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ASSESSMENT OF NUTRIENT POLLUTION CAUSED BY LAND BASED ACTIVITIES IN İZMİR BAY; TÜRKİYE

A. Kaymakçi, U. Sunlu, Ö. Egemen
Ege University Faculty of Water Products,
Department of Hydrobiology, Urla İskele-İzmir, Türkiye.

Introduction

One thing is certain that the Izmir Bay is in a state of pollution center in region in respect of aestetic and welfare where pollution increased in the course of time from what it used to be in 1960's. The most important factors of this current status are: domestic wastes of more than 3 million people; industrial wastes of almost 1500 factory; waste water discharge during maritime transportation and shipyard services filling materials arised from the recreation of seaside alluvions carried with rivers and valleys.

Besides, the İzmir Bay is surrounded by major agricultural plateau. Menemen plateu in the North-North West of İzmir is one of the most important production field where agricultural irrigation is utilised. Bay is also influenced by the pollution caused by the agricultural activities in the Gediz water shed and erosion of a large area by Gediz river.

Only recently marine eutrophication is being regarded as pollution, particularly in nearshore environments, where more often low water transparency, oxygen depletion and algal blooms occur. Nutrient concentration in sea water and sediment increase remarkably going from offshore to inshore, due to the proximity of terrestrial and domestical inputs and to the increase of abiotic and biotic processes strictly related to the progressive decrease of water depth.

Study area

The Bay of İzmir is located in the Western part of Turkey and surrounded by a densely populated community. The Bay is divided into a Inner, Middle and Outer Bay from the standpoint of topographical and hydrographical characteristics. Inner Bay is small in area (57 km^2) and shallow in depth (max. 15m). It receives the majority of domestic and industrial waste-waters. This part of the Bay also receives some inflow of fresh waters from several creaks which are mostly polluted by industrial wastes. Because of limited water exchange with the Outer Bay and Aegean Sea pollution of the Inner Bay has reached unacceptable levels. Eutrophication of the

Inner and the Middle Bay has already started, spreading progressively to the Outer Part of the Bay (Fig.1).

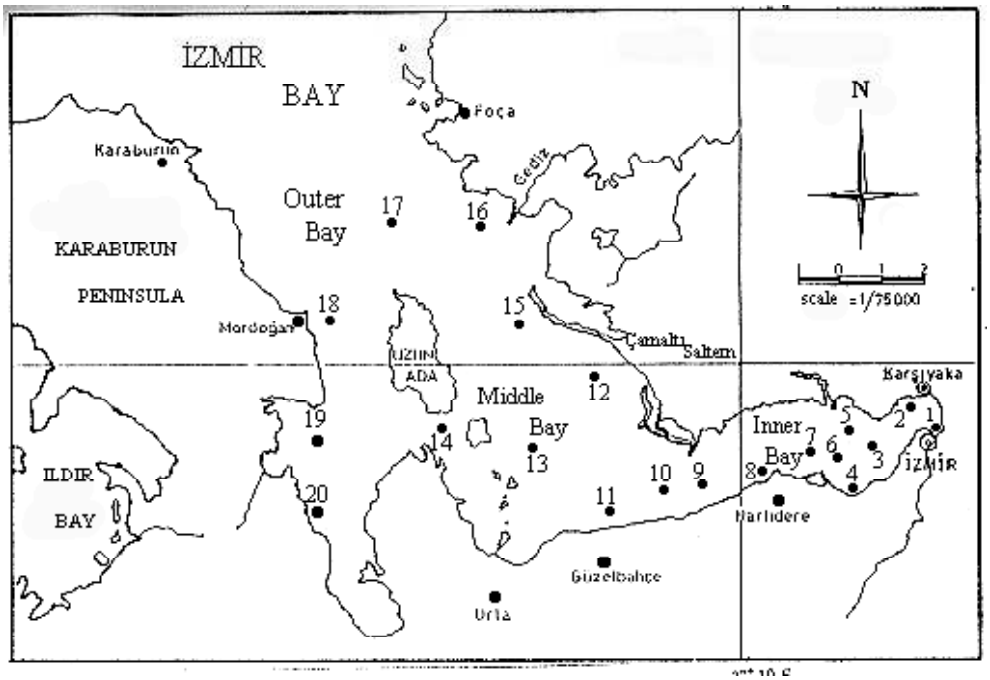

Fig. 1. Sampling Stations

Materials and methods

The aim of this study is to determine nutrient pollution caused by land-base activities in the İzmir Bay. Because of this purpose we have selected 20 station and measured seasonal variation of sea water temperature, pH, salinity, dissolved oxygen, NO_2^--N, NO_3^--N, NH_4^+-N, PO_4^{3-}-P, and SiO^-_4-Si in deep and surface water from January 1996 to January 1997.

Concentrations of nutrient elements were measured with a spectrophotometer (Strickland and Parsons, 1972; Parsons et all., 1984). Physico-chemical parameters of the bay waters such as temperature (YSI Model 33 SCT-meter), oxygen (Winkler method), were measured on board ship whereas salinity was determined with Mohr-Knudsen method and the pH with portable pH meter in the laboratory.

Results and discussion

Rainfall, vaporization, streams and waste water discharge affect the variations of salinity in the İzmir Bay. As a result of rain in winter salinity has decreased to 30,32%. In this study, the stations where low salinity is measured are located at the Inner Bay. 11 river mouths, 128 drainage system mouths to the Inner Bay are suggested to be the reasons of this condition (Table1).

Tab. 1. The avarage values of physico-chemical parametres in the *İ*zmir Bay

Locations	Water column	T (°C)	pH	%oS	D.O (mg/l)
Inner Bay	Deep	19,2	7,66	35,23	4,42
	Surface	19,6	7,67	34,43	5,39
Middle Bay	Deep	18,1	7,74	35,45	7,71
	Surface	18,4	7,75	35,16	7,75
Outer Bay	Deep	17,3	7,87	36,30	7,87
	Surface	18,4	7,63	35,71	7,63

pH values measured in the Outer Bay are relatively higher in comparison with the other regions of the Bay. The waste-waters low in pH value flow into the Bay and this affects the values along the shore (Table1).

Owing to the oxygen consumption during the decomposition of organic substances which is reached by the discharge water; a significant increase in the dissolved oxygen concentrations from the Inner bay to The Outer bay is determined when the variations of dissolved oxygen in the vertical direction are taken into consideration; in summer, the surface concentration of dissolved oxygen is relatively higher when compared with the bottom concentration throughout the Bay (Table1).

Water samples were taken from 7 stations of the Inner Bay, 4 stations in the Middle Bay and 11 stations in the Outer Bay. The results of the measured parameters were between 0,01-5,46 µM for nitrite, 0,00-7,59 µM for nitrate, 0,04-65,67 µM for ammonium (Fig. 2. and 3) 0,09-12,06 µM for phosphate (Fig 4 and 5), 0,0-6,38 mg/l for silicate (Fig. 6 and 7).

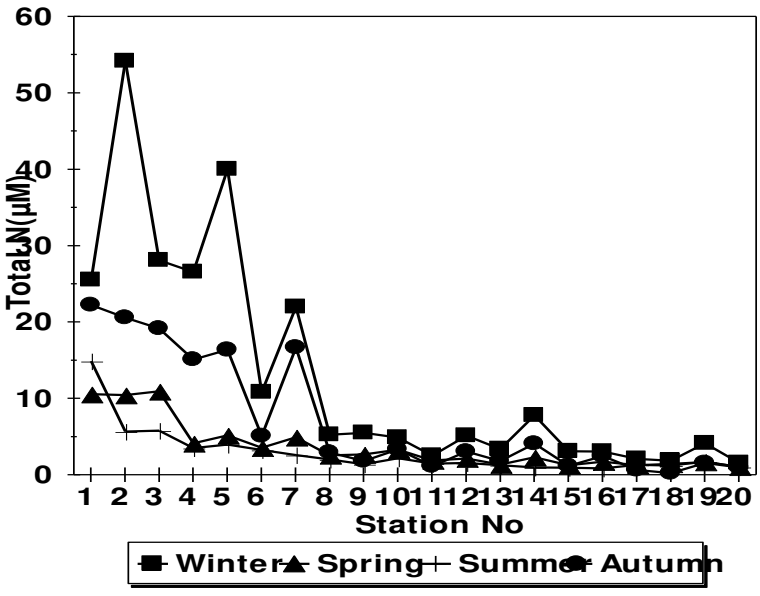

Fig. 2. Seasonal variations of ∑N in deep waters

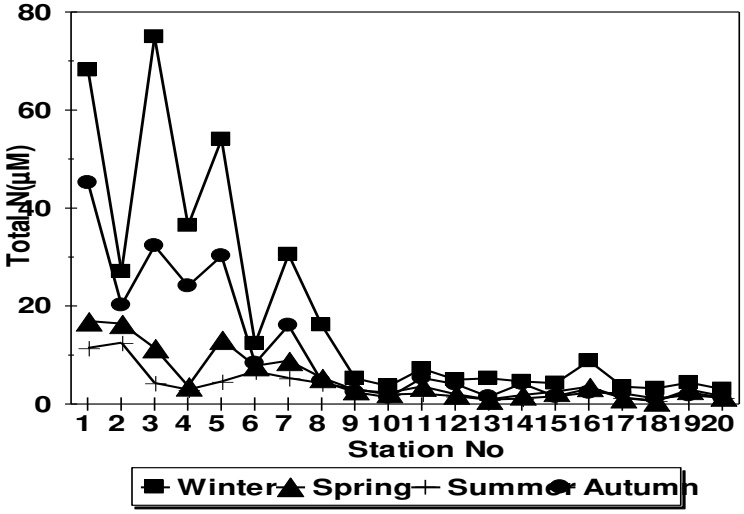

Fig. 3. Seasonal variations of ∑N in surface waters

The concentration of nutrients gets lower from the Inner Bay to the Outer Bay and besides transformations among various nitrogen forms take place. Througout the Bay NH_4^+ dominancy and a decrease in nitrite concentration from the Inner Bay to the Outer Bay are observed.

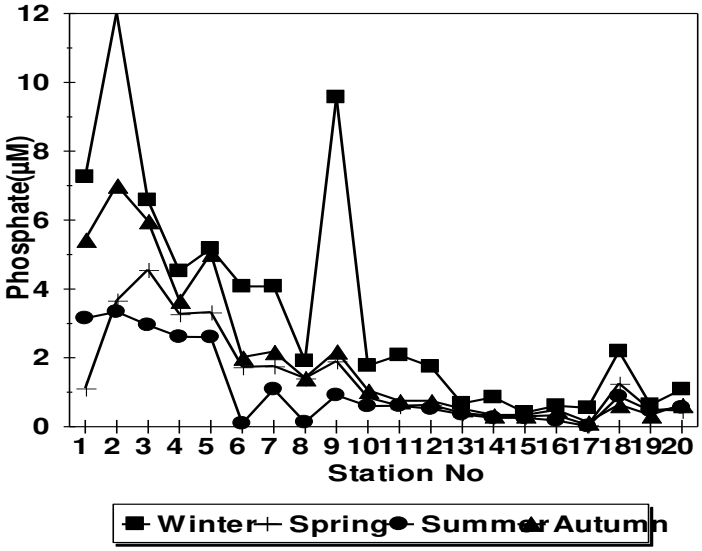

Fig. 4. Seasonal variations of PO_4^{-3}-P in deep water

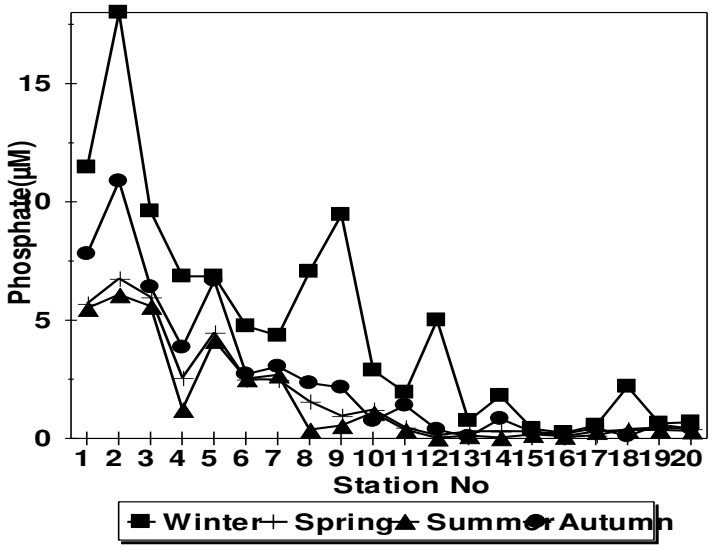

Fig. 5. Seasonal variations of PO_4^{-3}-P in surface water

As a result of this study, maximum values are obtained in winter when phytoplankton production of nutrients is decreased and relatively lower values are obtained in spring, summer and autumn when production is incerased.

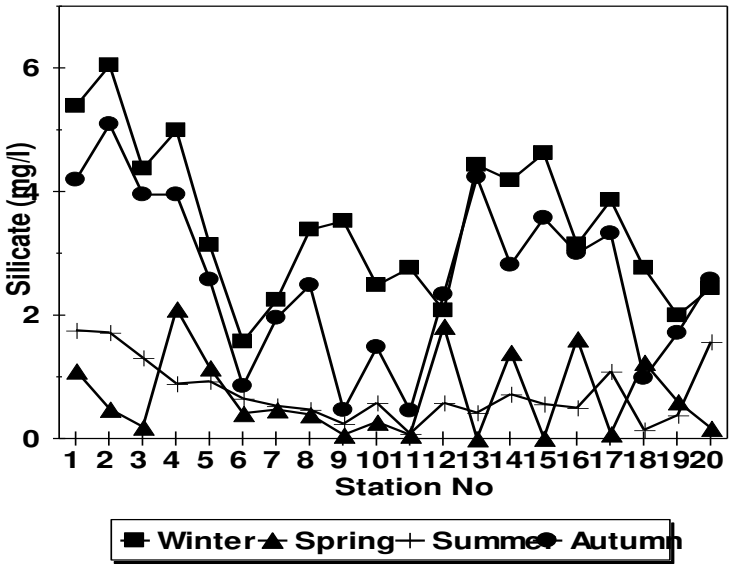

Fig. 6. Seasonal variations of silicate in deep water

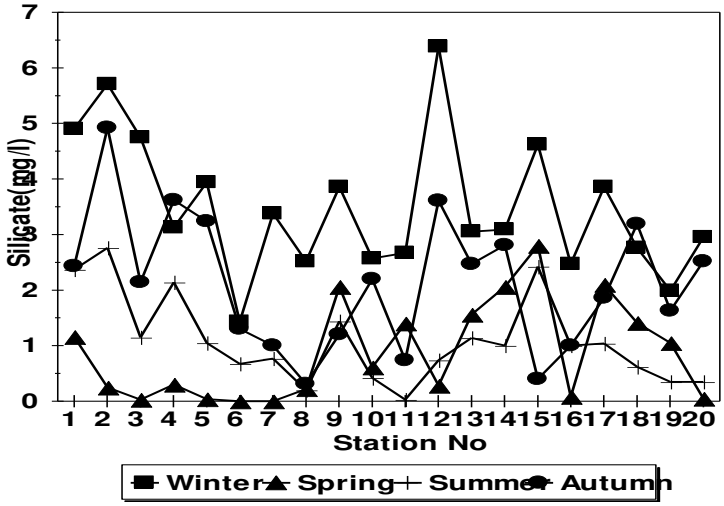

Fig. 7. Seasonal variations of silicate in surface water

We can say that the affects of low concentration (which is caused by agricultural activities) of waste discharge water carried by Gediz River are the reason of the maximum values of nutrient concentration in the surface water in Gediz estaurine.

According to the measurements obtained from the Bay as a result of high concentration of nutrients, particularly Inner Gulf and Gediz Delta are identified in the "polluted water" classification. Previous nutrient concentrations are given in Table 2 from different regions of Mediterranean Sea. When nutrient concentration of Inner Bay is compared with the values reported by UNEP, UNESCO, FAO, 1988, inner part of İzmir Bay is classified in hypereutrophic waters. This condition is an evidence for us that the ecological equilibrium of the Bay is completely prejudiced as a result of domestic and industrial discharges from the land-base activities.

Tab. 2. Minimum and maximum nutrient concentrati*ons from İ*zmir Bay and different regions of Mediterranean (µM)

Locations	NO_2^--N	NO_3^--N	NH_4^+N	PO_4^{-3}P	SiO_4^--Si	References
Adriatic Sea	0,01-1,11	0,01-21,90	0,01-4,25	0,01-2,26	0,21-3,03	Vukadin, 1992
Thessaloniki Bay	0,06-1,31	0,03-0,88	0,14-1,59	0,06-3,33	0,56-1,42	Psyllıdou et all,1995
La Spezia Gulf	-	0,0-17,17	0,0-13,98	0,0-1,14	0,46-16,64	Catini et all,1992
İzmir Bay	-	0,1-80,0	0,1-216,0	0,01-7,02	0,3-11,0	D.B.T.E.,1997
İzmir Bay	0,72-4,62	0,06-3,08	438,3-1020,7	0,38-5,48	5,02-15,66	Sunlu, 1994

"Big Channel Project" (Big scale waste-water treatment project) is put across by municipality of İzmir in order to control the pollution in the Bay and rearrange the current status. After fullfilling the requirements of the project such as constructing a main collect the waste water of 11 valleys and 128 domestic sewage outfall.

When the Big Channel Project will be finished it would be possible to let the İzmir Bay to clean itself. The results reported in this study can be used as reference when the Big Channel Project will be in full operation.

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