

## TROPHIC CONDITION IN THE BOKA KOTORSKA BAY

Sladjana Krivokapic <sup>1\*</sup>, Branka Pestoric <sup>2</sup>, Suncica Bosak <sup>3</sup> and Grozdan Kušpilić <sup>4</sup>

<sup>1</sup> \*Department of Biology, Faculty of Science, University of Montenegro, Montenegro - sladjana69@yahoo.com

<sup>2</sup> Institute of Marine Biology, Kotor, Montenegro

<sup>3</sup> University of Zagreb, Faculty of Science, Division of Biology, Zagreb, Croatia

<sup>4</sup> Institute of Oceanography and Fisheries, Split, Croatia

### Abstract

Two indicators of the trophic state, TRIX index and Fp ratio, for the first time were used to assess trophic conditions in the Boka Kotorska Bay. The TRIX value in this area ranged from 3.02 to 5.58 ( $4.11 \pm 0.66$ ) while the values of the Fp ratio varied between 0.05 and 0.33 ( $0.17 \pm 0.08$ ). The results indicated that the study area corresponds to a "good" trophic state, with moderately productive waters.

**Keywords:** *Adriatic Sea, Eutrophication*

### Introduction

The inner part of Boka Kotorska Bay, where our research took place, is a relatively shallow, semi-enclosed Bay strongly influenced by freshwater discharge. This input, together with sewage discharge and agriculture runoff, causes nutrient enrichment and eutrophication which can lead to highly undesirable changes in ecosystem structure and function. One of the principal effects of the enhanced nutrient concentration is a massive increase in primary productivity. Vollenweider [1] has defined a trophic index (TRIX) based on chlorophyll *a*, oxygen saturation, dissolved inorganic nitrogen and total phosphorus to characterize the trophic state of coastal waters. Claustre [2] has defined the Fp ratio which indicates the variability of the phytoplankton community i.e. the influence of environmental conditions on the phytoplankton community. The aim of this study was to apply trophic index TRIX and Fp ratio for assessment of the trophic state of the Boka Kotorska Bay.

### Material and methods

Seawater samples were taken seasonally from April 2008 to March 2009 at three stations in the inner part of the Boka Kotorska Bay. Temperature, salinity and oxygen concentrations were measured *in situ* by multi Line P4-Universal Meter. Concentrations of nutrients were measured on unfiltered water samples using standard colorimetric methods [3]. The qualitative and quantitative analyses of pigments in the water samples were determined using HPLC method [4]. The Fp ratio was calculated as described by Claustre [2] using pigment concentrations while the trophic index TRIX was calculated according Vollenweider et al. [1].

### Results and discussion

Temperature followed changes in seasonal insolation, with minimum value measured in winter (10.70 °C) and maximum in summer (27.90 °C), both in the surface layer. Salinity was lower in spring because of rain and run-off with minimum value of 5.2 PSU in the surface layer, while maximum value was established in the bottom layer during winter (37.0 PSU). Oxygen ranged from minimum saturation in winter (61%, 2m below the surface) to its maximum in summer (114%) in the 5m below surface layer where also high phytoplankton production has been established.

Chlorophyll *a* concentrations were found often enhanced after rainfall, which indicates to the importance of diffusive nutrient inputs for the ecosystem in the Bay. The highest N:P ratio (199) was detected in the same period on surface that can indicate to P limitation common in the Mediterranean [6] and the Adriatic sea [7].

According to chlorophyll *a* concentration and the criteria of Håkanson the area could be described as oligo-mesotrophic. The TRIX values (Figure 1.) in this area ranged from 3.02 to 5.58 ( $4.11 \pm 0.66$ ) while the values of the Fp ratio varied between 0.05 and 0.33 ( $0.17 \pm 0.08$ ). According to TRIX classification criteria, the mean seasonal value between 4 and 5, investigation area corresponds to good trophic state, moderately productive waters with occasional water turbidity, anomalous water colors and bottom water hypoxia episodes. Values of TRIX and Fp were similar as in Gulf of Trieste [5] and northern Adriatic [8] and indicated slight eutrophic conditions. It seems that this two indicators are complementary, and we agree with Flander-Purtle and Malev suggestion [9] that in new TRIX trophic index it is necessary to include also Chl *a* degradation products as an indication of the physiological status of the phytoplankton community.

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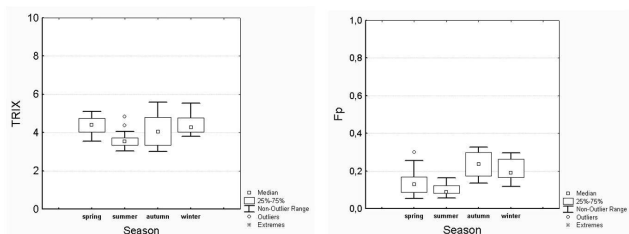


Fig. 1. Box & Whisker representation of seasonal TRIX and Fp index in inner part of the Boka Kotorska Bay