Phytoplankton carbon biomass in Gruz and Mali Ston Bays (Southern Adriatic)

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According to the annual phytovolume distribution, the Gruz (N 42°52', E 17°40') and Mali Ston (N 42°40', E 18°05') Bays have been included in the same category of moderately eutrophicated ecosystem (VILICIC, 1989), but those bays have different eutrophication sources. Most of the eutrophication in the Mali Ston Bay is caused by washing of nutrient salts from surrounding sediments, whereas in the Gruz Bay, both natural and anthropogenous eutrophication sources abound. Fresh waters from the Ombla river and sewage waters enrich the Gruz Bay with nutrients, whereas open sea waters frequently influence near the bottom layer. This paper compares phytoplankton carbon biomass values between the two bays.

Phytoplankton in the Gruz (Gruz station, 25 m max. depth) and Mali Ston Bays (Usko station, 12 m max. depth) was sampled from February 1988 to February 1989. Phytoplankton samples were preserved with 2% neutralized formaldehyde solution, and their cell counts were obtained by the inverted microscope method (UTERMOHL, 1958). Total cell volume was calculated from cell density and cell volume data of each species, according to SMAYDA (1978). Phytoplankton biomass in terms of carbon content was estimated from total cell volume according to EPPLEY *et al.* (1970). Physical-chemical parameters were determined by standard oceanographic methods (STRICKLAND and PARSONS, 1972).

Annual distribution of total phytoplankton carbon biomass in the Gruz and Mali Ston Bays is represented in Fig. 1. An intense development of the total phytoplankton biomass was registered in the spring-summer period. Temporal distribution of the microplankton (>20µm) and nanoplankton (<20µm) biomass matches seasonal rhythms characteristic of coastal eastern Adriatic waters. Considerable differences were observed in range, maximum and mean annual microplankton, nanoplankton and total phytoplankton biomass (Table 1). Seasonal fluctuations were even more pronounced in the Gruz Bay, where the maximum annual value tripled the values for Mali Ston Bay, and were caused by a more intensive exchange between sewage and the open sea waters. Therefore, when compared to Gruz Bay, Mali Ston Bay is the area of greater ecological stability, in spite of high salinity values and fluctuations in nutrient salts. The Gruz Bay maximum annual nutrient concentration was recorded in April and was caused by fresh water influx from the river Ombla. An intensive development of dinoflagellate *Prorocentrum triestinum* was recorded (119 µg C/l) in May. In both bays, seasonal fluctuations in nanoplankton carbon biomass were less pronounced than in microplankton. The contribution of nanoplankton to total phytoplankton carbon biomass ranged from 53 to 96% in the Gruz Bay, and 36 to 85% in the Mali Ston Bay. The relative contribution of microplankton to the total phytoplankton biomass in the Mali Ston Bay exceeded that of nanoplankton only in March, when the maximum annual microplankton biomass was recorded, and to which the species *Chaetoceros compressus* and *Rhizosolenia stolterfothii* contributed the most. According to frequency distribution data, nanoplankton biomass values mostly ranged from 10-15 µg C/l, and total phytoplankton from 15-20 µg C/l in both bays. Maximum microplankton carbon biomass frequency in the Gruz Bay ranged from 0-1 µg C/l, whereas in the Mali Ston Bay, it ranged from 3-4 µg C/l. Those differences between the bays confirm the prevailing influence of the open sea waters in the Gruz Bay.

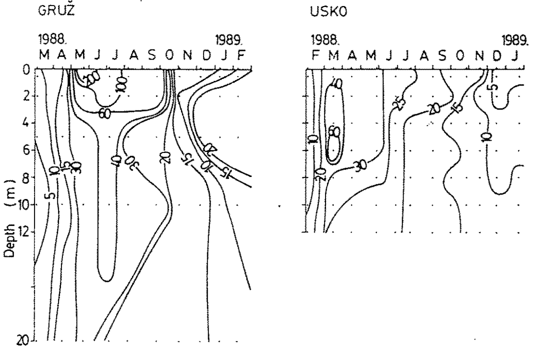

Fig. 1. Distribution of the total phytoplankton carbon biomass (µg C/l) in the Gruz and Mali Ston Bays.

Tab. 1. Temperature (T), salinity (S) and microplanklon (M), nanoplankton (N) and total phytoplankton carbon biomass in the Gruz and Mali Ston Bays.

	Gruž Bay (n=46) Range	Mean	SD	Mali Ston Bay (n=83) Range	Mean	SD
T (°C)	12.9 - 26.1			9.5 -26.8		
S x 10^3	26.55- 38.66			28.31-38.87		
M (µg C/l)	0.11-168.59	9.47*	28.11	0.24-55.23	6.28*	7.81
N (µg C/l)	2.61- 78.03	24.74*	17.54	2.79-29.5	12.25*	6.07
Total (µg C/l)	3.07-246.62	33.94*	42.56	5.01-64.32	18.53*	9.89

Means at the same line followed by * are significantly different (P<0.001, Student's t-test), SD = standard deviation

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Tintinnid ciliates in the stratified water column in the Gulf of Trieste (Adriatic)

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During 1989-1991 a study of tintinnids and other microzooplankton components has been carried out in the southern part of Gulf of Trieste. Tintinnids were monitored over three years, two of which were characterized by the massive presence of mucus macroaggregates.

Tintinnids were sampled monthly with a 5-l Niskin bottle on three stations at three depths in the southern part of Gulf of Trieste (Adriatic sea). Organisms were determined and enumerated under a Wild invert microscope. Tintinnid loricae were measured in order to estimate lorica volume for apropriate shape for biomass estimation. The relationship between lorica volume and carbon content of VERITY & LANGDON (1984) was used for conversion .

Twenty-nine tintinnid species were determined. The tintinnid spring community was dominated by *Helicostomella subulata*, *Stenosemella nivalis* and *S. ventricosa*, while in the summer the species of the genera *Eutintinnus*, *Tintinnopsis* and *Favella* were important. Other genera occured rarely in low numbers.

Seasonal dynamics of tintinnid biomass during the period of water column stratification showed large differences between the three years. High values of tintinnid biomass in the late summer period in 1989 were probably a consequence of the intrusion of south Adriatic water as indicated by the presence of open sea species. The total tintinnid biomass ranged from 0.2 mg C/m² in May to 33 mg C/m² in September. Distinctly lower values were obtained for the spring-summer period 1990 and varied from 0.2 mg C/m² to 19.4 mg C/m². The lowest biomass was encountered during 1991, reaching a maximum of only 4 mg C/m² in mid July. Only the spring-summer 1989 data were comparable to those of REVELANTE & GILMARTIN (1983) for stratified conditions in Northern Adriatic - 57 mg C/m².

The September peak of tintinnid biomass in 1989 and 1990 is probably evidence of the resting cyst phenomenon. We found small specimens of *Helicostomella subulata* in great numbers in the near bottom samples.

It also seems that tintinnid biomass was adversely influenced by the occurence of mucus aggregates in the water column.

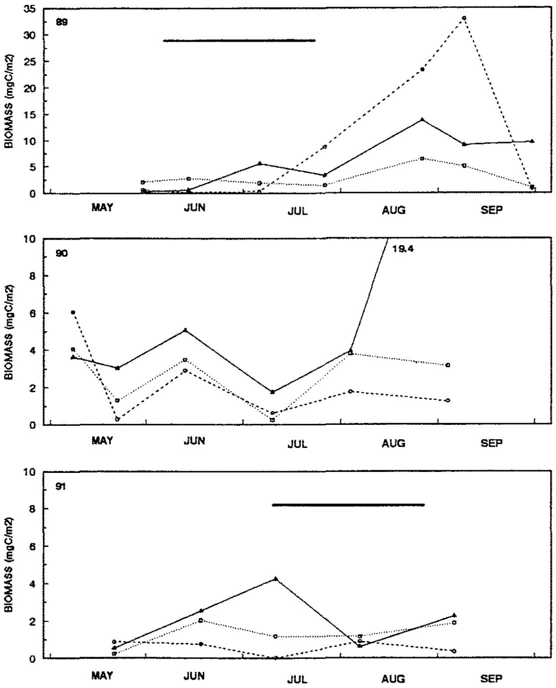

Fig. 1 Tintinnid biomass (mg C/m^2) in a stratified water column at three stations in the southern part of the Gulf of Trieste during 1989, 1990 and 1991 (note the scale difference). Time periods denoting the massive occurence of mucus aggregates is delineated by the bold line.

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