C-I5

The Determination of Oceanographic Characteristics, Primary Productivity and limiting Nutrient(s) of the Izmit Bay, Marmara Sea

S. TUGRUL*, O. BASTURK* and E. MORKOC**

*Institute of Marine Sciences, METU, P.K. 28, Erdemli, Icel (Turkey)
*Marmara Research Center, TUBITAK, P.K. 21, Gebze, Kocaeli (Turkey)

For the water quality management of the İzmit Bay, located on the northeastern part of the Marmara Sea, a long-term survey has been conducted in May 1984-July 1988 (Tuğrul et.al., 1989). The İzmit Bay, as being a part of the Marmara Sea, is influenced by the water exchanges taking place between the Black Sea and the Aegean Sea (Tuğrul et.al., 1986). The bay has a permanent two-layer stratification throughout the year as in the Marmara Sea. The degree of stratification and characteristics of the water masses show considerable interannual variations, particulary in the upper layer.

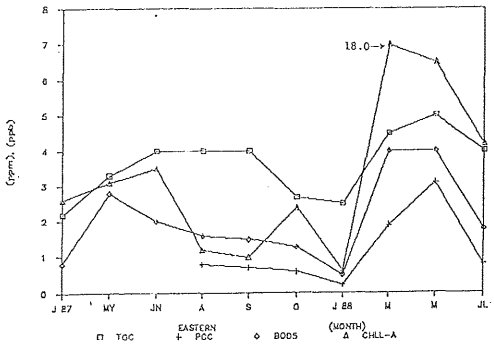
The dissolved oxygen, nutrient, total and particulate organic carbon, and chlorophyll-a concentrations within the bay are mainly governed by waste load inputs, primary production and physically by the water exchanges with the adjacent water masses of Marmara Sea. Because of the relatively long residence time of the bottom waters of the bay (below 30 m) and sinking of biodegradable particulate organic matter of algal and anthropogenic origins, the dissolved oxygen consumption rate exceeds its supply rate and thus the dissolved oxygen concentration decreases from 2 ppm in April to below 0.5 ppm in October.

The primary productivity and bio-assay studies have been carried out seasonally by C-14 technique for one year in 1987-1988 (Morkoç and Tuğrul, 1989). The results of POC, BOD_5, chlorophyll-a and primary productivity have demonstrated that there exist significant inputs of nutrient elements (N,P) associated with the biodegradable organic matter of industrial and domestic origins to the bay system. The annual algal production was found to be about 185 g-C/m² in the relatively less polluted waters of the western region whereas it reached 330 g-C/m²/year in the inner bay. The highest production value of 3810 mg-C/m²/day was measured in March, 1988, which corresponds to the spring-bloom time in the Marmara Sea.

The results of bio-assay predicted that the limiting nutrient elements on phytoplankton production were found to be ortho-phosphate and reactive silicate whereas the nutrient measurements in the surface waters of the bay indicated that the nitrate very likely limits the algal production within the bay, as expected in the Marmara Sea.

The nutrient results demonstrate that the $(NO_3+NO_2)/(o\text{-}PO_4)$ ratio (in mole) in the lower layers of the bay is less than 11, indicating denitrification reaction in the oxygen poor bottom waters of the bay. The concentrations of ortho-phosphate and (nitrate+nitrite) in the bottom waters range between 0.8-1.2 µM and 7-11 µM, respectively, depending upon the temporal and spatial variations of physical and biochemical processes within the bay.

As the consequence of large quantities of wastewater dischange to the eastern and central bay waters (Tuğrul et.al.,1986), BOD_5, TOC, POC and Chll-a measurements (see the figure below) clearly indicate a considerable amount of biodegradable organic



The variations of TOC, POC, BOD_5 (ppm) and Chll-a (ppb) with time in the surface water of the eastern region of the bay.

matter input to the inner bay. From the long-term TOC and POC measurements, the two important conclusions can be derived: first, a significant fraction of the land-based organic matter is degraded in the euphotic zone, the second is that 10-30% of TOC is in POC form. The highest POC concentration was always recorded in the surface layers (0-5 m) of the polluted waters of the eastern region whereas it associated with the chll-a maxima in the outer bay. The water quality modelling study has also verified these conclusions (Tuğrul et.al.,1989). The POC/Chll-a ratio in the bay waters showed seasonal changes, with the highest value in the summer months. The water quality model of the bay has predicted that the bay system is very sensitive to deep-sea discharges. Thus, at least, 90% of the present waste loads entering the bay should be removed by adequate wastewater treatment techniques prior to deep-sea dischange to the bay system.

REFERENCES

Tuğrul,S., Sunay,M., BaştÜrk,Ö. and Balkaş,T.(1986). The İzmit Bay case study. In: The role of the oceans as a Waste Disposal Option, ed.by G.Kullenberg, D.Reidel Publ.,pp.243-274.

Tuğrul,S., Morkoç,E. and Okay,O.(1989). The determination of Oceanographic characteristic and assimilation capacity of the İzmit Bay. In: Wastewater Treatment and Disposal studies, NATO TU-WATERS Project, Final report, TÜBİTAK-MRI Chem.Eng.Publ. pp.193-259.

Morkoç,E. and Tuğrul,S.(1989). Determination of primary production and limiting nutrients in the Bay of İzmit, NATO TU-WATERS Project, Final report, TÜBİTAK-MRI Chem.Eng.Dept. Publ. No. 232, 60 pp.

C-I6

Nitrogen and Phosphorus in Freshwaters Flowing into the Northern Adriatic Sea

V.-U. FOSSATO and G. CAMPESAN

Istituto di Biologia del Mare, CNR, Venezia (Italia)

The Italian coast of the northern Adriatic Sea is under direct influence of freshwaters conveyed by a number of rivers, which drain a land surface of about 120,000 km2.
The mineralogical-petrographic characteristics of the whole catchment basin are relatively well known: the rivers Po, Adige, Brenta and Bacchiglione belong to a subcarbonatic area, in which carbonate percentage in the sediment varies from 12% to 50% northwards(1), while the rivers Piave, Livenza, Tagliamento and Isonzo belong to a carbonatic area with CaCO3 plus MgCO3 percentages ranging from 61% to 86% and calcite/dolomite ratio increasing eastwards(2).

Table 1. Nitrogen and Phosphorus in the waters and carbonate content in the sediments of the rivers flowing into the northern Adriatic Sea. TIN = Total Inorganic Nitrogen µg-at/l; OP = Orthophosphate Phosphorus µg-at/l; N/P = Nitrogen to Phosphorus atomic ratio; % CO3 = % Total Carbonates in sediments; X = Mean; SD = Standard Deviation.

River	Years	Samples No.	TIN X	TIN SD	OP X	OP SD	N/P X	N/P SD	%CO3 Min - Max
Isonzo	1976-77	50	59.4	23.7	0.29	0.22	371	288	61.0-81.7
Tagliamento	1983-84	20	68.1	23.1	0.19	0.17	456	380	69.1-80.2
Livenza	1986-87	27	127.4	46.2	0.91	0.42	155	55	63.8-86.2
Adige	1968-78	196	68.1	21.0	1.51	0.71	46	43	11.3-15.3
Po	1968-84	270	121.5	64.9	2.81	1.87	69	97	6.9-14.9

The physical and chemical characteristics of freshwaters have been investigated and reliable concentration data series of nitrogen and phosphorus are available for some of these rivers(3,4,5,6,7,8,9). Table 1 summarizes published data on nutrient concentrations in freshwaters and carbonate content in sediments. The data available, although limited to inorganic dissolved forms of nitrogen and phosphorus, clearly indicate that: (i) significant differences in the concentration of nitrogen and phosphorus and in the N/P atomic ratio exist among different rivers; (ii) nitrogen and phosphorus of the Po and Adige rivers have increased significantly in the past two decades due to man-made inputs, but the N/P ratio remained almost unchanged; (iii) the lowest phosphorus values and the highest N/P ratio were generally measured in the carbonatic area, where phosphorus concentrations are an order of magnitude lower than in the rivers of the subcarbonatic area.
In principe, no river entering Adriatic coastal waters can be considered "unpolluted"; thus, the N/P atomic ratio reflects the balance between nitrogen and phosphorus concentrations originated from natural sources (by dissolution of rocks and soils) and from man-made sources (sewage and industrial effluents, runoff from fertilized agricoltural land). In moderately polluted waters of the carbonatic area, as it is the case of the rivers Isonzo, Tagliamento and Livenza, the high N/P ratio may be interpreted in terms of phosphate retention as a particulate or as an adsorbed phase on soils. Since the optimum N/P ratio for algae growth ranges from 10 to 20, freshwaters from karstic watersheds are generally limited by phosphorus.

REFERENCES

(1) Jobstraibizer P. and P. Malesani. Memorie della Società Geologica Italiana 12 (1973) 411-452.
(2) Stefanini S. Studi Trentini di Scienze Naturali, Sez. A 45 (1968) 101-124
(3) Bregant D. and G. Catalano. Istituto Talassografico di Trieste. Pubbl. n. 545 (1978) 1-12.
(4) Cioce F., Stocco G. and R. Toniolo. Istituto veneto Sci. 85 (1977) 119-132.
(5) Fossato V.U. Archo. Ocean. Limnol. 18 (1973) 59-70.
(6) Fossato V.U., Campesan G., Craboledda L., Dolci F. and G. Stocco. (in preparation)
(7) Fossato V.U., Perin G., Carniel A., Craboledda L. and F. Dolci. Atti 7° Congresso A.I.O.L. (1988) 279-282.
(8) Marchetti R., Pacchetti G. and A. Provini. Nova Thalassia 7 suppl. 2 (1985) 311-340.
(9) Provini A.and G. Pacchetti. Ingegneria Ambientale 11 (1982) 173-183.

C