Study of the benthic community in a mussel culture area in Thermaikos gulf

ENVIRONMENTAL BIOLOGY

INTER-INSTITUTIONAL POSTGRADUATE PROGRAM

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Introduction

Aquaculture contributes substantially to meeting the increasing food demands of the global population. Mussel aquaculture, based on the cultivation of suspension-feeding bivalves, is a well-established activity worldwide. Although mussel biodeposits can modify sediment characteristics and benthic community composition, these effects are usually restricted to areas directly beneath or adjacent to farms and may be reversible after harvesting or fallowing periods (Dimitriou *et al.* 2015). In Greece, mussel farms are mainly located in the Northern Aegean Sea and are primarily based on the cultivation of the Mediterranean mussel *Mytilus galloprovincialis* (Theodorou *et al.* 2011). Benthic ecological indices provide a useful tool for assessing environmental quality in aquaculture-impacted sediments (Lampa et al. 2025). This study aims to evaluate the environmental status of the area surrounding mussel farms in the Chalastra basin, located in the northwestern Thermaikos Gulf, following the mass mortality events reported during 2024–2025. The assessment is based on **benthic macrofauna** and **key environmental variables**, including sediment grain-size composition, total and labile organic matter (TOM and LOM), redox potential (Eh), and sediment chlorophyll-a (Chl-a).

Material and Methods

Field sampling: in June 2025 at four stations: **Under Farm** (active mussel farms), **Far** (50 m), **Old Farm** (inactive mussel farms), and **Control** (500 m) in the Chalastra basin. At each station, 3 sediment cores and 6 macrofaunal cores were collected by divers, for environmental and biological analyses, respectively. **Sediment analyses** included *in situ* Eh measurements, sediment grain-size composition, determination of LOM, TOM, and Chl-a at four depth layers (0-1, 1-3, 3-5, 5-7cm). Macrofauna samples were sieved (0.5 mm) and organisms were identified to the lowest possible taxonomic level. Principal Component Analysis, **PCA**, was used to assess spatial patterns in abiotic variables, while non-metric multidimensional scaling, **nMDS**, and **SIMPER** analyses were applied to examine macrofaunal community structure. Community bioturbation potential, **BPc**, following Queirós et al. 2013, and diversity indices were also calculated. Ecological status was assessed using the benthic indices **BENTIX** (Simboura & Zenetos, 2002) and **BQI-Family** (Dimitriou *et. al* 2012). All multivariate analyses were performed using **PRIMER v7**.

Results

Sediment grain-size analysis: high proportions of silt and clay across all sampling stations. ***In situ*** **measurements of Eh**: reducing sediment conditions at all stations (Fig.1).

PCA: spatial differences in abiotic conditions among stations, Control station: higher Chl-a, LOM, and silt–clay content, Far and Under Farm stations were associated with TOM and fine sediment fractions (Fig.2).

nMDS: showed clear clustering of the Far and Control stations, whereas the Old Farm and Under Farm stations were more distinct (Fig.3).

SIMPER: indicated high average dissimilarity between the Control and Old Farm stations, 72.74%, with *Aricidea (Acmira) assimilis* and *Heteromastus filiformis* contributing strongly to the characterization of the Control station.

A literature-based trait review indicated the dominance of **small-sized organisms** across all stations. Mobile taxa were more prominent at the Control station, whereas taxa with reduced mobility were more characteristic of the Under Farm and Old Farm stations.

BPc was higher at the Old Farm and Under Farm stations, suggesting greater potential for sediment reworking by the benthic community at these sites.

BENTIX: Old Farm and Under Farm were classified as having **"Moderate"** ecological status, while all other stations were classified as **"Good"**.

BQI-Family: "**Good**" ecological status across all stations.

Abundance and diversity indices did not show clear spatial differences among stations, although lower abundance, N, and species richness, S, were recorded at the Under Farm station.

Discussion

Overall, the findings suggest that mussel farming has limited effects on benthic ecosystem health in the study area. The observed spatial variability appears to be influenced not only by farm-related organic enrichment, but also by the natural hydrodynamic and geomorphological characteristics of the Chalastra basin.

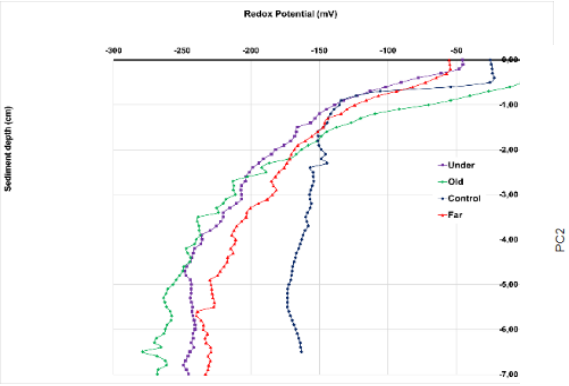

Figure 1. Vertical distribution of Eh within the sediment.

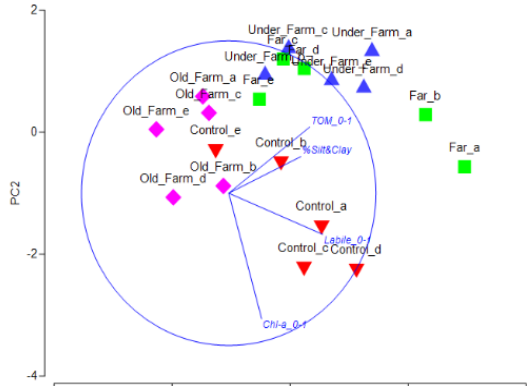

Figure 2. Results of the PCA for the environmental variables.

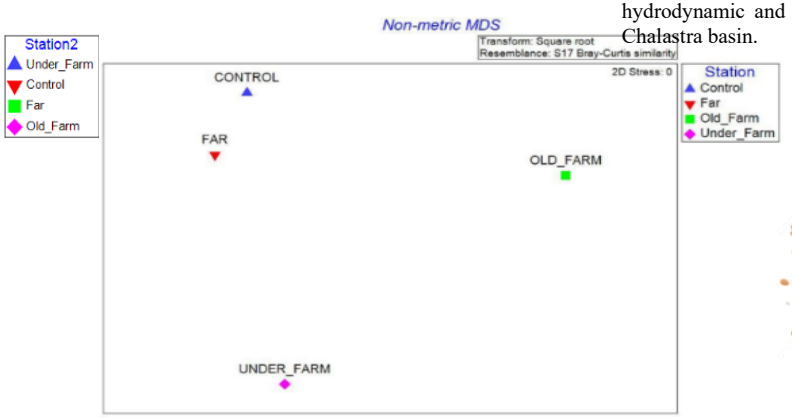

Figure 3. Results of the macrofauna data by nMDS.

References

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