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 Urals.

Keywords: algae, benthos, Desmidiales, 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 algocenoses 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 Urals. 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 Urals (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...
lakes, river valleys with rare plant and bird species recorded in the Red Data Book of Komi Republic (Taškaev, 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 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
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), LEMENWEGER (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” (GURY & GURY, 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 (GOTTELLI & 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 μS/cm, and temperature – from (6.3)16.0°C to 20.3°C.

Desmid community composition

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

In the Kherbtovyi 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 (STERLYGOVA, 2008; STEPANKOVIĆ et al., 2008; ŠOVRAN 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, Staurodesmus, 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; STEPANKOVIĆ et al., 2008) Even though the genera Cylindrocystis, Pleurotaenium, Teilingia had the lowest number of species; they are still typi-cal genera of the northern mountainous regions (COESEL, 1996; GETZEN et al., 1994; JARUSHINA, 2004).

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

| Taxa                  | Species number | % of total species |
|-----------------------|----------------|--------------------|
| Mesotaeniaceae        | 7              | 6.0                |
| Cylindrocystis        | 2              | 1.7                |
| Nettia                | 3              | 2.6                |
| Planotaenium          | 1              | 0.9                |
| Spirotaenia           | 1              | 0.9                |
| Gonatozygaceae        | 1              | 0.9                |
| Gonatozygon           | 1              | 0.9                |
| Peniaceae             | 2              | 1.7                |
| Penium                | 2              | 1.7                |
| Closteriaceae         | 13             | 11.2               |
| Closterium            | 13             | 11.2               |
| Desmidiaceae          | 93             | 80.2               |
| Actinotaenium         | 5              | 4.3                |
| Bambussina            | 1              | 0.9                |
| Cosmarium             | 29             | 25.0               |
| Desmidium             | 1              | 0.9                |
| Euastrum              | 13             | 11.2               |
| Hylatotheca           | 1              | 0.9                |
| Microasterias         | 4              | 3.4                |
| Pleurotaenium         | 3              | 2.6                |
| Sphaeroderma          | 1              | 0.9                |
| Spondylosum           | 3              | 2.6                |
| Staurodesmus          | 9              | 7.8                |
| Teilingia             | 1              | 0.9                |
| Tettemorus            | 2              | 1.7                |
| Xanthidium            | 2              | 1.7                |
| Total                 | 116            | 100                |
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               |                                                                     |                                            |                   |
| Mesoteniacae              |                                                                     |                                            |                   |
| Cylindrocystis brebissonii Menegh. | 28.2–77 × 12.4–33 | 2a, 6b, 8b, 12b, 13b | Common             |
| Cylindrocystis crassa de Bary | 15 × 55 | 1a | Single             |
| Netrium digitus (Bréb. ex Ralfs) Itzigs. et Rothe | 26–214.5 × 22–121.4 | 1a, 2a–b, 3a, 4a–b, 6b, 10a, 11b, 12a–b | Common             |
| * Netrium naegelii (Bréb. ex W.Archer) West | 110–115.5 × 22–33 | 10a | Single             |
| Netrium oblongum (de Bary) Lütkem. | 95.14 × 22.3 | 13b | Single             |
| Planotaenium interruptum (Bréb. ex Ralfs) Petlovany et Palamar-Mordvintseva | 143 × 38.5 | 3b | Single             |
| * Spirotaenia condensata Bréb. | 214.5 × 33 | 4b | Single             |
| Gonatozygaceae            |                                                                     |                                            |                   |
| Gonatozygon brebissonii de Bary | 115 × 8 | 4b | Single             |
| Peniaceae                 |                                                                     |                                            |                   |
| Penium polymorphum Perty (Perty) | 60 × 25 | |                   |
| Closteriaceae             |                                                                     |                                            |                   |
| Closterium baillyanum (Bréb. ex Ralfs) Bréb. | 385 × 44; I. 16.5 | 6b | Single             |
| Closterium costatum Corda ex Ralfs | 240.1 × 25.8; Ap. 7.1 | 8b | Single             |
| Closterium dianae Ehrenb. ex Ralfs | 196.7 × 18.2 | 1a, 2a–b | Rare              |
| Closterium ehenbergii Menegh. ex Ralfs | 172.5–225.5 × 34.5–46; Ap. 6.8–12.3 | 1a, 3a, 8b | Rare              |
| * Closterium kuizingii Bréb. | 368 × 23 | 7a | Single             |
| Closterium lineatum Ehrenb. ex Ralfs | 308 × 27.5; Ap. 11 | 2b, 3a, 4b, 7a, 8b | Rare              |
| Closterium moniliferum Ehrenb. ex Ralfs | 203.3–214.5 × 38.5–45.4; Ap. 11 | 3b, 8a–b | Rare              |
| *Closterium porrectum Nordst. | 232.6–311 × 16.1–26.5 | 2a, 3a | Rare              |
| Closterium pronum Bréb. | 198.3 × 8.6 | 5a | Single             |
| Closterium ralfsii Bréb. ex Ralfs | 247.5–264 × 27.5; Ap. 5.5–11 | 2a, 7a | Rare              |
| Closterium tumidum L.N. Jonhson | 170.5 × 33 | 3b | Single             |
| *Closterium turgidum Ehrenb. ex Ralfs | 467.5 × 49.5; Ap. 22 | 2b | Single             |
| Closterium venus Kütz. ex Ralfs | 59.2–95.7 × 17.4–15.7 | 1a, 2b | Rare              |
| Desmidaceae               |                                                                     |                                            |                   |
| *Actinotaenium crassiusculum (de Bary) Teiling | 56 × 15.7 | 13b | Single             |
| Actinotaenium cucurbita (Bréb. ex Ralfs) Teiling | 22–49.5 × 12–22 | 6b, 13b | Rare              |
| Actinotaenium cucurbitum (Bisset) Teiling | 49.5–60.5 × 22 × 27.5 | 12b | Single             |
| *Actinotaenium diplosporum (P.Lundell) Teiling | 29.4 × 15.6; I. 8.9 | 6b, 14b | Rare              |
| Actinotaenium rufescens (Cleve) Teiling | 44–60.5 × 22–27.5 | 6b, 12b, 13b | Rare              |
| Bambusina borreri (Ralfs) Cleve | 20–33 × 16.5–27.5 | 6b,11b, 12a–b | Rare              |
| Cosmarium abbreviatum Racib. | 23.2 × 27.5 | 4b | Single             |
| Cosmarium amoenum Bréb. ex Ralfs | 49.5–60.5 × 23–27.5; I. 8.9–15.7 | 2b | Single             |
| Cosmarium angulosum Bréb. | 12.6 × 12.1; I. 3.1 | 1a, 2b, 4b, 8a, 10a–b | Common           |
| Cosmarium biretum Bréb. ex Ralfs | 104.5 × 44; I. 27.5 | 1a, 2a, 11a | Common           |
| Cosmarium blytii Wille | 23.2 × 23.2; I. 20.3 | 1a, 3a, 7a, 8b, 10a, 13b | Common           |
| Cosmarium botrytis 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           |
| Cosmarium botrytis var. subtumidum Wittr. | 44–55 × 44–55; I. 22–33 | 6b | Single             |
| Cosmarium circulare Reinsch | 55 × 49.5; I. 14.5 | 1a | Single             |
| Cosmarium constrictum Delponti | 33 × 27.5; I. 16.5 | 7b | Single             |
| Cosmarium contractum Kirchn. | 27.5–43.5 × 26.6–33; I. 5.8–11 | 1a, 2b, 4a–b | Rare              |
| Cosmarium depressum (Nägeli) P.Lundell | 37.8–42.3 × 35.7–36.8; I. 10.8–13.4 | 1a | Single             |
| Cosmarium difficile Lütkem. | 27.5 × 33 | 2a | Single             |
| Taxa                                             | Measurements of the cells (length × width), of isthmus and apex, μm | Lake number and habitat type abbreviations | Frequency category |
|-------------------------------------------------|---------------------------------------------------------------------|-------------------------------------------|--------------------|
| *Cosmarium galeritum var. subtumidum* Borge      | 49.5 × 44; I. 16.5                                                   | 1a                                        | Single             |
| Cosmarium humile Nordst. ex De Toni              | 27.5–33 × 16.5–27.5; I. 5.9–11                                      | 5a                                        | Single             |
| Cosmarium isthmium West                          | 33–38.5 × 22 × 27.5; I. 11                                          | 10a                                       | Single             |
| Cosmarium laeve Rabenh.                         | 8.5 × 33; I. 11                                                      | 3b                                        | Single             |
| Cosmarium meneghinii Bréb. ex Ralfs             | 18 × 14                                                             | 2a                                        | Single             |
| *Cosmarium moniliforme* Ralfs                    | 21 × 11.2; I. 5.9                                                   | 2b, 3b                                    | Rare               |
| Cosmarium nasutum Nordst.                       | 35 × 49.5; I. 16.5                                                  | 13b                                       | Single             |
| Cosmarium phaseolus Bréb. ex Ralfs              | 35 × 28; I. 11.2                                                    | 2b                                        | Single             |
| *Cosmarium polygonatum* Halász                   | 15–16.5 × 14; I. 5.5                                               | 1a, 5a                                    | Rare               |
| Cosmarium pseudopyramidatum P. Lundell          | 38.5–44 × 27.5; I. 11                                              | 8b                                        | Single             |
| Cosmarium punctulatum Bréb.                     | 27.5–34.5 × 22; I. 6.3–9.3                                         | 2b                                        | Single             |
| Cosmarium pyramidalum Bréb. ex Ralfs            | 38.5–60.5 × 22–55; I. 9.6–16.5                                      | 4b, 9a, 11a, 13b                         | Rare               |
| Cosmarium quadratum Ralfs ex Ralfs              | 60.5 × 38.5; I. 16.5                                               | 13b                                       | Single             |
| Cosmarium regnellii Wille                       | 12.5–15.5 × 12.9–13; I. 3                                          | 1a, 2a–b, 4b, 12b                       | Rare               |
| Cosmarium subcostatum Nordst.                   | 22–27.5 × 19.1–23.2                                                | 1a                                        | Single             |
| Cosmarium subprotopodium Nordst.                | 23.2–37.7 × 20.3–29; I. 8.7–9.5                                     | 1a, 4b                                    | Rare               |
| Cosmarium subtruncatum Nordst.                  | 27.5 × 22; I. 16.5                                                  | 3b                                        | Single             |
| Cosmarium undulatum Corda ex Ralfs              | 29 × 20.2; I. 8.7                                                   | 1a                                        | Single             |
| Desmidium schwartzi C.Agardh ex Ralfs           | 11–16.5 × 33                                                       | 1a, 12a–b                                | Rare               |
| *Euastrum anseratum* Ehrenb. ex Ralfs            | 44–121 × 23.2–55; I. 11–22; Ap. 16.5–22                            | 4a–b, 9a, 10a–b, 14b                     | Common             |
| *Euastrum bidensiatum* Nägeli                   | 38.5–55 × 27.5–38.5; I. 5.5–22                                      | 4b, 6b, 8a–b, 9a, 10a                    | Common             |
| *Euastrum binale* 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             |
| *Euastrum denticulatum* F. Gay                  | 26.1–27.5 × 21.7–22                                                | 1a, 2b, 8b, 10a                          | Rare               |
| *Euastrum elegans* Ralfs                        | 17.4–38.5 × 14.5–38.9; I. 2.9–13.6                                  | 2a–b, 7a–b, 10a, 12a, 15b                | Common             |
| *Euastrum gemmatum* Ralfs                       | 55–60.5 × 44–46; I. 14.5                                           | 4a–b, 9a                                 | Rare               |
| *Euastrum insulare* (Wittr.) J.Roy               | 19.1–27.5 × 14.5–22; I. 5                                           | 1a, 4a–b                                 | Rare               |
| *Euastrum intermedium* Cleve                     | 66 × 38.5; I. 133                                                  | 4b                                        | Single             |
| *Euastrum oblongum* Ralfs                       | 157 × 77; I. 22                                                    | 4a                                        | Single             |
| *Euastrum polchellum* Bréb.                     | 27.5–55 × 16.5–38.5; I. 5.5–16.5                                   | 2b, 3a, 7a–b, 8b, 10a, 12a, 15b          | Common             |
| *Euastrum subalpinum* Messik.                   | 16.5–22 × 11–16.5                                                  | 4a, 10a, 14b                             | Rare               |
| *Euastrum turneri* West                         | 34.8–37.7 × 26.1; I. 8.7–14.5                                       | 2a–b                                     | Rare               |
| *Euastrum verrucosum* Ehrenb. ex Ralfs           | 92.5–121 × 80–110; I. 22–27.5                                      | 1a, 2a–b, 9a                             | Rare               |
| Halyotheca dissilens Bréb. ex Ralfs             | 13.8–19.8 × 18.6–21.7                                              | 1a, 2a, 7a–b                             | Rare               |
| Micrasterias crux-mellitensis Ralfs             | 137.5–143 × 115–126.5; I. 34.5–55                                  | 4b, 10b, 11b                             | Rare               |
| *Micrasterias furcata* C.Agardh ex Ralfs        | 176 × 115.5; I. 22                                                  | 4b                                        | Single             |
| *Micrasterias papilifera var. glabra* Nordst.    | 121 × 137.5; I. 16.5                                                | 2b                                        | Single             |
| Micrasterias radiosa Ralfs                      | 137.5–143 × 115.5–132; I. 16.5                                     | 2b                                        | Single             |
| *Pleurotaenium maximum* (Reinsch) P.Lundell      | 495 × 38.5                                                          | 11b                                       | Single             |
| *Pleurotaenium trabecula* Nägeli                | 291.5–506 × 27.5–46; I. 27.5; Ap. 16.5                              | 7a, 11a–b, 12a, 15b                     | Rare               |
| *Pleurotaenium trabecula var. crassum* Wittr.    | 319 × 27.5                                                          | 10b                                       | Single             |
| *Pleurotaenium truncatum* Bréb. ex Ralfs         | 360.8–363 × 57.3–60.5; I. 38.5–39.5; Ap. 22.1–27.5                 | 2a, 4a                                    | Rare               |
| Sphaerozomas aubertianum West                    | 15 × 22.1; I. 5.9                                                   | 2b, 12b                                  | Rare               |
| *Spongiosolus ellipticum* West et G.S.West       | 20.3 × 20.3; I. 5.3                                                 | 10b                                       | Single             |
| *Spongiosolus moniliforme var. compressum* 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 |
|-------------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------|--------------------|
| *Spondylosium planum* (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               |
| *Staurastrum anatimus* Cooke et Wills                       | 44 with processes × 55; I. 11                                      | 9a                                          | Single             |
| *Staurastrum arctiscon* (Ehrenb. ex Ralfs) P.Lundell        | 82.5–115.5 with processes × 82.5–99; I. 22–38.5                     | 2a–b, 3b                                     | Rare               |
| *Staurastrum boreale* West et G.S. West                     | 29 × 43; I. 7.5                                                     | 8a                                          | Single             |
| *Staurastrum brachiatum* Ralfs ex Ralfs                     | 15–27.5 × 27.5–38.5; I. 5.5                                       | 5a, 6b                                       | Rare               |
| *Staurastrum cristatum* (Nägeli) W.Archer                   | 36 × 43.5; I. 17.4                                                 | 1a                                          | Single             |
| *Staurastrum furcigerum* (Brév.) W.Archer                   | 63.8 with processes × 43.5 × 72.5; I. 26.1                        | 1a                                          | Single             |
| *Staurastrum hexacerum* Wittr.                             | 27.5 with processes × 33; I. 11                                    | 10a                                         | Single             |
| *Staurastrum hirsutum* Ehrenb. ex Ralfs                     | 34.5–38.5 × 29–31 with processes; I. 11                           | 2b, 4b                                       | Rare               |
| *Staurastrum manfelditii* Delponte                         | 38.5 × 55; I. 11                                                   | 2b                                          | Single             |
| *Staurastrum margaritaceum* Menegh. ex Ralfs                | 22–27.5 with processes × 22–27.5; I. 5.5–11                        | 7b                                          | Single             |
| *Staurastrum paradoxum* Meyen ex Ralfs                      | 27.5 with processes × 44; I. 16.5                                  | 2b                                          | Single             |
| *Staurastrum pelagicum* West et G.S. West                   | 32.7 × 34.5 × 51.9 with processes; I. 17.4                        | 2b                                          | Single             |
| *Staurastrum polytrichum* Rabenh.                          | 49.5 × 38.5; I. 16.5                                              | 12b                                         | Single             |
| *Staurastrum proboscideum* (Brév.) W.Archer                 | 33 × 33; I. 11                                                     | 7a                                          | Single             |
| *Staurastrum sexcostatum* Brév. ex Ralfs                    | 66–99 with processes × 71.5–93.5; I. 17.4–27.5                     | 2a-b                                        | Rare               |
| *Staurastrum tohopekaligense* Wolle                         | 55–87 with processes × 33–66.7 × 44–92.4 with processes × 23.2–43.5; I. 16.5–20.3 | 2b                                          | Single             |
| *Staurastrum vestitum* Ralfs                               | 23.2–43.5 × 60.5–66.7 with processes                              | 10a                                         | Single             |
| *Staurodesmus convergens* (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               |
| *Staurodesmus dejectus* (Brév.) Teiling                     | 44 × 38.5; I. 11                                                   | 3a, 10a                                     | Rare               |
| *Staurodesmus dickiei* (Ralfs) S.Lill.                      | 38.5 × 38.5–44 × 55–60.5 with processes, I. 16.5–27.5             | 2b, 9a                                      | Rare               |
| *Staurodesmus glaber* (Ralfs) Teiling                      | 38.5–44 × 49.5–71.5 with processes; I. 16.5                       | 2b, 4a–b                                    | Rare               |
| *Staurodesmus incus* (Hassal ex Ralfs) Teiling              | 11 × 16.4; I. 5                                                   | 7b                                          | Single             |
| *Staurodesmus octocornis* (Ehrenb. ex Ralfs) Stastny, kalaud et Neustupa | 16.4 × 23; 6; I. 5.7                                              | 2a–b                                        | Rare               |
| *Staurodesmus patens* (Nordst.) Croasdale                   | 27.5–38.5 × 26.5–27.5; I. 5.5                                      | 7a, 8b                                      | Rare               |
| *Staurodesmus spetsbergensis* (Nordst.) Teiling             | 38.5 × 27.5–38.5; I. 16.5                                         | 9a                                          | Single             |
| *Staurodesmus subpygmaeus* (West) Croasdale                 | 27.5–33 × 33; I. 11                                                | 3b                                          | Single             |
| *Teilingia quadrispinata* (Scott et Grönblad) Kurt Först.   | 7.5 –10.7 × 8.7–11.5; I. 4.1–5.7                                  | 2b, 4b, 12b                                 | Rare               |
| Tetmemorus brebissonii Ralfs                               | 66–115.5 × 11.5–34.5                                              | 8b                                          | Single             |
| Tetmemorus laevis Ralfs ex Ralfs                            | 71.5–76.8 × 16.5                                                   | 13b                                         | Single             |
| Xanthidium antilopeum 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             |
| Xanthidium cristatum Brév. ex Ralfs                         | 60.5 with processes × 49.5 × 55 with processes × 38.5; I. 27.5     | 2a, 3a, 11b                                 | Rare               |
trum ansatum, E. bidendatum, E. binale, E. elegants, E. pulchellum, Netrium digitus, Spondylosum plumum, 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 bidendatum, Staurotrum arcticcon, Staurodesmus glaber, Tetmemorus brebissonii; and the boreal-arctic (2.5%), namely Penium polymorphum, Staurostrum spetsbergensis, Tetmemorus leavis (Kostkevičiene 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; Stamenkovic 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, obviously 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 $71.8 \pm 20.1$ and in “b” habitat – $94.9 \pm 33.7$. 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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DVYNEČIŲ FLORA CHREBTOVYJ DRAUSTINIO EŽEUOSE ŠIAURĖS URALE (RUSIJA)

Rima Briškaite, Elena Patova, Sigitas Juzenas

Santrauka

Straipsnyje aptariama dvyniečių rūšių įvairovė, jų paplitimas Chrebtovij draustinio termokarstinio ir kalnų ežeruose (Šiaurės Uralas). Rasta 116 dvyniečių rūšių, kurios priklauso Closteriaceae (13 rūšių), Desmidiaceae (93), Gonatozygaceae (1), Mesotaniaceae (7), Peniaceae (2) šeimoms. Dvidešimt septynis rūšis buvo rastos pirmą kartą šiame regione. Šešiasdešimties rūšių, kurios sudarė 51,7 % visų rastų dvyniečių rūšių, radiniai buvo pavieniai, aptikti tik vienoje tirtoje augavietėje. Didžiausias dvyniečių rūšių skaičius (88 rūšys) rastas vandens mėginiuose, paimtuose iš ežerų pakraščių ištrauktų Sphagnum spp. ar kitas samanas.