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Revue de micropaléontologie xxx (2016) xxx–xxx

Revue de
micropaléontologie

Original article

Ostracods and environmental variability in lagoons and deltas along the north-western Mediterranean coast (Gulf of Lions, France and Ebro delta, Spain)

Ostracodes et variabilité environnementale dans les lagunes et deltas du nord-ouest de la Méditerranée (Golfe du Lion, France et delta de l'Ebre, Espagne)

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Abstract

The aim of this paper is to characterize various lagoon and delta environments through the analysis of ostracod fauna. Various aquatic environments from the Mediterranean coastline of the Gulf of Lions (Languedoc-Roussillon, France) and Ebro delta (Catalonia, Spain) were studied. The sample sites (60) are different in terms of marine and fluvial influence. Environmental parameters (salinity, water depth, sedimentary texture, plant cover) were measured and compiled from available data in order to characterize the biotopes. We interpreted the species distribution as related to the degree of isolation from the sea, the hydrological internal currents and the proximity of river mouths. Moreover, the assemblage composition seems influenced by the lagoon vegetation growth. These data can be used for the palaeoenvironmental reconstructions, particularly in Holocene deltaic context where the mobility of river mouths and the forming and evolution of sand bars and lagoons are recurring issues.

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Keywords: Bioindicator; Brackish water; Marginal marine environments; Confinement gradient; River mouths influence

Résumé

L'objectif de ce travail est de caractériser différents environnements lagunaires et deltaïques par leur faune d'ostracodes. Plusieurs milieux aquatiques des côtes basses du Golfe du Lion (Languedoc-Roussillon, France) et du delta de l'Ebre (Catalogne, Espagne) ont été étudiés. Les sites de prélèvement (60) sont variés en termes d'influence marine et fluviale. Les paramètres environnementaux mesurés ou disponibles (salinité, hauteur d'eau, texture des sédiments, recouvrement végétal) ont été utilisés pour caractériser les biotopes. Nous interprétons la répartition des espèces en fonction du degré de fermeture morphologique par rapport à la mer, des circulations hydrologiques internes, et de la proximité des embouchures fluviales. De plus, le développement de la végétation dans les lagunes semble influencer la composition des assemblages. Ces données peuvent être utiles pour reconstituer des milieux anciens, en particulier en contexte deltaïque Holocène, où les questions relatives à la mobilité des embouchures fluviales, à la formation et à l'évolution des barrières littorales et des lagunes, se posent souvent.

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Mots clés : Bioindicateurs ; Eaux saumâtres ; Environnements marins littoraux ; Gradient de confinement ; Influence des embouchures fluviales

1. Introduction

The study of ostracods in coastal environments has been ongoing for quite some time (Carbonel, 1980). Research into present-day ecology shows that the composition, density and

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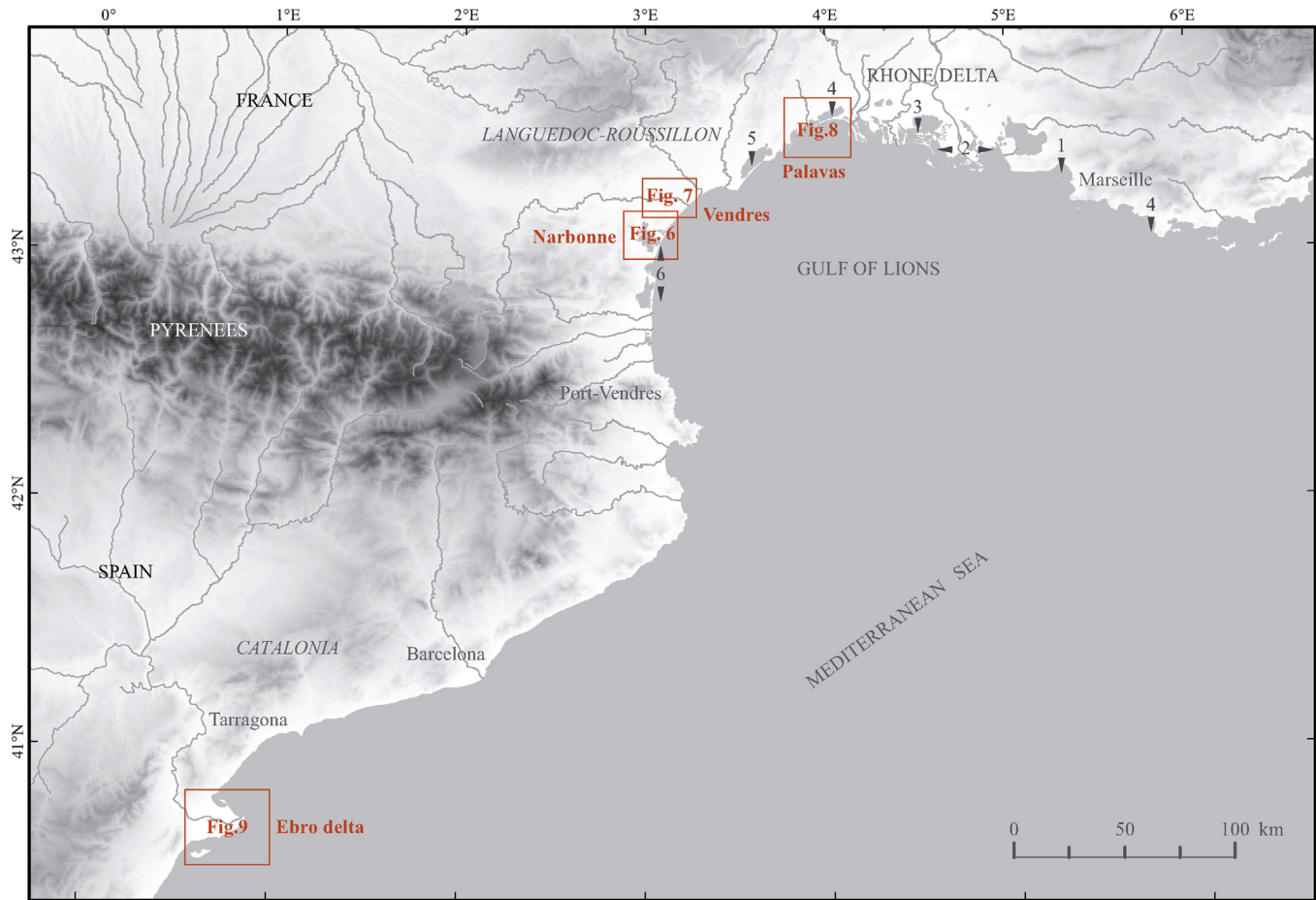


Fig. 1. Location of the study zones and others works concerning recent ostracods (1. Reys, 1961a, 1961b, 1963, 1964, 1965a, 1965b, 2. Kruit, 1955, 3. Steger, 1972, 4. Bodergat, 1983, 5. Hartmann, 1958 et Kurc, 1961, 6. Hartmann, 1953, 1960).

diversity of assemblages are controlled by natural environmental parameters (salinity, temperature, pH, oxygen, hydrodynamic conditions, nature of substratum) and/or linked to anthropogenic pollution (nutrient and heavy metal contents) (Frenzel and Boomer, 2005). More recently, ostracods have been frequently used in coastal geomorphology/geoarchaeology as bioindicators of past hydrologic and geomorphologic conditions (Mazzini et al., 2015).

In the Mediterranean, ecological studies have focused extensively on stenohaline marine environments (bibliography summarized by Lachenal, 1989). A collection of detailed ecological data for brackish water ostracods in northern Europe can be found in Frenzel et al. (2010), but no compilation of this kind of study is available for the Mediterranean area. The need for more ecological data in lagoonal and deltaic environments remains in spite of a growing body of local studies such as the Venice lagoon (Ruiz et al., 1999, 2000b), the Moroccan Nador lagoon (Ruiz et al., 2006a), the Tunisian El Melah lagoon (Ruiz et al., 2006b), and the estuarine brackish environments of the adjacent Atlantic coast in southern Spain (Ruiz et al., 1997, 2000a) and northern Morocco (Nachite et al., 2010).

The aim of this paper is to enhance knowledge of the ostracod ecology in North-western Mediterranean brackish environments by the analysis of a main area located on the coast

of the Gulf of Lions (Languedoc-Roussillon, France; Fig. 1) and an additional area of the Ebro delta (Catalonia, Spain). The resulting database was also conceived as an aid for the reconstruction of late Quaternary coastal environments, especially in our main research area. As such, it aims to characterize the largest possible panel of brackish-water environments. The main French study area is composed of several lagoons, some of them connected to rivers (such as the Aude, Berre, Lez, Vidourle river), while the Spanish site allows us to investigate a deltaic environment. Some lagoons in this general area have been studied (Kruit, 1955; Hartmann, 1953, 1958, 1960; Kurc, 1961; Steger, 1972; Bodergat, 1983) but results are sometimes ambiguous regarding species determinations, and imprecise regarding the environmental characterization of sites.

Lagoon and delta ostracods typically belong to the “coastal brackish-marine” and “continental brackish” ecological groups, according to the four classification groups of Anadon et al. (2002). For example, these are certain species of the *Cyprideis*, *Loxoconcha*, *Leptocythere*, *Xestoleberis* and *Heterocypris* genus. They are euryhaline and eurythermal, tolerating important seasonal salinity and temperature variations. On account of this high tolerance and the lack of references on modern ecology, these ostracods are often used in Holocene coastal

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