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Identification of Harmful Marine Microalgae with Special Reference to Physico-Chemical Aspects of Coastal Waters in Western Province, Sri Lanka

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Abstract

The objectives of the study were to identify the harmful marine microalgae; their abundance, composition; and determine the associations between coastal water quality and phytoplankton community. One hundred and sixty-five surface water and phytoplankton samples were collected from 15 selected locations along western coast monthly from January to November 2016. Water temperature (WT), pH, dissolved Oxygen (DO), salinity, electrical conductivity (EC) and turbidity were determined in-situ and collected water samples were tested for ammoniacal nitrogen ($N\text{-}NH_4^+$), nitrate nitrogen ($N\text{-}NO_3^-$), nitrite nitrogen ($N\text{-}NO_2^-$), dissolved phosphorous (DP), Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and chlorophyll-*a* according to standard methods. Phytoplankton samples were collected by filtering 50 L of water through 55 µm plankton net and preserved with Lugol's solution at final concentration of 1%. Quantification of phytoplankton was carried out using Sedgwick rafter counting chamber and potentially harmful phytoplankton species were identified under the light microscopy (Total Magnification 100X) using the standard identification keys. One-way ANOVA results revealed that WT, DO, turbidity, TSS, nutrients i.e. $N\text{-}NO_3^-$, $N\text{-}NO_2^-$, DP, and BOD, COD obtained significant variation between four climatic seasons. Mean values of WT, pH, DO, salinity and BOD were within the proposed coastal water quality standards of Sri Lanka by CEA. A total of 83 marine microalgae species were identified belong to eight different classes i.e. Bacillariophyceae, Coscinodiscophyceae, Mediophyceae, Dinophyceae, Cyanophyceae, Zygnematophyceae, Ulvophyceae and Synurophyceae. Majority composition of microalgae consisted 62.6% of diatoms followed by 31.3% of dinoflagellates. *Gymnodinium* sp., *Pyrodinium* sp., *Ceratium fusus, Dinophysis caudata* and *Prorocentrum* sp. were identified as potentially harmful dinoflagellate species. Diatom species namely *Coscinodiscus centralis, C. wailesii, Rhizosolenia* sp., *Chaetoceros* sp., *Pseudo-nitzschia* sp., *Cylindrotheca closterium, Nitzschia* sp., and *Amphora ovalis* were considered to be harmful for fish and invertebrates in mass proliferations. According to Pearsons' Correlation results, Shannon diversity index obtained significant positive correlations between $N\text{-}NH_4^+$ ($r=0.665$, $p=0.007$), DP ($r=0.614$, $p=0.015$), turbidity ($r=0.679$, $p=0.005$) and abundance of dinoflagellates ($r=0.530$, $p=0.042$). Principal component analysis (PCA) produced four groups of sampling locations according to first two principal components that cumulatively explained 59.4% of the total variance. Most influential factors for principal components were nutrients namely $N\text{-}NO_3^-$, $N\text{-}NO_2^-$, $N\text{-}NH_4^+$, DP and physiochemical parameters i.e. WT, pH, DO, EC and TSS. PCA results revealed the positive correlation between phytoplankton diversity, abundance, nutrients, BOD, and TSS as well. There was no bloom conditions of harmful microalgae observed during the study period. However, excessive amounts of nutrients can influence harmful algal blooms since few harmful species were recorded. In comparison with past water quality data this study revealed an increasing trend of water pollution in coastal areas in Sri Lanka. Therefore, nutrient inputs from land based sources have to be well regulated by maintaining standard limits of effluent discharges into water ways that are ultimately connected to the sea. Thus, a frequent water quality monitoring programme is required for coastal water around the country. Comprehensive studies with respect to more environmental factors and extensive marine microalgae surveys, molecular identification of harmful algae, quantification of dissolved and cell bound toxins in marine algae are recommended as future research studies.

Keywords: Marine microalgae, Water quality parameters, PCA, Diatoms, Dinoflagellates