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# PHOTOSYNTHETIC PICOPLANKTON IN THE WESTERN ALBORAN SEA IN MARCH 1992.

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## INTRODUCTION

Within the frame of the EROS 2000 project, we have been studying the different picoplanktonic populations of the Mediterranean Sea quantitatively with the help of flow cytometry. In the present report, we provide new data obtained during the March 1992 *Valdivia* cruise.

## MATERIAL AND METHODS

Samples were collected during the second leg of *Valdivia* cruise (March 1992) by Ray Barlow. Samples were fixed with 0.5 % paraformaldehyde (modified from Vaultot et al. 1989) and stored at -80 °C until flow cytometric analysis that was performed according to the same protocol than described previously (Vaultot et al., 1990).

Three picoplanktonic populations were discriminated: *Prochlorococcus*, *Synechococcus*, and picoeukaryotes. For each of these populations, five parameters were determined: cell concentration, forward and right angle light scatter, orange (phycoerythrin) and red (chlorophyll) fluorescences (all four parameters normalised to 1 µm beads).

## RESULTS AND DISCUSSION

Of the three picoplankton populations determined, *Prochlorococcus* exhibited the lowest concentration (Fig. 1) and was usually composed of two sub populations, differing by 2 to 4-fold in red chlorophyll (Chl) fluorescence (only the low-Chl population is represented in Fig. 1). This contrasts to most of our previous observations in the Mediterranean Sea and elsewhere (Neveux et al. 1989, Vaultot et al. 1990, Campbell and Vaultot, submitted), which demonstrated that *Prochlorococcus*, when present, was usually the most abundant population. Moreover *Prochlorococcus* is seldom encountered with such low Chl fluorescence (Fig. 2) in mixed waters. In view of the Atlantic nature of the

surface layer (Barlow et al., this volume), these cells could well be a remnant non-growing surface population from the Atlantic. This hypothesis is reinforced by the fact that these cells only weakly respond to the onset of thermal stratification in contrast to *Synechococcus* and picoeucaryotes (see below).

*Synechococcus* and picoeucaryotes had in all cases very similar vertical distributions (Figs. 1 and 2), as confirmed by the close relationship between their concentrations, *Synechococcus* being slightly more abundant (not shown). During the course of the cruise, the uniform vertical distributions obtained on March 5 for both the cell concentration and the Chl fluorescence (Figs. 1 and 2) and reflecting the deeply mixed layer, rapidly evolved as the result of the increased thermal stratification. In surface cell concentrations increased about 8-fold (Fig. 3) with an apparent minimum generation time of one day during the growth phase (March 7 to 9, Fig. 3). Stratification induced photoadaptation of surface population that markedly reduced their Chl fluorescence (Fig. 3), in contrast to the deeper samples (Fig. 2) for which it remained stable. The maximum difference between surface and deep Chl fluorescence was about 2.5-fold on March 9 (Fig. 2). The remarkable daily oscillation of the Chl fluorescence observed for picoeucaryotes and less marked for cyanobacteria, could be linked to Chl synthesis during the light period, a phenomenon often reported in laboratory cultures, but very rarely in field populations, because very difficult to measure.

The picoplankton data obtained during the Valdivia cruise, although not fully analysed yet, are very consistent with the HPLC pigment data presented by Barlow et al. in this volume. Chl *a* increased about 3-fold, Chl *b* about 5-fold and 19' hexanoyloxyfucoxanthin about 2.5-fold between March 5 and 10. The two latter pigments could correspond to two sub populations of the picoeucaryotes (data not shown) one of prasinophytes and the other of prymnesiophytes. The cyanobacteria must induce quite significant concentration of zeaxanthin, although this latter pigment was not reported in Barlow et al.'s report (this volume). In contrast it is unlikely that the prochlorophytes, in view of their low concentration, make any contribution to Chl *a* and *b*.

In conclusion, the Valdivia cruise provides a very good example of the development of a surface bloom in Mediterranean waters in response to thermal stratification. The extremely similar behaviours of *Synechococcus* and picoeucaryotes is reminiscent of that observed between *Synechococcus* and *Prochlorococcus* in the north-western Mediterranean Sea during the 1989 Discovery cruise. It suggests that under certain conditions, widely different populations may respond very similarly to forcing by environmental factors such as thermal stratification.

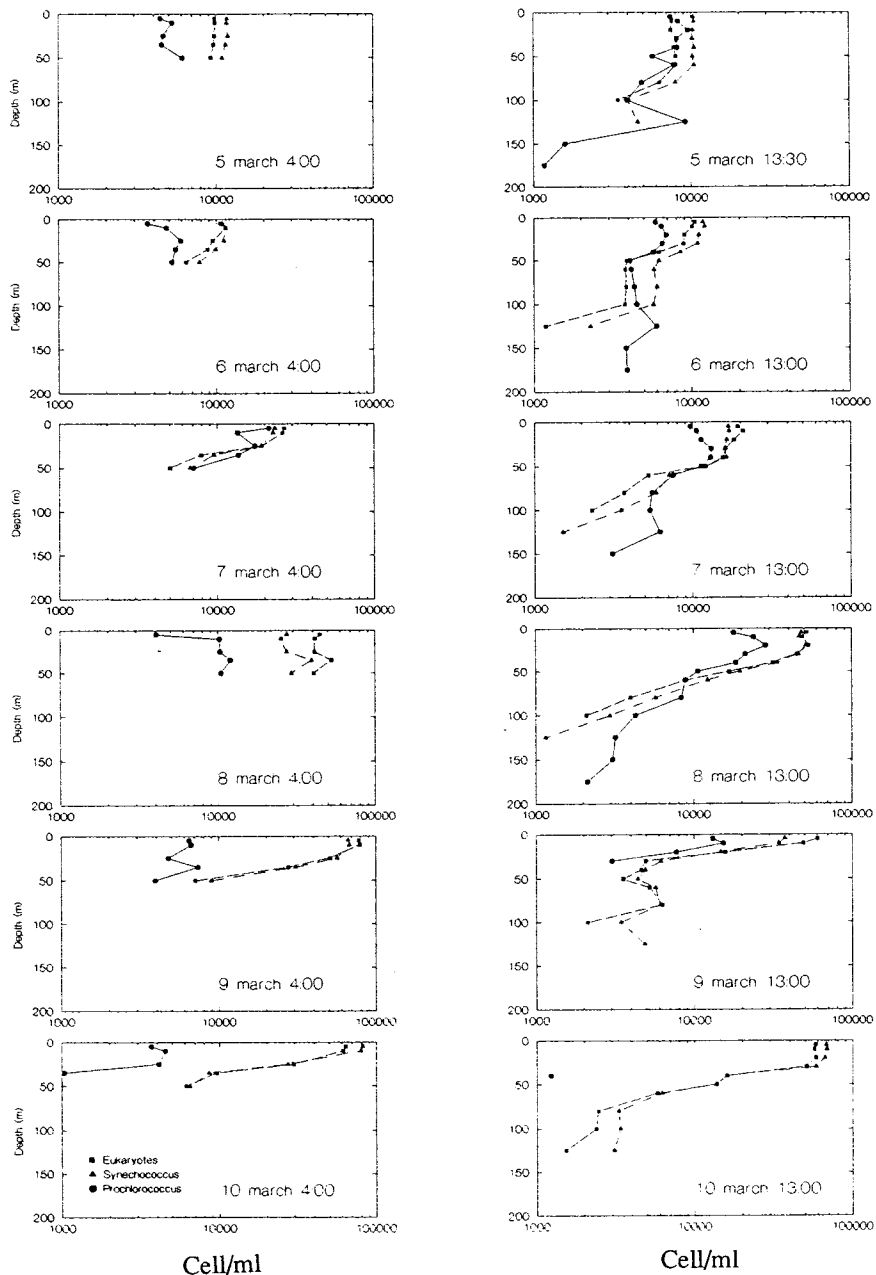


Fig. 1: Western Alboran Sea, March 1992, Valdivia cruise. Vertical distributions of cell concentrations for three picoplankton populations: *Prochlorococcus* (circles), *Synechococcus* (triangles), and picoeukaryotes (squares). In fact, two *Prochlorococcus* populations were observed but only the one with the lowest Chl fluorescence, that was the in general the most abundant, was plotted.

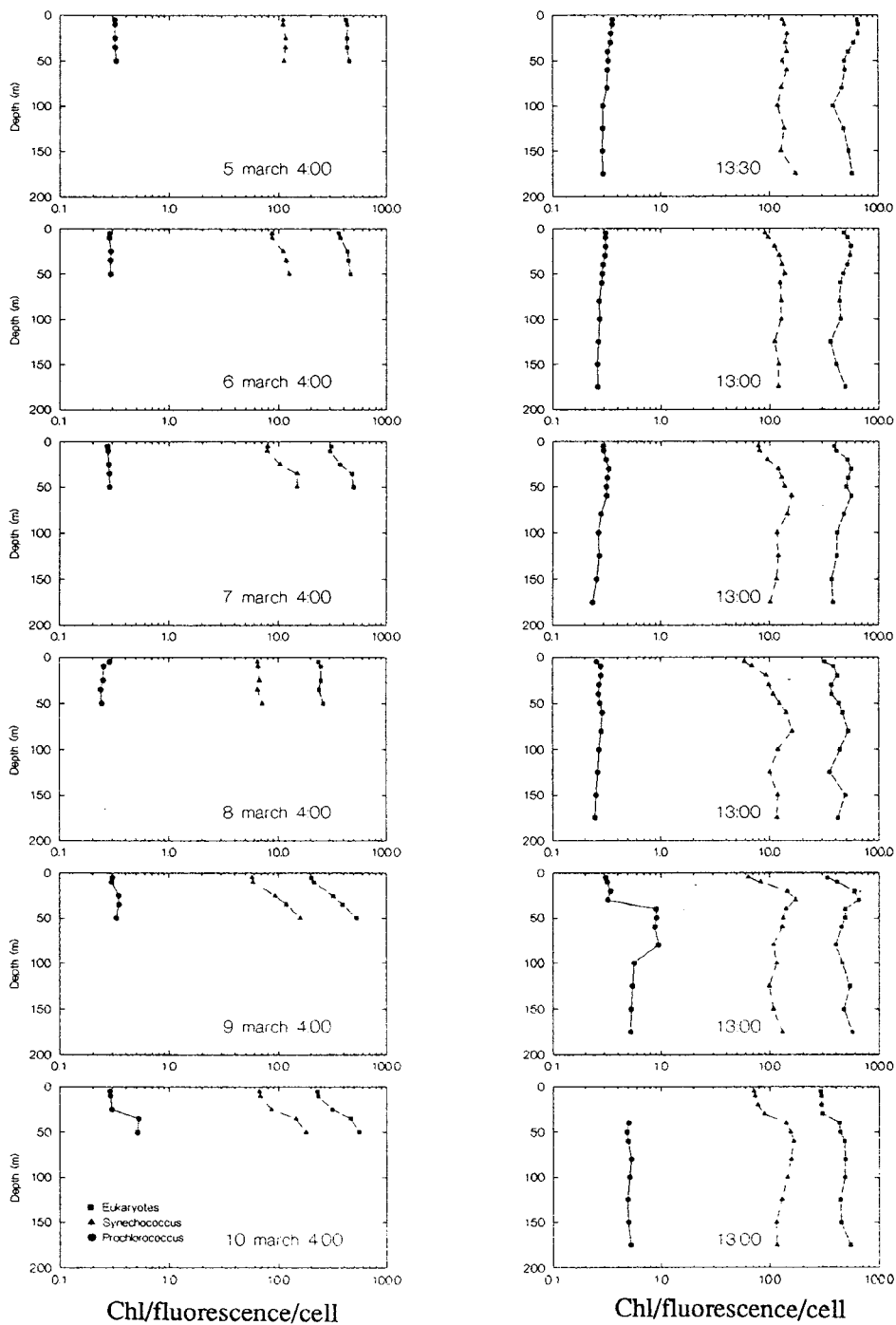


Fig. 2: Western Alboran Sea, March 1992, Valdivia cruise. Same as Fig. 1 but for cell chlorophyll fluorescence (normalised to  $1 \mu\text{m}$  beads).

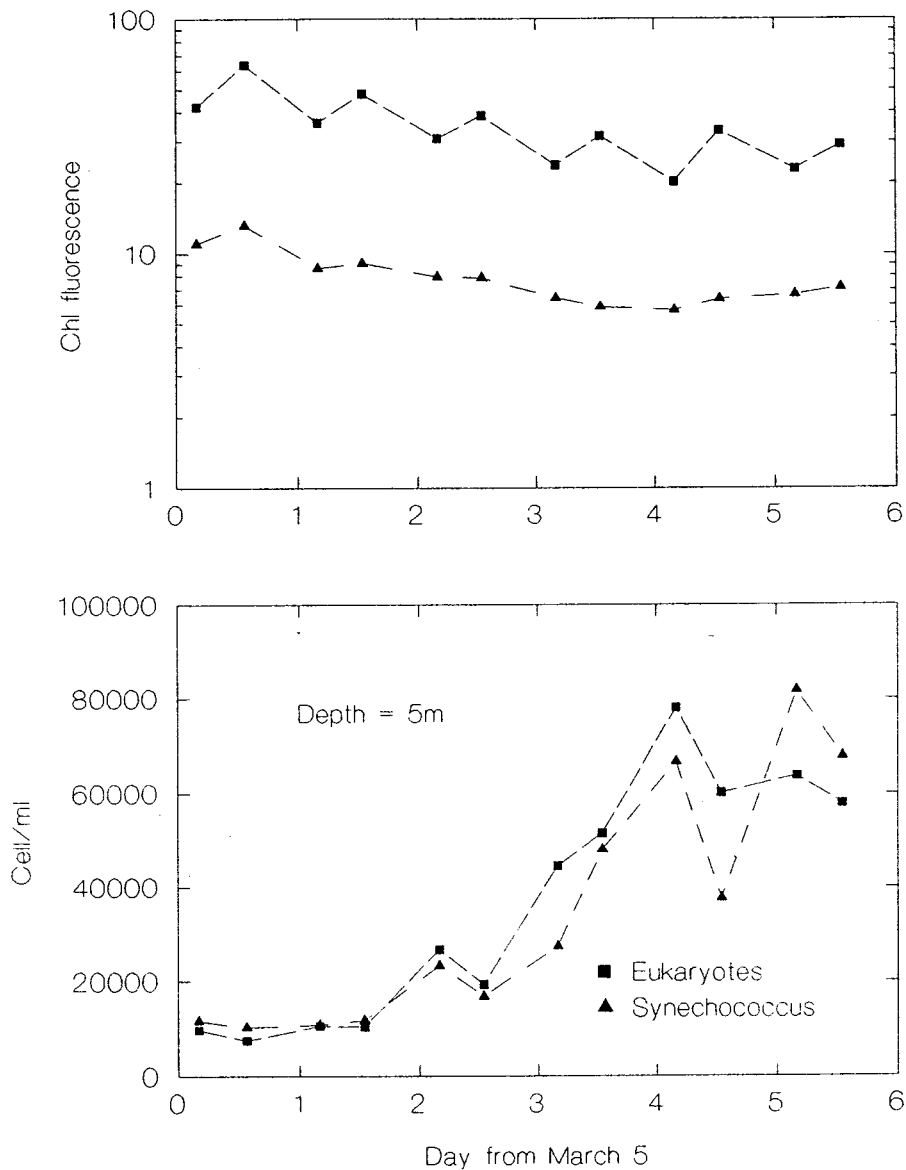


Fig. 3: Western Alboran Sea, March 1992, Valdivia cruise. Time evolution starting from March 5 of the concentration (bottom panel) and Chl fluorescence (top panel) for *Synechococcus* (triangles) and picoeukaryotes (squares).

## ACKNOWLEDGEMENTS

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