

5.0 Discussion

Eutrophication has been identified as a major water pollution issue in Sri Lanka. Due to careless and uncontrolled land use practices, many water bodies of Sri Lanka are threatened. Kandy Lake is one of the examples. Therefore it is a prior necessity to restore this water body through proper Lake Management practices. First hand information on trophic status of the water body is very useful in planning the Lake management programme.

Biological monitoring of a water body is an integral part for the management of the total ecological health of the water body and it is becoming increasingly important in water quality monitoring assessment. Organisms respond to multiple interactions of lake conditions and therefore, usage of bio indicators and diversity indices as a tool in predicting trophic status of the lake will be an added advantage in determination of water quality.



This study is an effort to develop such bio monitoring tools which is cheaper and affordable to a developing country like Sri Lanka in eutrophication monitoring.

5.1 Physico chemical properties

5.1.1 Water Transparency

Secchi disk transparency values observed for the Kandy Lake during the study period indicates typical values for a eutrophic Lake. The values observed were in the range of 45cm to 95 cm. According to the OECD (1982) programme for assessment of trophic status (Table 2.7) lakes are classified into three categories depending on the Secchi disk transparency

values. As indicated in Table 2.7 the Secchi depth value >2 indicate the eutrophic status of the lake.

According to these values Kandy Lake belongs to hyper eutrophic status where growth of algal mass is high, which influence the water transparency to a very low level shifting the Secchi disk values below 1m. Similar low values has been recorded in many eutrophic lakes in Sri Lanka such as Victoria reservoir, Kotmale reservoir (Piyasiri 1991,1995) Baticaloa lagoon (Sathanandan-1994). This indicates low secchi disc transparency values >1 as in Kandy Lake is typical for eutrophic status of a Lake.

5.1.2 Thermal properties

Kandy Lake is a shallow water body. Thermal properties along the vertical column of the water body clearly indicate the mixing nature. Mixing along vertical is a common phenomenon in many shallower lakes. Similar conditions have been observed in the Beira Lake, Rantambe reservoir (Piyasiri 1991) and this thermal behavior often tends to accelerate the blooming process via nutrient mixing.

5.1.3 Dissolved Oxygen content

Kandy Lake along the vertical profile during the study period indicates the lake mixing. Oxygen depletion in the bottom regions of Kandy Lake is an observed feature and it is indication of the accumulated organic load in the bottom sediments of the Kandy Lake. Bottom regions of the eutrophic lake are anoxic due to stratification (Abel - 1989). However anoxic condition was not found at the bottom of the Kandy Lake probably due to its mixing nature.

5.1.4 pH

pH values observed for the Kandy Lake varied between 6.92 - 10.45 . These high values could be mainly due to degeneration of its algal bloom. Similar high values have been observed even in Kotmale reservoir during its blooming condition in 1991 (Piyasiri 1995, 2001). This condition can be simply explained by the fact that the buffer capacity of water depends on the concentration of OH⁻ ions. As DO increased, H⁺ ions become OH⁻ ions and the pH obviously increased and vice versa.

5.1.5 Conductivity

The specific conductivity of the Kandy Lake varies 0.16 mS-0.32 mS/cm. According to Dissanayaka-1982 high values indicates an abundant input of free ions into the Lake water the effluent load receiving form domestic waste water, the weathering of the more basic rocks and also from the sediment.



5.1.6 Nutrients

High nutrient levels recorded during this study indicates high nutrient loading of the lake. (Average values of Nutrients varied in between as Orthophosphate 512.95µg/L -204.65µg/L and Nitrate 0.243 mg/L-0.114 mg/L).

According to the Guidelines for lake and reservoirs on Eutrophication survey (Table 2.4) these values indicate the Eutrophicated nature of the Lake. This high nutrient values may be due to receiving of high nutrient loads from its catchment. Being situated at a low elevation in the city as many as 29 drains of varying sizes from various sources like hotels, hospital and nursing homes restaurants, sewer lines etc. discharge effluents into the lake. This location also leads to washouts from roads in to the lake during the rainy season. In addition leaves and flowers from the trees surrounding the lake and bird droppings fall in to the water.



All the above reasons may lead to show high nutrient values in the Kandy lake which has been attributed to heavy algal growth that observed during the study period.

According to the observations of the laboratory experiments it was clear that high levels of nutrients lead to high density of phytoplankton in the lake.

5.1.7 Chlorophyll –a

During this study recorded levels of chlorophyll was 100-250 mg/m³. Such elevated chlorophyll a levels are, however, largely due to natural input of nutrients exacerbated by anthropogenic influences like agriculture runoff and sewage. Same situations has been recorded in lake Washington in 1960 - 1965 (Mason -1991). According to the Classification of the New Zealand lakes Table 2.7 b & Table 2.7 a (Vollenweider, 1981) Kandy Lake belongs to the category of Hypereutrophic Status.



5.2 Phytoplankton and Species diversity index in the Kandy lake.

5.2.1 Phytoplankton

Only few (Six -06) Phytoplankton species in grater abundance were recorded in Kandy Lake during the study period. A number of surveys have demonstrated that pollution produces striking changes in biotic community. These structural changes can be quantified numerically and are very useful in assessment of water quality based on the principle that polluted water supports always low diversified flora and fauna while clean water supports high community diversity.(Triverdi- 1981). This low species diversity found in Kandy lake indicates the highly polluted status of the Lake.

The major Phytoplankton species found in Kandy Lake were *Microcystis*, *Melosira* and *Pediastrum*. According to Prescott (1939) the differences in the dominant phytoplankton assemblage of the lake reflects their trophic levels. He reported that oligotrophic lakes are characterized by Chlorophycean flora while the eutrophic lakes were found to be dominated by Cyanophycean forms. During the study it was revealed that most dominant species is *Microcystis* that belongs to Cyanophyceae. According to results of the study density of *Melosira granulata* was also highly significant in Kandy Lake. *Melosira granulata* also indicates high organic pollution of the water. (Pearsall-1932, Sawyer -1947, Prescott-1951). It is a well established indicator of Eutrophication (Rawson- 1956).

5.2.2 Species diversity index in the Kandy lake

According to the calculated values for water samples of Kandy lake, the diversity index values for the entire lake throughout the investigation period are below 1.0. According to Wilhm and Dorris -1968 diversity index <1 is highly polluted and >3 is clean water. It was proven by the Staub et al in 1970 based on their study on the effects of industrial waters on primary planktonic producers in the Mississippi River. Therefore values obtained for the Kandy Lake indicate highly polluted status. Even during different seasons the values have never increased indicating permanent eutrophic status of the Kandy lake.

According to the comparison made by Tiverdi - 1980 on diversity index (based on Shannon and Weavers formula) and species richness (based on Margalef's formula and Menhinick's formula) shows a little variation which is not very significant. Therefore the degree of severity can also be judged by the species richness in such situations. The same situation

was recorded in this study and the Margalef's and Menhinick's values were also below 2 indicating the heavy pollution of the Lake.

6.0 Conclusion and Recommendations

6.1 Conclusion.

- According to the physico chemical & biological observations of the present investigations of Kandy Lake water, it is already eutrophic and therefore its bottom sediment may contains high nutrient concentrations adsorbed to the bottom sediment. Therefore even with the further nutrient inputs are controlled the blooming could occur due to accumulated nutrient loads in the bottom
- The phytoplankton diversity is very low and represented by only 06 species namely, *Microcystis aeruginosa*, *Microcystis incerta*, *Melosira granulate* *Pediastrum duplex*, *Merismopedia tenuissima*, *Diatoma elongate*.
- Out of them the highest density was observed for *Microcystis sp.* and secondly high densities were observed for *Melosira granulate* .
- *Pediastrum* was found in almost all the samples but densities were very low.
- The diversity index values found for Kandy Lake was well below one through out the investigation period for the entire lake indicating that the lake is eutrophic.
- During lake management practices the trends in diversity values could be used as a monitoring tool in eutrophication management.

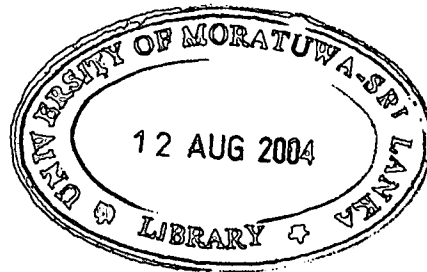
6.2 Recommendations

- The diversity index value of <1 found for Kandy lake could be used as a reference value to monitor the trends during restoration of the lake.

- Diversity index values could be used as a monitoring tool in management of Kandy Lake against eutrophication even without time consuming & costly chemical analysis procedures.
- As nutrient loads accumulated in the bottom sediment due to eutrophication there is a need for quick remedial efforts if the Lake is to be saved from this bad situation. Therefore it is highly recommended to oxidize the bottom organic matter of the lake using appropriate techniques.



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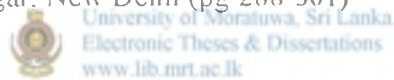
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