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

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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.

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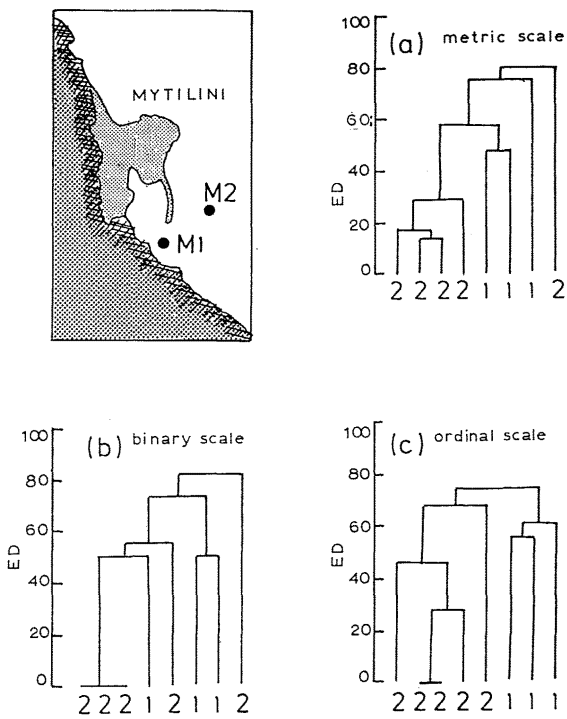

Figure 1. Top left; Station Locations (a),(b) and (c): Station grouping based on scaled data (a) metric scale (log transformed), (b) binary scaling and (c) ordinal scaling.

REFERENCES

BOELSCH D. F., 1977.- Application of numerical classification in ecological investigations of water pollution. EPA-600/3-77-033.

PAGOU K. and IGNATIADES L., 1988.- *Biol. Oceanogr.* 5: 229-241.

UN, 1984.- Coastal Area Management and Development. Pergamon Press.