MACROBENTHIC COMMUNITY PATTERNS ACROSS THE MARINE BRACKISH GRADIENT

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Abstract
Structure of four ecotonal environments consisted of lagoons, estuaries and marshes were investigated in comparison with their adjacent marine areas across Kalloni Gulf (Island of Lesvos, NE Aegean) for the first time. Significant differences were detected between and within ecotonal and marine ecosystems in terms of benthic community organization. Ecotonal areas were consisted of typical marine/estuarine and lagoonal species in a varying degree of numerical dominance. Observed differences concerning the prevailing environmental conditions at each ecosystem suggest a strong gradient from the sea towards the ecotones. Biocommunities seemed to experience a pronounced environmental stress only in the ecotones and not in the marine areas. Findings of this study support the role of confinement in the paralic domain in the Mediterranean as a function of a number of environmental factors governing biological communities' patterns.
Keywords : Zoobenthos, Brackish Water, Coastal Systems, Aegean Sea, Eastern Mediterranean.

Introduction
Transitional coastal ecosystems, a term used for a variety of ecosystems such as lagoons, estuaries, semi-enclosed bays and saltmarshes, constitute areas of special ecological and economical interest since they are located to the inter-surface of land and sea (land/water ecotone). These ecosystems are characterized by their buffering role towards land effects at the coastal zone (e.g. eutrophication incidents) [1]. Kalloni Gulf (Lesvos Island, NE Aegean Sea, Greece) comprises a rich mosaic of wetland patches such as lagoons, estuaries and marshes along the coastline. The present research effort aims to investigate for the first time marine/land ecotones in various transitional ecosystems of the Kalloni Gulf, in comparison with their adjacent marine areas concerning the prevailing environmental conditions and the benthic biological structure.

Materials and methods
The study areas were four Kalloni Gulf wetlands [Polihnitos saltworks (stations Pol-Br and Pol-Mar), Vouvaris estuaries (stations Bou-Br and Bou-Mar), Kalloni saltworks (stations Kal-Br and Kal-mar) and Parakoila marshes (stations Par-Br and Par-Mar)]. Macrobenthic samples were collected in each one of the aforementioned coastal areas (marine site - Mar; ecotone site - Br), by means of a Van-Veen sampler during Spring 2006. Environmental variables either clear physicochemical ones or variables related with food availability (e.g. Salinity, Temperature, Chloroplastic pigments concentration, Inorganic Nutrients, Sediment Organic content) were also measured in the studied areas. Uni- and multivariate methods based on Bray-Curtis similarity index were employed to detect biological and environmental patterns [2].

Results
Marine and brackish areas presented pronounced differences concerning environmental conditions (ANOSIM test results Global R: 0.729, p<0.2%). Values of environmental parameters (e.g. Nutrients, Chlorophyll- *a* and Organic load concentrations) measured, were higher in the Brackish ecosystems (hypo-saline such as estuaries, marshes or hyper-saline areas such as saltworks) in relation to those in the adjacent marine environment. MDS plots of the environmental parameters revealed a strong environmental gradient from the sea towards the ecotones (Fig. 1). As far as the benthic communities are concerned, the most abundant species distributed along the ecotones can be divided into three groups: *freshwater* species such as the larvae of the Insecta *Chironomus* sp.; typical *lagoonal* species of marine ancestry such as the gastropods *Hydrobia acuta* and *Pirenella conica*; and *marine/estuarine* species such as the Molluscs *Bittium reticulatum, Abra segmentum*, the Polychaetes *Hediste diversicolor, Capitella capitata*, and the Amphipods *Gamarus aequicauda, Microdeutopus gryllotalpa*. On the contrary, the dominant species in the marine sites were typical *marine* species such as the Molluscs *Gibbula albida, Pusillina radiate*, *Loripes lacteus,* and typical *marine/estuarine* species such as the Mollusc *Bittium reticulatum*. Multivariate analysis (Fig.1) revealed a clear separation between the ecotonal and the marine areas (ANOSIM test results Global R: 0.7, p<0.5%). Application of ABC curves and Geometric class plots techniques on the macrofaunal data have revealed that only the Ecotonal areas constitute stressed ecosystems. Finally, results of the BIOENV analysis have revealed that the macrobenthic community distribution pattern was mainly governed by environmental factors related to food availability (i.e. Chl- *a*, Nutrients).

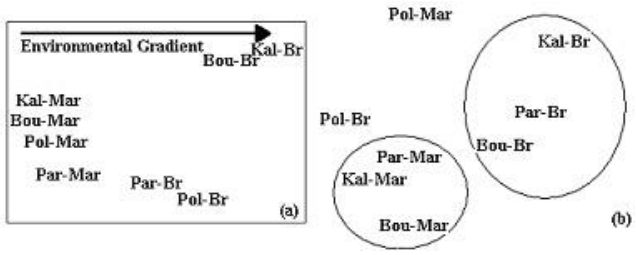

Fig. 1. Environmental (a) and Macrobenthic community (b) patterns across the Kalloni Gulf study sites produced from the multivariate analyses

Discussion
Comparison of the transitional water ecosystems and the adjacent marine area is a poorly explored issue in the NE Aegean coastline. The observed diversity within and between ecotonal and marine habitats seemed to be comparable denoting no diversity modification or even loss from sea to ecotones, a fact that supports the claim that land/water ecotones constitute habitats of substantial ecological value [3]. Furthermore, the observed diversity levels were similar with these recorded from other Transitional Coastal Ecosystems across the Hellenic coastline [4]. Dominance of certain species was the observed community mode thus confirming the hypothesis that the presence of only few keystone species can support ecosystem functions in ecotonal habitats [5]. The observed marine-brackish gradient in the Kalloni Gulf wetlands corresponds to the zonation model typical for the paralic domain [1]. Perturbation events detected in the ecotonal ecosystems should probably be attributed to the highly dynamic and severely fluctuating environmental conditions known to prevail in transitional ecosystems across the Mediterranean [3].

References

1 - Guelorget O. & Perthuisot J.P. 1992. Paralic ecosystems. Biological organization and functioning. *Vie et Milieu*, 42, 215-251.
2 - Clarke K.R. & Warwick R.M. 2001. Changes in Marine Communities: an Approach to statistical analysis and interpretation. 2nd Edition. PRIMER-e, Plymouth, U.K.
3 - Barnes R.S.K. 1980. Coastal lagoons. The natural history of a neglected habitat. Cambridge University Press, 106 pp.
4 - Nicolaidou A. Reizopoulou S. Koutsoubas D. Orfanidis S. & Kevrekidis Th. 2005. Biological components of Greek Lagoonal Ecosystems: An overview. *Mediterranean Marine Science*, 6, 31-50.
5 - Levin L., Boesch D., Covich A., Dahm C., Erséus C., Ewel C., Kneib R. Moldenke A. Palmer M. Snelgrove P. Strayer D. & Weslawski J. 2001. The function of marine critical transition zones and the importance of sediment biodiversity. *Ecosystems* 4, 430-451