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ANABAENOPSIS RACIBORSKII WOLOSZ.BLOOM IN LAKE BALATON IN THE SUMMER AND AUTUMN OF 1982

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Introduction

Anabaenopsis raciborskii is a worldspread N_2-fixing blue-green alga. It is very common in the tropic lakes of India and Indonesia. It was frequently noticed in the southern parts of the Sovietunion, and occurred in Brasilia and in the temperate region of North America. In Central Europe the species is recorded in Austria, in Czechoslovakia and in Romania. Its first sure occurrence in Hungary was in the Lake Szelidi (southern Hungary) in 1975, and then it was noticed in some fish-ponds and in dead-arms of Danube as well.
In the algologically well studied Lake Balaton Anabaenopsis raciborski appeared in 1978 (Oláh & al 1978) and in the next year its mass production was observed in the most eutrophic Keszthely-bay of the lake. In the summer and autumn of 1982 a permanent bloom of Anabaenopsis raciborskii swept through the lake in a west to east direction.
Aims of this paper are (i) to describe the quantitative characteristics of the algal bloom and population dynamics of Anabaenopsis raciborskii, (ii) to outline the effect of the algal bloom on the water quality areas of the lake and (iii) to assess some environmental factors which might be responsible for the algal bloom.

Methods

During the bloom of Anabaenopsis raciborskii samples were taken on three occassions from ten places along the longitudinal axis of the lake (see Fig.1) and on 40 occassions in the Tihany region. Algae were counted with inverted microscope, then cell counts and volumetrical biomass were estimated. Phytoplankton community structure was tested with Czekanowsky's similarity index, and cluster analysis was made based on UPGMA fusion algorhytm.
Meteorological data derive from the achives of the Siófok and Tihany observatories of the Hungarian Meteorological Service.

Results and Discussion

According to the studies on the phytoplankton of Lake Balaton large blue-green algal blooms developed mainly in the Keszthely-bay, the western part of the lake. In other parts of the lake blooms of N_2-fixing blue-green algae did not occur before 1982. On the basis of community structure studies Lake Balaton could have been shared into three parts (western, middle- and eastern) with differnet water quality. Summer maxima of phytoplankton biomass are given on Fig. 1 in the years of 1965, 1978 and 1982.
Anabaenopsis bloom expanded from western to eastern direction with a time lag of about three weeks. Borders between the three large water quality areas became very weak (Fig. 2). Cluster analysis of the data of the summer of 1982 indicated the three large water quality areas, but similarity values are higher than they were in 1978.Lake area with the "worst" water quality expanded (Fig. 3).
Development of the Anabaenopsis raciborskii bloom was studied by daily sampling at the Tihany area of the lake. Number of Anabaenopsis filaments began to increase first between July 20 and 25 (Fig. 4). Then population increase has stopped which was connected with a storm and with a decrease in water temperature. After the storm water temperature began to increase. Since that time Anabaenopsis raciborskii number increased continuously to about 100 million filaments pro liter

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about the middle of September (Fig.5). Whole lenghts of the Anabaenopsis bloom was 70 days, 35 days before the peak and 35 days after it. Collapse of the bloom began when the water temperature was still 24-25^{0} C. Anabaenopsis contribution to total biomass was 90-95 in September (Fig. 6) making the phytoplankton relatively poor in species with small cell sizes. This might have been the reason for Dr. Zankai had not found grazing zooplankton during this period almost at all. The presence of the tremendous filaments is unfavorable from the point of view of filtration and nutrient uptake of grazing zooplankton.

Population dynamics of Anabaenopsis raciborskii was very regular during the bloom, it can be described with an orthogonal polinom of the 5 th order (Fig. 5). Correlation between the function and Anabaenopsis population curve is 0.98.

As possible reasons for the Anabaenopsis bloom both nutrient enrichment and meteorological conditions should be mentioned. Nutrient load of Lake Balaton has had a many years increasing tendency. According to the meteorological data of the year 1982 (Fig. 7) more than the half of the whole year precipitation was in the two months just before the beginning of the bloom. It means that the nutrient load from the catchment area of Lake Balaton must have increased. July-August precipitation was two times higher than the average of the previous ten years. Number of sunny hours and the water temperature were significantly higher in 1982 than in other years, water temperature exceeded 29^{0}C on some occassions. It was in 1972, when similarly high water temperature was last recorded. These meteorological conditions might have been favourable for Anabaenopsis raciborskii, which alga is very common in tropic regions.It might be also favorable, that the wind velocity was generally low, 2-3 weeks calm periods occurred. Summarizing these results we concluded, that the main reason for the Anabaenopsis bloom in Lake Balaton in the summer and autumn of 1982 might have been the increasing tendency of nutrient enrichment, and the exceptional meterological conditions as well.

References

OLAH, J., M.I.SAMRA, M.A.ABDEL MONEIM, L.TOTH and L. VÖRÖS, 1981: Nitrogen fixation in fish-producing agro-ecosystems, Lake Balaton, reservoir, fishponds. A halhustermelés fejlesztése 10, HKI Szarvas, Hungary, pp.1-208 (in Hungarian with English summary).

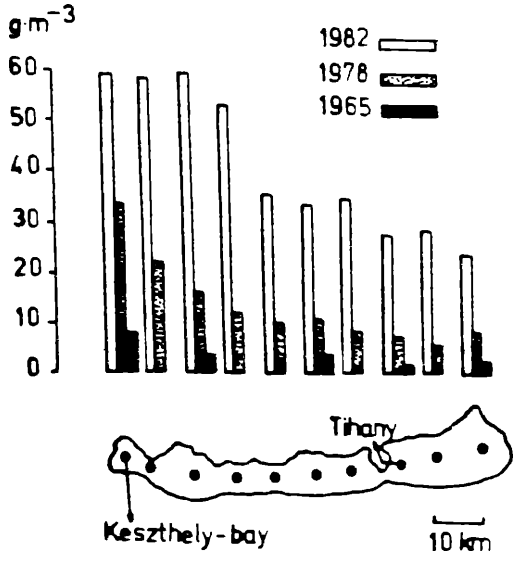

Figure Summer maxima of phytoplankton biomass along the longitudinal axis of Lake Balaton 1965, 1978 and 1982

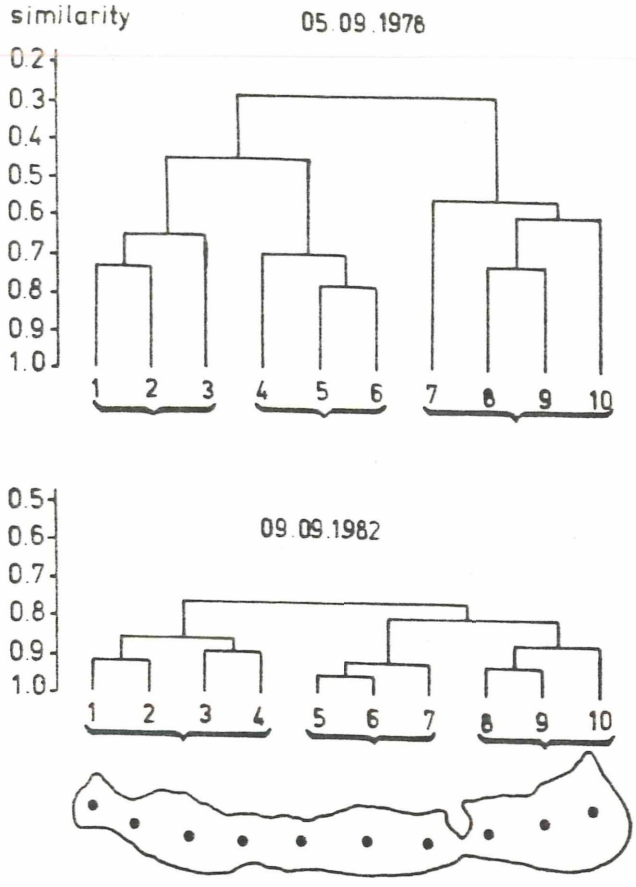

Figure 2: Cluster dendrogram of the phytoplankton community structure based on samples taken along the longitudinal axis of Lake Balaton on 5th September 1978 and on 9 th September 1982

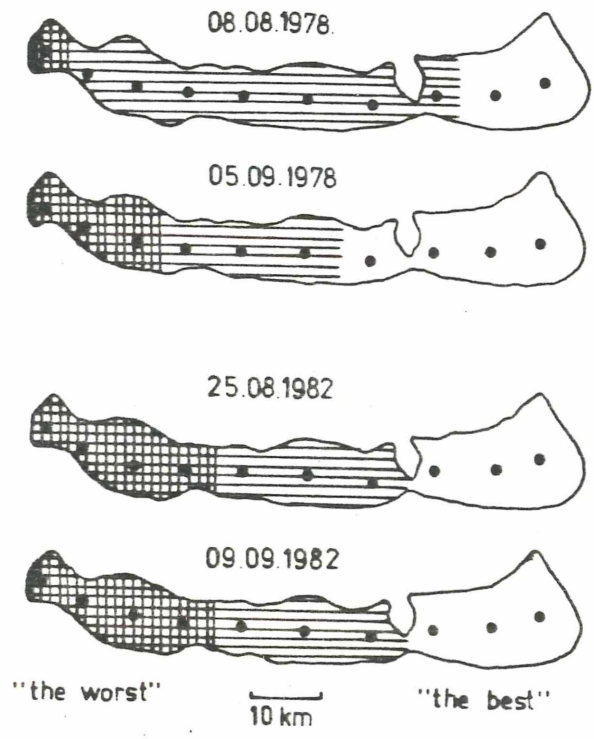

Figure 3: Water quality areas of Lake Balaton

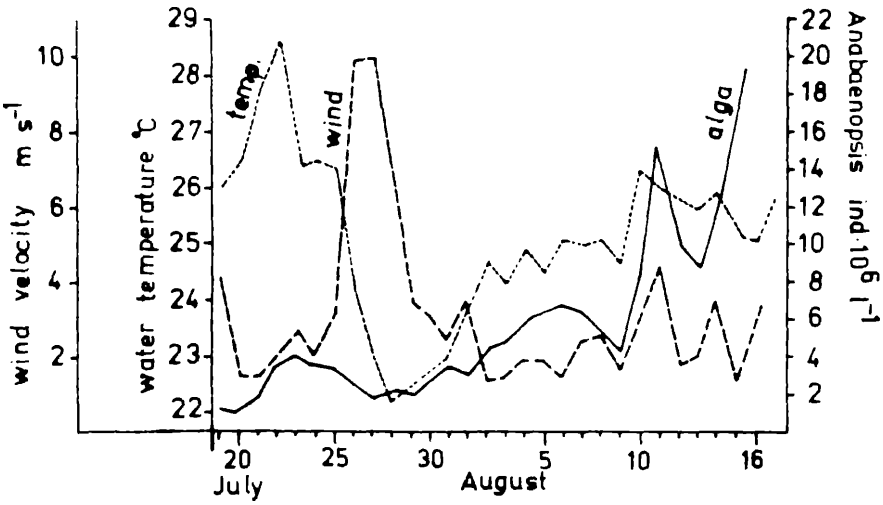

Figure Wind velocity, water temperature and numbers of Anabaenopsis raciborskii filaments between 19 July and 16 August 1982 in Lake Balaton at Tihany

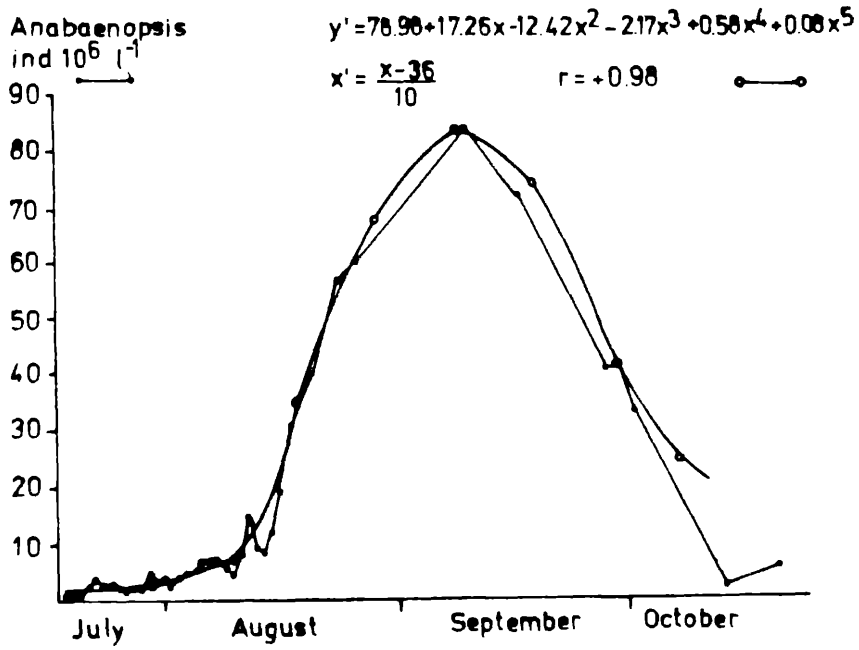

Figure 5: Population dynamics of Anabaenopsis raciborski between July and October 1982 in Lake Balaton at Tihany and the orthogonal polinom fitted on the data

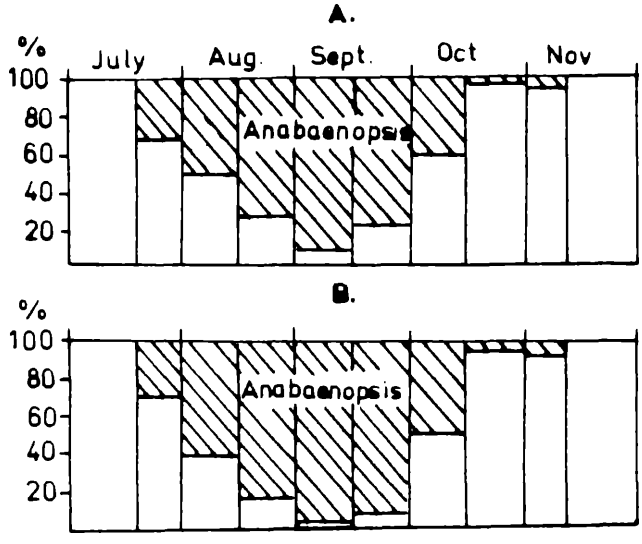

Figure 6: Contribution of Anabaenopsis raciborskii to numbers (A) and biomass (B) of phytoplankton between July and November 1982 in Lake Balaton at Tihany

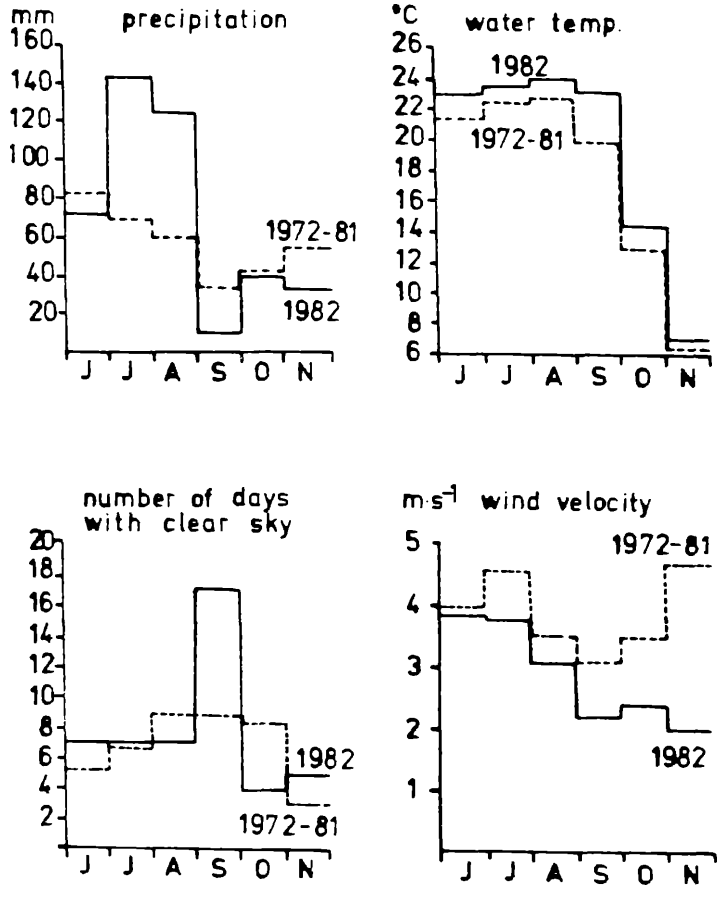

Figure 7: Monthly averages of some meteorological variables in 1982 and 1972-81 measured by the Siófok and Tihany observatories of the Hungarian Meteorological Service