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DESMID FLORA OF AUKŠTUMALA RAISED BOG (NEMUNAS RIVER DELTA, WESTERN LITHUANIA)

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Abstract

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Desmid algae from three families, 17 genera were registered in the investigated habitats of the Aukštumala Telmological Reserve. A total of 56 desmid algae taxa (50 species and six varieties) were recorded. Species of the Desmidiaceae family dominated. They comprised 73% of all desmid species found. Mesotaniaceae and Closteriaceae comprised 16% and 11%, respectively. The highest diversity was discovered in the samples collected on the margins of the pools (45 species) and in the wet hollows with *Sphagnum* cover (35 species). Most species were found in the samples collected in August (36 species) or in March and June (25 and 28 species, respectively). The seasonal and spatial distribution of desmid algae species was observed.

Keywords: algae, *Desmidiales,* Europe, Lithuania, raised bog, *Zygnematales*.

INTRODUCTION

Raised bogs cover 39.378 ha (0.61%) of the Lithuanian territory (Povilaitis et al., 2011). Aukštumala raised bog is situated in the western part of Lithuania. It is deltaic mire that has developed under the influence of geomorphological processes in the delta of the River Nemunas. In the earlier stages of development, Aukštumala mire was affected by alluvial processes. It differs from other Lithuanian raised bogs in the microrelief with predominant hollows and in the abundance of polls (Seibutis, 1958). The thickness of the peat layer before drainage reached more than eight meters (Couwenberg & Joosten, 2002). First peat exploitation works in Aukštumala mire were started in 1882, and have been continued in the eastern part of the raised bog till now. Long-term peat exploitation had negative influence on the non-exploited territory of the raised bog. Since 2006, the restoration efforts have been made in Aukštumala raised bog to raise the water table in the areas affected because of peat mining operations. It is known that positive dynamics of the development of plant communities may determine the ecosystem's condition of the whole raised bog, particularly in the case, when water level regime remains natural and friendly to the formation of this ecosystem; in affected places such water regime is restored and supported even by using artificial facilities (Pakalnis et al., 2005).

Desmids are a specific group of algae. They are able to thrive in different types of freshwater bodies. Because of unique cell structure, reproduction and morphometric characteristics, desmids are able to adapt to different ecological environmental conditions. They are most frequently found on the margins of the artificial lakes, in raised bogs and their pools especially with *Sphagnum*. Desmids are known as sensitive indicators of the raised bog ecosystem changes (Klemenčič et al., 2010; Sterlyagova, 2008). Therefore, the study on the variety and structure of desmid species can be used for the indication of the processes running in raised bog.

The algal flora of Aukštumala raised bog has not been investigated till now. The aim of this work was to analyse the species composition of desmids as well as their prevalence in different habitats in this raised bog till the beginning of nature management works. Such research data should provide a possibility to assess the effectiveness of restoration works performed in the raised bog as well as changes in the plant communities.

STUDY AREA

Aukštumala raised bog is the first mire scientifically studied (1898–1900) by German scientist C. A. Weber. It is one of the largest bogs of Lithuania, situated in the western part of the country, in the River Nemunas delta region between Lake Krokų Lanka, the Rivers Tenenys and Minija lower courses (Basalykas, 1958). To date, only 1285 ha of the 3018 ha of active raised bog have remained (Fig. 1). According to Boč & Mazing (1979), Aukštumala raised bog is in the zone of the convex bogs having ridge-hollow complex; it is situated on the south-eastern onshore of the Curonian Lagoon, in the Baltic seashore province (western Lithuania).

These raised bogs are characterized by high convexity and complexes of hollows and hummocks, and large number of pools. Based on the regional peatland division performed by Purvinas & Seibutis (1957), the investigated raised bog is attributed to the western peatland region that is characterized by steep slopes and flat plateaus. The surface of Aukštumala raised bog's plateau in 150–500 m section gradually ascends up to 4.5–5.0 m above the sea level. Microrelief is characterized as a complex of hummocks and hollows; groundwater is in 20 to 30 cm depth, acid (pH about 4.5). Intense rise of current delta in the northern part enables to conclude that oligotrophic environment predominated there for a long time without the influence of nutritious water (Basalykas, 1958).

Anthropogenic factors highly changed the surface of Aukštumala raised bog. Before peat extraction, the complex of more than 100 pools was located on the plateau of the raised bog, which indicated late stage of its development. Despite of anthropogenic influence, five habitat types of European importance

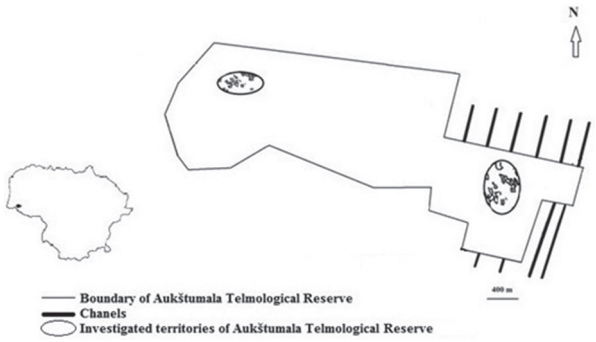

Fig. 1. Location of the study areas in the Aukštumala Telmological Reserve: 8, 8a, 9, 9a, 10, 11 in the western part, and 1, 2, 3, 4, 5, 6, 6a, 7, 12, 13, 14, 15, 16 in the eastern part

(European Commission, 2013) occur in the territory of the Aukštumala Telmological Reserve: 7110 *Active raised bogs, 7120 Degraded raised bogs, 3160 Natural dystrophic lakes and ponds, 9080 *Fennoscandian deciduous swamp woods and 91D0 *Bog woodland.

Hydrological conditions in Aukštumala raised bog were disturbed by drainage channels and do not allow concentration of the water surplus during rainy months. It was noticed that during cold season, rainfalls accumulate less water than snow. This negatively affects the surface of the raised bog, particularly in the area more affected by drainage system. The climate diagram (Fig. 2) based on the data of Šilutė hydro-meteorological station (rainfall amount, ambient temperature, humidity and thickness of the snow cover) express the climatic conditions in the investigated area in 2007 (Černiauskaitė, 2008).

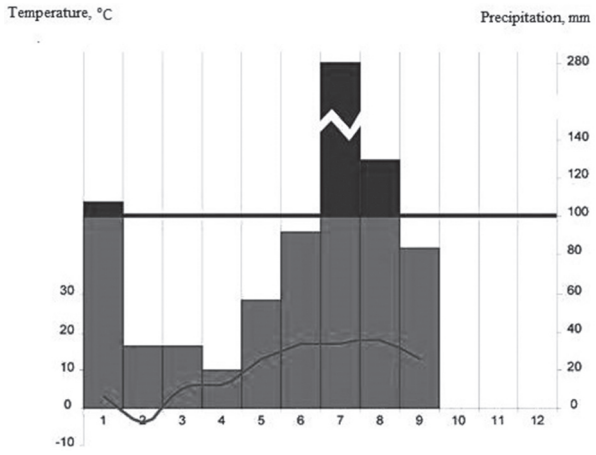

Fig. 2. Diagram of temperature and rainfall in Aukštumala raised bog in 2007 based on the data of Šilutė hydro-meteorological station (after Černiauskaitė, 2008)

During the study period, despite low rainfall, the drought was not recorded (Fig. 2). Nevertheless, the water outflow from Aukštumala raised bog occurred via drainage ditches (Černiauskaitė, 2008).

To date, the Aukštumala Telmological Reserve includes 273 small bog pools with a total area of 11.9 hectares. On the shores of the pools, oligotrophic, mesotrophic and eutrophic (in more disturbed places) wetland plant communities occurred. At the wettest sites such as hollows and edges of the pools, prevailed plant communities of the *Rhynchosporion albae* alliance with predominant *Carex limosa* L., *Drosera anglica*, *Rhynchospora alba* (L.) Vahl., *Scheuchzeria palustris* L., *Sphagnum cuspidatum* Ehrh. ex Hoff. Small areas of Aukštumala raised bog were occupied by pool vegetation ascribed to *Caricetum limosae* with characteristic species such as *Carex limosa*, *Scheuchzeria. palustris*, *Drosera rotundifolia*, *Andromeda polifolia*, *Oxycoccus palustris* Pers., *Eriophorum angustifolium*, *Carex rostrata* Stokes. Moss cover consisted of *Sphagnum magellanicum*, *S. cuspidatum*, *S. angustifolium* (C.Leans ex Russ.) C.Jeans (Meškauskaitė et al., 2001).

MATERIALS AND METHODS

Desmid algae samples were collected in the raised bog pools of the Aukštumala Telmological Reserve in June 2001 (samples were collected episodically) and in March, June and August 2007. Twelve pools were investigated in the eastern and western parts of the raised bog. Seasonal desmid algae sampling was performed by squeezing out submerged *Sphagnum* collected in different habitats: in the wet hollows (13 samples); on the margins of the pools (22 samples). Some samples were taken from *Sphagnum* mats freely floating on the pool surface and from the open peat.

The geographical coordinates of the studied habitats were determined using the GPS receiver *Garmin etrex*. The field measurements of water pH, temperature and conductivity (measured using HANNA HI991300 Portable pH/EC/TDS/Temperature Meter) were registered. A total of 38 desmid algae samples were collected. Samples were collected by squeezing out submerged *Sphagnum*. They were stored in plastic containers of 40 ml and concentrated till 10 ml applying sedimentation procedure. Shortly after collecting, the samples were preserved with 40% formaldehyde to final concentration of 4%. Quantitative analysis of desmid algae were performed according to Lesiak (1990). The number of cells was calculated in three replicas of each sample. The data on algae cell abundance were expressed in the units of relative abundance (Table 1). Desmid algae cells were not counted from *Sphagnum* mats freely floating on the pools and from the open peat in the samples.

Table 1. Scale value of relative abundance of desmid cells

Relative abundance	Cell number ml^{-3}
1 – Single	1–10
2 – Abundant	11–100
3 – Dominant	> 100

Desmid algae samples were identified using microscope Olympus BX51. The reference materials are deposited at the Herbarium of Vilnius University (WI). For taxonomic identification of desmid algae species, characteristics referred by Coesel & Meesters (2007), Dillard (1990, 1991, 1993), Lind & Brook (1980), Lenzenweger (1996), Krieger (1933, 1935, 1937), Krieger & Gerloff (1962, 1969), Opute (2000), Palamar-Mordvinceva (1982b), Palamar-Mordvinceva & Petl'ovaniy (2009), Ružička (1977, 1981), West & West (1904, 1905, 1908, 1912), West et al. (1923) were used. General distribution of desmid species was described according to Palamar-Mordvinceva (1982a) and Palamar-Mordvinceva & Petl'ovaniy (2009).

RESULTS AND DISCUSSION

Physico-chemical characteristics of the studied localities

The analysis of water samples collected in the Aukštumala Telmological Reserve showed that water was acidic – pH ranged between 3.6 and 5.3 (6.0); conductivity varied from 20 to 60 (80) µS/cm and temperature – 10.1–31.0°C (Table 2).

Taxonomic composition

In the investigated habitats of the Aukštumala Telmological Reserve, desmid algae of three families, 17 genera and 56 lower-ranked taxa (50 species

Table 2. Characteristics of the habitats investigated in the Aukštumala Telmological Reserve

Number of habitat	Geographic coordinates (N and E)	pH	Temperature, °C	Conductivity, µS/cm	Habitat type	Number of habitat	Geographic coordinates	pH	Temperature, °C	Conductivity, µS/cm	Habitat type
1.	55°23'23.9" 21°21'49.6"	3.8–5.1	10.5–25.0	40	H	9.	55°24'23.6" 21°19'36.8"	4.1–4.2	12.2–29.0	–	H
2.	55°23'23.3" 21°22'02.1"	3.6–4.9	26.0–28.0	30–50	H	9a	–	6.0	–	30	H
3.	55°23'16.3" 21°22'15.3"	4.1–4.6	26.0–27.0	40–50	PM	10.	55°24'24.6" 21°19'35.7"	3.9–4.0	26.0–28.0	50	PM
4.	55°23'13.0" 21°22'19.2"	4.2–4.7	24.0–28.0	30	PM	11.	55°24'22.9" 21°19'35.4"	4.0	25.0–29.0	40	PM
5.	55°23'12.4" 21°22'21.4"	4.6–5.3	23.0–27.0	20	PM	12.	55°22'50.0" 21°22'30.9"	3.8	25.0	–	OP
6.	55°23'11.6" 21°22'20.8"	4.5–4.8	24.5–27.0	20	PM	13.	55°23'22.5" 21°22'21.5"	4.5	29.0	–	PM
6a		4.8	–	–	F	14.	55°23'01.7" 21°22'19.8"	5.1	10.1	40	PM
7.	55°23'03.8" 21°22'27.3"	3.9–4.6	24.3–26.0	80	PM	15.	55°23'02.2" 21°22'21.2"	4.5	10.4	40	PM
8.	55°24'22.3" 21°19'35.4"	4–4.5	25.0–31.0	60	F	16.	55°23'09.5" 21°22'25.3"	4.5	16.8	30	PM
8a	55°24'23.4" 21°19'40.0"	4–4.1	25.0–31.0	–	PM						

Abbreviations: H – *Sphagnum* cover of the hollow, PM – *Sphagnum* cover of the pool margin, F – free-floating *Sphagnum* mat in the raised bog pool, OP – open peat

and six varieties), i.e. 9.4% of all recorded desmids in Lithuania, were found. In comparison with the other studied raised bogs of Lithuania, desmid species diversity in Aukštumala raised bog was relatively low. Dubičiai and Kamanos raised bogs were explored in more detail, and there respectively 181 and 172 desmid species were found (Briškaitė et al., 2008; Jakimavičiūtė, 1999; Kostkevičienė et al., 2003; Vilkaitis, 1937, 1940).

Species of the Desmidiaceae family dominated. They comprised 73% of all desmid species found (Table 3). Species of the families Mesotaeniaceae and Closteriaceae comprised 16% and 11% of all recorded species, respectively. The highest species diversity was noted in the genera *Cosmarium* – eight species (14% of all recorded species) and *Closterium* – six species (14%). The diversity of the genera *Cosmarium* and *Closterium* was high in other studies of desmids in Europe (Cvijan & Lauševič, 1991; Klemenčič et al., 2010; Šovran et al., 2013) and Lithuanian bogs (Kostkevičienė et al., 2003; Briškaitė et al., 2008). The other abundant genera were *Actinotaenium*, *Micrasterias*, *Netrium* and *Staurastrum*. Five species of each genus were identified, which accounted 9% of all recorded species. The number of species of the genera *Bambusina*, *Cylindrocystis*, *Euastrum*, *Haplotaenium*, *Spondylosium*, *Xanthidium*, *Tetmemorus* comprised 3–7% of all recorded species. The lowest species diversity was in the *Docidium*, *Hyalotheca*, *Mesotaenium* and *Spirotaenia* genera. This accounted for 2% of all species recorded.

Diversity in various habitats

The greatest diversity of desmid algae (45 species) was recorded in the samples collected on the margins of the pools (Table 4). Of these, 19 species

Table 3. Taxonomic composition of desmids in the Aukštumala Telmological Reserve

Taxa	Species number	% of total species number,
Mesotaeniaceae	**9**	**16**
Cylindrocystis	2	4
Mesotaenium	1	2
Netrium	5	9
Spirotaenia	1	2
Closteriaceae	**6**	**11**
Closterium	6	11
Desmidiaceae	**41**	**73**
Actinotaenium	5	9
Bambusina	1	2
Cosmarium	8	14
Docidium	1	2
Euastrum	4	7
Haplotaenium	2	4
Hyalotheca	1	2
Micrasterias	5	9
Spondylosium	2	4
Staurastrum	5	9
Tetmemorus	4	7
Xanthidium	3	5
Total	**56**	**100**

were peculiar to this type of habitat. Thirty five desmid species were found on *Sphagnum* cover in the wet hollows, however, only 11 species were characteristic particularly of the hollows. *Actinotaenium cruciferum*, *Closterium pronum*, *C. strigosum*, *Cosmarium contractum*, *C. phaseolus*, *Docidium undulatum*, *Euastrum ansatum*, *E. crassum*, *Haplotaenium minutum* var. *gracile*, *Netrium interruptum*, *N. oblongum*, *N. oblongum var. cylindricum*, *Staurastrum anatinum*, *S. anatinum* var. *vestitum*, *Xanthidium octocorne* and all species of the genus *Micrasterias* were found on the margins of the pools. *Actinotaenium cucurbitinum* var. *subpolymorphum*, *A. diplosporum*, *Closterium coastatum, Cosmarium bioculatum*, *C. obliquum*, *Cylindrocystis gracilis*, *Euastrum insulare*, *Mesotaenium macrosccopum*, *Staurastrum denticulatum*, *S. polymorphum* and *Xanthidium armatum* were found in the wet hollows on the samples of *Sphagnum* cover.

Other species found in all studied habitats were: *Actinotaenium cucurbita*, *Bambussina borrery*, *Closterium gracile*, *Cosmarium botrytis*, *Cylindrocystis brebissonii*, *Haploteanium minutum*, *Micrasterias truncata*, *Netrium digitus*, *Staurastrum furcatum*, *Xanthidium antilopeum* and all species of the genus *Tetmemorus* (Table 4).

Temporal variation of diversity

The analysis of desmid species diversity showed seasonal change. The highest diversity was in August (36 desmid species). In other months, the diversity of species was lower: 28 species in July and 25 species in March were registered.

In all studied seasonal period, *Closterium gracile*, *Cylindrocystis brebissonii*, *Haplotaenium minutum*, *Micrasterias truncata*, *Netrium digitus*, *Tetmemorus brebissonii*, *Xanthidium antolopeum* were present in all investigated habitats, whereas *Closterium acerosum*, *Hyalotheca dissilens*, *Tetmemorus brebissonii* var. *minor* were found only on the margins of the pools, and *Actinotaenium cucurbita* occurred only on *Sphagnum* cover in the wet hollows.

Actinotaenium diplosporum, *Cylindrocystis gracilis, Mesotaenium macrosccocum*, *Micrasterias denticulata*, *Spirotaenium condensata* and all species of the genus *Netrium*, except *N. digitus* var. *lamellosum*, occurred only in the samples collected in August.

On the margins of the pools, *Cosmarium botrytis*, *Closterium pronum*, *Euastrum crassum*, *E. ansatum, Micrasterias thomasiana*, *Xanthidium octocorne* were found only in June. *Actinotaenium cucurbita* var. *subpolymorphum and Cosmarium bioculatum* in the wet hollows of *Sphagnum* cover were present only in June.

In both habitats, *Closterium striolatum*, *Cosmarium moniliforme*, *Staurastrum furcatum* and all species of the genus *Staurastrum* were found in August, while *Actinotaenium cruciferum*, *Closterium strigosum*, *Docidium undulatum*, *Haplotaenium minutum* var. *gracilis*, *Micrasterias jenneri*, *M. rotata* were present on the margins of the pools, and *Euastrum insulare*, *Xanthidium armatum* occurred on *Sphagnum* cover in the wet hollows.

Abundance and temporal variation of dominant species

The highest average number of algae cells were registered in the samples from *Sphagnum* cover of the pool margin – 4297 cells L^{-1}. The abundance of desmids in the samples of other habitats was as follows:

Table 4. Taxonomic list of desmids, their cell measurements, habitats and relative abundance in the Aukštumala Telmological Reserve

Taxa	Measurements (length × width) of the cells, µm	Habitats and relative abundance of desmids						
		Wet hollows of *Sphagnum*			Margins of the pools			Other habitat
		Mar	June	Aug	Mar	June	Aug	
ZYGNEMATALES								
Mesotaeniaceae								
**Cylindrocystis brebissonii* Meneghini	31.9–110.0 × 14.5–38.5	**3**	**2**	**3**	**1**	**1**	**1**	**X**
Cylindrocystis gracilis I.Hirn	29 × 8.7	**1**	–	–	–	–	–	–
**Mesotaenium macroscoccum* (Kützing) Roy et Bisset	29–36 × 14.5–16.8	**1**	–	–	–	–	–	–
**Netrium digitus* (Ehrenberg) Itzigsohn et Rothe	82.5–340 × 28.8–115.0	**3**	**2**	–	**3**	**1**	**3**	**X**
Netrium digitus var. *lamellosum* (Brébisson) Grönblad	121–375 × 33–79.2	–	–	–	**1**	–	**1**	**X**
Netrium interruptum (Ralfs) Lütkemüller	185.6–287.1 × 59.4–60.0	–	–	–	**1**	–	–	–
Netrium oblongum (de Bary) Lütkemüller	139.2–170.2 × 22–33.6	–	–	–	**1**	–	–	–
Netrium oblongum var. *cylindricum* W.West et G.S.West	88–148.5 × 27.5–33	–	–	–	**1**	–	–	–
Spirotaenia condensata Brébisson ex Ralfs	159.5–185.6 × 16.5–24	**1**	–	–	**1**	–	–	–
DESMIDIALES								
Closteriaceae								
Closterium acerosum (Schrank) Ehrenberg ex Ralfs	174–517.5 × 14.5–44; I. 5.8–11; Ap. 5.5–8.7	–	**1**	–	**1**	**1**	**3**	–
Closterium costatum Ralfs	250–278 × 25–44	–	–	**1**	–	–	–	–
Closterium gracile Brébisson ex Ralfs	66–280.5 × 2.9–11.6; Ap. 2.9–5.8	**2**	**1**	**1**	**3**	**3**	**3**	**X**
Closterium pronum Brébisson	205.2–258.1 × 6.2–9.2	–	–	–	–	**1**	–	–
Closterium strigosum Brébisson	690 × 23	–	–	–	–	–	**1**	–
Closterium striolatum Ralfs	219.5–434.5 × 18.7–27.5; Ap. 8.25–11	–	–	**1**	–	–	**1**	–
Desmidiaceae								
Actinotaenium cruciferum (De Bary) Teiling	15–27.5 × 11.6–14.5	–	–	–	–	–	**1**	–
**Actinotaenium cucurbita* (Ralfs) Teiling	17.4–82.5 × 14.5–38.5; I. 14.5–28.8	**2**	**2**	**1**		**2**	**1**	**X**
Actinotaenium cucurbitinum (Bisset) Teiling	29–63.8 × 14.5–26.1	–	–	**2**	**1**	–	**1**	–
**Actinotaenium cucurbitimum* var. *subpolymorphum* (Nordstedt) Teiling	49.3–63.8 × 26.1–38.5	–	**1**	–	–	–	–	–
Actinotaenium diplosporum (Lundell) Lütkemüller	43.5–46.4 × 20.3–26	**1**	–	–	–	–	–	–
**Bambusina borreri* (Ralfs) Cleve	17.4–34.8 × 11.6–23.2	–	–	**1**	–	**2**	–	**X**
Cosmarium amoenum Ralfs	44–55.1 × 23.2–33; I. 14.3–26.1	–	**1**	–	**1**	–	–	–
Cosmarium bioculatum Brébisson	11.6–14.5 × 11.6–14.5; I. 5.8–8.7	–	**1**	–	–	–	–	–
Cosmarium botrytis Ralfs	43.5–72.5 × 31.2–40.6; I. 4.8–31.9	–	**1**	**1**	–	**2**	**2**	**X**
Cosmarium contractum Kirchner	43.2 × 24; I. 4.8–7.2	–	–	–	**2**	**1**	–	**X**
Cosmarium moniliforme Turpin ex Ralfs	47.5–52.2 × 29–31.9; I. 7.9–8.7	–	–	**1**	–	–	**1**	–
**Cosmarium obliquum* Nordstedt	22–26.1 × 14.4–20.3; I. 11.6–14.5	**1**	**1**	–	–	–	–	–
Cosmarium phaseolus Ralfs	29–31.9 × 26.1–29; I. 8.7–23.2	–	–	–	–	**1**	**1**	–

Taxa	Measurements (length × width) of the cells, µm	Habitats and relative abundance of desmids						
		Wet hollows of *Sphagnum*			Margins of the pools			Other habitat
		Mar	June	Aug	Mar	June	Aug	
Cosmarium pyramidatum Ralfs	40.6–99 × 22–61; I. 8.7–37	–	–	–	**1**	**1**	–	**X**
Docidium undulatum Bailey	286 × 22	–	–	–	–	–	**1**	–
Euastrum ansatum Ralfs	95–100 × 52.8–55; I. 26–29	–	–	–	–	**1**	–	–
Euastrum binale Ralfs	23.2–49.5 × 16.6–33; I. 5.8–22	–	**1**	–	–	–	**1**	–
Euastrum crassum (Brébisson) Kützing	125–180 × 75–90; I. 2.0	–	–	–	–	**1**	–	–
Euastrum insulare (Wittrock) J. Roy	23.2 × 14.5; I. 11.6	–	–	**2**	–	–	–	–
Haplotaenium minutum (Ralfs) Bando	81.2–137.5 × 8.7–23.2	**1**	**1**	**3**	**1**	**1**	**2**	**X**
Haplotaenium minutum var. *gracile* (Wille) Bando	110–137.5× 7.5–14.5; I. 14–19.	–	–	–	–	–	**1**	–
Hyalotheca dissilens (Smith) Brébisson	11–40.6 × 14.5–38.5	–	–	**1**	**3**	**2**	**2**	**X**
Micrasterias denticulata (Greville) Ralfs	168–205.2 × 120–192 ; I. 24–26.4	–	–	–	**1**	–	–	–
Micrasterias jenneri Ralfs	137.5–175.2 × 95–130; I. 2.0	–	–	–	–	–	**1**	–
Micrasterias rotata (Greville) Ralfs	231–264 × 165–247.5; I. 38.5–78.3; Ap. 44–55	–	–	–	–	–	**1**	–
Micrasterias thomasiana Archer	247.5 × 165	–	–	–	–	**1**	–	–
Micrasterias truncata (Corda) Brébisson	60.9–154 × 66.7–110.2; I. 16.5–33	**1**	**1**	**1**	**1**	**2**	**2**	**X**
Spondylosum planum (Wolle) W.West et G.S. West	7.9 × 11.6; I. 5,2	–	**1**	–	–	**1**	–	–
Spondylosium pulchellum Archer	9– 15 × 7.9 – 8.7; I. 5.2	–	**1**	–	–	–	**1**	–
Staurastrum anatinum Cooke et Wills	29–72.5 × 87–104.4; I. 14.5–22	–	–	–	–	–	**2**	–
Staurastrum anatinum var. *vestitum* (Ralfs) Brook	29 × 87; I. 9.0	–	–	–	–	–	**1**	–
**Staurastrum denticulatum* (Nägeli) Archer	49.5 × 27.5; I. 11.0	–	–	**1**	–	–	–	–
Staurastrum furcatum (Ralfs) Brébisson	36–47 × 43–67; length with processes 55–79; I. 12–16	–	–	**1**	–	–	**1**	**X**
Staurastrum polymorphum Ralfs	26.1 × 20.3–23.2; I. 8.7	–	–	**1**	–	–	–	–
**Tetmemorus brebissonii* (Menegini) Ralfs	60.5–231 × 11.5–34.5	**2**	**3**	**3**	**2**	**3**	**2**	**X**
Tetmemorus brebissonii var. *minor* De Bary	66 × 22	–	–	**1**	**1**	**1**	**1**	**X**
Tetmemorus granulatus Ralfs	93.5–159.5 × 16.5–29	–	**2**	**1**	–	**1**	–	**X**
Tetmemorus laevis Ralfs	71.5 –93.5; I. 16.5–22	**1**	–	**1**	–	–	**1**	**X**
Xanthidium antilopeum Kützing	55–82.5 × 43.5–63.5; cell with processes 49–241 × 69.5–159.5; I. 11–29	**2**	**3**	**3**	**2**	**3**	**3**	**X**
Xanthidium armatum Ralfs	113.4–118.8 × 66–73.9; cell with processes 116.2–132 × 79.2–87.1; I. 31.7–42	–	–	**1**	–	–	–	–
Xanthidium octocorne Ralfs	18.4 × 16.6; I. 6.7–11.6; cell with processes 29–38.9 × 33.3–34.8	–	–	–	–	**1**	–	–

Abbreviations: I. – breadth of isthmus; Ap. – breadth of apex; * – species found in 2001; X – species recorded, but abundance was not evaluated; „–“ species was not found

from *Sphagnum* cover of the hollow – 3490 cells L^{-1}, from free-floating *Sphagnum* of the pools – 2095 cells L^{-1}, from open peat – 330 cells L^{-1}.

The analysis of the abundance of desmid cells in March, June and August allowed to identify the dominant species such as *Closterium acerosum* and *C. gracile* (on the margins of the pools), *Cylindrocystis brebissonii* (on *Sphagnum* cover in the wet hollows), *Haplotaenium minutum* and *Hyalotheca dissilens* (on the margins of the pools), *Netrium digitus* (on *Sphagnum* cover in the wet hollows, on the margins of the pools), *Tetmemorus brebissonii* and *Xanthidium antilopeum* (on *Sphagnum* cover in the wet hollows, on the margins of the pools) (Table 4).

Other abundant species were found in various habitats during one or other season. In the samples collected in March on the margins of the pools, *Cosmarium contractum* was prevalent; in June and August, *C. contractum* was replaced by *Bambussina borreri*, *Cosmarium botrytis*, *Haplotaenium minutum*, *Hyalotheca disselens*, *Micrasterias truncata*, *Staurastrum anatinum* species (Table 4).

In the samples collected in March from the wet hollows of *Sphagnum* cover, *Closterium gracilis* was prevalent. In June and August, *C. gracilis* was replaced by *Cylindrocystis brebissonii*, *Netrium digitus* and *Tetmemorus granulatus*, and in August – by *Actinotaenium cucurbitinum* and *Euastrum insulare* (Table 4).

The abundance of the remaining algae cells was low – individual cells were found in different months in different habitats.

Chorology of desmids

Typical species of the acid bogs are *Closterium striolatum*, *Cylindrocystis brebissonii*, *Netrium digitus*. *Closterium striolatum* is tolerant to wide pH fluctuations: were found in samples with pH ranging from 4.0 to 7.0 (Coesel et al., 2007). *Cosmarium botrytis*, *C. phaseolus* species are characteristic of mezotrophic acidic and neutral habitats (Šovran et al., 2013).

In the Aukštumala Telmological Reserve, a large number of boreal (17 species) and of widely in the world distributed species (11 species) were found,,which is respectively 30% and 20% of all recorded desmid species. Also two artic-alpine species (*Cosmarium botrytis*, *Spondylosium planum*) and one subalpine (*Cosmarium obiquum*) were present.

Morphological variation

Dimensions of desmid species identified in many samples collected in the Aukštumala Telmological Reserve corresponded to the descriptions given in literature. However, some of the species dimensions differed. Measured dimensions are presented below.

The size of ***Cylindrocystis brebissonii*** Meneghini cells (31.9–110 × 13.8–38.5 µm) in specimens from Aukštumala raised bog were slightly bigger compared to the dimensions given by Coesel & Meesters (2007), Lind & Brook (1980), Opute (2000), Palamar-Mordvinceva (1982b) (20–90 × 10–50, maximum length 110 µm).

Cells of ***Netrium digitus*** (Ehrenberg) Itzigsohn et Rothe in Aukštumala raised bog were smaller (82.5–340 × 28.8–115 µm) compared to the specimens from the other areas (100–400 × 30–120 µm) given by Coesel & Meesters (2007), Krieger (1937), Lind & Brook (1980).

Some cells of ***Cosmarium moniliforme*** Turpin ex Ralfs from Aukštumala raised bog were wider (47.5–52.2 × 29–31.9 µm) compared to the dimensions given by Krieger & Gerloff (1969), Dillar (1991), Lind & Brook (1980), Palamar-Mordvinceva (1982b) (16–52 × 10–27 µm).

In Aukštumala raised bog, ***Cosmarium pyramidatum*** Ralfs cells of some specimens were longer and narrower (40.6–99 × 22–61 µm) compared to the species dimensions provided by Dillard (1991), Lind & Brook (1980), Palamar-Mordvinceva (1982b), Shukla et al. (2008) (37.5–59 × 28.0–70 µm).

Euastrum binale Ralfs from Aukštumala raised bog had longer cells (23.2–49.5 × 16.6–33 µm) and narrower istmus (2.2–8) compared to the species dimensions given by Lenzenweger (1996) and West (1904) (15–30 × 12.5–21 µm; istmus 3–8.5 µm).

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AUKŠTUMALOS AUKŠTAPELKĖS DVYNIEČIŲ FLORA (NEMUNO DELTA, VAKARŲ LIETUVA)

Rima Briškaitė

Santrauka

Aukštumalos telmologinio draustino dvyniečių floros tyrimai buvo atlikti 2001 ir 2007 metų kovo, birželio, rugpjūčio mėnesiais. Straipsnyje pristatomi pirminiai duomenys apie Aukštumalos aukštapelkės dvyniečių rūšių įvairovę ir jų pasiskirstymą tirtose buveinėse.

Iš viso tyrimo metu identifikuotos 56 dvyniečių rūšys iš 17 genčių, priklausančių *Mesotaneaceae*, *Closteriaceae*, *Desmidiaceae* šeimoms. Didžiausia dvyniečių rūšių įvairovė būdinga *Desmidiaceae* (41) šeimai. Daugiausia rūšių rasta *Closterium* gentyje, tai sudarė 14% visų rastų dvyniečių rūšių. Didžiausia dvyniečių rūšių įvairove pasižymėjo ežerokšnių pakraščio buveinė – 45 rūšys. Gausiausia dvyniečių rūšių buvo rasta rugpjūčio mėnesį – 36 rūšys. Tyrimo laikotarpiu visose tirtose buveinėse buvo nustatytos šios dominuojančios rūšys: *Closterium gracile*, *Cylindrocystis brebissonii*, *Haplotaenium minimum*, *Hyalotheca dissilens*, *Micrasterias truncata*, *Netrium digitus*, *Tetmemorus brebissonii*, *Xanthidium antilopeum*. Nustatytas sezoninis ir erdvinis pasiskirstymas.