Eutrophication assessment based on scaling nutrient and chl*a* values

S. DONTSIOS and M. KARYDIS

Department of Environmental Studies, University of the Aegean, MYTILINI (**Greece**)

Ecological investigations of water pollution based on numerical classification (BOELSCH, 1977) have been used extensively for environmental planning and decision making (UN., 1984). This type of ecological application assumes discrete states in environmental quality since high resolution is required to distinguish between different pollution levels. Eutrophication assessment problems are further complicated due to seasonal trends (PAGOU & IGNATIADES, 1988). In the present work numerical classification was applied to assess eutrophication. Nutrient and chl*a* data were scaled (ordinal and binary scaling) to improve the resolution of the method.

Two sampling sites were selected along the coastal area of Mytilini, the site M1 being near the sewage outfall (eutrophic system) and the site M2 being offshore (oligotrophic system). Methodological details have been described elsewhere (PAGOU & IGNATIADES, 1988). The raw data (nutrient and chl*a* values) were used for the data analysis. The data were log transformed and mean values per station and depth were calculated. The 5 x 8 matrix (5 variables x 8 sampling sites) was row standardized. Three types of scales were developed: (a) Metric scale which was the 5 x 8 data matrix, (b) Binary scale: values exceeding the mean were expressed by the state 1 otherwise state 0, (c) Ordinal scale: Four values (1-4) were given to the data; the value 1 reflecting the most favorable condition and value 4 the least desirable situation ($1 < \mu-\sigma$; $\mu-\sigma < 2 < \mu$; $\mu < 3$ $\mu+\sigma$; $> \mu+\sigma$). The euclidean distance (ED) was used as a dissimilarity measure and the group average as a clustering algorithm (BOELSCH, 1977).

The dendrogram based on metric scaling is shown in Fig. 1(a). It is observed that the pattern is mixed since samples from M1 are grouped together with the site M2. Grouping of sampling sites M1 and M2 based on binary scaling has also shown a mixed pattern. On the contrary, the ordinal scaling (Fig. 1(c)) showed a very good resolution between M1 and M2, the two clusters fused at a similarity level about 75%.

These results indicate that ordinal scaling is the best approach in assessing eutrophication levels; this scaling might be a trade off between the high "noise" of the metric data and the oversimplified system description given by the binary scale.

Acknowledgement

The present work was supported by a FAO/UNEP grant (GRE/68-H).

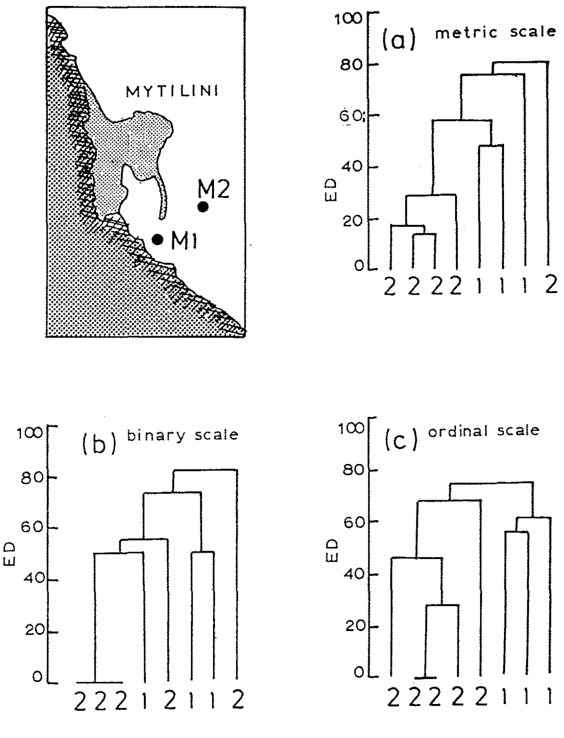

Figure 1. Top left; Station Locations (a),(b) and (c): Station grouping based on scaled data (a) metric scale (log transformed), (b) binary scaling and (c) ordinal scaling.

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Stoichmetry of some basic organic constituents in surface sediments of the Southeast Mediterranean Sea

Fatma E. El. NADY, N.M. DOWIDAR and T. ABOUL KASSIM
Oceanography Dept. Faculty of Science Alexandria
University, Alexandria (**Egypt**)

The Eastern harbour of Alexandria is a more or less polluted basin because of its ecological condition. To asses the degree of pollution in this area, organic constituents as organic phosphorus, nitrogen and organic carbon were measured in the surficial bottom sediments as well as the grain size analysis. A remarkable increase in these concentrations were recorded comparing with those obtained before, because of the continuous discharge of organically sewage pollution which are not biodegradable. Higher concentrations were observed at stations directly affected by sewage discharge. The comparatively low organic content in the harbour irrespective of the discharge of large amounts of untreated sewage discharge is mostly due to the effective exchange between Mediterranean neritic waters and the harbour water.

Introduction

The Eastern Harbour of Alexandria receives two types of direct anthropogenic inputs, one is domestic waste effluent; intermitting discharged to the harbour through eleven outfalls. The other from the shipyard activities at the harbour's western side. The effect of these on the hydrochemistry, nutrients and heavy metals were studied by EL-NADY (1982). Over 183 x 10^6 m^3 of untreated sewage and waste waters are discharged annually into the coastal water of Alexandria. Out of this amount, about 35.2x10^6 m^3 are discharged into the harbour. This quantity is about 2.31 times the water volume of this basin.

Material and Methods

The surface sediments from the harbour were collected using a modified Ekman grab from the sampling sits (Fig. 1). Samples were preserved frozen in an aluminium foil for further analysis of organic constituents. Portion of each sample was used for the determination of the grain size. Inorganic, organic and total phosphorus were determined according to the methods described by ASPILA *et al.* (1976). Organic nitrogen was determined by the Methods described by STRICKLAND and PARSONS (1972). The method used for the determination of dissolved and particulate organic carbon was that of MENZEL and VACCARO (1964) and its modification by FREDERICKS and SACKETT (1970).

Results and Discussion

Grain size analyses showed that sand fraction represents the main core of the sediments, that ranged from 50 to 97% with an average of 80%. The mud fraction hardly exceed few percent (< 17%) and was entirely restricted to the sheltered area. The coarser sediments were eventually concentrated in the area faces the open sea action. The gravel fraction in the deep sediments ranged between 17 and 46%.

Phosphorus content of muds is of considerable importance in estuarine and shallow water ecology. The overall average of inorganic, organic and total phosphorus of the surficial bottom sediments were 0.086±0.052%'0.02±0.011% and 0.106±0.06% respectively. These values are greater than those recorded in the oceanic and near shore sediments, but comparable to that found in polluted areas. The equilibrium state between phosphate adsorbed on the sediment particles and that dissolved in the overlaying water seems to be greatly governed by the oxidation state of the bottom sediments. At pH range between 6 and 8, a complete adsorption takes place (JITTS, 1959).

Organic nitrogen content ranged from 0.152 to 0.4% at stations III and VII respectively. The isopleths of the areal distribution of organic nitrogen showed a decrease from the eastern and western sides of the harbour.

Despite the high load of organic matter discharged into the harbour and its high fertility, the concentration of organic nitrogen was not too high (average 0.254 ± 0.1%) although higher than that in the coastal waters off the Nile Delta. This may indicate that the greater part of nitrogen in the particulate organic matter is rapidly decomposed by bacterial action and converted into soluble forms. The average weight ratio of organic nitrogen to total phosphorus (N/P) amounted to 2.68 which is resulting from the continuous discharge of nitrogenous compounds through sewage runoff.

Organic carbon content (OC) ranged from 1.73% to 9.11% at stations III (at El Boughaz opening) and VII respectively. The isopleths of organic carbon of the sediments showed a decrease from the south western sides of the harbour towards the center. The percent of OC was remarkably high (average 3.2 + 2.638%). Comparing with the Egyptian areas, the percent of organic matter in the sediments was remarkably high, presumably because of the increased productivity of the basin.

The carbon nitrogen and carbon phosphorus ratios are useful means for interpreting the data on organic carbon. The C:N ratio ranged between 6.56 and 21.44. The C/P ratio ranged between 91.0 and 285. The studied area Scores higher C/P ratios compared with the other areas.

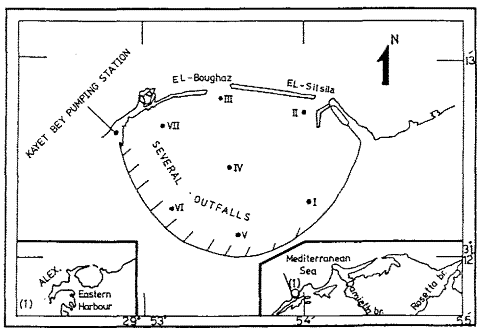

Fig. 1.- Sampled stations in the Eastern Harbour during the period 1985-1986.

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