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CYANOBACTERIA–PHYTOPLANKTON DYNAMICS OF A HYPERTROPHIC AFRICAN LAKE

Tamar Zohary*, Aracangela M. Pais-Madeira**, Richard D. Robarts*** and K. David Hambright*

** Israel Oceanographic & Limnological Research, The Yigal Allon Kinneret Limnological Laboratory, P.O. Box 345, Tiberias 14102, Israel*
*** Division of Water Technology, CSIR, Pretoria 0001 South Africa*
**** National Hydrology Research Institute, Environment Canada, 11 Innovation Boulevard, Saskatoon, Canada*

KEYWORDS

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Phytoplankton species composition and abundance were recorded weekly or bi-weekly for nearly 7 years in a hypertrophic reservoir (Hartbeespoort Dam, South Africa), together with a range of physical and chemical parameters. These data were used to demonstrate a case where competitive exclusion by cyanobacteria was a major factor structuring the phytoplankton community.

A total of 73 species were recorded, of which only 20 were occasionally abundant, and only 5 became dominant (>50% of total biomass) at least once (*Microcystis aeruginosa* Kutz. emend. Elenkin, *Oocystis lacustris* Chod., *Aulacoseira* (formerly *Melosira*) *granulata* (Ehr.) Simonsen, *Cyclotella meneghiniana* Kutz., *Carteria cordiformis* (Carter) Diesing).

The earlier years of the study (1982–1986) were drought years characterized by low water levels (10–15 m below the level at full supply), nutrients (N, P, Si) in excess supply at all times of the year, and overwhelming dominance of the cyanobacterium *Microcystis aeruginosa* (Fig. 1), a *K*-selected species well adapted to withstand the range of environmental conditions throughout summer, fall and winter each year. In spring *M. aeruginosa* sedimented out and a fast successional episode followed in which several species of chlorophytes, diatoms and cryptophytes appeared and disappeared until *Oocystis lacustris* became dominant for a few weeks, to be replaced by *M. aeruginosa* early in the summer. During the following rainy years (late 1986 to 1988) the impoundment filled. Major washout losses due to intentional flushing of *M. aeruginosa* scums downstream, concomitant with a considerable decline in surface water phosphorus concentrations associated with elevated TN/TP ratios, probably reduced the abundance of *M. aeruginosa*. Its bloom extended over a smaller portion of the year in 1987 and disappeared in May 1988. *M. aeruginosa* did not bloom throughout 1989 and 1990 (Chutter and Roussow, 1992).

The number of phytoplankton species co-occurring in Hartbeespoort Dam was always low (monthly mean = 7.9 ± 2.2 SD). Shannon's diversity index (Sommer, 1993) was generally low, ranging from 0.1 to 2.2 and

subject to distinct seasonality, with highest values during spring each year, when *M. aeruginosa* was absent. The inter-annual maximum diversity as well as the highest number of species (13) occurred after the disappearance of *M. aeruginosa*, in spring 1988. When *M. aeruginosa* was dominant (>50% of total phytoplankton biomass) its relative abundance explained 87% of the variability in the diversity index. A time–series analysis of the data showed that biomass increases of other phytoplankton species occurred over the entire spectrum of environmental conditions such as temperature, SRP concentration, and z_{eu}/z_m, but were mostly restricted to times of low *M. aeruginosa* biomass (usually below 20 g wet weight m^{-3}). Our conclusion is that competitive exclusion was more influential than "classical" factors such as temperature, light, nutrients or grazing as a key factor governing species composition and abundance of phytoplankton in this hypertrophic subtropical reservoir.

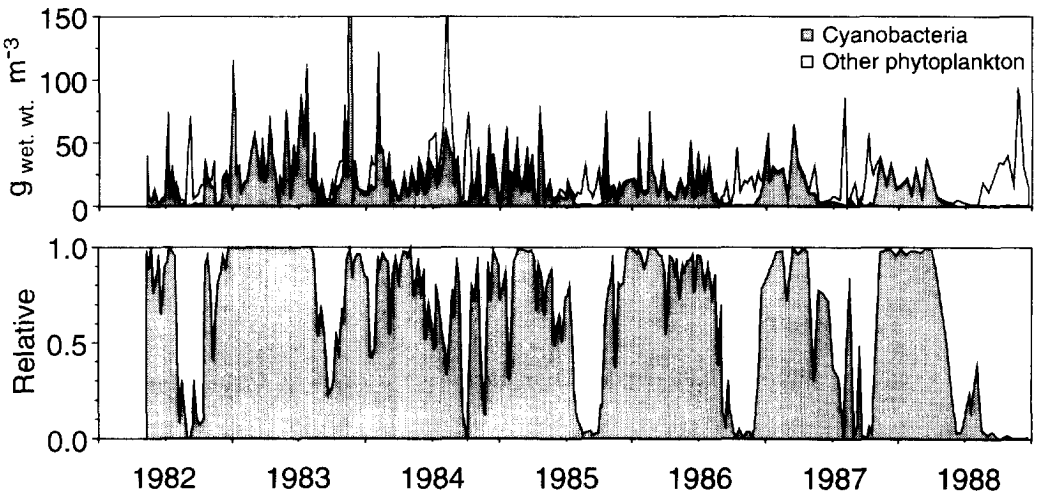

Figure 1. Weekly or bi-weekly changes in biomass of cyanobacteria (mostly *Microcystis aeruginosa*) and other phytoplankton (upper panel) and the relative contribution of each group to total phytoplankton biomass (lower panel) in Hartbeespoort Dam, South Africa.

A full report of this work is to be published elsewhere (Zohary *et al.*, in press).

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