The Distribution and Use of Box (*Buxus sempervirens* L.) in the northeastern Iberian Peninsula during the Holocene

The aim of this paper is to evaluate the distribution of box (*Buxus sempervirens* L.) in the Holocene vegetation of NE Spain and its use during prehistory. The scarcity of box in pollen records contrasts with the frequent presence of box charcoal at archaeological sites in the north-eastern Iberian Peninsula. Box charcoal has been documented in 41 Holocene sites, indicating its systematic use as firewood. To date, wooden artefacts have only been documented at La Draga, an early Neolithic site (5324-4977 cal BC) located on the shore of Lake Banyoles (Spain). The abundance of *Buxus sempervirens* among the artefacts is remarkable, with 85 out of 155 objects made from this wood, including sickle handles, digging sticks, wedges, adze handles, needles, combs and other objects of unknown function. The evaluation of *Buxus sempervirens* charcoal and pollen data from different Holocene sites, and the evidence of its use for the manufacture of objects, demonstrate the importance of this species for prehistoric societies.

Keywords: *Buxus sempervirens*, tools, wood, charcoal, pollen, archaeobotany, prehistory

Introduction

Box (*Buxus sempervirens* L.) is one of the most precious woods in Europe. Boxwood is very hard, dense, heavy, fine-grained, and resistant to splitting and chipping, which makes it suitable for carving. Those extraordinary properties, as well as its appearance, have made box one of the most valued wood types for the manufacture of small objects (Meiggs 1983; Ulrich 2007).

Box was frequently used as firewood in southern Europe in the Holocene; box charcoal remains are well documented in archaeological sites in the north-east of the Iberian Peninsula and south-east France (Piqué et al. 2018; Caruso-Fermé and Piqué 2014; Thiébault and Vernet 1992, Vernet 1990, Heinz and Thiébault 1998; Delhon et al. 2009).

Due to the low preservation potential of uncharred wood, other uses of box are less represented in the archaeobotanical record. However, the few archaeological sites with good preservation conditions for uncharred wood have provided evidence for the use of boxwood for tools and goods during prehistory. Boxwood has been used for the production of digging sticks (Aranguren et al. 2018; Bosch et al. 2006) and spoons or vessels (Piqué 1999a), tablets (Warnock and Pendleton 1991) and many other types of objects (Carrión and Rosser 2010) Some of the uses of box have enjoyed remarkable continuity until modern times. One noteworthy example is the production of box combs. Although prehistoric combs were made with different raw materials, among them bone and wood (Castro-Curel 1988), those made with boxwood are well documented during prehistoric and historic times in different parts of Europe. Box combs have been documented in the Neolithic in the Iberian Peninsula and circum-Alpine area (Bosch et al. 2006, Bocquet and Noël 1985), in the same region in the Bronze Age (Piqué 1999a, Piqué and Noguera 2002, Rodanés-Vicente and Alcolea 2017) and at Iron Age sites in the Iberian Peninsula (Broncano 1989). In Roman times box combs were widely used across Europe and the Near East (Costa Vaz et al. 2016; Derks and Vos 2010, Chabal and Feugere 2005, Mumcuoglu and Hadas 2011). Box combs are also well documented in medieval (Smirnova 2007) and modern times. Box combs were used as textile implements for combing vegetal and/or animal fibres (de Diego et al. 2017) but also for human care (Mumcuoglu and Hadas 2011), or for funerary rituals (Lull et al. 1999).

This long tradition attests the value of this wood for past societies.

Nowadays box is frequent in southern Europe. Human pressure on the environment and climatic variations are key to understanding the expansion and development of box in Europe. According to fossil evidence, it was present during the Pleniglacial and Late glacial across most of its modern distribution area in Europe, increasing in the first half of the Holocene and declining during the second half due to aridification (di Domenico et al. 2012). In the north-east of the Iberian Peninsula, box charcoal is frequently recorded at Holocene archaeological sites (Piqué et al. 2018), and box objects have been found in an archaeological site (Bosch et al. 2006). However, its local distribution and the nature and intensity of its exploitation have not been analysed or discussed from an overall perspective. The low pollen production and poor dispersal capacities of box pollen are limitations to its documentation in the landscape and for understanding its distribution through time.

The aim of this paper is to evaluate the role of box in the vegetation during the Holocene and how it was used during prehistory in the north-east of the Iberian Peninsula. For this purpose, it first discusses the case of La Draga, an early Neolithic site (Palomo et al. 2014, 2017) where several types of box remains (charcoal, pollen, leaves and wooden objects) have been documented, to evaluate the visibility of these different types of remains in archaeological contexts and to gain insights into the use of box. Secondly it reviews the geographical distribution of box remains (charcoal and pollen) in north-eastern Iberia during the Holocene. Finally, it considers the remains of box charcoal in order to obtain a more accurate picture of the use of box as firewood, by examining the intensity of its use compared with other taxa.

Material and methods

At present, in the north-east of the Iberian Peninsula, wooden artefacts have only been documented at La Draga (figure 1), a site located on the eastern shore of Lake Banyoles at 173 m asl (Girona, Spain, 42° 07′ 36″ N, 2° 45′ 31″ E). La Draga is one of the earliest farming settlements in the NE of the Iberian Peninsula (Palomo et al. 2014, 2017).The available radiocarbon dates have determined an occupation from 5324 to 4977 cal BC (Phase I), and a most recent occupation from 5210 to 4796 cal BC (Phase II). Several sectors have been excavated (figure 1). In Sector A the archaeological level is above the water table; this sector has provided the most recent chronologies. In Sector B, the archaeological level is below the water table, and Sector C is currently underwater. In these sectors the two phases of occupation overlap. In Sectors B and C the waterlogged conditions have favoured the preservation of organic remains, including wood and leaves, from the earliest occupation (Bosch et al. 2006; Palomo et al. 2013; 2014). In addition, charcoal (Piqué 2000, Caruso-Fermé and Piqué 2014) and pollen (Revelles et al. 2016, 2017) from both phases are also well preserved.

Charcoal and wood remains were identified by comparing their anatomy with modern reference collections and specialized literature (Schweingruber 1990). Samples of charcoal were fragmented manually in order to obtain the cross and longitudinal sections. In the case of uncharred wood, thin sections were prepared. The samples were observed at 40 X, 100 X, 200 X and 500 X with an Olympus BX50 microscope, equipped with reflected and transmitted light.

Fossil leaves were identified by comparing the leaf macroscopic morphology with recent leaves, when possible, and the epidermal cell morphology. Leaf epidermal clearings were obtained from a 0.5cm^2 piece of the middle section of the leaf. The adaxial and abaxial epidermis were dissociated by immersing the material in a solution

of glacial acetic acid and 30% hydrogen peroxide (1:1) at 60C (da Silva et al. 2016). Leaves were kept in the clearing solutions for 10 min, in the case of the ancient leaves, or overnight in the case of the fresh material. Epidermis were washed with distilled water, stained by 1% safranin for 30 seconds and mounted in glycerol. Slides were observed at 200 X under a Leica DM5000B optical microscope.

To reconstruct the distribution of box, a database has been compiled with records of charcoal from 229 sites of different chronologies situated in the north-east of the Iberian Peninsula. Box has been identified in 77 archaeological levels at 41 sites. The database includes contextual data for the archaeological sites (chronology, altitude and latitude) as well as the number of documented box remains. The sites are dated between *ca*. 25,000 BC and the first millennium BC, although most of the records are from Holocene levels. The location of archaeological box charcoal for all chronological periods was plotted with ArcGIS Desktop v.10.5 and compared with the modern distribution area of box (Font 2018).

A review of natural deposits and archaeological sites from north-east Iberia has been carried out. Despite *Buxus sempervirens* being characterized by its low pollen production and poor dispersal capacities (Cañellas-Boltà et al. 2009), it has been documented in several records at presence/absence level.

Box ecology and current distribution

Box is an evergreen shrub or small tree native to Europe, northwest Africa and South Asia. Two species of box are native to west Europe. *Buxus sempervirens* L. is widely distributed in the Mediterranean region; it is abundant in the Pyrenees and Pre-Pyrenees, Southern France, the Pre-Alps and the Jura mountains, and it is also present in the Iberian, Italian and Balkan Peninsulas (di Domenico et al. 2012). Some scarce evidence

has been recorded also in Britain and Northern France, although its native status is not clear and it has been suggested that it was introduced during the Roman expansion or in medieval times (Decocq et al. 2004, Salvesen et al 2009, Lodwick 2017). *Buxus balearica* Lam. grows in North Africa, Balearic Islands and some restricted parts of the south-western Iberian Peninsula. *Buxus balearica* and *Buxus sempervirens* do not overlap nowadays in the study area.

Buxus sempervirens occurs in a wide ecological range in the NE of the Iberian Peninsula, mainly on basic soils (Tena 2009). Box is abundant in *Quercus pubescens* oak forests but also as an understory of pine (*Pinus* sp.), evergreen oak (*Quercus* sp. evergreen) or beech (*Fagus sylvatica*) forests. Box can be dominant in some areas in open dry montane shrubland. It is dominant at the middle altitudes in sub-Mediterranean montane ecosystems, although it also grows at lower altitudes and in the sub-Alpine zone (Folch i Guillén 1988) from (100) 400 to 1600 (2000) m asl. Nowadays, in the study area, box is distributed from the Pyrenees to the pre-littoral area and the south of the River Ebro basin (figure 2).

Human action has favoured the expansion of box in disturbed areas as it colonizes degraded oak forest where it can become dominant (Masclans 1990; Debusche and Lepart 1992). Box has expanded as a consequence of felling and clearing the forests in which it developed as part of the shrubby substratum (Tena 2009).

The wood of *Buxus sempervirens* is very hard, heavy and fine-grained. Its wood is very suitable for carving and has been used in several traditional woodcrafts in the NE of the Iberian Peninsula.

Archaeobotanical records of box in the Holocene

Charcoal and pollen records of box dating to the Upper Pleistocene are scarce. The earliest evidence of box pollen in the NE Iberian Peninsula dates to *ca*. 28,000 cal BC in Lake Banyoles (Pérez-Obiol and Julià 1994).Upper Pleistocene evidence of box charcoal is also scarce although the number of sites with charcoal studies is low for this chronology. Box has been identified in three of the eight levels with charcoal studies: Cova de l'Arbreda (Serinyà, Girona), dated around 25,310-24,550 cal BC (Ros 1987) and levels E and C1 at Balma Guilanyà, dated between 13,110-12,910 and 10,810-10,490 cal BC (Allué et al. 2012).

Charcoal remains of box are frequent in archaeological sites in the study area throughout the Holocene. It is attested in 41% of the levels (10 from a total of 24 levels with charcoal data) dated between 10,000-5500 cal BC (figure 3, table supplementary material).

Box pollen occurs during the Early Holocene in several sequences in NE Iberia, although it is more common in high mountains and sub-Mediterranean areas. In that sense, a scarce but regular presence of box pollen has been documented in the sub-Mediterranean region of La Garrotxa-Pla de l'Estany (E, F in figure 3) and in high altitudes, in the Catalan Pyrenees (A, D in figure 3).In this period (*ca*. 6150 cal BC), box pollen has also been identified in archaeological samples at Bauma del Serrat del Pont (La Garrotxa, Girona) (Burjachs 1997, 2002; Piqué et al. 2018).

Between 5500-4000 cal BC, the presence of box charcoal increases, and it has been recorded in71% of the archaeological levels (28 of the 39 with charcoal data) formed by occupations of early farming communities (figure 3, table supplementary material).

Evidence of *Buxus sempervirens* pollen is higher during the Middle Holocene (6200-2200 cal BC), it is documented in the abovementioned sub-Mediterranean and high altitude sequences (A, D, E, F in figure 3) and also in coastal sequences (G, J in figure 3). A more sporadic occurrence during the Middle Holocene has been attested in southern sites (B, C in figure 3). Box pollen has been identified in archaeological samples from Neolithic sites as La Draga (Pla de l'Estany) during the Early Neolithic (5300-4900 cal BC) (Revelles et al. 2016, 2017) and Bauma del Serrat del Pont (La Garrotxa), with higher peaks during the Late Neolithic, ca. 2750 cal BC (Burjachs 1997, 2002; Piqué et al. 2018).

Box charcoal dated between *ca.* 4000-2000 cal BC, which corresponds to the local Middle and Late Neolithic, Chalcolithic and early Bronze Age, has been documented in 24% (16 from a total of 65) of the archaeological levels with charcoal studies (figure 3, table supplementary material). During 2000-175 cal BC, the local Bronze Age-Iron Age, box has been documented in a similar percentage of sites: 24% (20 levels of the 83 with charcoal studies) (figure 3, table supplementary material).

During the Late Holocene, *Buxus sempervirens* pollen is more sporadic and tends to disappear in the last two millennia. Nevertheless, it is documented in several records, showing higher frequencies in high altitude sites (A, D, I in figure 3), but also is documented sporadically in the sub-Mediterranean region (H in figure 3) and on the coast (B, C, G, J in figure 3).

In addition, different kinds of box remains have been identified in the early Neolithic site of La Draga (5300-4900 cal BC). Phase 1 has provided an exceptional collection of wooden tools produced with several types of wood (table 1), and 85 out of 155 (52.5%) were made from box (Bosch et al. 2006; Palomo et al. 2013, López-Bultó 2015, 2018). Ten fresh leaves of box recovered from the oldest level have been

identified (figure 4). Finally box charcoal has also been documented in the two phases of occupation at this site. Box represents between 1.4%of the remains in Phase I (total N=1,107), 3% in the more recent Phase II (total N= 698) and 14% in the structures identified in Sector A (total N=3,136) (table supplementary material) (Piqué 2000, Caruso and Piqué 2014, Franch and Piqué in press).

The site of La Draga (5300-4900 cal BC): evaluating box visibility in archaeological sites

Box was one of the types of woods most often used to make tools in the site of La Draga. As mentioned above, 85 (52.5%) of the tools recovered at the site were made from box (Bosch et al. 2006; Palomo et al. 2013, López-Bultó 2015). The abundance of boxwood tools indicates the deliberate selection of this wood. Boxwood was used for several purposes: for sickle handles and digging sticks, to make wedges, adze handles, needles, combs and other objects of unknown function. Box tools were manufactured at the site, as demonstrated by the presence of unfinished artefacts, some of them still with bark, as well as very well finished tools.

An intriguing question is the presence of leaves of box recovered from the oldest level. Natural leaf fall can be rejected as we assume that box did not grow in the vicinity of the settlement. The local growth of box in the surroundings can be discarded because the settlement of La Draga was located on the lake beach surrounded by a riparian forest, an unsuitable environment for the growth of this taxon. The leaves might be the result of the transportation of entire branches to be used for tool manufacturing. However it should be noted that box leaves have been used medicinally in historical times in the region (Font i Quer 1999).

The abundance of tools made from box contrasts with the low presence of this taxon in firewood residues during the same phase of occupation. Charcoal remains indicate the use of box as firewood in the two phases of occupation (Piqué 2000; Caruso-Fermé and Piqué 2014), but the percentage of box charcoal fragments is relatively low and only comes to 1.4% of the fragments in the earliest phase at La Draga. The amount of box charcoal increased in the recent phase to 3% and reached 14% in Sector A at the site. In this phase the uncharred botanical material is not preserved and no wooden tools have been recovered. According to the scarcity of charcoal remains, box was used very little as fuel, especially in the oldest phase, but was intensively used as raw material for manufacturing tools. The scarcity of box charcoal suggests that firewood was not the primary use of box, at least in the oldest occupation, and the charcoal remains could be the result of burning woodworking waste or obsolete tools.

Finally, the presence of box in the pollen record at this site has been extensively documented (Revelles et al. 2016, 2017). Box pollen was identified in many archaeological layers at La Draga, in both phases and in the lake marl previous to the occupation, but was so scarce that it could not be quantified (figure 5). This under-representation is coherent with the short pollen dispersal distances of this taxon and the fact that box would have occurred in oak forest clearances, far enough away to prevent box pollen easily reaching the site. As explained above, the surroundings of the site were an unsuitable environment for the growth of this taxon.

The case of La Draga illustrates the low visibility of box in the archaeological record. On the one hand, its presence in the vegetation is rarely detected or is under-represented in the pollen record. On the other hand, the use of box could have been

more important than it seems according to the remains of charcoal. The use of box for tool manufacturing may have produced only a weak signal in archaeological records.

The use of box as firewood

Box was recurrently used by human communities as firewood during the Holocene. The presence of box charcoal has been documented in 77 archaeological levels from the Mesolithic to the Iron Age, which is indicative of its importance for those societies. It was exploited as fuel by the last hunter-gatherer societies, farming communities, and by Bronze and Iron Age societies. Box is the first or second best represented taxon in some sites, while it is marginal in others (figure 6). The causes of this variation can be diverse but the availability of box in the settlement surroundings should be considered as one of the main factors.

Box is more abundant in sites located in the north of the region and inland. The highest percentages correspond to the sites located in the Pre-Pyrenees and central Catalonia, such as Bauma del Serrat del Pont, where most levels have 50-20% of box remains. Similar percentages have been recorded at Cova del Toll, Cova de l'Avellaner, M 22 Peracalç or Institut de Batxillerat de Manlleu, all located in the north. Other sites, like Bosc del Quer, have provided very low number of determined remains and their representativeness is doubtful. In contrast, sites located in the south and in the coastal and pre-littoral areas rarely contain more than 10% of box remains.

Altitude also seems to have played a role in the presence of box. Thus, the sites with the lowest box percentages, less than 5%, are located at low or very high altitude (figure 6). Among the 25 sites located below 250 m asl, only four have provided more than 10% of box remains. One of them corresponds to a site with very few fragments identified (Ca l'Estrada), in the other sites, box appears in percentages lower than 3%.

Above 900 m asl percentages of box were also low, less than 10%. Indeed, among the 13 archaeological levels located at these altitudes, only four show values higher than 10%, again in this case one of the sites has provided a very low number of charcoal remains (Feixa de la Ceba). In contrast, the highest percentages are documented at sites located between 250-745 m asl, with most of the sites reaching percentages over 10%, and several levels more than 20% of box charcoal remains.

The sites represent a wide chronological and geographical span and only in very few periods is it possible to compare sites of similar chronologies in the same area. One of these areas is La Garrotxa where 13 levels dated between 5500-2000 cal BC have been studied. In these levels high percentages of box are documented in almost the entire period, although some differences can be noted. The open air settlements of La Dou, Codella, Plansallosa and Prunera display large differences between values, although they have the highest values of charcoal box remains (from 10 to 63%, and only in one case below 17%). In contrast, the eight temporary occupations in the caves of Bauma del Serrat del Pont and Cova 120 show lower values (from 5 to 31% and only in three cases above 18%). The long occupations at open air settlements could have had a greater impact on the settlement surroundings than in the case of temporary occupations of caves, favouring the expansion and availability of box in their surroundings.

Significance of box during the Holocene in the NE of the Iberian Peninsula

The presence of charcoal and pollen data of box in the study area is very limited in the Upper Pleistocene records. According to the fossil evidence it has been suggested that *Buxus* may have persisted during the full and late Ice Age across Europe in most of its

modern distribution (Di Domenico et al. 2012). The evidence of *Buxus sempervirens* in northeast Iberia supports this hypothesis.

The expansion of box after the beginning of the Holocene has been documented by the clear increases in the number of archaeological sites and pollen sequences with box in the region. This expansion of box during the Holocene has also been documented in other southern and central European regions where the increase in the number of sites recording box, in the form of both pollen and charcoal, has equally been noted (Di Domenico et al. 2012, Delhon et al. 2009; Heinz and Thiébault 1998, Heinz et al., 2004).

The low visibility of box in the Holocene pollen records contrasts with the abundance of charcoal remains, which indicates that it was available in the settlement surroundings and intensively gathered. In some sites, the presence of box is marginal (less than 10% of the remains) but percentages higher than 10% of remains are common. The number of charcoal remains analysed in each site is quite variable which could have had an impact in the results. Therefore, in order to avoid sampling bias the archaeological levels with fewer than 70 fragments were excluded from the quantitative analysis of data, and have only been taken into account at qualitative level. The recurrence and abundance of box charcoal suggests a clear under-representation of this taxon in the pollen records. The fact that charcoal represents the residue of firewood gathered in the surroundings of the settlements enables the hypothesis of box distribution at local level.

During the early Holocene (10,000-5500 BC) the altitude of the sites with box charcoal ranges from 260 m to 1,150 m asl, which suggests a wide altitudinal distribution range. Box is identified throughout the territory, in the south and pre-littoral ranges, Central Catalonia and the Pre-Pyrenees. In the sites with more than 100

fragments, box represents from 0.67 to 34% of the charcoal remains, but the highest values are documented at sites dated in the 8th-7th millennia cal BC (figure 6). In these sites box is associated with *Acer* sp., *Pinus sylvestris-nigra* and deciduous *Quercus*.

Between 5500-4000 cal BC the number of sites with box increases notably, although they are distributed within the same area and similar altitudinal range (from 173 to 1,100 m asl). The percentages of box during this period are highly variable. In the sites dating to the 6th millennium cal BC they represent normally less than 10 % of the identified fragments. However, during the 5th millennium cal BC the percentages of box fragments tend to be higher than 10%, and in some sites represent more than 30% of the identified fragments (figure 6). The most frequent taxa associated with box in these sites are deciduous *Quercus*, *Acer* sp. and *Corylus avellana*. Other taxa are present only at the oldest sites, such as *Laurus nobilis, Juniperus* sp. or *Pinus sylvestris-nigra*, which mainly appear between 5500-5000 cal BC.

Between 4000-2000 cal BC, the number of levels with box decreases, and its distribution is restricted to sites located in the central pre-littoral range, Pre-Pyrenean area and Pyrenees. All the sites with box remains are located from 260 m to 1,360 m asl; again in a wide altitudinal distribution. Box represents between 30-50% of the fragments in most of these sites (figure 6). *Corylus avellana*, and deciduous *Quercus* are present in all the sites together with box. Other frequent taxa are *Acer* sp. and evergreen *Quercus*.

Finally, between 2000 cal BC and175 cal BC, the levels with evidence of box are situated in the Pyrenees, Pre-Pyrenees and pre-littoral valleys and ranges. The majority of the sites are below 600 m asl, and only one was at a higher altitude (1,365 m asl). The percentage of box in these sites is normally lower than 5%, and the highest

values are documented at sites dated in the 2nd millennium cal BC (figure 6). During this period, the taxa associated with box are mostly deciduous and evergreen *Quercus*.

According to the site locations, during the Holocene box was widespread from the north (the Pyrenees) to the south (Ports de Tortosa). All the archaeological sites are close to the present distribution areas of box, which suggests an uninterrupted distribution during the entire Holocene. The site altitudes, which range from sea level to 1150 m asl, indicate a wide altitudinal distribution of box in all periods.

The distribution of box charcoal during the Holocene varies in relation to the number of remains, the number of sites where it has been identified, and the associated taxa. It cannot be ruled out that the very low or very high presence of box charcoal at some sites could be related to uses of boxwood rather than to low or high abundance of the species in the immediate environment. Charcoal remains are the result of human selection of wood mainly as fuel, but also useless artefacts could have been thrown into the fire.

The number of sites with box remains is highest in the early-middle Holocene levels, and therefore the highest density of sites with box occurs between ca. 5500-4000 BC. It is present in 71% of archaeological levels dated in this period, and this is also when the highest values of charcoal fragments have been identified. The increase in the use of box may have been favoured by human activity, especially in agrarian and pastoral societies. Degradation of the oak forests could have favoured the expansion of box in the surroundings of the inhabited places, since box is a pioneer taxon which expands in disturbed oak forest. The increase of box percentages in middle Holocene sites has been documented also in southern France where it has been interpreted as a result of disturbances caused by human activity (Delhon et al. 2009). A similar tendency is observed in the northeast of the Iberian Peninsula. In this sense, in La Bauma del

Serrat del Pont the abundances of box and oak are inversely related: the increase in box coincides with the decrease in oak (Piqué et al. 2018). The case of La Draga should also be highlighted: disturbance of the oak forest has been documented associated with the arrival of the early Neolithic population at the settlement (Revelles et al. 2015). Thousands of oak trees were cut down in this site to obtain raw material for the construction of dwellings and firewood. In this site the proportion of box charcoal increased in the most recent phase and reached 14% of the remains (Caruso and Piqué 2014). Clearances produced by human activity may have enlarged the areas favourable to the growth of box.

The number of sites with evidence of box decreases after 4000 cal BC, coinciding with the climatic change observed in southern Europe from the Middle to Late Holocene (Di Domenico et al. 2012). Given that box occurs in humid conditions, the general aridification during the Holocene, accentuated during the Late Holocene, would have affected the distribution of this taxon in the landscape. Certainly, the decrease in box charcoal coincides with the increase in the evergreen *Quercus* in charcoal records in the region, as this species becomes common in sites dated from 2000 cal BC, indicating the existence of drier conditions (Figure 6). The pollen record also indicates a change in climate conditions in northeast Iberia from the Middle to Late Holocene transition (3000-2000 cal BC) onwards. The change in seasonality, with a longer dry season and lower precipitation and water availability in summer, provoked changes in vegetation that explain the current landscape in this region, with the replacement of broadleaf deciduous woodland by evergreen sclerophyllous forests and shrublands in a progressively more open landscape (Revelles et al. 2018). This is consistent with environmental dynamics in the Mediterranean region, where an aridification process during the Late Holocene is evident (Denèfle et al. 2000; Jalut et

al. 2000, 2009; Roberts et al. 2001; Sadori and Narcisi 2001; Carrión et al. 2010; Sadori 2013). The abrupt decline in mesic taxa is well documented in the Balearic Islands where a change in climate towards drier conditions and more pronounced seasonality has been proposed (Burjachs et al. 2017).

Conclusions

The integration of different types of evidence indicates the presence of *Buxus sempervirens* in the north-east of the Iberian Peninsula during the Holocene. The distribution of box was widespread, from sea level to high altitudes and from north to south. Despite its low presence in pollen records, charcoal remains have revealed an intensive use of box as firewood since the Mesolithic. The exploitation of box was especially intense between 5000-4000 cal BC and the decrease in box coincides with a major presence of evergreen *Quercus* in the region accompanied by a drier climate.

Boxwood was also particularly sought out for the manufacturing of tools, as seen in the early Neolithic site of La Draga. At this site, box pollen appears in very low percentages but box is well represented by macro-remains such as leaves, charcoal and wood. The site of La Draga demonstrates that the weak signal of box in charcoal and pollen records is compatible with the use of box for other purposes.

References

Alcolea, M. 2017.”Paisaje vegetal y gestión de recursos leñosos durante la transición epipaleolítico – neolítico en el valle del Ebro. Aportaciones desde la antracología.” Unpublished PhD diss., Universidad de Zaragoza

Allué, E. 2011. “Estudi antracològic del jaciment de Forat de Conqueta (Santa Linya, Lleida)”. *Treballs d'Arqueologia* 17: 27-35.

Allué, E., J. Martínez-Moreno, N. Alonso, and R. Mora. 2012." Changes in the vegetation and human management of forest resources in mountain ecosystems at the beginning of MIS 1 (14.7-8 ka cal BP) in Balma Guilanyà (Southeastern Pre-Pyrenees, Spain)". *Comptes Rendus Palevol* 11(7): 507-518.

Allué, E., F. Burjachs, J.L. Vernet, J.I. Morales, A. Rodríguez-Hidalgo, A. Cebrià and J. Rosell. 2013. "Cova del Toll (Moià, Bages): Perspectiva paleoambiental i arqueobotànica del Plistocè i Holocè." *Quadern de Prehistòria Catalana* 21: 21-38.

Allué, E., Ll. Picornell-Gelabert, J. Daura, and M. Sanz. 2017. "Reconstruction of the Palaeoenvironment and Anthropogenic Activity from the Upper Pleistocene/Holocene Anthracological Records of the NE Iberian Peninsula (Barcelona, Spain)." *Quaternary International* 457: 172-189. DOI: https://doi.org/10.1016/j.quaint.2016.10.024.

Allué, E., J.L. Vernet, and A. Cebrià. 2009. "Holocene Vegetational Landscapes of NE Iberia: Charcoal Analysis from Cova de la Guineu, Barcelona, Spain." *The Holocene* 19 (5): 765-773. DOI: https://doi.org/10.1177/0959683609105301.

Aranguren, B., A. Revedin, N. Amico, F. Cavullid, G. Giachie, S. Grimaldi, N. Macchionie and F. Santaniello. 2018. "Wooden Tools and Fire Technology in the Early Neanderthal Site of Poggetti Vecchi (Italy)." *PNAS* 115 (9): 2054-2059. DOI: https://doi.org/10.1073/pnas.1716068115.

Base de dades Radiocarbòniques de Catalunya. Servei d'Arqueologia i Paleontologia (Generalitat), Departament de Prehistoria (UAB) (details; accessed April, 12th, 2018). http://ibercrono.org/cat14/index.php/main.

Boquer, S. 1995. *El jaciment de l'institut de batxillerat Antoni Pous*. Barcelona: Departament de Cultura de la Generalitat de Catalunya.

Bocquet, A. and M. Noël. 1985. "The Neolithic or Wood Age." *Endeavour, New Series* 9 (1): 34-41. DOI: https://doi.org/10.1016/0160-9327(85)90007-9.

Bosch, A., J. Chinchilla, J. Tarrús and R. Piqué. 2006. “Els objectes de fusta i fibres vegetals.” In *Els objectes de fusta del poblat neolític de la Draga. Excavacions 1995 – 2005*, edited by A. Bosch, J. Chinchilla and J. Tarrús. 27-126. Girona: Museu d’Arqueologia de Catalunya.

Broncano, S. 1989. *El depósito votivo ibérico de El Almarejo, Bonete (Albacete). Excavaciones Arqueológicas en España*. Madrid: Ministerio de Cultura de España.

Burjachs, F. 1994. “Palynology of the Upper Pleistocene and Holocene of the Northeast Iberian Peninsula: Pla de l’Estany (Catalonia).” *Historical Biology* 9(1-2), 17-33. DOI: https://doi.org/10.1080/10292389409380485

Burjachs, F. 1997. “L’entorn de l’assentament. Reconstitució del paisatge vegetal i el clima.” In *Procés d’ocupació de la Bauma del Serrat del Pont (La Garrotxa), entre el 2900 i el 1450 cal AC*, edited by G. Alcalde, M. Molist, M. Saña, and A. Toledo, 13-14, 41, 61, 77. Olot: Museu Comarcal de la Garrotxa.

Burjachs, F. 2002. “L’entorn de l’assentament. Reconstitució del paisatge vegetal i el clima.” In *Procés d’ocupació de la Bauma del Serrat del Pont (La Garrotxa) entre 5480 i 2900 cal AC*, edited by G. Alcalde, M. Molist and M. Saña, 19-22, 63-64, 79-80, 91-92, 97-98. Olot: Museu Comarcal de la Garrotxa.

Burjachs, F., R. Pérez-Obiol, Ll. Picornell-Gelabert, J. Revelles, G. Servera-Vives, I. Expósito and E-I. Yll. 2017. “Overview of Environmental Changes and Human Colonization in the Balearic Islands (Western Mediterranean) and their Impacts on Vegetation Composition during the Holocene.” *Journal of Archaeological Science: Reports*, 12: 845-859. DOI: https://doi.org/10.1016/j.jasrep.2016.09.018.

Burjachs, F. and L. Schulte. 2003. “El paisatge vegetal del Penedès entre la Prehistòria i el Món Antic.” In *Paisatges antics a la Mediterrània i a la Cossetania oriental*, edited

by J. Guitart, J.M. Palet and M. Prevosti, 249-254. Barcelona: Departament de Cultura, Generalitat de Catalunya.

Cañellas-Boltà, N., V. Rull, J. Vigo and A. Mercadé. 2009. "Modern Pollen Vegetation Relationships along an Altitudinal Transect of the Central Pyrenees (Southwestern Europe)." *Holocene* 19 (8): 1185-2000. DOI: https://doi.org/10.1177/0959683609345082.

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

Carrión, J.S., S. Fernández, P. González-Sampériz, G. Gil-Romera, E. Badal, Y. Carrión-Marco, L. López-Merino, et al, 2010. "Expected trends and surprises in the Lateglacial and Holocene vegetation history of the Iberian Peninsula and Balearic Islands." *Review of Palaeobotany and Palynology* 162: 458-475.

Caruso-Fermé, L. and R. Piqué. 2014. "Landscape and Forest Exploitation at the Ancient Neolithic Site of La Draga." *The Holocene*, 24 (3): 266-273. DOI: https://doi.org/10.1177/0959683613517400.

Castro Curel, Z. 1988. "Peines prehistóricos peninsulares". *Trabajos de prehistoria* 45: 243-258.

Costa Vaz, F., M. Martín-Seijo, S. Carneiro and J.P. Tereso. 2016. "Waterlogged Plant Remains from the Roman Healing Spa of Aquae Flaviae (Chaves, Portugal): Utilitarian Objects, Timber, Fruits and Seeds." *Quaternary International* 404 (A): 86-103. DOI: https://doi.org/10.1016/j.quaint.2015.09.063.

Chabal, L., and M. Feugere, 2005. "Le mobilier organique des puits antiques et autres contextes humides de Lattara." In *Onze puits gallo-romains de Lattara (Ier s. av. n. è. - IIe s. de n. è.). Fouilles programmées 1986-2000* edited by G. Piquès, R. Buxó. Lattara 18:137-188,.

da Silva, N., W.M. da Silva Oliveira, H. Antunes de Almeida Filho, L.F. Souza Pinheiro, D. Rodrigo Rossatto, R.M. Kolb, and O. Martinez Bruno. 2016. "Leaf epidermis images for robust identifications of plants." *Scientific Reports* 6: 25994.

De Diego, M., R. Piqué, P. Palomo, M. Saña Seguí, M. Mozota, I. Clemente, X. Terradas, 2017. Fibre Production and Emerging Textile Technology in the Early Neolithic Settlement of La Draga, Banyoles, north-east Iberia; 5300 to 4900 cal BC. In *Archaeological Textiles - Links Between Past and Present NESAT XIII*, edited by M. Bravermanová, H.Březinová, J. Malcolm-Davies, 293-302. Liberec-Praha: Technical University of Liberec.

Debussche, M. and J. Lepart. 1992. "Establishment of Woody Plants in Mediterranean Old Fields: Opportunity in Space and Time." *Landscape Ecology*, 6 (3): 133-145. DOI:. https://doi.org/10.1007/BF00130026.

Decocq, G., D. Bordier, JR. Wattez, and P. Racinet, 2004. "A practical approach to assess the native status of a rare plant species: the controverse of *Buxus sempervirens* L. in northern France revisited." *Plant Ecology* 173: 139-151. https://doi-org.are.uab.cat/10.1023/B:VEGE.0000026337.85794.fb

Delhon, C., S. Thiébault, and J-F. Berger. 2009. "Environment and landscape management during the Middle Neolithic in Southern France: Evidence for agro-sylvo-pastoral systems in the Middle Rhone Valley." *Quaternary International* 200 (1-2): 50-65. https://doi.org/10.1016/j.quaint.2008.05.008.

Denèfle, M., A.-M. Lézine, E. Fouache, and J.J., Dufaure. 2000. « A 12000 year pollen record from Lake Maliq, Albania." Quaternary Research 54: 423–432.

Derks, T. and W.V. Vos. 2010. "Wooden Combs from the Roman Fort at Vechten: the Bodily Appearance of Soldiers." *Journal of Archaeology in the Low Countries*, 2 (2): 53-77.

Di Domenico, F., F. Lucchese and D. Magri. 2012. "Buxus in Europe: Late Quaternary Dynamics and Modern Vulnerability." *Perspectives in Plant Ecology, Evolution and Systematics*, 14 (5): 354-362. DOI: https://doi.org/10.1016/j.ppees.2012.07.001.

Ejarque, A., R. Julià, S. Riera, J.M. Palet, H.A. Orengo, Y. Miras and C. Gascón. 2009. "Tracing the History of Highland Human Management in the Eastern Pre-Pyrenees: an Interdisciplinary Palaeoenvironmental Study at the Pradell Fen, Spain." *The Holocene*, 19 (8): 1241-1255. DOI: https://doi.org/10.1177/0959683609345084.

Ferré, M. and R. Piqué. 2002. "Explotació del paisatge forestal al Neolític final: resultats preliminars de l'estudi antracològic de la Prunera (Olot)." In *Pirineus i veïns al 3er mil.lenni A.C. De la fi del Neolític a l'Edat del Bronze entre l'Ebre i el Garona*, edited by O. Mercadal, 235-243. Puigcerdà: Publicacions de l'Institut d'Estudis Ceretans.

Folch i Guillén, R. 1988. Vegetació. Vol.7 of *Història Natural dels Països Catalans* of R. Folch i Guillén. Barcelona: Fundació Enciclopèdia Catalana.

Font, X. 2018. Mòdul Flora i Vegetació. Banc de Dades de Biodiversitat de Catalunya. Generalitat de Catalunya i Universitat de Barcelona. (details; accessed April, 4th, 2018) http://biodiver.bio.ub.es/biocat/homepage.html.

Font i Quer, P. 1999. *Plantas Medicinales. El dioscórides renovado*. Barcelona: Península.

Franch, A., and Piqué, R. in press. El combustible leñosos del yacimiento neolitico de La Draga (Banyoles): aplicación del estudio del diámetro. Actas VI Congreso Neolítico Peninsular, Granada 2016.

Garcés-Pastor, S., N. Cañellas-Boltà, A. Pèlachs, J.M. Soriano, R. Pérez-Obiol, A. Pérez-Haase, M.A. Calero, O. Andreu, N. Escolà and T. Vegas-Vilarrúbia. 2017. "Environmental History and Vegetation Dynamics in Response to Climate Variations

and Human Pressure During the Holocene in Bassa Nera, Central Pyrenees." *Palaeogeography, Palaeoclimatology, Palaeoecology*, 479: 48-60. DOI: https://doi.org/10.1016/j.palaeo.2017.04.016.

Heinz, C. and J.L. Vernet. 1995. "Anàlisi antracològica dels nivells Mesolítics i Neolítics antics de la Balma Margineda, Paleoecologia i relacions Home-Vegetació." In Les excavacions de la Balma Margineda (1979-1991), edited by J. Guilaine and M. Martzluff, 26-64. Andorra: Ministeri d'Afers Socials i Cultura del govern Andorra.

Heinz, C., and S. Thiébault. 1998. "Characterization and palaeoecological significance of archaeological charcoal assemblages during late and post-glacial phases in southern France." *Quaternary Research* 50(1): 56-68.

Heinz, C., I. Figueiral, J. F. Terral, and F. Claustre, F. 2004. "Holocene vegetation changes in the northwestern Mediterranean: new palaeoecological data from charcoal analysis and quantitative eco-anatomy." *The Holocene* 14(4): 621-627.

Holden, T. G, J.G. Hather and J.P.N. Watson. 1995. "Mesolithic Plant Exploitation at the Roc del Migdia, Catalonia." *Journal of Archaeological Science* 22 (6), 769-778. DOI: https://doi.org/10.1016/0305-4403(95)90006-3.

Jalut, G., A. Esteban-Amat, L. Bonnet, T. Gauquelin, and M.Fontugne. 2000. "Holocene climatic changes in the Western Mediterranean, from south-east France to south-east Spain." *Palaeogeography, Palaeoclimatology, Palaeoecology* 160: 255–290.

Jalut, G., J.J. Dedoubat, M. Fontugne, T. Otto. 2009. "Holocene circum-Mediterranean vegetation changes: climate forcing and human impact." *Quaternary International* 200, 4–18.

Jordà, J.F., R. Mora and R. Piqué. 1992. "La seqüència litoestratigràfica y arqueològica del yacimiento de la Font del Ros (Berga, Barcelona)." *Cuaternario y Geomorfologia* 6: 21-30.

Llobera, X. 1987. "La Feixa del Moro i el neolític mig-recent a Andorra*." Tribuna d'Arqueologia 1985-1986:* 17-19. Barcelona: Departament de Cultura, Generalitat de Catalunya.

Lodwick, L. A. 2017 Evergreen plants in Roman Britain and beyond: movement, meaning and materiality. *Britannia*, 48. pp. 135-173.

López-Bultó, O. 2015. "Processos d'obtenció, transformació i ús de la fusta en l'assentament neolític antic de la Draga (5320-4800 cal BC)". PhD diss., Universitat Autònoma de Barcelona.

López-Bultó, O., and R. Piqué. 2018. "Wood Procurement at the Early Neolithic site of La Draga (Banyoles, Barcelona)." *Journal of Wetland Archaeology* 18 (1): 56-76, DOI: 10.1080/14732971.2018.1466415.

Lull, V., R. Micó,, C. Rihuete,, and R. Risch, 1999. *Ideología y sociedad en la prehistoria de Menorca: La Cova des Càrritx y la Cova des Mussol,* V. Lull. Ciutadella: Consell Insular de Menorca.

Masclans, F. 1990. *Guia per a conèixer els arbres*. Barcelona: Centre Excursionista de Catalunya.

Meiggs, R. 1983. *Trees and Timber in the Ancient Mediterranean world*. Oxford: Clarendon Press.

Mumcuoglu K.Y., and G. Hadas. 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 (2): 223-229.

Oms, F., M.À. Petit, E. Allué, A. Bargalló, H. Blain, J. López-García, P. Martín, et al.. 2009. "Estudio transdisciplinar de la fosa EE1 de la Cova Colomera (Prepirineo de Lleida): implicaciones domésticas y paleoambientales en el Bronce Antiguo del noreste de la Península Ibérica." *Trabajos de Prehistoria* 66(1), 123-144.

Palomo, A., R. Piqué and X. Terradas. 2017. *La revolució neolítica. La Draga, el poblat dels prodigis*. Barcelona: Museu d'Arqueologia de Catalunya.

Palomo, A., R. Piqué, X. Terradas, A. Bosch, R. Buxó, J. Chinchilla, M. Saña and J. Tarrús. 2014. "Prehistoric Occupation in Banyoles Lakeshore: Results of Recent Excavations in La Draga Site (Girona, Spain)." *Journal of Wetland Archaeology* 14 (1): 58-73. DOI: http://dx.doi.org/10.1179/1473297114Z.00000000010.

Palomo, A., R. Piqué, X. Terradas, O. López-Bultó, I. Clemente and J.F. Gibaja. 2013. "Woodworking Technology in the Early Neolithic Site of La Draga (Banyoles, Spain)". In *Regards croisés sur les outils liés au travail des végétaux / An interdisciplinary focuson plant-working tools*, edited by P.C. Anderson, C. Cheval, A. Durand, 383-396. Antibes: APDCA.

Parra, I., E. van Campo and T. Otto. 2005. "Análisis palinológico y radiométrico del sondeo Sobrestany. Nueve milenios de historia natural e impactos humanos sobre la vegetación del Alt Empordà." *Empúries* 54: 33-44.

Pèlachs, A., J.M. Soriano, J. Nadal and A. Esteban. 2007. "Holocene Environmental History and Human Impact in the Pyrenees." *Contributions to Science* 3 (3): 423-431.

Pérez-Obiol, R. 1988. "Histoire tardiglaciaire et holocène de la végétation de la région volcanique d'Olot (NE Péninsula Ibérique)." *Pollen et Spores* 30 (2), 189-202.

Pérez-Obiol, R. and R. Julià. 1994. "Climatic Change on the Iberian Peninsula Recorded in a 30.000 yr Pollen Record from Lake Banyoles." *Quaternary Research* 41 (1): 91-98. DOI: https://doi.org/10.1006/qres.1994.1010.

Piqué, R. 1999a. "La gestión de los recursos leñosos en la Cova des Càrritx". In *Ideología y sociedad en la prehistoria de Menorca: La Cova des Càrritx y la Cova des Mussol*, V. Lull, R. Micó, C. Rihuete, R. Risch, 489-520, Ciutadella: Consell Insular de Menorca.

Piqué, R. 1999b. “Estudis Paleobiològics.” In *Can Roqueta. Un establiment pagès prehistòric i medieval (Sabadell, Vallès Occidental), Excavacions arqueològiques a Catalunya*, edited by P. González Marcen, A. Martín and R. Mora, 207-220. Barcelona: Direcció General del Patrimoni Cultural, Servei d’Arqueologia.

Piqué, R. 2000. “La gestió dels recursos llenyosos a La Draga.” In *El poblat lacustre neolític de La Draga. Excavacions de 1990 a 1998*, edited by A. Bosch, J. Chinchilla and J. Tarrús, 140-149. Girona: Monografies del CASC 2, Centre d’Arqueologia Subaquàtica de Catalunya.

Piqué, R. 2002a. “Anàlisi Antracològica.”. In *Procés d’ocupació de la Bauma del Serrat del Pont (La Garrotxa) entre 5480 i 2900 cal AC. Publicacions Eventuals d’Arqueologia de la Garrotxa 7,* edited by G. Alcalde, M. Molist and M. Saña, 17-18, 54-56, 77. Olot: Museu Comarcal de la Garrotxa.

Piqué, R. 2002b. “Paisatge i explotació forestal durant el I mil·leni a la plana empordanesa.” *Cypsela*, 14: 211-228.

Piqué, R. 2006. “L’aprofitament del combustible vegetal a Can Barraca.” In *Can Barraca, una necròpolis d’incineració de fa 2800 anys a Besalú (La Garrotxa),* edited by P. Martín Machín, 48-49. Girona: Diputació de Girona.

Piqué, R., and M. Noguera 2002. Landscape Management of Forest Resources in the Balearic Islands during the II-I Millennium BCE. In *World islands in prehistory: international insular investigations:V Deia International Conference of Prehistory* edited by W.H. Waldren and J.A. Ensenyat, 292-300. Oxford: Archaeopress.

Piqué, R. and C. Mensua. 2007. “L’aprofitament de l’entorn forestal per a l’obtenció del combustible.” In *Cabanes, sitges i tombes. El paratge de Can Roqueta del 1300 al 500 AC. Quadern d’Arqueologia 4*, edited by X. Carlús, F. J. López, M. Oliva, A. Palomo,

A. Rodríguez, N. Terrats, C. Lara, N. Villena, 73-75. Sabadell: Museu d'Història de Sabadell.

Piqué, R. and C. Mensua. 2008. "Anàlisi antracològica." In *Procés d'ocupació de la Bauma del Serrat del Pont (La Garrotxa) entre 7400 i 5480 cal AC.,* edited by G. Alcalde and M. Saña, 22-23,63-64,80-82, 92, 98. Olot: Museu Comarcal de La Garrotxa.

Piqué, R., J. Revelles, F. Burjachs, L. Caruso-Fermé and R. Pérez-Obiol. 2018. "Interdisciplinary Approach to the Landscape and Firewood Exploitation During the Holocene at La Garrotxa (Girona, NE Iberia)." *Quaternary International* 463(B): 401-413. DOI: https://doi.org/10.1016/j.quaint.2016.11.025.

Revelles, J., F. Burjachs, A. Palomo, P. Piqué, E. Iriarte, R. Pérez-Obiol, X. Terradas. 2018. "Human-environment interaction during the Mesolithic-Neolithic transition in the NE Iberian Peninsula. Vegetation history, climate change and human impact during the Early-Middle Holocene in the Eastern Pre-Pyrenees." *Quaternary Science Reviews* 184: 183-200.

Revelles, J., F. Burjachs and B. van Geel. 2016. "Pollen and Non-pollen Palynomorphs from the Early Neolithic Settlement of La Draga (Girona, Spain)." *Review of Palaeobotany and Palynology* 225:1–20. DOI: https://doi.org/10.1016/j.revpalbo.2015.11.001.

Revelles, J., F. Burjachs, N. Morera, J.A. Barceló, A. Berrocal, O. López-Bultó, C. Maicher, et al. 2017. "Use of Space and Site Formation Processes in a Neolithic Lakeside Settlement. Pollen and Non-pollen Palynomorphs Spatial Analysis in La Draga (Banyoles, NE Iberia)." *Journal of Archaeological Science* 81: 101-115. DOI: https://doi.org/10.1016/j.jas.2017.04.001.

Revelles, J., S. Cho, E. Iriarte, F. Burjachs, B. van Geel, A. Palomo, R. Piqué, et al. 2015. "Mid-holocene Vegetation History and Neolithic Land-use in the Lake Banyoles Area (Girona, Spain)." *Palaeogeography, Palaeoclimatology and Palaeoecology* 435: 70-85. DOI: https://doi.org/10.1016/j.palaeo.2015.06.002.

Riera, S., and A. Esteban-Amat. 1994. "Vegetation History and Human Activity During the Last 6000 Years on the Central Catalan Coast (Northeastern Iberian Peninsula)." *Vegetation, Hitory and Archaeobotany* 3 (1): 7-23. DOI: https://doi.org/10.1007/BF00208885.

Roberts, N., M.E. Meadows, and J.R., Dodson. 2001. "The history of Mediterranean-type environments: climate, culture and landscape." *The Holocene* 11, 631–634.

Rodanés, J.M., M. Alcolea. 2017. "Los objetos de madera". In *La cueva sepulcral del Moro de Alins del Monte. Prehistoria de la Litera, Huesca*, J.M. Rodanés Vicente, 53-61. Zaragoza: Prensas de la Universidad de Zaragoza.

Ros, M.T. 1987. "Anàlisi antracològica de la cova de l'Arbreda." *Cypsela* IV: 67-71.

Ros, M.T. 1988. "L'aplicació de l'anàlisi antracològica a l'arqueologia catalana." *Cota zero* 4: 51-60.

Ros, M.T. 1995. "Estudi antracològic de tres jaciments de la Vall del Llierca (Garrotxa, Catalunya). L'activitat humana i el medi vegetal del Neolític Antic al Bronze Final." In In *cultures i medi. De la prehistoria a l'edat mitjana. 20 anys d'arqueologia pirinenca. Homenatge al professor Jean Guilaine. X Col.loqui internacional d'arqueologia de Puigcerda, del 10 al 12 de novembre de 1994*, edited by J. Padró i Parcerisa, 87- 96. Puigcerdà: Institut d'Estudis Ceretans.

Ros, M.T. and J.L. Vernet 1987. "L'environment végétal de l'homme du Néolithique à l'âge du Bronze dans le Nord-Est de la Catalogne d'après l'analyse anthracologique de la Cova del Frare, St. Llorenç de Munt (Matadepera, Barcelona)" In *Actes du Colloque*

International Premières Communautés Paysannes en Mediterranée Occidentale. Montpellier 1983, edited by J. Guilaine, J. Courtin, J.L. Roudil and J.L. Vernet, 125-129. Paris: CNRS Éditions.

Sadori, L. 2013. "Postglacial pollen records of Southern Europe." In: *Encyclopedia of Quaternary Science*, edited by S.A. Elias, vol. 4: 179–188. Amsterdam: Elsevier.

Sadori, L., and B. Narcisi, 2001. "The postglacial record of environmental history from Lago di Pergusa, Sicily." *The Holocene* 11: 655–672.

Salvesen, P. H., B. Kanz, and D. Moe. 2009. "Historical Cultivars of *Buxus sempervirens* L. Revealed in a Preserved 17 th Century Garden by Biometry and Amplified Fragment Length Polymorphism (AFLP)." *European Journal of Horticultural Science* 130-136.

Schweingruber, F.H. 1990. *Anatomie europäischer Hölzer. Anatomy of European Wood*. Berna and Stuttgart: Haupt.

Smirnova L.I. 2007. "Wooden combs in the light of the history of comb-making in Novgorod." In *Wood use in medieval Novgorod*, edited by M. Brisbane and J. Hather, 298-334. Oxford: Oxbow Books.

Tarrús J. and A. Bosch. 1990. "Els nivells postglacials de la cova d'En Pau (Serinyà, Pla de l'Estany)." *Cypsela* VIII: 21-47.

Tena, D. 2009. "5110 Formaciones estables xerotermófilas de *Buxus sempervirens* en pendientes rocosas (*Berberidion* p.p.)." In *Bases ecológicas preliminares para la conservación de los tipos de hábitat de interés comunitario en España*, edited by E. Bermejo Bermejo, F. Melado Morillo, 1-67. Madrid: Ministerio de Medio Ambiente, y Medio Rural y Marino.

Thiébault, S. and J.L. Vernet. 1992. "Végétations méditerranéennes et civilisations préhistoriques: le cas de Font-Juvénal." In *Bulletin de la Société Botanique de France,*

Actualités Botaniques 139 (2-4), 441-450. DOI: https://doi.org/10.1080/01811789.1992.10827119.

Ulrich, R.B. 2007. *Roman woodworking*. New Heaven and London: Yale University Press.

Vernet, J. L. 1990. Man and vegetation in the Mediterranean area during the last 20,000 years. In *Biological invasions in Europe and the Mediterranean Basin*. pp. 161-168. Dordrecht: Springer.

Vila, S. and R. Piqué. 2012. "Paisatge vegetal i gestió del combustible a la plana occidental catalana entre el neolític i l'edat mitjana: estat de la qüestió des de l'anàlisi antracològica" *Revista d'Arqueologia de Ponent*, 22: 9- 35.

Warnock, P., and M. Pendleton.1991. "The Wood of the Ulu Burun Diptych." *Anatolian Studies* 41, 107-110. doi:10.2307/3642933

Captions

Table 1. Taxa identified in the wooden tools from the early Neolithic site of La Draga (5324 to 4977 cal BC).

Figure 1. Location of the study area (left), the site of La Draga (centre) and location of Sector A, B and C within the site of La Draga (right).

Figure 2. Present distribution of *Buxus sempervirens* in the NE Iberian Peninsula (from Biodiversity data bank of Catalonia, http://biodiver.bio.ub.es/biocat/#pas4). Each square corresponds to a 10x10km area. The intensity of colour indicates the abundance of the records cited in the Biodiversity data bank of Catalonia (Font 2018).

Figure 3. Distribution of *Buxus sempervirens* charcoal in archaeological sites (red dots) and of pollen sites with evidence of boxwood (blue dots) per chronology at north-east of

the Iberian Peninsula. (1) Balma Guilanyà; (2) Balma Margineda; (3) Bauma del Serrat Pont; (4) Bosc del Quer; (5) Ca l'Estrada; (6) Ca l'Oliaire; (7) Camp de la Farigola; (8) Can Barraca; (9) Can Gambús; (10) Can Roqueta DIASA; (11) Can Roqueta II; (12) Can Roqueta-Can Revella; (13) Cingle Vermell; (14) Codella; (15) Cova 120; (16) Cova Bonica; (17) Cova Colomera; (18) Cova de la Guineu; (19) Cova de l'Avellaner; (20) Cova del Frare; (21) Cova del Toll; (22) Cova del Vidre; (23) Cova d'en Pau; (24) Escola Meritxell; (25) Feixa de la Ceba; (26) Feixa del Moro; (27) Font de la Conqueta; (28) Font del Ros; (29) Institut de Batxillerat de Manlleu; (30) La Dou; (31) La Draga; (32) La Prunera; (33) M22 Peracalç; (34) Mas Castellar; (35) Missatges; (36) Plansallosa; (37) Pou Nou 2; (38) PujoletMoja; (39) Roc del Migdia; (40) Sant Martí d'Empúries; (41) Serra del Mas Bonet.

(A) Bassa Nera (Garcés Pastor et al., 2017); (B) Creixell (Burjachs and Schulte, 2003); (C) Cubelles (Riera and Esteban-Amat, 1994); (D) Estany de Burg (Pèlachs et al., 2007); (E) Lake Banyoles (Pérez-Obiol and Julià, 1994; Revelles et al., 2015); (F) Les Palanques (Pérez-Obiol, 1988); (G) Mercabarna (Riera and Esteban-Amat, 1994); (H) Pla de l'Estany (Burjachs, 1994); (I) Pradell Fen (Ejarque et al., 2009); (J) Sobreestany (Parra et al., 2005).

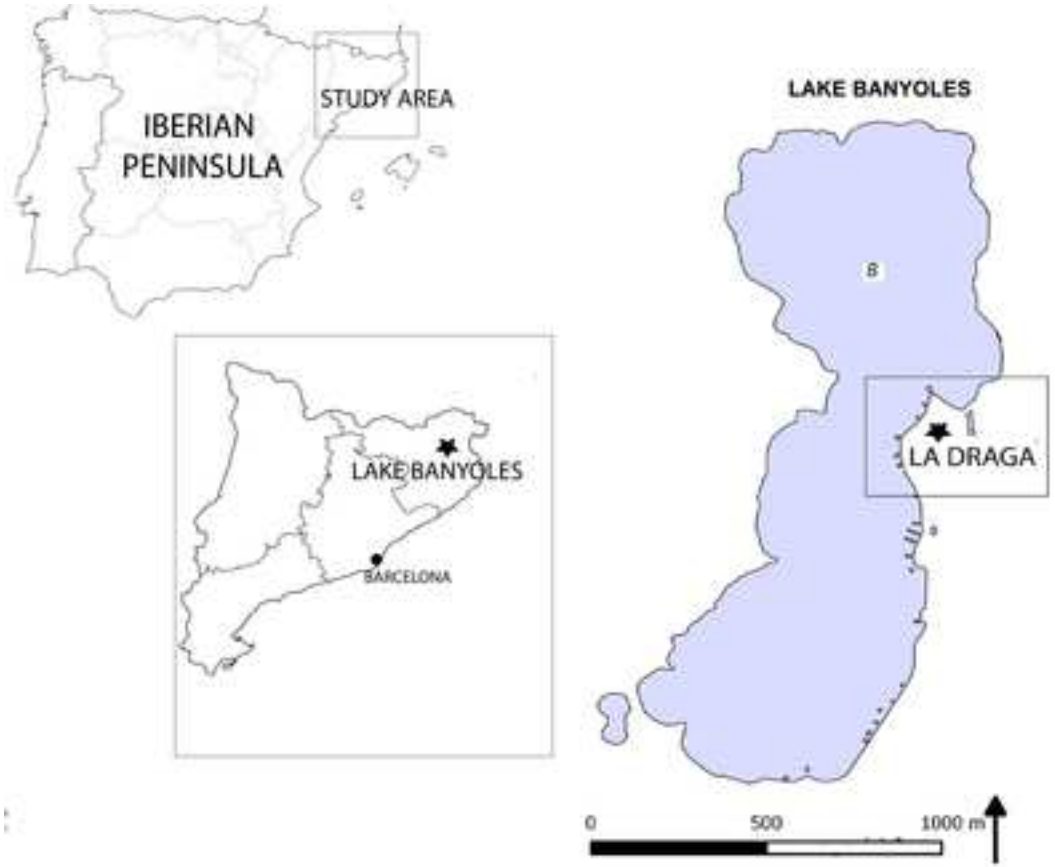
Figure 4. A) Fresh fossil leaves of Buxus sempervirens collected at La Draga archaeological site. B) Epidermal clearings of fossil and contemporary leaves of Buxus sempervirens used to confirm species identification. Preparations were stained with 1% safranin.

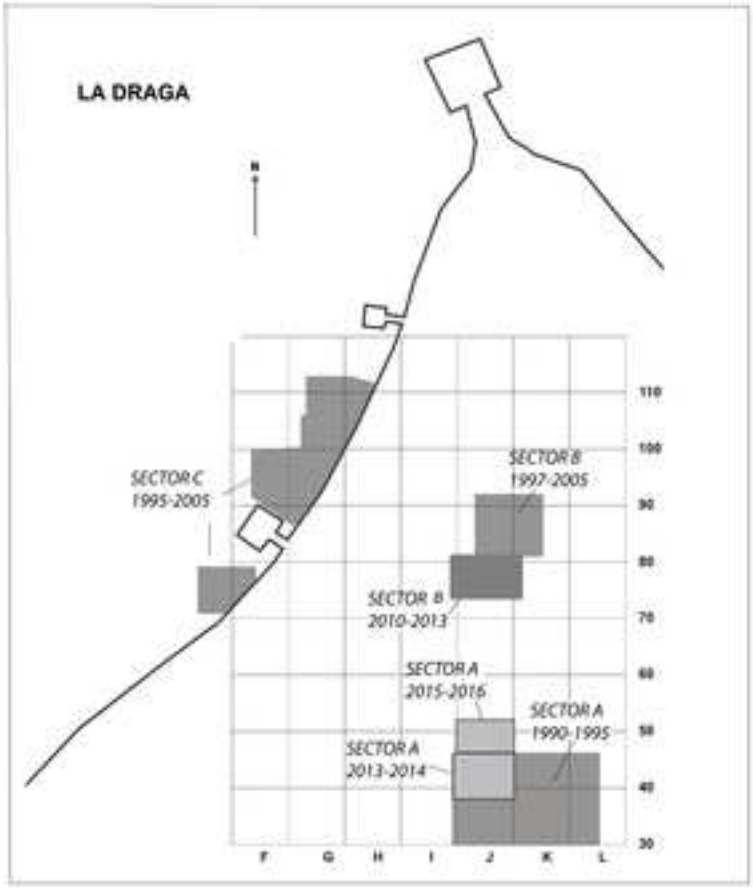
Figure 5. Summary pollen diagram for SB2 (silhouette) and La Draga (histogram). Presence/absence of *Buxus* in SB2 core (crosses) and at La Draga (dots). Categories: shrubland (*Erica*, Cistaceae, *Heliathemum*, *Vitis*, *Hedera helix*, *Crataegus*,

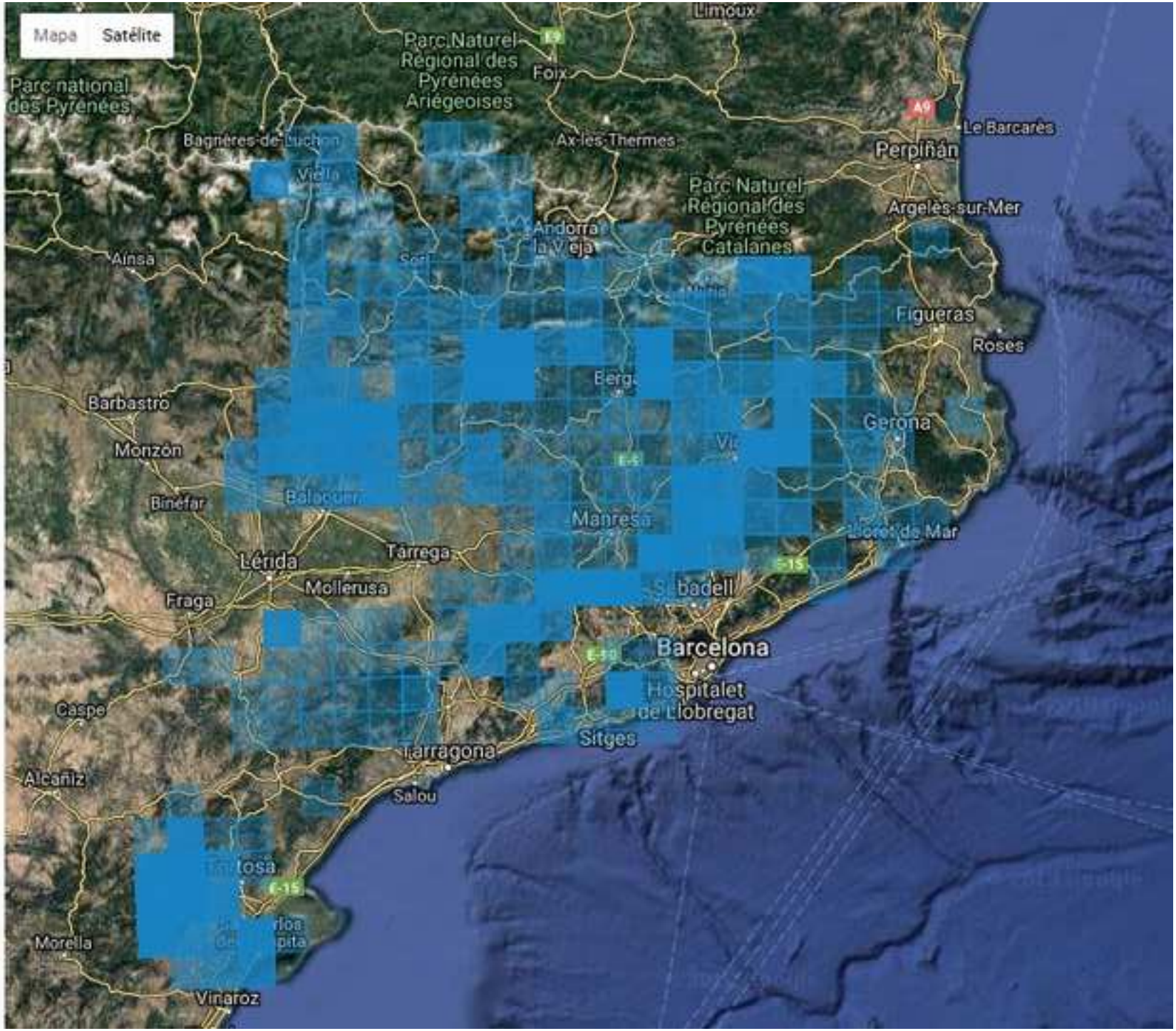
Sanguisorba, *Rhamnus*), grasslands (Poaceae, *Artemisia*, *Filipendula*, Asteraceae, Apiaceae, *Galium*-t, *Plantago*, Lamiaceae). X axis: percentage, Y axis chronology.

Figure 6. Percentage anthracology diagram of box and a selection of the most frequent taxa identified. Charcoal taxa are plotted according the geographical area and chronologically. For each area data are plotted from older (bottom) to recent (top).

Supplementary material table. Sites with presence of box charcoal in the north-east of the Iberian Peninsula. C14 dates from Base de dades Radiocarbòniques de Catalunya. Servei d'Arqueologia i Paleontologia (Generalitat), Departament de Prehistoria (UAB) (details; accessed April 12th, 2018). http://ibercrono.org/cat14/index.php/main







Non-colour figure

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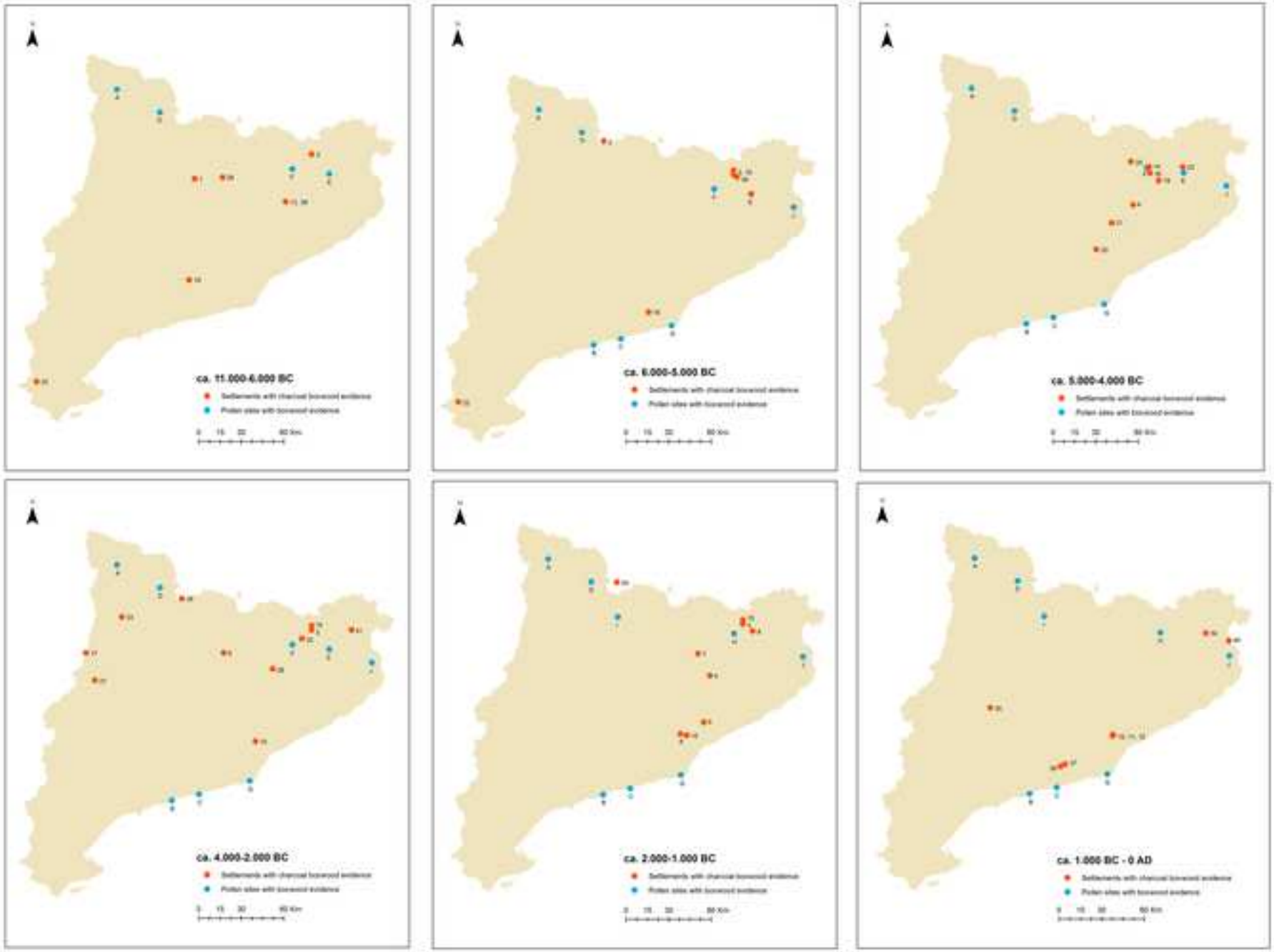

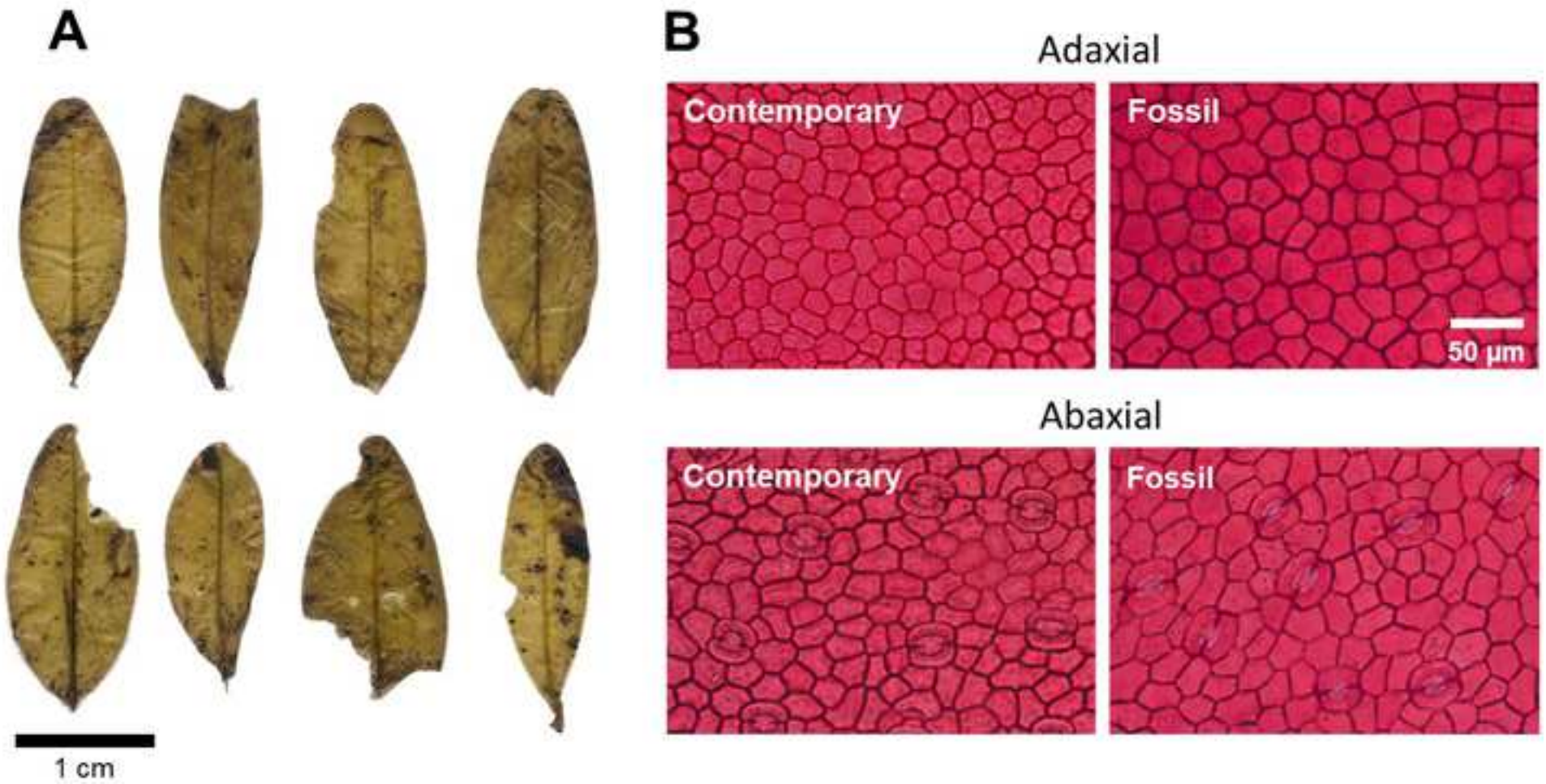

Non-colour figure

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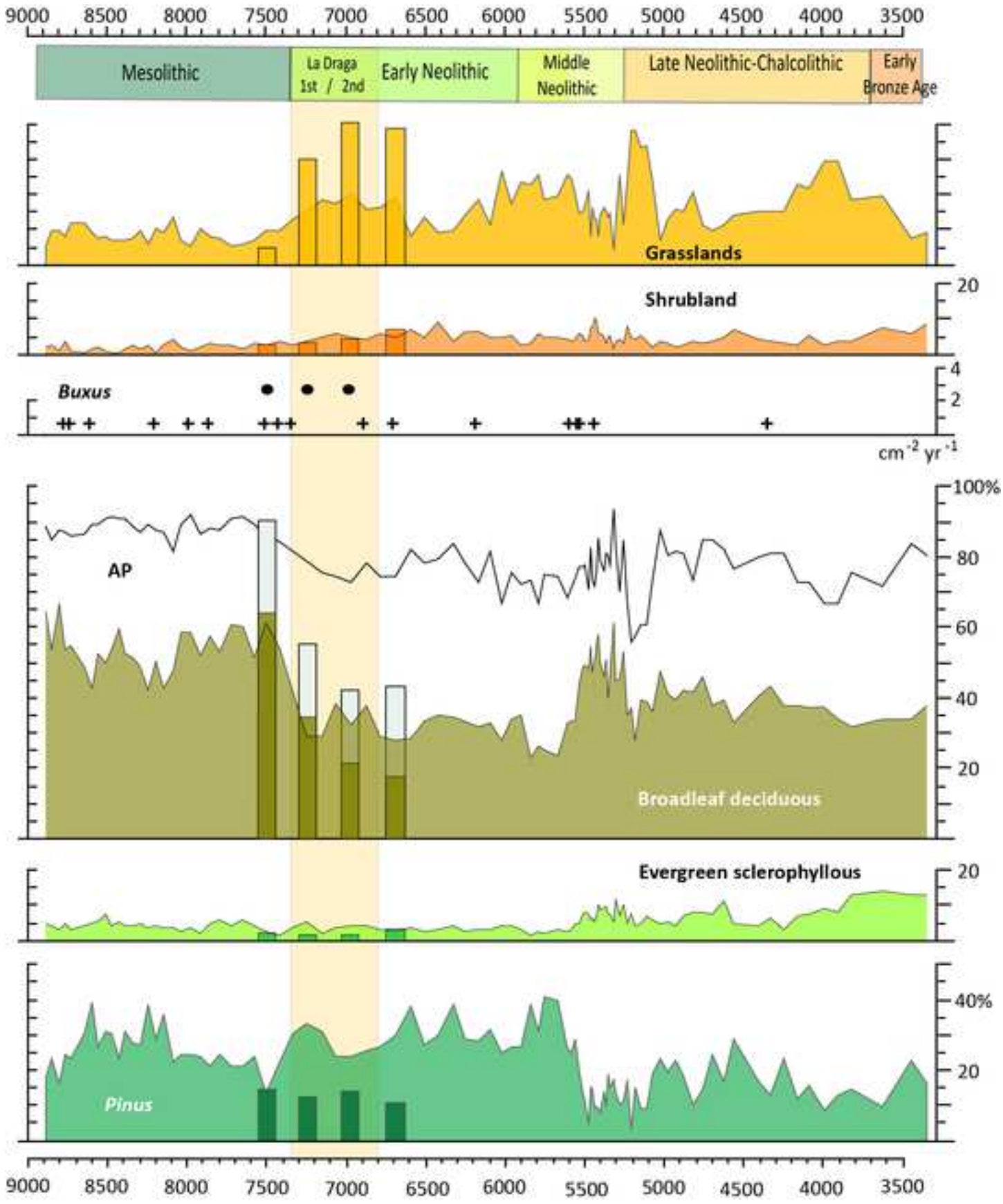

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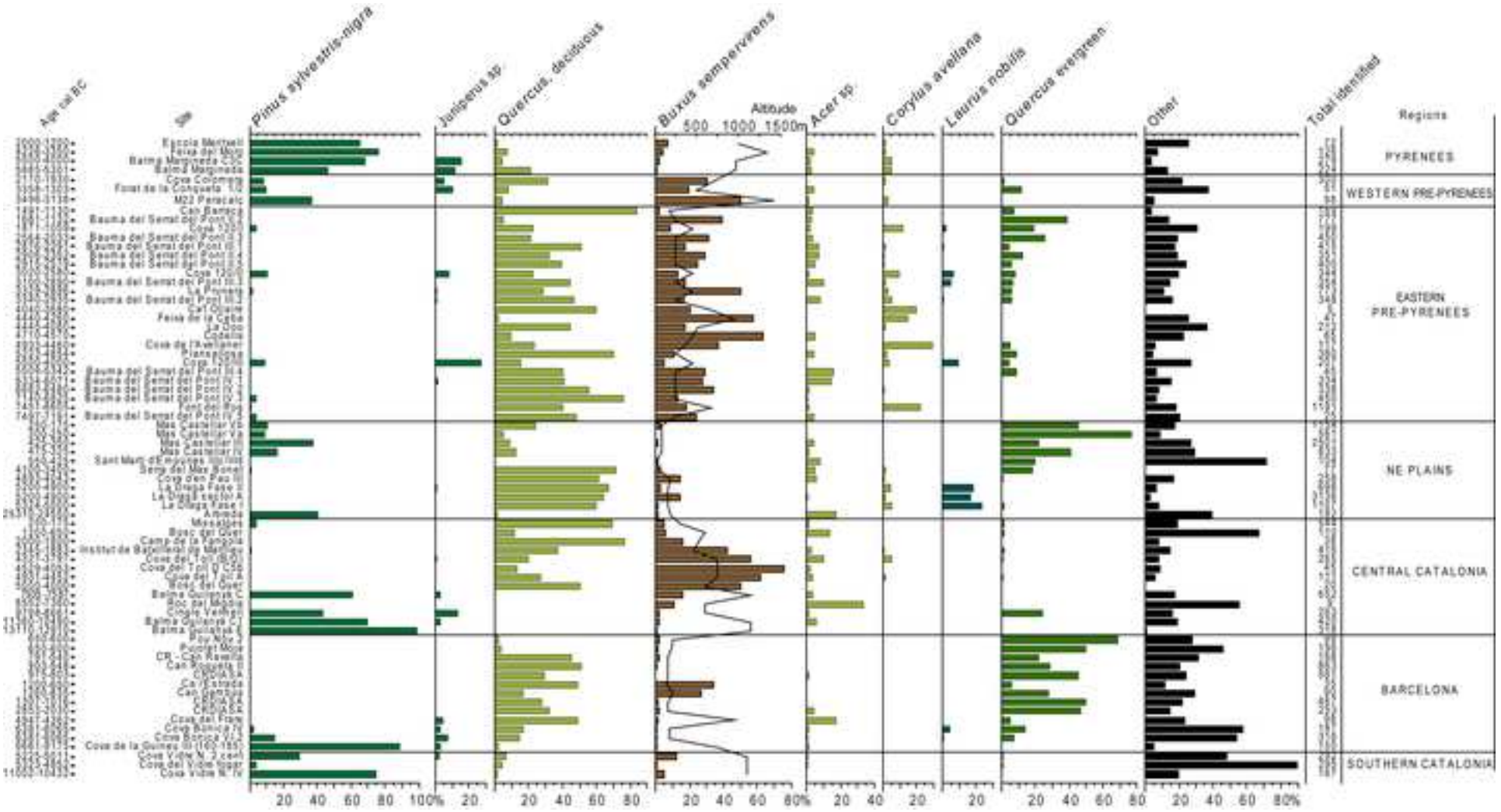

- table 1.xlsx

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Supplementary Data

Click here to access/download;Supplementary Data;Table suplementary materials.xlsx

Site	Localization	Altitude	*Chronology calibra*
Arbreda	Serinyà	200	*25310-24550*
Balma Guilanyà E	Navès	1150	*13110-12910*
Balma Guilanyà C1	Navès	1150	*11360-11160*
Cingle Vermell	Vilanova de Sau	600	*9798-8661*
Cova de la Guineu III (160-185)	Font-rubí	734	*9661-9175*
Roc del Migdia	Vilanova de Sau	600	*8552-7360*
Balma Guilanyà C	Navès	1150	*7935-7587*
Bauma del Serrat del Pont IV.5	Tortellà	260	*7497-7191*
Font del Ros	Berga	680	*7451-6605*
Bauma del Serrat del Pont IV.3	Tortellà	260	*7140-6825*
Bauma del Serrat del Pont IV.2	Tortellà	260	*6682-6480*
Bauma del Serrat del Pont IV.1	Tortellà	260	*6334-6071*
Cova del Vidre N. IV	Roquetes	1100	*6350-6015*
Balma Margineda	Sant Julià de Lòria	970	*5885-5301*
Bauma del Serrat del Pont III.4	Tortellà	260	*5509-5342*
Balma Margineda C3C	Sant Julià de Lòria	970	*ca. 5500-4000*
Cova 120/III	Les Sales de Llierca	460	*ca. 5500-4000*
La Draga Fase I	Banyoles	173	*5324-5000*
Cova del Vidre fogar	Roquetes	1100	*5323-4852*
Cova del Vidre N. 2 cent	Roquetes	1100	*5225-5011*
Plansallosa	Tortellà	250	*5223-4854*
La Draga Fase II	Banyoles	173	*5200-4900*
La Draga sector A	Banyoles	173	*5200-4900*
Cova Bonica IV	Vallirana	177	*6381-6065*
Cova Bonica VI.2	Vallirana	177	*6381-6065*
Bosc del Quer	Sant Julià de Vilatorta	600	*ca.* 5000-4000
Cova del Frare	Matadepera	960	*4947-4362*
Cova de l'Avellaner	Les Planes d'Hostoles	370	*4933-4460*
Cova del Toll A 82/91	Moià	745	4931-4452
Cova del Toll A 85/96	Moià	745	4931-4452
Cova d'en Pau III	Serinyà	200	*4893-4043*
Codella	Les Presses	460	*ca.* 4710-4570
Cova del Toll D C5b	Moià	745	4529-4053
La Dou	La Vall d'en Bas	510	*4445-4080*
Feixa de la Ceba	Vallfogona	960	ca. 4440-4260
Cova del Toll B C2c	Moià	745	4327-3803
Cova del Toll B C4	Moià	745	4321-3797
Cova del Toll D C3	Moià	745	4321-3797
Cova del Toll D C4	Moià	745	4321-3797
Cova del Toll B C3	Moià	745	4307-3797
Cova del Toll B C2b	Moià	745	4225-3656
Feixa del Moro	Juberri	1335	*4226-3350*
Serra del Mas Bonet	Vilafant	75	ca. 4100-3400
Ca'l Oliaire	Berga	654	*4040-3680*
M22 Peracalç	Peracalç	1365	*3496-3138*
Forat de la Conqueta 1/2	Santa Linya	500	*3358-2938, 1507-1*
Bauma del Serrat del Pont III.2	Tortellà	260	*3340-2935*
La Prunera	Sant Joan les Fonts	458	*3329-2896*

Bauma del Serrat del Pont III.3	Tortellà	260	*3100-2890*
Cova 120/II	Sales de Llierca	460	*3020-2580*
Bauma del Serrat del Pont II.5	Tortellà	260	*2915-2579*
Bauma del Serrat del Pont II.4	Tortellà	260	*2906-2352*
Bauma del Serrat del Pont III.1	Tortellà	260	*2876-2291*
Can Roqueta DIASA	Sabadell	160	*2853-2030*
Bauma del Serrat del Pont II.3	Tortellà	260	*2564-2033*
Institut de Batxillerat de Manlleu	Manlleu	470	*2345-1883*
Cova Colomera	Sant Esteve de la Sarga	670	*2170-1930*
Camp de la Farigola	Les Masies de Voltregà	530	*ca. 2000-1800*
Escola Meritxell	Andorra la Vella	1000	*ca. 2000-1200*
Cova 120/I	Sales de Llierca	460	*1871-1059*
Bauma del Serrat del Pont II.2	Tortellà	260	*1681-1132*
Can Barraca	Besalú	186	*1491-1130*
Can Roqueta DIASA	Sabadell	160	*1307-1016*
Can Gambús	Sabadell	220	1260-835
Bosc del Quer	Sant Julià de Vilatorta	600	*ca.1200-650*
Ca l'Estrada	Canovelles	150	*ca. 1200-650*
Can Roqueta DIASA	Sabadell	160	*975-803*
Can Roqueta II	Sabadell	160	903-548
Can Roqueta - Can Ravella	Barberà del Vallès/Sabadell	160	*791-540*
Pou Nou 2	Olérdola	227	*ca. 650-600*
Pujolet Moja	Vilafranca del Penedès	207	*ca. 650-600*
Sant Martí d'Empúries IIIc/IIId	L'Escala	14	*ca.* 550-425
Mas Castellar IV	Pontós	94	*ca.* 475-325
Mas Castellar III	Pontós	94	*ca.* 425-350
Mas Castellar Va	Pontós	94	*ca.* 300-250
Mas Castellar Vb	Pontós	94	*ca.* 250-175
Missatges	Tàrrega	315	*ca.* 250-175

Chronology	Acer sp.	Buxus sempervi	Corylus avellana	Juniperus sp.	Laurus nobilis
22590±290	17.6	1.1	0.0	0.0	0.0
11110±40	0.0	0.3	0.0	0.3	0.0
9840±50, 9410	6.0	2.1	0.0	2.8	0.0
9760±160	1.5	1.9	0.0	13.3	0.0
9850±80	1.3	0.7	0.0	2.7	0.0
8800±240	33.3	11.1	0.0	0.0	0.0
8680±50	3.8	15.6	0.0	2.5	0.0
8310±40	4.0	24.0	0.0	0.0	0.0
8050±150	1.0	18.0	21.8	0.0	0.0
8060±40	0.4	12.7	0.2	0.0	0.0
7770±50	1.2	34.3	0.9	0.0	0.0
7330±40	14.4	27.2	0.0	1.5	0.3
7290±70	0.0	4.8	0.0	0.0	0.0
6640±160	2.7	0.9	4.9	11.6	0.0
6470±40	15.6	28.9	0.0	0.0	0.0
	1.8	1.8	5.4	15.4	0.0
	0.0	4.8	3.4	27.1	9.7
6270±40	0.0	1.4	5.4	0.1	23.5
6180±90	0.7	0.7	0.0	0.0	0.0
6181±35	0.3	12.3	0.0	2.4	0.0
6130±60	3.9	10.5	2.1	0.0	0.0
6010±40	0.0	3.0	4.2	0.6	18.1
6060±40	0.6	14.2	1.2	0.0	17.1
7347 ± 71	1.1	0.5	0.0	2.7	4.8
7347 ± 71	0.6	0.3	0.0	7.3	0.9
	0.0	50.0	0.0	0.0	0.0
5800 ±130	17.3	1.0	0.0	4.1	0.0
5830±100	0.0	36.8	29.1	0.0	0.0
5810±100	7.2	56.5	2.9	0.0	0.0
5810±100	0.0	66.7	0.0	0.0	0.0
5620±180	5.8	14.3	0.8	0.0	0.0
	4.7	63.5	0.0	0.0	0.0
5490±100	2.2	75.6	0.0	0.0	0.0
5450±50	0.0	17.5	1.9	0.0	0.0
	0.0	57.4	14.9	0.0	0.0
5240±100	7.5	60.0	2.5	2.5	0.0
5200±100	7.9	57.9	0.0	0.0	0.0
5220±100	39.4	21.1	0.0	0.0	0.0
5220±100	0.0	79.3	6.9	0.0	0.0
5210±90	4.8	69.0	2.4	0.0	0.0
5100±100	0.0	51.1	20.0	0.0	0.0
4930±170	4.0	4.0	1.6	0.0	0.0
	5.2	2.6	1.3	0.0	0.0
5080+-80	0.0	20.0	20.0	0.0	0.0
4590±40	1.0	50.0	3.1	0.0	0.0
4475±60, 3155	3.9	19.6	0.0	9.8	0.0
4490±70	7.8	16.7	5.5	0.9	1.1
4395±55	0.0	49.9	2.8	0.4	0.0

4340±40	10.2	17.5	1.4	0.3	5.4
4240±70	1.5	13.1	9.6	7.8	6.7
4200±70	5.3	25.0	1.0	0.0	0.0
4100±100	7.1	28.8	0.9	0.0	0.0
4020±100	7.0	17.3	1.2	0.0	0.7
3900±120	4.0	2.0	0.4	0.0	0.0
3840±90	3.1	31.1	0.0	0.0	0.4
3700±80	2.6	42.1	0.7	0.2	0.0
3659±30	0.0	30.6	1.3	5.3	0.0
	0.0	15.8	0.0	0.0	0.0
	0.0	6.9	1.4	0.0	0.0
3190±140	2.0	8.5	11.6	0.0	2.0
3160±100	2.7	39.3	0.1	0.0	0.1
3070±60	3.6	1.8	0.0	0.0	0.0
2950±45	0.0	1.1	0.0	0.0	0.0
2850±80	0.0	26.7	0.0	0.0	0.0
	13.6	5.5	0.0	0.0	0.0
	0.0	34.3	0.0	0.0	0.0
2725±45	1.4	0.2	0.0	0.0	0.0
2615±55	0.0	0.2	0.0	0.0	0.0
2510±30	0.0	1.8	0.0	0.0	0.0
	0.0	2.0	0.0	0.0	0.0
	0.0	1.0	0.0	0.0	0.0
	7.7	1.0	0.0	0.0	0.0
	1.6	0.1	0.0	0.0	0.0
	4.4	1.1	0.0	0.0	0.0
	0.2	0.2	0.0	0.0	0.0
	0.2	2.6	0.0	0.2	0.0
	1.5	5.0	0.0	0.2	0.0

Pinus sylvestris-	Quercus evergr	Quercus decidu	Other	Total determined
40.7	0.0	1.1	39.6	182
99.0	0.0	0.0	0.4	318
70.0	0.0	0.0	19.1	420
43.3	24.3	0.0	15.6	263
88.7	0.0	2.0	4.7	150
0.0	0.0	0.0	55.6	9
60.6	0.2	0.0	17.3	652
4.0	0.0	48.0	20.0	25
0.7	0.0	40.3	18.2	1191
4.0	0.0	76.0	6.7	450
0.3	0.0	55.3	8.0	338
0.3	0.0	41.0	15.3	334
74.9	0.0	1.2	19.2	167
46.0	0.0	21.0	12.9	224
0.0	8.9	40.0	6.7	45
68.1	0.0	4.3	3.2	279
9.2	4.3	15.0	26.6	207
0.0	1.8	60.0	7.8	1107
4.1	1.0	4.1	89.5	295
29.5	0.7	6.8	47.9	292
0.3	8.7	70.3	4.2	380
0.4	0.0	67.5	6.3	698
0.0	0.0	64.1	2.7	3136
2.1	13.9	17.1	57.8	187
15.2	7.3	14.9	53.5	316
0.0	0.0	50.0	0.0	20
0.0	5.1	49.0	23.5	98
0.0	5.1	23.1	6.0	117
0.0	1.4	23.2	8.7	69
0.0	0.0	31.0	2.4	42
0.0	1.2	61.6	16.3	258
0.0	0.0	9.4	22.4	85
0.0	0.0	13.3	8.9	45
0.0	0.0	44.3	36.3	212
0.0	0.0	2.1	25.5	47
0.0	2.5	25.0	0.0	40
0.0	0.0	7.9	26.3	38
0.0	1.4	29.6	8.5	71
0.0	0.0	10.3	3.4	29
0.0	0.0	16.7	7.1	42
0.0	0.0	26.7	2.2	45
76.2	0.0	7.1	7.1	126
1.3	18.2	71.4	0.0	77
0.0	0.0	60.0	0.0	5
36.7	0.0	4.1	5.1	98
9.8	11.7	7.8	37.1	51
0.0	5.7	46.8	15.5	348
1.6	6.1	28.5	10.7	773

0.0	6.5	44.4	14.4	354
10.8	8.4	22.7	19.5	344
0.0	5.8	39.3	23.8	400
0.0	12.3	32.2	18.8	351
0.2	4.6	51.3	17.6	415
0.0	47.0	32.0	14.6	253
0.0	25.3	21.1	18.9	450
1.2	1.9	37.0	14.2	416
8.3	1.3	31.7	21.4	300
0.0	0.0	76.3	7.9	38
65.3	0.0	1.4	25.0	72
4.0	19.1	22.6	30.2	199
0.3	38.7	5.3	13.5	777
0.0	7.1	84.0	3.6	169
0.0	49.7	27.4	21.8	467
0.0	27.8	16.7	28.9	90
0.0	1.8	11.8	67.3	110
0.0	5.7	48.6	11.4	35
0.0	45.6	28.9	23.9	561
0.0	28.5	51.2	20.0	863
0.0	22.0	45.2	31.0	168
0.0	68.7	2.0	27.3	99
0.0	49.5	3.6	45.9	196
0.0	20.2	0.0	71.2	104
16.1	41.2	12.4	28.7	833
37.5	21.7	8.7	26.5	2501
9.1	76.5	5.2	8.9	561
10.7	45.1	23.7	17.5	1154
4.0	1.7	69.1	18.6	544

References

Ros 1987
Allué et al 2012
Allué et al 2012
Ros 1988
Allué et al. 2009
Holden et al. 1995
Allué et al 2012
Piqué and Mensua 2008
Jordà et al. 1992
Piqué and Mensua 2008
Piqué and Mensua 2008
Piqué and Mensua 2008
Piqué unpublished
Heinz and Vernet 1995
Piqué 2002a
Heinz and Vernet 1995
Ros 1995
Caruso-Fermé and Piqué 2014
Alcolea 2017
Alcolea 2017
Ros 1995
Caruso-Fermé and Piqué 2014
Caruso-Fermé and Piqué 2014, Franch unpublished
Allué et al. 2017
Allué et al. 2017
Piqué unpublished
Ros and Vernet 1987
Ros 1995
Allué et al. 2013
Allué et al. 2013
Tarrús and Bosch 1990
Piqué unpublished
Allué et al. 2013
Piqué et al. 2018
Franch unpublished
Allué et al. 2013
Allué et al. 2013
Allué et al. 2013
Allué et al. 2013
Allué et al. 2013
Allué et al. 2013
Llobera 1987
Piqué unpublished
Piqué unpublished
Piqué unpublished
Allué 2011
Ros 1995
Ferré and Piqué 2002

Ros 1995
Ros 1995
Ros 1995
Ros 1995
Ros 1995
Piqué 1999
Ros 1995
Boquer 1995
Oms et al. 2014
Piqué unpublished
Piqué unpublished
Ros 1995
Ros 1995
Piqué 2006
Piqué 1999
Piqué Unpublished
Piqué Unpublished
Piqué unpublished
Piqué 1999
Piqué and Mensua 2007
Piqué and Mensua 2007
Piqué Unpublished
Piqué Unpublished
Piqué 2002b
Piqué 2002b
Piqué 2002b
Piqué 2002b
Piqué 2002b
Vila and Piqué 2012