SHORT-TERM VARIABILITY OF ZOOPLANKTON BIOMASS AND SIZE STRUCTURE IN THE NORTHWESTERN MEDITERRANEAN

M. Alcaraz [1] *, A. Calbet [1], X. Irigoien [2], I. Trepat [1] and E. Saiz [1]
[1] Institut de Ciències del Mar, CSIC, Barcelona, Spain - * miquel@icm.csic.es
[2] AZTI, Herrera Kaia portualdea z/g 20110 Pasaia (Gipuzkoa), Spain

Abstract
The short-term variability of phyto- and mesozooplankton biomass and size structure was estimated at different time and space scales in the NW Mediterranean. Three stations representative of contrasting hydrographic structures were repeatedly sampled for zooplankton, hydrographic parameters and phytoplankton (chlorophyll a _) in a 12 day period. Although the variability for all the parameters was higher at the shorter time- and space scales (hours, meters), the rate of change at larger scales must be carefully considered.

Key Words: Plankton biomass, variability, Catalan Sea

Introduction

Plankton production models require reliable parameterisations of extensive properties like biomass and size spectrum, both known to display changes at broad time and space scales. At some scales, variability can be interpreted according to Stommel's classical diagram of plankton variability (1). In the case of zooplankton, part of this variability, mainly that derived from predictable sources (i.e., tidal currents, light-induced activity rhythms, etc.) is generally considered to be avoided by adequate sampling schedules, while other sources of variability are seldom considered. In this study, the variability at different spatial (meters - tens of Km) and temporal (hours - weeks) scales of phyto- and zooplankton biomass and size are estimated and discussed in the light of the contrasting hydrographic properties related to a persistent density front in the Catalan Sea (NW Mediterranean).

Study area and methodology

Plankton was studied along a transect (VARIMED-95 cruise, June 1995) off Barcelona (Fig. 1), crossing the Catalan density front (2). Three stations, representative of contrasting hydrographic structures (Coastal C, Frontal F,and Offshore Ostations, Fig. 1), were sampled every four days during the 12 days cruise, at 4-6 hr interval. Zooplankton was collected using a Longhurst-Hardy Plankton Recorder net fitted with 200 µm-mesh. Four to seven depths from surface to 100 m were sampled in each cast. Hydrographic data were simultaneously obtained with a Seabird CTD installed in the net. Chlorophyll a_ (Chl a) data were obtained from the in vivo?uorescence profiles after adequate ?uorometer calibration.

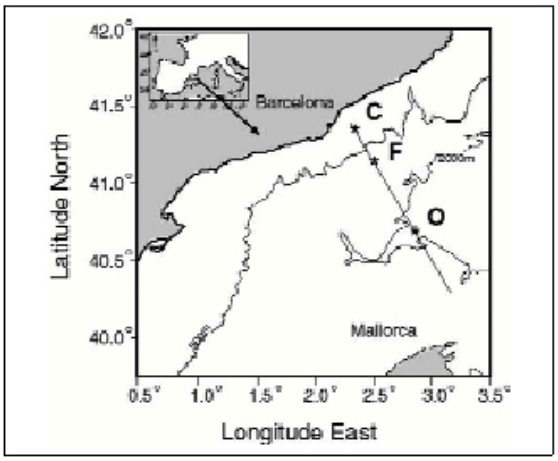

Fig. 1. Map showing the position of Coastal, Frontal Offshore stations in the study area.

Zooplankton biomass (as organic C and N) was analysed on aliquots from the corresponding depth-samples obtained on each cast using a Carlo-Erba C – H - N analyser. Zooplankton community size structure was obtained by image analysis. Zooplankton biomass data have been expressed as µg C l $^{-1}$, and average individual size as µgC/ind., according the distribution of organisms in 13 biomass-classes in a doubling scale (log $_2$) (3).

Results and discussion

Zooplankton biomass and individual size showed similar trends, increasing from coastal to offshore stations (Table 1), while the highest concentrations of chlorophyll corresponded to the front. All structural properties here considered (Table 1) were significantly more variable at front, as expected by the higher dynamism in frontal areas as observed and discussed in (4).

Table I. Average values and variability (C.V., %, in parenthesis) at the Coastal (C), Frontal (F) and Offshore (O) stations for Zooplankton biomass (µgC/l), Individual size (µgC/ind) and Chlorophyll a (µg/l), at time- and space scales of 102 h and 102 m).

VARIABLE	C	F	O	Total
Zoo (µg/l)	148 (28)	1.30 (75)	2.73 (3)	1.90 (37)
Size (µgC/ind)	7.29 (67)	11.18 (126)	23.10 (3)	12.25 (97)
Chlorophyll (µg/l)	0.238 (3)	0.251 (21)	0.201 (12)	0.230 (11)

Zooplankton and Chl a_ tended to vary inversely with time and space scales, the first being less variable during the night than during daylight hours (Table 2). At all time and space scales, the highest variability corresponded to individual size, particularly for 12 hr –tens of meters time-space scales due to the arrival in the sampling area of larger individuals during the night (vertical migration). Apart from this relatively high frequency variability, other variability sources acting at different time- and space scales are particularly important, and must be carefully considered in plankton production models.

Table II. Variability (C.V., %) of Zooplankton biomass (µgC/l), Individual size (µgC/ind) and Chlorophyll a (µg/l) at different time- and space scales. In parenthesis (day – night) values.

SCALES		PARAMETERS		
Time	Space	Zoo biomass	Chlorophyll a	Size
h	m	(µgC/l)	(µg/l)	(µgC/ind)
4-6 h	10 m	59 (66 – 55)	48 (44 – 50)	70 (69 – 65)
12 h	10^2 m	38	47	81
10^2 h	10^2 m	24	36	58
10^2 h	10^1 m	18	32	56

Acknowledgements

This work has been financially supported by Spanish grants AMB94-1019 and REN2001-1693/MAR to M.A. and E.S. We thank all the participants to the VARIMED-95 cruise.

References

1-Haury I.R., Mc Gowan J.A., and Wieve P.H., 1978. Patterns and processes in the time-space scales of plankton distributions. In: Steele J.H. (ed.), Spatial pattern on plankton communities. Plenum Press, N.Y.
2-Estrada M., and Margalef R., 1988. Supply of nutrients to the Mediterranean photic zone along a persistent front. In: Minas H.J., and Nival P. (eds.), Océanographie pélagique méditerranéenne. Oceanol. Acta.
3-Alcaraz M., Saiz E., Calbet A., Trepat I. and Broglio E., 2003. Estimating zooplankton biomass through image analysis. Mar. Biol., 143: 307-315.
4-Calbet A., Alcaraz M., Saiz E. and Estrada M., 1996. Planktonic herbivorous food webs in the Catalan Sea (NW Mediterranean): temporal variability and comparison of indices of phyto-zooplankton coupling based in state variables and rate processes. J. Plankton Res., 18: 2329-2347.