Acta Agrophysica, 2003, 1(3), 479-484

PRELIMINARY STUDY ON PLANKTONIC CILIATES IN SLIGHTLY EUTROPHIC LAKE UŚCIWIERZ

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Summary. Ciliates abundance and species composition were analysed in the slightly eutrophic Lake Uściwierz of Łęczyńsko-Włodawskie Lakeland. Samples were taken in the pelagic zone in spring (May), summer (June) and autumn (November) 2002. Ciliates were collected with a 5-litre Bernatowicz sampler, every 1-metre in the deepest place, from the surface to the depth of 5 m. Twenty nine (29) species of ciliates were found in the plankton samplers. The mean abundance of the ciliates was 6 ind. ml^{-1} and the mean ciliates biomass was 81 $\mu g \cdot l^{-1}$. The following species dominated among the ciliates: Peritrichida (*Vorticella* sp.), Oligotrichida (*Halteria gradinella* and *Strombidium* sp.) and Scuticociliatida (*Cinetochilum margaritaceum*).

Keywords: pelagic zone, planktonic ciliata, trophic status

INTRODUCTION

An ecological role of ciliates as trophic links in the pelagic food webs has been increasingly appreciated during recent years [16]. Ciliates graze on autotrophic and heterotrophic pico- and nanoplankton, functioning as prey for larger zooplankton and planktivorous fish and contribute to the re-mineralization and cycling of nutrients [1, 15]. Ciliates appear to be particularly important in the freshwater ecosystems [11, 18]. What is more, they have been shown to serve as very sensitive indicators of water quality [9].

Up till now, no research on plankton ciliates in the area of the Łęczyńsko-Włodawskie Lakeland has been carried out. Hence, the aim of the present research was to study temporal fluctuation in the numbers of plankton ciliates and their relation to the trophic (TP and TOC) parameters of the slightly eutrophic Lake Uściwierz.

MATERIALS AND METHODS

The present studies were carried out in the slightly eutrophic Lake Uściwierz located in the Łęczyńsko-Włodawskie Lakeland [17].

Samples were taken in the pelagic zone in spring (May), summer (June) and autumn (November), 2002 by means of a 5-litre Bernatowicz sampler, every 1-metre in the deepest place, from the surface to the depth of 5 m. Samples from all layers were pooled together, carefully mixed and 500 ml sample was fixed with the Lugol's salution. Each sample was condensed to 5-15 ml and ciliates were determined and counted under the NIKON microscope. Four microscopic slides were prepared from each sample and examined. Taxonomic identifications were based on instruction by Foissner *et al.* [10].

Ciliate biomass was estimated by the multiplying the numerical abundance by the mean cell volume calculated from direct volume measurements using appropriate geometric formulas [7].

The following physical and chemical factors were examined: temperature, pH, conductivity, TOC and total phosphorus. Temperature, pH, conductivity were determined *in situ* using an electrode Jenway 3405 or a Hydrolab and the remaining factors were analysed in the laboratory, according to methods by Hermanowicz *et al.* [12].

RESULTS AND DISCUSSION

A total number of 29 ciliate species of were found in the plankton samples. The highest number of species was noted in autumn – 29 species and lowest in summer – only 7 ciliate species. The ciliate species composition in the slightly eutrophic Lake Uściwierz was similar to that reported in other papers [11, 13] (Tab. 1).

The mean abundance of ciliates was 6 ind. ml^{-1} with a minimum of 5ind ml^{-1} in spring and maximum of 9 ind. ml-1 in summer (Fig. 1a). The mean ciliates biomass of was 81 $\mu g\ l^{-1}$ (range from 61 $\mu g\ l^{-1}$ in spring to 78 $\mu g\ l^{-1}$ in summer) (Fig. 1b). The maximum biomass levels were similar to those found in the eutrophic lakes in Florida [4]. The maximum density levels of ciliates were often observed during mid or late summer [15].

Ciliates density was correlated with TOC ($r = 0.89$, $p < 0.01$) and TP ($r = 0.88$, $p < 0.05$) (Fig. 2a-b). Beaver and Crisman [4] found that the protozoan abundance tend to increase with an increasing lake productivity. The present study clearly showed that the ciliates abundance was correlated with lake productivity.

Table 1. The composition of the major ciliate taxa in pelagial of Lake Uściwierz

Taxa	Lake Uściwierz
OLIGOTRICHIDA	
Codonella cratera LEIDY	+++
Halteria gradinella MUELLER	+++
Strombidium sp.	+++
Strombilidium humile PENARD	+++
HAPTORIDA	
Actinobolina radians STEIN	+
Askenasia spp.	++
Didinium sp.	+
Enchelys sp.	+++
Homalozoon vermiculare STOKES	+++
Mesodinium spp.	+++
Spathidium sensu lato	+++
HETEROTRICHIDA	
Caenomorpha spp.	+++
Stentor amethystinus LEIDY	++
Stentor coeruleus PALLAS	+++
HYMENOSTOMATIDA	
Disematostoma tetraedricum FAURE-FREM.	+++
Frontonia sp.	+
Stokesia vernalis WENRICH	++
SCUTICOCILIATIDA	
Cinetochilum margaritaceum EHRENBERG	+++
HYPOTRICHIDA	
Euplotes sp.	++
PERITRICHIDA	
Vorticella convallaria - Komplex	+++
Vorticella microstoma - Komplex	+++
Vorticella sp.	++++
PLEUROSTOMATIDA	
Litonotus sp.	+++
PROSTOMATIDA	
Bursellopsis sp.	+++
Coleps hirtus MUELLER	+++
Coleps spetai FOISSNER	+++
Holophrya sp.	+++
Prorodon sp.	+++
SUCTORIDA	++
No. of taxa	29

The highest percentage of the total abundance was observed in the case of the following species: Peritrichida *(Vorticella* sp.*)*, Oligotrichida *(Halteria gradinella* and *Strombidium* sp.*)* and Scuticociliatida *(Cinetochilum margaritaceum)* (Fig. 3). Oligotrichida and Scuticociliatida are the dominant groups in the plankton [8]. In the Lake Uściwierz, Peritri Peritrichida were the most numerous and the other two groups were of minor importance. Beaver and Crisman [3] found that small bacterivorous ciliates, mainly Scuticociliatida, are typical in the eutrophic lakes.

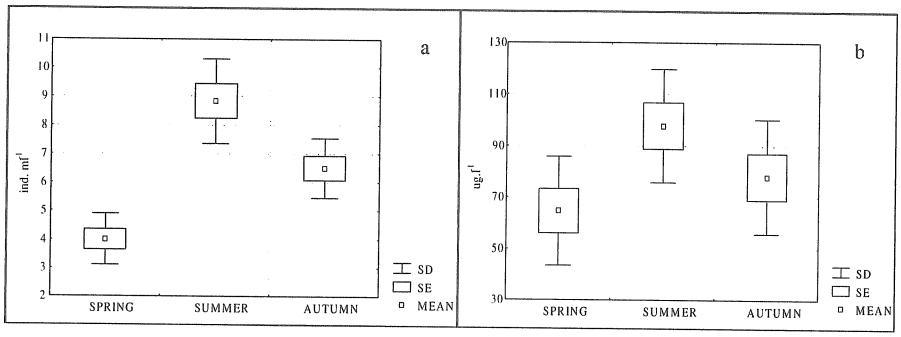

Fig. 1. Seasonal changes the number (a) and biomass (b) planktonic ciliates in Lake Uściwierz

Vorticellid ciliates which reached their peak density in summer were found to be attached to the frustules of *Asterionella* and strands of *Anabena*. Vorticellid ciliates were reported as relatively important in the eutrophic, temperate lakes in summer [2,14]. The mixotrophic taxa, such as *Strombidium* (Oligotrichida) were the second most abundant group, especially in summer. These results are in good agreement with the statement of Carrias *et al.* [6] who demonstrated that the relative importance of *Strombidium* was markedly higher in summer. Their distribution is dictated probably by the phytoplankton density [13]. Members of the Oligotrichida dominate numerically in the oligo- and mesotrophic lakes [5] but other authors observed *Strombidium* in the eutrophic lakes [3]. Probably an increase in the nutrient concentration is the main factor responsible for the changes in the ciliates domination structure. A rising percentage of Peritrichida and a decrease in the Oligotrichida abundance was also observed [18]. In autumn, Pleurostomatida and Prostomatida, (*Coleps hirtus* and *Coleps spetai*) dominated. The abundance of ciliates in the lake studied was higher than in the small eutrophic lake in the English Lake District [2].

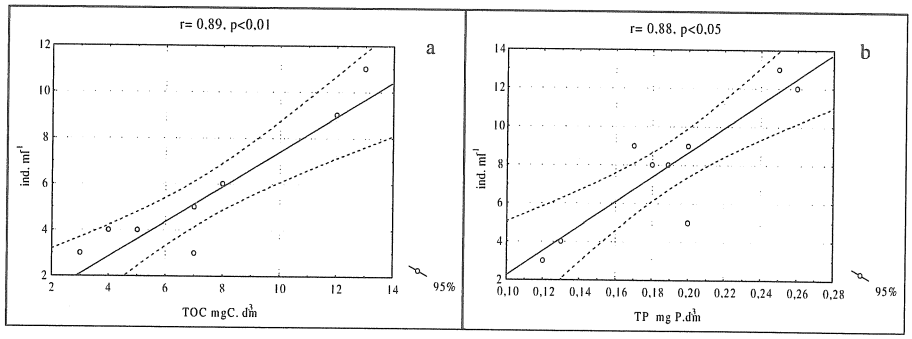

Fig. 2. Relationship between ciliate numbers and TOC (a), TP (b) in Lake Uściwierz

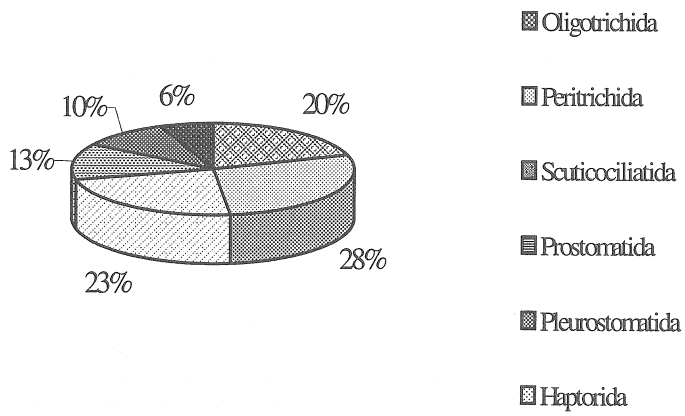

Fig.3. Abundance of the major ciliate taxa in Lake Uściwierz

CONCLUSIONS

1. In slightly eutrophic Lake Uściwierz 29 species of ciliates were found in plankton sample. The mean abundance 6 ind. ml^{-1} and mean biomass of ciliates was 81 $\mu g\ l^{-1}$.

2. This lake was generally dominated by ciliates belonging to the orders Peritrichida (*Vorticella* sp.), Oligotrichida (*Halteria gradinella* and *Strombidium* sp.) and Scuticociliatida (*Cinetochilum margaritaceum*).

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WSTĘPNE BADANIA NAD PLANKTONOWYMI ORZĘSKAMI (*CILIATA*) LEKKO EUTROFICZNEGO JEZIORA UŚCIWIERZ

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Streszczenie. Badania orzęsków planktonowych prowadzono w lekko eutroficznym jeziorze Uściwierz położonym na Pojezierzu Łęczyńsko-Włodawskim. Próby planktonowe pobierano wiosną, latem i jesienią czerpaczem Bernatowicza. Celem oceny liczebności orzęsków pobierano próby wody o objętości 1 l, które utrwalano płynem Lugola. Następnie próby zagęszczano do 30 ml przy pomocy siatki planktonowej. W laboratorium protozooplankton poddawano analizie jakościowej i ilościowej. Stwierdzono występowanie 29 taksonów orzęsków należących do 8 rzędów. Średnia liczebność tych mikroorganizmów kształtowała się na poziomie 6 osobn.·ml^{-1}, zaś ich biomasa nie przekraczała 81 µg·l^{-1}. W jeziorze dominowały głównie trzy gatunki: miksotroficzny *Strombidium viride* z rzędu Oligotrichida, *Cinetochilum margaritaceum* z rzędu Scuticociliatida oraz gatunki z rodzaju *Vorticella*.

Słowa kluczowe: pelagial, orzęski planktonowe, status troficzny