EUTROPHICATION AND MACROPHYTES IN THE GULF OF THESSALONIKI, GREECE THE BIOTOPE OF AGIA TRIADA

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Abstract

Seasonal variation of key eutrophication and benthic community features have been studied on a shallow area at Agia Triada, Gulf of Thessaloniki, Greece, between April 1994 and April 1995. By using cluster and multidimensional scaling analysis (MDA), two main communities, one dominated by *Ulva rigida* and the other by *Enteromorpha intestinalis* have been identified in the biotope. Seasonal trends of nitrogen and phosphorus concentrations in the water suggest the dependence of nitrogen upon biomass density. The N/P atomic ratios in the water and in algal tissue have been used to estimate the nutritional state of the studied biotope.

Key-words: Aegean Sea, coastal waters, phytobenthos, nutrients

Introduction

Efflux of municipal sewage, industrial waste water and run off from agriculture development into shallow and closed marine baseness lead to an increase of primary production as a consequence of an extended increase of macrophytic communities dominated by green algae of the genera *Ulva* and *Enteromorpha*. Field (1) and laboratory experiments (2) indicate that the increase of biomass of these genera is directly related to nutrients concentrations, mainly nitrogen and phosphorus. However, as these nutrients are often supplied in pulses, N/P ratio is constantly altered depending on both pulse and uptake rate. The discussion concerning the role of N/P ratio as a control factor of the community structure and thus as limiting factor of primary production is still open and controversial (2,3).

The present study was realized within the framework of the joint research programme "Eutrophication and Macrophytes" (EUMAC). The results presented concern the effects of eutrophication on the benthic macrophytic communities in the Ag. Triada biotope, Gulf of Thessaloniki.

Study area

The Gulf of Thessaloniki is situated in the northeast of the Aegean Sea (Fig. 1) comprising a shallow (maximum depth 28m) and confined basin of 165km^2 surface area. The study area of Ag. Triada extends for 3 km along the south east coast of the gulf. The seabed is mainly sandy with scattered stones and rock where upon benthic vegetation develops.

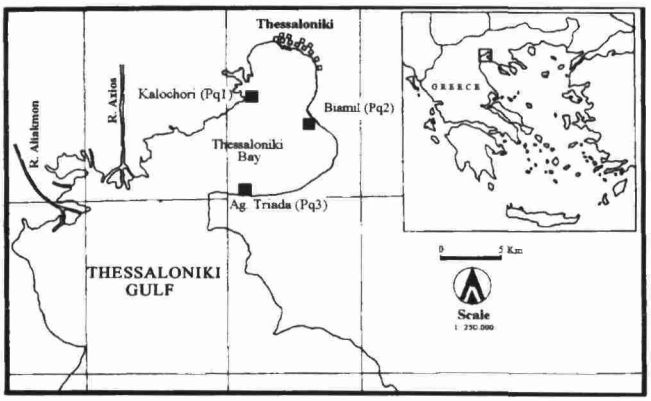

Figure 1. Map of the studied area.

Materials - Methods

Algae segments were collected from approximately 1m depth on a monthly basis along with the monitoring of physicochemical parameters during the period from April 94 to April 95.

Biological parameters: Biomass (wet and dry weight), coverage (%). The applied methodology is according to Littler (4) and has been described in details by Lazaridou *et al.* (5).

Physicochemical parameters: Temperature, salinity, pH, dissolved oxygen, irradiance, water transparency, suspended solid mater and inorganic nutrients. The methodology used is described in details by Haritonidis *et al.* (6).

Results and Discussion

Structure of macrophytic communities

Diversity and dominance indicate a tendency to degradation of the marine environment of the Gulf of Thessaloniki as a consequence of the efflux of municipal sewage and industrial and agricultural effluents (see also 7, 8, 9). The low species diversity as documented for the biotope (5) is a well known effect of long term pollution in the coastal marine environment (10, 11, 12).

Based on coverage data, the dominant species were: *Ulva rigida*, *U. curvata*, *Enteromorpha linza*, *E. intestinalis*, *Ectocarpaceae spp.*, *Petalonia fascia*, *Scytosiphon lomentaria* and *Hypnea musciformis*. Cluster (not shown) and MDA analysis (Fig. 2) have shown two main communities. The first (I) is dominated by the species *E. intestinalis* and the second (II) by the species *U. rigida*. The *E. intestinalis* community dominates the biotope in winter and spring, where the *U. rigida* community dominates during summer and autumn. In October'94 the biotope was dominated by *U. rigida* and *H. musciformis* and is shown at the scatter diagram as a separate point. With the exception of *H. musciformis*, the rest of dominant species belong to short-lived opportunists which are characteristic of eutrophicated temperate coastal areas (10, 11, 12). Based on the coverage and MDA analysis data a simple scheme of the macrophytic succession in the biotope was produced (Fig. 3).

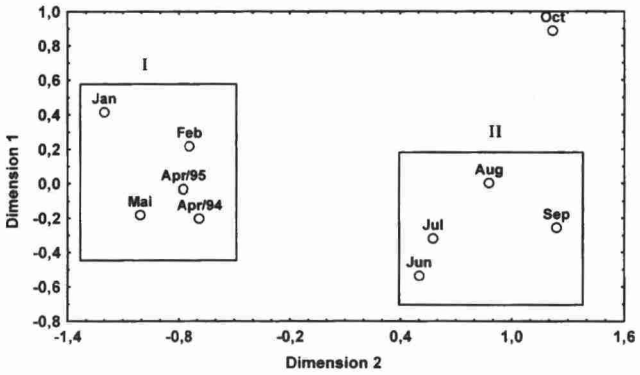

Figure 2. Multidimensional scaling analysis (MDA) based on coverage data.

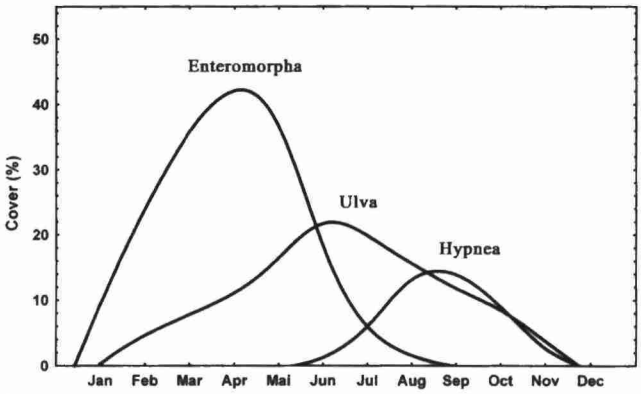

Figure 3. Simple sheme of macrophytic succession based on coverage data and the results of MDA.

Physicochemical parameters and macrophytic abundance

The exact determination of the factors which are responsible for the increase of the macrophytic biomass in the marine environment, especially in shallow and enclosed areas, is a difficult task (1). Figure 4 shows the seasonal variation of the macrophytic biomass (dry weight) in the study area. Correlation analysis between physicochemical parameters and biomass showed a statistically significant correlation ($p<0,05$) only within total dry biomass (TDB) and irradiance. However, TDB and inorganic nutrients, mainly nitrates, are correlated as follows: Total inorganic nitro-