Do gelatinous "Macroaggregates" in the northern Adriatic influence the biomass dynamics of free-living microheterotrophs ?

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An investigation of the effect that gelatinous "macroaggregates" have on the smaller size classes of free-living plankton was conducted during the periods of summer stratification in 1986, 1987, 1988, 1989 and 1990. Sampling was conducted along a trans-Adriatic trophic gradient from off the Po delta, Italy (sta's 10, 9) to the Istrian peninsula, Croatia (sta. 6), and southward toward the middle Adriatic (sta. 23). Water column plankton populations were enumerated by epifluorescent or inverted microscopy. The analysis of autotrophic populations is currently being published (REVELANTE and GILMARTIN, 1992). Herewith are reported some of the observations on the microheterotrophs.

The primary production, and dependent trophic levels, of the pelagic food web of the northern Adriatic fluctuate widely as a function of interannual differences in the Po River nutrient input (GILMARTIN *et al.*, 1990). In 1986 and 1988 the "Po effect" was strong relative to other years yet, fortuitously, gelatinous "macroaggregates" were strongly developed during the 1988 cruises and absent during the 1986 cruises.

The free-living phytoplankton populations in the ambient water did not exhibit a significant difference in the amplitude of cell densities in 1986 (a nonaggregate year), and 1988 and 1989 when large phytoplankton containing "macroaggregates" were present. During all years the biomass dynamics of the free-living autotrophs were primarily related to the temporal characteristics of Po River discharge and/or horizontal advection of Po waters, and were independent of the presence or absence of "macroaggregates" (REVELANTE and GILMARTIN, 1992).

Similar trends are here reported for the microheterophic populations of free-living bacteria. The data are summarized in Figure 1. which presents the average mean water column densities of microheterotrophs along the west to east trophic gradient, and southward, during the summer stratified seasons of 1986, 1987, 1988 and 1990.

The densities of free-living heterotrophic bacteria at western stations (10, 9) had similar amplitudes in the "macroaggregate" year 1988 compared with other years when "macroaggregates" were not present. The spatial distribution of free-living heterotrophic bacteria, and the observed gradients, mirrored those of the small pico-autotrophs, and were primarily related to hydrographic conditions. Preliminary analysis also indicate that other microheterotrophs (unpublished data), such as microflagellates and ciliated protozoans, also did not significantly increase in the ambient water when "macroaggregates" were present.

During the sampling cruises high densities of free-living heterotrophic bacteria were observed in both 1986 and 1988, strongly implying that the presence of high abundances of large "macroaggregates" in 1988 did not influence the biomass of free-living water column populations. However attached microheterotrophic populations, associated with micro-flocs and larger aggregates, did increase significantly during "macroaggregate" years (REVELANTE and GILMARTIN , 1992).

In addition, in 1986 and 1988 the oceanography of the northern Adriatic, combined with the discharge characteristics of the Po River, created a circulation pattern under which the "Po influence" was strong in eastern, and even in southern waters. Yet, over the entire range, freeliving microheterotroph population densities differed little between 1986 and 1988 despite 1986 being a non-aggregate year.

These data indicate that during the stratified season the population distribution and biomass characteristics of the free-living smaller plankton size classes in the water column, whether autotrophs or heterotrophs, wasn't changed by the presence of gelatinous "macroaggregates". This strongly implies dependent elements of the pelagic food web in the region were similarly unaffected.

We speculate that in "macroaggregate" years a separate and distinct food web is introduced into the northern Adriatic ecosystem, which is superimposed on top of the basic pelagic food web. The "packaging" of the new organic substrate, represented by the "macroaggregates" creates a spectrum of larger than usual particle size classes which are thus unavailable to extant pelagic consumers. As a consequence it is probably processed by a microbial loop through a distinctly separate food web directly and physically associated with the "macroaggregates". Therefore we conclude that "macroaggregates" contribute to the pelagic food web primarily through decomposition and nutrient regeneration rather than by serving as "prey" for primary consumers. This conclusion in no way ignores the impact that sinking "macroaggregates" may have on the benthic community, but only to the impact they may have on the pelagic community.

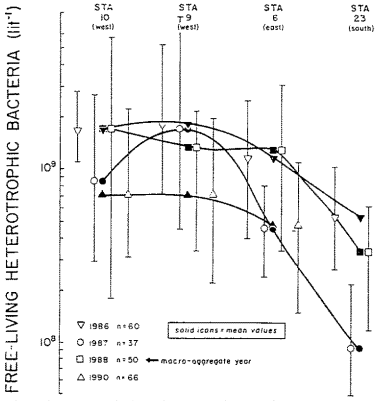

Fig. 1. The regional and temporal distribution of microheterotrophs. Filled icons (v) are annual mean icons repositioned so that their curves nest vertically.

REFERENCES

GILMARTIN M., DEGOBBIS D., REVELANTE N. and SMODLAKA N., 1990.- The mechanism controlling plant nutrient concentrations in the northern Adriatic Sea. *Int. Revue ges. Hydrobiol.*, 75: 425-445.

REVELANTE N. and GILMARTIN M., 1992 (?).- The lateral advection of particulate organic matter from the Po delta region during summer stratification, and its implications for the northern Adriatic. Estuar. *Coast. Shelf Sci.* (in press).

Phytoplankton seasonal trend in the coastal waters of the Northern Adriatic Sea (Alpe Adria Project, March - July, 1990)

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In the frame of the Alpe Adria Project, a serie of 10 cruises was carried out by the Institutes of the Adriatic Regions during the period March-July, 1990, on 10 stations located in the coastal waters of the Northern Adriatic Sea (see fig. 1). This paper deals with the phytoplankton observations performed in this period.

The meteorologial and hydrological conditions of 1990 were characterized by low freshwater inputs coming from major rivers into the basin; therefore, the absence of an evident diluted surface layer favoured the intrusion of high salinity waters from south, so influencing not only the intermediate and deep layers but the surface waters too. Nutrients are generally present with low concentrations, only showing an increase in the western diluted waters in the samples of May (FRANCO, 1990).

Phytoplankton abundance reflects the hydrological dynamics: in the whole basin, during the early spring (March and April), phytoplankton communities were present in low cell numbers, mainly dominated by microflagellates. In the first part of May, a diatom growth was observed in the whole sampling area: this phenomenon was more evident in the S-W portion of the basin, strictly influenced by the Po and Adige rivers (more than 10^7 cells/l). Moving clockwise, till the southern part of Gulf of Trieste, diatom number decreases (from 2 to 0.7 10^6 cells/l). As species composition, *Cyclotella* sp, *Nitzschia delicatissima* complex and *Nitzschia seriata* complex were diffused everywhere.

After the diatoms drop, microflagellates increase till the end of June, showing peaks of 3.3, 2.4, and 4.7 10^6 cells/l, respectively in the plume of the Po river, in the northern and southern waters of the Gulf of Trieste. The month of July was characterized by a reduction of phytoplankton biomass and by a high species diversity, most of them representative of summer Adriatic communities, as *Rhizosolenia alata*, *Cerataulina pelagica*, *Chaetoceros* sp, in addition to *Nitzschia delicatissima* and other entities already observed.

During the sampling period, dinoflagellates increase, reaching 15% of the total; they are mainly represented by unarmoured forms, as *Gymnodinium* and *Gyrodinium* spp and by species belonging to the *Prorocentrum* genus, as *Prorocentrum micans*, *Prorocentrum minimum* and *Prorocentrum aporum*.

As conclusions, we can assess that, during the 1990 spring, phytoplankton communities were dominated by microflagellates, according to previous reports (SOCAL *et al.*, 1982), with highest abundances in the eastern waters (FANUKO, 1980). The diatom bloom was limited to a short period, with maxima in the S-W waters influenced by the Po river (see SOCAL and BIANCHI, 1989).

Phytoplankton vertical distribution, referred to the stability of the water column, was more evident in the western waters, showing higher abundances in the narrow surface layer, directly influenced by river outputs. In these waters, the high observed variability suggests that mesoscale processes are more significant here than in other coastal areas.

During the sampling period, no gelatinous aggregates were observed; the only exception was a report about some filamentous materials noticed in the Gulf of Trieste (end of June).

The general oceanographic conditions are not comparable with those recorded earlier (1988 and 1989) and later (1991), during which periods widespread "dirty sea" phenomena were observed (BRAMBATI, 1988; MARCHETTI *et al.*, 1989).

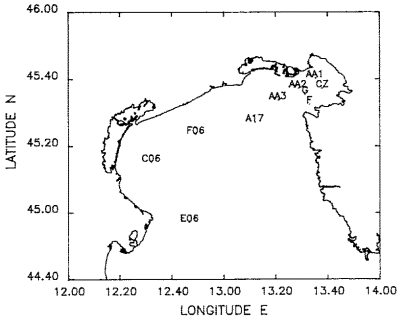

Fig. 1.- Sampling stations.

REFERENCES

BRAMBATI A., 1988.- Il fenomeno del "mare sporco" nell'Adriatico (luglio-agosto 1988). Le opinioni di alcuni esperti. C.N.R. Progetto Strategico Oceanografia e Tecnologie Marine, Trieste-Roma, 67 pp.

FANUKO N., 1980.- Some aspects of phytoplankton communities in the eastern part of the Gulf of Trieste, North Adriatic. *Nova Thalassia* 4, 31-42.

FRANCO P., 1990.- Oceanographic features of the Northern Adriatic basin and their evolution during the 1990 Alpe Adria Project. *In:* Campagna scientifica di ricerca e di monitoraggio sullo stato chimico, fisico e biologico delle acque dell'Alto Adriatico, in relazione al fenomeno di formazione degli ammassi gelatinosi. 1990,1-15.

MARCHETI R., IACOMINI M., TORRI G. & FOCHER B., 1989.- Caratterizzazione preliminare degli essudati di origine fitoplanctonica raccolti in Adriatico nell'estate 1989. *AcquaAria* 8, 883-887.

SOCAL G. & BIANCHI F., 1989.- Adriatico settentrionale in condizioni di stratificazione 3. Distribuzione della biomassa e dei popolamenti fitoplanctonici. 1983-84. *Boll. Oceanol. Teor. Appl.*, numero speciale, 93-109.

SOCAL G., BIANCHI F. and FRANCO P., 1982.- Abbondanza e biomassa fitoplanctoniche nell'Adriatico settentrionale. Crociere 1979. *Atti Conv. Ris. Biol. Inq. Mar. P. F. Oceanogr. Fondi Marini*, 25-32.

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