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PHYTOPLANKTON COMMUNITIES OF THE LAKE BIAŁE (ŁĘCZNA-WŁODAWA LAKELAND)

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Summary. Studied lake is situated in the eastern – one of the least transformed – part of the Łęczna--Włodawa Lakeland. In summer, the reservoir is subjected to strong anthropopressure associated with intensive recreation and tourism. Its morphometric features make it is resistant to degradation. Differences in phytoplankton communities structure in two subsequent vegetation periods, mainly blue-green algae population increase, may indicate the beginning of the lake trophy status change (eutrophication stage beginning). A massive appearance of *Planktothrix rubescens* (DeCandolle ex Gomont) Anagnostidis et Komárek – potentially toxic filamentous blue-green alga never recorded earlier – in spring 2008 is an alarming phenomenon that proves the change of the reservoir water quality.

Key words: phytoplankton, lakes, *Planktothrix rubescens,* eutrophication

INTRODUCTION

In summer, the Lake Białe is subjected to heavy anthropopressure due to intensive recreational and tourist activity.

On the basis of biological indicators (chlorophyll *a* and Ecological Status Macrophyte Index – ESMI) as well as physicochemical properties determined by WIOŚ, the lake is classified in the 1st class of ecological water status, which was also confirmed by the preliminary classification made in 2008 according to a new way for surface water quality evaluation.

According to those new rules of ecological waters assessment, phytoplankton is an important factor in evaluating the ecological status of aqueous reservoirs. Qualitative, and especially quantitative changes in phytoplankton structure are an example of rapid adaptation of the organisms to variable habitat conditions, and at the same time, the algae may affect those conditions themselves.

The aim of the present work was to determine the qualitative and quantitative structure of phytoplankton communities as one of the biological indicators of water ecological status assessment.

MATERIAL AND METHODS

The Lake Białe is located in the eastern – one of the least transformed – part of the Łęczna-Włodawa Lakeland. It is a deep, dimyctic mesotrophic reservoir with high natural and recreational features [Harasimiuk *et al*. 1998]. Its morphometric traits (33.6 m depth, 14 988 thousand m^3 capacity, 106.4 ha surface area) make it very resistant to degradation.

Phycological and physicochemical studies of water taking into account the season changes within phytoplankton were carried out from July 2007 till October 2008. Water samples were collected in north-eastern part of the reservoir that is intensively used for recreation.

Non-concentrated samples for qualitative determinations were collected using a plankton net, while microscopic analyses were performed using live and conserved material.

For quantitative evaluations, water samples were collected from particular depths and algae were counted in sedimentation chambers of reversed microscope [Utermöhl 1958]. Chlorophyll *a* concentration determinations were made by means of the Nusch method [1980].

At the same time, general analysis of water physicochemical properties were carried out *in situ* – temperature, electrolytic conductivity, and acidity.

RESULTS

The characterisation of physicochemical parameters of studied reservoir water is presented in Table 1. Water acidity and electrolytic conductivity on all dates remained at similar levels. Whereas, a decrease in visibility was recorded in 2008.

Table 1. Physicochemical parameters and chlorophyll *a* concentration in Białe Lake in 2007–2008

Parameters	2007		2008		
	summer	autumn	spring	summer	autumn
Acidity, pH	7.69	7.91	7.46	7.82	7.82
Electrolytic conductivity, μS cm^{-1}	163.0	163.0	185.0	169.0	176.4
Temperature, °C	26.5	16.0	9.5	25.7	10.6
Visibility, m	2.5	4.5	1.2	2.3	1.6
Chlorophyll *a* concentration, μg dm^{-3}	7.33	16.13	10.2	8.43	7.7

In total, 58 procaryotic and eucaryotic algae species from 7 systematic groups were identified. Algae of *Chlorophyta* – 24 taxons (making up 42% total taxon number) and *Cyanoprokaryota* – 15 taxons (26%) dominated. Among *Bacillariophyceae*, 10 taxons were found (17%). Among *Euglenophyta* and *Dinophyta*, 3 taxons were present (5%), 2 taxons from *Cryptophyta* and a single species from *Chrysophyceae* group. The taxonomic structure of algae communities on the particular study dates was similar – *Chlorophyta* and *Cyanoprokaryota* were the most numerous; only in a spring sample the largest group of algae found belonged to *Bacillariophyceae* (Fig. 1).

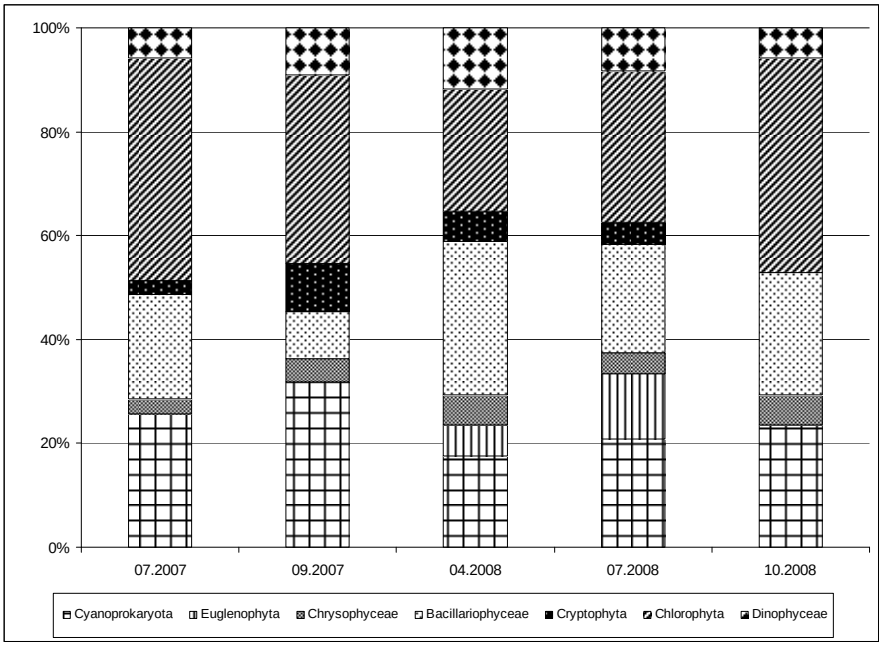

Fig. 1. The share of the specific groups of algae in phytoplankton of Białe Lake in 2007–2008

The algae population in subsequent months oscillated within quite a wide range, from 350 ind. cm^{-3} to 38 200 ind. cm^{-3} (Fig. 2). The highest total population number was recorded in summer 2007 and spring 2008. The high number in 2007 was determined by green algae from *Chlorococcales* order – mainly *Dictiosphaerium pulchellum* Wood and chroococal blue-green algae – mainly *Chroococcus limneticus* Lemm. and *Snowella lacustris* (Chod.) Kom. et Hindák. The high population of the spring sample was affected by massive appearance of filamentous blue-green algae *Planktothrix rubescens* (DeCandolle ex Gomont) Anagnostidis et Komárek, the quantitative share of which amounted to 18 700 ind. cm^{-3}, making up 56% of total phytoplankton population. That blue-green algae species dominated also in autumn, making up to 95% of total phytoplankton number.

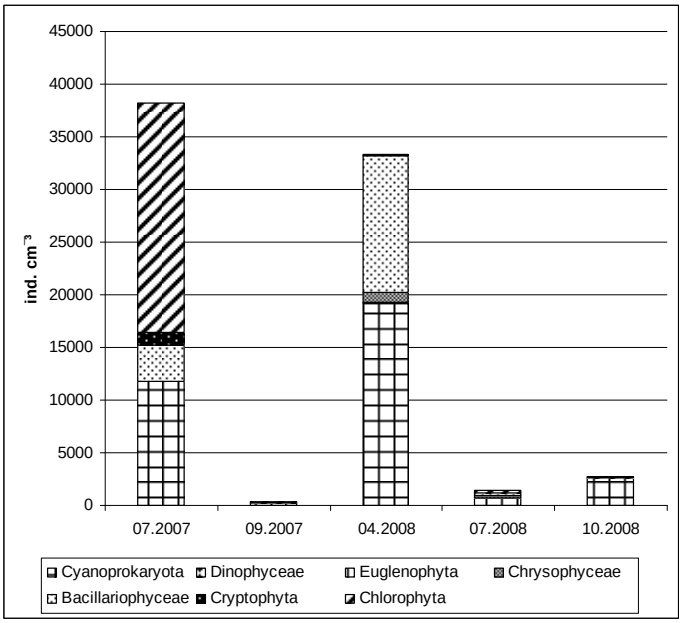

Fig. 2. Abundance of phytoplankton in the Białe Lake in 2007–2008

The chlorophyll *a* concentration – on most of the sampling dates – ranged from 7.33 to 10.6 μg dm^{-3} chl *a*; its concentration increase to 16.13 μg dm^{-3} chl *a* (Tab. 1) was recorded only in autumn 2007, which could result from a strong tourist pressure in the summer.

DISCUSSION

The phytoplankton composition was quite stable throughout the studied period and the number of determined taxons and their qualitative changes through the seasons were characteristic for that type of deep mesotrophic lakes. Considering the phytoplankton quantitative structure, *Cyanoprokaryota* dominated for a majority of the seasons, while chroococal blue-green algae were dominant in summer and filamentous forms of *Planktothrix rubescens* in spring and autumn. A massive appearance of that latter species occurred in spring 2008, and it was also the main component of phytoplankton in autumn 2008. It is characteristic for that blue-green alga – its massive appearance within the bulk of a reservoir water making „water blooming" is usually reported during the spring and autumn circulations [Lampert and Sommer 2001, Czernaś and Krupa 2003, Legnani *et al*. 2005], while during the summer stagnation, it can be found mainly in the metalimnion. It is a species that occurs in deep lakes at early eutrophication stages, at low concentrations of total phosphorus [Lampert and Sommer 2001,

Legnani *et al*. 2005]. Such a change in quantitative structure may be an indicator of the lake trophy status changing, or it may be a short-term one, resulting from habitat conditions changes [Czernaś and Krupa 2003] due to great tourist pressure in that case. Also the increase of chlorophyll *a* concentration in autumn 2007 to 16.13 μg dm^{-3} chl *a* may indicate the beginning of eutrophication [Wetzel 1983], or short-term disturbances due to strong anthropogenic pressure. Lower chlorophyll *a* concentration in summer might be associated with water layers characteristic for deep lakes when many species migrate to the metalimnion [Wojciechowska and Solis 2009].

Lower visibility is a consequence of changes in phytoplankton qualitative structure. It results from a study made by WIOŚ that visibility decreased from 5 m in 2007 to 3.8 m in 2008. According to our own studies, the lowest visibility was recorded in spring and autumn 2008 at a great quantitative share of *Planktothrix rubescens*. Those short-term disturbances, making water quality worse, may disappear after their cause elimination with no principal changes in lake ecosystem functioning [Krupa and Czernaś 2003].

CONCLUSIONS

1. Determinations of selected physicochemical parameters classify the studied lake as mesotrophic, while its waters are considered to be of the 1st purity class.

2. The quantitative structure changes, mainly great share of *Planktothrix rubescens,* may indicate the beginning of the lake trophy status changing to eutrophication.

3. The changes may be short-term, and not changing the habitat conditions after the elimination of their cause.

4. In the case of Lake Białe, knowledge on the phytoplankton communities structure seems to be necessary to evaluate the ecological status of the lake, direction and rate of changes, as well as to undertake possible activity to inhibit the eutrophication.

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ZBIOROWISKA FITOPLANKTONU JEZIORA BIAŁEGO (POJEZIERZE ŁĘCZYŃSKO-WŁODAWSKIE)

Streszczenie. Badane jezioro położone jest we wschodniej, jednej z mniej przekształconych części Pojezierza Łęczyńsko-Włodawskiego. W okresie letnim zbiornik ten podlega silnej antropopresji związanej z intensywnym wykorzystywaniem rekreacyjnym i turystycznym. Jego cechy morfometryczne powodują, że wykazuje ono dużą odporność na degradację. Różnice w strukturze zbiorowisk fitoplanktonu w dwóch kolejnych okresach wegetacyjnych, głównie wzrost udziału ilościowego sinic, mogą wskazywać na początek zmian statusu troficznego jeziora (początkowa faza eutrofii). Niepokojącym zjawiskiem świadczącym o zmianie jakości wód zbiornika jest zaobserwowany w sezonie wiosennym 2008 r. masowy pojaw *Planktothrix rubescens* (DeCandolle ex Gomont) Anagnostidis et Komárek, nienotowanej wcześniej potencjalnie toksycznej sinicy nitkowatej.

Słowa kluczowe: fitoplankton, jeziora, *Planktothrix rubescens,* eutrofizacja