Aquatic Life Health Quality Assessment in a Selected Region of Mahaweli River in Kandy District, Sri Lanka

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Abstract - Mahaweli River is the largest and longest river in Sri Lanka, and it is the major drinking water source for a large portion in the Central Province. The aim of this study was the determination of water quality and aquatic life health quality in a selected region of Mahaweli River. Planktons and physicochemical parameters of surface water were studies at six sites, from Tennekumbura Bridge to Victoria Reservoir for a period of three months. Almost all the measured physicochemical parameters were within the Central Environmental Authority (CEA) standards limits for aquatic life, Sri Lanka Standards (SLS) or World Health Organization's guideline for drinking water. Concentration of orthophosphate ranged between 0.232 to 0.708 mg L^{-1}, and it has exceeded the standard limit of aquatic life according to CEA guidelines (0.400 mg L^{-1}) at Site 1 and Site 2. According to the Pearson correlation coefficient (significant correlation at $p < 0.05$), it is obvious that some physicochemical parameters (temperature, Dissolved Oxygen-DO, Total Dissolved Solids-TDS, Total Suspended Solids-TSS, phosphate, sulphate, chloride fluoride and sodium) were significantly correlated to the distribution of some plankton species such as *Aulocoseira, Navicula, Synedra, Pediastrum, Fragilaria, Selenastrum, Oscillataria, Tribonema* and *Microcystis*. Furthermore, species appear in blooms (*Aulocoseira*), organic pollutants (*Navicula*) and phosphate high eutrophic water (*Microcystis*) were found indicating deteriorated water quality in Mahaweli River.

Keywords: bioindicator, environmental variables, physicochemical parameters, planktons, water quality

I. Introduction

Only 0.3% of the Earth's fresh water is accessible to humans as streams, rivers and lakes. Among many fresh water bodies in Sri Lanka, Mahaweli River is the largest and longest river, which is 335 km in length and draining area is 10 448 km^3 [1]. Most importantly, the major drinking water source for a large portion of inhabitants in the Central Province is the Mahaweli River. Therefore, the aim of this study was to determination of water quality and aquatic life health quality in a selected region of Mahaweli River. To understand the status of water body, and to determine how much deviated from the standard value, measured parameters should be compared with water quality standards.

II Materials and Methods

Six sites (Site 1: 7° 16' 50" N, 80° 40' 00" E; Site 2: 7° 16' 34" N, 80° 40' 27" E; Site 3: 7° 16' 15" N, 80° 41' 28" E; Site 4: 7° 14' 06" N, 80° 44' 36" E; Site 5: 7° 14' 18" N, 80° 44' 39" E; Site 6: 7° 13' 32" N, 80° 46' 11" E) were selected for a period of three months from Tennekumbura Bridge to Victoria Reservoir. As the riverine habitats of Sri Lanka are rapidly being altered through many anthropogenic activities [2], sampling locations were selected based on the various anthropogenic activities occurring at bank of the river. Physicochemical parameters such as temperature, pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS) and Dissolved Oxygen (DO) were measured at the site itself using digital portable meters. 5-day Biological Oxygen Demand (BOD_5), Total Suspended Solids (TSS), hardness, concentration of anions (fluoride, chloride, bromide, nitrite, nitrate and sulphate) and metal concentration (Cr, Fe, Ni, Cu, Zn, As, Cd, Pb, Hg, Ti, Na, K, Ca, Mg) were measured at the laboratory according to standard methods. For all laboratory analysis, water samples were collected into 500 mL Polyethylene Terephthalate (PET) bottles which were prewashed with a detergent, distilled water and water from the respective site to be collected. For cation determination using ICP-MS (Inductively coupled plasma-mass spectroscopy), one drop of nitric acid was added into sample bottles during the time of sample collection. Sample bottles were kept in an ice box during transportation and were stored in the refrigerator at 4°C until the analysis. Planktons were observed as biological parameters [3]. Using a plankton net (mesh size 20 µm), surface water samples were collected into acid washed dried vials, were kept in an ice box during transportation and were stored in the refrigerator at 4°C until the analysis. Diversity and abundance of planktons were studied within 4 days of sample collection using standard manuals of plankton identification under the light microscope.

III. Results and Discussion

All the onsite parameters, BOD_5, TSS and hardness were withing the Central Environmental Authority (CEA) standard limits of aquatic life, Sri Lanka Standards (SLS), or World Health Organization (WHO) guidelines for drinking water [4]. Concentration of orthophosphate ranged between 0.232 to 0.708 mg L^{-1}, and it has exceeded the standard limit of aquatic life according to CEA guidelines (0.400 mg L^{-1}) at Site 1 and Site 2, where there is high disturbance by cultivations and close households. Heavy metals like As, Cd, Hg, Pb, Ti, Zn, Cu, Ni, Cr, and some other metals (Fe, Mn, Al, Na, K, Ca, Mg) were found in all six sites during the study period. Concentration of all these cations were below the maximum permissible levels under CEA's ambient water quality guidelines, SLS or WHO standards. When considering biological parameters, distribution of species abundance and species diversity of planktons have varied depending on the sampling location and sampling time. According to the Pearson correlation coefficient (significant

correlation at $p < 0.05$), it is obvious that some physicochemical parameters (temperature, DO, TDS, TSS, phosphate, sulphate, chloride fluoride and sodium) were significantly correlated to the distribution of some plankton species such as *Aulocoseira*, *Navicula*, *Synedra*, *Pediastrum*, *Fragilaria*, *Selenastrum*, *Oscillataria*, *Tribonema* and *Microcystis*. Furthermore, species appear in blooms (*Aulocoseira*), organic pollutants (*Navicula*) and phosphate high eutrophic water (*Microcystis*) were found indicating deteriorated water quality in Mahaweli River due to agricultural activities, solid waste disposal and release of domestic effluents. Relative abundance of common plankton species observed during the study period is shown in fig. 1.

IV CONCLUSION

As a conclusion, species appear in blooms (*Aulocoseira*), organic pollutants (*Navicula*) and phosphate high eutrophic water (*Microcystis*) can be found in every site during the study period. Some reasons behind the deteriorated water quality in Mahaweli River are due to, agricultural activities, solid waste disposal and release of domestic effluents. It is necessary to improve environmental monitoring and management to control the further deterioration of water quality of the river.

References

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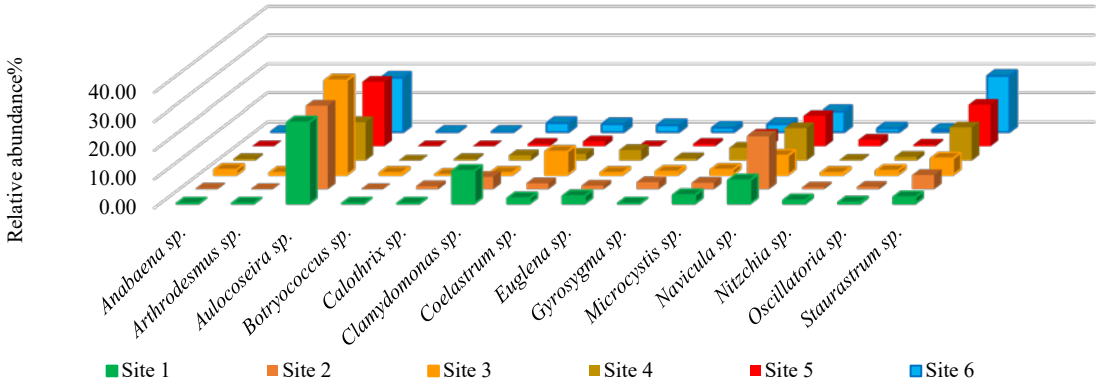

Fig. 1 Variation of relative abundance of common plankton species observed in a selected region of Mahaweli River.