# ASSESSING FRESWATER AND NUTRIENT FLUXES IN NESTOS RIVER AND ITS PLUME

Nikolaos Kamidis [1] *, Georgios Sylaios [1] and Vassilios A. Tsihrintzis [2]

[1] NAGREF - Fisheries Research Institute, Nea Peramos, 64007 Kavala, Greece. - nik_kami@yahoo.com

[2] Laboratory of Ecological Engineering and Technology, Department of Environmental Engineering, School of Engineering, Democritus University of Thrace, 67100 Xanthi, Greece.

**Abstract**

Three oceanographic cruises were conducted to determine the seasonal and spatial variability of the water column characteristics along the coastal zone of western Thracian Sea, under the variable influence of Nestos River discharge rates.

*Keywords : Estuaries, Coastal Waters, River Input.*

Introduction

Nestos River flows for 230 km through Bulgarian and Greek territory before emptying in Thracian Sea. The mean annual discharge for the period 1966-1990 was measured to 37 $m^3$/s, ranging below 10 $m^3$/s (August) and 150 $m^3$/s (February). The coastal area of River Nestos outflow is influenced by the cooler and fresher Black Sea Water (BSW), which moves cyclonically along the Thracian Sea [1]. The present study aims at describing the level of riverine influence in the distribution of nutrients, chlorophyll and suspended matter along the coastal zone near the Nestos River mouth.

Materials and Methods

Three hydrographic cruises were conducted during March, May and August 2006 for the collection of water quality data from 24 stations, commencing 20 km upstream of the river's outflow, following its route and covering the broader river plume area. Sampling cruises took place during high (84.8 $m^3$/s in March 2006), intermediate (59.0 $m^3$/s in May 2006) and reduced (21.0 $m^3$/s in August 2006) river flows. Temperature, salinity, conductivity and density were recorded using a Seabird SBE-19plus CTD. Water samples were collected from the surface and the bottom layer of the water column for the determination of nutrients according to [2] and chlorophyll-a according to [3] method. Finally, meteorological data were obtained from Chryssoupolis Airport located 10 km from the river mouth.

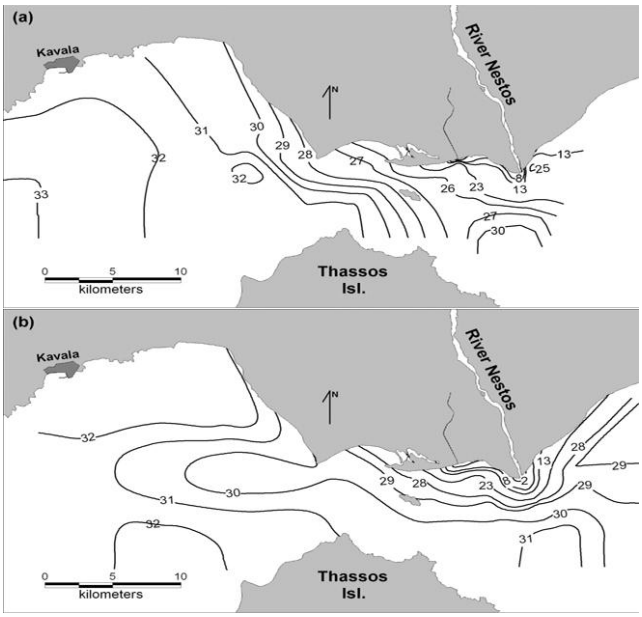


Fig. 1. Surface salinity spatial distribution during (a) high and (b) intermediate river flow.

Results and Discussion

Explicit T-S diagrams were used to define the level of background salinity corresponding to the limit between BSW and river plume water, and thus estimate the freshwater volume of the river plume area [1], which was calculated at 176x$10^6$, 172x$10^6$ and 13x$10^6$ $m^3$ for March, May and August, respectively. Nestos River dissolved inorganic nitrogen (DIN) loads were calculated at 116.1, 70.9 and 29.4 tones per month for the increased, intermediate and reduced flow conditions, respectively. Similarly, dissolved inorganic phosphorus (DIP) loads were assessed at 16.7, 21.0 and 3.2 tones per month, for the increased, intermediate and reduced flow conditions, respectively. River plume nutrient concentrations, integrated over the entire freshwater layer, showed that the total DIN content reached 29.6 tones in March 2006, reduced to 5.6 tones in May 2006 and dropped further to 0.4 tones in August 2006. Similarly, the total DIP pool within the propagating river plume water was estimated at 4.5 tones, 4.4 tones and 0.03 tones, respectively. Plume dynamics were mostly governed by the strong geostrophic and tidal currents, enhanced in the Nestos River mouth area due to the presence of Thassos Passage, a narrow canal connecting Kavala Gulf with North Aegean Sea [4]. Atmospheric forcing seems to play a secondary role in plume expansion. Maximum plume surface expansion was observed in May, due to limited vertical mixing (Figure. 1).

Nutrient stoichiometric ratios within the plume depicted nitrogen limitation during March and May, and phosphorus limitation at the distant stations of the coastal zone, under low flow conditions. Nutrients spatial distribution presented an inverse linear relation to salinity, indicating the conservative mixing behavior under high (DIN: $R^2$= 0.96, DIP: $R^2$= 0.87 and Si: $R^2$=0.94) and intermediate (DIN: $R^2$= 0.92, DIP: $R^2$= 0.89 and Si: $R^2$=0.92) flow rates, while weaker correlations prevailed in August (DIN: $R^2$= 0.04, DIP: $R^2$= 0.13 and Si: $R^2$=0.30) due to the limited nutrient fluxes.

## References

1 - Sylaios G., Koutrakis E. and Kallianiotis A., 2006. Hydrographic variability, nutrient distribution and water mass dynamics in Strymonikos Gulf (Northern Greece). *Cont. Shelf Res.* 26: 217-235.

2 - Parsons T.R., Maita Y. and Lalli C.M., 1984. A manual of chemical and biological methods for seawater analysis, Pergamon Press, New York, 510 p.

3 - American Public Health Association (APHA), Water Pollution Control Federation, (1989). Standard Methods for the Examination of Water and Wastewater, (eds. Clesceri L.S., Greenberg A.E., Trussell R.R.), APHA.

4 - Sylaios G., Stamatis, N., Kallianiotis, A. & P. Vidoris (2005). Monitoring and assessment of land-based nutrient loadings, distributions and cycling within Kavala Gulf. *Water Res. Manag.* 19: 713-735.