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# GREEN ALGAE POPULATION CHANGES IN FISH PONDS

Lubomira Burchardt, Beata Messyasz, Beata Mądrecka

Department of Hydrobiology, Adam Mickiewicz University
Umultowska str. 89, 61-614 Poznań, Poland, e-mail: burchard@amu.edu.pl, messyasz@amu.edu.pl

**Summary.** In both studied ponds big green algae species diversity was noted. Dominant species analysis of the green algae density revealed that similar biomass was found in the Duży and Mały Ponds, with the dominant taxa alternating between *Pediastrum* and *Scenedesmus/Desmodesmus* populations. *Cosmarium regnellii*, *C. abbreviatum*, *Lagerheimia ciliata* were observed during July and August, while *Monoraphidium arcuatum*, *M. griffithii*, *M. irregularis*, *M. komarkove* and *M. tortile* increased in abundance during September. *Chlamydomonas globosa*, *Crucigenia tetrapedia*, *Desmodesmus communis*, *Oocytis lacustris*, *Tetraedron minimum* and *T. triangulare* populations were of the same abundance from July to September.

**Key words:** fish pond, green algae, summer population, Chlorococcales, *Scenedesmus*, *Desmodesmus*

## INTRODUCTION

As a rule, natural phytoplankton consists of species belonging to different taxonomical groups. Apparently, only those species that constitute a significant part of the total biomass can be easy subjected to population analysis. Chlorococcales green algae, mainly dominating in shallow and fertile water ecosystems [Reynolds 1984, Lee 1999], have small size of cells and their big number does not often find its reflection in the total biomass of the phytoplankton. Nevertheless, fish ponds with an extremely rich level of nutrient concentrations are an example of the green algae mass development, which creates the possibility to estimate their population changes based on the differences in biomass composition.

Populations of individual species are commonly variable and respond in order to factors stimulating their growth. The large amount of green algae in shallow water bodies, most of them belonging to the chlorococcales genera, provides differentiation in population size of particular algae species. For comparison, we included two fish ponds into our green algae populations' characterisation study. The qualitative phytoplankton composition in both ponds in Kamionki was already described [Mądrecka 2004, Messyasz *et al*. 2005, Messyasz 2006] and high green algae species richness confirmed. The purpose of this study was to determine the changes of green algae populations in the period of their dominance within the phytoplankton community in two size-diversified fish ponds.

## STUDY AREA, MATERIALS AND METHODS

The fish ponds on which examinations were carried out are on land being the property of a private owner in Kamionki near Poznań. The pond, which is probably of natural origin, was divided into two small water bodies. They were deepened and their edges were regulated. The bigger one, Pond Duży, has the surface of 0.6 ha, and the smaller one, Pond Mały – about 0.09 ha. The depth of the ponds is varied; 2.0 m is the average depth for Pond Duży and 1.5 m for Pond Mały.

Analyses of the green algae changeability were conducted weekly from 20$^{th}$ July to 28$^{th}$ September in both fish ponds. Every time, physicochemical analyses of water, including the measurement of the water temperature, pH, and the concentrations of oxygen, nitrogen and phosphorus were performed. Species composition, the number of cells and value of biomass in particular periods were compared. Also, a list of dominating species in terms of biomass was created. The dominating species were those which reached a minimum of 10% of the total biomass.

## RESULTS AND DISCUSSION

Fish ponds are containers which, on account of their function, are quite shallow, due of which continuous mixing up of the total volume water is taking place in them. The examined ponds, formed after transformation of the natural reservoir, were characterized by high trophy caused by strong mineral and organic fertilizing which was aimed at increase their productivity. Secchi disk visibility was small in July and August and it amounted to about 30 cm, and started growing up to 50 cm in September. The pH value of water showed slight alkalinity and ranged from 7.6 to 8.6 in the period of the examinations. Concentrations of nitrogen were at a high level in both ponds (nitrates: 0.2-0.7 mg $l^{-1}$; ammonium: 0.15-1.74 mg $l^{-1}$) with slightly higher values in Pond Duży. In the case of dissolved phosphorus, its values were also high and clearly raised at the end of September. Chlorophyll *a* concentration was great during the study and achieved a maximum in the first half of August (pelagic zone of Pond Duży: 2.08.2004 – 180 μg $l^{-1}$) while the lowest values were noted on the 12$^{th}$ September – lower than 20 μg $l^{-1}$. That day a distinct fall in temperature and a rainfall occurred.

Great species richness of *Chlorophyta,* with 135 taxa in Pond Duży (vs. 252 taxa in phytoplankton community) and 126 taxa in Pond Mały (vs. 228 taxa) was noted. They contained first of all colony-forming and coccal forms. Green algae are mainly cosmopolitan species which are characteristic for small fertile bodies of water but also for big lakes, containing high nutrient concentrations [Reynolds 1984, Knösche *et al*. 2000, Bucka and Wilk-Woźniak 2002, Burchardt *et al*. 2003]. Moreover, *Scenedesmus*/*Desmodesmus* can also absorb nitrogen in the form of urea [Bucka and Wilk-Woźniak 2002]. The optimum of appearance of this group takes place in the summer and the autumn seasons [Reynolds 1984, Barica 1994, Padisák and Dokulil 1994, Alam *et al*. 2001], which found confirmation in this study. Chlorophyta biomass in Pond Duży varied within the range from 32.374 mg $l^{-1}$ to 165.000 mg $l^{-1}$ (which constituted 42-97% of the total phytoplankton biomass; on average 74%), while that in Pond Mały from 15.911 to 186.942 mg $l^{-1}$ (48-88% of the total biomass; on average 76%, Fig. 1). A relatively big decrease in the total phytoplankton biomass, including green algae, was noted only on 5$^{th}$ September (rainfall and a drop in the

water temperature). Furthermore, a rise in the cyanobacteria participation from *Anabaena* and *Aphanizomenon* genera in Pond Duży, as well as from diatom *Asterionella formosa* in Pond Mały (up to 44% in the total biomass – 12.09.) were observed in that period. This diversity was caused by slightly lower temperature of water and bigger overshadowing of Pond Mały by trees. More intensive development of cyanobacteria in the end of summer, including blooms of water, is typical for shallow water ecosystems [Burchardt and Pawlik-Skowrońska 2005]. Essentially, such high biomass concentrations of phytoplankton are characteristic for hypertrophy [Reynolds 1984, Kawecka and Eloranta 1994].

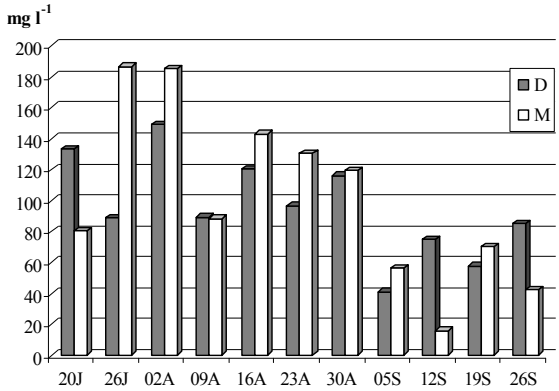


Fig. 1. Distribution of total green algae biomass in examined fish ponds in 2004 (D – Pond Duży; M – Pond Mały; J – July; A – August; S – September)
Rys. 1. Rozmieszczenie biomasy całkowitej zielenic w badanych stawach rybnych w 2004 roku (D – Staw Duży; M – Staw Mały; J – lipiec; A – sierpień; S – wrzesień)

*Chlamydomonas globosa*, *Crucigenia tetrapedia*, *Desmodesmus communis*, *Oocytis lacustris*, *Tetraedron minimum* and *T. triangulare* biomass stayed on fairly constant high level through the whole research season in the pelagial part of both fish ponds. In the case of *Desmodesmus maximus*, *D. intermedium*, *D. subspicatus*, *Monoraphidium minutum*, *Pediastrum biradiatum* var. *longecornutum*, *P. tetras* and *Staurastrum paradoxum* maximum biomass in August followed by a decline in September was observed. Figure 2 shows changes in *P. biradiatum* v. *longecornutum* biomass in the period from July to September 2004 in both water bodies – Duży and Mały. It should be noted that distinct and stable *Pediastrum* species domination occurred in both ponds. *Pediastrum* genera, a littoral alga, is often found at high concentration in phytoplankton assemblages, possibly supplementing pelagic zone as a result of water movement and turbidity [Lee 1999].

*Cosmarium regnellii*, *C. abbreviatum*, *Lagerheimia ciliata* were green algae species which reached large biomass at the beginning of the research period and were replaced by the *Monoraphidium* species (*M. arcuatum*, *M. griffithii*, *M. irregularis*, *M. komarkove*, *M. tortile*) in September. Colony-forming green algae species develop mainly in late August and early September [Reynolds 1984, 1996, Lee 1999], when the stability of the water column is higher than in other periods of the year. The more intensive development of such forms in relation to June and beginning of August was not observed in the examined ponds.

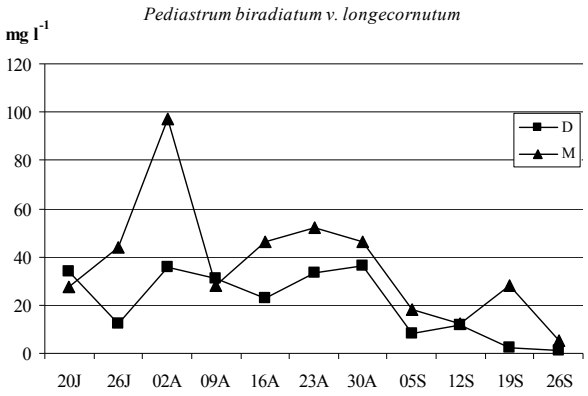


Fig. 2. An example of changes in the biomass of dominant green algae species in examined fish ponds in 2004 (D – Pond Duży; M – Pond Mały; J – July; A – August; S – September)
Rys. 2. Wybrany przykład zmian biomasy dominującego gatunku zielenicy w badanych stawach rybnych w 2004 roku (D – Staw Duży; M – Staw Mały; J – lipiec; A – sierpień; S – wrzesień)

Although *Chlorophyta* genera in both fish ponds exhibited similar biomass pattern and population dynamics, particular species can vary in their response to individual physicochemical factors of each pond.

## CONCLUSIONS

Differences concerning changes in green algae populations in examined water bodies were similar and closely depended on physicochemical parameters. Fish ponds are among the most nutrient-enriched and mixing habitats, and algal biomass, including green algae, attains large concentrations, which we found also in this study. There was a steady decline in chlorophytes biomass throughout September 2004. This corresponded to declining water temperature and level of dissolved phosphorus. Two common genera, *Pediastrum* and *Scenedesmus*/*Desmodesmus* dominated green algae community for the period of record. From the results of this study, it is evident that it is possible to distinguish at least green algae populations with stable density, similarly as with growing or decreasing densities in the community.

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## ZMIANY POPULACJI ZIELENIC W STAWACH RYBNYCH

**Streszczenie.** W obu stawach stwierdzono duże zróżnicowanie gatunkowe zielenic. Analiza gatunków dominujących zielenic wykazała podobne zakresy biomasy w Stawie Dużym i Małym z występującymi na przemian wśród dominantów populacjami *Pediastrum* i *Scenedesmus/Desmodesmus*. *Cosmarium regnellii*, *C. abbreviatum*, *Lagerheimia ciliata* występowały na początku badań, podczas gdy *Monoraphidium arcuatum*, *M. griffithii*, *M. irregularis*, *M. komarkove* and *M. tortile* osiągnęły wyższą biomasę we wrześniu. Biomasa populacji *Chlamydomonas globosa*, *Crucigenia tetrapedia*, *Desmodesmus communis*, *Oocytis lacustris*, *Tetraedron minimum* i *T. triangulare* ulegała tylko drobnym wahaniom.

**Słowa kluczowe:** staw rybny, zielenice, populacja letnia, Chlorococcales, *Scenedesmus*, *Desmodesmus*