



Variation of *Aulacoseira granulata* as an eco-pollution indicator in subtropical large river Ganga in India: a multivariate analytical approach

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Abstract

Aulacoseira granulata (Ehrenberg) Simonsen 1979 are considered as the eco-variable species which varies in density and diversity along with their morphological traits with the interference of environmental changes, so it is considered as one of the major ecological indicators of the water quality of lotic as well as lentic aquatic ecosystems. To assess major environmental factors which contribute to *A. granulata* bloom in the riverine system, a study was carried out from 2018 to 2019 comprising four different seasons at 11 sampling sites of river Ganga in the middle and lower stretch of river Ganga comprising freshwater and estuarine zones. For the analysis, different univariate, as well as multivariate, analytical tools such as principal component analysis (PCA) and water pollution index (WPI) were used. In the finding, it was observed that the average abundance of *A. granulata* was found maximum during the winter season. Among all the studied sites, the maximum average abundance was at Balagarh ($71,576 \text{ cell l}^{-1}$) and minimum at Diamond Harbour (68 cell l^{-1}). The environmental factors such as dissolved oxygen, depth, and altitude showed a significant influence on the growth of *A. granulata*, while the water temperature negatively influenced the growth rate of *A. granulata*. The WPI showed a significantly negative correlation with cell length. Finally, the study concludes that the blooming of *A. granulata* is highly influenced by varied environmental conditions along the river Ganga, suggesting possible eutrophication. Therefore, a certain minimum flow and depth especially during the lean season have to be maintained for the sustenance of planktonic biota in the river Ganga.

Keywords Plankton bloom · Ganga · Ecological indicator · *Aulacoseira granulata* · WPI · PCA

Introduction

Planktonic organisms are considered as a true biotic indicator of any sort of alterations in aquatic health. Being the nodal point of any aquatic food chain, it certainly depicts the condition through which an aquatic environment is passing by, as they are highly sensitive to any sort of abiotic abnormalities in the environment (Pham 2017). The planktonic bloom in several open water aquatic systems has now become a serious concern globally which is further coupled

with increasing anthropogenic pollution (Nwankwegu et al. 2019; Hossain et al. 2012). Blooms are often a noticeable occurrence irrespective of the form of the aquatic ecosystem (lotic or lentic). Epiphytic plankton, mainly diatoms, are being used as ecological indicators for several decades (Rimet et al. 2015). In a lotic ecosystem such as rivers and streams, diatoms form one of the ubiquitous planktonic communities (Jia et al. 2009). These diatoms (Bacillariophyceae) have also been reported from the mighty Ganga river system in several past literatures (Hossain et al. 2012; Pandey et al. 2017; Srivastava et al. 2020). Diatom community representing the genus *Aulacoseira* (commonly known as pennate diatoms) belonging to the phylum Bacillariophyceae are widely available species in various inland freshwater systems (Chong et al. 2009). They are found mostly in colonial growth habitats. The growth rate of the diatoms is faster in contrast to other phytoplanktonic taxa (Weitz and

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