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POPULATION DYNAMICS OF THE CHLOROCOCCAL ALGA *PEDIASTRUM SIMPLEX* MEYEN IN A CARP FISH POND

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In the year 1992 we researched the fish stock influence on the phytoplankton development in 6 fish ponds of the Donji Miholjac Fishery. In our work we presented the results of the research on the phytoplankton in the 7D Fish pond. This pond was a specific one in respect of biomass production of *Pediastrum simplex* Meyen and its participation in the total phytoplankton biomass.

Introduction

The latest papers dealing with the biomanipulation (Bíró et al. 1990, Gliwicz 1990, Meijer et al. 1990, Tátrai et al. 1991, etc.) have shown that the phytoplankton community development can be influenced by fish stock. According to Komárková et al. (1986) it can be even decisive in fish pond ecosystems and this moved us in 1992 to examine the influence of fish stock on phytoplankton development in 6 carp fish ponds of the Donji Miholjac Fishery (Eastern Croatia). These fish ponds are supplied by the Drava river waters and they were under the same anthropogenic influence. The differences were in the quantity and age of fish stock.

In the 7D Fish pond (0.5 ha) 3 m deep, stocked with a very large quantity (900 kg/ha) of one year old carp, phytoplankton developed in a rather specific way. *Pediastrum simplex* developed there in massive amounts. Such an abundance of that species in fish pond ecosystems is not known in the literature. Our aim was, by analyzing the phytoplankton fresh weight biomass, to find out the development of *Pediastrum simplex* population with regard to decisive ecologic factors important for the development.

Materials and Methods

The pond was examined every 14 days and samples were taken for hydrological and hydrochemical analysis, from May to October 1992. For the phytoplankton analysis we used a representative sample of the Fish pond water, i. e. the whole vertical water column taken by Ruthner's bottle from 5 localities. The samples for the quantitative phytoplankton analyses were preserved by Lugol's solution made after Utermöhl (1938). Physical and chemical properties were measured by standard methods (APHA 1975). Phytoplankton species were identified according to: Bourrelly (1966, 1968, 1970), Hindák et al. (1975, 1978), Hindák (1977–1990), Huber-Pestalozzi (1961–1983), Sulek (1969). Quantitative analysis of phytoplankton was done by »tubular-chamber« method after Utermöhl (1938). The phytoplankton wet weight biomass was calculated from the volume in such a way that 1 cubic cm equaled 1 mg of biomasa. To calculate the biomass we applied the method by Mihaljević and Vuković (1993).

Results and Discussion

During the research period, from May to October 1992, the water temperature in the 7D Fish Pond varied from 12.00 °C to 26.00 °C and was correlative to the air temperature (Fig. 1). In the first part of the raising season (May – August) the water temperature varied from 21.00 °C to 26.00 °C; after that it began to decrease gradually to 12.00 °C at the end of October 1992. At the beginning and at the end of the raising season phytoplankton biomass was low and the water transparency very high (0.5 m, Fig. 1). During the summer, transparency diminished to the lowest value (0.20 m, Fig. 1) caused by the increase of phytoplankton biomass and fish movement. Although the fish pond was mechanically aerated, the dissolved oxygen content varied from 5.57 mg/L in June to 19.21 mg/L in October; it means that oxygen saturation varied from 73.28% to 204.80%. Among the chemical elements, which are of greater importance for the phytoplankton growt (OECD 1982) we measured the total nitrogen and phosphorus concentration in the pond (Fig. 2). Mean total phosphorus and total nitrogen concentrations during the research period were equal to 181.91 and 576.76 μg/L. Figure 2 shows how low the total phosphorus and the total nitrogen concentrations were at the beginning of the raising season, and high concentrations in midsummer. At the end of the raising season the concentrations decreased.

Forsberg et al. (1978) established, according to the total nitrogen and total phosphorus ratio, limiting factors criteria for the phytoplankton development: if this ratio is higher than 12, phosphorus is the limiting factor; if it is lower than 7, nitrogen is the limiting factor. In the investigated Fish Pond phosphorus was the limiting factor for phytoplankton growth from May to August 1992, and nitrogen in October 1992.

The phytoplankton biomass varied in the research period from 20.00 mg/L to 122.13 mg/L (Fig. 3). At the beginning of the research, phytoplankton community *Cryptophyceae-Volvocales* (biomass 21.22 mg/L) appeared with the domination of *Carteria ovata, Cryptomonas erosa* and species of the genus

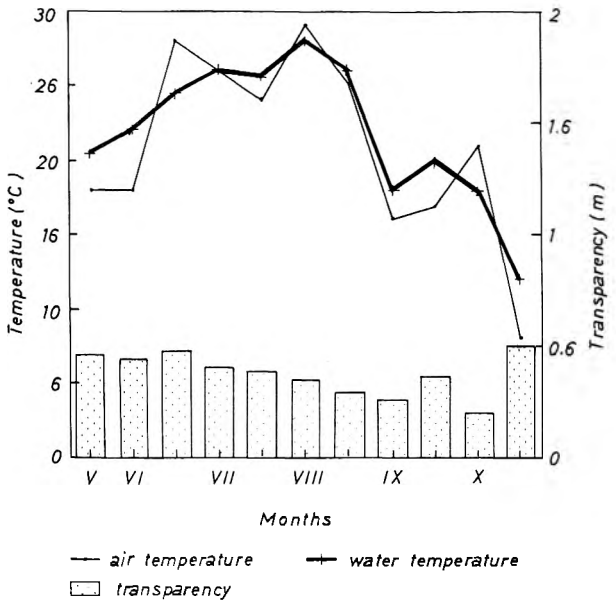

Fig.1. Air temperature, water temperature and water transparency in the Fish pond 7D in 1992.

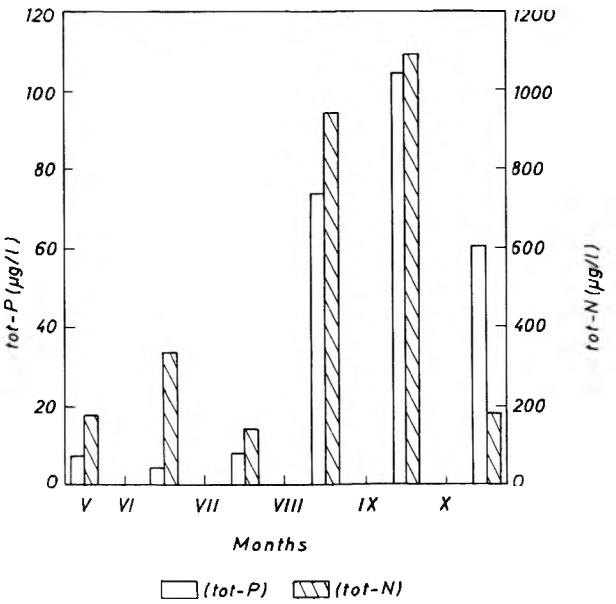

Fig. 2. Total phosphorus and total nitrogen concentrations in the Fish pond 7D in 1992.

Chlamydomonas. Although *Rhodomonas minuta* was the most abundant species (34.1% of the total cell counts) it did not play a significant role in the total phytoplankton biomass (4.2%) because of its small sized cells. Many authors (Komárková et al. 1986, Sommer 1989, Vyhnálek et al. 1991, and others) point out that *Cryptophyceae* community appears in and immediately after the period of the so called clear-water-phase.

Qualitative composition of the phytoplankton community changed considerably at the beginning of June 1992, but its biomass remained quantitatively almost the same (20.02 mg/L, Fig. 3). *Coelastrum microporum* (41.7% of total phytoplankton biomass) and *Pediastrum simplex* (31.3% of total phytoplankton biomass) predominated in the phytoplankton community. Already at the end of June, *Pediastrum simplex* became predominant (36.04 mg/L, 67.5% of the total biomass) in the phytoplankon community composed of 41 species. Its biomass increased to 39.67 mg/L at the beginning of July and to 53.28 mg/L in the middle of July 1992, i. e. 72.2% and 75.6% respectively of the total phytoplankton biomass. At the beginning of August, during the high water temperature (27.00 °C) *Pediastrum simplex* community reached its biomass maximum (109.25 mg/L, Fig. 3, or 89.4% of the total phytoplankton biomass). At that time nutrient concentration increased too (Fig. 2). At the beginning of September 1992, at the maximal concentrations of nutrients, *Pediastrum simplex* took 91.9% of the total phytoplankton biomass and became a monotypic community. Its biomass had decreased to 27.32 mg/L (Fig. 3) by the end of October 1992, but its part in the total phytoplankton biomass was still high (81.4%).

Up to now we have not found a monotypic *Pediastrum simplex* community, neither have we found it in the literature. Hindák et al. (1978), Sulek (1969) and others point out that *Pediastrum simplex* appears rarely in continental waters. Cronberg (1980) mentions the presence of 6 *Pediastrum species* in Lake Trummen, among which *Pediastrum simplex.* Gucunski (1973, 1982, 1991) reports from her investigation of the Kopački Rit waters, rich in plankton flora and vegetation, that *Pediastrum simplex* was the rarest and the least present of all 12 taxa of *Pediastrum* genus. But in Belje fish ponds, which belong to the larger protected area of Kopački Rit, Mihaljević and Gucunski (1991, 1993) found an abundant population of this species in summer phytoplankton. Reynolds (1984) points out the prevalence of *Pediastrum, Coelastrum* and *Oocystis* species in summer phytoplankton community in hypertrophic ecosystems. Since the *Pediastrum simplex* community developed only in the 7D Fish pond, where carp fish stock was very large (900 kg/ha) we believe that fish and their various excretion products were one of two possible factors which influenced the phytoplankton community structure. The second factor might be periodical disinfection of the pond with slaked lime, which according to Fott (1967) favors chlorococcal growth.

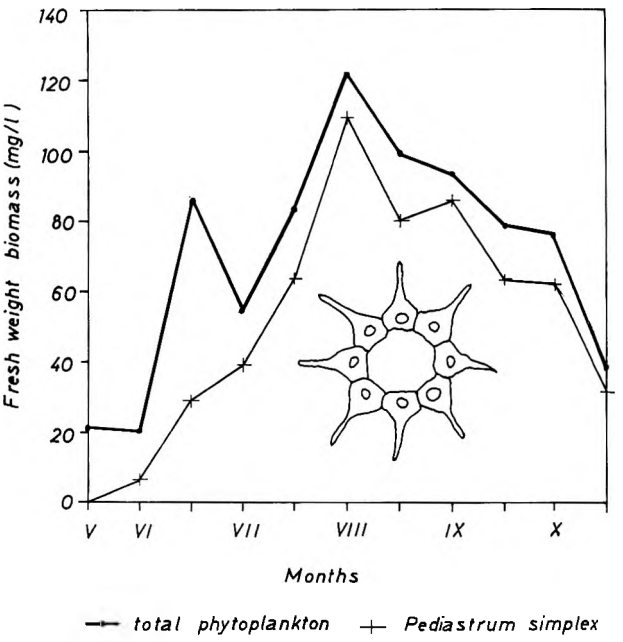

Fig. 3. Total phytoplankton biomass and *Pediastrum simplex* biomass in the Fish pond 7D in 1992.

Conclusion

In the 7D Fish pond phytoplankton community biomass the chlorococcal alga *Pediastrum simplex* predominated in the period May – October 1992. *Pediastrum simplex* biomass increased from 36.04 mg/L (at the beginning of June) to 109.25 mg/L (at the beginning of August); it represented 31.3 to 91.9% of the total community biomass.

The one year old carp fish stock (900 kg/ha), as well as periodical additions of slaked lime, temperature of water and the amounts of phosphorus and nitrogen had the greatest influence on the development of *Pediastrum simplex* population.

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SAŽETAK

DINAMIKA POPULACIJE KLOROKOKALNE ALGE *PEDIASTRUM SIMPLEX* MEYEN U ŠARANSKOM RIBNJAKU

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U radu su izneseni rezultati istraživanja fitoplanktona ribnjaka 7D Ribnjačarstva u Donjem Miholjcu (Hrvatska) tijekom uzgojne sezone svibanj – kolovoz 1992. godine. U biomasi fitoplanktonske zajednice ovoga ribnjaka dominirala je klorokokalna alga *Pediastrum simplex* Meyen. Njezina se biomasa povećavala od 36,00 mg/L (početak lipnja) do 109,25 mg/L (početak kolovoza 1992.), te tako činila 31,3–89,4% ukupne fitoplanktonske biomase. Velika gustoća jednogodišnje šaranske mlađi 900 kg/ha), povremeno vapnjenje ribnjaka, povoljna temperatura vode, te niske količine fosfora i dušika vjerojatni su razlozi snažnoga razvoja populacije vrste *Pediastrum simplex.*

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