SMALL-SCALE VERTICAL DISTRIBUTION OF ZOOPLANKTON IN THE CATALAN SEA: RELATIONSHIPS WITH PHYSICAL CHARACTERISTICS

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Abstract

The patterns of the vertical distribution of mesozooplankton in relation to physical and biological heterogeneities were studied in a 5-day time series at a fixed station in the Catalan Sea (NW Mediterranean). CTD, microturbulence, and TAPS® (high-resolution acoustic probe) profiles, and depth-stratified LHPR® hauls from 15 depth-strata (from 0 to 200 m depth), were alternated along the time series. Strong density gradients and microturbulence (epsilon), related to deep fluorescence layers were determinant for the daylight distribution of zooplankton.

Keywords: Zooplankton , Vertical Profile, Western Mediterranean, Phytoplankton, Hydrography

Introduction

In most of the plankton production models, space is not taken into consideration, as if the pelagic trophic relations took place in an evenly distributed universe. Food or predators are parametrised as average concentration values, although spatial heterogeneity and time variability (patchiness) at all scales is a constant characteristic for marine physical and chemical variables, as well as for plankton communities. The vertical structure of plankton in patches or layers has been described since long [1], but their effects on the coupling between the different trophic components and the oceanographic singularities that control the matter and energy transfer have been poorly studied. In order to allow us to explain some paradoxical features of consumers production under conditions of low average resource availability, in the Framework of the PERFIL-MED cruise we studied the time-changes on the vertical pattern distribution of meso- and microplankton in relation to physical heterogeneities during the summer stratification period.

Study area and methodology

The study took place on board the R/V García del Cid, from the 27/06/09 to the 01/07/09 in the Catalan Sea, NW Mediterranean, at a fixed station (40.45 ºN, 2.39 ºE). Profiles of physical (T, S), chemical (O_2) and biological (fluorescence) data were made with a CTD SBE 911plus. The high-resolution vertical distribution of the rate of turbulent mechanical energy dissipation, epsilon, was obtained with a MST micro-structure profiler®. The vertical distribution of organisms ranging from 50 µm to 2 mm ESR was obtained with a TAPS® (high resolution acoustics, 6 frequency channels from 265 to 3000 KHz). For depth-stratified plankton hauls (15-level, from 0 to 200 m depth) we used a LHPR® fitted with 200 and 50 µm-mesh gauzes, and the on-board analysis of microplankton was made with a FlowCam® on depth-selected water samples. All the profiles were obtained in the 0-200 m depth water column. The analysis of zooplankton biovolume, the organic C_{zoo} contents (from biovolume and a conversion factor, [2]), individual numbers and the identification of taxonomic groups, was made using the free software ZooImage® [3], which uses ImageJ® for the step of image analysis, and R for classification and data analysis.

Results and discusion

A clear deep phytoplankton (fluorescence) layer, accompanied by higher microplankton biomass (data not shown) had developed at the base of the thermocline (Fig. 1 A) , the depth of the peak slightly differing for day and night profiles (52 m night, 58 m day). The same pattern was observed for daylight zooplankton biomass (Biovolume, BV, Fig. 1 C) both directly measured in LHPR samples and that obtained using acoustics (TAPS). Nocturnal zooplankton profiles showed not only higher BV both for LHPR and TAPS, but a shallower peak (vertical migration). The zooplankton LHPR maxima coincided with higher microturbulence (epsilon) values (Fig. 1 B), and during the day with the fluorescence maxima.

The pattern of TAPS profiles was very similar to that of LHPR, although appeared shallower probably due to the effect of internal vawes in the time interval between both samplings. The higher food concentration in the deep fluorescence layer (both phyto and microzooplankton) could explain the coincidence of zooplankton day maxima with the deep fluorescence layer. A better comprehension of the control exerted by physical and biological variables for the vertical heterogeneity of zooplankton biomass would be obtained after a detailed study of the time series for the corresponding variables.

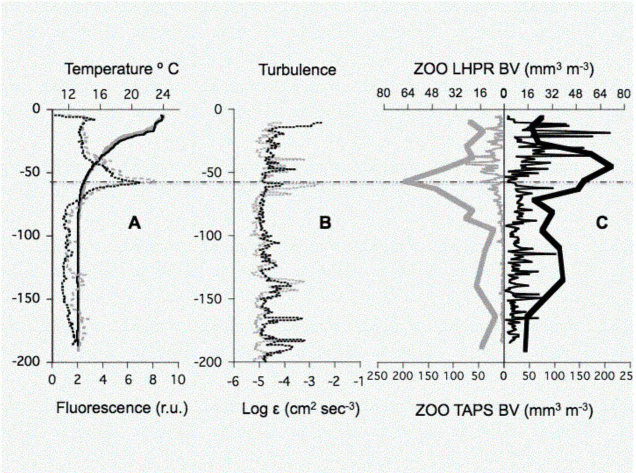

Fig. 1. Examples of two vertical profiles at day (grey lines) and night (black lines) of A: Temperature (ºC) and fluorescence (relative units). B: Microturbulence; C: Zooplankton biovolume (mm^3 m^{-3} from high-resolution acoustics, TAPS (thin lines) and LHPR samples (thick lines). The horizontal dashed line indicates the depth of the fluorescence maximum at day.

References

1 - Alcaraz M., 1985. Vertical distribution of zooplankton biomass during summer strtatification in the Western Mediterranean. *In*: Gibbs P.E. (ed.), Proceedings of the 19th EMBS. Cambridge University Press, Cambridge, pp 135-143.

2 - Alcaraz M., Saiz, E., Calbet A., Trepat I. and Broglio, E. 2003. Estimaating zooplankton biomass through image analysis. *Mar. Biol.* 143: 307-315.

3 - Fernandes J.A., Irigoien X., Boyra G., Lozano J.A. and Albaina A. 2009. Optimizing the number of classes in automated zooplankton classification. *J Plankton Res* 31: 19-29.