

DESMID FLORA IN THE LAKES OF THE KHREBTOVYI NATURE RESERVE IN THE POLAR URAL (RUSSIA)

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Abstract

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Fourteen thermokarst lakes and one mountain lake were explored in the study period. A total of 116 species of desmids belonging to 22 genera were identified. The genera *Cosmarium* (29), *Staurastrum* (18) and *Closterium* (13) were most abundant. The highest number of species (88) was recorded in the habitats with *Sphagnum* and brown mosses. Twenty-seven species and one variety of desmids were observed for the first time in the Polar Ural Mountains.

Keywords: algae, benthos, *Desmidiiales*, Polar Ural Mountains, Russia.

INTRODUCTION

Desmids are one of the most diverse groups of algae in the mountain-tundra water bodies. They play an important role in the formation of algalocenoses in water bodies and especially are typical in phyto-benthos and periphyton (GETZEN, 1985). Desmids belong to one of the groups that can inhabit water bodies with low concentration of organic materials. To date, the Arctic regions experience increasing anthropogenic impact on natural landscapes, accelerating processes of global climate change, and degradation of the natural complexes. Mainly because of remoteness and limited accessibility of the territory, the diversity and distribution of desmids are not sufficiently explored in the Polar Ural water bodies, including mountain lakes. The aim of this paper was to review the diversity and distribution of species in the explored water bodies in the territory of the Khrebtovyi Nature Reserve.

STUDY AREA

The Urals are the mountain range that stretches in the north-south direction in Russia, making border between Asian and European continents. The total area of the mountains is about 25 000 km. The Polar Ural covers the northern end of the overall structure of the Ural Mountains – starts from the origins of the Khulga River in the southern part and stretches almost for 550 km, up to the Konstantynov Kamen' Mountains in the north. In 1989, in the part of this territory, the Khrebtovyi Nature Reserve was established, the aim of which is to preserve typical and rare landscape of the Polar Ural (Fig. 1).

In the area of the Reserve, different types of vegetation are also under protection, including rare larch forests, crooked birch forests, willow forests, palsas, lichen mountain tundra, rocky tundra, brushwood moss lichen tundra and barrens. The list of protected objects consists of thermokarst and mountain

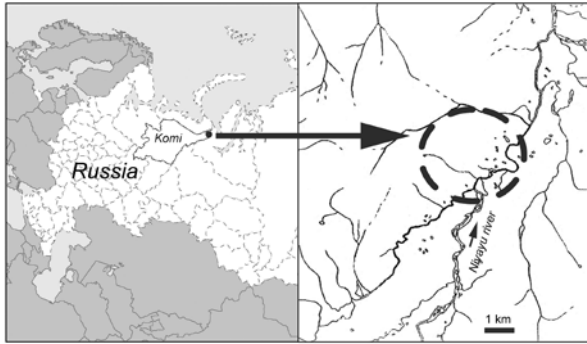


Fig. 1. Location of the Khrebtovyi Nature Reserve (Polar Ural). The research was carried out in the territory marked by a dotted line

lakes, river valleys with rare plant and bird species recorded in the Red Data Book of Komi Republic (TASKAEV, 2009). The area of the Reserve covers 4000 hectares of the southeast slope of the Enganepe Ridge within the Polar Urals.

The climate of the Polar Ural is distinctly continental. The Polar Ural belongs to the Eastern region of the Atlantic climate area. The average annual temperature is below zero, and in different regions it varies from -6°C to -9°C (the average temperature in January is -20°C). Period without frosts lasts from 21 June to 21 August (the average temperature in July varies from 8°C to 11°C). The average temperature of growing season is above 10°C . In the Polar Ural, the amount of precipitation during the year is 1000–1500 mm. Permanent snow cover comes on the 20th of October and remains until the 10th of March. The depth of snow cover reaches 80–90 cm (KEMMERIX, 1966; ŠVAREVA, 1962).

A detailed description of the natural resources at the nature complex named the Khrebtovyi Nature Reserve is provided in the monograph “The biological diversity of protected areas in Komi Republic”(DEGTEVA, 2010).

MATERIALS AND METHODS

The research of desmids was conducted in the Khrebtovyi Nature Reserve in the Polar Ural in 14 thermokarst and one mountain lakes in July 2008 (Fig. 2).

A total of twenty-three samples of phytobenthos algae were collected by squeezing water from plant material of two different types: roots and rhizomes

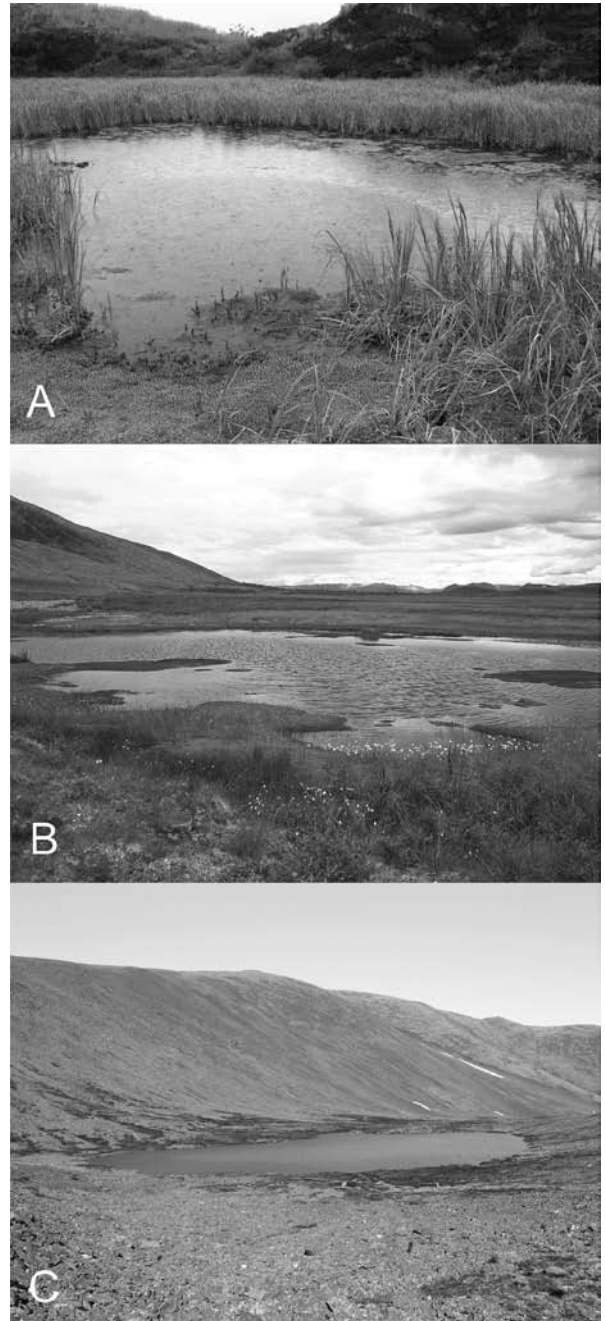


Fig. 2. The investigated habitats in the Khrebtovyi Nature Reserve. Photo A: lake with a dominant *Carex aquatilis* Wahlenb.; photo B: lake with a floating mat of *Sphagnum* spp.; photo C: mountain lake

of vascular plants taken in the helophyte zone dominated by *Carex aquatilis* Wahlenb. (habitat a) and *Sphagnum* spp. and/or other mosses taken on the edges of lakes or floating mats (habitat b) (Table 1).

Table 1 provides the data on lake geographical

Table 1. Characteristics of the lakes and habitats investigated in the Khrebtovyi Nature Reserve in the Polar Ural

Lake number	Geographic coordinates	Elevation, m	Temperature, °C	pH	Conductivity, µS/cm	Macrophytes	Habitat types*
1	67°19'15.7" N; 65°03'28.5" E	182	16.6	6.5	25	<i>Carex aquatilis</i> Wahlenb., <i>C. canescens</i> L., <i>Comarum palustre</i> L., <i>Equisetum fluviatile</i> L.	a
2	67°19'14.6" N; 65°03'23.9" E	183	16.0	6.2	60	<i>Carex aquatilis</i> , <i>Comarum palustre</i> , <i>Equisetum fluviatile</i> / mosses	a, b
3	67°19'13.7" N; 65°03'04.7" E	179	17.3	6.8	25	<i>Carex aquatilis</i> , <i>Eriophorum</i> sp., <i>Hippuris vulgaris</i> L., <i>Sparganium</i> sp., mosses	a, b
4	67°19'43.4" N; 65°04'48.6" E	182	20.3	7.0	73	<i>Carex aquatilis</i> , <i>Eriophorum</i> sp., <i>Comarum palustre</i> , <i>Fontinalis</i> sp., <i>Polytrichum</i> sp.	a, b
5	67°20'30.0" N; 65°06'4.0" E	188	20.0	6.6	12	<i>Carex aquatilis</i>	a
6	67°20'0.7" N; 65°05'27.3" E	191	6.3	4.5	23	<i>Carex aquatilis</i> , <i>Eriophorum chamissonis</i> C.A.Mey., <i>E. scheuchzeri</i> Hoppe, <i>Sphagnum</i> spp. and other mosses	b
7	67°20'13.0" N; 65°05'49.2" E	177	16.5	5.8	5	<i>Carex aquatilis</i> , <i>Comarum palustre</i> , mosses	a, b
8	67°20'29.1" N; 65°05'57.3" E	182	16.8	5.8	10	<i>Carex aquatilis</i> , <i>Comarum palustre</i> , <i>Sphagnum</i> spp.	a, b
9	67°20'25.9" N; 65°06'33.0" E	180	17.7	6.5	11	<i>Carex aquatilis</i> , <i>Comarum palustre</i> , <i>Eriophorum</i> sp.	a
10	67°19'44.3" N; 65°05'36.2" E	181	19.5	6.4	14	<i>Carex aquatilis</i> , <i>Comarum palustre</i> , mosses	a, b
11	67°19'36.6" N; 65°04'40.5" E	183	19.1	5.7	8	<i>Carex aquatilis</i> , <i>Comarum palustre</i> , mosses	a, b
12	67°19'36.9" N; 65°04'36.3" E	181	18.4	6.4	2	<i>Comarum palustre</i> , <i>Sphagnum</i> spp. and other mosses	a, b
13	67°20'12.1" N; 65°01'12.1" E	481	8.8	7.0	4	<i>Carex aquatilis</i> , <i>Eriophorum</i> sp., <i>Polygonum</i> sp., <i>Saxifraga</i> sp., mosses	b
14	67°19'20.1" N; 65°03'38.2" E	186	13.4	6.4	15	<i>Comarum palustre</i> , <i>Eriophorum vaginatum</i> L., <i>Hippuris vulgaris</i> , <i>Sphagnum</i> spp. and other mosses	b
15	67°19'22.7" N; 65°03'58.3" E	183	12.4	6.6	4	<i>Carex aquatilis</i> , <i>Comarum palustre</i> , <i>Petasites</i> sp., <i>Sphagnum</i> spp. and other mosses	b

Notes: *Abbreviations of the habitat types: a – roots and rhizomes of vascular plants taken in the helophyte zone dominated by *Carex aquatilis*, b – *Sphagnum* spp. and/or other mosses taken on the edges of lakes or floating mats.

coordinates, elevation, water parameters such as pH, temperature measured by using HANNA HI991300 portable pH/EC/TDS/temperature meter, and description of lake vegetation. Each algal sample contained 40 ml of lake water, which was later concentrated up to 10 ml by sedimentation method. The algae samples were preserved in 40% formaldehyde to reach the final concentration of 4%. In laboratory, samples were investigated using OLIMPUS BX51 microscope. The collection of samples is deposited at Vilnius University Herbarium (WI).

To identify desmid algae taxa, we used the research data of the following authors: COESEL &

MEESTERS (2007), DILLARD (1990, 1991, 1993), KRIEGER (1933, 1935, 1937), KRIEGER & GERLOFF (1962, 1969), LIND & BROOK (1980), LENZENWEGER (1996), PALAMAR-MORDVINCEVA (1982a), PALAMAR-MORDVINCEVA & PETL'OVANYJ (2009), RŮŽIČKA (1977, 1981), WEST & WEST (1904, 1905, 1908, 1912), WEST et al. (1923). Distribution of desmids was determined after PALAMAR-MORDVINCEVA (1982b). The nomenclature of desmid species were checked in the "AlgaeBase" (GUIRY & GUIRY, 2016), macrophyte species – in THE PLANT LIST (2013). Standardized names of authors were given after THE INTERNATIONAL PLANT NAME INDEX (2012).

Two-dimensional non-metric multidimensional scaling (NMDS) and the Jaccard similarity index for the presence/absence data were applied to compare algal species compositions in different study sites and habitats (LEGENDRE & LEGENDRE, 1998). The complete algal species richness was predicted using non-parametric estimator Chao 2, which is well suited for incidence based data (GOTELLI & COLWELL, 2010). Statistical data analysis was performed using the computer programme PAST version 3.14 (HAMMER et al., 2001).

RESULTS AND DISCUSSION

Physicochemical characteristics of the lakes

The analysis of water parameters of the investigated thermokarst and mountain lakes showed that they belong to slightly acidic or neutral type, pH varied from (4.5)5.7 to 7.0, conductivity – from 2 to 73 $\mu\text{S}/\text{cm}$, and temperature – from (6.3)16.0°C to 20.3°C.

Desmid community composition

From the samples collected in the Khrebtovyi Nature Reserve, we identified 116 species of desmids belonging to five families: *Desmidiaceae*, *Closteriaceae*, *Mesotanenaceae*, *Peniaceae* and *Gonatozygaceae* (Table 2).

In the Khrebtovyi Nature Reserve, we found only 22% of desmid species compared to the northern territories of Russia (LUKNITSKAYA, 2006). In the investigated territory of the Polar Ural, the families *Desmidiaceae* and *Closteriaceae* are predominant groups, this is consistent with the conclusions of other authors (STERLYAGOVA, 2008; STEPANKOVIČ et al., 2008; ŠOVRAŇ et al., 2013) that these families are most diverse in the northern mountainous areas. These families comprised 91.4% of all algae species found. However, the lowest number of desmid species were from such families as *Gonatozygaceae* and *Peniaceae* (2.6% of all desmid species found). The highest diversity of species was observed in *Cosmarium*, *Staurastrum*, *Euastrum* and *Closterium*. These four genera united 62.9% of all identified species. Such taxonomic composition is typical to the northern European and Russian regions (LUKNITSKAYA, 2006; STEPANKOVIČ et al., 2008) Even though the genera *Cylindrocystis*, *Pleurotaenium*, *Teilingia* had the lowest number of species; they are still typi-

Table 2. Taxonomic composition of desmids in the habitats of the Khrebtovyi Nature Reserve

Taxa	Species number	% of total species number
<i>Mesotaeniaceae</i>	7	6.0
<i>Cylindrocystis</i>	2	1.7
<i>Netrium</i>	3	2.6
<i>Planotaenium</i>	1	0.9
<i>Spirotaenia</i>	1	0.9
<i>Gonatozygaceae</i>	1	0.9
<i>Gonatozygon</i>	1	0.9
<i>Peniaceae</i>	2	1.7
<i>Penium</i>	2	1.7
<i>Closteriaceae</i>	13	11.2
<i>Closterium</i>	13	11.2
<i>Desmidiaceae</i>	93	80.2
<i>Actinotaenium</i>	5	4.3
<i>Bambussina</i>	1	0.9
<i>Cosmarium</i>	29	25.0
<i>Desmidium</i>	1	0.9
<i>Euastrum</i>	13	11.2
<i>Hyalotheca</i>	1	0.9
<i>Micrasterias</i>	4	3.4
<i>Pleurotaenium</i>	3	2.6
<i>Sphaerosozma</i>	1	0.9
<i>Spondylosum</i>	3	2.6
<i>Staurastrum</i>	18	15.5
<i>Stauroidesmus</i>	9	7.8
<i>Teilingia</i>	1	0.9
<i>Tetmemorus</i>	2	1.7
<i>Xanthidium</i>	2	1.7
Total	116	100

cal genera of the northern mountainous regions (COESEL, 1996; GETZEN et al., 1994; JARUSHINA, 2004).

Twenty seven species and one variety of the identified desmids were found for the first time in this northern region. Taxons of that kind in the common table of desmids are marked with an asterisk (Table 3). The species such as *Cosmarium isthmium* and *Gonatozygon brebissonii* are included in the Red List of St. Petersburg area (CVELEV, 2000) and species *Cosmarium contractum*, *C. nasutum*, *Micrasterias radiosa* are recognized as rare on the territory of Russia.

The species prevalent only in one lake combined 51.7% of the desmid flora, whereas 38.8% of desmid species appeared to be rare and were found in 2–5 samples (Fig. 3). Frequently found species were discovered in 6–15 samples; they belong to *Cosmarium angulosum*, *C. blytii*, *C. botrytis*, *C. regnellii*, *Euas-*

Table 3. Taxonomic list of desmids, their cell measurements, habitats and species distribution in the water bodies of the Khrebtovyi Nature Reserve

Taxa	Measurements of the cells (length × width), of isthmus and apex, μm	Lake number and habitat type abbreviations	Frequency category
DESMIDIALES			
Mesoteniaceae			
<i>Cylindrocystis brebissonii</i> Menegh.	28.2–77 × 12.4–33	2a, 6b, 8b, 12b, 13b	Common
<i>Cylindrocystis crassa</i> de Bary	15 × 55	1a	Single
<i>Netrium digitus</i> (Bréb. ex Ralfs) Itzigs. et Rothe	26–214.5 × 22–121.4	1a, 2a–b, 3a, 4a–b, 6b, 10a, 11b, 12a–b	Common
* <i>Netrium naegelii</i> (Bréb. ex W.Archer) West	110–115.5 × 22–33	10a	Single
<i>Netrium oblongum</i> (de Bary) Lütkem.	95.14 × 22.3	13b	Single
<i>Planotaenium interruptum</i> (Bréb. ex Ralfs) Petlovany et Palamar-Mordvintseva	143 × 38.5	3b	Single
<i>Spirotaenia condensata</i> Bréb.	214.5 × 33	4b	Single
Gonatozygaceae			
<i>Gonatozygon brebissonii</i> de Bary	115 × 8	4b	Single
Peniaceae			
<i>Penium margaritaceum</i> Bréb.	68–185 × 14–22	1a, 13b	Single
<i>Penium polymorphum</i> Perty (Perty)	60 × 25	13b	Single
Closteriaceae			
<i>Closterium baillyanum</i> (Bréb. ex Ralfs) Bréb.	385 × 44; I. 16.5	6b	Single
<i>Closterium costatum</i> Corda ex Ralfs	240.1 × 25.8; Ap. 7.1	8b	Single
<i>Closterium diana</i> Ehrenb. ex Ralfs	196.7 × 18.2	1a, 2a–b	Rare
<i>Closterium ebrenbergii</i> Menegh. ex Ralfs	172.5–225.5 × 34.5–46; Ap. 6.8–12.3	1a, 3a, 8b	Rare
<i>Closterium kuetzingii</i> Bréb.	368 × 23	7a	Single
<i>Closterium lineatum</i> Ehrenb. ex Ralfs	308 × 27.5; Ap. 11	2b, 3a, 4b, 7a, 8b	Rare
<i>Closterium moniliferum</i> Ehrenb. ex Ralfs	203.3–214.5 × 38.5–45.4; Ap. 11	3b, 8a–b	Rare
* <i>Closterium porrectum</i> Nordst.	232.6–311 × 16.1–26.5	2a, 3a	Rare
<i>Closterium pronum</i> Bréb.	198.3 × 8.6	5a	Single
<i>Closterium ralfsii</i> Bréb. ex Ralfs	247.5–264 × 27.5; Ap. 5.5–11	2a, 7a	Rare
<i>Closterium tumidum</i> L.N. Jonhson	170.5 × 33	3b	Single
* <i>Closterium turgidum</i> Ehrenb. ex Ralfs	467.5 × 49.5; Ap. 22	2b	Single
<i>Closterium venus</i> Kütz. ex Ralfs	59.2–95.7 × 17.4–15.7	1a, 2b	Rare
Desmidiaceae			
* <i>Actinotaenium crassiusculum</i> (de Bary) Teiling	56 × 15.7	13b	Single
<i>Actinotaenium cucurbita</i> (Bréb. ex Ralfs) Teiling	22–49.5 × 12–22	6b, 13b	Rare
<i>Actinotaenium cucurbitinum</i> (Bisset) Teiling	49.5–60.5 × 22 × 27.5	12b	Single
* <i>Actinotaenium diploporum</i> (P.Lundell) Teiling	29.4 × 15.6; I. 8.9	6b, 14b	Rare
<i>Actinotaenium rufescens</i> (Cleve) Teiling	44–60.5 × 22–27.5	6b, 12b, 13b	Rare
<i>Bambusina borneri</i> (Ralfs) Cleve	20–33 × 16.5–27.5	6b, 11b, 12a–b	Rare
<i>Cosmarium abbreviatum</i> Racib.	23.2 × 27.5	4b	Single
<i>Cosmarium amoenum</i> Bréb. ex Ralfs	49.5–60.5 × 23–27.5; I. 8.9–15.7	2b	Single
<i>Cosmarium angulosum</i> Bréb.	12.6 × 12.1; I. 3.1	1a, 2b, 4b, 8a, 10a–b	Common
<i>Cosmarium biretum</i> Bréb. ex Ralfs	104.5 × 44; I. 27.5	1a, 2a, 11a	Rare
<i>Cosmarium blytii</i> Wille	23.2 × 23.2; I. 20.3	1a, 3a, 7a, 8b, 10a, 13b	Common
<i>Cosmarium botrytis</i> Menegh. ex Ralfs	31.7–104.5 × 22–72.5; I. 10.3–38.5	1a, 2a–b, 3a–b, 4a–b, 6b, 7a, 8a–b, 9a, 10a–b, 11a–b, 12a, 13b, 14b	Common
<i>Cosmarium botrytis</i> var. <i>subtumidum</i> Wittr.	44–55 × 44–55; I. 22–33	6b	Single
<i>Cosmarium circulare</i> Reinsch	55 × 49.5; I. 14.5	1a	Single
<i>Cosmarium constrictum</i> Delponte	33 × 27.5; I. 16.5	7b	Single
<i>Cosmarium contractum</i> Kirchn.	27.5–43.5 × 26.6–33; I. 5.8–11	1a, 2b, 4a–b	Rare
<i>Cosmarium depressum</i> (Nägeli) P.Lundell	37.8–42.3 × 35.7–36.8; I. 10.8–13.4	1a	Single
<i>Cosmarium difficile</i> Lütkem.		2a	Single

Taxa	Measurements of the cells (length × width), of isthmus and apex, μm	Lake number and habitat type abbreviations	Frequency category
* <i>Cosmarium galeritum</i> var. <i>subtumidum</i> Borge	49.5 × 44; I. 16.5	1a	Single
<i>Cosmarium humile</i> Nordst. ex De Toni	27.5–33 × 16.5–27.5; I. 5.9–11	5a	Single
<i>Cosmarium isthmium</i> West	33–38.5 × 22 – 27.5; I. 11	10a	Single
<i>Cosmarium laeve</i> Rabenh.	8.5 × 33; I. 11	3b	Single
<i>Cosmarium meneghinii</i> Bréb. ex Ralfs	18 × 14	2a	Single
* <i>Cosmarium moniliforme</i> Ralfs	21 × 11.2; I. 5.9	2b, 3b	Rare
<i>Cosmarium nasutum</i> Nordst.	35 × 49.5; I. 16.5	13b	Single
<i>Cosmarium phaseolus</i> Bréb. ex Ralfs	35 × 28; I. 11.2	2b	Single
* <i>Cosmarium polygonatum</i> Halász	15–16.5 × 14; I. 5.5	1a, 5a	Rare
<i>Cosmarium pseudopyramidatum</i> P. Lundell	38.5–44 × 27.5; I. 11	8b	Single
<i>Cosmarium punctulatum</i> Bréb.	27.5–34.5 × 22; I. 6.3–9.3	2b	Single
<i>Cosmarium pyramidatum</i> Bréb. ex Ralfs	38.5–60.5 × 22–55; I. 9.6–16.5	4b, 9a, 11a, 13b	Rare
<i>Cosmarium quadratum</i> Ralfs ex Ralfs	60.5 × 38.5; I. 16.5	13b	Single
<i>Cosmarium regnellii</i> Wille	12.5–15.5 × 12.9–13; I. 3	1a, 2a–b, 4b, 12b	Rare
<i>Cosmarium subcostatum</i> Nordst.	22–27.5 × 19.1–23.2	1a	Single
<i>Cosmarium subprotumidum</i> Nordst.	23.2–37.7 × 20.3–29; I. 8.7–9.5	1a, 4b	Rare
<i>Cosmarium subtumidum</i> Nordst.	27.5 × 22; I. 16.5	3b	Single
<i>Cosmarium undulatum</i> Corda ex Ralfs	29 × 20.2; I. 8.7	1a	Single
<i>Desmidium swartzii</i> C.Agardh ex Ralfs	11–16.5 × 33	1a, 12a–b	Rare
<i>Euastrum anstatum</i> Ehrenb. ex Ralfs	44–121 × 23.2–55; I. 11–22; Ap. 16.5–22	4a–b, 9a, 10a–b, 14b	Common
<i>Euastrum bidentatum</i> Nägeli	38.5–55 × 27.5–38.5; I. 5.5–22	4b, 6b, 8a–b, 9a, 10a	Common
<i>Euastrum binale</i> Ehrenb. ex Ralfs	12.9–27.5 × 12.9–22; I. 4.6–7.9; Ap. 12.5–13.2	1a, 2b, 4b, 7a, 8b, 10a, 12a, 14b	Common
<i>Euastrum denticulatum</i> F. Gay	26.1–27.5 × 21.7–22	1a, 2b, 8b, 10a	Rare
<i>Euastrum elegans</i> Ralfs	17.4–38.5 × 14.5–38.9; I. 2.9–13.6	2a–b, 7a–b, 10a, 12a, 15b	Common
<i>Euastrum gemmatum</i> Ralfs	55–60.5 × 44–46; I. 14.5	4a–b, 9a	Rare
<i>Euastrum insulare</i> (Wittr.) J.Roy	19.1–27.5 × 14.5–22; I. 5	1a, 4a–b	Rare
<i>Euastrum intermedium</i> Cleve	66 × 38.5; I.33	4b	Single
<i>Euastrum oblongum</i> Ralfs	157 × 77; I. 22	4a	Single
* <i>Euastrum pulchellum</i> Bréb.	27.5–55 × 16.5–38.5; I. 5.5–16.5	2b, 3a, 7a–b, 8b, 10a, 12a, 15b	Common
* <i>Euastrum subalpinum</i> Messik.	16.5–22 × 11–16.5	4a, 10a, 14b	Rare
<i>Euastrum turneri</i> West	34.8–37.7 × 26.1; I. 8.7–14.5	2a–b	Rare
<i>Euastrum verrucosum</i> Ehrenb. ex Ralfs	92.5–121 × 80–110; I. 22–27.5	1a, 2a–b, 9a	Rare
<i>Hyalotheca dissilens</i> Bréb. ex Ralfs	13.8–19.8 × 18.6–21.7	1a, 2a, 7a–b	Rare
<i>Micrasterias crux-melitensis</i> Ralfs	137.5–143 × 115–126.5; I. 34.5–55	4b, 10b, 11b	Rare
* <i>Micrasterias furcata</i> C.Agardh ex Ralfs	176 × 115.5; I. 22	4b	Single
<i>Micrasterias papilifera</i> var. <i>glabra</i> Nordst.	121 × 137.5; I. 16.5	2b	Single
<i>Micrasterias radiosa</i> Ralfs	137.5–143 × 115.5–132; I. 16.5	2b	Single
* <i>Pleurotaenium maximum</i> (Reinsch) P.Lundell	495 × 38.5	11b	Single
<i>Pleurotaenium trabecula</i> Nägeli	291.5–506 × 27.5–46; I. 27.5; Ap. 16.5	7a, 11a–b, 12a, 15b	Rare
* <i>Pleurotaenium trabecula</i> var. <i>crassum</i> Wittr.	319 × 27.5	10b	Single
<i>Pleurotaenium truncatum</i> (Bréb. ex Ralfs) Nägeli	360.8–363 × 57.3–60.5; I. 38.5–39.5; Ap. 22.1–27.5	2a, 4a	Rare
* <i>Sphaerosoma aubertianum</i> West	15 × 22.1; I. 5.9	2b, 12b	Rare
* <i>Spondylosium ellipticum</i> West et G.S.West	20.3 × 20.3; I. 5.3	10b	Single
* <i>Spondylosium moniliforme</i> var. <i>compressum</i> Grönblad	38.5–44 × 27.5; I. 11	2b	Single

Taxa	Measurements of the cells (length × width), of isthmus and apex, μm	Lake number and habitat type abbreviations	Frequency category
<i>Spondylosium planum</i> (Wolle) West et G.S.West	10.1–16.5 × 11–16.5; I. 3.5–11	2b, 3a, 4a–b, 5a, 7a–b, 15b	Rare
* <i>Staurastrum anatinum</i> Cooke et Wills	44 with processes × 55; I. 11	9a	Single
<i>Staurastrum arctiscon</i> (Ehrenb. ex Ralfs) P.Lundell	82.5–115.5 with processes × 82.5–99; I. 22–38.5	2a–b, 3b	Rare
<i>Staurastrum boreale</i> West et G.S.West	29 × 43; I. 7.5	8a	Single
<i>Staurastrum brachiatum</i> Ralfs ex Ralfs	15–27.5 × 27.5–38.5; I. 5.5	5a, 6b	Rare
* <i>Staurastrum cristatum</i> (Nägeli) W.Archer	36 × 43.5; I. 17.4	1a	Single
<i>Staurastrum furcigerum</i> (Bréb.) W.Archer	63.8 with processes × 43.5 × 72.5; I. 26.1	1a	Single
<i>Staurastrum hexacerum</i> Witttr.	27.5 with processes × 33; I. 11	10a	Single
* <i>Staurastrum hirsutum</i> Ehrenb. ex Ralfs	34.5–38.5 × 29–31 with processes; I. 11	2b, 4b	Rare
* <i>Staurastrum manfeldtii</i> Delponte	38.5 × 55; I. 11	2b	Single
<i>Staurastrum margaritaceum</i> Menegh. ex Ralfs	22–27.5 with processes × 22–27.5; I. 5.5–11	7b	Single
<i>Staurastrum paradoxum</i> Meyen ex Ralfs	27.5 with processes × 44; I. 16.5	2b	Single
* <i>Staurastrum pelagicum</i> West et G.S.West	32.7 × 34.5 × 51.9 with processes; I. 17.4	2b	Single
* <i>Staurastrum polytrichum</i> (Perty) Rabenh.	49.5 × 38.5; I. 16.5	12b	Single
* <i>Staurastrum proboscideum</i> (Bréb.) W.Archer	33 × 33; I. 11	7a	Single
<i>Staurastrum sebaldii</i> Reinsch	66–99 with processes × 71.5–93.5; I. 17.4–27.5	2a–b	Rare
<i>Staurastrum sexcostatum</i> Bréb. ex Ralfs	40.6–60.5 with processes × 38.5; I. 16.5–17.4	2a–b, 7a–b	Rare
* <i>Staurastrum tohopekaligense</i> Wolle	55–87 with processes × 33–66.7 × 44–92.4 with processes × 23.2–43.5; I. 16.5–20.3	2b	Single
<i>Staurastrum vestitum</i> Ralfs	23.2–43.5 × 60.5–66.7 with processes	10a	Single
<i>Stauroidesmus convergens</i> (Ehrenb. ex Ralfs) S.Lill.	44–55.1 × 40.6–44 × 58–60.5 with processes × I.: 11.6–16.5	2a–b, 15b	Rare
<i>Stauroidesmus dejectus</i> (Bréb.) Teiling	44 × 38.5; I. 11	3a, 10a	Rare
<i>Stauroidesmus dickiei</i> (Ralfs) S.Lill.	38.5 × 38.5–44 × 55–60.5 with processes, I. 16.5–27.5	2b, 9a	Rare
* <i>Stauroidesmus glaber</i> (Ralfs) Teiling	38.5–44 × 49.5–71.5 with processes; I. 16.5	2b, 4a–b, 7a–b	Rare
<i>Stauroidesmus incus</i> (Hassal ex Ralfs) Teiling	11 × 16.4; I. 5	7b	Single
* <i>Stauroidesmus octocornis</i> (Ehrenb. ex Ralfs) Stastny, kaloud et Neustupa	16.4 × 23.6; I. 5.7	2a–b	Rare
<i>Stauroidesmus patens</i> (Nordst.) Croasdale	27.5–38.5 × 26.5–27.5; I. 5.5	7a, 8b	Rare
<i>Stauroidesmus spetsbergensis</i> (Nordst.) Teiling	38.5 × 27.5–38.5; I. 16.5	9a	Single
* <i>Stauroidesmus subpygmaeus</i> (West) Croasdale	27.5–33 × 33; I. 11	3b	Single
* <i>Teilingia quadrispinata</i> (Scott et Grönblad) Kurt Först.	7.5–10.7 × 8.7–11.5; I. 4.1–5.7	2b, 4b, 12b	Rare
<i>Tetmemorus brebissonii</i> Ralfs	66–115.5 × 11.5–34.5	8b	Single
<i>Tetmemorus laevis</i> Ralfs ex Ralfs	71.5–76.8 × 16.5	13b	Single
<i>Xanthidium antilopeum</i> Kütz.	33–116.2 with processes × 27.5–94.5 × 33–86.9 with processes × 27.5–76.8; I. 11–34.2	1a, 2a–b, 6b, 7b, 11b, 15b	Common
<i>Xanthidium cristatum</i> Bréb. ex Ralfs	60.5 with processes × 49.5 × 55 with processes × 38.5; I. 27.5	2a, 3a, 11b	Rare

trum ansatum, *E. bidentatum*, *E. binale*, *E. elegans*, *E. pulchellum*, *Netrium digitus*, *Spondylosum planum*, *Xanthidium antilopeum* (Table 3).

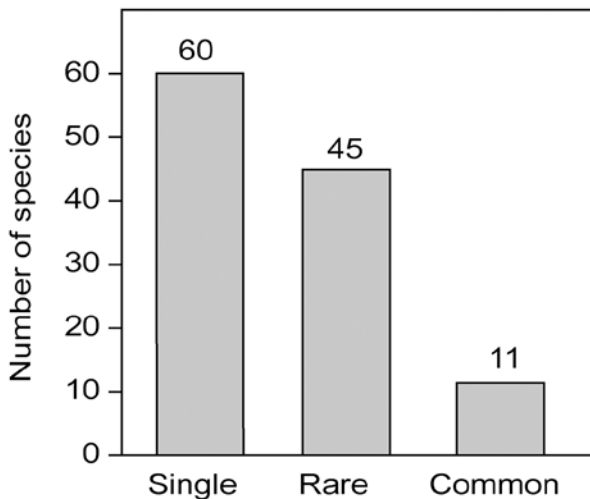


Fig. 3. Distribution of species in the studied water bodies of the Khrebtovyi Nature Reserve

The most diverse group of desmids in the Khrebtovyi Nature Reserve consisted of algae species distributed worldwide – 33% of all desmid species found in the research area, 16.9% of species were distinctly characteristic of the northern algal flora. They belong to Boreal element, namely *Actinotaenium crassiusculum*, *A. cucurbita*, *Cosmarium amoenum*, *Micrasterias radiosa*. There also were a few species representing the boreal-alpine element (6.7%), namely *Actinotaenium cucurbitinum*, *A. rufescens*, *Closterium costatum*, *Cosmarium biretum*, *Cosmarium galeritum*, *Euastrum bidentatum*, *Staurastrum arcticon*, *Staurodesmus glaber*, *Tetmemorus brebissonii*; and the boreal-arctic (2.5%), namely *Penium polymorphum*, *Staurastrum spetsbergensis*, *Tetmemorus leavis* (KOSTKEVICIENE et al., 2003; STERLYAGOVA, 2008). These floral elements give evidence that algal flora in the bogs has been strongly affected by the glaciers (COESEL, 1996; STAMENKOVIČ et al., 2008).

The composition of desmid species in the samples taken from different habitats was analysed by applying the Jaccard index and NMDS technique (Fig. 4). As it could be seen from Scatter plot, sample groups from “a” and “b” habitats were overlapping in 2D space. It can be concluded that complexes of desmid species in those habitats were similar. However, ob-

viously lower diversity of desmid species was in the samples taken squeezing rhizomes and roots of *Carex* or *Equisetum* plants, where altogether 70 species were observed. In comparison, 88 species were identified in the samples taken from *Sphagnum* and other mosses. Differences in the species richness of desmid flora were even more evident when Chao2 estimator was applied: in the “a” habitat, the number of species was 71.8 ± 20.1 and in “b” habitat – 94.9 ± 33.7 . Thus, more favourable environment for desmid algae in the studied lakes were habitats with *Sphagnum* and brown mosses, where more rich algal complexes had formed, compared to habitats with rhizomes and roots of *Carex* or *Equisetum* plants. In the further studies on algal flora, it might be possible to find species from the *Micrasterias*, *Staurodesmus* and *Xanthidium* genera since the habitats with *Sphagnum* and brown mosses are suitable for the mentioned groups.

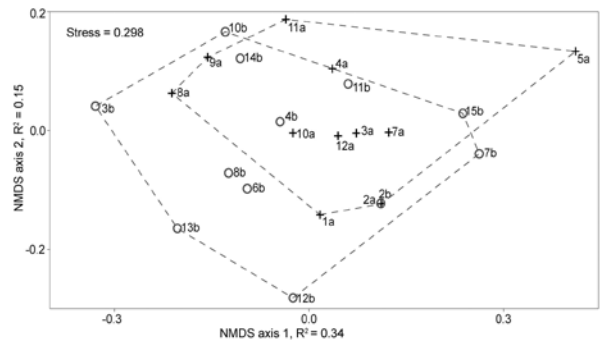


Fig. 4. Non-metric multidimensional scaling (NMDS) technique and the Jaccard similarity index of species composition recorded in the samples from the research area based on the presence/absence data (abbreviations of the number of lakes and habitat types as in Table 1). Dotted line shows convex hulls – the smallest convex polygon containing all points in the group

In the samples taken from the Khrebtovyi Nature Reserve, the species richness was poor and algae were not frequent. However, a large number of desmid species were found for the first time in that territory. Formation of algal flora in the Khrebtovyi Nature Reserve is still poorly understood, mainly because of the remoteness of the area and difficult research conditions. Chao 2 estimated maximum possible species richness was nearly one and a half times higher in the lakes with *Sphagnum* and brown mosses mats on the shores. That presupposes a need of further expeditions and more numerous samples from lakes in the Khrebtovyi Nature Reserve.

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DVYNIČIŲ FLORA CHREBTOVYJ DRAUSTINIO EŽERUOSE ŠIAURĖS URALĖ (RUSIJA)

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Santrauka

Straipsnyje aptariama dvyniečių rūšių įvairovė, jų paplitimas Chrebtovj draustinio termokarstiniuose ir kalnų ežeruose (Šiaurės Uralas). Rasta 116 dvyniečių rūšių, kurios priklausė *Closteriaceae* (13 rūšių), *Desmidiaceae* (93), *Gonatozygaceae* (1), *Mesotaniaceae* (7), *Peniaceae* (2) šeimoms. Dvidešimt septynios rūšys buvo rastos pirmą kartą

šiam regione. Šešiasdešimties rūšių, kurios sudarė 51,7 % visų rastų dvyniečių rūšių, radiniai buvo pavieniai, aptikti tik vienoje tirtose augavietėje. Didžiausias dvyniečių rūšių skaičius (88 rūšys) rastas vandens mėginiuose, paimtuose išspaudus iš ežerų pakraščių ištrauktus *Sphagnum* spp. ar kitas samanias.