

# DISTRIBUTION OF DISSOLVED OXYGEN AND NUTRIENTS IN THE WATER COLUMN OF THE INNER SARONIKOS GULF (CENTRAL AEGEAN SEA) AFFECTED BY THE PSITTALIA SEWAGE OUTFALL

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## Abstract

The chemical signal of the sewage effluents of Athens and Piraeus cities was detected at 40-55m during May-September 2000, whereas in October the signal was detected deeper, at approximately 60-65m. The dissolved oxygen values in the inner Saronikos gulf ranged between 2.98 ml/l and 5.85 ml/l. Low concentrations were found mainly at the depth of the sewage effluents (40-60m). The highest concentrations of ammonium and phosphate were measured near Psittalia, at 40-60m depth, whereas for nitrate and silicate an increase with distance from the sewage sea outfalls is recorded which is related to organic load mineralization. The sewage diffused mainly towards the south-southwest of Psittalia.

*Keywords: Aegean Sea, sewage, dissolved oxygen.*

## Introduction

The wastes of the Athens metropolitan area, after a primary treatment in the Psittalia Sewage Treatment Plant, are discharged in the inner Saronikos Gulf at 63 m depth and thereafter follow the water circulation of the area. A number of studies undertaken within the framework of monitoring programs (e.g. MEDPOL Saronikos, 1987-2000; Monitoring of the Saronikos gulf ecosystem affected by the Psittalia sea outfalls 1998 - 1999), have recorded the concentrations and distribution of dissolved oxygen (DO) and nutrients in Saronikos gulf. This work, performed in the framework of the program: "Monitoring of the Saronikos Gulf ecosystem affected by the Psittalia sea outfalls (2000)", provides a brief summary of the results of a 6-month study concerning the impact of the Psittalia sewage on dissolved oxygen and nutrient distribution in the inner Saronikos gulf.

The objectives of this work were: (a) to record the concentrations of dissolved oxygen (DO) and nutrients in the inner Saronikos Gulf in a 6-month sampling period, (b) to investigate the way that the sewage diffuses in the inner Saronikos Gulf and (c) to assess the impact of sewage discharge on the oxygen and nutrients distribution.

## Materials and Methods

Seawater samples from 11 sampling stations in the inner Saronikos Gulf were collected monthly. Additionally, in May 2000 and August 2000, a dense and more detailed grid of 25 stations was used (Fig.1). DO measurements were carried out on the oceanographic vessel "AEGEO" using the Winkler method [1]. Phosphate and ammonium were also measured on board with a Perkin-Elmer UV/VIS (Lambda 2S) Spectrophotometer using standard methods [2 & 3], whereas silicate, nitrate and nitrite were measured with a BRAN+LUEBBE auto-analyzer following standard methods [4 & 5].

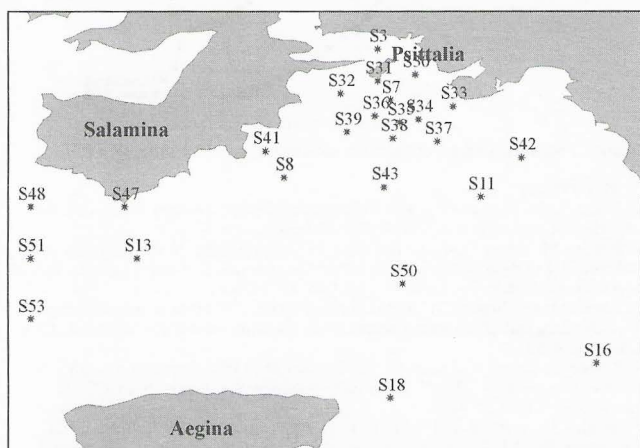


Fig. 1: Location of sampling stations in the inner Saronikos Gulf, in May and August 2000.

## Results and discussion

The load of treated wastes during the sampling period "May 2000-October 2000" was trapped below 40m depth, due to the stratification of the water masses in the inner Saronikos Gulf during May to early December [6].

DO concentrations ranged between 2.98 and 5.85 ml/l. The lowest concentration was measured in September near the bottom (95m) of

station S8, west of Psittalia (S7). The vertical distribution of DO at the stations located near Psittalia showed minimum values at the wastewater layer (40-60m) due to oxidation of the organic matter of the sewage effluents.

Nutrient concentrations ranged as follows:  $PO_4^{3-}$ : 0.01-2.26  $\mu M$  (maximum value at station S31 near Psittalia, in August),  $NO_3^-$ : 0.03-7.04  $\mu M$  (maximum value at the bottom layer of station S39, south-western of Psittalia, in July),  $SiO_4^{2-}$ : 0.53-14.6  $\mu M$  (maximum value at the bottom layer of station S8, southwestern of Psittalia, in September) and  $NH_4^+$ : 0.01-21.8  $\mu M$  (maximum value at S30, near Psittalia, in May). The most intense and extended chemical signal of the sewage effluents was detected during May. Nitrate and silicate distribution showed an increase with distance (from Psittalia) and depth, which was related to the mineralization of the accumulated organic load. The sewage effluent, during the most of the sampling period, seems to diffuse mainly towards the south - southwest of Psittalia (Fig. 2 & 3) while in May it appears to move, almost equivalently, towards the southeast and southwest of Psittalia.

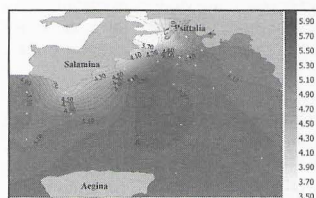


Fig. 2 : Horizontal distribution of DO (ml/l) at the depth of sewage effluents, during August 2000.

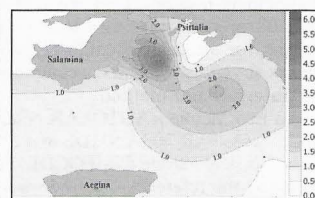


Fig. 3 : Horizontal distribution of ammonium ( $\mu M$ ) at the depth of sewage effluents, or 50 m, during June 2000.

## Conclusions

During May to October 2000, low DO concentrations along with high ammonium and phosphate concentrations were measured within the layer of 40-60m (depending on the sampling period), mainly towards south-southwest of Psittalia due to the presence of the sewage effluent from the Treatment Plant. High concentrations of nitrate and silicate were measured at a greater distance (1.5-1.7 Km) due to the decomposition of the accumulated organic load. The sewage discharge seems to influence the DO and nutrient distribution and subsequently the water quality in the inner Saronikos Gulf.

## References

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