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Phytoplankton in Lake Tanganyika: a Comparison of Community Composition and Biomass off Kigoma with Previous Studies 27 Years Ago

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ABSTRACT. *The composition and temporal distribution of phytoplankton was studied in the northern basin of Lake Tanganyika and was compared with existing data from 1975 from a nearby locality. Sampling was conducted every 2 weeks from February 2002 to February 2004 at a pelagic station in Lake Tanganyika off Kigoma (Tanzania). Changes in algal community structure were observed: the reported cyanobacteria-chrysophytes-chlorophytes community of 1975 was replaced by a cyanobacteria-chlorophytes-diatom community. Moreover differences in species composition were detected between 1975 and 2002–2003. Besides the rarity of chrysophytes not all the species reported from 1975 were observed and conversely new taxa were found. While taxonomic issues make a direct comparison difficult, our data provide evidence for real floristic changes. These changes may be related to the decreasing productivity of the lake, as was recently reported for Lake Tanganyika and confirmed in the present study.*

INDEX WORDS: *Lake Tanganyika, phytoplankton, species composition, seasonality, algae.*

INTRODUCTION

The first investigation on the algal composition of Lake Tanganyika dates back to the beginning of last century (West 1907). Van Meel (1954) published the results of the algological research, undertaken during a hydrobiological and limnological mission to the lake just before the Second World War. A year later Symoens (1955a, b, 1956) reported on important blooms of blue-green algae in the northern basin. From the end of the seventies a series of studies focused on the ecology of the phytoplankton of the lake (e.g., Hecky *et al.* 1978; Hecky and Kling 1981, 1987; Haberyan and Mhone 1991; Caljon 1992; Sarvala *et al.* 1999). Although most studies dealt with the pelagic region, some interest was also given to the littoral zone (Cocquyt *et al.* 1991). Renewed taxonomic interest on algae from Central Africa during the nineties let to the publication of a checklist of the algal flora of the East African Great Lakes. Recently a strong decline in biomass and changes in the importance of dominant algal phyla were reported to have occurred in the lake over the past three decades (Verburg *et al.* 2003), driven by increased stabilization of the water-column resulting from climatological factors (e.g., regional increase of air-temperature) (O'Reilly *et al.* 2003). While there are other potential mechanisms leading to the observed changes, we need also to take into account the possibility that the inferred changes are artefactual as a result of interannual variability in climate forcing of the lake dynamics. Unfortunately no long-term data exist on Lake Tanganyika's phytoplankton succession. Differences exist in levels of identification, nomenclature, and sample treatment, all which complicate a comparison among available data. Here we report on the algal dynamics and composition for a 2-year period and compare these with previous observations (Hecky *et al.* 1978; Hecky and Kling 1981, 1987).

In the 1970s the phytoplankton composition near Kigoma was characterized during the wet season (October-April) by a cyanobacteria-chrysophyta-chlorophyta assemblage when there was high light and reduced nutrient availability in the epilimnion. During the dry season (June–September) diatoms

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became the dominant group, favored by the low light and high nutrient availability during periods of increased vertical mixing. Blooms of *Anabaena* spp. developed at the end of the dry season when the water column restratified. The average euphotic depth during the 1975 surveys was 28 m (Hecky *et al.* 1978, Hecky and Fee 1981), although it may have varied over a wide range (Sarvala *et al.* 1999). Phytoplankton biomass and composition near Kigoma was given for the first 30 m.

The results of the present phytoplankton study are part of the Climlake project and a bi-weekly sampling was conducted in the northern basin of Lake Tanganyika off Kigoma (Tanzania). Climlake is a Belgian multidisciplinary project combining hydrodynamics, nutrient distribution, plankton dynamics, geochemical signals, paleoecology, and fisheries. It aims to develop a model for improving the understanding of Lake Tanganyika variability and sensitivity to climate change.

MATERIAL AND METHODS

Study Site

Monitoring took place in a pelagic station off Kigoma, Tanzania (04°51.26′ S, 29°35.54′ E) (CLIMP-K) from February 2002 to February 2004 in collaboration with the local department of TAFIRI (Tanzanian Fisheries Research Institute). The sampling site is identical to the one used in the FAO/FINNIDA LTR project (Plisnier *et al.* 1997) but 2 km closer to the shore than the sampling station in 1975. Standard sampling periodicity was every 2 weeks.

Sampling

Water was collected with a 5-L HYDROBIOS or a 12-L GO-FLO sampling bottle at 20-m intervals from the surface up to 100 m depth. One-litre subsamples of water from each depth were transferred to a one-litre polyethylene bottle and fixed in situ with an acid Lugol's solution, formalin, and sodium thiosulphate solution (3%) (after Rassoulzadegan in Sherr *et al.* 1993). Samples were settled for sedimentation during 48 h in the laboratory of TAFIRI at Kigoma. The supernatans was removed and the concentrated samples were transferred to 100-mL bottles for transportation to Belgium. Prior to pouring the samples in sedimentation chambers of 10 mL, the samples were concentrated again during 48 h in order to fit a whole sample in the sedimentation chamber and colored with a drop of Rose Bengal (Aldrich Chem. Co) to enhance visibility of the cell content.

Limnological profiles using a CTD and transparency measurements (Secchi disk depth) were carried out during the sampling. Nutrient analyses were done with standard spectrophotometric techniques, Macherey-Nägel analytical kits and/or absorbance (Descy *et al.* 2005). Euphotic depth was derived from Secchi depth by calculating the vertical light attenuation coefficient and the mixing depth was estimated from the top of the thermocline as shown by temperature and oxygen profiles obtained by the CTD (Descy *et al.* 2005)

Microscopic Investigation

Phytoplankton counts of cells/colonies ≥5 µm were done on a Zeiss Axiovert 135 inverted microscope according to the Utermöhl method (Uthermöhl 1931). Identification was done with standard works (e.g., Geitler 1932, Komárek and Fott 1983, Starmach 1985, Popovský and Pfiester 1990) and more specific literature on Lake Tanganyika (e.g., Van Meel 1954, Hecky *et al.* 1978, Caljon pers. notes). For each sedimentation chamber 30 fields were examined at a 400× magnification, to have at least 500 cells counted (minimum was 572, maximum 4,648 cells). Biovolumes were calculated from mean linear cell dimensions of each species and using appropriate formulas (Hillebrand *et al.* 1999). Biomass estimations, expressed as mg/m^3, were calculated assuming a density of 1. Counts were made for the samples of 20 m depth. However, it must be noted that organisms ≥2 µm were also included in the studies of Hecky and Kling (1981, 1987) and Vuorio *et al.* (2003).

Data Analyses

The phytoplankton biomass data were submitted to ordination and classification techniques using the programs CANOCO and Statistica respectively. After elimination of rare species, occurring in less than 10% of the samples with a relative biomass inferior to 1, data were log transformed prior to the analyses.

RESULTS

Species Composition

The pelagic phytoplankton community biomass near Kigoma was dominated by cyanobacteria, chlorophyta, and diatoms. Chrysophyta and crypto-