EPHEMERAL ARCHAEOLOGY SOUTH OF THE CENTRAL PYRENEES: AN ASSEMBLAGE OF WOODY PLANT-BASED MATERIALS FROM CUEVA DEL MORO DE ALINS (HUESCA, NE IBERIA).

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Abstract

Plant-based materials in archaeological contexts are exceptional finds. Although forest resources would have constituted a basic raw material for the economy of past societies, our knowledge of their use is limited by their perishability, and the conservation problems that make them almost entirely invisible in the archaeological record. In the Iberian Peninsula, the evidence of plant resource consumption is limited to a few contexts with exceptional conditions of preservation, such as the extreme dryness that occurs in some caves or shelters in the central Ebro basin. This region is emerging in recent years as a highly important locality for the archaeology of "short-lived materials" or Ephemeral Archaeology. This work presents the results of taxonomic, typological and technical studies, including previously unpublished work, regarding the assemblage of wooden objects and basketry from the Cueva del Moro de Alins (NE Iberia) burial cave, including direct radiocarbon dating. Radiocarbon dating has been vital for the contextualisation of the entire assemblage, which was illegally despoiled in the early 90s, and contains three well-differentiated moments of occupation: Neolithic, Bronze Age and Late Antiquity.

1. INTRODUCTION

Non-charred plant finds are surprising in archaeological contexts. However, specific anoxic conditions such as waterlogging or extreme aridity sometimes allow the exceptional preservation of these biodegradable raw materials in Mediterranean environments. The scant amount of plant-based artefacts recovered in archaeological contexts further complicates their interpretation due to the lack of references for typological classification, in addition to the difficulty in assessing their role in material

culture (Hurcombe, 2014). In recent years the central Ebro basin (NE Iberian Peninsula) has emerged as an important region for the recovery of plant-based materials in both historical and prehistoric contexts, more specifically certain cave localities within this region (Alcolea, 2018; Domingo et al., e.p.). The current study presents the results of taxonomic, typological and technical studies of the woody plant-based materials from Cueva del Moro de Alins (Huesca), as well as their direct radiocarbon dates, which have been key in the contextualisation of the entire archaeological assemblage.

The unexpected discovery in Cueva del Moro de Alins of an assemblage of woody plant-based materials originating from Bronze age to Late Antiquity demonstrates the use of wood as a raw material for personal and domestic objects and furniture in the central Pyrenees over time.

Plant-based materials (wooden objects, fragments and basketry fragments) have been key in the interpretation of this assemblage not only because of their uniqueness, but also because they permit direct radiocarbon dating, which has contributed to the sequencing of the different human occupations of the cave that otherwise lack a well-defined archaeological sequence. This has also confirmed the contemporaneity of these plant-based remains to the other archaeological materials from this site (pottery, lithic and metallic objects and a large amount of human remains) (Rodanés, 2017).

2. ARCHAEOLOGICAL AND GEOGRAPHICAL FRAMEWORK

2.1. Location and site description

Cueva del Moro de Alins (UTM 277759E 4654896N) is located on the southern slope of a tributary valley of the Barranco de las Carboneras cliff, near the municipality of Alins del Monte (Huesca, Spain). It forms part of the Sierra de la Carrodilla southern slope, a limestone mountain range that marks the beginning of the Aragonese Pre-Pyrenees at its boundary with the Ebro depression. This range presents a complex topography through the presence of faults and small folds, the highest points being Buñero (1109 masl) and San Quílez (1084 masl) (Figure 1). This strategic location, between the valley lowland and the Pyrenean Mountains, provides a plethora of contexts and palaeoeconomic resources.

The access to the cave is a narrow horizontal gallery facing northeast, about 700 meters above sea level. Access to the cave is extremely challenging; many areas of the cave can only currently be accessed through the use of speleology equipment. The gallery opens between irregularly shaped limestone blocks that lead to a long passage, at the end of which is a trapezoidal room with a vertical well 15 m deep and less than half a meter wide at the top (Figure 1). The lower level of the cave is formed by another horizontal gallery. The geomorphological characteristics of the cave complex strongly suggest that the inhabitability of the space would have probably restricted the types of past human activities to those of a mainly sepulchral nature, in addition to providing the conditions for the exceptional conservation of perishable materials.

2.2. Biogeographical framework

This area is currently characterised by a continental Mediterranean climate with long, dry summers, an average annual temperature between 12 and 14 ºC, and 500 mm of annual precipitation. The vegetation is characteristic of the transitional zone between the meso-Mediterranean and sub-Mediterranean biogeographic belts (Rivas Martínez, 1982).

Present-day flora is influenced by the altitudinal gradient, orography, calcareous lithology and the high levels of anthropic impact. Vegetation surrounding the cave is mainly composed of holm oak (*Quercus rotundifolia, Quercus coccifera*) (Braun-Blanquet y Bolos, 1987), as well as green olive (*Phillyrea latifolia, Phillyrea angustifolia*), terebinth (*Pistacia terebinthus*), wayfarer (*Viburnum lantana*), snowy mespilus (*Amelanchier ovalis*) and phoenicean juniper (*Juniperus phoenicea*). These sclerophyllous plant communities create the typical Pyrenean oak forest (*Quercus faginea, Quercus cerrioides*) that also includes boxwood (*Buxus sempervirens*) in higher altitudes, shaded zones and ravines (Fernández Palacio, 2008). There are also extensive plantationsof Aleppo pine (*Pinus halepenesis*) in this region, which is a native meso-Mediterranean species that has been re-introduced for wood production (Chevalier, 1995). The flora that makes up the undergrowth is extremely varied. *Ceterach officinarum* and *Chaenorium origanifolium* stand out in sunny spots, while shaded areas are dominated by *Ramonda miconi, Umbilicus rupestris* or *Polypodium cambicum* (Fernández Palacio, 2008).

2.3. Historical and archaeological context

This region has been populated since Prehistory. Although the first evidence of human settlement in the region dates to the Palaeolithic (Rovira et al., 1991; Montes and Utrilla, 2014), occupation intensified during the Neolithic when cave occupations became common, either as intensive and persistent habitations as is the case of Cueva de Chaves (Baldellou, 2011, Rodanés y Picazo, 2005) or as exceptional occupations in otherwise inhabitable cavities, indicative of funerary functions, such as Cueva de los Moros de Gabasa (Laborda and Gisbert, 2016) or Cueva del Moro de Olvena (Rodanés et al., 2016) (Figure 2). Occupations in caves then gave way to the characteristic small open-air settlements of the Late Neolithic and Chalcolithic (Gallart et al., 2017).

During the transition to the Bronze Age, changes occurred in the palaeoeconomic model, and there was an acceleration in the processes that precipitate greater social complexity (Rodanés, 1992). A greater number of identified archaeological sites originate from the Bronze Age than from previous periods. A novel feature of this period is the prevalence of open-air settlements located on plains and gentle slopes, occasionally occupying natural rock shelters, and occupying places close to permanent or seasonal water courses (rivers or seasonal torrents in ravines) where the land is suitable for agricultural practices and there is pasture for livestock feeding (Gallart et al., 2017, 32-42). During this period burial caves become very common in the Spanish Pre-Pyrenees, many being used

repeatedly, and possibly replacing the megalithic phenomenon that predominates in other Pre-Pyrenean areas (Rodanés, 1999). Prominent examples of such sites include Drolica, Los Cristales (Montes and Martíez Bea, 2006), San Juan de Loarre (Pastor y Vicente, 2009), Paco Pons (Montes et al., 2016) and Cueva de los Moros de Gabasa (Figure 2). At the end of this period during the Late and Final Bronze Age, coinciding with the appearance of the Urnfield culture, significant changes occur in the material culture. Populations then became concentrated in larger communities during the Iron Age, resulting in a lower number of archaeological sites recovered from this period (Rodanés and Picazo, 2018).

The changes in human settlement patterns are notable during the Roman period. An important portion of the population became concentrated in urban centres such as *Osca*, *Labitolosa* or *Barbotum*, which maintained control and imposed a hierarchy over their *territorium* (Navarro et al., 2000; Magallón and Sillières, 2013). Rural settlements were organised into farms and *villae* (Chasseigne, 2002) that supplied the urban centers (Figure 2). However, evidence of human activity with a funerary function in Pyrenean and Pre-Pyrenean caves or rock shelters remains common during the Roman occupation. Examples include Cueva de los Moros de Gabasa and Cueva del Moro de Olvena (Utrilla and Baldellou, 1996), Els Trocs (Rojo et al., 2012) and Cova Colomera (Oms et al., 2008). During the Late Antiquity (4^{th} and 5^{th} centuries), a period of social instability in this region (Diarte-Blasco, 2016), the caves were primarily used as refuges, for hiding treasure, or for pastoral uses (Utrilla et al., 2014), largely replacing the funerary function (Domingo et al., e.p.).

2.4. History of the archaeological assemblage

This study presents the results of the analysis of the woody plant-based materials from an archaeological assemblage that has been stored in the Museum of Huesca since 1992, originating from the despoiling of Cueva del Moro de Alins. The illegal removal of this material and the resulting destruction of the stratigraphic contexts occurred at an unknown date before the summer of 1992. The archaeological assemblage is composed of ceramic, lithic and metallic materials as well as a large amount of human remains. The woody plant-based materials are the subject of this paper. The existence of an archaeological site inside this cavity was verified and communicated to the local authorities by a group of archaeologists lead by J.M. Rodanés in 1991. The circumstances of the discovery and its stratigraphic de-contextualisation has led to a considerable delay in the study of this assemblage, and has represented a consequential handicap in its interpretation.

In 2015 the study of the various material types that compose the archaeological assemblage was undertaken by different specialists. The case of the woody plant-based materials (basketry and wooden objects) was particularly controversial. Until very recently considerable doubt existed regarding the origin and the age of these materials. Given i) their exceptional state of conservation, ii) the limited evolution of the artisanal technological processes in the production of these types of objects between Prehistory

and the present day, and iii) the lack of typological references due to their infrequent preservation in archaeological contexts, meant that for years these objects were considered to be modern, possibly attributed to the Maquis resistance movement in the Spanish Pyrenees. Therefore, the first step in their analysis was the direct radiocarbon dating of several objects, which confirmed their origins as dating from Prehistory and from the Classical period. The cave where these objects were discovered was revisited with the logistical support of the Centre of Speleology of Aragon in order to describe the topography of the cave and to characterise its biogeographic environment.

2.5. Phases of occupation

The radiocarbon dates, six from woody plant-based materials and three from the abundant anthropological remains recovered from the cavity (Table 1, Figure 3), in combination with the entire material assemblage recovered from the site, has allowed us to reconstruct the extensive sequence of human activity in the cave, in which three different phases can be clearly distinguished that correspond with settlement patterns described by other archaeological studies in the region. The various identified functions of Cueva de los Moros de Alins have undoubtedly been strongly influenced by the cave's inhabitability. The identified phases are:

i) Neolithic: although we lack radiocarbon dates for this period, some of the materials recovered such as decorated pottery fragments, variscite beads and what are probably polished stone tools suggest that the first human activity at this site was during the Neolithic. Funerary use of such cavities was common during the Neolithic (Rodanés and Picazo, 2005; Ramón, 2006; Rodanés 2007).

ii) Bronze Age: this occupation is the most thoroughly documented at Cueva del Moro de Alins due to eight radiocarbon dates obtained from wooden objects, basketry and human bone remains. Although the radiocarbon dates of the human bones are restricted to a narrow range of time around 3800 cal BP (Table 1, Figure 3), those from woody plant-based materials indicate a broader timespan across almost four centuries, suggesting a prolonged funerary use of the cave during the Bronze Age. Other materials that probably belong to this phase based on their typology are pottery, bone arrowheads or flint blades with a cereal patina, and several metal objects such as a rivet dagger, flat axe, arrowhead and a needle. Burial caves were also very common in the Spanish Pre-Pyrenees during this period (Rodanés et al., 2016).

iii) Finally, a number of the archaeological artefacts made of metal, glass and wood are assigned to historical periods (Rodanés and Aranda, 2015; Rodanés et al., 2015). Direct radiocarbon dating of a wood fragment places this activity during the Late Antiquity (Table 1, Figure 3) instead of the early Roman Empire, as was initially proposed (Rodanés and Aranda, 2015). In Cueva del Moro de Alins, since there are no historical radiocarbon dates from human remains, we maintain the hypothesis that the cave would not

necessarily have been used as a burial site during this period, but as a cache (Rodanés, 2017).

3. MATERIAL AND METHOD

The assemblage of woody plant-based materials presented in this paper is composed of 29 elements: 11 recognizable wooden objects or fragments, 10 unidentified fragments of worked wood, 7 basketry fragments and 1 knot made from a hazel switch (Table 2).

The first stage of the analysis was the direct AMS radiocarbon dating of some of these artefacts (Table 1 and 2). Taking destructive samples for radiocarbon dating presented some problems because of the high museographic value of the objects. The samples were always taken on less visible sections or on existing breakages, with the objective of avoiding compromising the physical integrity of the objects. It was important to develop the sampling processes for radiocarbon dating and for the techno-typological study in parallel in order to avoid damaging the object, while simultaneously selecting the parts of the wood that were the most suitable for dating. The latter includes narrow branches or the outer rings of large trunks in order to minimize the influence of the "old wood effect" as much as possible.

During the macroscopical analysis, each object was photographed, drawn and measured. When possible, the portions of the plants supplying the raw material were identified, as well as some aspects of the manufacturing process, the typological classification and the possible function of the object. Broken and/or burned parts have been also documented and reconstructed when possible.

In respect to taxonomic analysis (the identification of the plant species used as the raw material), the methodology has consisted of the manual extraction of semi-thin sections with a blade on less visible parts or on existing breakages. Due to the aforementioned important museographic value of some of these objects, the use of a microtome was avoided. The sample slices were then moistened with a solution of water and glycerine and placed on a slide.

The observation of the cellular wood structure was made with a double light microscope (optical and dark-field functions), Leica DM2700M, through which different ocular lens allow between x100 and x1000 magnification factors. The images accompanying this text have been taken using the digital camera Leica MC190 HD coupled to the microscope and the software Image Builder XYZ from the Leica Application Suite (LAS) (Figure 4). The taxonomic identification is based on the comparison of the observed elements with different atlases specialised in the anatomy of wood (Schweingruber, 1990; García Esteban et al., 2003) and slice samples from present-day wood. Nomenclature follows the guidelines in *Flora europaea* (Tutin et al., 1964).

The remains of pigments in some of the basketry fragments have been analysed by X-ray fluorescence (XRF) using an INNOV-X Alpha equipped with an X-ray tube and silver anode, in working conditions: 35kW, 2 mA, with the aim of verifying the presence of iron

oxides as the source of a reddish coloration. Photographs of the basketry fragments were digitally treated using the specific software DStretch for imageJ in order to determine the extent and design of these pigments.

4. RESULTS AND DISCUSSION

Among the 29 woody plant-based materials studied in this paper, 28 of them presents traces of being worked. They can be separated into several categories: recognizable wooden artefacts or fragments (11), unidentified fragments of worked wood (10), basketry fragments (7) and a knot (1). Despite the fragmentation and decay of the woody plant-based materials, some utilitarian objects can be recognised. The typology of these objects is related to the function of the site in each occupation phase documented.

4.1. Basketry fragments

Basketry refers to artefacts made out of vegetable fibres of a limited length. All plant parts may be commonly used materials, from leaves or herbaceous stems to tree bark or roots. The seven basketry fragments recovered in this site are made of the same materials using the same technique and have corresponding dimensions, so they are probably different parts of a single object (Table 2).

All fragments are made of the same types of materials, however within the fragments the different structural components are made of different species. The fragments comprise two sets of elements, consisting of interwoven strands (Adovasio, 1978; Wendrich, 1991). Passive elements, which form the basket's structure without a connective function, are made from unidentified monocot stems. Active elements, that wrap around the monocot stems, are made from willow fibres (*Salix* sp.). The willow material, although deformed, preserves the main diagnostic anatomical characteristics of the secondary xylem, observed during the microscopic analysis (Figure 4).

In respect to technique, the coiled baskets can be described as moving clockwise or counterclockwise as they work their way outwards from the centre. While the active element is a vertical stitch, the passive element is a bundle of separate, and probably shorter, fibres (Harvey, 1986). The stitches wrap around the horizontally oriented foundation as it spirals outward and upward, holding the working end against the previous row, forming a V-shaped design (Leroi-Gourham, 1943; Alfaro, 1984). These elements create the basket's form and structure.

Regarding the morphology of the conserved fragments, six of them are flat and one is rounded (Figure 5). All flat fragments are composed of several rows (Table 1). Our interpretation is that this is a single object, formed by the six wall or border fragments. The rounded element (11084) is probably also related, being part of a kind of cover or base, although we cannot disregard the possibility that it was an independent element, such as a rug or a lathe.

We suggest as a hypothesis that on certain parts of this object, which is presumably a basket, that there were some simple decorative motifs in red pigment. The presence of a

pigment composed of iron oxides amongst the woody willow fibres has been confirmed by X-ray fluorescence (XRF) analysis. Although the digital treatment of the images (DStretch for ImageJ) supports the presence of this decoration, we are unable to determine either its extent or design.

The oldest examples of basketry and cordage in the Iberian Peninsula come from the Neolithic deposits of Los Murciélagos de Albuñol (Granada) (Alfaro, 1980) and La Draga (Gerona) (Piqué et al., 2018; Romero-Brugués et al., 2018). A greater number of examples of these types of objects have been recovered from later archaeological periods. In the Iberian penisula notable examples include Cueva Sagrada (Lorca) (Ayala, 1987) and Terlinques (Villena, Alicante) (Jover et al., 2001), as well as various Bronze Ages sites in the Iberian SE such as Cabezo Redondo, Castellón Alto, Cerro de El Cuchillo, and La Ceñuela (Jover and López Padilla, 2013). Other important European finds include those from the stilt-house settlements typical to Central Europe, such as those located around Neuchatel (Robenhausen, Niederwil, Murtensee, Wauwilermoos and St. Aubin), Egolzwit Lu, Auvernier, and Fiavé in northern Italy (Alfaro, 1980; Cacho et al., 1996; Ramseyer, 2000; Perini, 1987); also, Chalain-Clairvaux (Masurel, 1985), and Charavines (Isère), the latter including possible remains of pigments (Bocquet, 1994, 57, 76-81). As a technology, coiled baskets seems to be common in European prehistory. In respect to the raw materials, herbaceous plants such as flax (*Linum usitatissimum* L.) and esparto (*Stipa tenacssima* L.) appear to be dominant, while examples of woody plants, such as the case of Cueva del Moro de Alins, are much more rare (Médard, 2008).

The "knot" (11077), made of a twisted switch of common hazel (*Corylus avellana*), is an element that is difficult to classify (Figure 7). Hazel typically grows as a shrub, common in many European woodlands, reaching 3–8 m tall. Hazel wood is a traditional material used for basketry, fabrics and cordage, among other uses. It was traditionally grown as a coppice, so that regenerating shoots may be harvested every few years, narrow and large poles being used for different purposes.

4.2. Wooden objects and Unidentified fragments

Probably the most exceptional and recognizable wooden object recovered at the site is a little comb (11074) made of boxwood (*Buxus sempervirens*). The comb has a rectangular body with a straight base with two parallel and holes 10 mm in diameter, and a quadrangular section with rounded edges. A single row of thin teeth takes up more than half of its length (Figure 6). Although it is not intact (the row of teeth being the most affected area by breakages), it is very well-preserved. The direct radiocarbon date of 3550 ± 30 BP places this object within a Bronze Age funerary context (Table 1). Combs are common, particularly in association with this type of archaeological context in the Iberian Peninsula and the Balearic Island, where the examples are numerous: Càrritx (Lull et al., 1999), Menut (Veny 1982, 369), Can Martorellet (Pons Homar, 1999), Son Maimó (Picornell, 2012) or Son Ferragut (Buxó and Piqué, 2008), among others. Nevertheless the interpretation of this object remains problematic. Its function may have been related

to textile activities or personal hygiene, while other authors suggest that it has a symbolic meaning and a ritual function.

An important category of objects in this assemblage includes various fragments of polypode (multi-footed) plates or trays. The most complete of these fragments (10101) is another one of the most outstanding objects of this assemblage. It consists of a plano-convex section, but the original shape of the complete object cannot be determined as the edges of the fragment suffer from fire damage. There are four well-preserved cone-shaped supporting feet that have a circular cross-section and a small base (12 - 14 mm diameter). The surface of the feet are polished, but distinctive faceted work marks may be observed on the rest of the object. It is made of Scots pine type wood (*Pinus* tp. *sylvestris*). Direct radiocarbon dating (3600±30 BP) indicates that this object also belongs to the Bronze Age funerary context (Table 1). Another large polypode container may be reconstructed from two fragments, included in the collection of fragments that lack an identified context (s/n 1-2). In this case, only one oval, cylindrical foot 59 mm wide and 29 mm high is preserved. The species identification of both wooden fragments as oak (*Quercus* deciduous) suggest that they originally come from the same artefact. There are two other fragments that are also interpreted as the feet of containers. One of them is quite similar to the object described above (10101) and manufactured from the same wood (11415.2). The other (11415.1), whose origin is less easy to interpret, is made of ash wood (*Fraxinus* sp.).

Containers form a typical category of artefacts present in the types of archaeological sites where plant-based material may be preserved. They are present in both domestic and funerary contexts, and the containers documented in the Mediterranean display a variety of different types and sizes. In some cases these objects emulate the shapes of pottery. The manufacturing process is simple, and similar in all cases, consisting of interior carving and external and internal polishing. Cueva del Moro de Alins containers and fragments would have had a funerary function associated with the multiple burials from the Bronze Age. Examples of containers exist in many Iberian sites (Maluquer, 1954, 12; Veny, 1982; Ayala, 1987, 16; Lull et al., 1999, 339-346; Piqué, 1999, 506-507), however none of these objects display any notable similarities to those from Cueva del Moro. Similar types of containers exist in more distant localities in Northern Italy from the palafitic cultures during the Middle Bronze Age, in particular the trays from Fiavé (Perini 1987, 288 and 289, Fig. 119 and 120, Lam 41 and 181). The most notable has a slightly concave surface which is supported by two wide parallel feet, although the woodwork may be unfinished and intended design may have been four separate legs. It is a unique specimen that has no parallels in similar subalpine cultural localities, and is reminiscent of the oldest European ceramic types of the GBK group.

The spindle-shaped object (11076) made of ash wood (*Fraxinus* sp.), which despite a breakage and some fire marks is mostly complete, is enigmatic in terms of its typology and function. This elongated instrument has a clearly wider in the central part, and two rectangular perforations; one in the centre in the wider area, and the other, broken, at the edge. It is perfectly polished and does not retain any appreciable indications of the method

of manufacture (Figure 6). In the inventory of the Huesca Museum it is classified as a handle. It is difficult to determine its function and, consequently, to find similar specimens. Spindle-shaped objects with rectangular or square perforations are found in the palafito of Fiavé, the so-called *Spolette* (Perini 1987, 332-333, fig. 159). The main difference between these and the Cueva del Moro artefact is that the latter does not show use-wear traces, while the Italian examples present clear traces of contact between textile elements and the wood. The most plausible hypothesis is that this object is part of a composite tool into which other pieces of wood (or other materials) could be inserted, perhaps used for the treatment of textile or vegetable fibres. None of the other remains from the cave match the holes.

There are also objects recovered from the cave that have no function or category assigned to them. In this archaeological assemblage from Cueva del Moro there are different categories of unclassified objects; in several cases the finds may be utilitarian objects that were broken or burned, or that have deteriorated. In other cases these may be unfinished objects, parts of a larger object constructed from several pieces, or simply carving chips. Some of these objects could be related to funerary culture, as deposits of this type in the Peninsula and the Balearic Islands often contain wooden stretchers or the remains of coffins (Picornell et al., 2008; Picornell, 2012; Romero-Brugués et al., 2018).

The final hypothesis in respect to this assemblage is related to plant-based materials from the Late Antiquity. The only radiocarbon date for this period (1690 ± 30 BP) comes from a fragment initially classified as an unidentified fragment without context (s/n 3). A detailed study of the unidentified fragments that lack context led us to connect this fragment with two others (s/n 4 and s/n 5), reconstructing what is possibly a broken and incomplete handle from the three fragments. This reconstructed artefact was made of Aleppo pine wood (*Pinus halepensis*), as were four other objects in this assemblage: a cramp (11075), two wooden planks (11091-11092) and a carving chip (s/n 7). The "cramp" (11075) consists of a small oval fragment of wood with a bronze clip (Figure 7). The metal sample was analysed by X-ray fluorescence spectrometer (INNOV-X Alpha) in addition to a total of 22 bronze and iron metal objects from the deposit (Rodanés et al., 2016). Some of these objects consisted of alloys and compositions that belong to the Roman period, and would have been the durable parts of larger elements that were made mainly of perishable materials. All of these findings lead us to cautiously suggest the possible presence of a wooden chest in the cave during Late Antiquity, of which only some parts have been preserved. There exist some similar finds in the Ebro basin (NE Iberia), such as the *Arca ferrata* (Tarazona, Zaragoza) (Beltrán, 2004, 143), and the chest from Calahorra, (La Rioja) (Tudanca and López de Calle, 2000, 53). The exceptional conditions that permit the conservation of plant-based materials outside caves are almost exclusively restricted to waterlogged wells (Carrión & Rosser, 2010; Fernández Ochoa et al., 2015; Piqué et al., 2016; Costa-Vaz et al., 2016).

4.3.Woody plant resources as a raw material

Of all the archaeological remains recovered in the Cueva del Moro those made of plant-based raw materials are undoubtedly the most striking for their exceptional preservation, given the usual tendency for these types of objects to decompose in the archaeological record. The raw material of all of these objects is derived from woody plants - xylem being one of the most resistant parts of plants - while no remains of herbaceous plants have been found, not even in the construction of the basketry.

A total of eight woody taxa have been identified in this archaeological assemblage: box (*Buxus sempervirens*), hazel (*Corylus avellana*), ash (*Fraxinus* sp.), juniper (*Juniperus* sp.), Aleppo pine (*Pinus halepensis*), Scots pine (*Pinus sylverstris* tp.), oak (*Quercus* deciduous) and willow (*Salix* sp.). This list constitutes a considerable variety of raw materials, especially considering the small size of the plant-based assemblage studied in this paper. We have documented the use of hard- and softwood species (wood types with different properties) that are also representative of different ecological plant communities. The use of each type of wood as a raw material could be the consequence of ecological factors and/or technological choices.

Based on available chronological information and our current knowledge of the associations between certain plants and different biotopes, we have documented the exploitation of three different types of landscapes for the procurement of wood as a raw material (Figure 8). Among the wooden objects belonging to the Bronze Age the wood of sub-Mediterranean trees was used as a raw material, such as Scots pine (*Pinus* tp. *sylvestris*) and oak (*Quercus* sp. deciduous), as well as shrubs such as box (*Buxus sempervirens*). This leads us to believe that the wood was obtained from the mixed pine-oak sub-Mediterranean forest that dominated the Pre-Pyrenean mid-mountain areas during this period (Montes et al., 2016; González-Sampériz et al., 2017). Riparian vegetation was also exploited during the Bronze Age as indicated by the direct radiocarbon dates of ash (*Fraxinus* sp.) and willow (*Salix* sp.). Hazel (*Corylus avellana*) could certainly be part of the undergrowth of the mixed pine-oak sub-Mediterranean forest, although it also sometimes accompanies riparian vegetation (San-Miguel-Ayanz et al., 2016). On the other hand, with regards to the raw materials of the objects assigned to the Roman period, there is a clear predominance of Aleppo pine (*Pinus halepensis*), a thermophilous tree species that still grows around the site, forming a typical Mediterranean pine forest.

Vegetable fibres used as raw material for basketry elements and the "knot" would probably have been deliberately selected due to their pliability and strength among the available species. Willows (*Salix* sp.) belongs to a genus including around 400 species of deciduous trees and shrubs of which the secondary xylem (wood) cannot be distinguished to species on the basis of the variation of its anatomical features. They are found primarily on moist soils, as an important part of the European riparian forests. Either bast or thin rods from willow can be woven into wicker, this species being greatly valued as it is less likely to split while being woven than many other woods. Willow is often gathered for this purpose during the spring when young shoots are still pliable and have not yet developed new growth. It must therefore be taken into account that the ease of procuring

sufficient quantities of this raw material depends on the time of year. Hazel (*Corylus avellana*) is a shrub common in many European woodlands reaching 3 – 8m in height. The wood of hazel is a traditional material used for basketry, fabrics and cordage, among other uses. It is traditionally grown as a coppice, so that regenerating shoots may be harvested every few years, with narrow and regular poles being used for different purposes. The use of both willow (*Salix* sp.) and hazel (*Corylus avellana*) wood bast fibres is traditionally common, and well-documented in Prehistory and Antiquity. Northern Europe, containing a high number of localities that permit the conservation of plant material, contains the best examples (Bennike et al., 1986; Myking, 2005; Russell et al., 2007; Andersen 2013; Harris and Jones, 2017). A particularly ancient example of this technology is the remains of a Stone Age (9140±135) fishing net, often called the "Antrea Net Find" (Karelian Isthmus, Finland), made of willow bast (Salicaceae) (Miettinen et al., 2014).

As previously stated, wood selection was probably made following two principal criteria: its availability in the environment, and its technical and morphological characteristics. Tree species such as pine (*Pinus* tp. *sylvestris*) and oak (*Quercus* sp. deciduous) generally produce straight trunks, and are therefore appreciated as materials for carpentry and building. The votive containers that we find in this funerary context would also have been highly suitable for a utilitarian use, as very common species are used, probably selected for the high density of their wood, especially in the case of oak, and for their resistance to transversal compression (Castroviejo et al., 1986-2012). The other objects that undoubtedly involve a more complex manufacturing process, in this case the comb and the spindle-shaped object, are made of woods that are exceptionally easy to work. Both ash (*Fraxinus* sp.) and box (*Buxus sempervirens*) are greatly valued for the manufacture of small utilitarian objects due to the density and weight of their wood, as well as its resistance to splitting and decay (Castroviejo et al., 1986-2012).

The use of boxwood as a raw material in the manufacture of the Moro de Alins' comb deserves a special mention. The use of different varieties of boxwood as the raw material for the manufacture of this type of object has been documented in archaeological contexts from very diverse periods and with a surprising geographical range. The Balearic combs, made of *Buxus balearica*, are well known due to their exceptional preservation and fairly frequent presence in burial caves (Veny 1982; Pons Homar 1999; Lull *et al.* 1999; Buxó y Piqué 2008; Picornell 2012). The oldest known examples, such as the Neolithic comb of La Draga (Banyoles) (Palomo et al., 2013), have also been made with boxwood, as is the case for the few known examples from the Roman and medieval periods (Pugsley, 2003; Derks and Vos, 2010; Mumcuoglu and Hadas, 2011; Costa-Vaz et al., 2016). We also find interesting examples of combs made of respective local varieties of boxwood in more distant locations, from Egypt (Derks and Vos, 2010) to the Jomon and Kofun cultures in Japan (Kizawa, 2011). There has been much speculation about the selection of this raw material for the manufacture of this specific object. Beyond the suitability of boxwood for the manufacturing of small and intricate objects, other hypotheses related to a ritual use of this species have been raised. It is also the case that boxwood combs

sometimes appear far from the presumed natural distribution areas of this species. The case of the Moro de Alins' boxwood comb is also striking. This cave is located in the centre of one of the European regions most heavily populated by this species (San-Miguel-Ayanz et al., 2016), but the occurrence of boxwood (*Buxus sempervirens*) in this assemblage is scarce, except for the small comb.

5. CONCLUSIONS

This study provides new information on the subject of the archaeology of "short-lived materials" or Ephemeral Archaeology, for which data is generally scarce given the perishability of these materials. The lack of information about the perishable material culture of the past affects knowledge of both the raw materials and the woodworking technology and tools, as well as the types of objects produced. The study of this woody plant-based material assemblage from Cueva del Moro de Alins has significantly contributed to establishing the chronocultural periodisation of the prehistoric and historical activity within the cave. The majority of the plant-based materials studied were assigned to the Bronze Age, some of which probably had a funerary function. Others have been assigned to a cache deposited during the Late Antiquity. We have documented the use of local woody plant raw material that has contributed to understanding the Pre-Pyrenean environment, the evolution of the vegetative cover, and the forest resource availability in the surroundings of the cavity. When these materials are compared to other European contexts, the existence of recognizable classes of objects present over a large geographical range is revealed, for example in the case of the wooden combs commonly associated with funerary contexts. However, the limited number of these types of objects prevents a typological evolution of these products to be established, as is possible with manufactured objects made of common and durable materials such as pottery, flint or metal. Based on available archaeological research, in respect to woody plant-based materials, there is a continuity of object type, raw materials, and woodworking technology, observed from Prehistory to the handcrafted productions of the 20th century.

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References

Adovasio, J.M. (1977). *Basketry technology: A guide to identification and analysis.* Chicago: Aldine Publishing Company.

Alcolea, M. (2018). Arqueología efímera en Aragón. Novedades y metodología para el estudio taxonómico y morfo-tipo-técnológico de objetos de madera y cestería. In J.I. Lorenzo and J.M. Rodanés (eds.): Actas del II Congreso de Arqueología y Patrimonio Aragonés, 191-199.

Alfaro, C. (1980). Estudio de los materiales de cestería procedentes de la Cueva de los Murciélagos (Albuñol, Granada). Trabajos de Prehistoria 37, 109-162.

Alfaro, C. (1984). Tejido y Cestería en la Península Ibérica. Historia de su técnica e industrias desde la Prehistoria hasta la Romanización. Bibliotheca Praehistorica Hispana. Vol XXI. Madrid 1984.

Andersen, S. H. (2013). Artefacts of wood, withies and plant fibres., In: Tybrind Vig: submerged Mesolithic settlements in Denmark., Hojbjerg : National Museum of Denmark & Moesgård Museum : pp. 115-219.

Ayala, M. (1987). "Enterramientos calcolíticos de la Sierra de La Tercia. Lorca. Murcia. Estudio preliminar". Anales de Prehistoria y Arqueología 3, pp. 9-24.

Baldellou, V. (1984). La Cueva del Forcón (La Fueva-Huesca). Bolskan 1, 149-176.

Baldellou, V. (1987). Avance al estudio de la Espluga de la Puyascada. Bolskan 4(3), 42.

Baldellou, V. (2011). La Cueva de Chaves (Bastarás-Casbas, Huesca). *SAGVNTVM Extra 12*, 141-144.

Barril, M., Ruíz Zapatero, G. (1980). Las cerámicas con asas de apéndice de botón del NE de la Península Ibérica». Trabajos de Prehistoria 37, 181-219.

Bennike, P., Ebbesen, K., Jørgensen, L. B. (1986). Early neolithic skeletons from Bolkilde bog, Denmark. Antiquity 60(230), 199-209.

Beltrán, M. (2004) *Arca ferrata* o *arca areata*. In M. Beltrán and J. Paz (coord.) Las Aguas sagradas del Municipium Turiaso. Excavaciones en el patio del colegio Joaquín Costa (Antiguo Allué Salvador). Tarazona (Zaragoza). Caesaraugusta 76, 143-170.

Blanquet, J. B., & de Bolòs, O. (1987). Las comunidades vegetales de la depresión del Ebro y su dinamismo. Delegación de Medio Ambiente. Ayuntamiento de Zaragoza.

Bocquet, A. (1994). Charavines il y a 5000 ans (Vol. 199). Faton.

Bronk Ramsey, C. (2009). Bayesian analysis of radiocarbon dates. Radiocarbon, 51(1), 337-360.

Buxó, R., Piqué, R. (2008). Arqueobotánica: los usos de las plantas en la Península Ibérica. Barcelona. Ed. Ariel.

Cacho, C.; Papi, C.; Sánchez- Barriga, A., Alonso, F. (1996). La cestería decorada de la cueva de los Murciélagos (Albuñol, Granada)". *Complutum* Extra 6(1), 105-122.

Carrión, Y., y Rosser, P. (2010). "Revealing Iberian woodcraft: conserved wooden artefacts from south-east Spain". Antiquity 84(325), 747-764.

Castán, A. (1985). Los restos de la Cueva del Toro y el fondo de una leyenda. In Actas del XVII Congreso Nacional de Arqueología (Logroño 1983), Universidad de Zaragoza, Seminario de Arqueología, 919-932.

Castroviejo, S. (coord. gen.). 1986-2012. Flora iberica 1-8, 10-15, 17-18, 21. Real Jardín Botánico, CSIC, Madrid.

Chevalier, F. (1995). *La repoblación forestal en la provincia de Huesca y sus impactos geográficos.* Instituto de Estudios Altoragoneses. Diputación de Huesca.

Chasseigne, L. (2002). Prospection dans le piémont pyrénéen : le nord du somontano du Barbastro (Huesca) à l'époque romaine. Saldvie 2, 177-194.

Costa-Vaz, F., Martín-Seijo, M., Carneiro, S., Tereso, J.P. (2016). Waterlogged plant remains from the Roman healing spa of Aquae Flaviae (Chaves, Portugal): Utilitarian objects, timber, fruits and sedes. Quaternary International 404, 86-103.

Derks, T., Vos, W., (2010). Wooden combs from the Roman fort at Vechten: the bodily appearance of soldiers. Journal of Archaeology in the Low Countries 22, 53-77.

Diarte-Blasco, P. (2016). New thinking in old landscapes: discoveries, research and approaches for Late Antique and Early Medieval Iberia. Medieval Settlement Research 31, 1-14.

Domingo, R., Diarte, P., Villalba-Mouco., V., Alcolea, M. y Montes, L. (e.p.). "A boy, a bow and some bees. Tragaluz Norte: a Late Antique rockshelter in the Spanish pre-Pyrenees (Alquézar, Huesca)". Journal of Arachaeological Science: Reports.

Escó, C., Calvo, M.J. (1986) Cueva de la Carrasca (Almazorre-Bárcabo, Huesca), Arqueología Aragonesa 1984, Gobierno de Aragón, 105-107. Zaragoza.

Fernández Ochoa, C., Gil Sendino, F., Salido Domínguez, J., García Díaz, P. (2015). El uso de la madera en el periodo Tardoantiguo: objetos de la vida cotidiana procedentes de la excavación de la Fábrica de Tabacos de Gijón (Asturias). Zephyrus LXXVI, 141-158.

Fernández Palacio, J. (2008). *Flora de una geografía diversa.* In A. Palomares Puertas and J. Rovira Marsal, (coords.): Comarca de la Litera. Colección Territorio 29, 27-39. Gobierno de Aragón.

Gallart, J., Rodanés, J.M., Rovira, J. (2017) Los primeros pobladores de La Litera. 150.000 años de historia. Huesca.

Gallart, J., Ribes, J., Rovira, J. (1986). El jaciment del Bronze de Subau a el Gaió (la Llitera). Ilerda XLVII, 49-64.

García Esteban, L., Guindeo Casasus, A., Peraza Oramas, C., De Palacios, P. (2003). La madera y su anatomía. Anomalías y defectos, estructura microscópica de coníferas y frondosas, identificación de maderas, descripción de especies y pared celular. Ed. Mundi-Prensa. Madrid.

González-Sampériz, P., Aranbarri, J., Pérez-Sanz, A., Gil-Romera, G., Moreno, A., Leunda, M., Sevilla-Callejo, M., Corella, J.P., Morellón, M., Oliva, B., Valero, B. (2017). Environmental and climate change in the southern Central Pyrenees since the Last Glacial Maximum: A view from the lake records. Catena 149, 668–688.

Harvey, V. I. (1986). *The techniques of basketry*. Seattle: University of Washington Press.

Harris, S., Jones, A.M. (2017). Beautiful Things. Textiles and fibre artefacts from an Early Bronze Age cremation, Whitehorse Hill, England. In M. Bravermanová, H. Březinová and J. Malcolm-Davies (eds.): Archaeological Textiles – Links Between Past and Present. Technical University of Liberec, Faculty of Textile Engineering and Institute of Archaeology of the CAS. Prague. 21-31.

Hurcombe, L.M. (2014) Perishable Material Culture in Prehistory: Investigating the Missing Majority. Ed. Routledge. Oxon.

Jover, F.J., López Padilla, J.A., Machado, M.C., Herráez, M.I., Rivera, D., Precioso, M.L., Llorach, R. (2001). La producción textil durante la Edad del Bronce: un conjunto de husos o bobinas de hilo del yacimiento de Terlinques (Villena, Alicante). Trabajos de Prehistoria 58(1), 171-186.

Jover, F. J., López Padilla, J.A. (2013). La producción textil durante la Edad del Bronce en el cuadrante suroriental de la Península Ibérica: materias primas, productos, instrumentos y procesos de trabajo. Zephyrus LXXI, 149-171.

Kizawa, N. (2011) A basic study of excavated wooden combs, wood species, and manufacturing techniques. Gangoji Institute for Research of Cultural Property. Nara.

Laborda, R., Gisbert, M. (2016). Nuevos restos arqueológicos en las Cuevas de Los Moros de Gabasa. La Sima del Ciervo II/Cueva Salaber (Peralta de Calasanz, Huesca). In J.I. Lorenzo and J.M. Rodanés (eds.): Actas del I Congreso de Arqueología y Patrimonio Aragonés, 143-151.

Leroi-Gourham, A. (1943) L'homme et la matière. Albin Michel, Red. 1971. París.

Llull, V., Micó, R., Rihuete, C. y Risch, R. (1999). “Ideología y Sociedad en la Prehistoria de Menorca. La cova des Càrritx y la Cova des Mussol”. Consell Insular de Menorca, Ajuntament de Ciutadella, Fundació Rubio, Barcelona.

Maya, J. L. (1990). La Edad del Bronce y la Primera Edad del Hierro en Huesca. *Bolskan* 7, 159-196.

Magallón, M.A., Sillères, P. (2013). Labitolosa (La Puebla de Castro, province de Huesca, Espagne). Une cité romaine de l’Hispanie citérieure. Ausonius, Bordeaux.

Magallón, M.A., Saénz, C. (2014). Restos romanos en el abrigo de Forcas II (Graus, Huesca). In P. Utrilla and C. Mazo: La Peña de las Forcas (Graus, Huesca). Un asentamiento estratégico en la confluencia del Ésera y el Isábena, 427-450. Prensas Universitarias de la Universidad de Zaragoza.

Maluquer, J. (1954). Los poblados de la Edad del Hierro, de Cortes de Navarra. Zephyrus 5, 1-15.

Masurel, H. (1985). Vanneries, tissus, rèserves de fil et liens trouvés à Chalain et conservés au Musèe de Lons-le-Saunier”. En *Néolithique Chalain-Clairvaux. Feuilles anciennes.* Presentations des collections du Musée de Lons-le-Saunier, 1. Musée d’Archéologie, 201-210.

Médard, F. (2008). L’acquisition des matières textiles d’origine végétale en préhistoire. In Les nouvelles de l’archéologie [On line] 114. URL: http://nda.revues.org/602.

Miettinen, A., Sarmaja-Korjonen, K., Sonninen, E., Jungner, H., Lempiäinen, T., Ylikoski, K., Mäkiaho, J.P., Carpelan, C. (2008). The paleoenvironment of the “Antrea Net Find”. The Finnish Antiquarian Society. Karelian Isthmus – Stone Age Studies in 1998-2003. ISKOS 16, 2008.

Montes, L., Utrilla, P. (2014). The cave of Los Moros-1 at Gabasa (Huesca). In Pleistocene and Holocene Hunters-Gatherers in Iberia and the Gibraltar Strait. The Current Archaeological Record. Universidad de Burgos-Fundación Atapuerca, 181-188.

Montes, L., Martínez-Bea, M. (2006). El yacimiento campaniforme de cueva Drólica (Sarsa de Surta, Huesca). *Salduie* 6, 297-316.

Montes, L., Domingo, R., González-Sampériz, P., Sebastián, M., Aranbarri, J., Castaños, P., García-Simón, L.M., Alcolea, M., Laborda, R. (2016). Landscape, resources and people during the Mesolithic and Neolithic times in NE Iberia: The Arba de Biel Basin. *Quaternary International 403*, 133-150.

Mumcuoglu, K.Y., Hadas, G. (2011). Head louse (Pediculus humanus capitis). Remains in a louse comb from the Roman period excavated in the Dead Sea region. Israel Exploration Journal 61, 223-229

Myking, T., Hertzberg, A., Skrøppa, T (2005). History, manufacture and properties of lime bast cordage in Northern Europe. Forestry 78(1), 65-71.

Navarro, M., Magallón, M.A., Sillières. P. (2000). *Barb(otum?):* una ciudad romana en el somontano Pirenaico. Saldvie 1, 247-272.

Oms, X., Bargalló, A., Chaler, M., Fontanals, M., García, M. S., López, J. M., Morales, J.I., Nievas, T., Rodríguez, A., Serra, J., Solé, A., Vergès, J.M. (2008). La Cova Colomera (Sant Esteve de la Sarga, Lleida), una cueva-redil en el Prepirineo de Lérida. Primeros resultados y perspectivas de futuro. In *IV Congreso del neolítico peninsular.* Vol. 1, 230-236.

Palomo, A., Piqué, R., Terradas, X., López, O., Clemente, I., & Gibaja, J. F. (2013). Woodworking technology in the early neolithic site of La Draga (Banyoles, Spain). Regards croisés sur les outils liés au travail des végétaux, 383-396.

Pastor, M.V., Vicente, D. (2009). La cueva sepulcral neolítica/calcolítica de San Juan en Loarre (Huesca). *Saldvie* 9, 335-368.

Pérez-Lambán, F., Laborda, R., Picazo, J., Gisbert, M. (2016). La Cueva del Búho (Ibdes, Zaragoza). Un nuevo hábitat en cueva durante la Edad del Bronce en el Sistema Ibérico. En J.I. Lorenzo and J.M. Rodanés (eds.): Actas del I Congreso de Arqueología y Patrimonio Aragonés, 163-170.

Perini, R. (1987). *Scavi archeologici nella zona palafitticola di Fiavé-Carera. Parte II. Campagne 1969-1976. Resti della cultura materiale, metallo-osso-litica-legno.* Servizio Beni Culturali della Provincia Autonoma di Trento.

Picornell, Ll. (2012). "Paisaje vegetal y comunidades prehistóricas y protohistóricas en Mallorca y Menoría (Illes Balears): una aproximación desde la antracología". Unpublished PhD dissertation. Universidad de Barcelona.

Picornell, Ll. A. Solé, E. Allué. (2008). Estudi arqueobotànic I tecnològic de les restes de fusta, carbó I fibres vegetals de la Cova des Pas (Ferreries, Menorca). Unicum 7, 22-24.

Piqué, R. (1999). Análisis de las maderas y carbones del yacimiento de la Cueva des Mussol (Menorca). In V. Llull, R. Micó, C. Rihuete and R. Risch (eds.): *La cova des Càrritx y la Cova des Mussol* : 427-438. Menorca.

Piqué, R., Palomo, A., Terradas, X., Tarrús, J., Buxó, R., Bosch, À., Chinchilla, J., Bogdanovic, I., López Bultó, O. y Saña, M. (2015). "Characterizing prehistoric archery: technical and functional analyses of the Neolithic bows from La Draga (NE Iberian Peninsula)". Journal of Archaeological Science 55, 166-173.

Piqué, R., Ravotto, A., López-Bultó, O. (2016). Roman wells of north-eastern Iberian Peninsula: Landscape and use of wooden resources. Quaternary International 404, 104-113.

Piqué, R., Romero, S., Palomo, A., Tarrús, J., Terradas, X., Bogdanovic, I. (2018). The production and use of cordage at the early Neolithic site of La Draga (Banyoles, Spain). Quaternary international 468, 262-270.

Pons Homar, G. (1999) Análisi Espacial del Poblament al Pretalaiòtic Final i Talaiòtic I de Mallorca (ss. XIX–VII a.C.). Palma de Mallorca: Consell Insular de Mallorca.

Pugsley, P. (2003). Roman Domestic Wood. Analysis of the Morphology, Manufacture and Use of Selected Categories of Domestic Wooden Artefacts with Particular Reference to the Material from Roman Britain. In: British Archaeological Reports International Series, vol. 1118. Oxford.

Ramón, N. (2006). *La cerámica del Neolítico antiguo en Aragón*. Institución Fernando el Católico. Zaragoza.

Ramseyer, D. (dir.) (2000). *Muntelier/Fischergässli. Un hábitat néolithique au bord du lac de Morat (3895 à 3820 avant J.-C.). Archéologie fribourgeoise. Freibuger Archäologie.* Fribourg 2000.

Rivas Martínez, S. (1982). Étages bioclimatiques, secteurs chorologiques et séries de végetation de l'Espagne méditerranéenne. Ecología Mediterránea VIII (1/2), 275-288.

Rodanés, J. M. (1992). Del Calcolítico al Bronce Final en Aragón. Problemas y perspectivas". En P. Utrilla (ed.): *Aragón/Litoral Mediterráneo. Intercambios culturales durante la prehistoria.* Institución Fernando el Católico, Zaragoza, 491-513.

Rodanés, J. M. (1999) *Las cuevas de Tragaluz y San Bartolomé (Sierra de Cameros, La Rioja). Los enterramientos en cueva en el Valle Medio del Ebro*. Instituto de Estudios Riojanos, Logroño.

Rodanés, J. M. (2007) Neolítico. *Cæsaraugusta* 78, 49-66.

Rodanés, J. M. (ed.) (2017). "La cueva sepulcral del Moro de Alins del Monte. Prehistoria de la Litera (Huesca)". Monografías Arqueoloógicas. Prehistoria 51. Prensas de la Universidad de Zaragoza.

Rodanés, J. M., Aranda, P. (2015). La ocupación altoimperial de la cueva del Moro de Alins del Monte (La Litera, Huesca). *Homenaje a Miguel Beltrán*. IFC. Zaragoza: 763-772.

Rodanés, J. M., Monterio, I., Aranda, P. (2016). Materiales metálicos de la Edad del Bronce de la Cueva del Moro de Alins del Monte (Huesca). En I. Lorenzo and J.M. Rodanés (eds.): Actas del Primer Congreso de Arqueología y Patrimonio Aragonés.

Rodanés, J. M., Lorenzo, J. I., Aranda, P. (2016). Enterramientos en cuevas y abrigos en el Alto Aragón durante el Neolítico y la Edad del Bronce. *Del neolític a l'edat del bronze en el Mediterrani occidental. Estudis en homenatge a Bernat Martí Oliver*. TV SIP 119, València: 411-426.

Rodanés, J. M., Picazo, J. (2005) *El proceso de implantación y desarrollo de las comunidades agrarias en el Valle Medio del Ebro*. Monografías Arqueológicas, 40, Zaragoza.

Rodanés, J. M., Picazo, J. (2018) Interaction and interchange. The génesis of the late Bronce and Early iron age in the middle ebro valley. In A. Cruz and J.F. Gibaja (eds.) Interchange in Pre- and Protohistory. Case Studies in Iberia, Romania, Turkey and Israel. BAR International Series 2891.

Romero-Brugués, S., Piqué, R., Picornell, L., Calvo, M., Fullola ot, J. M. (2018). The Production and Use of Cordage in the Balearic Bronze Age: The Cova des Pas (Ferreries, Menorca). *Environmental Archaeology*, 1-9.

Rojo, M.A., Peña-Chocarro, L., Royo, J.I., Tejedor, C., García-Martínez de Lagrán, I., Arcusa, H., Garrido, R., Moreno-García, M., Mazzuco, N., Gibaja, J.F., Ortega, I., Cobos, D., Kromer, B., Yalt, K.W. (2013). "Pastores trashumantes del Neolítico antiguo en un entorno de alta montaña: secuencia crono-cultural de la Cova de Els Trocs (San Feliú de Veri, Huesca)". Boletín del Seminario de Estudios de Arte y Arqueología 79, 9-55.

Rovira, J., Mir, A., Salas, R. (1991). Estaciones paleolíticas de superficie en la comarca de La Litera (Huesca) y su relación con los depósitos cuaternarios. *Bolskan* 8, 9-30.

Russell, T., Cutler, C., Walters, M. (2007). The illustrated encyclopedia of trees of the world. London.

San-Miguel-Ayanz, J., de Rigo, D., Caudullo, G., Houston Durrant, T., Mauri, A. (eds.) (2016), *European Atlas of Forest Tree Species*. Publ. Off. EU, Luxembourg,

Schweingruber, F.H. (1990). Anatomie europäischer Hölzer. Haupt Verlag. Berna y Stuttgart.

Tudanca, J. M., López De Calle, C. (2000). *Calagurris Iulia Nassica*. Evidencias de incendio y abandono en el sector norte de la ciudad altoimperial. *Estrato* 11, 42-54.

Tutin, T. G., Heywood, V. H., Burges, N. A., Moore, D. M., Valentine, D. H., Walters, S. M., & Webb, D. A. (1964). Flora europaea. *Cambridge: Univ. Press*, *1*(1964), 428.

Utrilla, P., Baldellou, V. (1996). La cueva del Moro de Olvena (Huesca), vol. II. *Bolskan 13*, 261-290.

Utrilla, P., Mazo, C. (2014). La Peña de las Forcas (Graus, Huesca). Un asentamiento estratégico en la confluencia del Ésera y el Isábena. Prensas Universitarias de la Universidad de Zaragoza.

Utrilla, P., Laborda, R., Sebastián, M. (2014). La reocupación de cuevas prehistóricas del Prepirineo oscense en época romana. Modelización mediante TIG. In A. Duplá, M.V. Escribano, L. Sancho, M.A. Villacampa (eds.): Miscelánea de estudios en *Homenaje a Guillermo Fatás.* Institución Fernando el Católico. Zaragoza. 673-682.

Figure captions

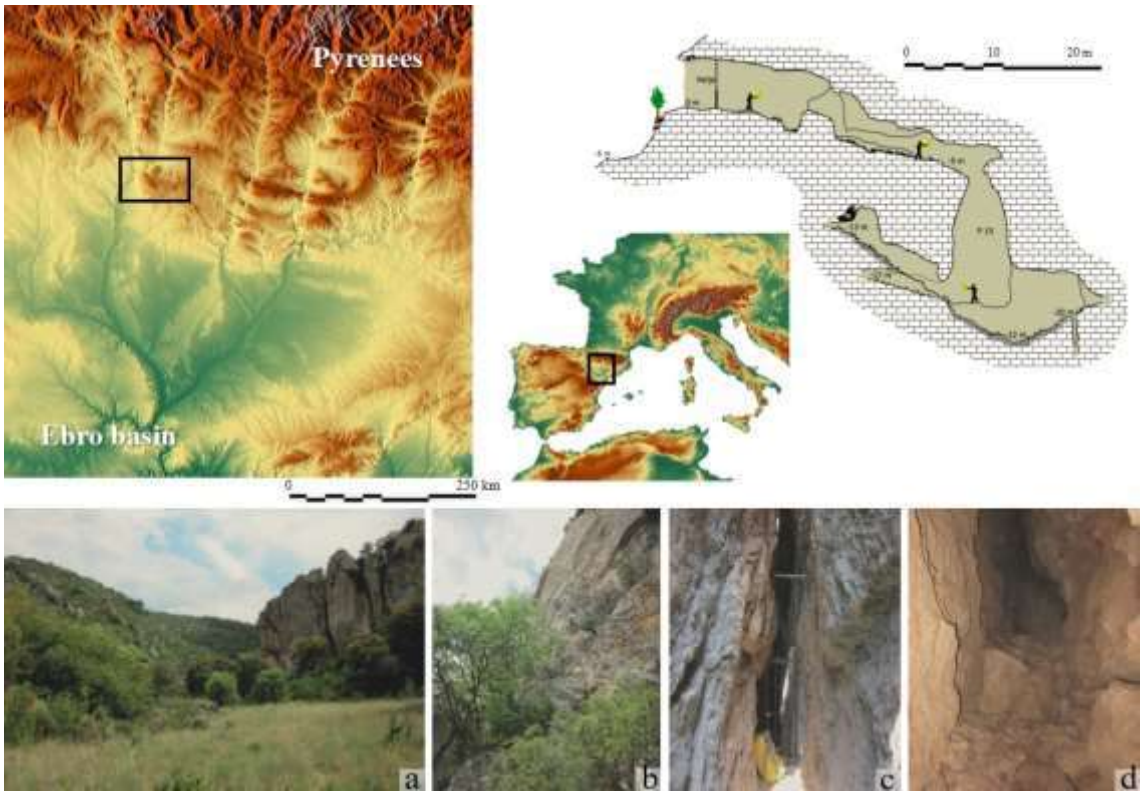


Figure 1. Location of Cueva del Moro de Alins (Huesca): (a) Barranco de las carboneras Cliff; (b) escarpment with the entrance of the cave (behind and to the right of the tree); (c) entrance of the cave and gate; (d) eastern end of the lower gallery. Topography and photographs: Aragon Speleology Centre (CEA).

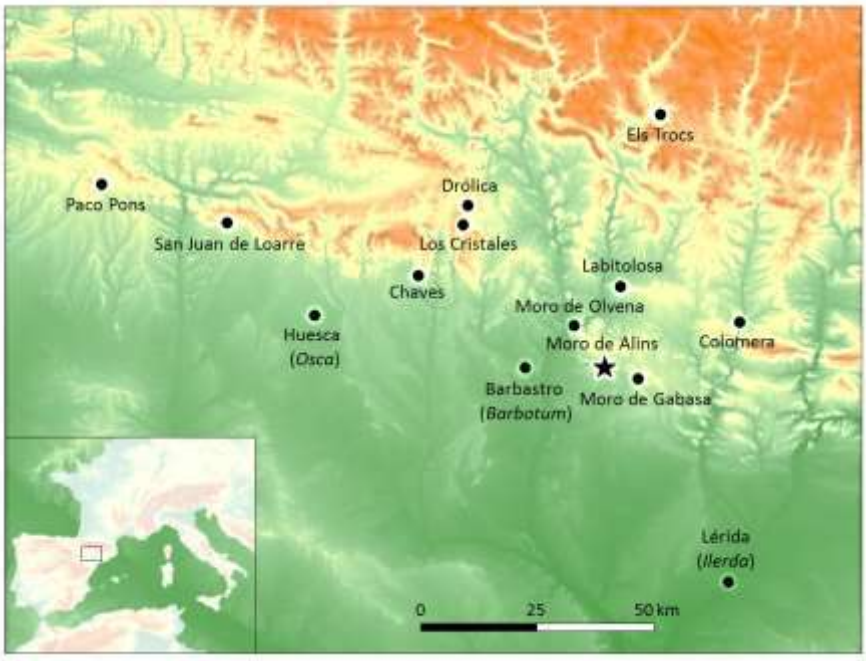


Figure 2. Location of the main archaeological sites mentioned in the text.

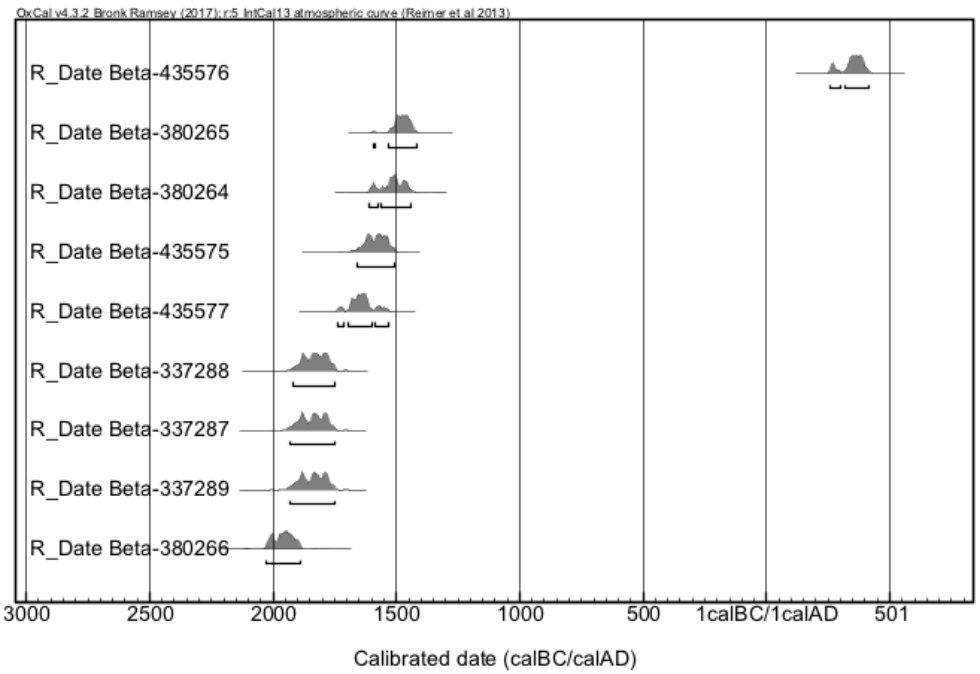
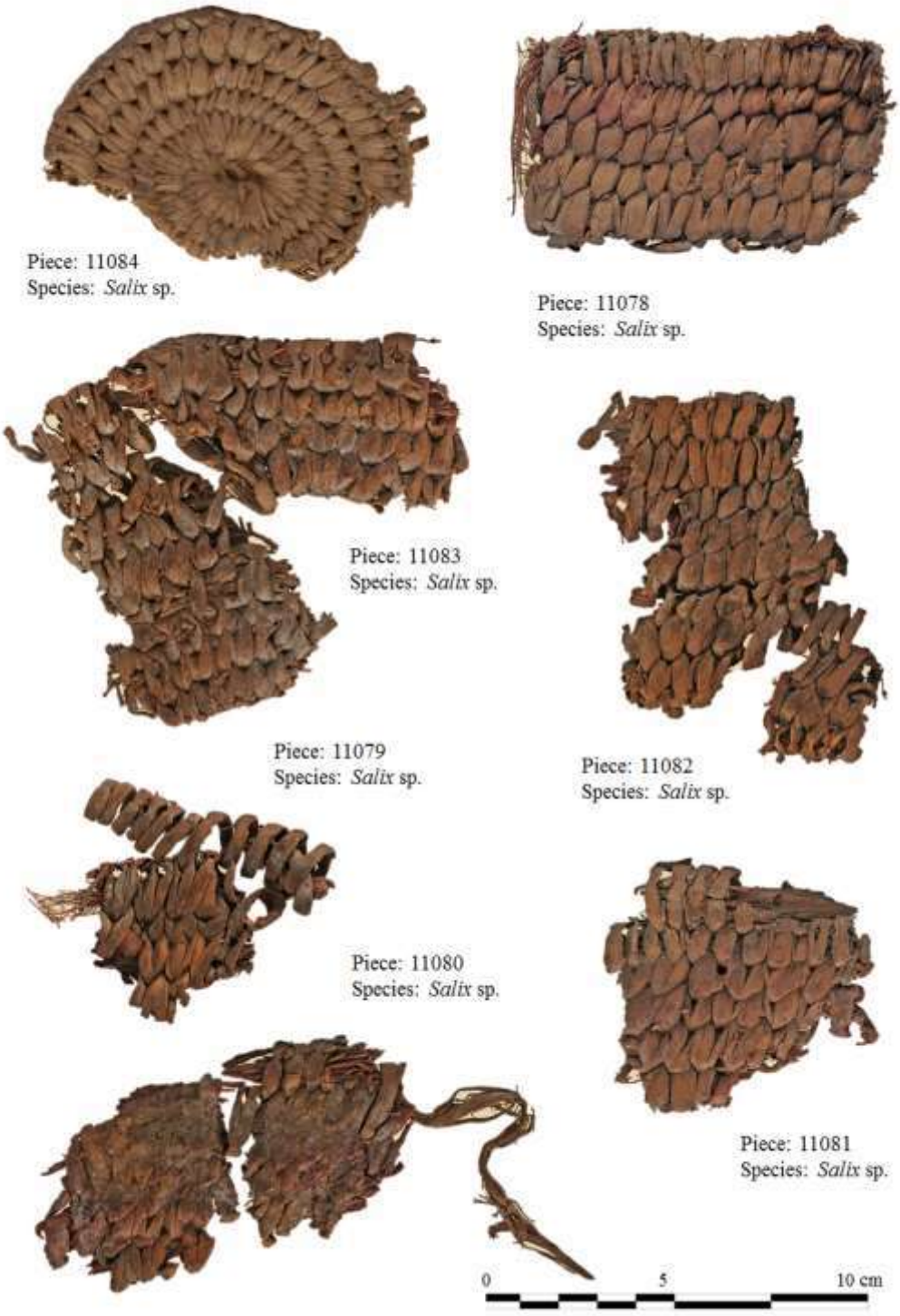


Figure 3. Calibrated radiocarbon dates from Cueva del Moro de Alins (Huesca). Multiplot was generated in Oxcal version 4.3 with IntCal13 (Bronk Ramsey, 2009).

Figure 4. Microscopic observation of wood anatomical features for taxa determination. A. *Salix* sp. Tangential section. Incident light microscope (100x). B. *Salix* sp. Radial section. Incident light microscope (100x). C. *Pinus* tp. *sylvestris*. Tangential section. Optical microscope (400x). D. *Pinus* tp. *sylvestris*. Radial section. Optical microscope (400x). E. *Quercus* sp. deciduous. Tangential section. Optical microscope (100x). F. *Quercus* sp. deciduous. Tangential section. Optical microscope (200x). G. *Corylus avellana*. Radial section. Optical microscope (200x). H. *Corylus avellana*. Radial section. Optical microscope (200x).



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802 Figure 5. Basketry fragments from Cueva del Moro de Alins (Huesca). Photographs: M.
803 Bea.

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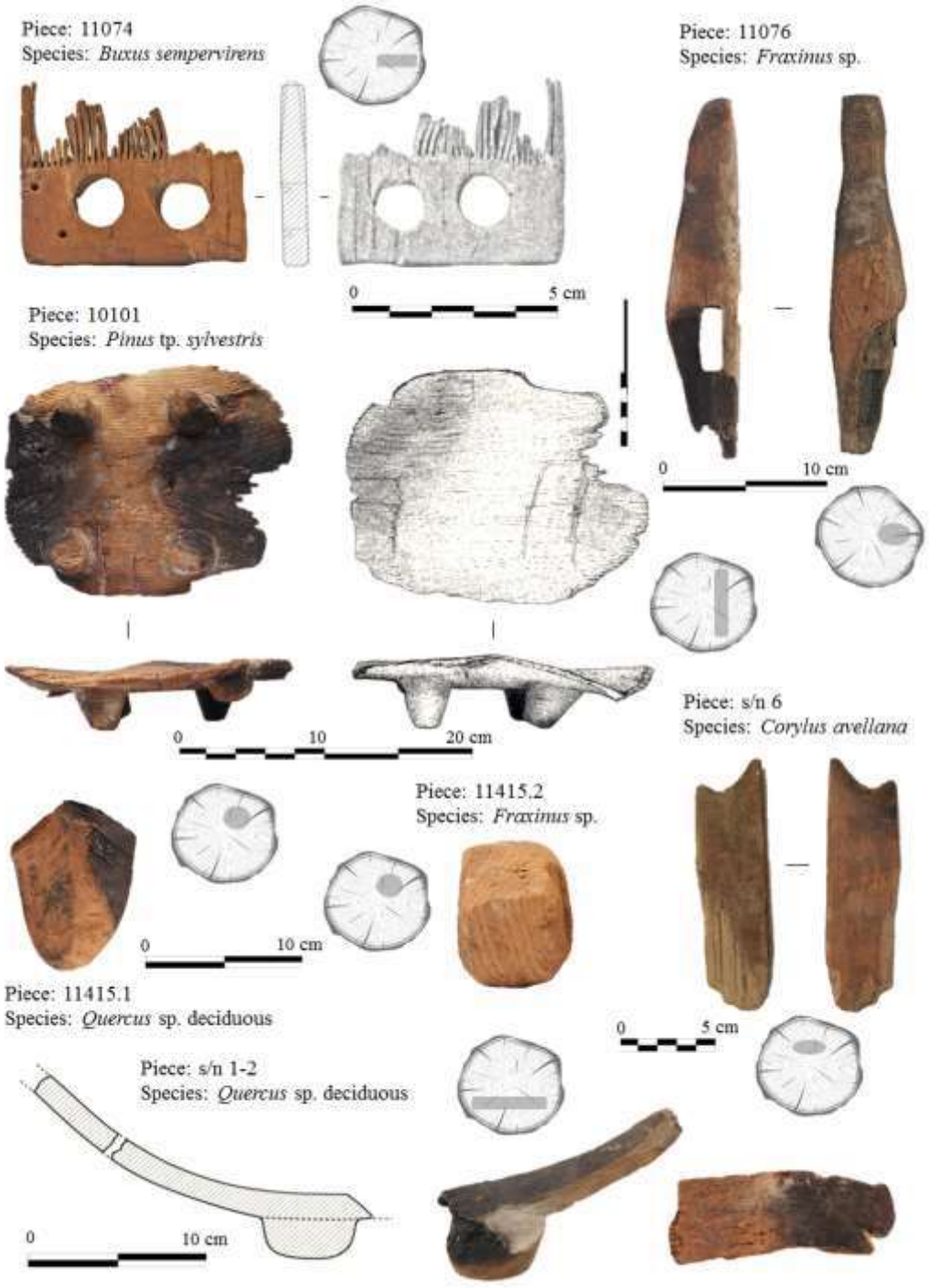

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807 Figure 6. Wooden artefacts and hazel knot from Cueva del Moro de Alins (Huesca).
808 Photographs: M. Bea / C. Mazo. Draws: M.C. Sopena.

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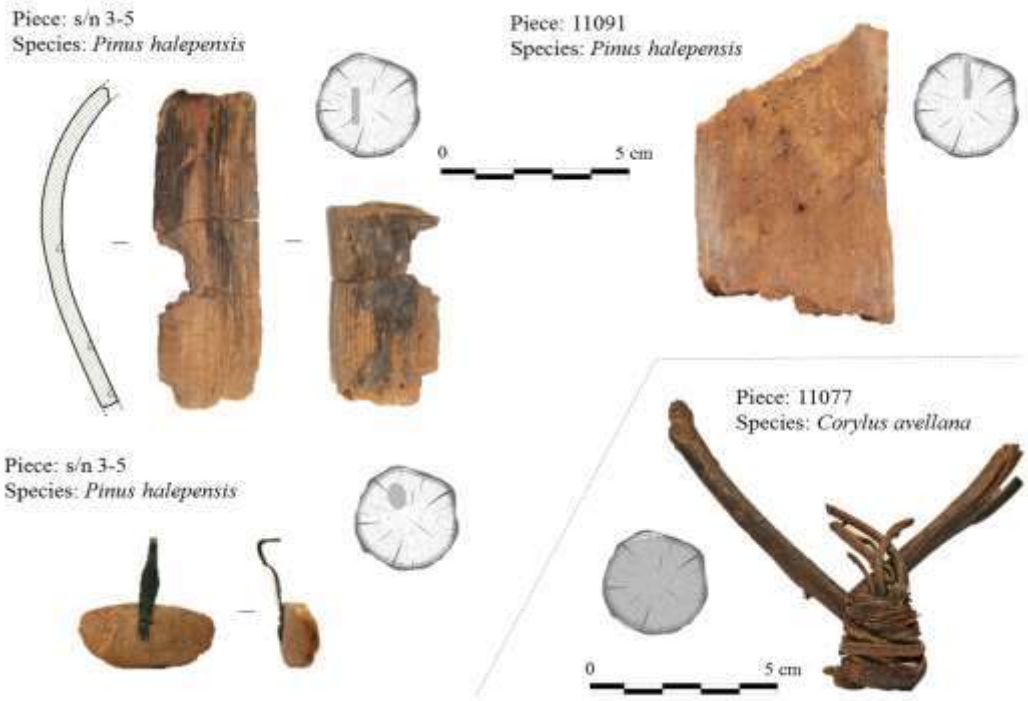

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812 Figure 7. Wooden artefacts from Cueva del Moro de Alins (Huesca). Photographs: M.
813 Bea / C. Mazo. Draws: M.C. Sopena.

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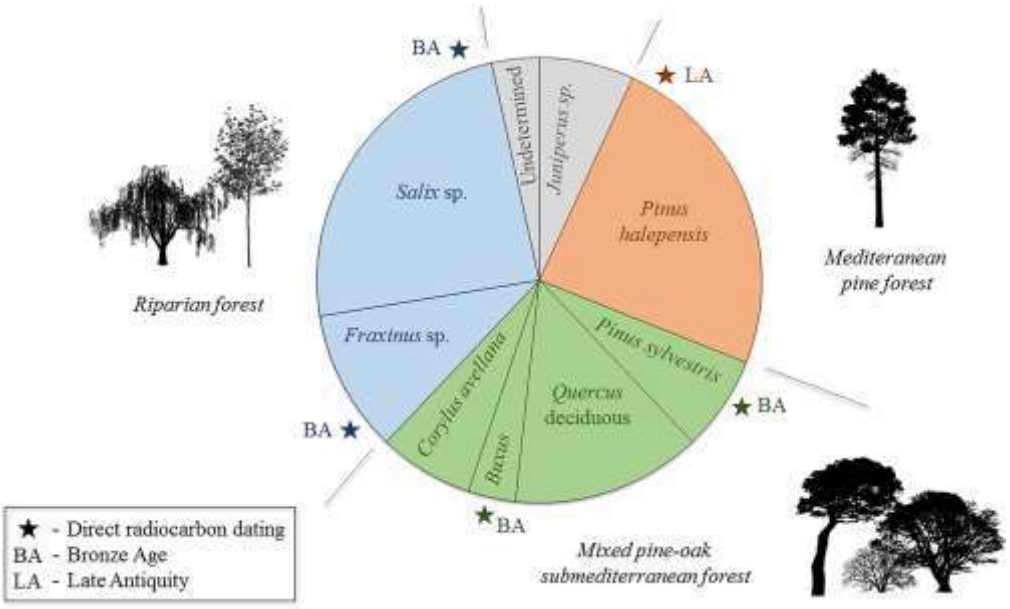

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816 Figure 8. Reconstruction of exploited plant communities for the procurement of wood
817 as a raw material.