TROPHIC GROUPS AND SHORT TERM VARIATIONS IN A COASTAL CILIATE COMMUNITY

S. Castaldo* and M. Modigh

Zoological Station A. Dohrn of Naples, Italy - saracast@libero.it ; modigh@alpha.szn.it

Abstract

Day-to-day variations in abundance, biomass, vertical distribution and trophic composition of the planktonic ciliate community were investigated between 15 and 23 June 1999 in the Gulf of Naples, Tyrrhenian Sea. Abundance ranged between 780 to 10230 cells l^{-1} and biomass between 0.7 to 3.3 mg C l^{-1}; aloricate ciliates dominated abundance and biomass of the ciliate assemblage. Among the aloricate ciliates the most important group was mixotrophic ciliates that contributed more than 40% to aloricate abundance. Nanociliates (< 18 μm Equivalent Spherical Diameter, ESD) were abundant in most samples, 130 - 4550 cells l^{-1}. A negative correlation between this group and a small pleurostomatid, *Amphyleptus sp.*, was found. The relative contribution of different ciliate trophic groups varied little among all samples, independently of ciliate abundance. Grazing control within the ciliate community is discussed.

Key Words: Trophic relations · Predation · Population Dynamics · Tyrrhenian Sea

Planktonic ciliates have been shown to play a much larger role than previously thought in pelagic systems in terms of biomass and carbon flow [1]. Different trophic modes can be distinguished among the ciliates. Autotrophy is found in the ciliate *Mesodinium rubrum*. Mixotrophic oligotrich ciliates, forms that retain functional plastids from ingested algae, rely on both photosynthesis and phagotrophy. Heterotrophic ciliates are a complex assemblage of tintinnids and aloricate forms; in terms of size they span from nano- to micro-zooplankton, and in terms of diet from bacterivorous to algivorous and predacious.

Materials and Methods

A station in the Gulf of Naples 2 miles offshore, 80 m depth, was sampled from June 15 to June 23 1999. Samples were collected between 10 - 11 a.m. at 1, 5, 10 and between 20 and 30 m, by means of a CTD-rosette using 12 l Niskin bottles. CTD data showed that during this period the pycnocline was positioned between 15 and 30 m depth. Microzooplankton samples, preserved in borax-buffered formalin (2% final concentration), were analysed with a Zeiss inverted microscope equipped also with epifluorescence. Ciliate biomass was calculated using the conversion factor 0.14 pg μm^{-3} for formol preserved samples [2].

Results

The ciliate assemblage was characterised by high values and pronounced variability both in terms of abundance (1329 – 10228 cells l^{-1}; Fig.1a) and biomass (1 – 33 μgC l^{-1}; Fig.1b) within the first 10 m. Below this first layer, less variability and lower values (< 2000 cells l^{-1}; < 2 μgC l^{-1}) were found.

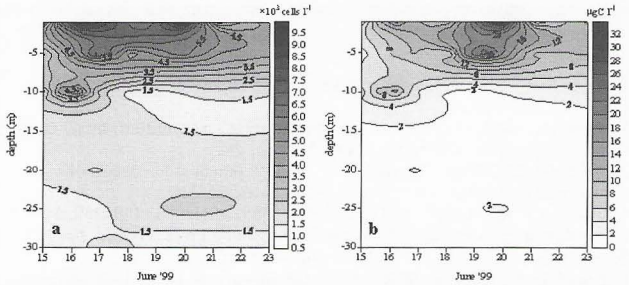

Fig. 1 : Total ciliate abundance (a) and biomass (b) versus depth between 15 and 23 June 1999

Despite these great variations in abundance and biomass the relative importance of the different trophic groups was fairly constant. Aloricate ciliates were the most abundant contributing 61±7% (p = 0.05) to total ciliate abundance (Fig.2), and among the aloricate ciliates the most important were mixotrophic ciliates, contributing 25±4% (p = 0.05) to total abundance. Nanociliates, i.e. nano-oligotrichs and scuticociliates, were the second most important group contributing 24±5% (p = 0.05) to total abundance. Prostomatids and pleurostomatids contributed less than 12%. The

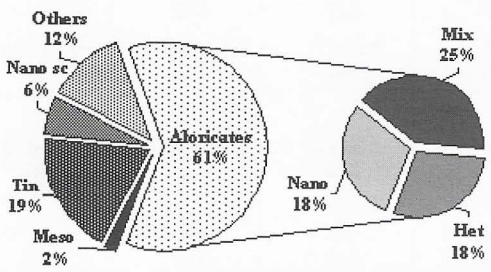

Fig. 2 : Average contributions to total abundance of the different ciliates trophic groups. Others : prostomatids and pleurostomatids; Nano sc = scuticociliates; Meso = *Mesodinium rubrum*; Tin = Ti,tinnidi; Aloricates = oligotrichs; Mix = mixotrophic oligotrichs; Het = heterotrophic oligotrichs; Nano = <18 μm ESD oligotrichs

relatively constant contribution of the different trophic groups might be explained, to some extent, by an internal control within the ciliate assemblage. To test this hypothesis we analysed the concentrations of small nanociliates (all dimensions < 20 μm) and the occurrence of the most abundant ciliate predator species encountered during the period of this study, presumably *Amphyleptus sp.* This small pleurostomatid, ≤ 55 mm, occurred only in the upper layer of the water column, 1 - 5 m, with maximum abundance of 2900 cell l^{-1}. Mean abundance in the layer 1 – 5 m of *Amphyleptus sp.* and of the small nanociliates are shown in figure 3. Low concentrations of *Amphyleptus sp.* occurred at high concentrations of nanociliates and vice versa. In fact, nanociliates showed their maximum on June 16 while *Amphyleptus sp.* reached maximum concentrations on June 20. A significant negative correlation ($r = -0.5$; $p < 0.05$; $N = 16$) was found between the small nanociliates and *Amphyleptus sp.* abundances, and an even stronger negative correlation occurred if a one-day delay in *Amphyleptus sp.* abundance was considered ($r = -0.6$, $p < 0.05$).

Discussion

The annual average of ciliate abundance and biomass vary within a narrow range, 1 - 10 cells ml^{-1} 1 - 10 ng ml^{-1} [3] in most aquatic systems of very different trophic status. Protozoan controlling protozoan has been hypothesized to explain the relatively low variability in ciliate occurrence [4; 5; 6]. The fairly constant contribution of the different ciliate trophic groups at any level of abundance and biomass, as observed in this study, might well be obtained by such protozoan grazing control. Due to the fast growth rates of ciliates they would escape, at least for short periods, the grazing control by metazoans. On the other hand, a protozoan predator having similar growth rates as its prey might closely check the prey population. Such relationship is suggested here by the negative correlation between the abundances of small nanociliates and the pleurostomatid *Amphyleptus sp.* However, the analysis of weekly microzooplancton samples over 4 years at the same station did not reveal the negative correlation encountered here between *Amphyleptus sp.* and small nanociliates, indicating weekly intervals to be too long to track the very rapid variations in ciliate abundances (Modigh, unpublished data). Grazing control within the ciliate assemblage as well as grazing by other protozoans, such as heterotrophic dinoflagellates, might explain the fairly constant trophic composition of the ciliate assemblage encountered in the Gulf of Naples.

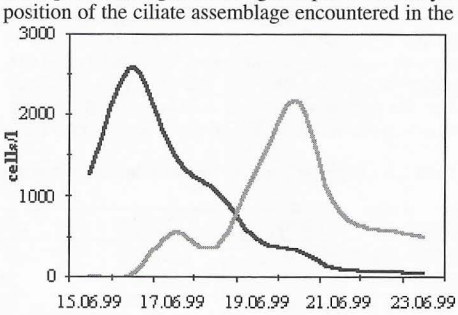

Fig. 3 : *Amphyleptus sp.* and nanociliates mean abundances in the layer 1-5 m

References

1 - Fenchel T., 1990. The role of protozoa in nature in terms of functional properties related to size. *Zool. Sci.*, 7: 51-58.

2 - Putt M. and Stoecker D. K. (1989): An experimentally determined carbon : volume ratio for marine "oligotrichous" ciliates from estuarine and coastal waters. *Limnol. Oceanogr.* (34-6), pp. 1097-1103.

3 - Lynn D.H. and Montagnes D.J.S., 1991. Global production of heterotrophic marine planktonic ciliates, pp.219-265. *In*: Reid P.C. and Turley C.M. (eds.), Protozoa and their role in marine processes. *Springer-Verlag*.

4 - Capriulo G.M., Sherr E.B., Sherr B.F., 1991. Trophic behaviour and related community feeding activities of heterotrophic marine protists, pp.219-265. . *In*: Reid P.C. and Turley C.M. (eds.), Protozoa and their role in marine processes. *Springer-Verlag*

5 - Paffenhöfer G.A., 1998. Heterotrophic protozoa and small metazoa: feeding rates and prey-consumer interactions. *J. Plankton Res.*, 20/1: 121-133.

6 - Stoecker D.K. and Evans G.T., 1985. Effects of protozoan herbivory and carnivory in a microplankton food web. *Mar. Ecol. Prog. Ser.*, 25: 159-167.