

## DEVELOPMENT OF ELECTROANALYTICAL INSTRUMENTATION FOR PHYSICO-CHEMICAL CHARACTERIZATION OF TRACE METALS IN THE MARINE ENVIRONMENT

Marko BRANICA

Center for Marine Research Zagreb, Rudjer Boskovic Institute,  
P.O. Box 1016, 41001 Zagreb, Croatia

In the framework of EUREKA - EUROMAR Project, the ELANI EU-493 project entitled: Electroanalytical Instrumentation Development for Physico-Chemical Characterization of Trace Metals in the Marine Environment has started in 1989, with the following objectives:

- development of a new electrochemical instrumentation for the
- direct electroactive trace metal determination
- metal complexing capacity determination
- determination of correlation of different species of trace metals (of natural and anthropogenic origin) and their physico-chemical properties in the aquatic environment.

The intention of this project is to give a contribution in elucidating of the appropriate water samples treatment, taking into account the entire process from sampling of the natural waters to the analytical treatment, including procedures for determination and final evaluation of relevant information from the experimentally obtained data. Field observations and theoretical and experimental laboratory work is devoted to the development of sensitive and specific instrumentation for establishing the governing mechanisms and the influence of various parameters on the fluxes and transformations of different forms of trace metals on the natural concentration level as well as on the level of metal pollutants in the European continental and marine aquatic environment.

The cooperation between the laboratories and a firm from the countries participating in this project (University of Liverpool, Liverpool, UK; The firm Eco-Chemie, Utrecht, The Netherlands; Forschungszentrum Juelich, Juelich, Germany and Rudjer Boskovic Institute, Zagreb, Croatia), resulted in a construction of a prototype of a portable instrument "ELANI-1", which will be described.

The results obtained for the determination of electroactive trace metals will be demonstrated in the case of Cu, Pb and Cd as well as the corresponding possibilities of metal complexing capacity determination in the model solutions as well as in the samples from the marine environment.

The development foreseen in the near future will be also discussed.

## STATISTICAL ANALYSIS OF CHEMICAL AND PHYSICAL QUALITIES OF THE SOUTHERN ADRIATIC SEA WATER

Nicola CASAVOLA<sup>1</sup>, Giovanni MARANO<sup>1</sup> and Costantino MASCIOPINTO<sup>2</sup>

<sup>1</sup> Laboratorio di Biologia Marina di Bari, Italia

<sup>2</sup> Istituto di Ricerca sulle Acque del C.N.R., Reparto di Bari, Italia

Since 1984 the Laboratory of Marine Biology in Bari has realized 29 seasonal cruises in the Low Adriatic Sea, to evaluate the biomass of small semipelagic fish, *Sardina* and *Engraulis*, and at the same time survey the waters' main physical chemical values (CASAVOLA *et al.*, 1984; CASAVOLA *et al.*, 1986).

Sampling has been carried out on a network of 20 stations over 5 transects, at a distance of 30 miles between each other, from Gargano to Otranto, using 5-litre NIO sampling bottles. The measurements of thermal, saline and oxygen stratifications have been carried out by means of an Idronaut probe, while transparency has been measured on the spot with the Secchi disc.

In the laboratory, concentrations of ortho-phosphate (PO<sub>4</sub>), total phosphorus (PT), ammonia nitrogen (NH<sub>3</sub>), nitrite nitrogen (NO<sub>2</sub>), nitrate nitrogen (NO<sub>3</sub>), total inorganic nitrogen (NI) and chlorophyll-a (CHL<sub>a</sub>) have been determined in each water sample according to the STRICKLAND & PARSONS methods (1972). It was realized that the coast waters in the Low Adriatic Sea present highly limited nitrogen and phosphorus concentrations, considerably inferior to the ones verified in other Adriatic coast areas. Therefore, analytical data once again evidence an oligotrophy.

To obtain a homogeneous chemical-physical classification of sea water samples a statistical elaboration on observed parameters (i.e. 12 parameters for each group of measurements) has been carried out. The data set used for the statistical analysis is composed of the seasonal mean values of 8 years measurements. The data refer to twenty stations and as there was a seasonal sampling for each station, the total number of data is eighty.

The statistical hierarchical agglomeration between similar groups has not been carried out because of the position of the stations, along the Adriatic coast of Puglia, is not random and the measured data are not enough. However, the Cluster analyses showed that among the sampling stations there are 2 groups of measurements with values more elevated than the other groups. In particular these 2 groups of measurements, carried out during the winter, are referred to the nutrients and the chlorophyll-a measured, and are located at the arrival and departure points of the sea current in the Gulf of the Manfredonia.

On the contrary the results of the factor analysis have been very significant. As well known this analysis is a statistical technique that allows a projection on principal axes of many independent variables that characterize the physical phenomenon. This procedure allows an easy representation in principal planes of the influence of each variable on the examined phenomenon. In this way the factor analysis attempts to represent relationships among sets of interrelated variables by a smaller set of relatively independent and interpretable, but not directly observable factors.

Thus, first of all, the results of this analysis have shown that the classification of quality of sea water can be considered a two dimensional problem. The two principal components, identified by means of several extraction methods (PC, PAF, ALPHA, ULS, ML, etc.) are related to the "biological activity" and to the "environmental conditions". The first component represents the nutrients in the sea water and includes all parameters of the "primary production" and of the "eutrophic product", that is the chlorophyll-a. The second component represents the physical and chemical conditions in which the biologic activity takes place, that is the temperature, the dissolved oxygen, the salinity, the transparency, etc.. The coefficients of the factors have been evaluated using the regression method applied on the standardized variables.

Using the principal Component extraction method (PC), the variance explained by each factor (i.e. eigenvalue) is 6.13 and 1.99 which are respectively 51% and 16% of the total variance.

Rotation of factors has been done to achieve a simple structure of them. The varimax method has been used to minimize the number of variable that have high loadings on the factors.

The final result of factor analysis shows that the characteristic of the quality of the Southern Adriatic sea water can be defined by 2 factors. The first one describes the biological activity and the second describes the environment conditions. Moreover each of the parameters NI, NO<sub>3</sub>, PO<sub>4</sub>, CHL<sub>a</sub> o PT is highly significant to explain the biological activity, while the temperature is the parameter that better describes the environmental conditions of the biological activity.

### REFERENCES

- CASAVOLA N., DE MARTINO L., MARANO G. & SARACINO C., 1984.- *Acc. Pugl. Sci.*, 41: 3-15.  
CASAVOLA N., DE MARTINO L. & MARTINO G., 1986.- *Nova Thalassia*, Suppl.3: 655-666.  
STRICKLAND J.D.H. & PARSONS T.R., 1972.- *Bull. Fish. Res. Bd. Can.*, 167: 1-312.