

ASSESSMENT OF MARINE COASTAL EUTROPHICATION BASED ON SCALING NITRATE CONCENTRATIONS

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The quantitative assessment of eutrophication still remains a problem in spite of the research that has been carried out over the last decades (LIKENS, 1972). Nutrient concentrations are often used in assessing trophic levels (KARYDIS *et al.*, 1983); however, there are problems related to the data analysis since nutrient values deviate from normality and big overlaps between data sets characterising oligotrophic, mesotrophic and eutrophic conditions are observed (IGNATIADES *et al.* 1992). In the present work these shortcomings on the data analysis have been considered and a distribution-free statistical procedure based on scaling nitrate concentrations is proposed as a methodological tool for quantitative assessment of the trophic conditions in marine coastal systems.

Nitrate concentrations from a eutrophic, a mesotrophic and an oligotrophic area, characteristic of Eastern Mediterranean waters (IGNATIADES *et al.* 1992) formed the basis of the scaling system for assessing eutrophication. Each data set was divided into quartiles and in this way a scoring system was developed. Nutrient values ranging from zero to the minimum value of the data set were assigned by the ordinal number 0, between the min. value and lower quartile (LQ) by 1, between LQ and median (M) by 2, between M and the upper quartile (UQ) by 3, between UQ and max. by 4 and finally nitrate concentration values exceeding the max. value of the data set were assigned by the ordinal number 5 (Fig. 1a).

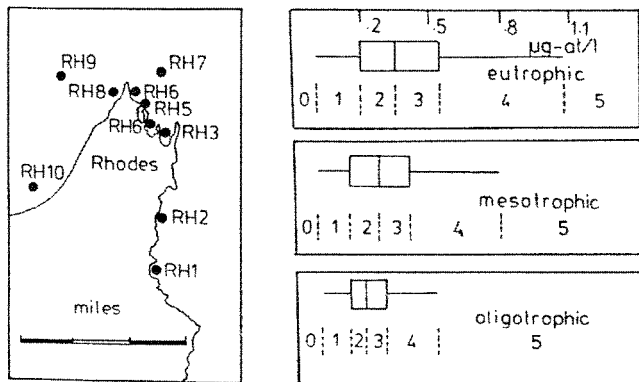


Figure 1. (a) Box-and-whisker plots of the three standard data sets and the ordinal scale described in the text. (b) Station locations

The sum of the scores from the three standard data sets of each data point representing a sampling site an estimate of the trophic level for that particular sampling site. Ten stations (Fig. 1b) spaced along the coastal area of Rhodes, Greece, were used to evaluate the effectiveness of the proposed procedure. It has been found (KARYDIS, 1992) that stations 3, 4 & 5 were eutrophic, 7 & 9 oligotrophic and the remaining sampling sites were mesotrophic. Mean annual values of nitrate concentrations were calculated and their scoring was recorded (Tab. 1)

	RH1	RH2	RH3	RH4	RH5	RH6	RH7	RH8	RH9	RH10
Raw values	0.68	0.45	2.51	6.25	3.00	0.60	0.35	0.42	0.28	0.51
NO ₃ scaling	13	11	15	15	15	13	9	11	7	11

Table 1 Mean annual values of nitrate concentrations along the coastal area in Rhodes, Greece. Second line of the table: score of the trophic levels based on the proposed scaling system

The numerical classification of the ten sampling sites is given in Fig. 2. It was observed that the stations were grouped into eutrophic (3, 4, 5), oligotrophic (7, 9) and mesotrophic (1, 2, 6, 8, 10) states. This grouping was far more pronounced and clear-cut using the results from the scoring system (Fig. 2b) compared to the log transformed raw values (Fig. 2a). This grouping was also statistically confirmed by ANOSIM a non-parametric permutation test (CLARKE, 1993). Further work is being carried out on a number of variables characterizing eutrophication.

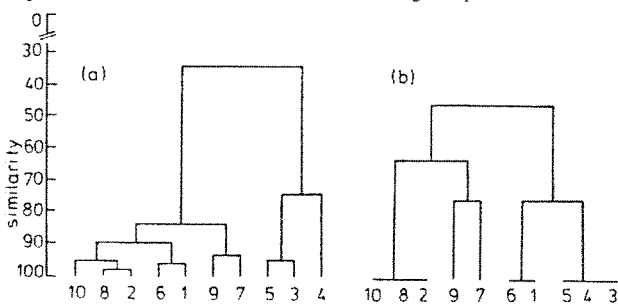


Figure 2. (a) Tree-diagram of the stations based on logtransformed raw values. (b) Tree-diagram of the stations based on the scaling system developed

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