Relation between the tintinnids' distribution, the salinity and total particulate matter in the Middle and Southern Adriatic Sea.

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The distribution of microzooplankton in the Middle and Southern Adriatic during a spring cruise are related to the thermohaline structure of the water masses and distribution of total particulate matter.

In the framework of the C.N.R. Project "Oceanography and Marine Technology", theme "Fluxes", we have studied the microzooplankton populations collected during the oceanographic cruise "Serpa 2" (April 1990) in the Middle and Southern Adriatic Sea (fig. 1). The samples were collected by using a 5 liter Niskin bottle at three levels: surface, intermediate and bottom, at 33 stations, fixed in 4% buffered formaline. Environmental data were collected simultaneously by multiprobe ME 1500.

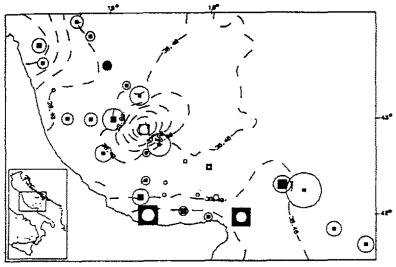

Figure 1: Relation between the salinity and agglutinated and hyaline tintinnids in the superficial layer.
■ = 100 ind.dm^{-3}tintinnids with agglutinated loricа
■ = 50 ind.dm^{-3}
○ = 100 ind.dm^{-3}tintinnids with hyaline lorica
○ = 50 ind.dm^{-3}
--- = salinity

Data on microzooplankton populations are scarse in this area while in the Northern Adriatic Sea their structure, distribution and temporal trend are well known (KRSINIC, 1977). REVELANTE and GILMARTIN (1983) and FONDA UMANI (1991) pointed out the dominance of ciliates other than tintinnids throughout the year, with the exception of winter time, when tintinnids prevail. Among these the species with agglutinated lorica such as the genus *Tintinnopsis* prevail. In the most southern area, microzooplankton populations are constituted by tintinnids, ciliates other than tintinnids, protozoa other than ciliates and micrometazoa. The first ones, studied here were constituted by 61 species (sensu KOFOID & CAMPBELL, 1929; 1939) and prevailed in the whole area in the period of the cruise. 21 ones of these correspond to species identified by KRSINIC (1982) in the same area. Among these the more abundant were the agglutinated species *Stenosemella ventricosa, Dictyocysta lepida, D. elegans* and the hyaline *Steenstrupiella steenstrupii, Dadayiella ganymedes, Eutintinnus elegans, E. fraknoii. E. lusus undae, E. rugosus, E. tubulosus*. Abundance values of total microzooplankton populations, ranging from 0.5 to 251 ind.dm^{-3}, were higher in the southern coastal area and in an offshore water nucleus, corresponding to the South Adriatic branch (1200 m deep). In the first area tintinnids with agglutinated lorica prevail while in the latter one hyaline species are dominant. The agglutination of the lorica is related to the availability of inorganic and/or organic particulated suspended matter (GOLD, 1979), both more abundant in the coastal area. In fact, the prevalence of the tintinnids characterized by agglutinated lorica was confined to coastal waters with lower salinity, while hyaline ones were dominant in higher salinity waters at each layers. An offshore nucleus of abundance of agglutinated tintinnids has been observed in surface layer, corresponding to residual coastal water at low salinity, included in a gyre. (fig. 1). Table 1 shows the total tintinnids are related to total microzooplankton; hyaline tintinnids are better related both to total microzooplankton and to total tintinnids than agglutinated ones; the last ones are inversely related with the salinity and directly related to the total suspended matter, hyaline tintinnids are related to temperature (tab. 1).

Tab. 1

	TM	TT	AT	HT	T	S	TPSM
TM	1						
TT	0.914	1					
AT	0.323	0.281	1				
HT	0.845	0.948	-0.038	1			
T	0.442	0.440	0.159	0.405	1		
S	-0.149	-0.063	-0.271	0.023	-0.096	1	
TPSM	0.211	0.157	0.198	0.098	0.085	-0.349	1

PROB(%)=5, R=0.198

TM = total microzooplankton; TT = total tintinnids; AT = agglutinated tintinnids; HT = hyaline tintinnids; T = temperature; S = salinity; TPSM = total particulate suspended matter

It appears that the agglutinated species need terrigenous inputs for the agglutination of the lorica, therafter they are strictly confined to the neritic coastal area. The hyaline species are widely distributed in the open waters of the Mediterranean, their presence in the South and the Middle Adriatic is related to the ingressions of Southern waters from the Tonian sea. In the investigated area in spring time the microzooplankton populations are very scarse compared to the values of the biomass normally found in the northernmost part of the Adriatic Sea. Their composition differs from the northern community overall in more offshore area, where hyaline species with are dominant.

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Ultrastructure of gelatinous aggregates in the Northern Adriatic Sea

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The formation of large amounts of gelatinous aggregates, containing microalgae, bacteria and protozoa has occurred extensively in the Northern Adriatic waters during summer months since 1988 (HONSELL and CABRINI, 1990-1991; CABRINI *et al.*, 1990). This phenomenon, although it has been reported in historical reviews since 1729, represents a change of the trend observed in the Northern Adriatic Sea in the mid-seventies and early eighties, which were characterized by recurrent red tides caused by monospecific blooms of dinoflagellates (BONI, 1983).

Samples of gelatinous aggregates were collected weekly by SCUBA divers in the Gulf of Trieste (Marine Reserve of Miramare) in the period June-August 1991 to investigate their species composition and fine structure. They were first observed in vivo, before and after staining with toluidine blue to show acid polysaccharides. For electron microscopy the aggregates were fixed with 3% glutaraldehyde in 0.1 M cacodylate buffer pH 7.1, postfixed in 2% osmium tetroxide, dehydrated with an ethanol series and embedded in Spurr resin for sectioning (TEM) or critical point dried and coated with gold/palladium (SEM). Ruthenium red (0.15 %) was added to the post-fixative to stabilize the extracellular polysaccharidic network (AVANZINI and HONSELL, 1984).

Many species of microalgae were present in the aggregates: the diatoms were generally very abundant, but sometimes the dinoflagellates also occurred in high cell numbers. The dominant species observed in the mucilage aggregates in the Gulf of Trieste were not the same during the different years: *Skeletonema costatum* was particularly abundant in 1988, *Thalassiosira sp.* in 1989, and *Nitzschia closterium* in 1991.

Preliminary results indicate that: a) the most abundant species found in aggregates during their maximum development was *Nitzschia closterium*. The cells appeared viable with a well developed frustule and no morphological indication of stress was noticed, different from what occurred to *Skeletonema costatum* in 1988 (HONSELL and CABRINI, 1990-1991). Blue toluidine staining revealed the presence of a polysaccharidic sheath surrounding the cells disposed in long rows (Fig. 1). b) transmission electron microscopy confirmed the presence of a fibrillar network around the cell (Fig. 2). This layer was organised in short and branched chains irregularly distributed in an amorphous matrix. The fibrillar network presented a variable sized mesh (Fig. 3). c) scanning electron microscopy showed various microalgae (mainly diatoms, dinoflagellates and small flagellates), bacteria and detritus embedded in an amorphous matrix with filaments (Fig.4).

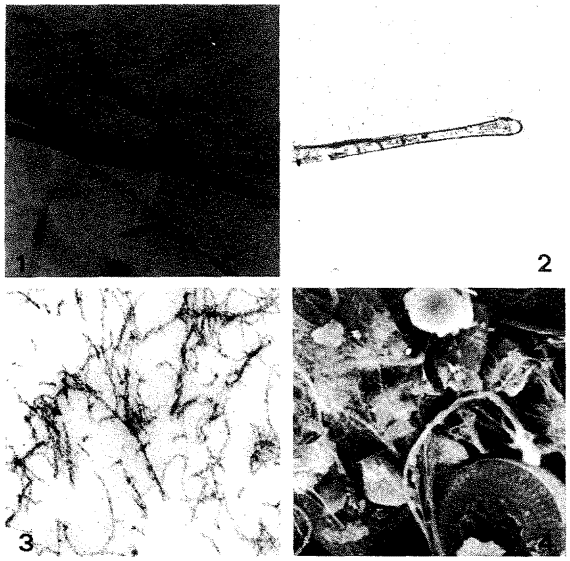

Fig. 1 - Light microscopy: *Nitzschia closterium* stained with toluidine blue: a mucilaginous sheath around the cells is evident. 600x.
Fig. 2 - Transmission electron microscopy: detail of a section of *N. closterium* with a fibrillar network around it. Ruthenium red staining. 5400x.
Fig. 3 - Enlargement of the gelatinous layer with short branched chains. 23600x.
Fig. 4 - Scanning electron microscopy: various microalgae and detritus are entrapped in a tridimensional filamentous network. 6000x.

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