A comparative study of the macrobenthic infauna of two bathyal Cantabrian Sea areas: The Le Danois Bank and the Avilés Canyon System (S Bay of Biscay)

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A R T I C L E   I N F O

A B S T R A C T

Multidisciplinary studies were carried out in the Cantabrian Sea (N Spain) to investigate benthic habitats and compare the communities of two areas: the Le Danois Bank in 2003–2008 under the ECOMARG project, and the Avilés Canyon System in 2010–2011 under the INDEMARES (LIFE+) project. The main aim of this publication is to describe the composition and spatial distribution of the benthic fauna inhabiting the sedimentary grounds of these deep-sea areas, as well as the possible relationships with the environmental variables that characterise these habitats.

The soft-sediments and infaunal communities of these two deep-sea ecosystems were sampled using a box corer. The granulometric analyses of the sediments showed a grain size gradient decreasing with depth in both areas. Their infaunal communities showed similar numerical abundance patterns, with decreasing values in relation to depth. The highest abundance values were reached below 500 m deep, and the lowest values were found at deeper stations. The infaunal communities of both areas were mainly dominated by polychaetes, followed by peracarid crustaceans and bivalve molluscs.

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1. Introduction

The deep sea is conventionally defined as the region below 200 m (Gage, 2001; Tyler, 2003). It represents the transition from the continental shelves, with shallow-water fauna, to the continental slope with deep-sea fauna. Consequently, the deep-sea floor is a huge ecosystem extending over most of the Earth's surface (Tyler, 2003). This habitat is mostly covered by sediments, but there are some other regions, like mid-ocean ridges, which have exposed rocks (Thistle, 2003). The topography of the deep-ocean floor can be interrupted by several physiographic features, such as submarine canyons or seamounts, among others. Submarine canyons are defined as deep incisions cutting the continental slopes and can operate as conduits of sediments and organic carbon to the deep ocean basin (Paterson et al., 2011). Turbidity currents erode these rugged topographies resulting in V-shaped profiles. On the other hand, seamounts are conspicuous features in submarine topography, rising from the ocean floor to just below the surface (Surugiu et al., 2008; Gage and Tyler, 1991).

Currently there is increasing information about the deep-sea ecosystem due to the development of new sampling methodologies that are more appropriate for exploring this environment than older sampling methods. It was previously assumed that the deep sea was poor in species and had high environmental stability (Sanders, 1968), slow sinking detrital rain, and no primary production (Tyler, 2003). However, it is now well known that the deep sea has a high biodiversity of organisms (Hessler and Sanders, 1967), is a dynamic environment (with periods of benthic storms and seasonal inputs) with primary production in specific habitats, such as vents and cold seeps (Tyler, 2003), and has different habitats due to the complex topography of the deep-sea floor (Stuart et al., 2003).

Several surveys were carried out during the period 2003–2011 to investigate the structure of macrofaunal benthic communities from two deep-sea areas of the Cantabrian margin (N Spain): the Le Danois Bank and the Avilés Canyon System, within the framework of the ECOMARG and INDEMARES (LIFE+) projects respectively. This paper aims to (i) compile data from these areas and characterise the composition and distribution of the macrobenthic fauna inhabiting these sediments; (ii) determine the possible relationship between the environmental variables measured and the distribution patterns of the benthic fauna; and (iii) compare these patterns with those of other similar geographic areas in order to evaluate the study areas' ecological value. These data could serve to develop appropriate strategies for the management and conservation of deep-sea benthic habitats.

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The multidisciplinary surveys carried out at the Le Danois Bank and Avilés Canyon System involved great sampling and taxonomic effort due to the large spatial coverage and high number of species that were identified. However, the surveys need to be continued and even extended because they provide the necessary baseline environmental information for improving our scientific knowledge of these interesting areas, which can be used to safeguard the invaluable biodiversity.

2. Material and methods

2.1. Study area

The Cantabrian margin (S Bay of Biscay) is a heterogeneous region located in the NE Atlantic. This region has high levels of biodiversity in comparison with adjacent areas due to its wide range of complex topographical substrates that have many different habitats. Moreover, it is a transition zone where typical temperate-water species from the south and from the north coexist (Sánchez and Olaso, 2004). This narrow margin (shelf width: 10–40 km) is characterised by slopes interrupted by several submarine canyons and a seamount-like marginal bank (Le Danois Bank) (Sánchez et al., 2009).

The present work is focused on two unusual topographical structures of this Cantabrian margin. The location and position of the sampling sites are shown in Fig. 1.

The ECOMARG project (www.ecomarg.net) was focused on studying deep-sea ecosystems (structure and dynamics), in particular the Le Danois Bank on the Cantabrian margin. These vulnerable deep habitats are a refuge for sensitive species, juveniles and reproducing individuals exploited in neighbouring areas. Although they are now more exposed to the increasing pressure of human activities due to the development of new fishing technologies, there is still little information on these deep benthic areas, and therefore they need to be researched with modern methodologies. The Le Danois Bank, recently declared the first offshore Spanish Marine Protected Area (MPA) and included in the Natura 2000 and OSPAR Commission MPA networks, is a large offshore bank that functions as a seamount surrounded by a complex system of channels and canyons. The bank is 25 km from the continental shelf and is separated from it by a deep intraslope basin (850–1200 m depth). Locally known as the 'El Cachucho' fishing ground, it is centred at 5°W longitude and 44°N latitude, and consists of a flat terrace at a depth of 450–600 m. Whereas the southern side of the bank slopes slightly towards the coast, the northern side has a steep flank whose base is located at 4400 m on the abyssal plain. The top of the bank is characterised by a mosaic of soft sediment areas and highly reflective rocky outcrops, while the intraslope basin is covered by muddy sediments (Sánchez et al., 2008).

The INDEMARES project (www.indemares.es) aims to identify special areas of conservation within the Natura 2000 Network. This new project was born to preserve and carry out the management actions needed in the areas included in the network, and to contribute to the protection and sustainable use of the biodiversity. At present, ten Spanish marine regions are covered by this project, including the Avilés Canyon System on the Cantabrian margin. As pointed out by Gómez-Ballesteros et al. (2014), the Avilés Canyon System is a complex, structurally-controlled canyon and valley system constituted by three main canyons of different morphostructural characters. They are, from west to east: Avilés Canyon, El Corbiro Canyon and La Gaviera Canyon. The Avilés Canyon is located 7 miles from the Spanish coast on an oblique line at 6°W, from 140 m to 4750 m depth. In addition, two conspicuous morphologic features exist: El Canto Nuevo marginal
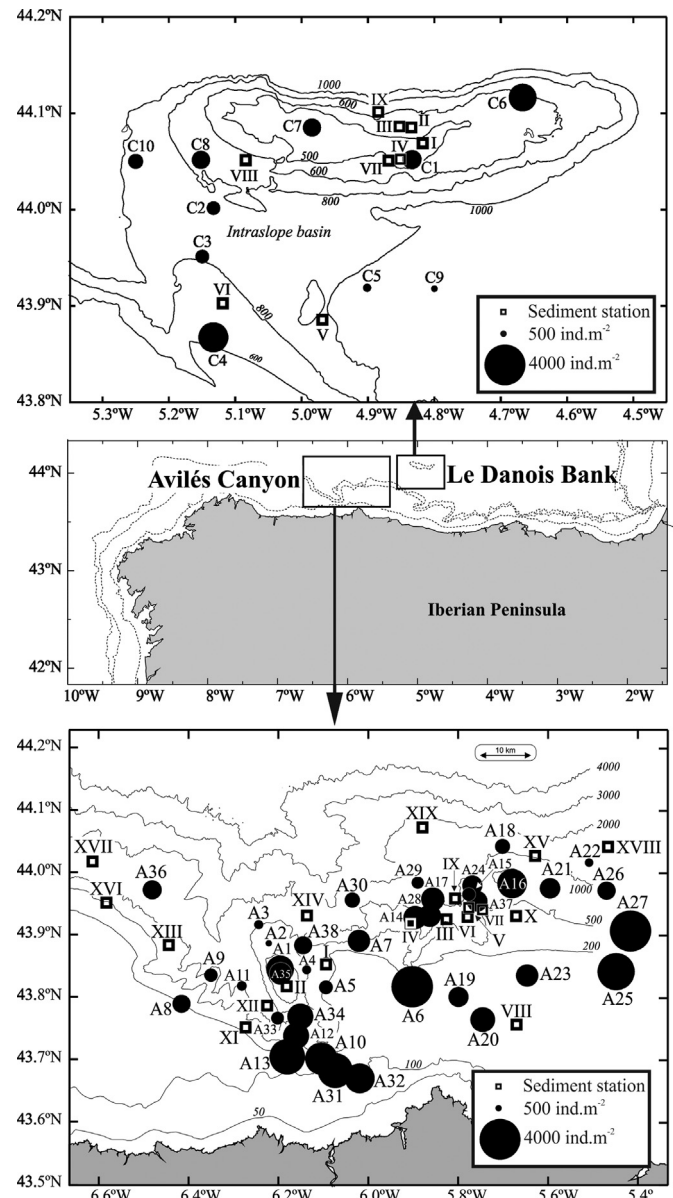

Fig. 1. Location of sampling stations on the Le Danois Bank and in the Avilés Canyon System (Cantabrian Sea). Symbol size is proportional to infaunal abundance indices. Square symbols with roman numerals mark the stations where only sediment was collected.

platform and the Agudo de Fuera rocky outcrop. This canyon system is known to provide Essential Fish Habitats (EFH) for important commercial species, such as hake and monkfish, as well as habitats for sharks, cetaceans and giant squid. However, several damaging interactions, such as accidental catches, are caused by the intense fishing activity in the area.

2.2. Sampling methods

The present work is based on different multidisciplinary surveys carried out in 2003, 2004, 2005 and 2008 at the Le Danois Bank (ECOMARG project; Sánchez et al., 2008), and in 2010 and 2011 at the Avilés Canyon System (INDEMARES project).

An USNEL box-corer (Hessler and Jumars, 1974), which is widely employed in deep-sea benthic surveys (Gage and Tyler, 1991; Eleftheriou and Moore, 2005), was used to sample an area of 0.09 m² on the bottom. A total of 19 stations at the Le Danois Bank and 57 stations at the Avilés Canyon System were sampled with