

SOFIA CELEWICZ-GOŁDYN

ABUNDANCE OF *DINOBYRYON DIVERGENS* IMHOFF IN THE EUTROPHIC LAKE ROSNOWSKIE DUŻE IN 2002-2003

*From Department of Botany
The August Cieszkowski Agricultural University of Poznań*

ABSTRACT. Changes in abundance of *Dinobryon divergens* Imhoff were analysed in four basins of the eutrophic lake Rosnowskie Duże (Wielkopolska National Park, western Poland). Surface water samples were taken from eight stations (pelagic and littoral zones of four basins of the lake) in 2002 and 2003 during the growing season. In 2002, *D. divergens* was very abundant, especially in basins I and II, where the trophic levels were the highest. This is unusual for eutrophic lakes, and can be connected with instability of the eutrophic state in Lake Rosnowskie Duże.

Key words: *Dinobryon divergens* Imhoff, eutrophic lake, shallow lake, phytoplankton, pelagic, littoral

Introduction

Lake Rosnowskie Duże in the Wielkopolska National Park is a eutrophic water body of glacial origin. The earlier phycological reports concerning that lake did not record any large contribution of the chrysophyte *Dinobryon divergens* Imhoff to the quantitative structure of phytoplankton (Juskowiak 1978, Organiściak 1978, Dąbska et al. 1981, Koczorowska and Wetula 1984, Abulgasem 1999, Alsambany 1999).

Phytoplankton analyses made in the spring of 2002 in this eutrophic lake provided inspiration for a detailed analysis of changes in abundance of this species. The aim of this study was to assess the contribution of *D. divergens* to the quantitative structure of phytoplankton in pelagic and littoral zones in four basins of lake Rosnowskie Duże, and to analyse its correlations with physicochemical properties of water.

Material and methods

Lake Rosnowskie Duże (area 34.2 ha, maximum depth 10.2 m, mean depth 3.9 m) is situated in the north-western part of the Wielkopolska National Park near Poznań

(western Poland). The lake has no surface outflow. It is subject to a strong human influence because it lies close to the village of Rosnówko and the road Poznań-Wrocław. Because of the gradual sediment deposition and colonization by aquatic vegetation, the lake has been naturally divided into four distinct basins (Fig. 1), differing in morphology (Table 1) and floristic composition of macrophytes.

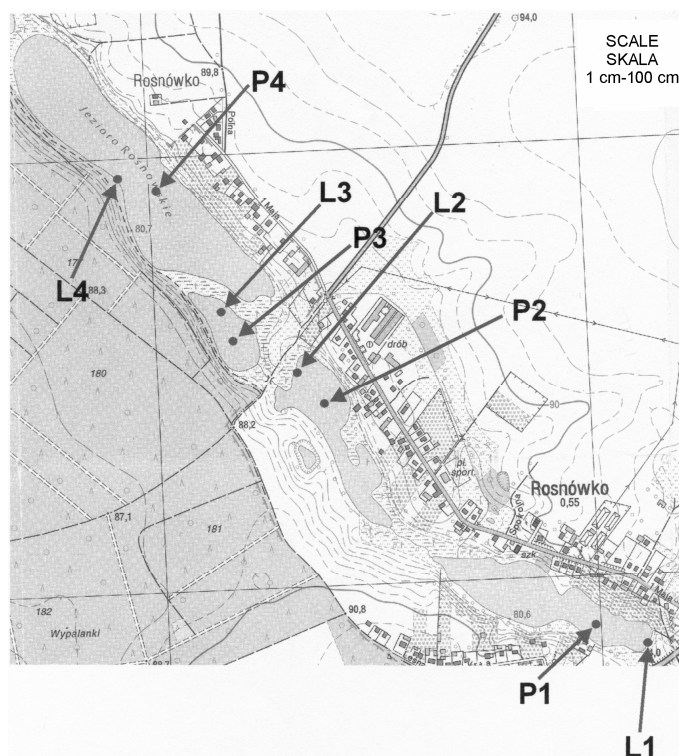


Fig. 1. Map of lake Rosnówskie Duże
Ryc. 1. Mapa Jeziora Rosnówskiego Dużego

Table 1
Morphometric characteristics of four basins of lake Rosnówskie Duże
Charakterystyka morfometryczna basenów Jeziora Rosnówskiego Dużego

Basin Basen	Maximum depth (m) Głębokość maksymalna (m)	Area (ha) Powierzchnia (ha)
I	7.8	4.4
II	3.5	3.0
III	5.5	1.8
IV	10.2	10.8

Phycological research was conducted in 2002 and 2003, during the growing season of hydromacrophytes (from May till September). Samples were collected every two weeks in spring and every month in summer. Eight sampling stations were established: in the pelagic and littoral zones of each basin (Fig. 1). Water samples were taken from the surface layer of water. They were preserved with Lugol's solution and formalin. In the laboratory, they were sedimented to a volume of 10 ml, and next analysed qualitatively and quantitatively. Cells of cyanoprokaryotes and eukaryotic algae were counted in Fuchs-Rosenthal chambers (**Kawecka and Eloranta** 1994). The species whose contributions to total phytoplankton abundance in a sample exceeded 10%, were regarded as dominants.

During each sampling session in the field, some physicochemical parameters were recorded: air temperature, surface water temperature, pH, concentration of dissolved oxygen, and conductivity. Secchi depth was measured only in the pelagic zone. At the beginning and end of the growing season in 2002 and 2003, also the concentration of chlorides was measured.

Water samples for analysis of chlorophyll *a* concentration were collected synchronously with those for analysis of phytoplankton. Chlorophyll *a* concentration was calculated on the basis of **Strickland and Parsons'** (1972) formulas modified by **Lorenzen** (1967).

Carlson's (1977) trophic state index was assessed on the basis of chlorophyll *a* concentration and Secchi depth in logarithmic transformation.

Pearson's correlation coefficients were calculated to assess the relationships between selected phytoplankton parameters (abundance and biomass of chrysophytes) and environmental variables (conductivity, oxygen concentration, water temperature). The coefficients were calculated for the whole study period jointly and were considered significant if $P < 0.05$.

Results

The trophic state index values calculated on the basis of chlorophyll *a* concentration and Secchi depth show that basins I and II were eutrophic, while basins III and IV (more distant from farms and the road) were usually meso-eutrophic. The highest values of this index based on chlorophyll *a* (68 units) were recorded on 13th May 2002 in basin II and on 27th May 2002 in basin I. The highest value based on Secchi depth (70 units) was recorded on 13th May 2002 in the pelagic zone of basin II.

Secchi depth in the lake ranged from 0.5 to 2.3 m, depending on sampling station. Considering Secchi depth in individual sampling sessions, basin I was usually characterized by the smallest values (0.5-1.5 m), basin II by slightly higher values (0.7-1.6 m), while the highest values were recorded in basins III (1.4-2.2 m) and IV (1.0-2.3 m). Only in summer months (July, August and September 2002, and July 2003) no significant differences in Secchi depth were observed between the four basins of the lake. In both years of the study, water transparency in the lake was higher in summer than in spring.

No significant spatial and temporal variation in water pH was observed in the lake, although it varied from 7.6 to 8.3.

The concentration of dissolved oxygen was characterized by a clear spatial variation. Its values ranged from 3.3 to 16.6 mg O₂/l. The highest value was recorded in May 2002 in the pelagic zone of basin I, while the lowest in July 2003 in the littoral zone of basin III. During the study period, high oxygen concentrations were observed usually at both sampling stations in basin I (mainly in the pelagic zone) and in the pelagic zone of basin IV.

The highest values of electrolytic conductivity in the summer of 2002 and in 2003 were recorded in basin I, with a decreasing trend from basin I to basin IV. The concentration of solutes ranged from 308 to 985 µS/cm. Similar spatial trends were observed in chloride concentrations, which varied from 74 to 103 mg Cl/l.

On the basis of qualitative analyses of the phytoplankton, a total of 133 taxa of phytoplankton algae were found in lake Rosnowskie Duże. In respect of diversity, the dominant groups were the green algae (57 taxa), diatoms (37 taxa), and cyanoprokaryotes (19 species). Chrysophytes accounted for only about 1% of all taxa. Within this group, only two species were noted: *Dinobryon divergens* Imhoff and *D. bavaricum* Imhoff.

Dinobryon divergens was an important contributor to total phytoplankton abundance. In 2002, it was frequently a dominant species during the growing season in both the pelagic and littoral zones: on 13th May (pelagic and littoral zones of basins I and II), 27th May (pelagic and littoral zones of basin II), 24th June (pelagic and littoral zones of basins I and III, and littoral zone of basin II), 8th July (pelagic and littoral zones of basin I) and 8th August (pelagic and littoral zones of basins I and III). The highest values of abundance of this species were recorded in the pelagic and littoral zones of basins I and II on 13th May (Figs. 2 and 3). High values of abundance were observed also on 24th June, in pelagic and littoral zones of basin I (Fig. 2). The lowest abundance of *D. divergens* in 2002 was recorded on 10th June and 9th September at all the sampling stations (Figs 2 and 3).

In the year 2003, this species was less abundant than in 2002 (Figs 4 and 5). It dominated only in three samples: in the littoral zone of basin II on 11th June and in pelagic and littoral zones of basin I on 4th August. The highest abundance of *D. divergens* was observed on 23rd June in the littoral zone of basin III (Fig. 4), and only slightly lower on 11th June in the pelagic zone of basin II (Fig. 4). The lowest number of cells of this species was noted on 26th May at all the stations (Figs 4 and 5).

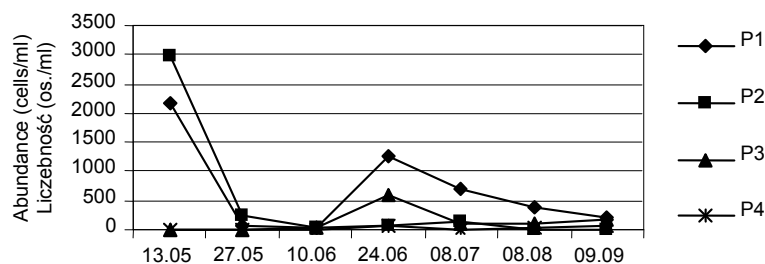


Fig. 2. Changes in abundance of *Dinobryon divergens* in pelagic zones of four basins of lake Rosnowskie Duże in 2002

Ryc. 2. Zmiany liczebności *Dinobryon divergens* w strefie pelagialu czterech basenów Jeziora Rosnowskiego Dużego w 2002 roku

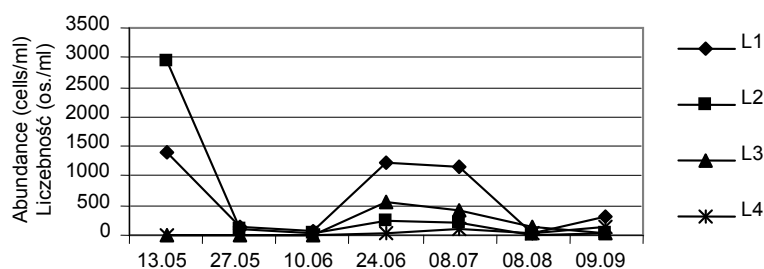


Fig. 3. Changes in abundance of *Dinobryon divergens* in littoral zones of four basins of lake Rosnowskie Duże in 2002

Ryc. 3. Zmiany liczebności *Dinobryon divergens* w strefie litoralu czterech basenów Jeziora Rosnowskiego Dużego w 2002 roku

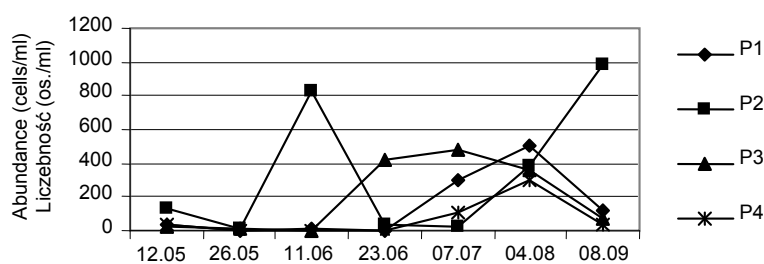


Fig. 4. Changes in abundance of *Dinobryon divergens* in pelagic zones of four basins of lake Rosnowskie Duże in 2003

Ryc. 4. Zmiany liczebności *Dinobryon divergens* w strefie pelagialu czterech basenów Jeziora Rosnowskiego Dużego w 2003 roku

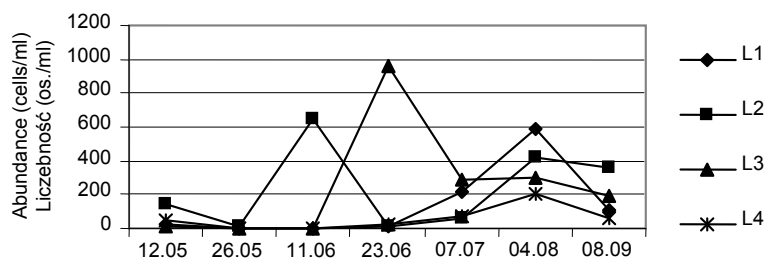


Fig. 5. Changes in abundance of *Dinobryon divergens* in littoral zones of four basins of lake Rosnowskie Duże in 2003

Ryc. 5. Zmiany liczebności *Dinobryon divergens* w strefie litoralu czterech basenów Jeziora Rosnowskiego Dużego w 2003 roku

Both chrysophyte abundance and biomass were weakly but significantly and positively correlated with oxygen concentration (Table 2). These two phytoplankton parameters were not correlated with conductivity and water temperature.

Table 2

Interactions between abundance and biomass of chryomonads and physiochemical parameters of water
Zależność pomiędzy liczebnością i biomasa zlotowiciowców a parametrami fizyczno-chemicznymi wody

Chryomonads Zlotowiciowce	Oxygen Tlen	Conductivity Przewodnictwo	Water temperature Temperatura wody
Abundance Liczebność	0.18	-0.07	0.08
Biomass Biomasa	0.16	-0.05	0.02

Discussion

The quantitative structure of phytoplankton in the eutrophic lake Rosnowskie Duże was frequently dominated by the chrysophyte *Dinobryon divergens* during the growing period (mainly in 2002). High values of abundance of this species were recorded in both littoral and pelagic zones of basins I, II and III of the lake. **Kawecka and Eloranta** (1994) after **Järnefelt** (1952) report that *D. divergens* is an indicator of oligotrophic waters. Optimum conditions for growth of chrysophytes are clear waters with low concentrations of nutrients and low water temperature (**Burchardt and Messyas** 2004, **Holmgren** 1984, **Landner** 1989). Thus it is surprising that this species dominated in a lake classified as eutrophic. The highest values of abundance of *D. divergens* were recorded in basins I and II, although the values of conductivity, chloride concentration and trophic state were also the highest there (due to the continuous inflow of nutrients from the catchment). Moreover, the great thickness of bottom sediments and the small depth of the lake suggest a possibility of intensive mobilization of nutrients from the bottom. The abundant occurrence of this chrysophyte in the period when water temperature was high (about 20°C on 13th May and 24th June), also contradicts literature data (**Burchardt and Messyas** 2004, **Holmgren** 1984). The dominance of the algae in basin I on 24th June 2002 can be explained by a decrease in nutrient concentrations (in particular, nitrates and soluble orthophosphates) after cyanoprokaryotic blooms (*Planktothrix agardhii* (Gom.) Anagn. et Kom. and *Limnothrix redekei* (Van Goor) Meffert) in that part of the lake (**Celewicz-Goldyn** 2005). Besides, in lake Rosnowskie Duże, a positive correlation was found between both abundance and biomass of chrysophytes and oxygen concentration. This may indicate that chrysophytes prefer well-oxygenated waters. In the surface layer of water (where the samples were collected), oxygen concentration was the highest.

The high abundance of *D. divergens* in 2002 may attest to instability of the eutrophic state in the lake (**Burchardt et al.** 1999, **Pelechata** 2002). In the year 2003, the quantitative structure of phytoplankton was greatly modified and the contribution of chrysophytes decreased remarkably.

Conclusions

An analysis of contributions of the chrysophyte *Dinobryon divergens* Imhoff to the quantitative structure of phytoplankton in lake Rosnowskie Duże showed that the species was very abundant there in 2002, especially in basins I and II. The high numbers of chrysophytes in this eutrophic lake may be partly due to the good oxygenation of the surface layer of water and low concentrations of nutrients in water after cyanoprokaryotic blooms. The dominance of *D. divergens* probably attests to instability of the eutrophic state in this lake.

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UDZIAŁ ŻŁOTOWICIOWCA *DINOBRYON DIVERGENS* IMHOFF
W STRUKTURZE ILOŚCIOWEJ FITOPLANKTONU EUTROFICZNEGO
JEZIORA ROSNOWSKIEGO DUŻEGO W LATACH 2002 I 2003

S t r e s z c z e n i e

Praca jest próbą określenia zmian liczebności żłotowiciowca *Dinobryon divergens* Imhoff w czterech basenach eutroficznego Jeziora Rosnowskiego Dużego (w Wielkopolskim Parku Narodowym). Próby do badań fykologicznych pobierano z warstwy powierzchniowej wody. Wyznaczono osiem stanowisk badawczych (w strefie pelagialu i litoralu każdego basenu). Badania prowadzono w latach 2002 i 2003, w czasie sezonu wegetacyjnego.

W 2002 roku stwierdzono dużą liczbę komórek *Dinobryon divergens*, głównie w basenach I i II, gdzie poziom trofii był najwyższy. Duża liczebność tego gatunku jest zjawiskiem nietypowym dla jezior eutroficznych i może być związana z niestabilnym stanem eutrofii w Jeziorze Rosnowskim Dużym.

Author's address:

Sofia Celewicz-Goldyn, Katedra Botaniki, Akademia Rolnicza im. Augusta Cieszkowskiego w Poznaniu, ul. Wojska Polskiego 71 C, 60-625 Poznań, e-mail: celewicz@au.poznan.pl