

# IS THE ZOOPLANKTON DECREASING? THE CASE OF 10 YEARS' STUDY IN THE BALEARIC SEA (WESTERN MEDITERRANEAN): 1993-2003

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## Abstract

The zooplankton off Mallorca has been studied for ten years (1993-2003), and related to the main physico-chemical properties of the surface water. Data from a monitoring station at 75m depth were collected every 10 days, and zooplankton biomass and abundance were estimated, and the main zooplankton groups identified. A significant decreasing trend was observed in both zooplankton indices with increasing salinity. However, a decrease was observed during the warmest years (1994-1998), a linear temperature trend was found, mainly due to the cooling of later years.

*Key-words: Hydrography, zooplankton, time-series, Balearic Sea*

## Introduction

The Balearic Sea is located in a boundary area between different water masses in the Western Mediterranean (1), where strong hydrographic annual variability is observed (2), related to changes in the planktonic community (3). In addition, plankton exhibits great variability over time, particularly at inter-annual level, in response to climatic forcing. The mechanisms controlling that variation are still far from understood and long-trend plankton studies are highly recommended in the Mediterranean (4, 5). They emphasize the need for assessing temporal trend to identify the causes of observed changes. Our goal is to describe the results of a 10 years' study of the zooplankton community and the environmental conditions in the Balearic Sea.

## Material and methods

From April 1993 to April 2003 sea water and plankton samples were collected every 10 days from a neritic zone off Mallorca Island (39°28'54"N; 2°25'57"E). To collect hydrographic data 51 Niskin bottles were used at 0-15-25-50 and 75 m depth, and a CTD- Sbe19. Zooplankton was collected by a Bongo Plankton net of 20 cm diameter and 250 µm mesh by means of oblique haul (0-75 m). The zooplankton samples were subdivided, the biomass samples were frozen at -20°C, and the composition samples were fixed in 5% neutralised formaldehyde. The laboratory analysis followed a protocol detailed in previous study (6).

## Results and discussion

**Physical environment-** Annual values of temperature based on measurements made synchronously with salinity were registered, and monthly data calculated. A clear seasonality was marked as a typical thermic regime of these temperate latitudes (1). Interannual variability was observed, with cooler winters during 1994, 1996 and 2000 (17.5°C), and a warmer 1995 and 1998 (18.3°C). During the study period, annual mean values increased particularly during 1997 and 1998. Because of this variability, a linear trend was found during the studied period. Although, an increase was observed during the spring and summer from 1995 to 1998. In general, the minimum temperature was measured in February-March (13.3°C at 75m depth, 1994, 1996) and the maximum in late August (27.4°C in 1998). The highest salinity values were registered during spring 1996 and 2000 (38.19), and the lowest in 1995 and 1998 (37.10). These lower values were related to recent Atlantic waters coming from the south (7). Higher salinities, detected mainly during 1996 and 2000, were related to northern Mediterranean waters (2). Due to the increase in annual values from 1998, an upward trend was observed in the area ( $R^2=0.56$ ;  $p<0.05$ ).

**Zooplankton** – The annual cycle of the mesozooplankton showed fluctuations, with peaks in winter and late spring. Biomass and abundance of zooplankton were higher during spring 1996 and 2000, almost entirely due to the presence of copepods. Significant correlation was found between both indices ( $R^2= 0.3$ ;  $p<0.01$ ). The highest zooplankton abundance was related to cooler temperature (17°C, spring mean values) and higher salinity (>38), as noted by previous studies (7) when northern Mediterranean waters were more important in the Mallorca Channel. Lower salinity and warmer temperature in 1995 and 1998 were related to more recent Atlantic waters flowing in (3, 2).

We observed a close relation between the zooplankton and the surface water masses in the channel, particularly important during spring. They relate a cooler and saltier waters with higher increase of

zooplankton. We confirm the considerable interannual variability in physico-chemical properties of the Balearic Sea, driving the main changes in zooplankton abundance. Even so, both indices - biomass ( $R^2=0.40$ ;  $p<0.01$ ) and abundance ( $R^2=0.12$ ;  $p<0.05$ ) – decreased during the 10 years' period. It would be useful to correlate the results of our study with large-scale changes in zooplankton in other areas of the Mediterranean and longer time-series.

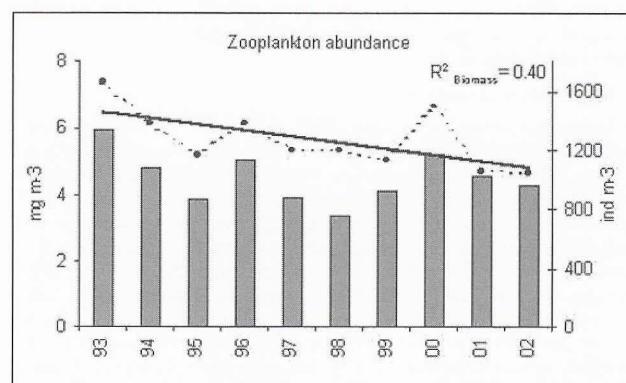


Fig. 1. Annual zooplankton biomass (dashed line) and abundance (bar) from April 1993 to April 2003.

## References

- 1 - Estrada M, Vives F. and M. Alcaraz, 1985. Life and productivity in open seas. Pp. 150-199. In: Margalef R. (ed.), The Western Mediterranean. Pergamon Press. London.
- 2 - Pinot J.M., Lopez Jurado J.L. and M. Riera, 2002. The Canales Experiment (1996-1998). Interannual seasonal and mesoscale variability of the circulation in the Balearic channels. *Progr. in Oceanogr.*, 55 : 325-370.
- 3 - Fernandez de Puelles M.L., Pinot J.M. and J. Valencia, 2003. Seasonal and interannual variability of zooplankton community in waters off Mallorca island (Balearic Sea, Western Mediterranean):1994-1999. *Ocean. Act.* (in press).
- 4 - Cataletto B., Feoli E., Fonda-Umani S. and Sund Cheng-Yong, 1995. Eleven years of time-series analysis on the net-zooplankton community in the Gulf of Trieste. *ICES J. mar. Sci.*, 52 : 669-678.
- 5 - Mazzocchi M.G. and M. Ribera d'Alcala, 1995. Recurrent patterns in zooplankton structure and succession in a variable coastal environment. *ICES J. mar. Sci.*, 52 : 679-681.
- 6 - Fernandez de Puelles M.L., Jansa J., Gomis C., Gras D. and B. Amengual, 1997. Variación anual de variables oceanográficas y planctónicas en el Mar Balear. *Bol. Inst. Esp. Ocean.* 13(1 - 2): 13-33.
- 7 - Pinot J.M., Tintore J. and D. Gomis, 1994. Quasi-synoptic mesoscale variability in the Balearic Sea. *Deep Sea Res.*, 41 : 897-914.