The recent study of the Copepod community from the Eastern Adriatic Coast caused by eutrophication

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This paper presents some recent results about progressive changes of the copepod community from the eastern Adriatic coast caused by eutrophication. Previous long-term results in front of the most important harbours of the eastern Adriatic, showed some changes of copepod composition and biomass (REGNER,D., 1987). As summer was found the most threatened season throughout the year, investigations were continued with the special attention to this season.

The material for this study was taken by vertical hauls of the Hensen plankton net (73/100, silk N°3), from bottom to surface at the permanent stations in front of Zadar, Šibenik, Split, Kardeljevo and Dubrovnik (Gruž), and from two stations in the Bay of Kaštela, situated in the middle part of the bay, and at the eastern - the most threatened area under the influence of the industrial wastes (Fig. 1).

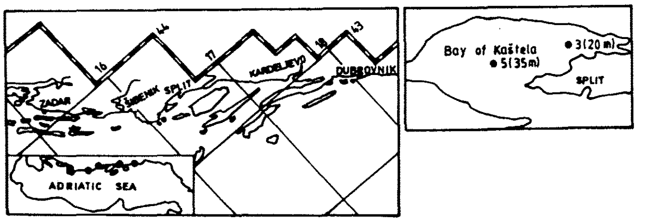

Fig. 1. The study area

In 1985-1988 period, about 40 species of copepods including two genera were found at the investigated stations in summer season.Neritic species that usually occur in higher density, dominated again at whole investigated area. Between all of them, Acartia clausi was markedly dominant, even with higher percentage than in the previous results (Fig. 2).

Furthermore, the long-term data on copepod biomass (expressed with number of copepods per m^3), showed the trend of the increasing, too. This phenomenon we can connect with the permanent increasing of phytoplankton density in the eastern Adriatic coast (PUCHER-PETKOVIĆ, 1989) in the same period.

Studies on some hydrographic and chemical parameters in 1984-1988 period have shown some oscillations, too. According Morović (in DUJMOV et al.,1988)sea-water

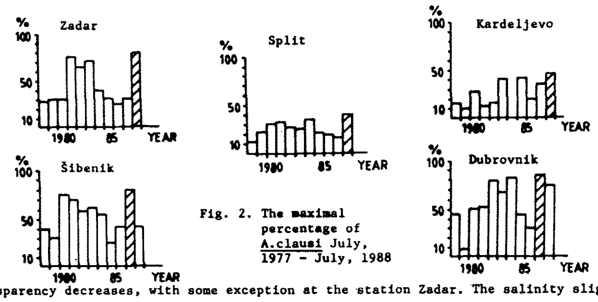

Fig. 2. The maximal percentage of A.clausi July, 1977 - July, 1988

transparency decreases, with some exception at the station Zadar. The salinity slightly increases in front of Zadar and Šibenik, while nitrate and phosphate levels slightly increase at all investigated stations (Stojanoski, Vukadin and Zvonarić in DUJMOV et al., 1988).

Besides, more interesting results were found at the Kaštela Bay during Red tide event. The percentage of Acartia clausi increased in summer from ten percents in the eastern part of the bay, to almost twice in the middle of the bay in three - years period (Tab. 1).

Tab. 1. The percentage of Acartia clausi at the Kaštela Bay

	Station 3	Station 5
July 1982-1985	60 %	35 %
July 1988	70 %	65 %

The biomass expressed by density showed the trend of the increasing from 1970 to 1988, too (Tab.2), even in the middle part of the bay, where the influence of the coast was not so strong as in the coastal part (before Red tide phenomena became rather frequent).

Tab. 2. The biomass of copepods (number/m^3) at the station 5

July 1970-74	188
July 1982-83	350
July 1988	484

So, the markedly increased percentage of Acartia clausi,as the increasing of copepod density, we can clearly connect with the progressive eutrophication of the eastern Adriatic coastal waters, and the increasing phytoplankton density especially in summer.

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Accumulation of Mercury in a marine food web of the Mediterranean

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High levels of mercury in some marine organisms from the Mediterranean have been explained by accumulation processes in the food chain (Buffoni at al., 1982).

Aim of this research is to investigate the mechanism of bioamplification of mercury in a marine food chain. This is a crucial step towards understanding the biogeochemical cycle of mercury in the marine ecosystem.

The characterization of a food chain in the Mediterranean is a difficult task due to the great number of species and to the lack of specialization in predation. The food web of the Red Shrimp has been studied in detail (Relini Orsi and Wurtz, 1977) and several species of this food chain (*Meganycthiphanes norvegica*, *Gennadas elegans*, *Pasiphaea sivado*, *Pasiphaea multidentata*, *Aristeus antennatus*) have been chosen as representing increasing trophic levels even if a strict distinction is not possible.

The presence in the environment of different chemical forms of mercury with different chemical behavior makes necessary to examine the distribution of the different chemical species separately. All samples have been thus analyzed for the total mercury content and for organic mercury content. Inorganic mercury is obtained as difference between total mercury and organic mercury.

Sampling and classification of specimens have been realized with the help of Prof. L. Relini Orsi and Prof. G. Relini of the Department of Zoology (university of Genova). All samples have been stored deep-frozen until the analysis was performed.

Samples have been freeze-dried before analysis to calculate the fresh weight/dry weight ratio without any loss of sample and to help its homogeneisation.

Organic mercury determination was carried out on an aliquot of the dried samples by graphite furnace atomic absorption spectrometry (GFAAS) after extraction in toluene and back-extraction in 0.01M sodium thiosulfate solution. The sensitivity of the method was 0.007 µg/g dry weight.

Total mercury was determined on the residual sample, after mineralization by nitric acid, by cold vapor atomic absorption spectrometry with gold amalgamation preconcentration (Au-CVAAS). The sensitivity of the method was 0.003 µg/g dry weight.

Accuracy of the whole procedure was tested as follows: (a) no loss of mercury occurs during freeze-drying process (personal communication), (b) organic mercury determination has been compared to other laboratories, and (c) total mercury determination has been checked with standard reference materials.

Results obtained are summarized in Figure 1, where the distributions of the logarithms of the concentrations found for inorganic and organic mercury are compared. Even if the distributions in the various species are overlapping, a noticeable increase in mercury (both inorganic and organic) can be detected. Along the trophic chain the accumulation of organic mercury is more marked than those of inorganic mercury.

The trophic chain proposed is a rough simplification of the natural processes, however the accumulation of mercury can be clearly seen.

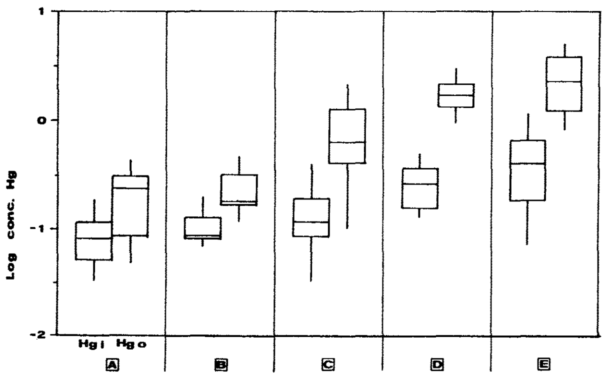

Figure 1. Box and whiskers plots of the concentrations of inorganic and organic mercury (as µg/g dry weight) of the selected species. On the vertical axis is reported the common logarithm of the concentrations. [A] *Meganycthiphanes norvegica*, [B] *Gennadas elegans*, [C] *Pasiphaea sivado*, [D] *Pasiphaea multidentata*, [E] *Aristeus antennatus*.

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