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Land Run-Off as a Source of Nitrogen in the Marine Coastal Environment of Alexandria

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INTRODUCTION: Nitrogen is one of the biologically important elements in the aquatic habitats. In addition to dissolved molecular nitrogen, sea water contains low, but extremely important, concentrations of inorganic and organic nitrogen. The present work deals with the concentrations of the different nitrogen species as well as their contribution to the total nitrogen budget in one of the most polluted basins off Alexandria, the Eastern Harbour (E.H).

MATERIAL AND METHODS: During the period 1985-1986, sampling was carried out at regular bimonthly intervals in a semi-closed bay, connected to the Mediterranean through two openings. The basin is subjected to about $35X10^6$ m^3 of unprocessed sewage, rendering its flushing rate to be 5 months. Nitrate, nitrite and ammonia were determined according to Strickland and Parsons (1972). Total dissolved nitrogen (TDN) and total nitrogen (TN) were determined on filtered and unfiltered samples using the technique described by Koroleff (1977) and modified by Valderrama (1981). Dissolved organic nitrogen (DON) and particulate nitrogen (PN) were estimated by calculations. The uptake rate of NO_3 & NH_3 by phytoplankton of the harbour water was determined using the procedure of Eppley et al (1969). The flux of nitrogen from the harbour sediments was measured following the method of Hargrave and Connolly (1978). Organic nitrogen in sediments was determined according to Niederl and Niederl (1942).

RESULTS AND DISCUSSION: Nitrate is the final oxidation product of nitrogen compounds in sea water. During the study period, its concentration in the E.H was comparatively high, the annual averages being 6.791 ± 4.654 and 4.826 ± 2.964 µg at/l for both surface and bottom waters, respectively. The nitrite concentrations were much lower than that of nitrate (The averages being 0.949 and 0.746 µg at/l for both surface & bottom waters, respectively). The importance of waste water discharged into the harbour as a source of ammonia was found from the inverse correlation between ammonia and salinity ($P<0.001$). In spite of shallowness of the E.H., ammonia concentration was relatively high, varying between 0.975-11.456 µg at/l (at the surface) and 0.480-12.334 µg at/l, near the bottom. The observed correlation ($P<0.001$) between NO_3 & NO_2 content and its insignificance with ammonia indicated that nitrate reduction rather than ammonia oxidation is a major source of nitrite.

Dissolved organic nitrogen (DON) was comparatively higher (annual average 11.866 ± 6.129 µg at/l) than that of DIN (average 10.06 ± 4.864 ug at/l). This is probably due to being assimilated by aquatic organisms at a much lower rate than inorganic forms or being resistant to bacterial attack, remaining in the water or sinking to the bottom (Riley and Chester, 1971). The correlations between DON with Chl a ($P<0.001$) and living biomass represented by ATP ($P<0.001$), confirmed the important role of living organisms as a source of DON.

High concentrations of PN occurred in summer, coinciding with the periods of maximum sewage discharge and chlorophyll a biomass (Aboul-

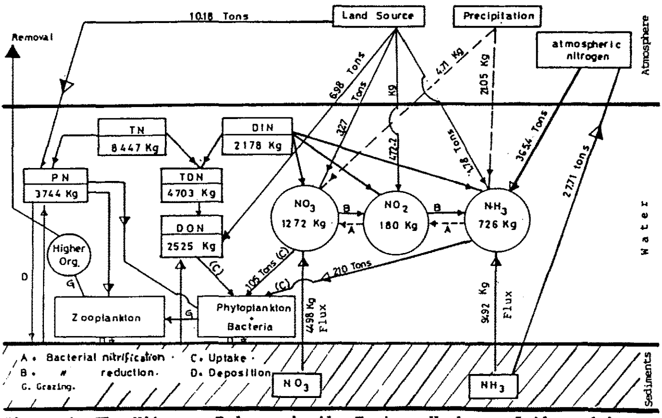

Figure 1: The Nitrogen Balance in the Eastern Harbour of Alexandria.

Kassim, 1987). The highly significant correlations between PN with POM ($P<0.001$) and salinity ($P<0.001$) are evidences for the role of phytoplankton and sewage discharge as important sources of PN.

On the average, most of the nitrogen budget of the E.H (59%) was in the dissolved from. DON was more abundant, constituting about 54% of TDN. Nitrate was the most abundant form of DIN forming 55.7%, followed by ammonia 37.1% and nitrite 7.2%. The mean atomic ratios of the different nitrogen and phosphorus forms, i.e. NO_3/DIP, DIN/DIP, DON/DOP, TDN/TDP, PN/PP and TN/TP were as follows: 13.62:1, 23.97:1, 24.52:1, 22.67:1, 11.33:1 and 15.85:1, respectively.

Within the values given in figure 1, the total input of all nitrogen compounds from land sources, flux from sediments, precipitation and nitrogen fixation amounted to 402 Tons/year. This amount exceeds that due to uptake, denitrification from bottom sediments and the amount present in the harbour environment by 51 Tons/year.

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