

Research Article

Assessment of Near-Bottom Water Quality of Southwestern Coast of Sarawak, Borneo, Malaysia: A Multivariate Statistical Approach

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Received 27 March 2017; Accepted 15 May 2017; Published 14 June 2017

Academic Editor: Wenshan Guo

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The study on Sarawak coastal water quality is scarce, not to mention the application of the multivariate statistical approach to investigate the spatial variation of water quality and to identify the pollution source in Sarawak coastal water. Hence, the present study aimed to evaluate the spatial variation of water quality along the coastline of the southwestern region of Sarawak using multivariate statistical techniques. Seventeen physicochemical parameters were measured at 11 stations along the coastline with approximately 225 km length. The coastal water quality showed spatial heterogeneity where the cluster analysis grouped the 11 stations into four different clusters. Deterioration in coastal water quality has been observed in different regions of Sarawak corresponding to land use patterns in the region. Nevertheless, nitrate-nitrogen exceeded the guideline value at all sampling stations along the coastline. The principal component analysis (PCA) has determined a reduced number of five principal components that explained 89.0% of the data set variance. The first PC indicated that the nutrients were the dominant polluting factors, which is attributed to the domestic, agricultural, and aquaculture activities, followed by the suspended solids in the second PC which are related to the logging activities.

1. Introduction

Coastal water quality is one of the worldwide environmental concerns and is of general growing concern in Malaysia. However, most studies were focused on microbiological and heavy metal contamination in West Malaysia [1–5]. Sarawak, which is in East Malaysia, is the largest state of Malaysia. Although deterioration of the coastal environment due to increasing population and urbanization is noticeable in Sarawak [6], the study conducted on Sarawak coastal water is scarce. Aquaculture and domestic sewage with high nutrients content is being discharged directly into rivers [7] while deforestation for timber production and agricultural development has increased soil erosion and inputs of fertilizers in Sarawak River [8, 9], all of which could lead to increased sedimentation and eutrophication in coastal areas.

Regular monitoring is recognized to be an essential step for the characterization of water quality, and the data is

useful in subsequent management decisions for the coastal ecosystem. Comprehensive study on surface water quality has been conducted worldwide but near-bottom water quality is often being neglected in water quality monitoring. Subsurface and near-bottom water often exhibited distinct different water quality due to inadequate mixing in deep water column [7, 10, 11]. Water quality is a principal factor that influences the biota community structure and health condition [12–16]. The study on near-bottom water quality is necessitated and pertinent to demersal fish and benthos community structure.

Multivariate statistical techniques have been proven to be useful in dealing with large sets of monitoring data and provide valuable insights into water quality study [17–21]. Among them, cluster analysis (CA) and principal component analysis (PCA) have been applied in the assessment of spatial variation of tidal river and freshwater forest streams water quality in Sarawak [7, 9, 22]. However, the study on Sarawak coastal water quality is scarce; and the application of CA