SPATIAL AND SEASONAL VARIABILITY OF THE ZOOPLANKTON IN THE BALEARIC SEA (WESTERN MEDITERRANEAN)

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Abstract

In order to know the temporal variability of the zooplankton community in the Balearic Sea, a sampling study of the water column was started in January 1994 during a period of two years. Three stations were monthly sampled in the waters off the Mallorca island at different depth. Besides the zooplankton, hydrographic and chlorophyll data were also collected and related. During the study the three stations presented close zooplanktonic fluctuations, however the coastal station was slightly different to the other two and more related to the chlorophyll pattern distribution, almost due to higher influence from deeper waters at the farther stations. According to the low biomass and the abundance organisms of the zooplankton, the area can be related to other transition areas in the Mediterranean Sea. The first year study, the zooplankton biomass was higher at the three stations, where two peaks were observed, in winter and spring. However during the second year, when the water was slightly warmer in winter and chlorophyll concentrations were lower, such clear oscillations of zooplankton were not observed. Considering the seasonal abundance of zooplankton (as n°ind/m^3) more fluctuations appeared and besides the winter and summer peaks the autumn one was also important due to groups other than copepods. So that, besides the seasonal variability observed higher interannual variability may be appreciated in the study area. No correlation was found between the copepods and the total mesozooplankton biomass in any of the stations indicating the high contribution from other zooplankton groups.

Key-words: zooplankton, biomass, Balearic Sea.

Introduction

Spatial zooplankton studies carried out in open areas of the Balearic Sea have given synoptic description for certain periods of the year (1-4) however temporal studies, describing the zooplankton pattern distributions are very few, specially in the Balearic Sea (5, 6). In other areas of the Western Mediterranean Sea, as the Liguro-Provenzal sea, the Iberian shelf and the Alboran sea, different temporal studies of the zooplankton have been described (7-10). The lack of this kind of studies in open areas and the strategic situation of the Balearic Islands in the central part of the Western Mediterranean where waters from different origins pass through motivated the present study as part of the Hercule project when the coastal station has been sampling weekly since April 1993. The time-scale of the different planktonic communities is also discussed in order to integrate the main events and interpretate the oscillations observed.

Studied area

The Balearic Sea is a transition area into the Western Mediterranean, that keeps two sub-basins apart with different waters masses. In the northern part, the Gulf of Lions, where the cool and saline water originates and in the southern part, the Algerian basin which is a receptor of warm, less saline Atlanctic water. The Balearic Islands form a geographical barrier between them, whose coast, depending on the time of the year, is influenced by these waters as well as by others from the eastern side (11, 12). The channels between the islands act as tranfer areas for dissolved and particulate material whose inflows/outflows strongly influence the distribution of the planktonic communities. The area chosen was located in the open sea where the platform down rapidly to the edge of the continental shelf (200 m depth) attempting to select a marine area, easily accesible, open to the main water circulation, thereby to study the seasonal fluctuations of the zooplankton in the Balearic Sea.

Material and methods

From January 1994 to December 1995 the three stations at 75, 100 and 200 m depth (St. 1, 2 and 3 respectively) were visited monthly at the same time each day. Zooplankton was sampled by a Bongo Plankton net, 250 μm mesh, by means of oblique hauls. To determinate hydrographic and phytoplanktonic parameters 3 l. Niskin bottles were used at depths of 0, 5, 15, 25, 50, 75, 100, 125 and 200 m. (whenever the depth was possible). CTD data were also recorded. The zooplankton samples, reserved for structural studies, were fixed in 4% neutralised formaldehyde buffered with borax. The samples for biomass studies were frozen at -20°C and 15 days later were analysized as (13) has recomended. The subsamples analysed were obtained using a Folsom Plankton splitter and the statistical treatment was recommended (14). Since the factors studied were not causative the analysis was mainly descriptive showing the pattern of the zooplankton in relation to some of the main oceanographic parameters.

Results and discussion

Seasonal changes of temperature, based on measurements made synchronously with the zooplankton, can be seen in Figure 1. The seasonality of fluctuations is clear and very similar for temperature at all three stations where the temperature ranged from 13.16°C in February to 27.1°C in July, both values observed in 1994. However, during 1995 the values varied from 13.5 in May and 26.5 in July, being warmer in winter. Besides that, a typical thermal regime of the Western Mediterranean was observed (15) with a seasonal thermocline, between 20 to 50 m depth from May to November, defining the stratification period and determining the seasonal biological production in the area. The mixed layer only appeared during

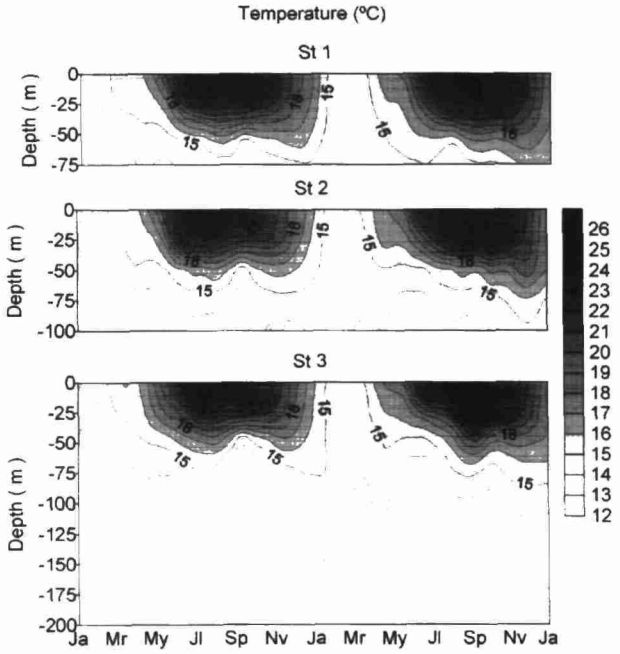

Figure 1. Temperature variation during the two-year study at the three stations of the Balearic Sea

the winter months when the water was cooler than 15°C. Considering the salinity, in 1994 the higher values were found during the winter and the lower in summer. However, in 1995 more irregular fluctuations appeared with lower salinity values, which ranged from 38.3 to 36.91, both at st. 3, indicating the influence of different water masses in the area.

It is important to point out that the euphotic layer was 70 m, on average. At this depth the light did not seem to be a limiting factor for phytoplankton in contrast to the low concentrations of nutrients. These are found throughout the year and are typically low, mostly undetectable during the stratification period on the surface, while higher nutrient levels were detected in deeper waters. In spring and autumn, when the thermocline starts and breaks down, the bottom nutrients come up to the euphotic zone, where they are consumed by the phytoplankton cells. The seasonal fluctuations of chlorophyll are observed in Figure 2 where the maximum concentration (1.3 μg/l) was located at the coastal station in January but was also important at the other stations. In 1994, a large phytoplankton bloom in the whole water column was observed, while in 1995 the winter bloom was seen only in the surface layer. Besides this, another important and regular phytoplankton concentration appears in May around 75 m with the highest value recorded (2 μg/l) however during the summer, below the thermocline, appeared high concentrations in contrast with the poor seasonal values (>0.4 mg/l).

During the first annual cycle the seasonal variability of the mesozooplankton biomass (Fig. 3) showed mainly two peaks: a) one at the begin-