Journal of Sea Research 85 (2014) 73–84

Contents lists available at ScienceDirect

Journal of Sea Research

journal homepage: www.elsevier.com/locate/seares

A functional approach to the seasonal variation of benthic mollusc assemblages in an estuarine-like system

Fernando Aneiros [a,*], Juan Moreira [b], Jesús S. Troncoso [a]

[a] Departamento de Ecología y Biología Animal, Facultad de Ciencias del Mar, Universidad de Vigo, Campus Universitario Lagoas-Marcosende, 36310 Vigo, Pontevedra, Spain
[b] Departamento de Biología (Zoología), Facultad de Ciencias, Universidad Autónoma de Madrid, C/ Darwin 2, 28049 Cantoblanco, Madrid, Spain

ARTICLE INFO

Article history:
Received 31 May 2013
Received in revised form 10 September 2013
Accepted 9 October 2013
Available online 20 October 2013

Keywords:
Mollusca
Subtidal sedimentary bottom
Seasonal variation
Trophic guild
Life habit
East Atlantic

ABSTRACT

The mollusc assemblages inhabiting two fine-sediment bottoms in the Ría de Aldán (NW Iberian Peninsula) were quantitatively sampled to test hypotheses about influence of sediment in faunal composition, seasonal variation and amensalist relationships. Both trophic guilds and life habits were considered for functional group classifications of the mollusc species found. The two assemblages were found to have differences in both numerically dominant species and general structure. Among numerically dominant species, *Kurtiella bidentata* was the only one present in numbers at both sites; it was second to *Chamelea striatula* at the site with the coarsest sediment and the top dominant at the one which had higher organic content, there followed by *Thyasira flexuosa*. There were significant changes in abundance, number of species and diversity indexes during the study period; maximum values of abundance occurred in autumn. Seasonal variations in univariate faunal parameters and functional groups were also correlated with those in sediment features and sediment heterogeneity was identified as a key factor to explain diversity of the assemblages. The extensive mussel raft culture in the area seemed not to affect negatively either abundance or diversity and might favour higher diversity by increasing the heterogeneity of the sediment through the supply of mussel shells. Hydrodynamic regime of the embayment is suggested to be a relevant factor in determining differences between the structures of assemblages. Seasonal changes in this regime would lead to major changes in the characteristics of the sediment and therefore in the mollusc assemblages. Higher intensity and frequency of these changes seem to promote a closer relationship between the assemblage and the sediment, as well as a tighter coupling between functional and taxonomic structure of the former. The existence of amensalist relationships was dismissed for both assemblages as no negative relationships between trophic guilds were found.

1. Introduction

Marine sedimentary bottoms are the most widespread habitats on Earth (Snelgrove, 1999; Wilson, 1991) and, though they represent a small proportion of them (Ellis et al., 2000), shallow subtidal ones are dwelled by extremely abundant and diverse benthic macrofaunal communities (Gray, 1997). The structure and organisation of these assemblages are complex and influenced by a variety of factors, both biotic and abiotic (Gray, 1981), and they are known to be very variable at both spatial and temporal scales (Morrisey et al., 1992a,b). Temporal variation in these communities has been reported to be related with both short and long-term changes in factors such as sediment features, freshwater input and different climatic and oceanographic aspects (e.g. Bourcier, 1996; Livingston et al., 1997; Nichols and Thompson, 1985), and also to be influenced by different kinds of anthropogenic disturbances (e.g. Abella et al., 1996; Bourcier, 1996; Warwick et al., 2002; Ysebaert et al., 2009). Furthermore, patterns of temporal variation are also closely related to the life cycles of the species which form the assemblage, mostly those which experience large seasonal fluctuations in abundance (Boero, 1994; Constable, 1999; López-Jamar and Parra, 1997), and the biotic relationships among them (e.g. Posey, 1990; Rhoads and Young, 1970). In the case of habitats located inside bays, benthic assemblages are affected by both local (within the bay) and regional (adjacent ocean) events (Warwick et al., 2002) and they need longer time to recover from disturbances than the ones in open waters (Bourcier, 1996). In this relatively sheltered coastal areas, one of the most common and important phenomena affecting soft-bottom benthic communities is organic enrichment, usually due to eutrophication of the water column (Gray et al., 2002; Moodley et al., 1998), which has complex effects on diversity and other parameters of benthic assemblages (Moodley et al., 1998; Whitlatch, 1981). This is partly due to its likeability to the generation of hypoxia (e.g. Gray et al., 2002) and its relationship with the food supply to the benthic fauna, which in turn determines if benthic communities are food-limited or not, and so their richness (Rosenberg, 1995), the existence of benthic–pelagic coupling (Austen et al., 1991), the relative importance of top-down vs.

* Corresponding author at: Facultad de Ciencias del Mar, Campus Universitario Lagoas-Marcosende, 36310 Vigo, Pontevedra, Spain. Tel.: +34 986812621.
E-mail addresses: f.aneiros@uvigo.es (F. Aneiros), juan.moreira@uam.es (J. Moreira), troncoso@uvigo.es (J.S. Troncoso).

1385-1101/$ – see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.seares.2013.10.005

bottom-up control (Foreman et al., 1995), the influence of competition and other density dependant factors (Buchanan et al., 1986), and even the feeding behaviour of some organisms (Ockelmann and Muus, 1978; Snelgrove and Butman, 1994).

A very useful approach to assess the structure and organisation of benthic assemblages and their relationships with abiotic and anthropogenic factors is to consider the biological traits of the organisms, for example by classifying them into different kinds of functional groups (e.g. Pearson, 2001). On the one hand, the relative importance of each of these groups of organisms is highly influenced by parameters such as near-bottom water flow, sediment grain size, carbonate content or food availability (e.g. Pearson, 2001; Sanders, 1958). On the other hand, the presence and activity of some functional groups strongly affect near-bottom hydrodynamics, sediment stability and redox status, organic matter input to the sediment and its turnover, and nutrient and oxygen exchanges between sediment and water (Pearson, 2001; Posey, 1990; Welsh, 2003); thus conditioning the presence of other functional groups (e.g. Pearson, 2001; Posey, 1990; Rhoads and Young, 1970). Considering the biological traits of the fauna present in an assemblage is therefore likely to provide insight on the reasons behind the changes observed on it (Bremner et al., 2003).

Molluscs usually are among the most important components of the benthic macrofauna in soft bottoms (e.g. Cacabelos et al., 2008a; Laudien et al., 2007) and, in some cases, they may be used as bioindicators of certain environmental aspects (e.g. Amin et al., 2008; Mirsadeghi et al., 2013). Muddy sediments often show a large diversity of molluscs (e.g. Cacabelos et al., 2008b; Holte and Oug, 1996; Laudien et al., 2007), as well as a high numerical dominance by some species, usually bivalves (López-Jamar and Parra, 1997; Moodley et al., 1998; Moreira et al., 2010b). Furthermore, molluscs present a wide range of trophic guilds and life habits (Arruda et al., 2003), from sessile suspension feeders to crawling carnivores, and are known to have very important bioturbatory effects (Welsh, 2003; Widdicombe and Austen, 1999). Therefore, the study of mollusc assemblages in general, and their temporal variation, in particular, is of great interest to improve our understanding of the structure and organisation of soft-bottom benthic communities.

The Galician Rias (NW Iberian Peninsula) are a group of tectonically-formed estuarine-like bays (Méndez and Vilas, 2005; von Richthofen, 1886) located in an area affected by seasonal coastal upwelling, what makes them very productive ecosystems (Figueiras et al., 2002; Fraga, 1981; Varela et al., 2005). They are characterized by a wide variety of both hard and soft substrata, which are home of a great benthic biodiversity (e.g. Cacabelos et al., 2008a; López-Jamar, 1978; López-Jamar and Cal, 1990). As the shoreline of these areas is highly populated, and both fishing and aquaculture (especially mussel culture in rafts) are extensive activities (Figueiras et al., 2002), different anthropogenic impacts are noticeable in the sediment (Alejo and Vilas, 1987; López-Jamar, 1978), which can cause alterations in the structure and organisation of benthic communities (e.g. Abella et al., 1996; Ysebaert et al., 2009).

The rich biodiversity of the rías has been extensively studied in the last decades (e.g. Esquete et al., 2011; Gómez Gesteira and Dauvin, 2005; López-Jamar and Cal, 1990), also including diversity and composition of mollusc assemblages (e.g. Moreira et al., 2005; Olabarria et al., 1998; Troncoso et al., 1993). Despite of that, certain aspects of the structure and functioning of assemblages are still little known, including seasonal variation and, specially, the role that biological traits play on both their organisation and their relationship with abiotic features. Furthermore, the effects that raft polygons for mussel culture have on the surrounding benthic assemblages are incompletely understood, despite some studies addressing the topic in the Galician Rías (Abella et al., 1996; Ysebaert et al., 2009) and elsewhere (e.g. *Ireland*: Chamberlain et al., 2001; *Nova Scotia*: Grant et al., 1995; *southern Brazil*: da Costa and Nalesso, 2006; *South Africa*: Stenton-Dozey et al., 1999).

In this paper we attempt to address some of these issues through a study of the seasonal variation of the mollusc assemblages inhabiting two fine-sediment bottoms in a Galician ría, on the basis of monthly quantitative samplings during a 13-month period. The main objectives of our study were: 1) to test whether faunistic composition of both sites would differ according to sedimentary differences, which we expected to be mostly reflected in abundance of numerically dominant species; 2) to test whether there would be significant temporal changes in total abundance and diversity and whether they would be related to the ones in sediment features, considering both the matrix of taxa and that of taxa grouped in functional groups according to trophic guilds and life habits; 3) to explore the existence of relationships between functional groups, expecting that negative correlations would occur between deposit and suspension-feeders according to the amensalism theory proposed by Rhoads and Young (1970).

2. Materials and methods

2.1. Study area

The selected area was the Ría de Aldán (Fig. 1), a small embayment located SW of the Ría de Pontevedra (42°16′40″–42°20′50″N; 8°49′–8°52′W). It has a length of 7 km by its main axis, which is oriented towards NW, and a maximum width of 3.5 km by its opening to the sea, where it reaches its maximum depth of 45 m. The salinity values of the ría are fully marine because of the great influence of oceanic swell and currents, which are strong enough to reach the inner areas. The bottoms of the ría are mostly sedimentary, ranging from muddy to gravel (Lourido et al., 2006). Aquaculture and fishing activities are plentiful in the area, especially the bivalve culture on rafts which is thought contributing to increase the silt/clay and organic matter content of the sediment, as it happens in nearby rías (Ysebaert et al., 2009). The diversity and spatial distribution of the molluscan fauna are well known for this area (Lourido et al., 2006; Parada, 2004; Rolán, 1983).

Two study sites were selected in the western half of the embayment, which is densely covered by rafts for mussel culture. Both sites have similar depths and are, in general terms, characterized by fine sediments (Table 1); there are, however, differences a priori in mud and organic matter contents.

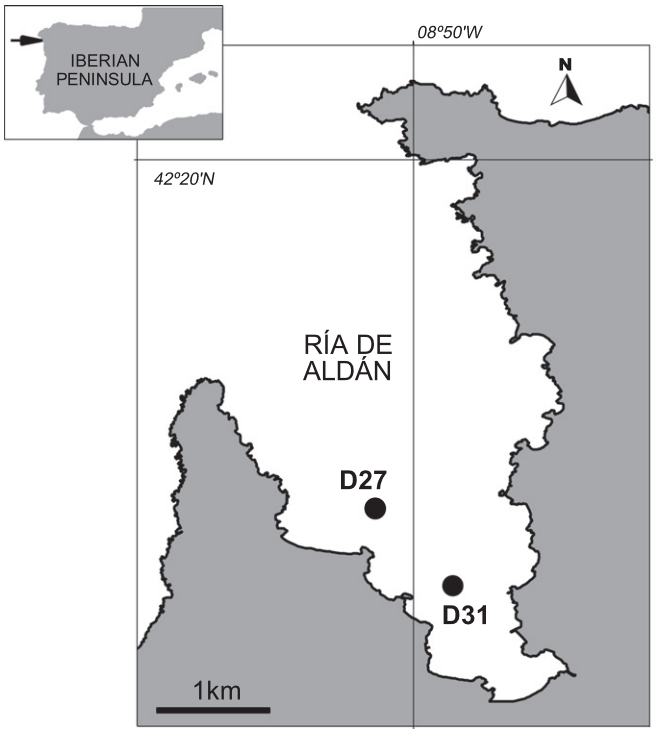

Fig. 1. Location of the Ría de Aldán and the sampling sites.