round, (88) *Pinnularia brebissonii* (Kützing) Rabenhorst, (89) *P. divergens* W. Smith var. *divergens*, (90) *Pinnularia* cf. *isselana* Krammer, (91) *P. lokana* Krammer, (92) *P. pisciculus* Krammer, (93) *P. subanglica* Krammer, (94) *P. subcommutata* Krammer, (95) *Placoneis dicephala* (W. Smith) Mereschkowsky, (96) *Sellaphora alastos* (Hohn et Hellerman) Lange-Bertalot et Metzeltin, (97) *Stauroneis* sp.

mis (Lange-Bertalot) Lange-Bertalot, *Pinnularia subanglica* Krammer, *P. subcommutata* Krammer, and *Psammothidium altaicum* Bukhtiyarova.

The local species diversity of the Polistovo–Lovatskii sphagnum tract is characterized by differences in the number of taxa in a sample (from 1 to 67, with an average of 18). This evidences the diversity of conditions at specific sampling sites.

The frequencies of occurrence differ in some species. The most widespread is *Tabellaria flocculosa* (Roth) Kützing (occurring at a frequency of 65.3%) (Fig. 1). The second group is composed by *Aulacoseira ambigua* (Grunow) Simonsen (55.1%). In the communities of Polistovo–Lovatskii sphagnum tract, this species replaces *A. islandica* (O. Müller) Simonsen, which dominates in the sphagnum bogs in Penza oblast [12]. The third group, whose frequency of occurrence ranges form 30% to 50%, is composed by *Frustulia krammeri* Lange-Bertalot et Metzeltin, *Cyclostephanos dubius* (Fricke) Round, *Aulacoseira subarctica* (O. Müller) Haworth, etc. (Fig. 1). A frequency of occurrence of 20–30% is characteristic of *Stephanodiscus minutulus* (Kützing) Cleve et Möller, *Eunotia bilunaris* (Ehrenberg) Mills, *E. meisteri* Hustedt, et al. The fifth group consists of 30 species that have frequencies of occurrence ranging from 10 to 20%. The sixth group account for 47 taxa with frequencies of occurrence of 5–10%. The values of this index in the remaining 159 species (62.1%) are less than 5%.

The general appearance of flora in the Polistovo–Lovatskii sphagnum tract, as well as in the bogs of Penza oblast, is formed by less than a half of the found

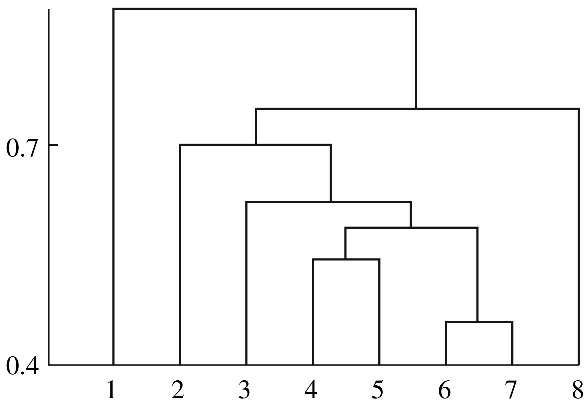

Fig. 2. The dendrogram of differences in the diatom species composition in the Polistovo–Lovatskii tract bogs. *Y* axis shows the differences by the Chekanovski–Sorensen index; *X* axis shows the biotopes: (1) Red'ya River; (2) Waterlogged periphery of the sphagnum tract; (3) Peat beneath the debris of higher plants; (4) Peat beneath the sphagnum quagmire; (5) Sphagnum cover; (6) Bordering zone between sphagnum cover and lakes shore lines; (7) Detritus from the lakes bottoms; (8) Lakes plankton.

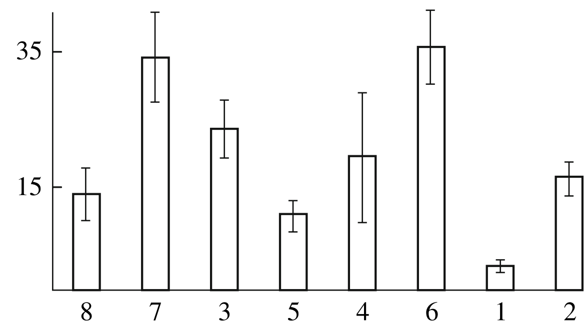

Fig. 3. Mean number of diatom species in similar biotopes of the Polistovo–Lovatskii tract: *Y* axis is the number of species; *X* axis is the same as in Fig. 2.; Error bars denote error of mean.

species. More than 60% of species and intraspecific rank taxa are present either in an accidental element of the flora or they are rare forms with limited distribution in the sphagnum tract. The leading diatoms (in terms of frequencies of occurrence) in the Polistovo–Lovatskii tract differ from those in the Penza oblast bogs [12].

The following species are the most widespread in various sphagnum tracts, including the Polistovo–Lovatskii: *Eunotia bilunaris*, *E. exigua* (Brébisson) Rabenhorst, *Tabellaria flocculosa*, *Hantzschia amphioxys* (Ehrenberg) Grunow, *Pinnularia microstauron* (Ehrenberg) Cleve, *P. borealis* Ehrenberg, *P. gibba* Ehrenberg, *Fragilaria ulna* (Nitzsch) Lange-Bertalot, *Frustulia saxonica* Rabenhorst, *Navicula cryptocephala* Kützing, and *Nitzschia palea* (Kützing) W. Smith [2, 5–7, 10–12, 15–24]. Among the centric diatoms, the most common in bogs are *Cyclotella meneghiniana* Kützing, *Aulacoseira granulata* (Ehrenberg) Simonsen, and *A. islandica*. The last two species were reported for the high bogs of northwestern Finland with a water pH ranging from 3–4 [25]. The species *Aulacoseira islandica* was found in the silts of the sphagnum bog in the Severnii Donets [20].

The peculiarities of diatom composition and quantity were studied in similar biotopes of the Polistovo–Lovatskii sphagnum tract. The strongest differences are typical for the Red'ya River communities with the least number of species (Figs. 2 and 3). The separate subcluster consists of the planktic communities in the studied lakes with a medium number of taxa. In the plankton samples collected in lakes, a large number of taxa was registered: *Thalassiosira faurii* (Gasse) Hasle, *Achnanthidium deflexum* (Reimer) Kingston, *Cocconeis placentula* Ehrenberg var. *placentula*, *C. placentula* var. *euglypta* (Ehrenberg) Grunow, *Cymatopleura solea* (Brébisson) W. Smith, *Cymbella peraspera* Krammer, *Diploneis* sp., *Gyrosigma acuminatum* (Kützing) Rabenhorst, *Navicula capitatoradiata* Germain, *N. oppugnata* Hustedt, *Nitzschia dissipata* (Kützing) Grunow, etc. Close similarities were also revealed for the communities with highest number of diatom taxa formed in the bordering zone between the sphagnum cover and shoreline, as well as in the bottom detritus (Figs. 2 and 3). The diatom composition of these biotopes is specific: *Actinocyclus normanii* (Gregory) Hustedt, *Aulacoseira italica* (Ehrenberg) Simonsen, *A. lacustris*, *A. pfaffiana* (Reinsch) Krammer, *A. valida*, *Cyclotella meduanae* Germain, *C. radiosa* (Grunow) Lemmerman, *Stephanodiscus binderanus* var. *oestrupii* Cleve-Euler, *Amphora libyca* Ehrenberg, *Asterionella ralfsii* W. Smith, *Brachysira microcephala* (Grunow) Compère, *Caloneis silicula* (Ehrenberg) Cleve, *Cavinula pseudoscutiformis*, *Cocconeis neothumensis* Krammer, etc. In the coastal zone, where the ecotone effect is usually pronounced, the most diverse communities develop; they include both benthic and planktonic forms.

In the studied lakes with highly colored waters, the water was not transparent to the bottom. Hence, the conditions of illumination at the bottom may be unfavorable for diatom development. The high similarity of algae species compositions in the lakes' detritus and in the bordering zone and plankton indicates the relations between biotopes in the bog ecosystems. The species composition revealed in lakes' benthos is formed by sedimentary forms and organisms drifted from the coastal regions. The medium number of species was found in the eutrophic periphery of the Polistovo–Lovatskii sphagnum tract, which has the highest similarity to the communities developed in the peat under the debris of higher plants (Figs. 2 and 3). The diatom communities of the sphagnum cover and peat underneath it include the number of species close to the values average for biotopes (Fig. 3). The fact that they have the highest similarity is evidence of common origin.

Thus, the highest number of species is a characteristic of waterlogged parts of the central zone of bog. At the periphery, the number of species is lower or similar to the one at certain parts of the sphagnum cover. In terms of species similarities and numbers of taxa, the primary (algal communities of plankton and sphagnum cover) and derived (benthic communities in lakes and peat underneath the moss cover) communities may be distinguished.

In the large area of the Polistovo–Lovatskii sphagnum tract, the horizontal heterogeneity of communities is higher that in small and single-type bogs of Penza oblast [13]. This is confirmed by the lower averaged value of the Chekanovski–Sorensen similarity index (0.28) than in the Penzenskaya oblast ecosystems [13].

CONCLUSIONS

The diatom species composition in the Polistovo–Lovatskii sphagnum tract within the Rdeiskii Natural Reserve (Rdeiskoye bog of Novgorod oblast) is considerably higher than in other studied boggy ecosystems in Russia and adjacent countries. Numerous representatives of centric diatoms were revealed in the studied tract. In terms of ecological–geographical properties, the flora is dominated by benthic, halophobic, halophilic, alkaliphilic, and acidophilic widespread algae. The Boreal and Arcto–Alpine species are also numerous. The species *Tabellaria flocculosa* and *Aulacoseira islandica* are spread all over the sphagnum tract. More than a half of species occur in solitary samples. The highest number of species is recorded in the bordering zone between the sphagnum and shoreline, as well as in the bottom detritus of the waterbodies situated within the bog. There are fewer diatoms in the communities of rivers, waterlogged peripheries, and bog sphagnum cover. Based upon the similarities of diatom species compositions, it is proposed that the primary and derived communities be separated. In general, the horizontal heterogeneity of diatom communities in the Polistovo–Lovatskii sphagnum tract is higher than in the ecosystems of Privolzhskaya Plateau, which are smaller and located in the forest–steppe zone.

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