EUTROPHICATION ASSESSMENT BASED ON PHYTOPLANKTON COMMUNITY ANALYSIS

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Although multivariate methods based on nutrient and chlorophyll concentrations have been widely used for eutrophication assessment (KARYDIS, 1992), few efforts have been made for the evaluation of water quality based on phytoplankton community analysis (CLARKE, 1993). In the present work, a number of scaling methods and resemblance measures were tested, in order to maximize the discrimination between an eutrophic and an oligotrophic system. Water samples were collected from February 1992 to May 1993, on a monthly basis, from two stations, M1 and M2, in the strait of Lesvos. The first one was sampled at 1, 5 and 10 m (experimental units A), while the other was sampled at 1, 5, 10, 20 and 30 m (experimental units B). M1 and M2 were characterized as eutrophic and oligotrophic respectively, in previous work (KARADANELLI *et al.*, 1992). A mean abundance was calculated for each species, during summer (May-October) and winter (November-April), dividing the original data-set into two subsets (summer and winter); the three sampling depths of station M1 and five of station M2 formed the eight columns of the data matrix. Numerical classification of the eight sampling units was performed by the group-average clustering algorithm, based on euclidean and absolute distances and Bray-Curtis similarity measure, since they have shown efficiency in discriminating polluted sites (KARYDIS, 1992; SIOKOU-FRANGOU & PAPATHANASSIOU, 1991). Data scaling was also applied, using metric (no scaling) and binary scaling. Values of species abundance exceeding the mean value of a sample were expressed by the state 1, otherwise state 0. Elimination of the data matrices was also performed, excluding species which occurred in the sampling units less than 10 times annually. Two clusters were formed, a eutrophic and an oligotrophic, and the differences between them, were tested by the non-parametric randomization test ANOSIM (CLARKE & GREEN, 1988). The results are presented in Table 1. Phytoplanktonic community data showed good resolution between the eutrophic and oligotrophic sites in most of the cases. It was observed that the discrimination was better when the rare species were excluded, which supports the view that these species add noise to the signal carried by the phytoplanktonic community structure. The resolution between the eutrophic and oligotrophic sites was almost the same, either using metric or binary scaling; similar classification trends were shown by both euclidean and absolute distances. The best discrimination, both in the summer and winter period, was achieved using the Bray-Curtis coefficient of resemblance, on the reduced data matrix with no scaling of the original values (Figure 1).

I. Summer period		
A. Species elimination: all species considered		
	Scales	
	Metric	Binary
B.C.	0.797*	0.348
E.D.	0.705*	0.698*
A.D.	0.673*	0.698*
B. Species elimination: rare species excluded		
	Scales	
	Metric	Binary
B.C.	0.806*	0.286
E.D.	0.721*	0.906*
A.D.	0.673*	0.906*
II. Winter period		
A. Species elimination: all species considered		
	Scales	
	Metric	Binary
B.C.	0.894*	0.400
E.D.	0.667*	0.523*
A.D.	0.667*	0.523*
B. Species elimination: rare species excluded		
	Scales	
	Metric	Binary
B.C.	0.903*	0.318
E.D.	0.667*	0.670*
A.D.	0.667*	0.670*

Tab. 1. ANOSIM test significance levels for differences between clusters (B.C. Bray-Curtis similarity measure, E.D. and A.D. euclidean and absolute distances, respectively).

** Statistically different clusters at the 0.05 probability level..*

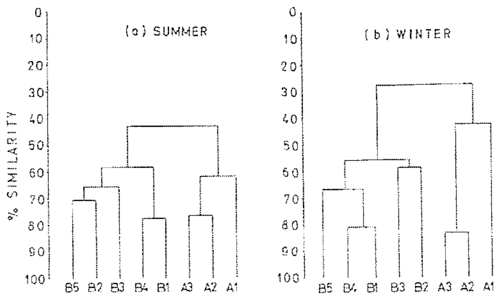

Fig.1. Dendrograms for group average clustering of the reduced data matrix with the Bray-Curtis coefficient in summer (a) and winter (b) period; (A1, A2, A3 and B1, B2, B3, B4, B5, represent different depths of the eutrophic and oligotrophic stations, respectively).

Numerical classification by the group average clustering algorithm, based on phytoplanktonic community data seems to be an efficient method to assess water quality. As a conclusion, the following stepwise procedure is proposed: a) reduction of the original data matrix by removing the rare species, b) no scaling of the original data values, c) use of the Bray-Curtis coefficient of resemblance, d) identification of distinct groups of sites with objectivity by the non-parametric randomization test ANOSIM.

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