CHLOROPHYLL *A* AND PRIMARY PRODUCTION OF SIZE FRACTIONATED PHYTOPLANKTON IN THE MIDDLE ADRIATIC SEA

Zivana Nincevic and Ivona Marasovic

Institute of Oceanography and Fisheries, Setaliste I. Mestrovica 63, P.O. Box 500, Split, Croatia

Abstract

Phytoplankton biomass and primary production were measured monthly in the nearshore and offshore waters of the Adriatic Sea from January 1994 to January 1995. At the same time, various size fraction categories (> 10 μm, 2-10 μm, < 2 μm) were determined in respect to total biomass and primary production. In the nearshore water phytoplankton biomass the most abundant category was microplankton while nano and picoplankton were less numerous. In the open sea waters this relationship is reversed.

Key-words: phytoplankton, primary production, Adriatic Sea.

Introduction

Phytoplankton biomass is important factor in determining the trophic level of marine ecosystem. In recent years, the interest for size-fractionated biomass and production was increased and size of phytoplankton cells has become an ecological variable [1] linked with the food chain. The cognition that the size of primary producers influences the oceanic carbon cycle [2, 3] and discovery of picoplankton [4] are the reasons for it. There have been only a small number of studies of the eastern Adriatic picophytoplankton. The aim of this work is to compare the coastal and offshore waters in regard to the vertical and spatial distribution of various size-fraction phytoplankton biomass and their contribution to the primary production in the middle Adriatic.

Materials and methods

In 1994. samples were taken monthly at two stations in coastal waters (03 and 25) and at one station in offshore waters (09) of the middle Adriatic Sea (Fig. 1). Chlorophyll *a* was determined fluorometrically in 90% acetone extracts using a Turner 112 fluorometer [5]. Primary production within the euphotic zone was measured *in situ* by ^{14}C - method [6,5]. Measurement of chlorophyll *a* and primary production were carried out on three size fractions (micro- > 10 μm; nano- 2-10 μm; picoplankton < 2 μm). All samples were pre-filtered through a 330 μm mesh net to remove large zooplankton. Measurment of chl *a* . Picoplankton samples filtered through 2 mm polycarbonate membrane filters and retained on the glass microfibre filters (GF/F). Nanoplankton samples pre-screened through 10 μm mesh net and retained on the glass microfibre filters. Microplankton obtained after subtraction of the picoplankton and nanoplankton fraction from whole water samples filtered through the glass microfibre filters. Micro- and nanophytoplankton cells were counted by the Ultermöhl method (1958). Samples of 25 ml taken at coastal stations were analyzed microscopically after a sedimentation time of 24 hours, whereas 100 ml offshore samples after 72 hours. The phytoplankton cells with a maximum length between 2 and 10 μm were designated as nanoplankton, and cells longer than 10 μm as microplankton.

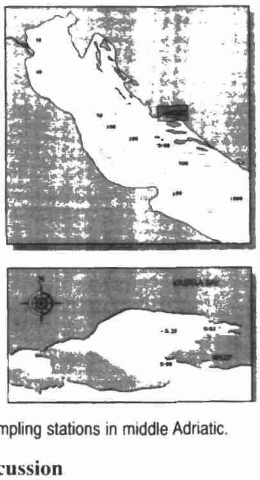

Figure 1. Location of sampling stations in middle Adriatic.

Results and discussion

During the investigation period, at station 09 chlorophyll *a* was ranged from 0.07 to 0.7 mg chl *a* m^{-3} except in September, when subsurface chlorophyll *a* maxima (SCM) (1. 18 mg chl *a*) were recorded around 30 meters depth. This SCM arised immediately after disappearance of the thermocline and microplankton contributed more than 90 % to total chlorophyll *a*. Chlorophyll *a* at station 25 ranged from 0.10 to 3.46 mg m^{-3}. Seasonal fluctuation in chlorophyll a at both station showed maximum value in winter while it was lower in the warmer period of year. This fact is in accordance with Ercegovic [7] who established the phytoplankton seasonal cycle for the Adriatic Sea. On the contrary, at station 03 the seasonal distribution of phytoplankton showed no regularity which is the characteristic of the eutrophicated area. Chlorophyll *a* ranged from 0.21 to 3.65 mg m^{-3} except in August during the bloom of the dinoflagellate *Gonyaulax polyedra* when it was 24.87 mg m^{-3} in the surface layer and 12.89 mg m^{-3} around 5 meter depth. Since 1980, when it was recorded for the first time, it has become regular occurrence in this part of Kastela bay and occasionally it has been accompanied by marine organisms mortality caused by the oxygen depletion in the bottom layer [8]. Chlorophyll *a* at these stations decreased with distance from the land. Size-fractionated biomass showed that the greatest part of the biomass at the offshore station 09 was consisted of the < 10 mm size fractions during the whole period except in September when the microplankton prevailed due to the SCM. Picoplankton size fractions were determined from July 1994 to January 1995. During the whole period it contributed more than 20 % of the total biomass and more than 50 % in July at the depths of 10, 30 and 50 meters. At station 25 the contribution of > 10 mm size fraction was greater than at station 09. Moreover, its greatest contribution was recorded at the surface layer (33-97%) while its importance was decreasing towards the bottom (Fig. 2). The greatest contribution of microplankton to the total biomass was at station 03 where it prevailed during the whole period of investigation. The relative contribution of the three size fractions to total chl a differed appreciably between nearshore and offshore stations (Fig. 3). In the rich nutrient area (station 03) microplankton prevailed [9], while in the low nutrient area (station 09) picoplankton had more important role because of its ability, due to larger cellular surface in respect to volume, to assimilate nutrients more efficiently than bigger phytoplanktonic organisms [10]. According to [11] the various size fractions reached different concentrations of chl *a*, but each of them had different limit. The comparison of our results which are also within these limits with their results is given in Table 1. Such results support the hypothesis that the picophytoplanktonic biomass is more stable, whereas temporal and spatial variations in total biomass are due to larger cells.

Table 1. Maximum concentrations of chl a in the various size fractions in the Western Mediterranean [11] and the middle Adriatic Sea (present study).

Raimbault et al. (1988)		Middle Adriatic	
size-fraction	mg chl a m^{-3}	size-fraction	mg chl a m^{-3}
< 1μm	0.5		
1-3 μm	1.3	< 2μm	0-0.47
3-10 μm	2	< 10 μm	0.03-1.64

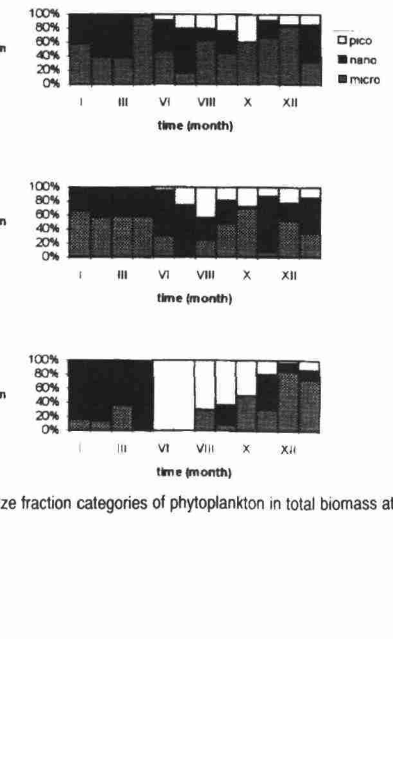

Figure 2. Various size fraction categories of phytoplankton in total biomass at different depths at station 25