TEMPORAL PLANKTON VARIABILITY IN A NERITIC AREA OF THE BALEARIC SEA-W. MED. (1994-2000)

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Abstract

Covering 7 years sampling observations, seasonal and inter-annual variability of chlorophyll *a* and zooplankton has been analysed and related to the physical structure of the water column in SW waters off Mallorca Island (Balearic Sea). During the period studied the sea temperature has ranged from 13.1ºC to 27.6ºC, February 1996 and August 1998 respectively and the salinity ranges varied from 37 to 38.2 PSU. The lower salinity was found during autumn 1995 and the highest during winter 1996 and 2000, both of these coinciding with the cooler winters of the time-series. Seasonal fluctuations were found in phyto and zooplankton, with winter and late spring peaks rather important. However, higher inter-annual variations were observed in relation to the changes appeared in the hydrographic conditions of the area. The relationship between physical and planktonic variables is discussed.

Keywords: Hydrographic conditions, chlorophyll, zooplankton, time-series, Balearic Sea.

Introduction

In response to climatic forcing, plankton exhibits great variability over time, at seasonal and inter-annual level. However, the mechanisms controlling that variation are still far from properly understood. In this sense, long-trend plankton studies made in the Mediterranean (1,6) emphasise the need for assessing temporal trend and for identifying the causes of observed changes. The strategic position of the Balearic Sea (4) and the interest of temporal studies in open areas (2) motivated the present study. Our aim was to describe the results of 7 years planktonic study in relation to physical properties of the sea water in order to highlight the long-trend and the relationship between them.

Material and Methods

From January 1994 to December 2000 sea water and plankton samples were collected every 10 days interval from a neritic and very open area of Mallorca island (39º28´54"N; 2º25´57"E). To determine hydrographic and chlorophyll data 5l Niskin bottles were used at 0-15-25-50 and 75 m depth. A CTD- Sbe19 was also used. Zooplankton was collected by a Bongo Plankton net of 20 cm diameter and 250 mm mesh by means of oblique haul (75 to 0 m). The zooplankton samples were subsamples, the samples for biomass were frozen at -20ºC and the composition samples were fixed in 5% of neutralised formaldehide. The laboratory analysis were made as previous study (3).

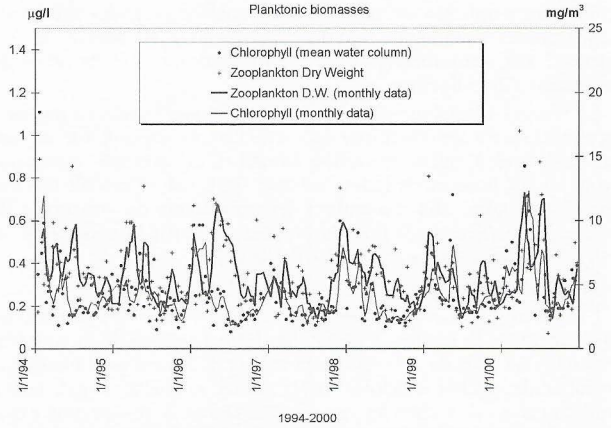
Results and Discussion

Physical environment - Annual changes of temperature based on measurements made synchronously with salinity were registered (time-serie annual mean of 17.89º C) and monthly data calculated. A seasonal cycle was clearly marked as a typical thermic regime of these temperate latitudes (2). Interannual variability was observed, with cooler winter during 1996 and spring 2000 and the warmest year in 1998. During the period study, annual mean values were slightly increased during 1994 and 1995, but the highest increase was during 1997, it kept going until the end of 1998 as a result of the warming tendency during both years (annual mean increased by 0.74º C). During 1999 and year 2000 the annual temperature decreased (0.6ºC from 1998).

Besides that, from December to March the water column remains mixed whereas the stratification period (between 20 to 70 m depth) occurs between April and November. Throughout the summer, the termocline goes sinks close to the bottom.

Seasonal behaviour of the salinity was also analysed (mean annual water column of 37.58 PSU) with the highest value during 1996 (38.19), near to spring 2000. The annual mean salinity varied during the period study (from 37.42 in 1995 to 37.72 in 1996). Lower values where found (37) during autumn 1995 and related to recent Atlantic waters (5). The higher salinities were detected during 1996 and 2000, related to northern Mediterranean waters (5).

Chlorophyll.- Annually chlorophyll maxima were observed in early winter due to the convective mixing period. However, the magnitude varied widely from year to year. The annual mean of the series was very low (0.25 μg/l) and only during 1994 and year 2000 slightly increased (to 0.34 μg/l), indicating the oligotrophy of the water. The highest chlorophyll value was registered in January 1994 (1.1 μg/l), being lower the other years. Another important peak was regularly observed during May, with the highest value in 1999 (3.5 μg/l) followed by 2000 (2.5 μg/l) at deeper layer. During the stratified period, below the thermocline high chlorophyll concentrations appeared and undetectable values in the upper layers, as it is usual in the W.M. (2). Interannual variability seems to be strongly influenced by the mesoscale patchiness characteristic of the stratified period (7).



Zooplankton - Mesozooplankton pattern showed more complex fluctuations although seasonal variations were also observed, with higher peaks in March and late spring, that seem to follow the phytoplankton blooms. Both of them, were almost due to the copepods. However, when the summer peak appears, as in 1994 and 2000, the cladocerans were the most abundant group. In the whole study period higher zooplankton abundance was observed during 1996 (6.7 mg D.W./m^3) and year 2000 (6.3 mg/m^3) as well, when the cooler and densier waters were found in the area. The annual mean zooplankton abundance was estimated as 5.7 mg/m^3 (9.7*10^2 ind/m^3).

All this data suggested that despite important interannual zooplankton variability observed, due to strong changes in environmental parameters, seasonal plankton dynamic also was evident. And from the analysis of the physical variables and plankton abundance the presence of a recurrent pattern could be observed, although it confirms the considerable interannual variability in the Balearic Sea, with differences on timing and magnitude, and not very different to other areas of the Mediterranean (1,6). In this sense we realise that to analyse forcing mechanisms of definite cause-effect is a very difficult task. Therefore in order to find out general trends in the Mediterranean in relation to Global Change longer time-series must be taken into consideration.

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