

EUTROPHICATION IN IZMIR BAY (EASTERN AEGEAN) : NUTRIENT LIMITATION AND MONITORING OF LONG-TERM EFFECTS

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Abstract

The distribution of inorganic nutrients and phytoplankton chlorophyll-a are investigated in Izmir Bay during 1996-1998. The concentrations of nutrients ranged between 0.01-10 μM for $\text{o.PO}_4\text{-P}$; 0.11-82 μM (NO_3+NO_2)-N; 0.37-39 μM Reac-Si. The results are compared with the values obtained from the relatively unpolluted waters of the Aegean Sea. Nitrogen is the limiting element in the Izmir Bay. The eutrophication of the Inner Bay has already started, spreading progressively to the other parts of the Bay. Phosphate which originate from detergents is an important source for eutrophication in the Bay, especially in the Inner Bay.

Keywords: Phosphorus, eutrophication, Eastern Aegean

Introduction

Izmir Bay is located in the western part of Turkey and surrounded by a densely populated community. The Bay has been divided into three sections (Outer, Middle and Inner) according to their physical characteristics related to their contents of the different water masses. The Middle Bay is separated from the Inner Bay by a 13 m deep sill (Yenikale Strait). There are series of islands parallel to the west coast of the Bay. The narrow Mordogan Strait, which is between Uzunada and the West Coast, has a sill of 14 m depth. The Gediz river which flows to the Outer Bay is the biggest river in the Izmir Bay. The Inner Bay is heavily polluted by nutrients and organic material. The main source of pollution are streams and hundreds of small domestic discharge outlets which flow to the Bay. Fishing, industrial activities, port activities and tourism are the main sources of income for the region. Most of the industries in Izmir are located in the Inner Bay region. Eutrophication of the Inner Bay is a serious problem throughout the year and red tide events are becoming more frequent. A number of studies have been carried out on the characterization and influence of domestic and waste water to the Izmir Bay (1,2,3) and on measuring the oceanographic characteristics (4,5,6,7). The distributions of inorganic nutrients and chlorophyll-a were investigated in Izmir Bay. The main aim of this study is to access the level of the eutrophication and to determined the limiting nutrients.

Material and Methods

The data were collected during cruises of R/V *K.Piri Reis* in 1996-1998 at 28 sampling points, in the framework of a "Izmir Bay Marine Research Project" supported by Izmir Metropolitan Municipality. The locations of sampling areas are given in Figure 1.

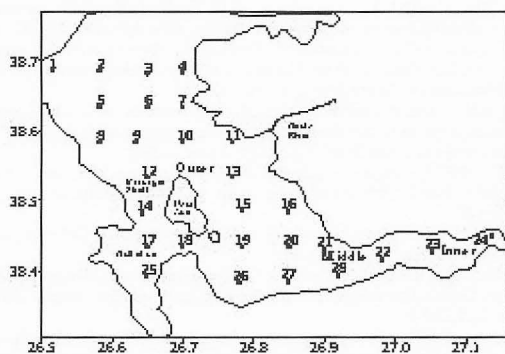


Figure 1. Location of stations in the Izmir Bay

Seawater samples were collected by Niskin bottles at standard depths and filled in 100 ml poltetilen bottles which had been prewashed with 10 % hydrochloric acid and immediately frozen until analysis. (Nitrate+Nitrite)-Nitrogen, o-phosphate phosphorus, reactive Si and chlorophyll-a were measured spectrophotometrically according to Strickland *et al.*(8).

Results and Discussion

Outer Bay : During winter and autumn, Nitrate+Nitrite concentrations were generally higher than those of spring and summer periods. The nutrient concentrations were low because of consumption for phytoplankton growth. The average of Nitrate+Nitrite concentrations were ranged between 0.11-3.5 μM (Table.1). There is no significant seasonal variation between sampling periods.

The seasonal variations of o.phosphate-phosphorus, reactive Si, (Nitrate+Nitrite)-Nitrogen and chlorophyll-a concentrations are illustrated in Figure 2. In the Outer Bay, nutrient results are similar to the Aegean Sea. There is no significantly changes with increasing depth for ortho-phosphate concentrations. Maximum values were recorded during autumn and

winter periods because of low consumption by phytoplankton. In the winter periods, chlorophyll-a concentrations were increased in the Outer Bay due to Gediz River. The spatial and vertical distribution of nutrients affect the distribution of phytoplankton.

Table 1. Nutrient concentrations in Izmir Bay, Aegean and Mediterranean Seas (μM)

Parameter	Outer bay	Middle Inner Bay	Aegean Sea (9,10)	N.E Mediterranean (11)
$\text{o.PO}_4\text{-P}$	0.01-0.37	0.01-10	0.01-0.30	0.01-0.24
$(\text{NO}_3+\text{NO}_2)\text{-N}$	0.11-3.5	0.12-82	0.10-3	0.05-6
Reac-Si	0.30-7.4	0.50-39	0.30-3	1-11
N/P	5.7-13.7	2.1-8.2	13.6-36.8	

Middle and Inner Bay : The concentrations of nutrient were higher in the Middle and Inner Bay than the Outer part of the Bay. Maximum o.phosphate-phosphorus and (Nitrate+Nitrite)-Nitrogen concentrations were observed during autumn due to bacterial degradation in the Inner Bay.

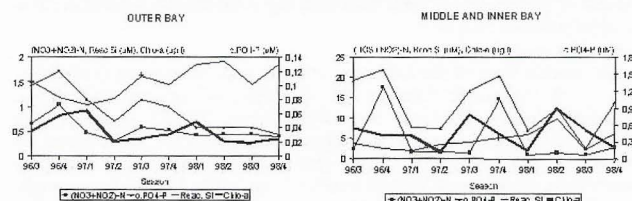


Figure 2. Seasonal changes of nutrient and chlorophyll-a concentrations in Izmir Bay

The N:P ratio are given in Table 1 and is significantly lower than the assimilatory optimal (N:P=15:1) in conformity with Redfield's ratio N:P=16:1. Nitrogen is the limiting element in the Izmir Bay. The eutrophication of the Inner Bay has already started, spreading progressively to the other parts of the Bay. Phosphate which originate from detergents is an important source for eutrophication in the Bay, especially in the Inner Bay.

References

- 1- Muezzinoglu A., Akyarlı A.O., Baysal B., Sengul F., 1982. Probable Impact of Proposed Waste Water Plant Effluents on izmir Bay Water Quality. Appropriate Waste Management for Developing Countries, New York, pp.475-492.
- 2- Uslu, O., 1993. A critical evaluation of waste water treatment and disposal schemes in Turkish castal municipalities. The First Inter .Conf.Medit. Coast. Environ. Medcoast 93, Antalya, pp.658-665.
- 3- Kısoglu Z., Yetis U., Balkas T., 1993. Waste management approach in Izmir Bay. The First Inter.Conf.Medit.Coast.Enviro. Medcoast 93, Antalya, pp.736-748.
- 4- IMST-063, 1988. Marine Research Project, Final Report, 141p.
- 5- IMST,1990; 1991. National Marine Measurement and Monitoring Programme, Aegean Sea Project Final Reports. Ins. of Mar.Sci. and Tech., Izmir, Turkey.
- 6- Balci A., Kucuksezgin F., Kontas A., Altay O., 1995. Eutrophication in Izmir Bay, Aegean Sea. *Toxicol. Environ. Chem.*, 48: 31-48.
- 7- Kucuksezgin F., 1996. Multivariate Analysis of Water Quality Parameters in Izmir Bay, Eastern Aegean. *Toxicol. Environ. Chem.*, 55: 135-144.
- 8- Strickland J.D.H., Parsons T.R., 1972. A practical Handbook of seawater Analysis. 2nd ed. Bulletin 167. Fisheries Research Board of Canada, Ottawa, 310p.
- 9- Stirn J., 1988. Eutrophication in the Mediterranean Sea. UNESCO Reports in Marine Science, 49: 161-187.
- 10- Kucuksezgin F., Balci A., Kontas A., Altay O., 1995. Distribution of Nutrients and chlorophyll-a in the Aegean Sea. *Oceanologica Acta*, 18(3): 343-352.
- 11- Salihoglu I., Saydam C., Bastürk Ö., Yılmaz K., Göçmen D., Hatipoğlu E., Yılmaz A., 1990. Transport and Distribution of Nutrients and chlorophyll-a by Mesoscale eddies in the Northeastern Mediterranean. *Mar. Chem.*, 29: 375-390.