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in

Camarda D. (ed.), Grassini L. (ed.).
Coastal zone management in the Mediterranean region

Bari : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 53

2002
pages 57-63

INVESTIGATION ON THE POLLUTION OF GEDIZ RIVER DELTAIC ZONE (IZMIR BAY, TURKEY)

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ABSTRACT

The aim of this research is to determine the temporal changes of physico-chemical environmental parameters and chlorophyll-a concentrations in the Gediz River Deltaic Zone. For this purpose, water samples were taken from 11 stations monthly in 1998-1999. In this study, minimum and maximum concentrations of temperature, pH, dissolved oxygen and salinity are as follows; 9-34 °C, 7.28-8.68, 0-13.6 mg/l and 0.58-52.6 ‰ respectively. The results of the other measured environmental parameters were between 0.36-30.25 µg/l for chlorophyll a, 0.00-90.06 µgat/l for NO_2^- N, 0.12-687.74 µgat/l for NO_3^--N, 0.02-370.5 µgat/l for NH_4^+-N, 0.04-211.12 µgat/l for PO_4^{3-}-P and 0.0-421.4 µgat/l for SiO_2-Si. Average values were 20.13 for temperature, 21.41 ‰ for salinity, 7.04 mg/l for dissolved oxygen. 7.26 for pH, 5.12 µg/l, for chlorophyll a, 14.59 µgat/l for NO_2^- N, 130.51 µgat/l for NO_3^--N, 61.098 µgat/l for NH_4^+-N, 13.61 µgat/l for PO_4^{3-}-P and 102.91 µgat/l for SiO_2-Si.

1. INTRODUCTION

Marginal marine environments including, estuaries, deltaic zones, lagoons, bays etc., are especially sensitive to long and short-term external factors. In particularly coastal wetlands are subject to diverse anthropogenic influences, including industrial development, domestic wastes, maritime transportation, agricultural activities and alluvions (flood, inundation) carried with rivers and valleys. For all these reasons, water analysis of coastal wetlands and deltaic zones play a very important role in the quality assessment of the marine environment. Waters of coastal deltaic zones are important hosts for nutrient pollution and as such should be included in routine environmental monitoring programs, although they do not furnish quantitative data on the absolute degree of pollution.

Izmir being the third most populated and economically developed city in Turkey is located at the eastern end of an intrusion (and old Gediz River delta) by the Aegean Sea. İzmir city is obviously much larger with its 12.825 square kilometers land and approximately 3 million population. The İzmir Bay surroundings are filled not only with settlements but also by irrigable agricultural land (Menemen Plateau) the return waters of which find the sea either directly or indirectly through the Gediz River. Water catchment area of İzmir Bay is approximately 20.000 square kilometers.

The Gediz River is very important because of the pollution load it brings to Bay. Izmir Bay is also influenced by pollution caused by land-based activities in the Gediz River watershed and erosion of large area by the Gediz River.

The aim of this study is to investigate the monthly changes of physico-chemical environmental parameters and chlorophyll-a concentrations and to access the pollution state of the Gediz River deltaic zone.

2. STUDY AREA

Izmir Bay is situated in the western coast of Anatolia, between 38° 20´- 38° 42´ N latitude and 29° 25´-27°10´ E longitude. Gediz River in the North. North west of Izmir Bay is one the largest rivers in the Western Part of Anatolia. The water catchment area of the Gediz River is approximately 18.000 square kilometers.(Fig1).

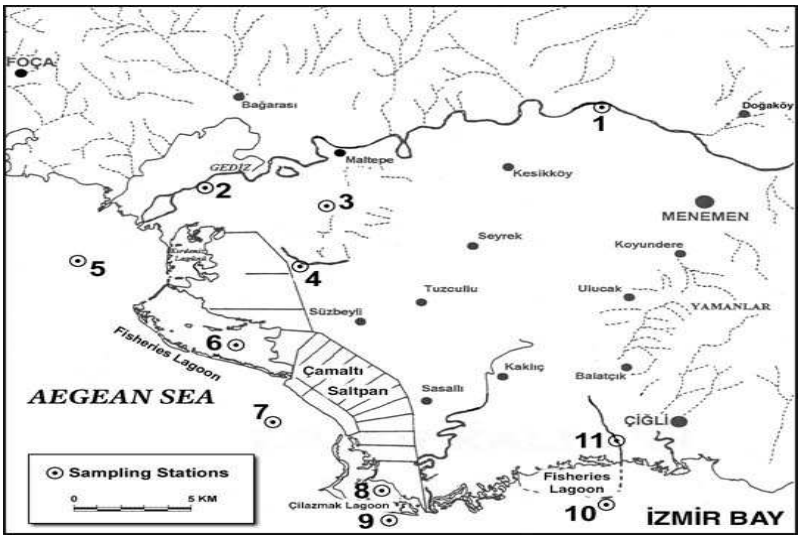

Figure 1. Map of Sampling Stations in the Gediz River Deltaic Zone.

3. MATERIAL AND METHOD

Fresh and seawater samples of 1 liter from 11 sampling stations of the Gediz River and its deltaic zone were taken monthly during the period February 1998 to January 1999. Dissolved oxygen concentrations were measured by Winkler method, salinity was analysed in the base of chlorinity by Mohr-Knudsen method, surface water temperature has been measured by 0.1°C sensitive electronic thermometer and pH values has been measured by ORION 420A model pHmeter. Nitrate, nitrite, ammonium, phosphate and silicate were estimated by standard methods (Strickland, Parsons, 1972; Parsons et. all., 1984, Wood, 1975). These were carried out by using Hach-DR 2000 UVD model spectrophotometer and also chlorophyll analysis were performed by using Turner 10-AU model Fluorometer.

4. RESULTS AND DISCUSSION

In this study, the average concentrations of temperature, pH, salinity and dissolved oxygen are as follows: 20.5 °C for temperature, 7.88 for pH, 6.96 ‰ for salinity, 6.94 mg/l for dissolved oxygen in fresh water stations. 19.8 °C for temperature, 8.05 for pH, 33.59 ‰ for salinity, 7.92 mg/l for dissolved oxygen in seawater stations.

Rainfall, vaporization, land-based discharges, and wave currents affect variations of salinity in the Gediz Deltaic zone. Maximum values of salinity were measured 38.33 ‰ summer months (Egemen and Sunlu, 1999). As a result of rain salinity decreased to 14.00‰ in seawater stations. On the contrary, as a result of vaporization and wave currents especially in summer months, salinity values reached 21.6 ‰ in fresh and brackish water. Minimum values of salinity measured as 0.58 ‰ for the same stations in winter months.

Values of pH measured at the Deltaic zone are relatively higher in comparison with the fresh and brackish water stations of the Gediz River. Land-based discharges, biological activities and water temperature affect the pH values in the investigated area. In this study Dissolved oxygen concentrations showed big fluctuations depending on the characteristics of stations (biological activities, saturations, water temperatures, differences of flow rates etc.).

The levels of chlorophyll are the proof of photosynthetic activities in waters. The results of chlorophyll were between 1.05-29.2 µg/l. Mean value was 6.61 µg/l for fresh water (Fig. 2). In seawater chlorophyll a values were changed in 0.17-30.25 µg/l. Average value was estimated as 3.63 µg/l (Fig. 3). As can be seen in the graphics chlorophyll concentrations show regular changes depending on the months. We can explain these fluctuations with phytoplankton life cycle stimulated by high nutrient concentrations (growth phase, death phase) and grazing processes. As can be observed in the graphics, variations of chlorophyll parallel the total nitrogen (especially nitrate) and phosphate variations.

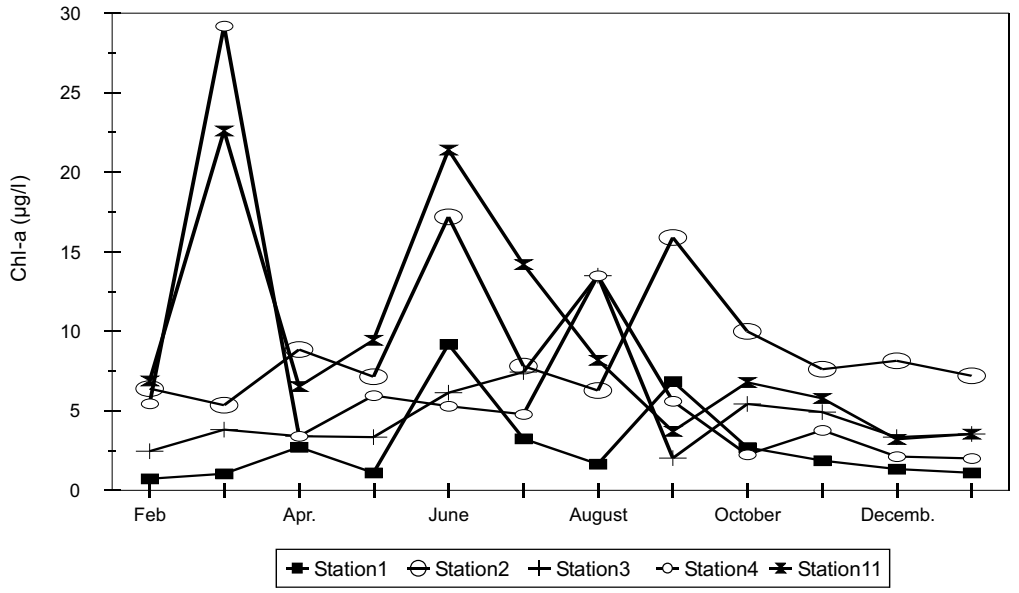

Figure 2. Monthly variations of chlorophyll in fresh and brackish water of the Gediz River.

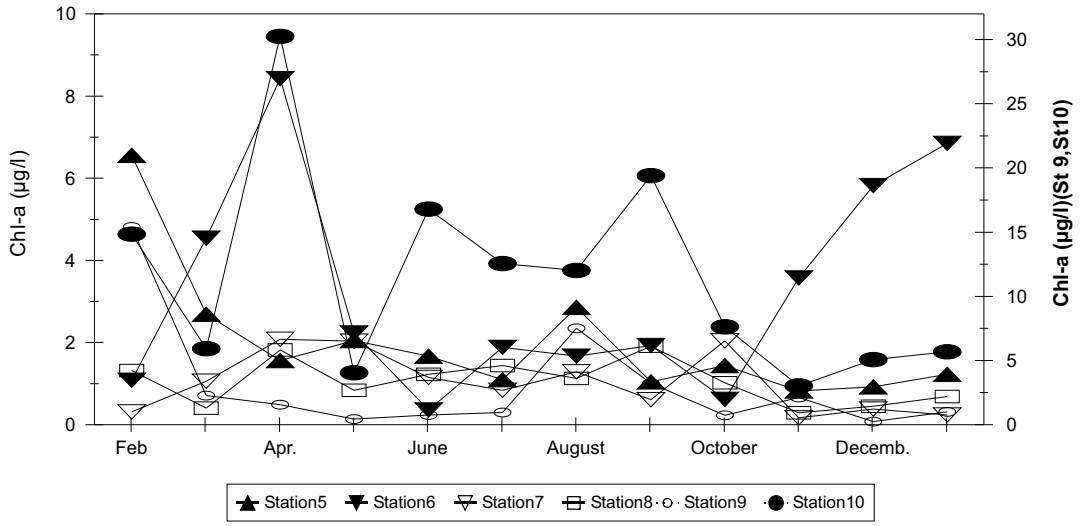

Figure 3. Monthly variations of chlorophyll a in seawater of the Gediz Deltaic Zone.

Total nitrogen values were between 0.23-706.08 µgat/l. The average value was estimated as 122.94 µgat/l. In fresh water stations especially station 2, total nitrogen values are relatively higher than the other stations. We can explain these peaks in graphics (fig. 4) by direct addition of organic pollutants from the leather industry discharge channel effect on the high nitrogen values. In seawater stations total nitrogen values are relatively richer in the Gediz River month (station 5), indicating that pollution is mainly due to urban and agricultural irrigation (fig.5)(Buyukişik, 1983; Buyukişik,1986)

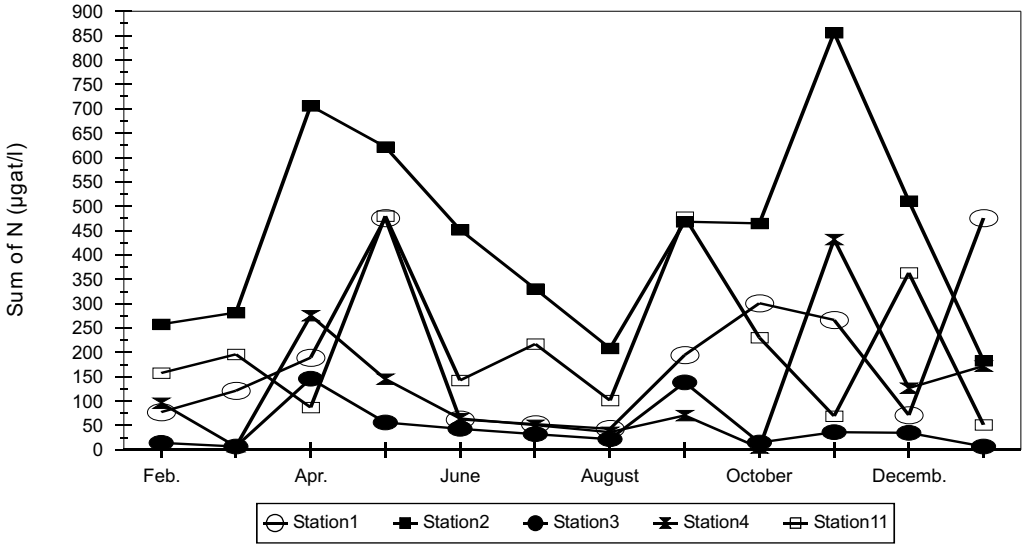

Figure 4. Monthly variations of ΣN a in fresh and brackish water of the Gediz River.

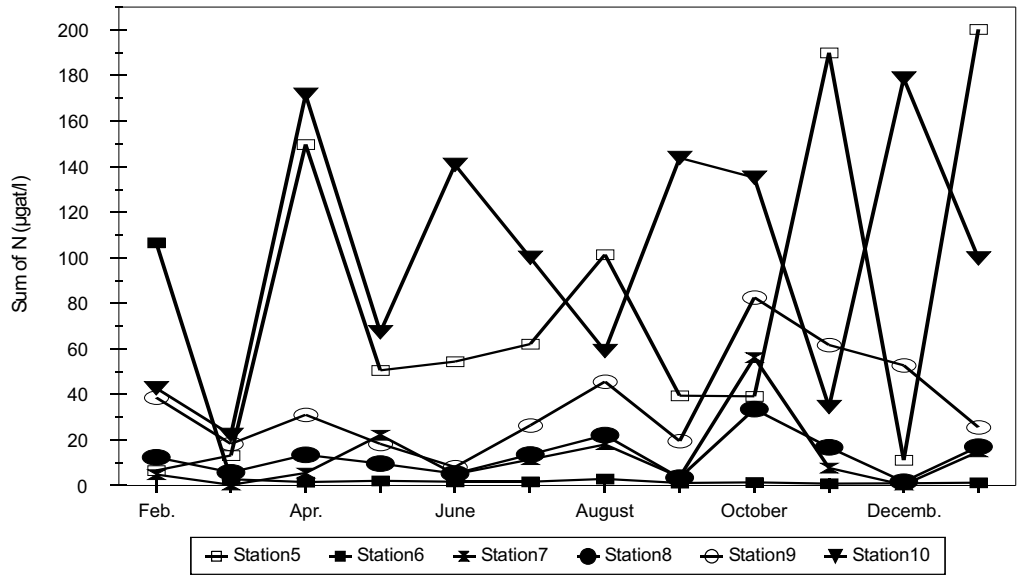

Figure 5. Monthly variations of ΣN in seawater of the Gediz Deltaic Zone.

Monthly variations of phosphate concentrations in fresh and seawater stations are shown in Fig. 6-7. Minimum and maximum concentrations of phosphate were between 0.04 and 211.12 µgat/l. Average value was estimated as 22.95 µgat/l for fresh water stations (Fig 6). Minimum and maximum concentrations of phosphate were between 0.00 and 24.49 µgat/l. Average value was estimated as 4.26 µgat/l for seawater stations (Fig 7). Phosphate values analyzed at fresh water stations are significantly higher in comparison with seawater stations because of detergents used by leather industries located nearby Station 2. Another factor is the phosphorous fertilizers, which are used in agricultural activities. Due to domestic wastes and drainage waters, animal husbandary consist of high concentrations of phosphate compounds.

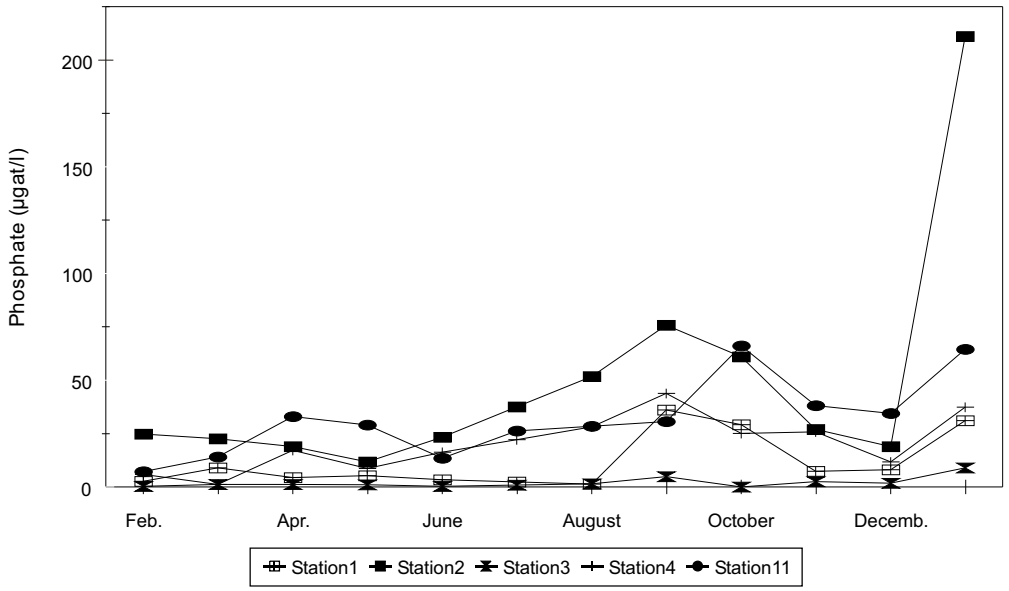

Figure 6. Monthly variations of phosphate a in fresh and brackish water of the Gediz River.

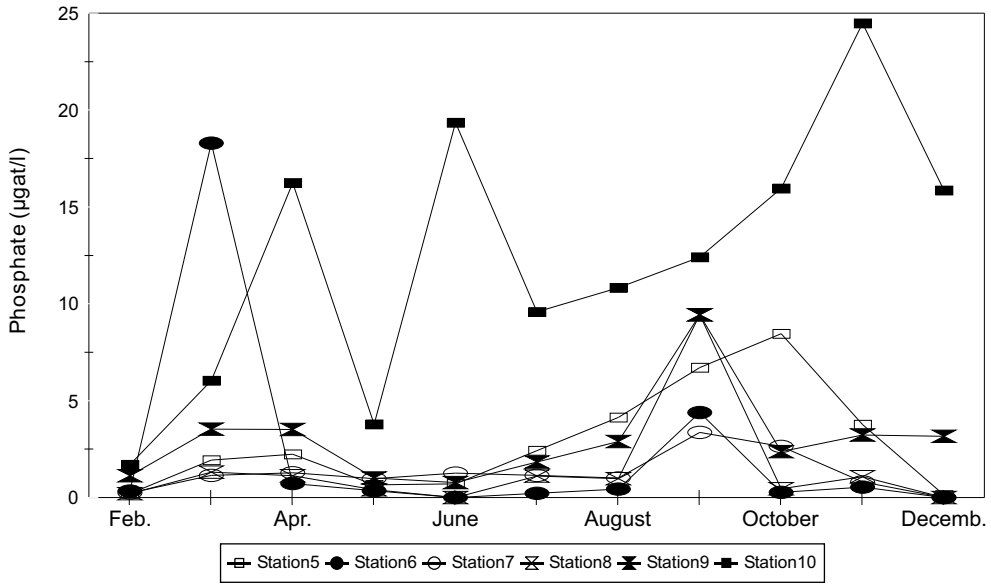

Figure 7. Monthly variations of phosphate in seawater of the Gediz Deltaic Zone.

Silicate concentrations were between 0.00-421.40 µgat/l; mean value was estimated as 176.85 µgat/l for freshwater stations (Fig. 8). Minimum and maximum concentrations of silicate were between 2.33 and 197.20 µgat/l. Average value was estimated as 28.97 µgat/l for seawater stations (Fig 9). Silicate is one of the land-based originated nutrients, so that the higher concentrations of silicate were measured in fresh water stations. Other factors that control silicate concentrations in the Gediz Deltaic zone are rainfall drainage water and diatomic activities.

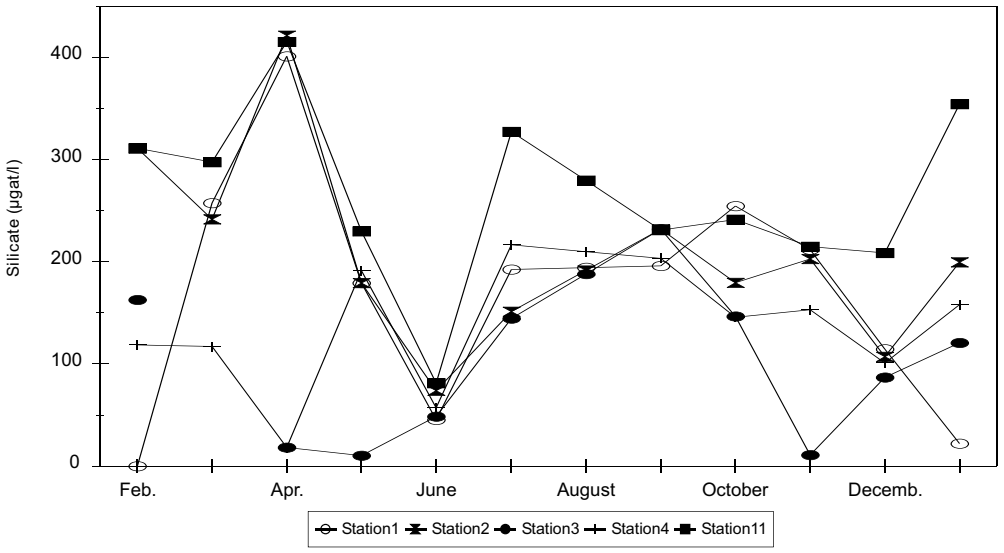

Figure 8. Monthly variations of ΣN a in fresh and brackish water of the Gediz River.

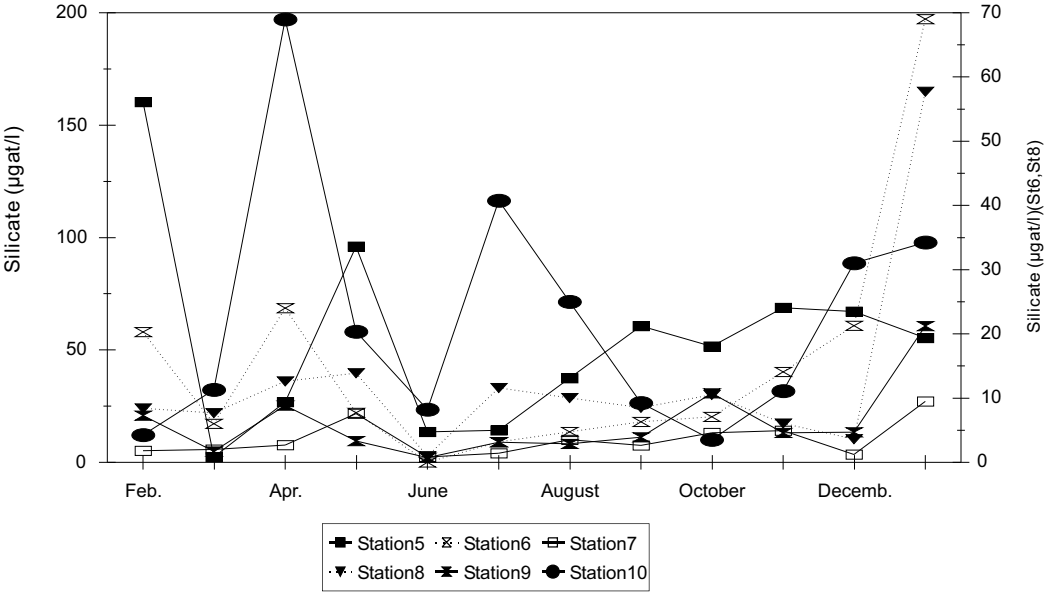

Figure 9. Monthly variations of silicate in seawater of the Gediz Deltaic Zone.

The number of industries, especially leather manufacturers that are leaving the city of İzmir due to strong environmental mitigation programs of the municipality, is increasing on the Gediz River. The water in the canals of the Menemen area is polluted with discharge waters from these industries. Industrial wastewaters in canals are diluted with irrigation water during the irrigation season. However, except during the irrigation season, canals convey mostly industrial wastewaters, thus contaminating the soil and İzmir Bay water (Kaymakci, 1998; Sunlu, 1994).

Izmir Bay pollution abatement has been brought to the national agenda twice since 1960s. However, the wastewater treatment plant project has not been given enough financial resources and administrative back up, and is thus left incomplete. During the long span of time varying conditions leave the prior projects absolute. Therefore each new effort should be revised considering the increasing scientific information and changing conditions in the human and environmental resources of Turkey.

We hope to have a clean Bay after a reasonable period following the implementation of the wastewater treatment plant.

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