

Nitrogen and Phosphorus in Freshwaters Flowing into the Northern Adriatic Sea

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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 | | OP | | N/P | | %CO ₃ Min - Max |
|-------------|---------|----------------|-------|------|------|------|-----|-----|-------------------------------|
| | | | X | SD | X | SD | X | SD | |
| 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 principle, 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 agricultural 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.

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