IMPACT OF AQUACULTURE ON NUTRIENT DISTRIBUTION IN AEGEAN SEA

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Abstract
To observe the potential impacts of the aquaculture site, the nutrient distirbution (ammonium, nitrite, nitrate, phosphate and silicate), and their ratios have been monitored as the indicators of water quality in a well-known aquaculture area in the middle of Aegean Sea during winter and summer period. In addition to the nutrients, the total suspended solids (TSS) and dissolved oxygen (DO) were also determined. The spatial variability in the nutrient distribution shows that the effect of fish farm and freshwater tributaries input flow throughout the agricultural areas on the water quality parameters have no differences. The nutrient ratios (N/P/Si=1:5:1 in winter; N/P/Si=1,5:2:1 in summer) indicate that nitrate and silicate are limiting.
Keywords: Aquaculture, Nutrients, Aegean Sea

Introduction
During last two decades, the intensification of marine aquaculture in the Mediterraneancoasts has been reacted by the other users. Among these users, the tourism entrepreneurs have been leading a competition based on the conflict of interest for coastal zones. Their main argument is the adverse impacts of fish farms on marine ecosystems. On one hand, the over sprawled fish farms in coastal zones, which Turkey is well behind in comparison with Greece with her ability to supply 60% of EC's demand for Mediterranean fish [1] and on the other hand, the sharp increase in world's demand for seafoods from 120 million tonnes towards to 160 million tonnes, display the conradictory nature of the issue. An effective monitoring programme for the fish farming activities is therefore important and essential. As the consequence of such a programme, the sustainability of marine aquaculture can be acquired by considering tourism, fisheries and aquaculture, and environmental protection via the perspective of integrated coastal zone management. The number of fish farms is relatively quite limited in Turkey, however, their adverse environmental impacts are highly speculated in spite of the highly restricted number of scientific monitoring researches on this issue.

Materials and Methods
Dissolved oxygen (DO) were measured by Winkler method. The filtered water samples were kept frozen for analysis in the laboratory. SiO and NO were analyzed using the Grasshoff, Ehrhartd and Kremling (1983) method, and (NO + NO), NH PO following Strickland and Parsons (1972) [2,3]

Results and Discussion
In the present study, the annual nutrient variations were given in the min and max ranges in Table1.
As expected, nutrients were higher in winter than ones in summer period. NO :PO ratios are almost stable during the two seasons. However, TIN:PO and Si:PO show changes. While TIN:PO is increasing, Si:PO is decreasing in summer period.

Tab. 1. Annual variation of water quality parameters with nutrients

Parameters	STATIONS					
	K1	K2	Coastal station		Ref.	
	Surface	Surface	Surface	Bottom	Surface	Bottom
NO2 µM	1,268-2,79	0,050-0,460	0,001-0,12	<0,001-0,26	0,001-0.005	<0,001-0,051
NO3 µM	2,149-8,68	0,119-21,995	0,043-1,85	0,051-2,032	0,095-0,297	0,049-0,341
NH4 µM	2,630-290	0,101-10,030	0,060-17,53	<0,060-7,07	0,06-1,268	0,225-0,853
Si µM	3,010-29,58	4,525-55,540	0,037-3,22	0,152-2,8	0,732-1,988	0,848-1,835
PO4 µM	1,405-5,85	0,111-0,129	0,005-0,08	0,010-0,1	0,018-0,124	0,045-0,082
DO ml/l	5,91-7,02	5,96-9,86	4,43-7,52	4,45-7,17	4,82-5,16	4,72-5,25
TSS mg/l	14,23-16,20	7,14-45,41	0,10-2,90	0,60-11,30	0,00-0,39	0,00-0,60

Tab. 2. Nutrient ratios during winter and summer periods

Ratio	Winter	Summer
NO_3:PO_4	1,08	1,49
TIN:PO_4	1,47	10,04
Si:PO_4	4,74	2,02*

*non-significant According to eutrophication scale given by Kardydis,1999 [4],the levels of nutrients near the fish and freshwater outfall reached the eutrophic level for phosphate and ammonium and ammonium, respectively.

References
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