The summer phytoplankton structure of some lakes located in Lithuanian protected areas

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Phytoplankton was investigated during the summer period in 13 lakes of Lithuanian protected areas in 1996–1999. The phytoplankton species composition, their productivity as well as peculiarities of distribution in deep stratified, deep and shallow lakes of Lithuanian protected areas is discussed. Altogether 314 species were identified. *Chlorophyceae* had the highest species diversity (29.0%), followed by *Bacillariophyceae* (22.3%) and *Cyanophyceae* (17.2%). About 50% of the species occurred only in a few lakes.

Phytoplankton investigations showed marked differences in its abundance (0.5–109.1 thous.cells/l) and biomass (0.1–67.7 mg/l). There were separated different dominating species in the phytoplankton community of the investigated lakes.

Key words: phytoplankton, species composition, productivity, lakes of the protected areas

INTRODUCTION

Essential changes in Lithuanian lakes, exactly like throughout the world, take place through human activities. The algae are one of the main producers of organic matter in the water bodies. The intensity of their growth determines the biological productivity and water quality of the aquatic systems. The phytoplankton species composition, trends in phytoplankton quantitative and qualitative development, patterns of algae seasonal succession in Lithuanian lakes were studied by a number of authors [1–5]. The convergence of phytoplankton structure in aquatic systems is a result of lake eutrophication and pollution processes [6].

The aim of this study was to investigate the plankton algae diversity, their productivity in lakes located in Lithuanian protected areas, where human activity is regulated by law.

MATERIALS AND METHODS

Phytoplankton was investigated in 13 lakes located in protected areas of Lithuania during the summer period in 1996–1999. Samples were collected from surface water layer (0.5 m) and through the water column (in deep, stratified lakes) in the deepest part of the lakes with a 1-liter Ruttner bottle. They were preserved with 4 ml 40% formaldehyde solution.

Phytoplankton was concentrated by a sedimentation procedure. The quantitative study was performed under LM, the algae were counted in the Fuchs-Rosenthal and Najotte chambers. The counting unit of smallest colonial algae cells (0.2–2 μm) was 50 cells, of filamentous algae 100 μm, of others algae – a cell. The biomass was determined according to alga cell volume [7].

The main limnological characteristics of the lakes studied are given in Table 1 [3, 8]. For each sampling site water temperature, water transparency (H_S) with a Secchi disc were measured. The concentration of dissolved oxygen was established as well.

RESULTS AND DISCUSSION

For the summer periods of 1996–1999, in the phytoplankton of the lakes 314 species, forms and variaties of algae belonging to 3 phyllums and 7 classes were identified. Most numerous were species of *Chlorophyceae* (29.0%), *Bacillariophyceae* (22.3%), *Cyanophyceae* (17.2%) and *Chrysophyceae* (15.0%). The total amount of species in summer phytoplankton of different lakes varied from 27 (Lake Ilgis, Žemaitija National Park) to 54 (Lake Didieji Gulbinai). About 50% of these species occurred only in a few lakes. Intensive development of few species (mainly blue-green algae) caused a taxonomic diversity decrease from mesotrophic to eutrophic lakes in summer phytoplankton.

In deep lakes phytoplankton consists mainly of chrysophytes, diatoms and green algae species. The

Table 1. **Morphological characteristics and hydrochemical data of the lakes studied**

Lakes	Water area, ha	Depth, m		H_S, m	t°C	pH	O_2, mg/l	N_{total}, mg/l	P_{total}, mg/l	Σ_{mean}, mg/l
		max	mean							
Akmena	276.5	30.2	11.2	6.5	23.0*	8.36	11.5	1.24	0.230	192.2
					7.5	7.0	4.3			
Balsys	55.0	38.8	15.2	3.2	21.5	8.20	10.8	1.38	0.117	–
					5.8	7.53	0.6			
Baluošas	427.3	33.7	10.9	5.1	24.0	8.70	9.6	1.49	0.060	301.1
					9.9	7.50	3.2			
Bedugnis	5.2	11.0	–	4.3	23.0	7.70	11.0	1.19	0.000	205.5
					7.0	6.50	1.0			
Beržoras	52.0	6.3	4.0	2.1	21.2	8.13	9.2	–	–	–
					18.0	7.30	4.3			
Didieji Gulbinai	36.7	11.8	4.2	1.15	24.0	–	16.6	2.96	0.050	402.7
					14.0		10.6			
Ilgis	95.0	10.5	4.3	2.2	22.5	7.90	9.8	2.73	0.230	326.4
					21.2	7.80	8.8			
Kalotė	51.4	1.2	–	t.b.	18.0	–	9.6	1.97	0.120	127.0
Katilnyčia	0.8	7.4	4.0	2.5	18.0	8.5	8.6	1.65	0.1	~1000
					7.0	7.0	0.0			
Kirkilai	4.0	7.0	2.0	1.9	21.0	6.90	7.5	1.10	0.070	~1000
					9.0	7.21	0.3			
Lynežeris	18.5	2.0	–	0.4	25.0		12.0	–	–	–
					23.0	8.60	10.3			
Plazis	3.5	1.0	–	t.b.	18.2	–	12	–	–	–
Vištytis	1786.9	50.1	16.0	4.0	17.0	8.22	9.6	1.56	0.025	219.3
					11.0	7.97	9.6			

* Determinator – surface water layer, numenator – water layer near the bottom; – no data; t.b. – till bottom sediments.

Table 2. **Total abundance (thous.cells/l) and biomass (mg/l) of summer phytoplankton in the surface water layer of some Lithuanian lakes (1996–1999)**

Lakes	Thous. cells/l	mg/l	Lakes	thous. cells/l	mg/l
Akmena	551.2	0.1155	Ilgis	4046.8	1.3989
Balsys	4775.2	2.4120	Katilnyčia	2324.8	3.1783
Baluošas	1412.5	0.6049	Kirkilai	1833.9	1.8151
Bedugnis	14216.5	5.7762	Lynežeris	109116.3	8.3280
Beržoras	21142.6	1.1406	Plazis	5485.0	67.0889
Didieji Gulbinai	5953.1	4.2216	Vištytis	1327.5	67.7521

blue-green algae species diversity was highest in shallow lakes. Phytoplankton in karst region lakes was found to contain the greatest species diversity of cryptophytes and euglenophytes.

Total phytoplankton abundance in the surface layer of the investigated lakes varied from 0.5 to 109.1 mln.cells l^{-1} and the biomass from 0.1 to 67.7 mg l^{-1} (Table 2). Nearly 30 species can be considered as dominating, composing from 10 to 80% of the total phytoplankton abundance and biomass.

In the deep, stratified lakes (Akmena, Balsys) chrysophytes (*Kephyrion, Dinobryon*) and diatoms (*Cyclotella, Fragilaria*) contributed about 80% of abundance and biomass. In Lake Baluošas dinoflagellates reached to 40% of total biomass (Table 3; Figure).

The total abundance and biomass in middle deep lakes (Gulbinai, Bedugnis) was formed by an intensive growth of green (*Coenocystis planctonica*), blue-green (*Limnothrix, Planktothrix)* algae, diatoms (*Aulacoseira*) and chrysophytes species (Table 2; Figure).

The highest biomass of summer phytoplankton in shallow lakes (Ilgis, Kalotė, Lynežeris) and in the littoral zone of Lake Vištytis was caused by an intensive growth of blue-green algae. The role of diatoms and chrysophytes in total phytoplankton abundance and biomass was significally lower there (Table 2, Table 3, Figure).

The peculiarities of abiotic characteristics provide specific environmental conditions for the development of plankton algae communities in Lithuanian karst region lakes. Chrysophytes (*Psedokephyrion, Syncrypta*), cryptophytes (*Cryptomonas*) and dia-

Table 3. **Summer phytoplankton dominating species abundance (%) and biomass (%) in the surface water layer of some Lithuanian lakes (1996–1999)**

Lakes	Dominating species
Akmena	*Kephyrion mastigochorum* Schmidt (36.8/21.8%)*; *Cyclotella distiguenda* Hustedt (25.0/14.3%); *Dinobryon divergens* Imhoff (23.0/7.1%); *Fragilaria crotonensis* Kitton (15.1/21.0%); *Synedra acus* Kützing et var. (17.2/20.8%); *Sphaerocystis planctonica* (Korš.) Bourrelly (4.7/11.8%)
Balsys	*Dinobryon sociale* Ehrenberg (45.1/56.2%); *Cyclotella glomerata* Bachmann (34.6/17.6%); *C. quadrijuncta* (Schöter) von Keissler (6.7/4.7%)
Baluošas	*Cyclotella comensis* Grunow in Van Heurch (47.4/28.1%); C. *distiguenda* Hustedt (20.1/4.5%); *Peridinium pygmaeum* (Lindem.) Bourrelly (0.7/35.7%)
Bedugnis	*Coenocystis planctonica* Korš. (53.9/11.96%); *Dinobryon divergens* (13.7/7.6%); *Ceratium hirundinella* (F. B. Müller) Dujardin (0.2/52.7%)
Beržoras	*Snowella septentrionalis* Komárek et Hindák (20.4/2.3%); *S. lacustris* (Chodat) Komárek et Hindák (13.3/1.48%); *Coelosphaerium minutissimum* Lemmerm. (17.7/0.8%); *Aulacoseira italica* (Ehrenberg) Simonsen (1.8/28.6%)
Didieji Gulbinai	*Limnothrix planctonica* (Voloszynska) Komárek (23.6/7.4%); *Planktothrix agardhii* (Gomont) Anagn, et Komárek (21.7/4.1%); *Aulacoseira italica* (6.3/30.2%); *Stephanodiscus hantzschii* Grunow (2.5/20.4%)
Ilgis	*Snowella lacustris* (34.7/0.6%); *Aulacoseira granulata* (Ehrenberg) Simonsen (13.9/40.2%); *Fragilaria crotonensis* (17.4/31.8%)
Kalotė	Snowella lacustris (72.5/30.9%); *Gloeotrichia natans* (Hedwig) Rabenhorst (0.1/30.9%); *Actinocyclus normanii* (Gregory) Hustedt (1.8/19.4%)
Katilnyčia	*Synedra acus* var. *radians* (Kütz.) Hustedt (38.5/6.8%); *Cryptomona*s sp. Ehrenberg (13.1/10.1%); *Peridinium aciculipherum* Lemmerm. (3.1/31.4%)
Kirkilai	*Pseudokephyrion pseudospirale* Bourrelly (66.2/17.9%); *Cryptomonas ovata* Ehrenberg (5.8/22.5%); *Syncrypta pallida* (Korš.) Bourrelly (14.7/7.5%)
Lynežeris	*Microcystis aeruginosa* (Kütz.) Kütz. (55.3/47.1%); *M. wesenbergii* (Komárek) Komárek (11.6/12.0%); *M. flos-aquae* (Wittrock) Kirchner (10.7/8.4%)
Plazis	*Sphaerocystis planctonica* (Korš.) Bourrelly (71.4/15.3%) *Volvox aureus* Ehrenberg (8.2/80.5%)
Vištytis	*Rivularia* sp. (Roth) C. Agardh (25.1/98.4%); *Asterionella formosa* Hass. (32.1/0.4%); *Cyanodyction* sp. Pascher (13.4/0.1%)

* Abundance/biomass.

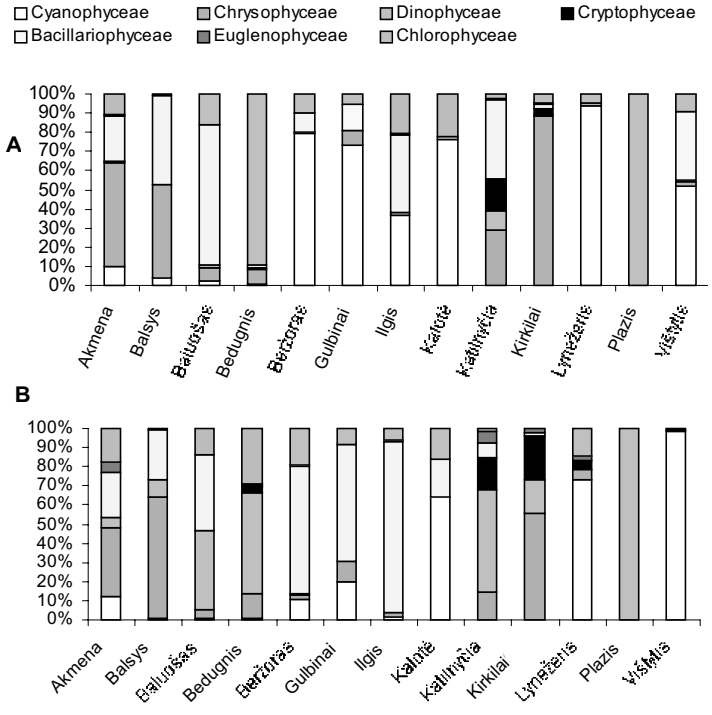

Figure. Relative abundance (A) and biomass (B) of different summer phytoplankton systematic groups in the surface water layer of some Lithuanian lakes (1996–1999)

toms (*Synedra*) were most important in summer phytoplankton there (Table 3, Figure).

Generally, it was very difficult to distinguish the role of different factors influencing the summer succession of phytoplankton in the study lakes. According to our data, the main factor influencing the algae species composition and productivity was the morphological peculiarities of the water bodies.

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KAI KURIŲ SAUGOTINŲ LIETUVOS TERITORIJŲ EŽERŲ VASARINIS FITOPLANKTONAS

S a n t r a u k a

1996–1999 m. buvo atlikti vasarinio fitoplanktono tyrimai 13 Lietuvos nacionalinių, regioninių parkų ir draustinių ežerų. Paviršiniame vandens sluoksnyje rasta 314 rūšių ir vidurūšinių taksonų, kurie priskiriami 3 skyriams ir 7 klasėms. Atskirų ežerų planktone identifikuota nuo 27 (Ilgio ež., Žemaitijos nac. parkas) iki 54 (Didžiųjų Gulbinų ež.) rūšių. Apie 50% identifikuotų rūšių sutinkama tik keliuose ežeruose. Termiškai giliuose ežeruose dumblių rūšių spektrą sudaro auksadumblainiai, titnagdumblainiai ir žaliadumblainiai. Kituose – melsvadumblainiai, titnagdumblainiai ir žaliadumblainiai. Karstinio regiono ežeruose nustatyta didžiausia kriptofitainių, šarvadumblainių ir euglendumblainių rūšių įvairovė. Tirtų ežerų fitoplanktono gausumo ir biomasės rodikliai gerokai skyrėsi ir sudarė atitinkamai nuo 0,5 iki 109,1 mln. ląst./l ir 0,1–67,7 mg/l. Ežeruose išskirti skirtingi vyraujančių rūšių kompleksai. Gilių ežerų paviršiniame vandens sluoksnyje pagal gausumo ir biomasės rodiklius produktyviausi auksadumblainiai it titnagdumblainiai, Kituose padidėja melsvadumblainių vaidmuo. Bedugnio ir Plazio ežerų planktone vyrauja žaliadumblainiai, karstinio regiono vandens telkiniuose intensyviai vystosi heterotrofiniai organizmai – auksadumblainiai, kriptofitainiai, šarvadumblainiai.