ANNUAL DISTRIBUTION OF NUTRIENTS AND PHYTOPLANKTON IN THE MARINE LAKE MIR (MIDDLE ADRIATIC)

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Abstract
Phytoplankton and physical-chemical parameters were investigated in the marine Lake Mir special geomorphological phenomenon of the Telašcica Nature Park. Nutrient limitation appears to have been important in defining the lakes' seasonal phytoplankton composition. There was a predomination of small diatoms in spring and autumn, while dinoflagellate dominance began in May and continued during summer. The phytoplankton abundance and biomass were similar those recorded in highly productive coastal Adriatic areas and in the Mediterranean.
Keywords: Adriatic Sea, Nutrients, Phytoplankton

Introduction
There are several marine lakes along the Croatian coast and on the islands of the eastern part of the Adriatic Sea. Phytoplankton succession and community composition reflect the environmental conditions of the ecosystem, among which the availability of nutrients play a significant role. Changes in nutrient supply are often reflected in their ratios. Deviations from nutrient ratios sufficient for a healthy growth of phytoplankton [1,2], either in the nutrient availability or uptake indicate a potential for nutrient limited phytoplankton growth. The present work reports the key environmental variables, particularly nutrient ratios, as predictors of phytoplankton abundance and structure.

Results and Discussion
Marine Lake Mir is landlocked marine environment, situated on the southern edge of Dugi Otok Island. The only communication with the adjacent sea is through the system of subterranean caves and siphons. Physical-chemical parameters and phytoplankton were collected monthly from November 1999 to October 2000. Parameters were determined by standard oceanographic methods [3,4].

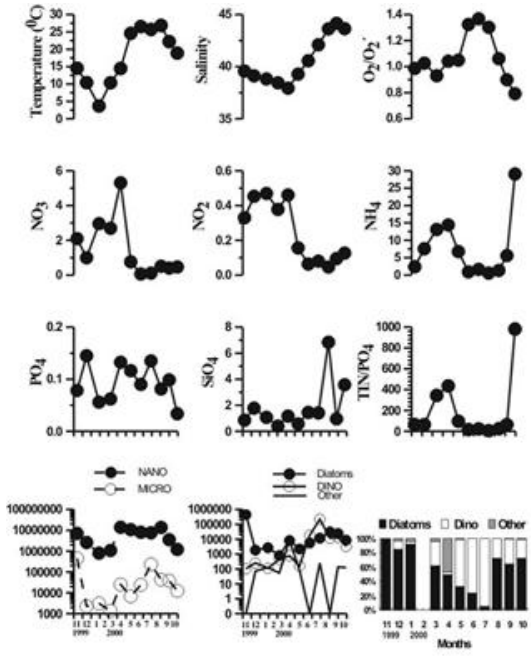

Fig. 1. Monthly distribution of physical-chemical parameters, MICRO, NANO, and relative contribution of different taxonomic groups to MICRO abundance in Lake Mir

During the investigation period (Fig.1) the temperature ranged from 3.65 ºC in January to 27.55 ºC in June, with annual temperature gradient of 24 ºC. Temperature rose from April to May and were more or less constant from June to August. In September, the water column began to cool. Throughout the year, the most of salinity values are greater than 39. in the summer period the salinity values are extremly high (>40) with the maximal value of 44.36 in September. In the water column doesn´t exist thermal or haline stratification throughout the year. Oxygen saturation (O_2/O_2') ranged from 0.74 to 1.43. Regarding nutrients, nitrate (NO_3) concentrations were low from June to October. Despite the depletion of nitrate, nitrogen limitation was found only in July, because of relatively high ammonium (NH_4) concentrations. Phosphate (PO_4) ranged from 0.02 to 0.19 µmol L^{-1} while silicate (SiO_4) ranged from 0.17 to 7.87 µmol L^{-1}. Microphytoplankton (MICRO) and nanophytoplankton (NANO) abundance ranged from 0.9 x 10^3 – 6.8 x 10^5 cells L^{-1} and 7.2 x 10^5 - 1.8 x 10^7 cells L^{-1}, respectively. Three peaks of MICRO were observed throughout the year (Fig.1). Domination of diatoms (mostly *Actinocyclus* sp.) was evident during the peaks in November 1999 and April 2000, when temperature and salinity were low and nitrate and ammonium were high. Dinoflagellates occurred in May and dominated the lakes' phytoplankton (65 - 95%) during the summer. Their dominance coincided with higher temperature, salinity, PO_4, and SiO_4, but lower NO_3. In July 2000, the MICRO peak was dominated by dinoflagellates (mostly *Scrippsiella trochoidea*). NANO was the dominant size fraction. The highest values of NANO were recorded in April and August 2000. Autumn, winter and spring provided an environment with low Si:N, while in summer Si:N, Si:P and N:P values indicated that no depletion of nutrients occurred (Fig.2).

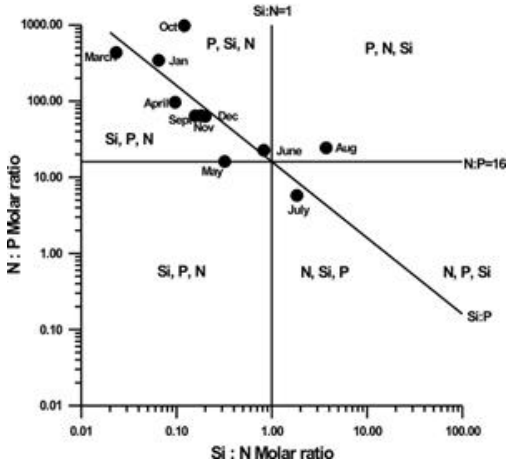

Fig. 2. Si:N:P molar ratios in Lake Mir. Molar quotients between *in situ* concentrations of potentially limiting nutrients are delimited by Si:N = 1, N:P = 16, and Si:P = 16 lines

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