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Transformation and human use of forests in the Western Pyrenees during the Holocene based on archaeological wood charcoal

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ABSTRACT

In this paper, we present a synthetic view of the results of anthracological studies in the Western Pyrenean Region during the Holocene. With this aim, we have compiled the results of wood charcoal analyses from archaeological sites taking into account that this region can be divided into several biogeographic areas. Firstly, we present the Aizpea archaeological site in the Pyrenees. Secondly, the deposits of Pico Ramos, Kobeaga II and El Mirón in the Coastal Area are described. Moving to the central part, into the Transition area, we describe the data of Mendandia as the main representative site, although the nearby sites of Atxoste, Kampanoste, and Kanpanoste Goikoa are also mentioned. Finally, for the southern sector of the Ebro Valley, we explain the archaeological sites of Peña Parda and Peña Larga. In addition, some specific issues that have been observed in some plant species found in this environment are also addressed. The main results show the use of different types of wood located near the archaeological sites and, in some particular cases, the selection of one of them.

1. Introduction

Archaeobotanical studies represent nowadays a significant contribution to the research carried out on archaeological sites. From this perspective, the study of wood remains recovered from many archaeological deposits provides useful details about the knowledge of past societies in general, and about the forest management in particular.

Every prehistoric habitation site occupied in the Holocene must have burnt large amounts of firewood in the course of everyday activities (to cook food, to work with raw materials in craft activities, to provide light and heat, and so on). The charcoal found at the sites is normally a sub-product of the combustion of firewood for these purposes. It is precisely because firewood is burnt that it is preserved and so many remains are recovered in the deposits (Piqué, 1999).

Consequently, the charcoal may be the result of many episodes of combustion and may reflect, at least to a certain extent, the composition of the woodland in the surrounding of the sites (Chabal, 1988). The ecological representativeness of the charcoal is an issue debated in archaeobotany, as the wood may have been specifically chosen by the users and therefore may have been subject to a strong selection. However, this is also an advantage for archaeologists because it means that the way in which humans exploited woodland resources in their surroundings can be assessed. In any case, notwithstanding human selection of wood, charcoal is a very reliable indicator of the presence of certain forest communities in the immediate surroundings of the sites (Chabal, 1988; Smart and Hoffman, 1988; Vernet, 1991; Badal, 1992; Shackleton and Prins, 1992; Pique, 1999; Ntinou, 2002; Badal et al., 2003; Carrión, 2005; Théry-Parisot et al., 2010 among others).

Anthracological studies enjoy a long history, which began in the late nineteenth century. However, the systematic application of this analytical technique at archaeological sites did not occur until the 1970s, with the research of J. L. Vernet and his group at the University of Montpellier (Vernet, 1973, 1976). In the Western Pyrenees, anthracology has been applied relatively recently (Uzquiano, 1992; Zapata, 2002). A laboratory has been operating in the University of the Basque Country since 1995. The laboratory is involved in advising, taking samples and analysing botanical materials from numerous projects inside and outside the Western Pyrenean region. Since the Archaeobotanical Laboratory was founded, it has carried out studies on different periods from the Lower Palaeolithic to the Middle Ages. Some of the most important research lines have

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been related to the vegetation history of the Upper Pleistocene and Holocene, the origin and development of agriculture in the Basque Country and the anthropisation of the environment (Zapata, 2002; Zapata et al., 2004; Iriarte et al., 2007–2008; Pérez-Díaz et al., 2010; Ruiz-Alonso et al., 2011, 2012, 2013; Ruiz-Alonso, 2014 among others).

In this paper we evaluate the forest management in the Western Pyrenean Region during the Holocene through the study of wood remains recovered from the most significant archaeological sites in the area. In addition, we focus our attention on the evolution of some interesting tree species that develop in this region.

2. Geographical setting

The particular geographical area in which this paper is framed, the Western Pyrenees, is located in the eastern end of the Cantabrian coast of the Iberian Peninsula. This region is bordered on the north by the Cantabrian Sea, on the east by the Pyrenees, on the west by the Cantabrian Range and on the south by the Ebro Valley (Fig. 1). It is not a very large area but rugged, with a great climatic and orographic variety. The geographical structure of the territory is characterized by the highest mountains in the central part of its territory, consisting of a series of mountain ranges in parallel to the coast (east–west), conforming between them several variable amplitude valleys (Ugalde, 1981; Loidi, 1987; Meaza, 1994; González and Serrano, 1995). These chains are important barriers which limits the spread of the Atlantic and Mediterranean climatic influences (Urrestarazu, 1985). Therefore, the Western Pyrenees do not form a homogeneous climatic region. Thus, we can distinguish clearly several climatic zones: the Atlantic area, the Pyrenees, the Transition zone and the Mediterranean climate region (Ugalde, 1981; Ollero et al., 1996).

The Atlantic area is a very rugged region, bordered on the south by the Septentrional Mountains. The climatic conditions are mild, both in temperature and precipitation. They are various domains of vegetation in this area, but the forests of pedunculate oaks (*Quercus robur* L.) are the most frequent, along with shrubs and herbaceous formations that have common features (Aseginolaza et al., 1996; Meaza, 1997).

The Pyrenees is a large mountain range that is located northeast of the Iberian Peninsula. They are a climatic barrier between southern France and northern Spain. The climate there is generally cold and wet in winter, with high temperatures in summer. It has large well-preserved forest masses with Scots pine (*Pinus sylvestris* L), pedunculate oak and beech (*Fagus sylvatica* L).

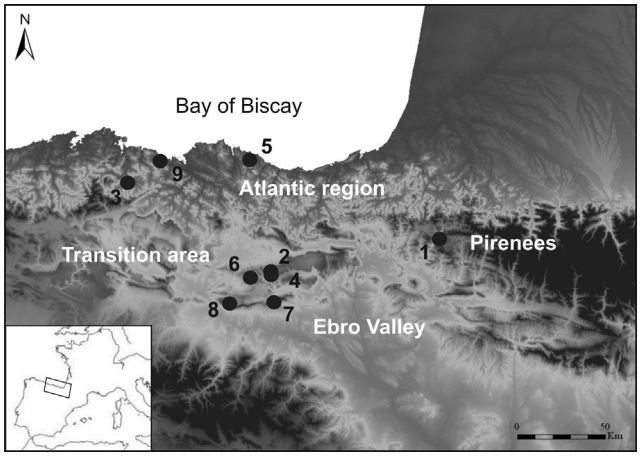

Fig. 1. Geographical location of the study area and location of the deposits mentioned in the text.

The Transition zone has a mild relief with extensive plains and hills. This area displays characteristics of both Atlantic and Mediterranean environments, hence it is presented as a transition zone between the oceanic and the Mediterranean climate conditions. The most frequent forests are formed by pedunculate oak (*Q. robur* L.), Pyrenean oak (*Quercus pyrenaica* Willd) and Portuguese oak (*Quercus faginea* Lam.), with Scots pine and beech forests in the hills (Aseginolaza et al., 1996; Meaza, 1997).

The Ebro valley (Mediterranean area) is the southernmost area of the Western Pyrenees. It is a narrow strip of land that is characterized by a smooth relief (Aseginolaza et al., 1996; González et al., 1998). The temperatures are cold, with low annual rainfall. Due to the climate of the area, this region is currently dominated by the cultivation of olive trees (*Olea europaea* L.) and vines (*Vitis vinifera*), leaving natural forests reduced to a minimum. Potentially, in the plains and hills the dominant tree was the holm oak (*Quercus rotundifolia* Lam.), whereas in the escarpments could be the Aleppo pine (*Pinus halepensis* Mill.) (Aseginolaza et al., 1996).

3. Materials and methods

Here we focus our attention on anthracological remains. In southern Europe, the most usual form of conservation of botanical macro-remains is charring. In fact, the fragments of wood charcoal are some of the commonest remains recovered in most excavations. Charcoal is the result of an incomplete combustion, because if it had been completed, the final result would be ashes. In the combustion process the organic components of the ligneous tissue are converted into a carbon-rich material that is resistant to decomposition and is practically unaffected by external agents (Chabal et al., 1999).

In addition to carbonisation, other exceptional conditions may enable the conservation of wood for thousands of years, for example a) anaerobic environments. These are waterlogged conditions, without oxygen, with very limited micro-organism action; b) impression of plant remains in pottery, clay, etc.; c) mineralisation processes where some parts of the plant are replaced by mineral covering; and d) freezing or desiccation processes. In general, these conditions are rare in the region we are dealing with and therefore this study concentrates on remains of charcoal (Zapata and Peña-Chocarro, 2013).

In all the archaeological sites presented here we have sampled and used the recovery strategies most appropriate for each site. The charcoal was recovered by screening of dry sediment or by wet sieving. This is a comprehensive recovery system as not only bio-archaeological remains are obtained but also all the archaeological material contained within the sediment (Zapata and Peña-Chocarro, 2013). Once the pieces of charcoal have been obtained, those over 2–4 mm in size are identified. This is done with an incident light microscope by examining the anatomy of the ligneous tissue in three cross-sections – transversal, longitudinal radial and longitudinal tangential. Several atlases and reference collections are used to compare and identify the fragments (Schweingruber, 1978, 1990; Hather, 2000; Vernet et al., 2001; García-Esteban, 2002 among others).

In this paper we have taken into account anthracological studies from archaeological sites of special interest that demonstrate the general dynamic in the areas of study. They show wide crono-cultural sequences, supported by many radiocarbon dates and they hold good representation of wood fragments (Fig. 1) (Table 1). However, the results do not form a homogeneous set because we have sites with lots of remains and others with less representation. For all of them, we have taken into account different interpretative approaches with the aim of improving our knowledge about the use of forests during Prehistory.