SOME ASPECTS OF THE LIMNOLOGY OF KANDY LAKE, SRI LANKA

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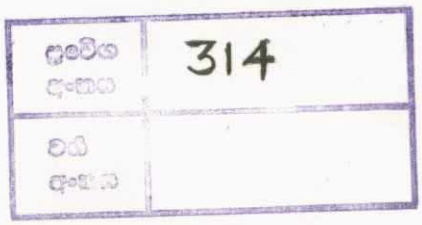

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Abstract

One of the most crucial water pollution problems prevalent in lakes and reservoirs located in urban environments is cultural eutrophication resulting in impairment of water for intended uses such as drinking, food processing, recreation, aesthetic purposes etc., Cultural eutrophication is set off due to nutrient enrichment (nitrogen and phosphorous) by anthropogenic events rather than natural processes. A man-made water body, Kandy Lake located in the heart of the second largest city adjoining a world's famous Buddhist temple in Sri Lanka was investigated for some aspects of its limnological characteristics at four sites established along the longitudinal axis in similar distances, monthly from September 1996 to August 1998. Spatial and temporal variations of physicochemical characteristics and nutrient concentrations of both surface and bottom waters at four sites were examined along with the measurements of photosynthetic rate and phytoplankton community structure in order to determining the present status of limnology and trophic status of the water body.

Physicochemical characteristics of surface water did not show significant spatial variation demonstrating a homogeneous condition in Kandy Lake, but marked vertical gradients of some physicochemical parameters were established in the deep basin located towards the dam of the Lake. The seasonal change in surface water temperature of Kandy Lake was between 24.5 °C – 32.0 °C. Although it was within the tropical range, daytime temperature of Kandy Lake varied within a narrow range with a marked vertical decrease establishing a

micro temperature/density stratification. At the deep basin, pH in surface water ranged between 7.4 - 8.76 and in the bottom water it was 6.18-7.40 showing alkaline to acidic nature of water column. Dissolved oxygen concentration at the deepest site was characteristic with a clinograde oxygen profile with occurrence of anoxia during some occasions. Calcium and bicarbonate dominant Lake water had specific conductivity around 300 μScm^{-1} and which is about threefold of inland surface waters found at similar elevations.

The mean ratio of total inorganic nitrogen to total phosphorus was about 16 indicating phosphorus limiting condition but the non-detectable concentrations of dissolved phosphorous was evident of rapid uptake by phytoplankton. The presence of NH_4-N, the most dominant nitrogen species and its upper limit (>2 mg l^{-1}) indicates extremely high heterotrophic potential in bottom water under anoxic conditions in the deep basin. The N and P dynamics coupled with the annual rainfall pattern and monsoon bound wind mixing determined the seasonal periodicity of phytoplankton species during the study period. The water body received sufficient incident light or Total Incoming Radiation and in turn, photosynthetically active radiation under tropical weather. Underwater light transmission and euphotic depth was high during the rainy season and it decreased significantly under dry weather conditions primarily due to self-shading by phytoplankton. Photosynthetic profiles were characteristic with marked surface photo inhibitions on many occasions resulting in maximum light saturated photosynthesis at sub-surface water. The area based net primary production was positive during the study period when vertical photosynthetic

rate was integrated up to euphotic depth with community respiration for the calculation of area based primary productivity. This indicates the autotrophic nature of Kandy Lake during the study period. The relationship between chlorophyll-a to total phosphorous showed eutrophic conditions of this water body throughout the study period.

The chlorophyll-*a*, which showed fluctuations (14-34 $\mu g\ l^{-1}$) under wet and dry weather condition, had a negative correlation with the Secchi disc visibility. Thirty-seven phytoplankton taxa commonly found in tropical waters were recorded in Kandy during the study period with a recently described centric diatom. Of the phytoplankton assemblage, *Pediastrum simplex*, a Chlorophyte commonly found in eutrophic tropical water bodies and *Aulacoseira granulata*, a chain forming centric diatom, known to be a climax species in the tropics, showed a rhythmic oscillation under wet and dry weather conditions. *Microcystis aeruginosa*, non-nitrogen fixing form of a bloom forming cyanobacteria, although present in small numbers, showed a progressive increase towards the end of the study. Evidently, long-term enrichment resulting from both anthropogenic and natural processes led to progressive eutrophication of the water body during the study period. Implementation of either top-down or bottom-up strategies or a combination of both for the restoration of Kandy Lake may be possible after a clear understanding on food web interactions and external and internal nutrient loading of this unique water body, is achieved.