Monitoring of water quality variation trends in a tropical urban wetland system located within a Ramsar wetland city: A GIS and phytoplankton based assessment

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ABSTRACT

The present study, was conducted in an urban wetland system within a Ramsar wetland city in Sri Lanka to study the effectiveness of using the Geostatitical and multivariate statistical techniques together with phytoplankton based biological indices to assess the wetland ecological status. Seven sites were selected from the wetland and the water quality parameters and the diversity and abundance of phytoplankton at each site was assessed. Thirteen species of phytoplankton from Class Cyanophyceae, 18 species from Class Chlorophyceae and six species from class Bacillorphyceae were recorded during the study. There were significant spatial variation of water quality parameters and phytoplankton composition among the study sites. Principal component analysis for water quality and phytoplankton distribution was performed. Palmers index, percentage biological index and the limnological condition index was calculated based on water quality and phytoplankton data. According to the classification based on Palmers index the sites located in the northern portion of the wetland indicated high organic pollution, while other sites indicated no or less less organic pollution. According to the limnological categorization based on pollution index, %BI and LICOI, the northern sites were categorized as sites with poor ecological quality and as severely contaminated sites. The sites in the southern portion of the wetland were categorized as moderately polluted sites with acceptable limnological conditions for the ecological functions to occur within tolerable limits. Water quality prediction maps for the wetland was developed using geostatistical methods and the water quality trends also agreed with the results of the biological indices and the results of the multivariate statistics. The results indicated that the geostatisical and multivariate techniques together with the Palmers index, percentage biological index and the limnological condition index can serve as important tools for monitoring the water quality trends in tropical urban wetland ecosystems.

1. Introduction

Sri Lanka is a tropical island which contains a large number of highly diverse freshwater and coastal wetlands. In Sri Lanka, there are six internationally important wetlands identified by the Ramsar convention. Colombo city which is the commercial capital of Sri Lanka is recently declared as a wetland city in October 2018. Colombo is the only South Asian city that is declared as a wetland city by the Ramsar Convention.

The Colombo city wetland complex consists of a continuum of freshwater marshlands located surrounding Diyawannawa wetland system and the total area is around 20 square kilometers. The Diyawannawa wetland system is the major flood retention area in the Colombo city.

The water quality of the Diyawannawa wetland system is influenced by many external factors such as characteristics of soil, vegetation, runoff and peripheral land use patterns. Maintaining the wetland water quality is important to maintain it's ecological functions properly. However, the variations in the external factors and the changes in the peripheral land-use can affect the wetland water quality. Therefore, wetland water quality monitoring is very important in wetland management programmes. Wetland water quality monitoring can involve variety of methods such as, measuring physical and chemical water quality parameters, visual assessment of eutrophication and use of biological parameters in terms of water quality prediction.

Phytoplankton are considered as a major group of individuals in wetland ecosystems that are identified as ideal biological indicators of monitoring water quality. They are linked to all other aquatic life as they are important components in the aquatic food webs. Therefore, changes in the phytoplankton communities in the aquatic ecosystems