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Ancient Forests in European drylands: Holocene palaeoecological record of Mazarrón, south-eastern Spain



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ABSTRACT

This paper presents a new Holocene palaeoecological record from coastal south-eastern Spain, a region characterised by high plant species diversity, varied physiography, high risk of desertification, and a history of human pressure on the landscape that stretches to antiquity. The pollen sequence shows four main vegetation phases: the first characterised by mixed forests of *Pinus* and evergreen *Quercus* accompanied by broad-leaved mesophilous trees, and a diversity of Mediterranean scrub; the second phase is characterised by mesophytic decline and expansion of *Artemisia*; a third, mid-Holocene phase of thermo-mesophytic maxima with prevalence of forested landscapes; and, finally, the progressive opening of the landscape with sparse pines, halo-xerophytic grasslands and sclerophyllous brushwood. The current treeless situation of south-eastern Spain is a relatively recent feature resulting from a dramatic change in the ecological structure of the regional landscapes. This paper stresses the continued vulnerability of these arid systems in the face of a changing climate. This sequence adds to previous palaeobotanical records (pollen and charcoal) and archaeological reports to suggest that deforestation started earlier in low-elevation areas and river basins than in the inland mountains and platforms, a factor that appears in connection to human exploitation of the natural environment.

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1. Introduction

The south-eastern region of the Iberian Peninsula is one of the most arid territories in Europe. At over 13,000 km², the Murciano-Almeriense bioprovince (Peinado and Rivas-Martínez, 1987) is particularly well suited for studies addressing diverse environmental and palaeoecological issues due to its high plant-species diversity, varied physiography with abundance of ecotones, high risk of desertification, and a long history of human pressures on the landscape that stretches back to antiquity. As with other dry lands (Horowitz, 1992; Scott and Woodborne, 2007), palynological developments in this region have only become possible after

overcoming a multiplicity of methodological difficulties (Carrión et al., 2009). Successful pollen analyses have concentrated on adjacent marine sediments (Magri and Parra, 2002; Parra, 1994; Targarona, 1997), peaty deposits in sub-coastal mountains (Anderson et al., 2011; Carrión et al., 2003a, 2007; Manzano et al., 2016, 2017; Ramos-Román et al., 2016), playa lakes (Burjachs et al., 1997; Giralt et al., 1999), valley-bottom fills in badland areas (Dupré et al., 1996; Noguera et al., 2000), and prehistoric sites including cave, rockshelters and open-air settlements (Carrión et al., 1995a, 1999, 2003b, 2013; Davis and Mariscal, 1994; Dupré, 1988; Fierro et al., 2011; Fuentes et al., 2005; López-García, 1988; Munuera, 1992; Munuera and Carrión, 1991) (Fig. 1). Investigations in palaeo-lagoons and coastal marshes are limited to a few studies (Carrión et al., 2010a, 2013; Pantaleón-Cano et al., 2003; Yll et al., 1994).

This paper brings new data from a Late Quaternary basin on the coast of south-eastern Iberia, where organic sediments have

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