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PHYTOPLANKTON COMMUNITY STRUCTURE IN SMALL WATER BODIES ON THE CYBINKA RIVER

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ABSTRACT. The study was undertaken to characterise the groups of phytoplankton in four lakes (Ósemka, Uli, Cyganek and Baba) supplied by the Cybinka River (a right tributary of the Cybina River). Lakes Ósemka and Uli were classified as mezo-eutrophic, while lakes Cyganek and Baba as eutrophic. The phytoplankton of these lakes was composed of 76 taxa. The greatest contribution in the number of taxa was brought by chlorophytes. In the other lakes down the course of the river the abundance and biomass of the phytoplankton were greater and the contribution of particular taxonomic groups changed. In Lake Ósemka the most abundant were the representatives of cryptophytes (38%) chrysophytes (35%) and chlorophytes (19%). In Lake Uli the dominant contribution was brought by cryptophytes (90%). In Lakes Cyganek and Baba the dominant group was cyanobacteria whose contribution was 51% in Lake Cyganek and 90% in Lake Baba.

KEY WORDS: phytoplankton abundance and biomass, Cybinka River

INTRODUCTION

The Cybinka River joins the Cybina River, which is the right tributary of the Warta River. Cybinka is a right tributary of Cybina River, its length is close to 17 km and its catchment area takes 35.44 km^2. The river takes its source near the village Imielenko. The majority of its run (almost 13.5 km) runs through the forests and only a section of about 3.5 km in the lower course runs through arable land with some forest patches. In the middle course it flows through five small inforest lakes: Ósemka (1.5 ha), Uli (6.4 ha), Cyganek (1.7 ha), Baba (2.2 ha) and Okrąglak (1.0 ha) (Fig. 1). These are typical small ponds of banks covered with dense vegetation, hardly accessible table and used by anglers. Their depth does not exceed 6.5 m (Gołdyn and Grabia 1998).

Floral composition and abundance of phytoplankton of small lakes were examined. The main aim of the study was to analyse the qualitative and quantitative differences in the phytoplankton of these four lakes (Ósemka, Uli, Cyganek and Baba).

MATERIAL AND METHODS

The study on the phytoplankton community structure has been performed in four lakes situated on the Cybinka River in western Poland: Ósemka, Uli, Cyganek and Baba (Fig. 1). Samples were collected in May 2007 from the deepest sites of the lakes. The samples were preserved immediately at the site with Lugol's solution, modified according to Utermöhl. The abundance of phytoplankton was estimated by using a Sedgwick--Rafter chamber.

Apart from the phytoplankton also the physico--chemical parameters of the lakes were determined along the vertical profiles. The measurements were made directly in the lake profiles by an instrument WTW Multi 350. The parameters measured included temperature, water dissolved oxygen, pH and electrolytic conductivity. The clarity of water was estimated by measuring the depth of Secchi disk visibility. In the samples of water collected from vertical profiles the concentrations of nitrogen (ammonium, nitrate and nitrite), phosphorus (soluble reactive phosphorus and total phosphorus), chlorophyll a and seston dry mass were measured. All analyses were made according to the Polish Norms (Siepak 1992, Elbanowska et al. 1999). The trophy of the lakes was classified on the basis of the criteria proposed by Carlson (1977).

RESULTS AND DISCUSSION

The highest concentration of chlorophyll a was found in Lake Baba at the depth of 4 m it reached 40.8 μg·dm^{-3}. A bit lower of 33.9 μg·dm^{-3} was its concentration in Lake Uli at the depth of 5 meters. In this lake the concentration of chlorophyll a increased with increasing depth: at the surface it was 2.5 μg·dm^{-3} and at the bottom as high as 31.0 μg·dm^{-3}. A similar distribution of the chlorophyll a concentration was noted in Lake Baba. High chlorophyll a and low oxygen concentrations in overlaying water might have resulted from numerous

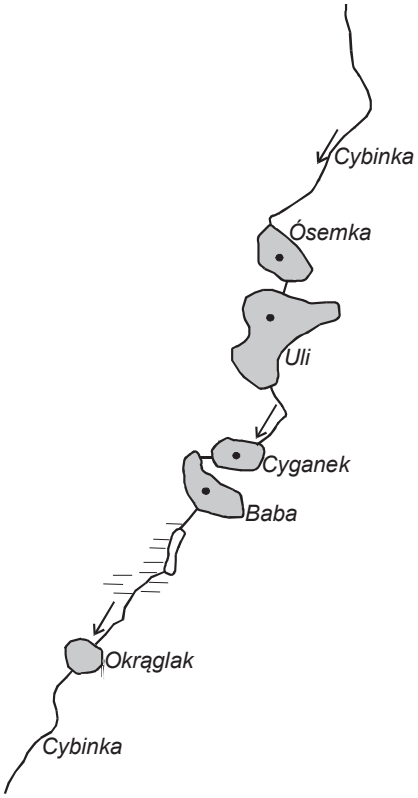

Fig. 1. Location of the studied water bodies on the Cybinka River

photoautotrophic purple bacteria development. These microorganisms contain bacteriochlorophyll a, which is also detected in the used method of chlorophyll a extraction. Analysis of the mean values over the profiles of different lakes, it was found that the lowest mean chlorophyll a concentration was in Lake Ósemka (1.15 μg·dm^{-3}), a little higher in Lake Uli 10 μg·dm^{-3}, in Lake Cyganek 8.4 μg·dm^{-3} and in Lake Baba the mean chlorophyll a concentration was the highest – of 19.2 μg·dm^{-3}. A comparison of the chlorophyll a concentration from the surface layer of the lakes to theirs bottom has shown that it increased in subsequent lakes along the course of Cybinka: 1.1 μg·dm^{-3} Lake Ósemka, 10.0 μg·dm^{-3} Lake Uli, 8.4 μg·dm^{-3} Lake Cyganek and 19.2 μg·dm^{-3} Lake Baba (Fig. 2).

A similar character of changes in the seston dry mass concentration was found, it changed from 2.2 mg·dm^{-3} in Lake Ósemka to 8.4 mg·dm^{-3} in Lake Baba). The mean values of electrolytic conductivity decreased in the subsequent lakes in the course of the river from 620 μS·cm^{-1} in Lake Ósemka to 294 μS·cm^{-1} in Lake Baba. The reverse tendency was noted as to the concentration of ammonium nitrogen (0.92 mgN·dm^{-3} in Lake Ósemka to 1.93 mgN·dm^{-3} in Lake Baba) and nitrate nitrogen (from 0.22 mgN·dm^{-3} to 0.49 mgN·dm^{-3}). The mean concentration of total phosphorus was the lowest in Lake Ósemka (0.04 mgP·dm^{-3}), the highest in Lake Uli (0.08 mgP·dm^{-3}), and in the other lakes its values were smaller. The mean concentrations of the water-soluble phosphates in Lakes Ósemka, Cyganek and Baba were similar and close to 0.03 mgP·dm^{-3}, and in Lake Uli their mean concentration was the lowest – of 0.005 mgP·dm^{-3}. The pH values determined in the surface layers were 7.75 in Lake Ósemka, 7.14 in Lake Uli, 8.23 in Lake Cyganek and 8.48 in Lake Baba.

The above physico-chemical parameters of the lake water reflected the changes in the phytoplankton density in the lakes studied. The subsequent lakes along the course of the Cybinka River were characterised by the trophy increasing from mezo-eutrophy to eutrophy. Seventy six phytoplankton taxa were identified in the studied lakes. The density of phytoplankton increased in the subsequent lakes along the Cybinka River course. The maximum concentration of organisms was noted in Lake Baba and it reached 17.0·10^3 ind.·cm^{-3} and 12.2 μg·cm^{-3}. The phytoplankton concentration was the lowest of 1.3·10^3 ind.·cm^{-3} and 1.1 μg·cm^{-3} in the last analysed lake on the river – Lake Ósemka (Fig. 3).

The most abundant group in the phytoplankton in Lakes Baba and Cyganek (the first two analysed lakes on Cybinka River) was cyanobacteria. The most numerous species of cyanobacteria was especially *Limnothrix redeckei* (Van Goor) Meffert (11.2·10^3 ind.·ml^{-1} in Baba Lake) but also *Pseudanabaena limnetica* after Lemmermann from Geitler (3.6·10^3 ind.·cm^{-3} in Baba Lake) and *Pseudanabaena acicularis* (Nygaard) Anagnostidis et Komarek (1.5·10^3 ind.·cm^{-3} in Cyganek Lake). *Limnothrix redeckei* is very common and reported as an expanding species (Nõges et al. 2003). There are many examples that the dominance of single solitary filamentous cyanobacteria characterised steady state conditions in lakes e.g.: *Planktothrix agardhii* in lake Langer See, *Limnothrix amphigranulata* in lake Melangsee and *Pseudanabaena limnetica* in the dimictic lake Scharmützelsee (Nixdorf et al. 2003). In Lake Baba some heterocytous cyanobacteria *Anabaenopsis elenkinii* V.V. Miller commonly found in tropical, subtropical, and temperate water bodies (Ballot et al. 2008) were also noted.

In Lake Ósemka the phytoplankton composed was represented especially by species from two groups

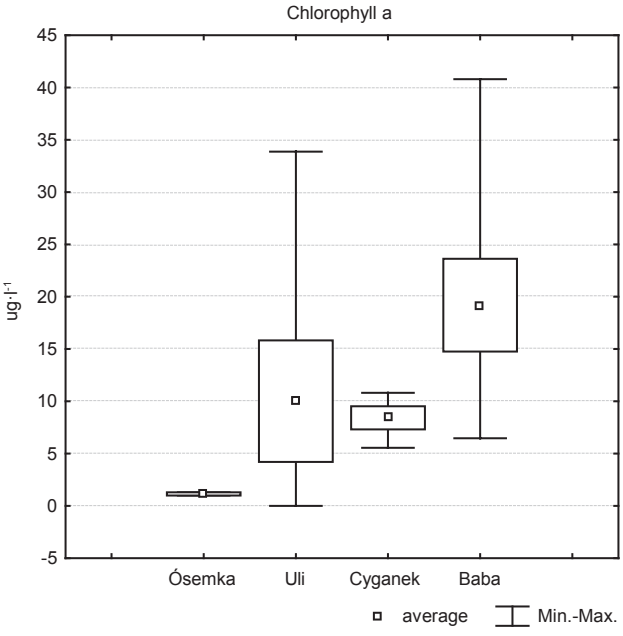

Fig. 2. Chlorophyll a concentrations in the water of analysed lakes (μg·dm^{-3}) along the course of the Cybinka River

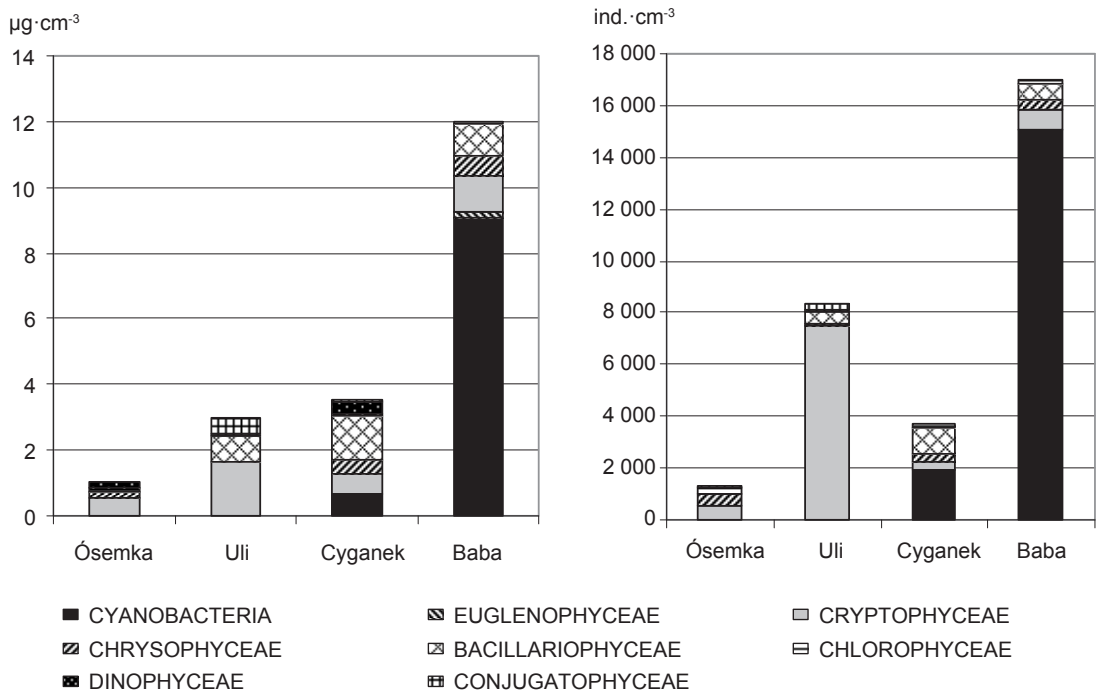

Fig. 3. Changes in the biomass, abundance and contribution of particular taxonomic groups in the phytoplankton of the investigated lakes

Cryptophyceae (38%) and Chrysophyceae (35%). The most abundant species were: *Cryptomonas marssonii* Skuja, *Rhodomonas lacustris* Pascher et Ruttner, *Dinobryon bavaricum* Imhof, *Kephyrion rubri-claustri* Conrad and *Erkenia subaequiciliata* Skuja. In this lake the greatest contribution of Chrysophyceae of 19% was found. The most abundantly represented species were: *Scenedesmus communis* Hegewald, *Monoraphidium minutum* (Nag.) Kom.-Legn, and *Tetraëdron minimum* (A. Braun) Hansgirg.

Cryptophytes were also dominant in Lake Uli and reached 90% of the phytoplankton abundance (Fig. 3). The most abundant species was *Rhodomonas lacustris* reaching $7.4 \cdot 10^3$ ind.·cm^{-3}.This species is often noted in most lake types especially in colder seasons (Dokuli and Skolaut 1986, Danilov and Ekelund 2001). However, it becomes less frequent in the phytoplankton community as the pH decreases below 5.5, and disappears completely in the lakes with a pH below 5.0 (Brettum and Halvorsen 2004).

Also diatoms were quite abundant in the lakes analysed. The Bacillariophyceae contribution was from 2% in the abundance and 4% in biomass in Lake Ósemka to 28% in abundance and 39% in biomass of the phytoplankton in Lake Cyganek (Fig. 3). Centric diatoms such as *Cyclotella* and *Stephanodiscus* and Pennate *Nitzschia* were the most often noted genera.

All of the analysed lakes were characterised by an afforested catchment, so that was not a factor influencing the different structure of phytoplankton community in the last two lakes situated on Cybinka River. The quantitative and qualitative composition of phytoplankton in the reservoirs could have been affected by the intensive exploitation of anglers. According to Szyper (Szyper et al. 1994), hudge loads of nitrogen and phosphorus can be attributed to anglers (7.8 kg of nitrogen and 1.44 kg of phosphorus per year, per one angler). Some watering places located there could have lover influence.

Concluding, the analysis of phytoplankton conducted in lakes situated on Cybinka River showed an increase in total phytoplankton abundance and biomass (Fig. 3). The physico-chemical parameters of the lakes were presenting the increasing of the trophy: from mezo-eutrophy in the first two lakes to the eutrophy in the third and fourth analysed lakes. The most important groups in first two lakes (Ósemka and Uli) were cryptophytes, chrysophytes and diatoms. In successive lakes (Cyganek and Baba) the most abundant were cyanobacteria reaching $1.5 \cdot 10^4$ ind.·cm^{-3} in Baba Lake.

Acknowledgments

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