THE EFFECT OF SHELLFISH FARMING ON THE WATER COLUMN NUTRIENT CONCENTRATION OF THE EASTERN MEDITERRANEAN

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Abstract
The effect of shellfish farming on the water column was investigated seasonally at a longline mussel farm (*Mytilus galloprovincialis* L.) of Maliakos Gulf, between October 2007 and July 2008. Nitrite and phosphate values showed significant differences among sampling stations and seasons ($p<0.05$ and $p<0.001$, respectively). Furthermore, in most cases concentrations of all nutrients and chl *a* at the farm site was lower than those observed at the control site. This indicates that shellfish farming contributes to the reduction of the primary production of Maliakos Gulf and consequently to the risk of eutrophication.
Keywords: Aquaculture, Mollusca, Coastal Waters, Nutrients, Aegean Sea

Introduction

Annual world harvest of wild mussel stocks has increased during the past 20 years and has led to overexploitation of natural beds. Mussel aquaculture is consequently an expanding industry. The impact of aquaculture on the concentration of nutrients in the Eastern Mediterranean has been addressed in a number of studies [1]. The environmental effects of mussel farming, where no excess food is supplied, are supposed to be much less than those of caged fish farming. However, relatively little is known of the effects of longline mussel farming on nutrient dynamics [2]. The objective of this study was to assess the effects of longline mussel farming on nutrient concentrations of Maliakos Gulf.

Materials and methods

The study was carried out in the Maliakos Gulf, central Greece, at a shellfish farm (38°50'99'' N 22°36'48'' E) between October 2007 and July 2008. Mussel (*Mytilus galloprovincialis* L.) was intensively cultivated in this farm. Two stations were sampled. The first was located at the centre of the mussel farm and the second at a distance of 500 m from the mussel farm center, referred as farm and control site, respectively. Vertical profiles of temperature, salinity, dissolved oxygen (DO) and chl *a* were measured at each sampling station by means of a CTD (SEABIRD-19plus). For nutrient analysis, samples were collected by means of a 1 L Niskin bottle at the surface, 5 m and 20 m depth from the surface to the bottom. From both sampling stations, five replicate samples were taken during all seasons, in order to determine natural variability within replicates (120 total samples). The water samples were placed in 250 ml plastic vials where mercury chlorine (1 ml $HgCl_2$ per 1 L sample) was added in order to neutralize the bacterial and other photosynthetic organisms [3]. Samples were stored at -20 °C until analysis took place with a spectrophotometer (SHIMADZU UV-1700) according to the procedure described by [3].The one-way nested analysis of variance (ANOVA) was used to analyze the effect of station and season on variations in chemical parameters.

Results and discussion

Physicochemical characteristics of both studied sites are summarized in Table 1. These results shows that almost in all cases the minimum, maximum and the mean concentration of the physicochemical characteristics was lower at the farm site compared to the control site. The above indicates the positive effect of shellfish farming on the water column nutrient concentration. The quantity of nutrients removed by shellfish harvest can be quite large [4]. Filter-feeding molluscs not only remove N from the water column, but also incorporate a high proportion of it into their tissues. When the molluscs are harvested, the N is removed from the system [5]. Shellfish feeding can also help to control or even prevent harmful algal blooms by removing the cells before the algae accumulate to environmentally detrimental levels [5]. During the course of this study, we concluded that shellfish farming is, by definition, a 'green' industry which plays a vary important role in the ecological system of Maliakos Gulf

Tab. 1. Minimum, maximum and mean ± standard error of physicochemical parameters of both studied sites.

Parameter	Farm site	Control site
Dissolved oxygen (mg L^{-1})		
Range	4.65-8.42	4.77-8.53
Mean ± SE	6.49 ± 0.05	6.74 ± 0.04
NH_4 (μM)		
Range	0.16-6.87	0.01-10.33
Mean ± SE	1.44 ± 0.26	1.90 ± 0.35
NO_2 (μM)		
Range	0.03-0.80	0.07-0.83
Mean ± SE	0.35 ± 0.03	0.32 ± 0.03
NO_3 (μM)		
Range	0.99-14.42	3.68-10.40
Mean ± SE	7.61 ± 0.54	7.66 ± 0.35
PO_4 (μM)		
Range	0.05-5.56	0.02-9.75
Mean ± SE	1.88 ± 0.29	2.38 ± 0.42
SiO_2 (μM)		
Range	4.92-32.15	5.52-36.12
Mean ± SE	12.57 ± 1.03	14.55 ± 1.29
Chl *a* (mg/m^3)		
Range	0.62-12.45	0.53-13.85
Mean ± SE	4.84 ± 0.13	5.00 ± 0.13

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