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Steppes, savannahs, forests and phytodiversity reservoirs during the Pleistocene in the Iberian Peninsula

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ABSTRACT

A palaeobotanical analysis of the Pleistocene floras and vegetation in the Iberian Peninsula shows the existence of patched landscapes with *Pinus* woodlands, deciduous and mixed forests, parklands (savannah-like), shrublands, steppes and grasslands. Extinctions of Arctotertiary woody taxa are recorded during the Early and Middle Pleistocene, but glacial refugia facilitated the survival of a number of temperate, Mediterranean and Ibero-North African woody angiosperms. The responses of Iberian vegetation to climatic changes during the Pleistocene have been spatially and temporarily complex, including rapid changes of vegetation in parallel to orbital and suborbital variability, and situations of multi-centennial resilience or accommodation to climatic changes. Regional characteristics emerged as soon as for the Middle Pleistocene, if not earlier: Ericaceae in the Atlantic coast indicating wetter climate, thermo-mediterranean elements in the south as currently, and broad-leaf trees in the northeastern. Overall, steppe landscapes and open *Pinus* woodlands prevailed over many continental regions during the cold spells of the Late Pleistocene. The maintenance of a high phytodiversity during the glacials was linked to several refuge zones in the coastal shelves of the Mediterranean and intramountainous valleys. Northern Iberia, especially on coastal areas, was also patched with populations of tree species, and this is not only documented by palaeobotanical data (pollen and charcoal) but also postulated by phylogeographical models.

1. Introduction

Published materials dealing with vegetational landscapes of the Iberian Pleistocene have considerably increased over the last few decades. This involves more studied sites, a broader time span, new long continuous sequences, the filling up of crucial geographic gaps, and a visible effort of bio-correlation. However, our knowledge of the Pleistocene vegetation is still incomplete, and a review of these gaps, together with a summary of the major developments is needed. The goal of this paper is therefore to critically revisit and synthetise the available palaeobotanical information, mainly in the form of pollen and charcoal records, but also plant megafossils and seeds (Fig. 1, Table 1). This information will be presented by periods (Early, Middle and Late Pleistocene) with the aim of illustrating the broad spectrum of vegetation changes in various parts of the Iberian Peninsula, characterised by different climatic influences, as well as the location and composition of glacial refugia for temperate and Mediterranean woody species.

A limitation to produce contending models of vegetation dynamics for the study period is the very small number of long, continuous palaeobotanical sequences available for the Iberian Peninsula. We are still dependent on the information derived from few sites such as Padul (Florschütz et al., 1971; Pons and Reille, 1988), Carihuela (Carrión et al., 1999; Fernández et al., 2007), and the marine ODP 976 site in the south (Combourieu-Nebout et al., 1999), and Area Longa in the north (Gómez-Orellana et al., 2007). To correlate these data with the number of fragmentary pollen sequences is challenging. At a first sight, regardless of the patchiness of the physical context, the general patterns of the Pleistocene European vegetation history are shared in the Iberian scene. However, there are peculiarities, especially related with the floristic composition and the spatial pathway of permanence of thermophilous floras during cold-arid periods. These patterns will be a topic of particular attention in this paper.

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