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Temporal changes in the structure of a slope suprabenthic community from the Bay of Biscay (NE Atlantic Ocean)

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ABSTRACT

The suprabenthic community of the upper slope off Arcachon (site A at about 400 m depth on a muddy sand substratum) was sampled monthly from February 1991 to January 1992 with a suprabenthic sled towed over the sea bottom. The fauna collected in the 0–50 cm water layer above the bottom was classified into 9 major groups and 109 species (56 amphipods, 12 mysids, 10 isopods, 10 decapods, 9 cumaceans, 6 euphausiids, 4 fishes, 1 lophogastrid and 1 tanaid). The total abundance of the community fluctuated between a maximum of 3199 ind./100 m^2 in July and a minimum of 82 ind./100 m^2 in November, with an annual mean value of 969 $\pm$ 601 ind./100 m^2. The community structure was mainly affected by the temporal abundance fluctuations of the asellote isopod *Munnopsurus atlanticus*. This species was numerically dominant during the first part of the year and showed a drastic decrease in August, followed by the dominance of the mysids *Erythrops neapolitana* or *Parapseudomma calloplura* in autumn and early winter. Such structural changes in the dominance of major taxa are discussed with respect to the feeding behaviour of species and food availability in the near-bottom environment. We conclude that the population dynamics of *M. atlanticus* in the upper bathyal was mainly governed by the seasonal development of its major prey, the benthic foraminifers, favoured by the spring phytodetritus deposition on the sea floor.

1. Introduction

According to the definition given by Brunel et al. (1978), suprabenthos (also designated as hyperbenthos; see Mees and Jones, 1997 for review of terminology) includes small-sized bottom-dependent animals (mainly crustaceans) which perform, with varying amplitude, intensity and regularity, seasonal or daily vertical migrations above the sea floor. These swimming organisms are known to live at least during daytime in the near-bottom environment where they constitute distinct assemblages, consuming suspended or deposited organic particle mainly issued from the overlying water column. Poorly collected by grabs and box-corers due to the swimming abilities of species, the soft-bottom suprabenthic communities are more efficiently sampled by specific sleds equipped with small mesh-size nets and towed over the sea floor at an adequate speed (1–2 knots). The trophic importance of these communities in demersal food webs is widely recognised in coastal as well as in deeper marine areas (Sorbe, 1977, 1981; Mauchline and Gordon, 1991; Cartes, 1991; Cartes and Sardà, 1989; Cartes and Abelló, 1992; Stefanescu and Cartes, 1992). They must be considered as a key compartment of the benthic ecosystem in the recycling of organic matter towards the pelagic ecosystem.

In the last decades, knowledge of the structure of deep suprabenthic communities from the Atlantic Ocean has increased, due to the use of adequate gears for the quantitative sampling of the motile near-bottom fauna at bathyal and abyssal depths (Elizalde et al., 1991, 1993; Brandt, 1993, 1996, 1997; Brandt and Piepenburg, 1994; Elizalde, 1994; Sorbe and Weber, 1995; Dauvin and Sorbe, 1995; Dauvin et al., 1995; Brandt et al., 1996; Cunha et al., 1997; Sorbe, 1999; Marquiegui and Sorbe, 1999; Dewicke, 2002; Vanquickelberghe, 2005). These studies described the species composition of the deep near-bottom communities, demonstrating the bathymetric zonation of the suprabenthic fauna, its abundance decrease with depth (although exceptions due to peculiar local conditions were also mentioned) and the importance of some major taxa such as Amphipoda, Cumacea, Isopoda, Mysida and Decapoda Caridea. However, most of these studies provided snapshot inventory of communities, but did not document temporal fluctuations in their structure due to rapid phytodetritus input in the near bottom environment after phytoplankton blooms in the euphotic zone (Billett et al., 1983; Lampitt, 1985). Besides other kinds of organic inputs to the deep-sea floor (wood, plant remains, animals carcasses, etc.), these periodic events were recognised to play a major role in structuring meio-, macro- and megabenthic communities via direct or indirect

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trophic link (Gooday and Turley, 1990; Gage and Tyler, 1991; Gooday et al., 1992). Such a close benthic–pelagic coupling was also extended to suprabenthic peracarid assemblages from the NE Greenland margin (Brandt, 1995). Furthermore, a 2-month time-series sampling in the same area provided first evidence for a synchronisation of reproductive processes with favourable near-bottom food conditions related to seasonally high phytodetritus input (Brandt, 1996).

The present study describes the temporal changes in a suprabenthic community from the upper bathyal of the SE Bay of Biscay, based on the analysis of a series of monthly samples taken during a full annual cycle. Community as well as population dynamics are subsequently discussed in relation to near-bottom environmental conditions and known feeding behaviour of dominant species.

2. Materials and methods

2.1. Study area

The study area is located on the continental slope near the Cap Ferret Canyon (Fig. 1). Its morphology is an asymmetric ridge sloping to the WNW with an abrupt northern flank which corresponds to the main channel of the canyon and a slight slope toward the south, bounded by another small canyon that interrupts the margin up to 400 m depth. Between these morphological boundaries, three sites were sampled monthly along an EW bathymetric transect in 1991–1992 (SUPRABATH cruises): sites A, B and C at about 400, 700 and 1000 m depth, respectively. However, the data herein presented only concern site A.

According to Durrieu de Madron et al. (1999) and van Aken (2000), the upper bathyal of the Cap Ferret area is mainly influenced by the Eastern North Atlantic Central Water (ENACW), a water body located between 200 and 600 m just above the high saline Mediterranean Overflow Water (MOW). In the eastern Bay of Biscay, the ENACW is a relative low salinity water mass characterised by a minimum value of 35.51–35.54 and a potential temperature of 10.8 °C at about 500 m depth. In that area, the near-bottom water temperature decreases with depth but with insignificant seasonal fluctuations at a determined bathymetric level (e.g. 0.8 °C at 400 m depth in the study area; ECOFER unpublished data), without impact on the reproduction of benthic taxa. Along the continental slope of the Bay of Biscay, currents are mainly oriented poleward (Pingree and Le Cann, 1990; Ferrer et al., 2009). The warm and salty Navidad Current penetrates the southern part of the Bay of Biscay from the Portuguese margin (warm water extension of the Iberian Poleward Current in the Bay of Biscay) particularly during winter (Pingree and Le Cann, 1990; García-Soto et al., 2002; Le Cann and Serpette, 2009). According to Pingree and Le Cann (1992), this surficial warm water tongue generates long lived anticyclonic 'swoddies' (down to depths of about 400 m from the ocean surface) at the latitude of the Cap Ferret Canyon. However, according to their known internal thermohaline configuration as well as their fugacious slope presence (see Pingree and Le Cann, 1992), such eddies have no effect on the structure of underlying bathyal benthic communities.

Few primary production data exist for the southern part of the Bay of Biscay and no complete yearly survey is available. In its oceanic region, a spring phytoplankton bloom is known to occur every year between March and beginning of May, with modal peak values of chlorophyll around 1–2 mg m^{-3} above a general background concentration of <0.5 mg m^{-3} (García-Soto and Pingree, 2009). In the Cap Ferret Canyon area, primary production measurements were seasonally carried out during ECOFER experiments in 1989–1991 (no data for winter months). According to these data, the daily production may reach 1.5 g C m^{-2} day^{-1} during the April/May bloom period but dropped to a mean value of 0.4 g C m^{-2} day^{-1} during the summer months (Laborde et al., 1999). No secondary autumn bloom occurred in that area during ECOFER surveys, although such a seasonal event typical of a temperate margin was actually observed further to the south on the central Cantabrian margin (Fernández and Bode, 1991; García-Soto and Pingree, 2009). Furthermore, no direct connection was found between euphotic primary production cycle and temporal patterns in vertical particle fluxes measured by trap experiments within the Cap Ferret Canyon (Heussner et al., 1999).

In the Cap Ferret area, near-bottom currents are directly controlled by the canyon morphology and follow the continental slope contours with a predominantly northward direction but with some reversals. Such an along-slope circulation probably plays an important role on the resuspension of the fine sediments along the gently sloping southern open slope and generates along-slope intermediate nepheloid layers in the upper bathyal (Durrieu de Madron et al., 1999). Sedimentological characteristics of surficial sediments are related to hydrodynamic conditions controlling grain-size distribution (Cremer et al., 1999; Etcheber et al., 1999).

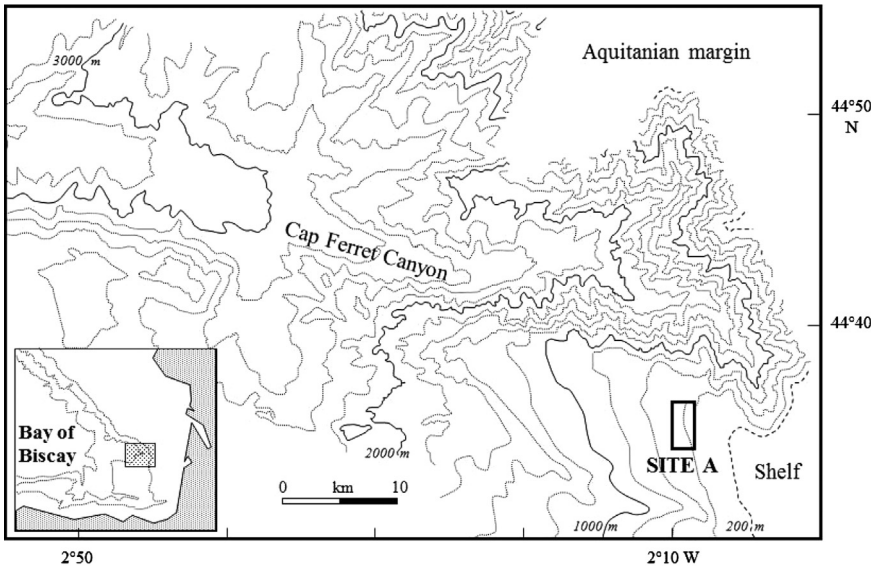

Fig. 1. Geographical location of site A on the southern margin of the Cap Ferret Canyon (southeastern Bay of Biscay).