SEASONAL TRENDS IN THE VERTICAL DISTRIBUTION OF COPEPODS IN THE BAY OF MALI STON (SOUTHERN ADRIATIC)

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Eleven daytime plankton samples were taken from March 1989 through July 1990 at Usko Station (N 42°40', E 18°05', 14-m depth) in the Bay of Mali Ston (Croatia). Samples were spaced at 2-m intervals with 125 µ mesh using a new type of zooplankton sampler (volume 250 l) described by KRSINIC (1990). The sampler can be efficiently used in quantitative investigations and vertical distribution of mesozooplankton in shallow waters (KRSINIC and LUCIC, 1993). The main objective of this paper is to describe potential of precise studies of copepods vertical distribution in the Bay of Mali Ston, a natural shellfish region. With regard to these first annual investigations on vertical distribution of copepods with this new tool, there are not comparisons with the other shallow regions in the Mediterranean Sea.

Of 40 copepod species identified, the calanoids *Paracalanus parvus, Centropages kroyeri* and *Acartia clausi* dominated. Among cyclopoids, *Oithona nana* was exceptionally dominant, followed by species of the *Genus Oncaea. Oithona helgolandica* and *Euterpina acutifrons* also were abundant.

Densities of copepods and copepodites were very high (Fig. 1). In spring, concentration increased toward the bottom; in April, 1989, density was 102,700 ind.m^{-3}. In August, the vertical distribution of copepod abundance was low near the surface (ca. 10,000 ind.m^{-3}), maximum at 8 m (56,000 ind.m^{-3}) and intermediate at other depths (ca. 20,000 ind.m^{-3}). With the exception of bottom layers, total abundance decreased during autumn. During winter, abundance again increased and, in February, a season maximum of 146,300 ind.m^{-3} was recorded. An exceptionally high concentration of 120,300 m^{-3} was also found in July 1990, at 12 m.

Differences in the vertical distribution of population density were significant (ANOVA, F=9.205, P<0.001). Surface (0 and 2 m) and mid-depth (4 and 6 m) concentrations were similar; in turn, these were different from concentrations found in deeper samples (Tab. 1).

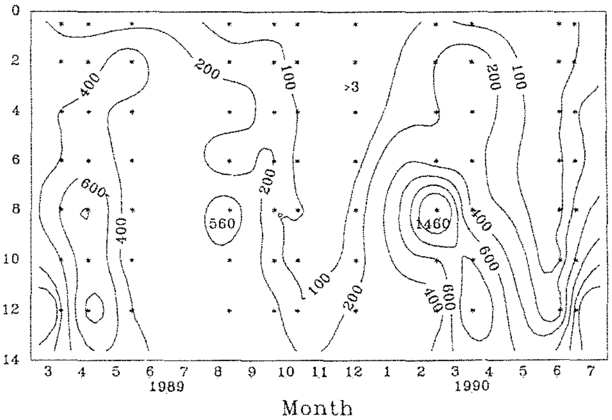

Fig.1. Distribution of copepods and copepodites (100 ind.m^{-3}) during 1989-1990 at Usko Station, Adriatic Sea.

LAYERS	bottom - medium		MIN - MAX	X ± S.D.
surface	P<0.001	N.S.	99 - 16587	5633 ± 5133
medium	P<0.001		279 - 54270	21238 ± 14330
bottom			3195 - 146300	41362 ± 36829

Tab.1. Comparison of the total abundance of copepods and copepodites between surface (0 and 2 m), middle (4 and 6) and bottom layers (8, 10 and 12 m) at the Usko station in the Bay of Mali Ston during 1989/90
*(SNK-test, *=significant differences at 95%, N.S.=not significant).*

REFERENCES

KRSINIC F.,1990. A new type of zooplankton sampler. *Journal of Plankton Research*, 12 : 337-343.

KRSINIC F. and D. LUCIC.1994. Mesozooplankton Sampling Experiments with the "Adriatic" Sampler: Differences of Catch Between 250 and 125 mm Mesh Netting Gauze. *Estuarine, Coastal and Shelf Science*, 38 : 113-118.

PHYTOPLANKTON IN THE ORGANIC PARTICULATE MATTER FLUX IN VARNA BAY (BLACK SEA)

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Varna Bay is one of the most affected by the anthropogenic pressure regions along the Bulgarian Black sea coast. Dramatic changes both in the chemistry and in the biology have been reported. An apparent shift in the dominant phytoplankton species composition together with an increase in the frequency and duration of the blooms have been well documented, the anoxia conditions during summer period becoming a recurrent phenomenon (MONCHEVA *et al.*, 1993). As the autochthonous organic matter produced as a consequence of eutrophication has been considered the key factor in the ecological disaster of the area, the investigation of the nature and fate of the organic flux constitutes a major interest. The subject of the present paper is to highlight the role of phytoplankton component in the organic matter and the dominant mechanism of its downflux transition in respect to the variability of some chemical and biological characteristics. The results are based on sampling from May to November 1993. The following determinants have been measured : temperature, O_2, pH, NH_4, Pmin., Porg, Ptot., Corg. and Ptot. in the suspended matter, zooplankton and phytoplankton species composition and abundance, Chl. A in the water. The flux of some of these parameters have been measured in sediment traps deployed, including fecal pellets, separated in geometrical and size classes. The phytoplankton standing crop is characterized by both high abundance and biomass during the entire period ranging from 1.3 to 12×10^6 cells/l and from 11.2 to 35.4 mg/l Chl A. The highest value is reached at the end of July (443) and the lowest at the end of May (0.1). It is the only case of *Chrysophyta* and *Dinophyta* species overdominating the BC species (Fig.1, 2). A sequence of blooms have been registered with the following principal species involved : *Chaetoceros socialis Laud., Cerataulina bergonii Perag., Peridinium triquetrum (Ehr.) Lebour., Prorocentrum minimum Ost., Emiliana huxleyi (Lohm.) Kampt* (May-June); *C. bergonii, Ch. socialis, Nitzschia closterium Cl., Detonula confervaceae (Cl.) Gran.* (July); *Skeletonema costatum (Grev.) Cl., C. bergonii* (September) and *Leptocylindrus minimus Gran., Thalassiosira subsalina Pr. Lavr., Th.parva Pr. Lavr.* (November). The summer phytoplankton assemblage registered is not typical for this season when usually dinoflagellates predominate. Most likely this could be related to the specific hydrological conditions. The dominance of western winds prevents the persistence of water stratification and supports nutrients input facilitating the maintenance of high diatom standing crop (SMETACEK, 1991) and high phytoplankton biomass (fig.1). The latter suggestion is supported by the graphs plotted on Fig.2. The comparison of zooplankton fecal pellets flux (Fp) with the NH_4 concentrations suggests a considerable contribution of Fp to NH_4 possibly related to their high disintegration rate (SMETACEK, 1980). Chl A, Corg. and Chl A : ZB curves provide indication of two patterns of interrelations. In the first one (31.05-22.06, the termination of spring bloom) the Chl. A-Corg lines are inverse probably due to the increased zooplankton crop (low Chl. A : ZB ratio) at almost equal Chl. A concentrations and Chl. A:Corg ratio (34.6%-21%). The ratio BC : NBC is low. In the second one Chl. A curve is almost parallel to Corg variability. The share of Chl. A in Corg. varies from 55% to 77.8% with the exception of August (26%; the termination of second bloom). The ratio of BC:NBC is high (Fig. 2B). The organic matter flux determinants considered (Fig. 2C) manifest both a direct settling of phytoplankton cells and zooplankton fecal pellets as possible mechanisms of sedimenting out the excess of phytoplankton biomass. The suspected switching factor is the BC : NBC ratio and the species composition. This is supported by the comparison of the dominant species record in the water and the sediment trap. The BC : NBC ratio in the sediment traps differs considerably from that from the watershed (0.09-34.2). The Fp seem to account for the phytoplankton transfer to sediments at a high BC:NBC water ratio (exceeding 100 in our case study). The variability of Chl. A in the sediment flux follows that in the water column with a time lag, the higher the phytoplankton biomass the greater the proportion that sediments out (Fig. 2D). The same stands for the Corg flux. The data presented suggest the following conclusions preliminary. Phytoplankton in Varna Bay is maintained high despite the magnitude of variation typical for eutrophicated areas. The same stands for Chl. A proportion and Corg in the water domain (ranging from 27 to 77%). The possible factor controlling the ratio Corg : Chl. A could be zooplankton grazing. Phytoplankton may be considered as a major component in downflux. The species composition and BC : NBC ratio in the water column seem to be decisive in the sedimentation mode, Fp dominating the flux at high BC:NBC ratio.

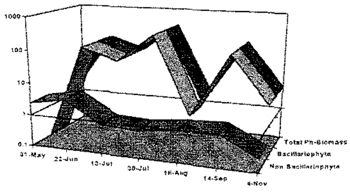

Fig.1. Phytoplankton biomass dynamics in log scale.

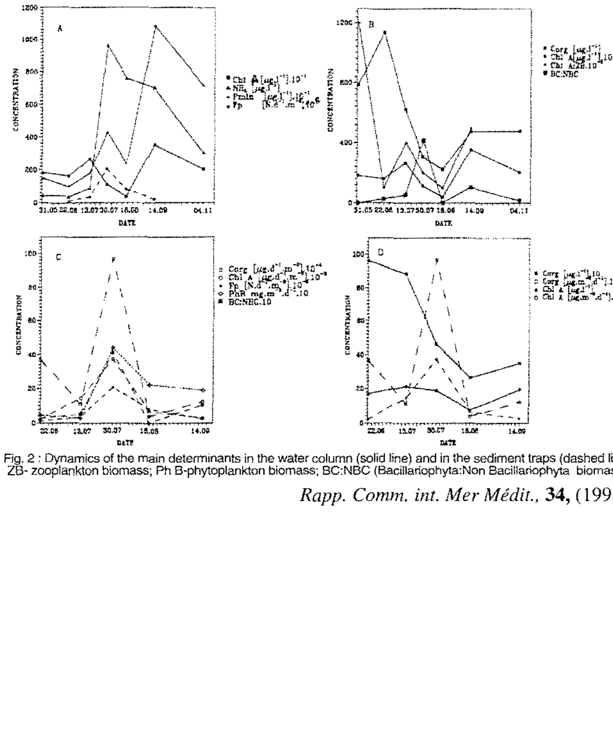

Fig. 2 : Dynamics of the main determinants in the water column (solid line) and in the sediment traps (dashed line) ZB- zooplankton biomass; Ph B-phytoplankton biomass; BC:NBC (Bacillariophyta:Non Bacillariophyta biomass)

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