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PHYTOPLANKTON COMMUNITY STRUCTURE IN A DAM RESERVOIR IN POZNAŃ

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Summary. Taxonomic composition, abundance and biomass of phytoplankton of the Maltański Reservoir were studied in 2005. Significant changes, seasonal and vertical, in the quality and quantity of phytoplankton were noted within the year of the study. There were 184 phytoplankton taxa identified and enumerated in the reservoir. They belonged to nine phytoplankton classes. The majority of the taxa belonged to the Chlorophyceae (46% of all taxa identified there), Bacillariophyceae (14%), Chrysophyceae (10%) and Cyanoprokaryota (9%). The contribution of other phytoplankton classes was smaller.

Key words: phytoplankton, abundance, biomass, seasonal variation, dam reservoir

INTRODUCTION

This paper reports results of a study of the phytoplankton structure and dynamics in the Maltański Reservoir, performed in the year 2005. The abundance and biomass of the phytoplankton were determined a number of times within this period. The main aim of the study was analysis of the qualitative and quantitative changes in the phytoplankton taking place within the year. The phytoplankton was dominated by Chrysophyceae and/ or Cryptophyceae in spring, and by Cyanobacteria in summer. Diatoms dominated in autumn, also with a lower contribution of cyanobacteria and green algae.

STUDY AREA, MATERIALS AND METHODS

The Maltański Reservoir is situated in Poznań (mid-western Poland). It accumulates water of the lower course of the Cybina River (right tributary of the Warta River). The catchment area of the Cybina River represents a typical agricultural region with domination of farm fields. The Maltański Reservoir covers an area of 64 ha with a mean depth of 3.1 m (Tab. 1). It is used for recreation and water sports. Within the reservoir the whole water column is well mixed by western winds [Joniak *et al*. 2000]. Taking advantage of the fact, samples were collected from one site in the middle of the reservoir and assumed to be representative for the water in the whole reservoir.

Table 1. Morphometric and hydrological data of the Maltański Reservoir
[acc. to Joniak *et al*. 2003, Gołdyn *et al*. 1994]
Tabela 1. Morfometryczne i hydrologiczne dane Zbiornika Maltańskiego
[za Joniak *i in*. 2003, Gołdyn *i in*. 1994]

Main characteristic of the Maltański Reservoir	
Area – Powierzchnia (ha)	64
Volume – Objętość (m^3)	2×10^6
Maximum depth – Głębokość maksymalna (m)	5
Mean depth – Głębokość średnia (m)	3.1
Mean residence time (days) – Średni okres wymiany wody (doby)	34

Samples for analyses were collected in 2005 between April and October, at two-week intervals. Each time the material was collected using a 5 dm^3 sampler, from the surface, at the depth of one, two and three meters. Samples of phytoplankton were not subjected to pre-concentration and were fixed with Lugol solution in Utermöhl modification. In analysing the abundance of the phytoplankton the Sedgwick-Rafter chamber was used, of 0.67 cm^3 in capacity, employing magnification of 400×. Biomass was calculated by approximating the shape of the organisms with geometric figures [Wetzel and Likens 1991].

RESULTS AND DISCUSSION

Phytoplankton of the Maltański Reservoir exhibited great diversity, both in respect to the number of taxa and phytoplankton abundance. Among the 184 taxa of identified phytoplankton the dominant were Chlorophyceae (85 taxa), Bacillariophyceae (26), Cyanobacteria (16) and Chrysophyceae (19, Tab. 2). Other classes: Euglenophyceae, Bacillariophyceae, Xantophyceae, Cryptophyceae and Conjugatophyceae brought smaller contributions to the phycoflora (2-8%). Earlier research on phytoplankton had shown the qualitative dominance of green algae in the phycoflora of the Maltański Reservoir in the period of 1993-1996 [Kozak 2005].

Table 2. Floristic composition of plankton given in the numbers of taxa recorded in the Maltański Reservoir
Tabela. 2. Skład gatunkowy fitoplanktonu wyrażony liczbą taksonów stwierdzonych w Zbiorniku Maltańskim

Class – Klasa	Number of taxa – Numer taksonu
Cyanobacteria	16
Euglenophyceae	9
Cryptophyceae	14
Chrysophyceae	19
Bacillariophyceae	26
Chlorophyceae	85
Dinophyceae	3
Xantophyceae	4
Conjugatophyceae	8
Summ – Suma	184

The abundance of phytoplankton in the seston of the Maltański Reservoir changed in a dynamic way over the period investigated. Also the vertical distribution of phytoplankton was determined (Fig. 1). The maximum concentration of organisms was noted in April

and reached 37.9 10^3 indiv. cm^{-3}, at a depth of 3 m (Fig. 1a). The second peak was observed in July, at 34.5 10^3 indiv. cm^{-3} (at a depth of 1 m). The phytoplankton concentration was the lowest in the end of May – 627 indiv. cm^{-3} (at the water surface layer).

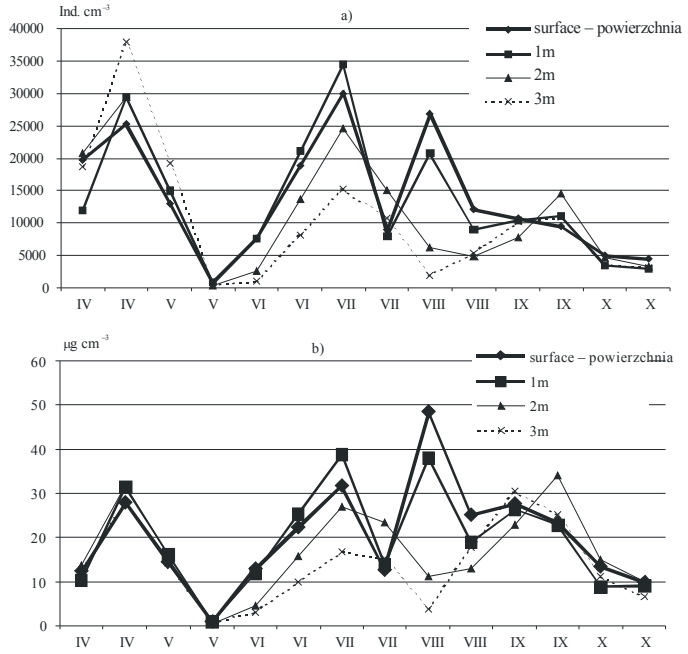

Fig.1. Temporal and vertical changes in the total abundance (a) and biomass (b) of phytoplankton throughout the year 2005

Rys.1. Sezonowe zmiany liczebności (a) i biomasy (b) fitoplanktonu na przestrzeni 2005 roku na badanych głębokościach

The biomass of the phytoplankton exhibited seasonal and depth variations. In the period of study a few peaks were noted in the phytoplankton biomass (Fig. 1b). The highest value of biomass was noted in July, on the surface, and reached 48.6 µg cm^{-3}.

In the spring (April) the increase in abundance and biomass was due to increased amount of chrysophytes and diatoms. The most frequent from the first group were *Erkenia subaequiciliata*, *Dinobryon sociale* and *D. divergens*. The second taxonomic group was represented mostly by long-cell organisms like *Asterionella formosa*, *Nitzschia acicularis* and *Fragilaria ulna* var. *acus,* as it is reported at one of the stages of annual course of plankton succession by Sommer *et al*. [1986].

Cyanobacteria were the most important group from the quantitative point of view. They were present in large numbers and high biomass from June till the end of August. Especially *Aphanizomenon flos-aquae* dominated in this group, reaching 22.4 10^3 individuals cm^{-3} and 35.5 µg cm^{-3} (in August at the water surface layer). This species was noted in the Maltański Reservoir also after refilling the reservoir, both in 1990 [Gołdyn and Mastyński 1998] and in 1993 [Kozak and Gołdyn 2004, Kozak 2005]. The same species has frequently been inducing water blooming in several dam reservoirs in Poland e.g. Sulejów dam reservoir [Romanowska-Duda *et al*. 2002] and Zemborzycki

Reservoir [Pawlik-Skowrońska *et al*. 2004]. *Aphanizomenon flos-aquae* was also noted in high concentrations in water bodies in Finland [Keto *et al*. 1992], Denmark [Jeppesen *et al*. 1990, Reimann *et al*. 1990] and in Holland [Van Donk *et al*. 1990].

In autumn also diatoms were dominant, with lower contributions of cyanobacteria and green algae. The most numerous among diatoms were *Aulacoseira granulata* morphotyp *curvata*, *Cyclotella meneghiniana*, *Stephanodiscus hantzschii*, among Cyanobacteria: except *A. flos aquae*, *Microcystis aeruginosa* and *Woronichinia naegeliana* were noted. Rarely cited *Aulacoseira granulata* morphotyp *curvata* was not observed in Maltański Reservoir earlier in the period 1993-1996 [Kozak 2005]. In 2005 green algae were represented in large numbers mainly by: *Monoraphidium contortum, Koliella spiculiformis, K. longiseta, Oocystis lacustris, Scenedesmus communis* and *Coelastrum astroideum.* They were also noted earlier in 1993-1996 [Kozak 2005].

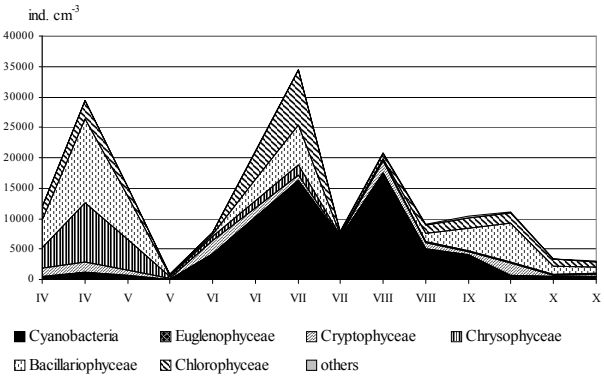

Fig. 2. Changes in the abundance of phytoplankton in the studied period within individual taxonomic groups (example: at the depth of 1 m)
Rys. 2. Zmiany liczebności fitoplanktonu w badanym okresie z uwzględnieniem poszczególnych grup taksonomicznych (przykład z głębokości 1 m)

CONCLUSION

In Maltański Reservoir 184 phytoplankton taxa were identified. The majority of them belonged to the Chlorophyceae whose contribution to the total number of phytoplankton was 46%. The contribution of the other classes to the phytoplankton was smaller: Bacillariophyceae 14%, Chrysophyceae 10%, Cyanoprokaryota 9%, Cryptophyceae 8%, Euglenophyceae 5%, Conjugatophyceae 4%, Xantophyceae 2% and Dinophyceae 2%. The most significant group in respect of concentration of organisms was cyanobacteria.

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STRUKTURA FITOPLANKTONU ZBIORNIKA ZAPOROWEGO W POZNANIU

Streszczenie. Niniejsze badania obejmują analizy składu taksonomicznego, liczebności i biomasy fitoplanktonu Zbiornika Maltańskiego w roku 2005. Stwierdzono wówczas istotne zmiany ilościowo-jakościowe zarówno sezonowe, jak i na poszczególnych głębokościach. Ogółem oznaczono 184 taksony w badanym zbiorniku, należące do dziewięciu klas taksonomicznych. Najliczniej reprezentowaną grupą były: Chlorophyceae (46% oznaczonych taksonów), Bacillariophyceae (14%), Chrysophyceae (10%) oraz Cyanoprokaryota (9%). Udział pozostałych klas fitoplanktonu był niższy.

Słowa kluczowe: fitoplankton, liczebność, biomasa, sezonowe zmiany, zbiornik zaporowy