

NUTRIENTS TRANSFER PROCESSES IN AN ESTUARINE ENVIRONMENT  
IN THE NORTH AEGEAN SEA

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Summary

The distribution of salinity, temperature, nutrients and phytoplankton of the Alexandroupolis coast both inside and outside the Evros River plume, were observed during three cruises between March 1981 and March 1982. The data presented here from the Evros River effluent region indicate that during periods of high river discharge (late winter) the distribution of surface mixtures of river and coastal water is considerably less uniform than periods of low river discharge. The water below the 10m depth does not appear to have changed between the March and August survey periods if salinity and nutrients are used as indicators. From the arguments above, it emerges that the waters of the Evros River plume consists primarily of two component mixtures of Evros River water and of surface sea-water, but they may contain variable fractions of entrained and intermixed deeper water. In the area under investigation, the river seems to make its effect felt in a different manner in two different zones.

The first, inside the Evros River plume, has an abrupt decrease in the salinity, and an increased concentration of nutrients. For this zone there is a highly significant correlation between nutrients and salinity, indicative of predominant physical influence upon their distribution, and the nutrients never decrease to zero level. In late winter, flocculation and precipitation are not important in the removal of nutrients from these mixtures and it is assumed that they are unimportant during the remainder of the year. The second zone outside the Evros River plume in which the above mentioned correlation is no longer significant because of the superposition of biological factors, showed algal growths which lowered the content of nutrients to the point of exhausting the limiting element, which was found to be nitrogen.

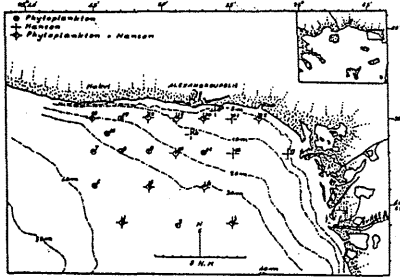


Fig. 1. Location of the stations

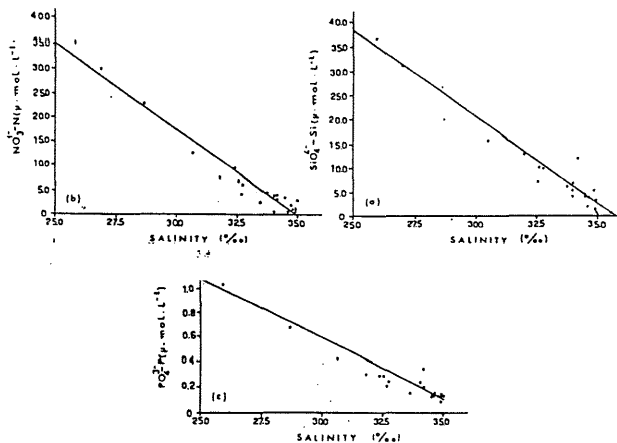


Fig. 2. Nutrients vs Salinity inside the Evros River plume

ANTROPOGENIC INFLUENCE OF THE KRKA RIVER ESTUARY ECOSYSTEM  
(MIDDLE ADRIATIC COAST)

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Summary

Results of researches of hydrographic, geological, chemical and biological parameters, carried out in the Krka estuary show that this area is under very strong influence of land factors, i.e. freshwater and industrial and urban effluents (still untreated).

Mentioned inflows bring large quantities of wastes and very toxic heavy metals (Zn, Cu, Pb and Hg) which have made this basin one of the most threatened areas along the eastern Adriatic coast.

Introduction

The area of Krka estuary, middle Adriatic coast, is a semiclosed basin with rather low values of current speed, peculiar morphological properties and high production. Water exchange with the adjacent sea is rather poor. Considerable discharge of freshwater (49 m<sup>3</sup>/sec) and sewage waters (45 x 10<sup>6</sup> m<sup>3</sup>/yr) are discharged into the sea. They affect to a considerable extent chemical properties of the study area.

Material and Methods

Samples were collected from several characteristic stations in the estuary in the vicinity of urban centre and from an open sea station. Samplings and analyses were carried out in 1983-1985. Standard oceanographic methods were applied.

Results and Discussion

Table 1. Annual inputs in the Krka estuary\*

	Inorganic nitrogen	Inorganic phosphorus	Suspended solids	Zn	Cu	Pb	Hg
Krka River	1410	126	1288	1.7	1.0	1.5	0.7
Sewage effluents	395	15	112	2.3	4.3	2.9	0.8
Total	1805	141	1300	4.0	5.3	4.4	1.5

\* All values are given in tons/year

Table 1 presents the major sources of wastes and estimated annual inputs of some important elements. The behaviour of dissolved inorganic phosphorus and other nutrients in Krka estuary was studied by Buljan (1969) and Buljan *et al.* (1980) who found that the rivers entering the Adriatic sea on the eastern coast were poor in phosphorus. This may be accounted for by the fact that phosphate is removed from these waters presumably by adsorption on particulate material and subsequent sedimentation.

Nutrient values are very high on the freshwater end of the estuary to be decreased to low values at the mouth (22.6 - 0.1 μmol/dm<sup>3</sup>). Nutrients showed considerable scatter as often found when one parameter is plotted against salinity. The data indicate a substantial loss of phosphate from the water of the estuary, the greatest proportion of the removal taking place in the upper estuary at salinities below 10 x 10<sup>-3</sup>. If the removal of phosphate is mainly due to biological activity than the other nutrients (ammonia and nitrates) will presumably also be removed what would result in a linear relationship between phosphate and nitrate and ammonia. We, however, had non-linear relationship which is indicative of non-biological removal of phosphate as well as silica, or maybe these salts originate from some other sources in the estuary (sewage waters). It is obvious that inorganic N is biologically controlled in the estuary while P and Si show rather a geochemical influence.

The study of trace metals is of considerable interest since some of them are essential for the life while others are highly toxic. Here we studied horizontal and vertical transport of these substances and their concentrations in sediments.

Horizontal transport is dominated by simple advective flow and the vertical transport is influenced by a number of physical, biological and chemical processes. It is obvious from the table that the sewage effluents are major sources of these trace metals in the Krka estuary.

Sediments act as a storage agent for trace metals. In general, Hg, Zn and As contents in surface sediment layers in the Krka estuary were higher by approximatively an order of magnitude in comparison to the values found at the open sea station Zn (140.0 : 29.0 mg/kg), Cu (45.8 : 8.6 mg/kg), As (14.2 : 1.8 mg/kg) and Hg (1.94 : 0.02 mg/kg). These values have made this basin one of the most threatened area along the eastern Adriatic coast.

References:

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