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Gathering and consumption of wild fruits in the East of the Iberian Peninsula from the 3rd to the 1st millennium BC

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Abstract

The multiple archaeobotanical studies from the east Iberian Peninsula from 2800 cal. BC to 200 BC have provided around twenty wild fruit taxa of varying importance. The aim of this work is to present these taxa and analyse the most important wild fruits, some of them being cultivated since the First Iron Age.

When considering sites with comparable sampling methods, a quantitative difference is not observed between wild species exploited in the several life zones represented in this synthesis: Thermo-, Meso-, Supra- and Montane-Mediterranean zones. Three taxa are common in the three life zones considered: this is *Quercus* sp., *Sambucus* sp. and *Rubus* sp. More thermophilic taxa, *Ficus carica* and *Olea europaea*, are present in the two lower zones, although their values decrease the more north we go and the more height we reach, contrary to what happens with *Vitis vinifera*.

The exploitation of wild resources as a food supplement, in addition to other uses, developed during these 2600 years with several differences. These differences are explained in part by the plants that grow in each of the territories and in part by the organization of the human groups and the forms of land exploitation.

Protohistoric human groups would have exploited nearby resources as it was done in the previous periods, and all data presented here allow us to confirm the continuity of this fundamental activity. However, gathering seems to have had a fairly small economic importance when considering the low rates of ubiquity of these plants in contrast to those of staple crops.

Keywords

Archaeobotany, Bronze Age, Iron Age, Protohistory, Western Mediterranean, Thermo-mediterranean, Meso-mediterranean

1. Introduction

Gathering wild fruits is a well-documented practice among forager groups (Metcalf 1958; Lee and Devore, 1968; Weiss *et al.*, 2004), which endures among farmer societies (Zapata, 2000; Antolín and Jacomet, 2015). Archaeological evidence of gathering is less frequent than that of other materials such as bones, that are better preserved or more easily recovered from archaeological sites. The importance of these fruits in the Mediterranean farmers' diet has been established through ethnographic (Forbes, 1976) and archaeobotanical (Antolín

and Jacomet, 2015) works, even if these plants have usually quite low recovery rates among archaeological seed and fruit remains.

We report in this work the archaeobotanical data that allows us to observe the gathering of wild fruits from 2800 cal. BC to 200 BC along the entire eastern strip of the Iberian Peninsula, from the north to the south. Concerning the north, we have chosen to take into account all the sites located in the eastern part of the Pyrenees, in the plain of Lleida and up to the central part of the Ebro Valley. The limits of the central region are the eastern foothills of the Iberian System, the Meseta plateau and the Penibaetic System. Concerning the south, the geographical boundary is the southern slopes of the Guadalquivir Valley (Fig. 1).

All these regions, from the high mountains to the coastal plains, are influenced by a Mediterranean climate, although the degree of impact is obviously not the same. The majority of the archaeological sites concerned by this work are concentrated in the most temperate areas: the coastal and inland plains, and the mid-mountain regions.

Rainfall rates are also diverse. The driest areas are situated in the Southeast (Eastern Andalusia) and in the inner part of the Ebro Valley, with less than 300 mm per year. The rest of the territory presents higher values, mostly around 600 mm, while some areas reach up to 1000 mm.

Climatic oscillations during this long chronological sequence do not seem to have been very pronounced. Throughout the 3rd millennium cal. BC the seasonality of rains is accentuated, with a more humid period around the end. Regarding the 2nd millennium, a drier event is detected during the first half but it is not yet possible to know its length. However, a wetter climate seems to return in the second half. These conditions were maintained until the beginning of the 1st millennium, when a new drier period begins, followed by a more humid phase during the second half (Jalut *et al.*, 2000; Ferrio *et al.*, 2006; Aguilera *et al.*, 2012).

Social evolution as well as archaeological periods are not uniform in these three regions during these almost three thousand years. We have thus decided to organise the data into five periods: period 1 - Chalcolithic (2800-2000 BC), period 2 - Early and Middle Bronze Age (2000-1300 BC), period 3 - End Bronze Age (1300-800 BC), period 4 - First Iron Age (800-600 BC) and period 5 - Second Iron Age/Iberian period (600-200 BC).

During the 3rd millennium we can observe some continuity on the settlement patterns generated in the previous period: presence of open-air habitats in addition to caves occupied for many purposes (shelter, habitat, farmyard...). Silos, excavated huts and ditches are usual elements found in both coastal and inland settlements. This relative homogeneity disappears at the end of this millennium coinciding with the expansion of the Bell Beaker culture. We now see for the first time in the southeast the emergence of elevated and fortified settlements coexisting with small sites in the plains. It is also the moment when social complexity becomes more evident, especially in the south with the Los Millares culture (Chapman, 2008). This stratification can be observed not only in the territorial and structural organisation of the settlements, but also through the storage units (Pérez-Jordà and Peña-Chocarro, 2013) and burials (Puchol *et al.*, 2013).

During the first half of the 2nd millennium, this social and territorial organisation endures in the South (El Argar culture), where some authors recognize the existence of urban or proto-urban centres (Lull *et al.*, 2014). At the same time, we can observe a lower concentration of the population in the central and northern regions, with the occupation of small habitats situated in elevated locations and in the plains, coupled with some caves (López Cachero, 2007). These settlement patterns seem to be maintained until the beginning of the 1st millennium, when a new process of restructuring the population commences, coinciding

with the arrival of eastern Mediterranean colonists. The last millennium sees the development of several processes in the majority of these territories that finish with the emergence of urban centres and territorial structures usually associated with archaic states (Ruiz and Molinos, 1998; Sanmartí, 2004).

2. Materials and methods

This work is exclusively based on seed and fruit remains and not on charcoal or pollen data, because of the intention to estimate human gathering and not only the presence of the species. The fruits considered correspond to all woody and shrubby taxa recovered in archaeological sites. All published sites have been considered, those with isolated sampling as well as those with systematic sampling. Only the sites with doubtful identifications have been excluded.

A total of 91 archaeological sites have been considered (Fig. 1), of which 6 are caves or rock-shelters and the rest open-air settlements. Some of them provide data for different periods. Period 1 shows twenty-two sites, period 2 sixteen, period 3 seven, period 4 twenty and period 5 thirty. So, the end of the 2nd millennium is the worst represented period.

In order to quantify the significance of each taxon of wild fruits identified, the ubiquity method is used, and the sample is the unit of measure. Therefore, ubiquity in this work corresponds to the percentage of samples in which a taxon is present, regarding only those samples that contain plant remains. In this way, systematically sampled sites are better represented.

The north region has provided 819 samples (from 46 sites), the south 753 (26 sites) and the centre 458 (19 sites), showing a disproportion among these territories. The lack of data is more evident when looking at the distribution of the samples per period. In the south, almost all the samples belong to periods 1 and 2, while in the centre period 3 has no samples, period 1 is almost not represented, periods 2 and 4 are quite well characterized, but period 5 is the best known. Finally, period 1 is the poorest in the north, almost like 2 and 3, while the data are concentrated on periods 4 and 5. To summarize, ancient periods are best represented in the south and recent periods towards the north. Numbers in brackets throughout the text correspond to the site number in Fig. 1 and the tables.

Most of the samples considered have been finely sieved (flotation, 0.5/0.25 mesh). Only in eight sites (9%) is the sieving method used unknown [sites 61, 68, 69, 70, 71, 72, 73, 79]¹. Taxa presenting chronological or stratigraphic problems, as well as appearing only once, have been excluded from the tables and graphics, such as *Crataegus*, *Celtis*, *Juglans* or *Ziziphus*.

Almost all plant remains are charred, with only two sites providing waterlogged material: Els Vilars d'Arbeca [26] and Tossal de les Basses [63]. In both, the samples come from wells and the taxa identified are not different from those recovered charred. *Rubus fruticosus* is not among charred remains only in Tossal de les Basses.

As this work focuses on wild plants, we have chosen to order the data following the different vegetation belts or life zones identified for the Mediterranean and, to a lesser extent (Pyrenees), the Euro-Siberian regions (Quézel, 1985; Rivas Martínez, 1987; Blondel and Aronson, 2005). These bioclimatic life zones are based mainly on altitude criteria, but they

¹ The numbers put in brackets throughout the text correspond to the number of site in figure 1 and the tables.

are also characterized by latitude, as well as by temperature and rainfall. All these elements determine the different plants growing together, which vary depending on the biogeographical region. Nearly all the archaeological sites considered in this work are situated between the Thermo-Mediterranean and the Meso-Mediterranean life zones, although the first reduces its area (and so the number of sites) while going gradually to the north (Fig. 2).

The Thermo-Mediterranean zone occupies coastal regions and it is warm, very altered nowadays because of human activities. It is characterized by dwarf palm, wild olive tree, Mediterranean buckthorn and oleander. The Meso-Mediterranean zone is the largest of the Iberian Peninsula and it is characterized by kermes oak and mastic tree maquia in semiarid areas, and by holm oaks in the dry and subhumid carbonated regions.

We also have a few sites in the Supra-Mediterranean zone (600 to 1200 meters), which contains deciduous forests (mainly oaks and chestnuts), sometimes mixed, depending on the substratum and the ombroclimate. Finally, the Montane-Mediterranean zone (1200 to 1800 meters), characterized by deciduous forests (oaks, beech trees and conifers), is also represented by a very few sites (Rivas Martínez, 1987; Blondel and Aronson, 2005). The two last zones have been put together in the graphics and tables.

Some life zones show a scarce number of samples for some periods and, therefore, data are not significant enough. Consequently, the interpretations carried out will not have the same value everywhere: problems occur in the north (absence of data for periods 2 and 3 in the Thermo-Mediterranean) and in the south (lacks periods 3 and 4 in the Meso-Mediterranean). The Supra-Mediterranean and Montane-Mediterranean zones are also insufficiently represented for most of the periods (Fig. 2, Tables 1 and 2).

3. The wild fruit taxa documented in Chalcolithic, Bronze and Iron Age archaeological sites

A total of 21 taxa of wild fruits complement staple crops in the diet of the populations of the eastern Iberian Peninsula from 2800 BC to 200 BC (Tables 1, 2 and 3). In general, their ubiquity values are very low, reaching at most 19% of the total samples (427 of 2126 total samples). In contrast, crops appear in around 90% of the samples.

Taxa are not uniform in all areas and periods although some of them appear in every life zone and during each phase, such as *Quercus*, *Vitis vinifera*, *Prunus*, *Rubus* and *Sambucus* (Fig. 3). Ubiquity is the only component that changes. It should be noted that only *Quercus* shows high values in all zones, from the Thermo-Mediterranean coast to the Montane-Mediterranean zone. In the latter it reaches very high rates (around 70% in period 2 or 50% in period 3) probably because of the small number of sites analysed that distorts the results. It is not possible to identify the different species of *Quercus* sp. (with a different bioclimatic distribution) from acorns. We consider, though, that all the acorns could be consumed regardless of the species. According to ethnobotanical studies in the Iberian Peninsula, evergreen oak (*Quercus ilex*) acorns are the most commonly eaten, but also those of *Q. coccifera* and more rarely *Q. faginea*, *Q. petraea*, *Q. pyrenaica* and *Q. robur* (Tardío *et al.*, 2006: 56-57).

Wild grapes (*Vitis vinifera* ssp. *silvestris*) are also present in almost all zones and periods, except for periods 1 and 5 of the Supra- and Montane-Mediterranean zones (only 1 site for each). Cultivated grapes (*Vitis vinifera* ssp. *vinifera*) become more abundant from period 4 especially in the Meso- and Thermo-Mediterranean life zones. In a few sites this taxon shows

ubiquity values higher than 50% and during period 5 it become one of the main crops (Pérez Jordà, 2013).

Berries hardly surpass 1% of the samples, except for periods with little data. Blackberries (*Rubus fruticosus*) are found in the Meso- and Thermo-Mediterranean zones, while raspberries (*Rubus idaeus*) only in Meso-Mediterranean.

Prunus are generally present with low ubiquity rates, around 1%, except in Supra- and Monta-Mediterranean zones. A few species of this genus have been identified: *Prunus avium/cerasus* is present in the Meso-Mediterranean zone (4 mentions in three sites), *Prunus mahaleb* appears in the Supra- and Montane-Mediterranean zones (3 mentions in one site) and *Prunus spinosa* is found in both Meso- and Supra-Mediterranean zones (1 mention in one site for each).

Elderberries are also rare in all zones. Red elderberry (*Sambucus cf. racemosa*) is the only species identified, appearing in the highest site of the Montane-Mediterranean zone, Cova del Sardo [7] (Antolín, 2013).

Other taxa have not been identified in all life zones. As regards to the genus *Pinus*, it is absent from the Supra- and Montane-Mediterranean zones, but we find it in the other two life zones. Stone pine (*Pinus pinea*) has exclusively been identified in the Thermo-Mediterranean zone during almost all the periods, while Aleppo pine (*Pinus halepensis*) appears in both Thermo- and Meso-Mediterranean zones but with lower ubiquity rates.

Olives (*Olea europaea*) are clearly dominant in the Thermo-Mediterranean zone unlike in the Meso-Mediterranean zone. The high rates are concentrated however during period 1.

The mastic tree (*Pistacia lentiscus*) seems important in the Thermo- and Meso-Mediterranean zones while the fig tree (*Ficus carica*) is more represented in the former (mainly in period 2). In these two life zones we have also isolated finds of the strawberry tree (*Arbutus unedo*), the myrtle (*Myrtus communis*) and the caper (*Capparis spinosa*), and we have one mention of rowan tree (*Sorbus* sp.) in the Meso-Mediterranean zone.

Finally, we can notice the presence of apple tree (*Malus* sp.) and silver fir (*Abies alba*) in the Montane-Mediterranean zone. Silver fir is rarely consumed, although Bonet and Vallès (2002: 236) point out the use of the cones to make a refreshing beverage in the Montseny region in Catalonia (Table 4). The hazelnut tree (*Corylus avellana*) is also present in this zone, as well as in Castellón Alto [80], a site situated on the border between the Meso- and Supra-Mediterranean zones.

The irruption of cultivated fruits during the First Iron Age (period 4) changed the status of wild fruits: the ubiquity rates of the latter during periods 4 and 5 are considerably lower and do not overtake 5% of the total plant remains. Some wild fruits gathered in previous periods such as grapes, olives and figs would be henceforth grown. At the same time, new fruits not indigenous to the Iberian Peninsula are introduced as a result of the arrival of Phoenician and later Punic people such as pomegranates (*Punica granatum*) and almonds (*Prunus dulcis*), which began to be consumed and probably grown from this moment onwards (Tables 1 and 2).

4. Evolution of the most important taxa

The evolution of the most important taxa mentioned above must be evaluated in relation to the belt where they grow in the same life zone in order to reflect the cultural diversity and the historical development of such a great territory as the one considered in this work.

Differences in interests of archaeological research, as well as the intensity of archaeobotanical studies, must also be taken into account when interpreting the results. In this section, we will focus on the five taxa with the greatest occurrence. Two were exploited as wild during the entire sequence, *Quercus* sp. and *Pistacia lentiscus*, while the other three, *Olea europaea*, *Vitis vinifera* and *Ficus carica*, indicate an evolution towards cultivation. It is not the purpose of this article to go into the controversy about the origin and history of cultivation of these three species (Gilman, 1981; Rovira i Buendía, 2007; Pérez Jordà 2013), and neither deal with the delicate problem of distinction between wild and cultivated forms (Mangafa and Kotsakis, 1996; Terral *et al.*, 2004; Bouby *et al.*, 2013; Uccesu *et al.*, 2014). However, we believe that it is important to evaluate the process of transition from one type of exploitation (gathering) to the other (growing). For this, we will consider the evolution of the ubiquity rates of these species, trying to establish the time of change mainly from the increase in this criterion.

4.1. Acorns (*Quercus* sp.)

Acorns (Fig. 4a) are one of the most exploited wild fruits during the whole sequence in the three life zones of all the regions (north, centre and south). Data show that their exploitation is more important during period 2 everywhere, including the Supra- and Montane-Mediterranean zones. Oak is indeed the most represented taxon from the Pyrenees. However, a downward trend would be observed after period 3, although it is difficult to assess because of a lack of samples from phase 4 onwards.

During the Bronze age *Quercus* is most exploited in the north and the centre, areas in which the population model is based on small settlements, which could facilitate a more intense exploitation of wild resources. In the south, where bigger settlements with a more complex territorial structure are found, gathering seems to have a lower importance. We could consider as a hypothesis the possibility that a higher concentration generated an equivalent deforestation, which may be hindering or restricting access to the fruits of the forest.

In most of the cases, the identification of the species is difficult due to the general absence of acorn cups. In the whole area, only two have been recovered in a waterlogged context from Els Vilars d'Arbeca [26], together with leaves and identified as *Quercus ilex/coccifera* (Fig. 5). A second case concerns acorns found in the site of La Mata (Campanario, Extremadura), out of our research area (in the Meso-Mediterranean zone), identified as *Quercus ilex* on the basis of the germ axis morphology (Vázquez Pardo *et al.*, 2004).

Human consumption of acorns could be proved at least for period 4 by their presence in a vessel in Tozal de los Regallos [20] (Alonso, 1999, 145) and also in a bowl near a rotary quern in Puntal dels Llops (Olocau, Valencia) (Bonet and Mata Parreño, 2002). In addition, the analysis of microremains from several querns from period 4 such as Barranc de Gàfols [27] (Juan, 2002) or the above mentioned La Mata (Juan and Matamala, 2004), show the use of these implements for grinding acorns.

Ethnographic data about the ways of consuming acorns is actually very abundant: they can be raw, roasted, boiled, crushed, stewed, baked in cakes, pancakes and breads, and also eaten as porridge (see for instance Tardío *et al.* 2006: 36; Hadjichambis *et al.* 2002: 397) (Table 4). Sun drying or roasting is needed to conserve the acorns. A process prior to consumption is also needed in order to remove toxic tannins and bitterness: boiling, soaking or macerating them, and then slightly roasting them (Stahl 1989; Vázquez Pardo *et al.*, 2004).

Ancient Roman writers also relate the consumption of acorns in *Hispania*, referring especially to the North and Northwest (Strabo, *Geography* III, 3, 7). Pliny the Elder (*Natural History* XVI, 15) says that in case of a lack of cereals these fruits were dried, peeled and ground into flour, and sometimes also roasted to sweeten them.

Finally, we have to consider the possibility of an over-representation of acorns in the archaeological sites due to direct exposure to fire in several of the steps involved in their culinary preparation.

4.2. Mastic tree (*Pistacia lentiscus*)

The presence of fruits of the mastic tree (Fig. 4b) in archaeological contexts is difficult to explain. Were they eaten or used for other purposes such as medicinal? Or, were they brought in with firewood and therefore have nothing to do with food?

In our area of interest, fruit remains are concentrated in the north, especially in the Meso-Mediterranean zone of the Ebro Valley (in five of eight sites). We can also observe higher ubiquity values during the earlier periods (from 1 to 3), while their presence decreased during the course of the Iron Age. It is interesting to note the absence of *Pistacia lentiscus* in the Thermo-Mediterranean zone of this region, but its presence in the centre and the south. With regards to the charcoal data, this species is quite abundant in the north, again in the Ebro Valley. We find high ubiquity rates for all the periods until the Iberian phase: 35%, 60% and 44% respectively for periods 2, 3 and 4, against 10% for period 5 (Vila and Piqué, 2012; Piqué, 2014). Therefore, it is possible that the recovered fruits were not intended for human consumption but attached to the branches used as firewood, at least in the Ebro Valley. Elsewhere in the north charcoal remains have been recovered during the whole Bronze Age and the First Iron Age, but the mastic tree does not seem to be used as firewood during the late Iron Age. We must also note that none of the sites with charcoal remains have provided fruit remains. The association fruits-firewood seems to be concentrated above all in the Ebro Valley, while elsewhere in the north, although the mastic tree is used as fuel, a widespread exploitation of its fruits seems unlikely.

In the Meso-Mediterranean zone of the central region, this taxon seems to have some importance during the first period, but it is insignificant during the other periods in all the areas. In any case, this species appears consistently among the charcoal remains as fuel and building material (Grau Almero and Duque Espino, 2007). Moreover, a link between *Pistacia lentiscus* and spaces for cattle stabling has also been observed both in caves used as pens (Morales *et al.*, 2013) and in shed areas inside of some settlements (Pérez Jordà, 2013). Plentiful assemblages of wood and seeds of *Pistacia lentiscus* were recovered in these places and were interpreted as fodder. Ethnographic work conducted in northern Morocco indeed shows the use of branches of the mastic tree (especially leaves) as fodder for sheep and goats, with the leftovers used later as fuel (Zapata Peña *et al.*, 2003). In addition, two storage findings of pure mastic fruits have been recovered from two sites in the southeast, dated on the early Bronze Age, which indicates a deliberate use (H.-P. Stika, personal communication).

Fruits are consumed in different ways and oil can also be extracted simply by heating them in a container, which could be a source of charred remains (Table 4). In addition, the use of the resin to flavour liqueurs, pastries and other products is well known, especially in the Eastern Mediterranean, as well as its medicinal properties (Rivera and Obón de Castro, 1991; Morales *et al.*, 2013).

In summary, the use of mastic fruit as food cannot be proved because of the existence of other practices using the wood as fuel, fodder or building material. However, it is worth noting the continuous presence of this taxon at least in the central and southern regions.

4.3. Figs (*Ficus carica*)

Despite the presence of figs (Fig. 6a) in all periods analysed, a net increase of ubiquity values is observed from the First Iron Age onwards. The distinction between wild and cultivated pips is very difficult (Morales Mateos and Gil, 2014), so we can take the increase of their presence from period 4 as a sign of intensification of the consumption of figs, already like a cultivated crop.

In the north, we have poor evidence of figs until period 4 in the Thermo-Mediterranean zone whereas they appear earlier in the Meso-Mediterranean zone, even if their ubiquity rates are low. During the Iron Age (periods 4 and 5), they are present in both zones but with values not greater than 25%. However, in the centre, we can clearly see an increase in their exploitation in the Thermo-Mediterranean zone, whether wild or cultivated, beginning in period 4 and especially during the next period (ubiquity rates rise almost to 40%).

Regarding the south, in contrast to the two other regions, ubiquity rates are very high in period 2 (almost 60%) even if figs are found in just two sites: El Argar [75] and especially Fuente Álamo [74] where they are very abundant (Stika, 1988; 2001; Stika and Jürich, 1999). The contrary can be observed during period 1: figs are present in four of the seven sites analysed but their ubiquity is very low. This can be explained by the high number of samples (a total of 121) from Las Pilas [85], of which only one has provided fig pips.

The fig tree is supposed to be cultivated in this last region during the 2nd millennium (Stika, 2000), even if the data does not seem to show it until period 4. It is also from this period onwards that the taxon is spreading to all regions. Before then it is mainly exploited in the south, which could be explained by the fact that the wild forms grow best in warmer areas (olives also follow this rule).

4.4. Olives (*Olea europaea*)

Olives (Fig. 6b) are very important in the south during the Chalcolithic. They appear during period 1 in five of the seven sites of the Thermo-Mediterranean zone and in one of the five sites of the Meso-Mediterranean zone. We also found them during period 2 in three of the six sites analysed in the Thermo-Mediterranean zone and in one of the six sites in the Meso-Mediterranean zone.

In the centre, olives are only documented in two sites of period 1 situated on the southern boundary of this region [61, 64], very close to the area where the Los Millares culture was developing. However, to the north of the Vinalopó river they are not found until period 4, when they could begin to be grown even if the data is very poor to affirm it. This situation changes during period 5: data are more regular and show the widespread distribution of the species even if it only presents ubiquity values of 15%. Another element that can be used to evaluate the cultivation of this taxon is the presence of structures for oil production, not known until the 5th-4th centuries BC (Pérez Jordà, 2000).

Therefore, data about olives gives again a similar view to that obtained for the figs, in which environmental conditioning could explain the fact that olives are a fundamental resource in warmer areas. The problem arises from the lack of data in the south from period 3 onwards,

making it difficult to assess whether the exploitation of olives and the establishment or the generalization of their cultivation was a continuous process or not. Finally, we have chosen to place the growing of olive trees in the middle of the 1st millennium BC, although some proposals have it start back from period 1 (Terral and Arnold-Simard, 1996).

4.5. Grapes (*Vitis vinifera*)

Exploitation of the grapevine (Fig. 6c) clearly shows two distinct situations. On the one hand, when there is evidence of its cultivation during the 1st millennium the values of ubiquity and the number of remains are both high, especially the latter. In many areas this plant becomes one of the main staple crops. On the other hand, during the 3rd and 2nd millennia, when there is no evidence of its culture, ubiquity rates are generally low but also the number of remains is not significant.

In the north, the lack of samples in the Thermo-Mediterranean zone for periods 1, 2 and 3 makes the results difficult to evaluate. However the ubiquity values shown during period 4 (First Iron Age: 24%) and period 5 (Iberian period: 36%) are remarkable, while in the Meso-Mediterranean zone this increase is only observed during period 5. At the end of the First Iron Age, contacts with Eastern Mediterranean societies have already begun in coastal areas, which could be conditioning the arrival of one of the agricultural products over which exchanges would focus: wine. From now on, grape pips are much more abundant, as well as evidence of culture.

In the centre, grapes are present during period 1 in the Meso-Mediterranean zone, and then during period 2 in one of the two sites and in one of the three sites of the Thermo- and Meso-Mediterranean zones, respectively. Data is lacking for periods 3 and 4 but signs of cultivation can be observed by the clear increase of this taxon. In period 5 it reaches 36% and 54% in the two zones, respectively.

Regarding the south, grape pips have low ubiquity rates during periods 1 and 2. In the Thermo-mediterranean zone during period 1 they are found in two of the six sites sampled and during period 2 in one of six. In the Meso-Mediterranean life zone, grape pips are present in one of four sites from period 1 and four of six from period 2.

From the 9th century we can observe an increase of *Vitis* ubiquity values that may correspond to pips of cultivated plants. In fact, the archaeological traces of a vineyard dated to this century have been recently found in Huelva (Western Andalusia) (Vera and Echevarria, 2013).

In general, data seem to indicate a higher importance of this taxon from the moment it is cultivated in the Iberian period, mainly in the Meso-Mediterranean zone of the central region, but also in Thermo-Mediterranean zone in the north and centre regions. Grapevines need some moisture, so they usually develop on the banks of rivers. In this sense, the hinterland, with more stable rivers, should have benefited from further development than the coast.

In any case, wild grapes do not seem to have been a main resource anywhere, which contrasts with the importance that cultivated grapevines will reach at least from the 8th century BC, getting values in some areas similar to those of cereals (Pérez Jordà *et al.*, 2007; López Reyes *et al.*, 2011b). In this sense, viticulture became a major agricultural practice from the 7th century BC, when structures of winemaking begin to be found (Gómez Bellard *et al.*, 1993; Pérez Jordà, 2000; Pérez Jordà *et al.*, 2013; López Reyes *et al.*, 2013).

5. Conclusions

The gathering of wild fruits for consumption by protohistoric populations of the east of the Iberian Peninsula from 2800 cal. BC to 200 BC is well established. The multiple archaeobotanical studies have provided around twenty taxa of varying importance. However, this practice seems to have a fairly small economic importance when considering the low rates of ubiquity of these plants in contrast to those of staple crops. These low rates do not seem directly linked to taphonomic reasons. In many cases, involuntary fire is the origin of the archaeobotanical remains, and even so a greater abundance of gathered fruits has not been observed. The inequality in the number of samples analysed per site also affects the results, as with figs at the site of Las Pilas, for example.

Among all documented fruits, only grapes, when cultivated, will reach a significance comparable to that of cereals. These last are the most common plant products in all sites during the sequence considered, especially hulled barley and free-threshing wheats, accompanied by some pulses (lentil, pea, broad bean...) and from the Iberian period, cultivated fruits (especially grapes, olives and figs).

When considering comparable sampling, a quantitative difference is not observed among wild taxa exploited in the different life zones considered in this work: Thermo-, Meso-, Supra- and Montane-Mediterranean zones. Three taxa are common in the three life zones represented (the two last being grouped), that is *Quercus* sp., *Sambucus* sp. and *Rubus* sp. Different species may be concerned, but the difficulty of identifying the archaeobotanical remains does not allow more precise details. More thermophilic taxa (*Ficus carica* and *Olea europaea*) are present in the two lower zones, although their values decrease the more north we go and the more height we reach, contrary to what happens with *Vitis vinifera*. Other taxa are conditioned by other factors, such as *Pinus pinea*'s requirement of sandy soils (limiting their presence to coastal areas) or *Abies alba*, *Corylus avellana*, *Prunus mahaleb* and *Prunus spinosa* of cooler temperatures and height.

Protohistoric human groups would have exploited nearby resources as it was done in the previous periods (Antolín and Jacomet, 2015). However, the hypothesis of trade or exchange of olives between the low areas (coastal) and the hinterland (Los Castillejos -90- and Castellón Alto -80-) during periods 1 and 2 has also been advanced (Rodríguez Ariza and Montes Moya, 2005).

It is not possible to make a direct extrapolation between archeobotanical data and plant diet, although the relationship between the ubiquity values of taxa and their importance as a food may certainly exist. The Iberian protohistoric societies undoubtedly did not discount that abundant resource with high nutritional value. Wild fruits are a remarkable source of carbohydrates, lipids and proteins. They are also mostly collected between late summer and early winter, a period of the year in which cereal harvesting is already finished and so workforce is available to collect the numerous products offered by the forest. Moreover, many of these fruits are easily conserved, facilitating storage in order to manage their use according to the dietary needs that will arise throughout the year.

Several factors can condition the scale of this activity. One appears to be the size of the groups, even though its increase shall act more like a constraint because the distance to the resources also increases. In addition, this activity is generally more important in temporary settlements, situated in the highlands and midlands and in many cases linked to livestock farming. The problem here is to discern whether these plants have been gathered for human or livestock consumption.

Some authors show a relation between the agrarian model and the importance of wild resources. Probably gathering was more compatible with intensive production systems than with extensive ones, where the environmental impact of agricultural activity would be higher (Altieri *et al.*, 2012; Antolín and Jacomet, 2015). In this area, especially in the central and southern regions, the passage from an intensive model during the Chalcolithic to an extensive one during the 2nd and 1st millennia BC has been proposed (Pérez Jordà, 2013; Pérez Jordà and Peña Chocarro, 2013). So, it would coincide with the greater importance of these wild taxa for periods 1 and 2 (from the Chalcolithic to the Middle Bronze age), even if we have to jointly evaluate not only the agricultural model but also the other factors mentioned such as the size of the groups.

In the settlements situated at high altitudes the main economical activity could have been animal husbandry. The exploitation of the surrounding land and forests might have been more for pastures than for growing crops, as well as for collecting wild resources. Nevertheless, the practice of agriculture has been detected in the Pyrenees valleys, for example in the Neolithic site of Camp del Colomer (Juberri, Andorra), where gathering edible wild plants was also important (Antolín, 2013: 153-179).

All data presented here allows us to confirm the continuity of a fundamental activity in pre-industrial societies. The exploitation of wild resources as a food supplement, in addition to other uses (medicinal, handicraft, etc.), was thus developed in eastern Iberia along these 2600 years with several differences. These differences are explained in part by indigenous plants growing in each of the territories and in part by the organization of the human groups and the forms of land exploitation. The significant lack of data that continues to exist in many of these regions, preventing chronological and geographical comparisons, needs to be filled by future systematic work.

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Legends

Figure 1.- Archaeological sites with archaeobotanical remains of wild fruits: 1. Llo-Lo Lladre, 2. Mas Castellar, 3. Cova 120, 4. Bauma Serrat del Pont, 5. Sant Martí d'Empuries, 6. Empuries, 7. Cova del Sardo. 8. Institut de Manlleu, 9. Camp Massot, 10. Illa d'en Reixac, 11. Ullastret, 12. Sant Esteve, 13. Cabezo de la Cruz, 14. La Codera, 15. Vincamet, 16. Cova de Punta Farisa, 17. Roques del Sarró, 18. Espina C, 19. Pla de Tabac, 20. Tozal de los Regallos, 21. Sebes, 22. Vilot, 23. Minferri, 24. Missatges, 25. Estinçells, 26. Vilars, 27. Barranc de Gàfols, 28. Castellet de Banyoles, 29. Can Gambús, 30. Sitges UAB, 31. Can Xercavins, 32. Can Olivé, 33. Malesses, 34. Bòbila Madurell, 35. Font de la Canya, 36. Sta Maria dels Horts, 37. Cinc Ponts, 38. Olerdola, 39. Mas d'en Boixos, 40. Biblioteca Sitges, 41. Sant Llorenç, 42. Xalet Nin Darró, 43. Mas d'en Gual, 44. Bordissal, 45. Sant Jaume, 46. Ereta del Castellar, 47. Torrelló d'Almassora, 48. Castillarejo de los Moros, 49. Castellet de Bernabé, 50. Tos Pelat, 51. L'Loma de Betxí, 52. Kelin, 53. Ereta del Pedregal, 54. La Vital, 55. Bastida de les Alcusses, 56. Arenal de la Costa, 57. Mola d'Agres, 58. Alt de Benimaquia, 59. Abric de Falguera, 60. Cabezo Redondo, 61. Elda, 62. Illeta dels Banyets, 63. Tossal de les Basses, 64. Les Moreres, 65. Cueva de los Tiestos, 66. Fonteta, 67. El Cigarralejo, 68. Cerro de las Viñas, 69. Rincón de Almendricos, 70. Cabezo del Plomo, 71. Cueva de la Salud, 72. Madres Mercedarias, 73. Cueva Sagrada, 74. Fuente Álamo, 75. El Argar, 76. Lugarico Viejo, 77. Almizaraque, 78. Fuente Amarga, 79. Cerro de la Virgen, 80. Castellón Alto, 81. El Malagón, 82. Puente Tablas, 83. Gatas, 84. Campos, 85. Las Pilas, 86. Los Millares, 87. Cerro de Montecristo, 88. Cuesta del Negro, 89. Callejón del Gallo, 90. Los Castillejos, 91. La Rebanadilla

Figure 2.- Bioclimatic life zones of the Eastern Iberian Peninsula (from Rivas Martínez 1987b, map 5). White plots show the archaeological sites.

Figure 3.- Cumulated ubiquity rates for taxa of the three selected life zones of the Eastern Iberian Peninsula.

Figure 4 – Evolution of the ubiquity rates per life zone and region of (a) *Quercus* sp. and (b) *Pistacia lentiscus*. P-1, 2800-2000 BC (N: 1 site, 6 samples; C: 0 sites, 0 samples; S: 7 sites, 195 samples); P-2, 2000-1300 BC (N: 0 sites, 0 samples; C: 2 sites, 74 samples; S: 6 sites, 104 samples); P-3, 1300-800 BC (N: 0 sites, 0 samples; C: 0 sites, 0 samples; S: 1 site, 9 samples); P-4, 800-600 BC (N: 1 site, 8 samples; C: 1 site, 8 samples; S: 0 sites, 0 samples); P-5, 600-200 BC (N: 4 sites, 29 samples; C: 4 sites, 29 samples; S: 2 sites, 15 samples).

Figure 5.- (1) *Prunus spinosa* (charred fruit stones, Sant Esteve d'Olius [12], period 5, photo D. López); (2) *Vitis vinifera* (charred drupe, Arenal de la Costa [56], period 1, photo G. Pérez); (3) *Sambucus* sp. (charred seed, Castellet de Bernabé [49], period 5, photo G. Pérez); (4) *Rubus idaeus* (waterlogged seed, Tossal de les Basses [63], period 5, photo G. Pérez); (5) *Quercus ilex/coccifera* (waterlogged cups, Els Vilars [26], period 5, photo SRI Service, UdL); (6) *Olea europaea* (charred fruit stones, Les Moreres [64], period 1, photo G. Pérez); (7) *Quercus* sp. (charred seeds, Minferri [23], period 2, photo SRI Service, UdL); (8) *Pistacia lentiscus* (charred nuts, Minferri [23], period 2, photo SRI Service, UdL).

Figures 6.- Evolution of the ubiquity rates per life zone and region of (a) *Ficus carica*, (b) *Olea europaea* and (c) *Vitis vinifera*. P-1, 2800-2000 BC (N: 1 site, 6 samples; C: 0 sites, 0 samples; S: 7

sites, 195 samples); P-2, 2000-1300 BC (N: 0 sites, 0 samples; C: 2 sites, 74 samples; S: 6 sites, 104 samples); P-3, 1300-800 BC (N: 0 sites, 0 samples; C: 0 sites, 0 samples; S: 1 site, 9 samples); P-4, 800-600 BC (N: 1 site, 8 samples; C: 1 site, 8 samples; S: 0 sites, 0 samples); P-5, 600-200 BC (N: 4 sites, 29 samples; C: 4 sites, 29 samples; S: 2 sites, 15 samples).

Table 1.- Sites per period in the Thermo-Mediterranean life zone with wild fruit remains and number of samples presenting each taxon.

Table 2.- Sites per period in the Meso-Mediterranean life zone with wild fruit remains and number of samples presenting each taxon.

Table 3.- Sites per period in the Supra- and Montane-Mediterranean life zones (Sm and Mm respectively) with wild fruit remains and number of samples presenting each taxon.

Table 4.- Main modes of consumption of the different anatomic parts of the wild plants documented in the East of the Iberian Peninsula.

Figure 1

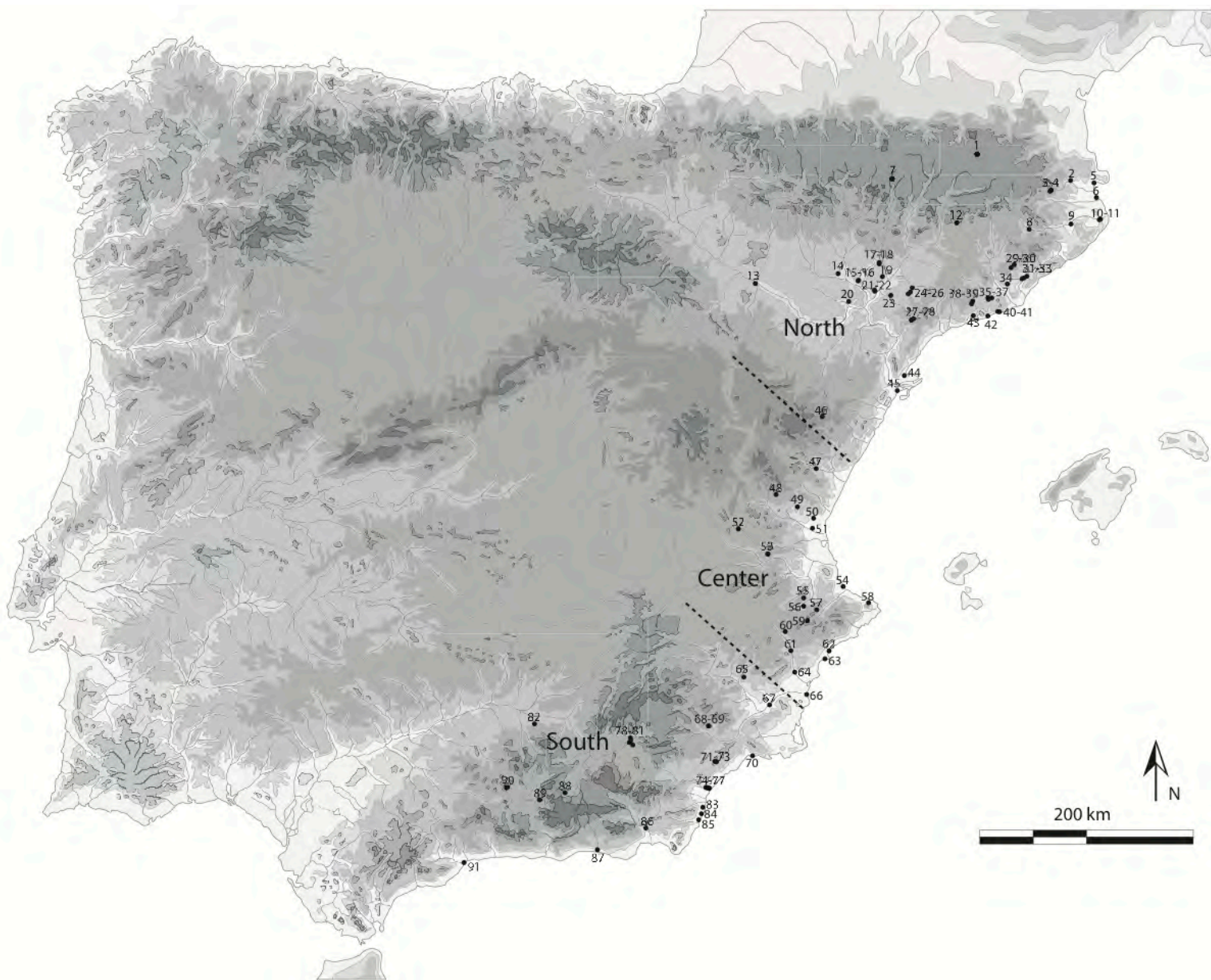
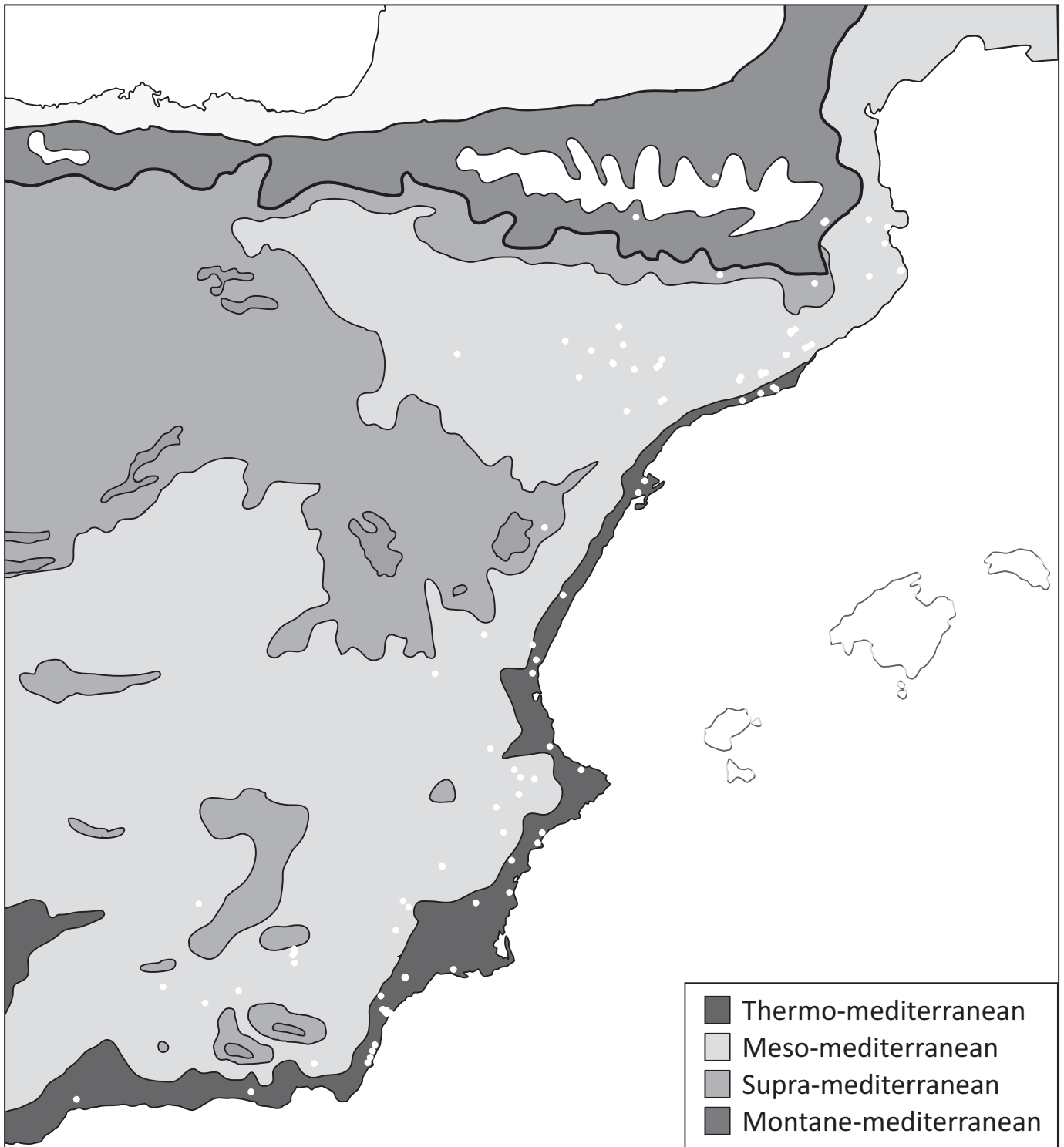
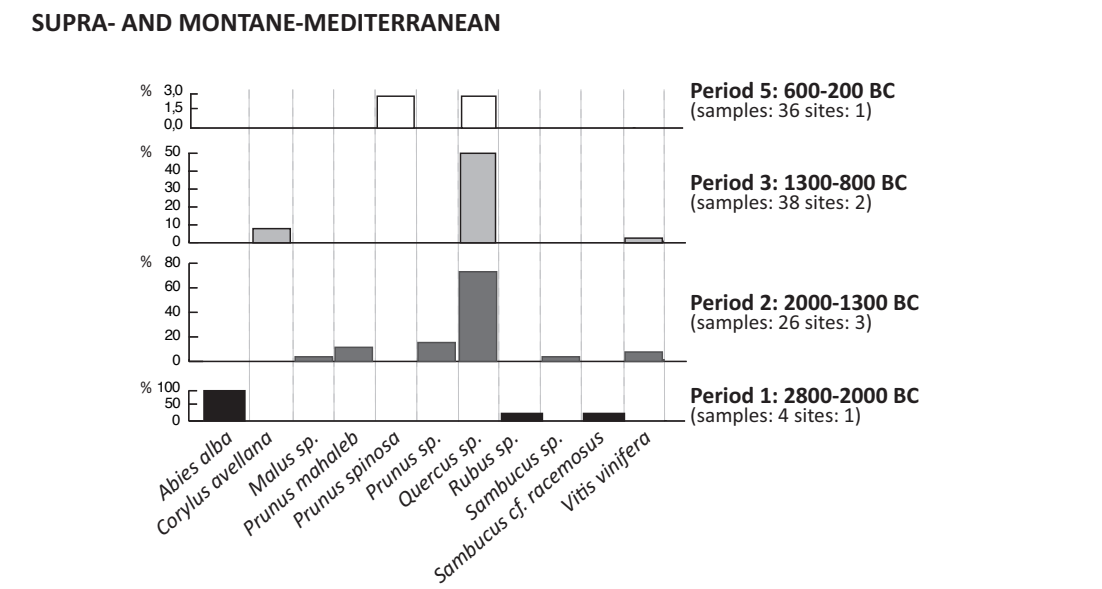
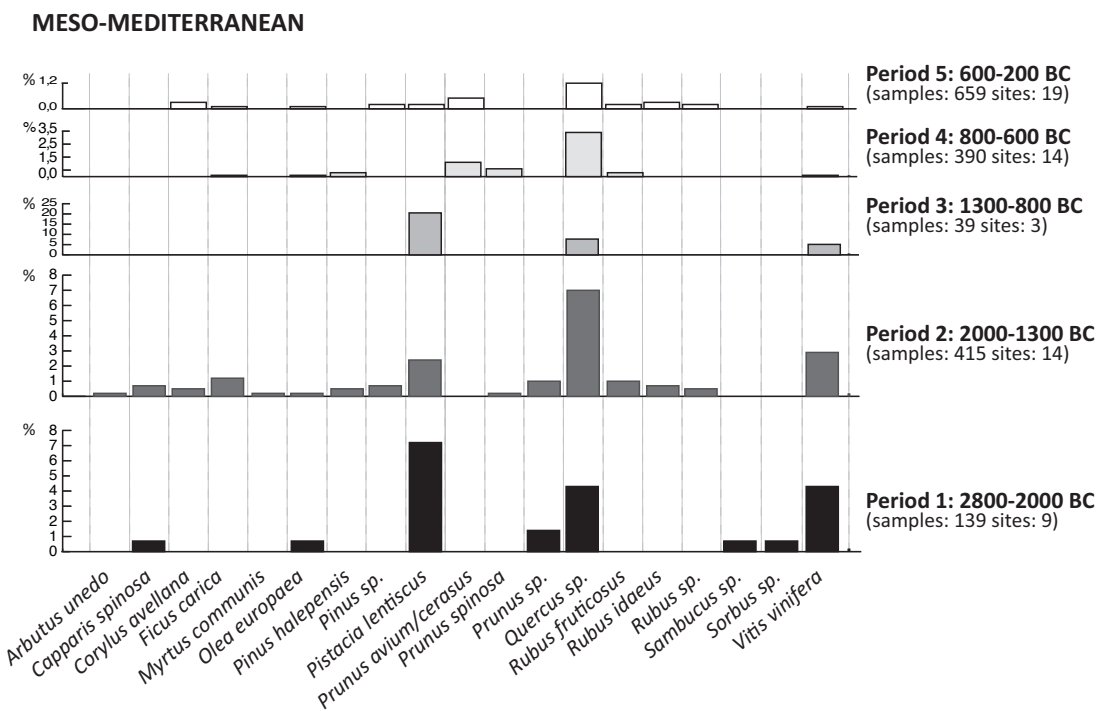
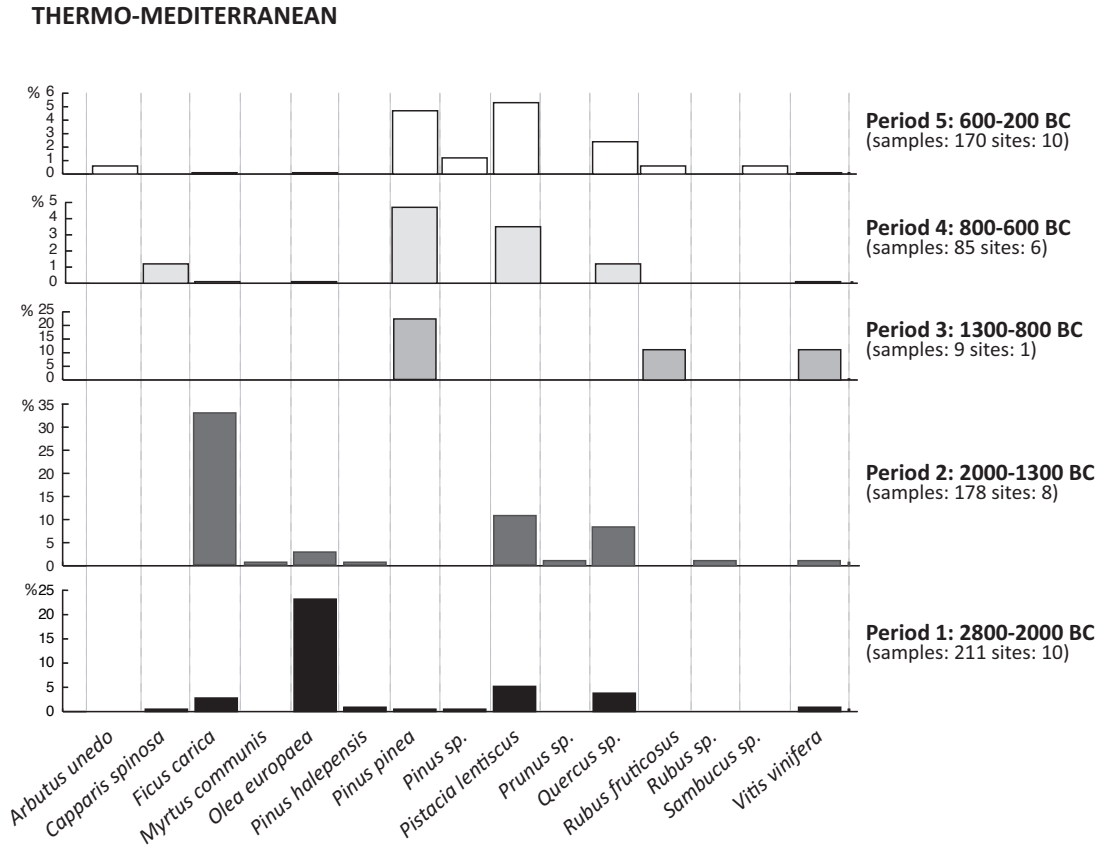
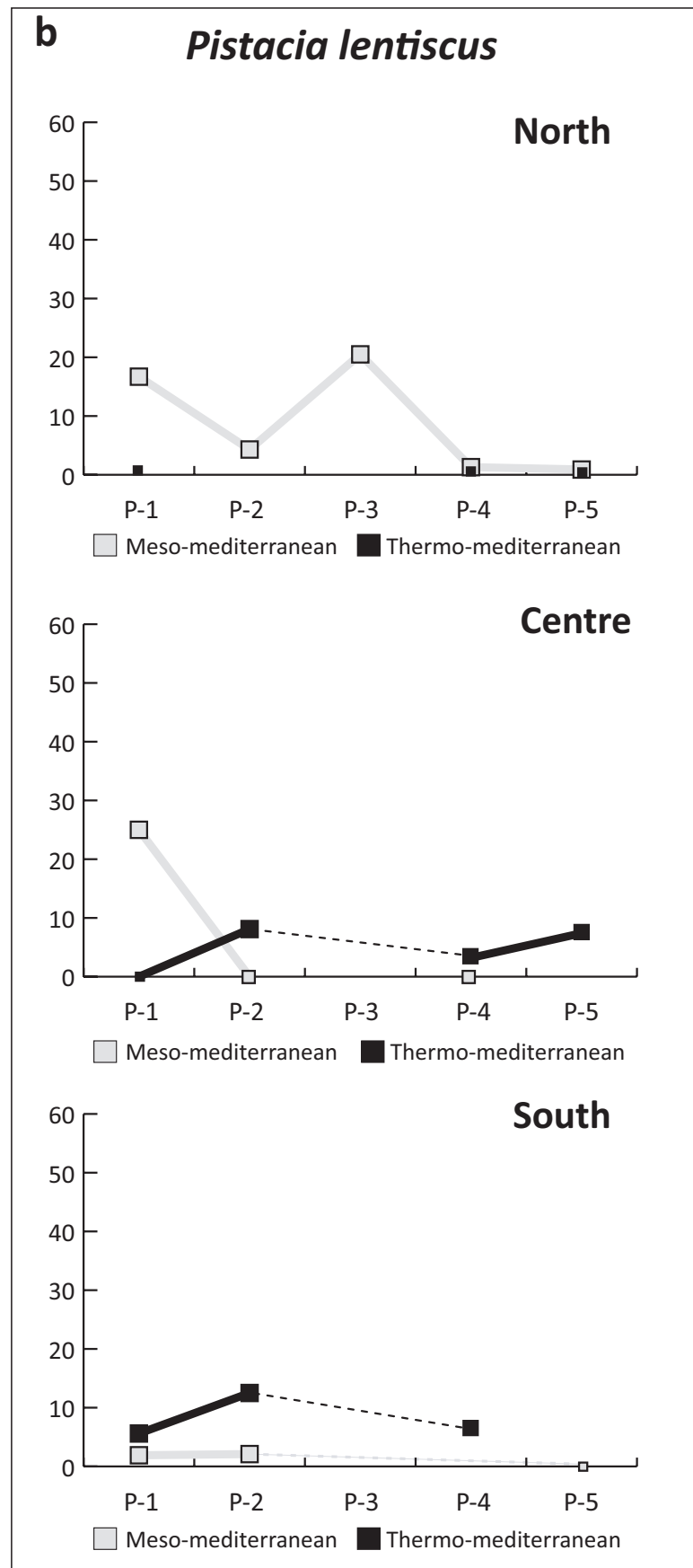
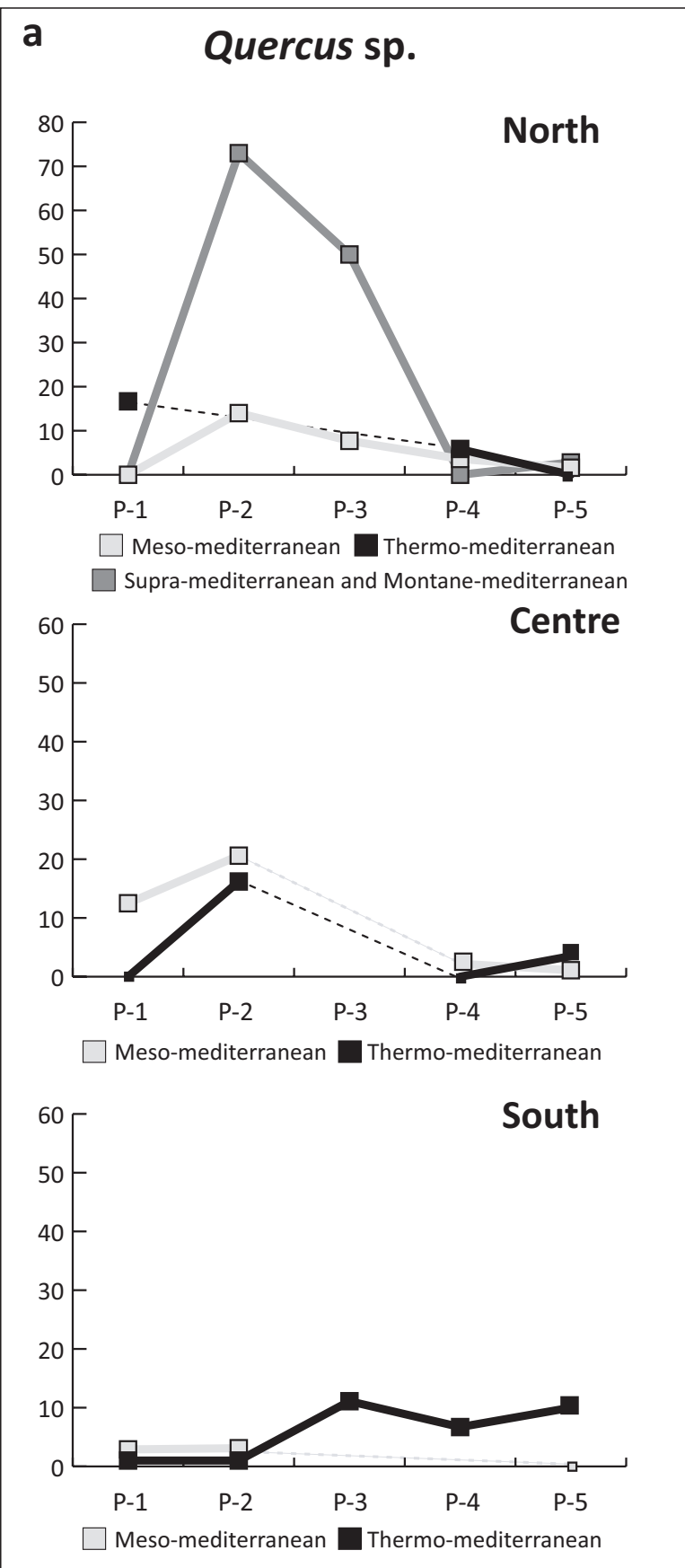


Figure 2







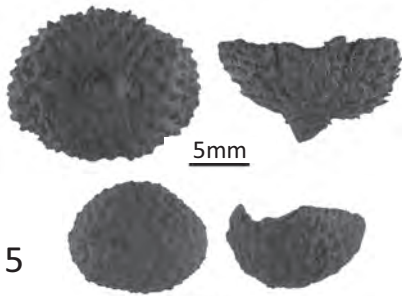
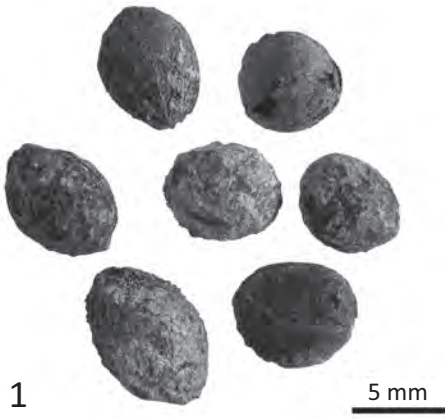


Figure 6

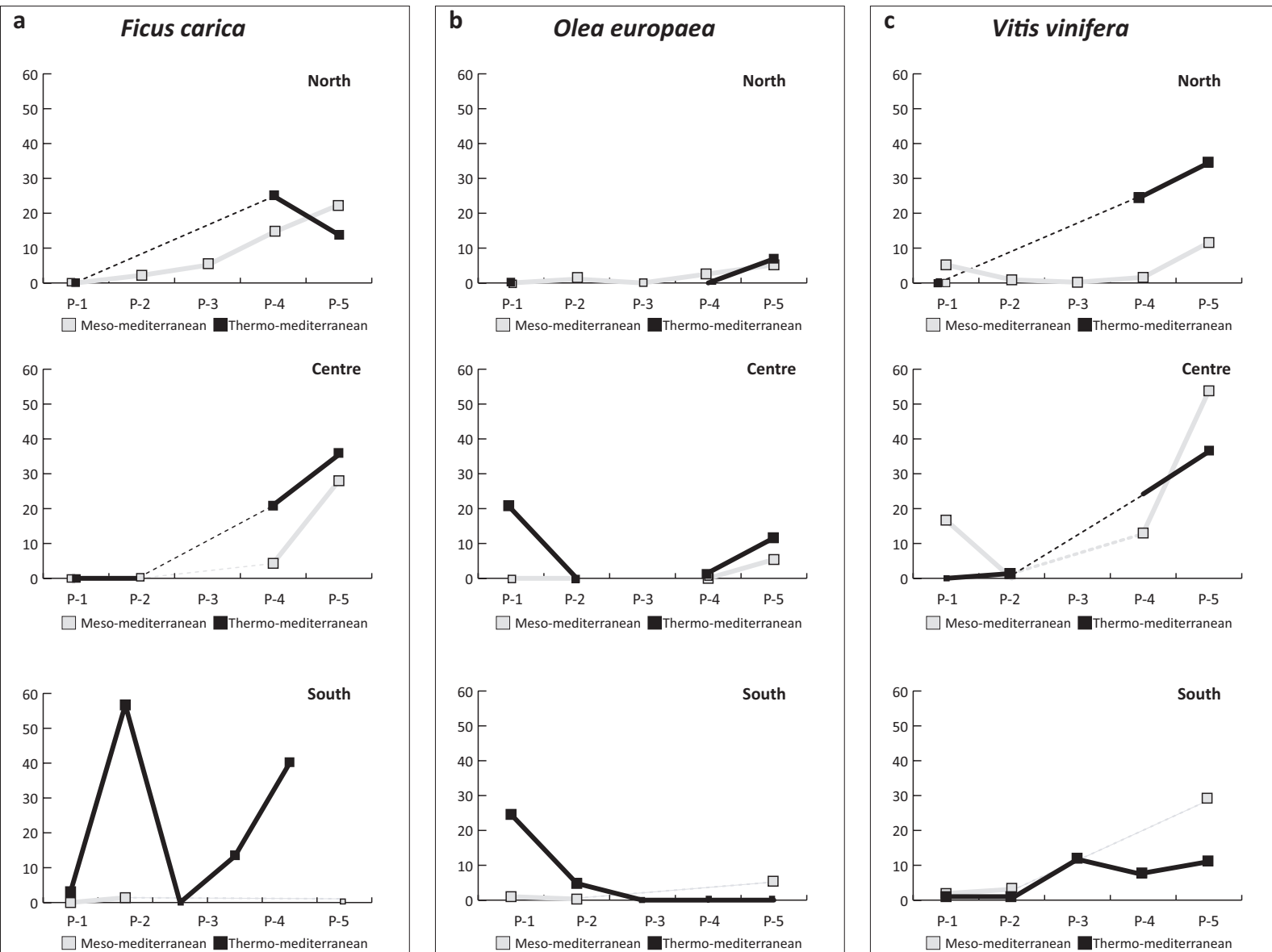


Table 2

THERMOMEDITERRANEAN LEVEL	Town, Province	samples	number of plant remains															References			
				<i>Arbutus unedo</i>	<i>Capparis spinosa</i>	<i>Ficus carica</i>	<i>Malus sp.</i>	<i>Myrtus communis</i>	<i>Olea europaea</i>	<i>Pinus halepensis</i>	<i>Pinus pinea</i>	<i>Pinus sp.</i>	<i>Pistacia lentiscus</i>	* <i>Prunus dulcis</i>	<i>Prunus sp.</i>	* <i>Punica granatum</i>	<i>Quercus sp.</i>		<i>Rubus fruticosus</i>	<i>Rubus sp.</i>	<i>Sambucus sp.</i>
PERIOD 1: 2800-2000 BC																					
77	Almizaraque	Herrerías, Almería	5	498			3			1	1							Stika and Jurich, 1999			
70	Cabezo del Plomo	Mazarrón, Murcia	6	499			1											Precioso, 1995 and 2004			
84	Campos	Cuevas del Almanzora, Almería	11	10886					7		1	1						Buxó, 1997			
73	Cueva Sagrada	Lorca, Murcia	1	387			1	1										Rivera and Obón, 1987			
61	Elda	Elda, Alacant	1	7						1								Precioso, 1998			
54	La Vital	Gandia, València	8	9								1						Pérez Jordà, 2013			
85	Las Pilas	Mojácar, Almería	121	149058			1			29	1				8		3	Rovira i Buendia, 2007			
64	Les Moreres	Creventill, Alacant	2	2775					1									Pérez Jordà, 2013			
86	Los Millares	Santa Fé de Mondújar, Almería	50	391					10								4	Buxó, 1997			
41	Sant Llorenç	Sitges, Barcelona	6	4													1	Antolí, 2013			
			211				1	6			49	2	1	1	11		8	2			
PERIOD 2: 2000-1300 BC																					
75	El Argar	Antas, Almería	13	419			7			3					4			Stika and Jurich, 1999			
74	Fuente Alamo	Cuevas de Almanzora, Almería	75	14415			51			1		1	8				1	Stika, 1988 and 2001			
78	Fuente Amarga	Galera, Granada	8	94										1				Buxó, 1997			
83	Gatas	Turre, Almería	1	-			1		1	1				1	1			1	Clapham <i>et al.</i> , 1999		
62	Illleta dels Banyets	El Campello, Alacant	2	2940											2			Pérez Jordà, 2013			
51	Lloma de Betxí	Paterna, València	72	456519										4			12	1	Pérez Jordà, 2013		
76	Lugarico Viejo	Antas, Almería	1	-													1		Siret and Siret 1890		
72	Madres Mercedarias	Lorca, Murcia	6	862										1	1				Precioso, 1995 and 2004		
			178				59		1	5	1			19	2		15	2	2		
PERIOD 3: 1300-800 BC																					
91	Rebanadilla	Málaga, Málaga	9	20								2					1		1	Pérez Jordà, 2013	
			9									2					1		1		
PERIOD 4: 800-600 BC																					
87	Cerro de Montecristo	Adra, Almería	3	29			2												Pérez Jordà, 2013		
58	Alt de Benimaquia	Denia, Alacant	24	15917			1		1				2						11	Pérez Jordà, 2013	
66	Fonteta	Guardamar del Segura, Alacant	33	459			13										1		2	Pérez Jordà, 2013	
91	Rebanadilla	Málaga, Málaga	12	23								4	1						1	Pérez Jordà, 2013	
45	Sant Jaume	Alcanar, Tarragona	8	1318			2										1		2	López Reyes <i>et al.</i> , 2011a	
47	Torrelló d'Almassora	Almassora, Castelló	5	1615															2	Cubero, 1993	
			85				1	17	1		1	4	3		1	1			18		
PERIOD 5: 600-200 BC																					
87	Cerro de Montecristo	Adra, Almería	20	303			8								1				2	Pérez Jordà, 2013	
40	Biblioteca Sitges	Sitges, Barcelona	5	77								1							3	López and Cano, unpublished	
44	Bordissal	Camarles, Tarragona	7	240						1									1	López, unpublished	
49	Castellet Bernabé	Lliria, València	14	14588	1		4	2	8				4	2	1	5	2		1	9	Pérez Jordà, 2013
67	Cigarralejo	Mula, Murcia	7	-					1		5			7			2			Rivera and Obon, 2005	
62	Illleta dels Banyets	El Campello, Alacant	24	6100			9	1						3		1			3	Pérez Jordà, 2013	
43	Mas d'en Gual	El Vendrell, Tarragona	10	1561			3						1						2	López <i>et al.</i> , 2011b	
50	Tos Pelat	Moncada, València	27	1637			16		1				2						7	Pérez Jordà, 2013	
63	Tossal Basses	Alacant, Alacant	49	1245			13		4	3					6		1		25	Pérez Jordà, 2013	
42	Xalet Nin-Darró	Vilanova i la Geltrú, Barcelona	7	62			1		1										4	López <i>et al.</i> , 2011b	
			170			1	55	3	16	8	2	9	9	15	4	1		1	56		

* Cultivated taxon introduced because of colonial influence

Table 3

SUPRA- MEDITERRANEAN MONTANE-MEDITERRANEAN		Town, Province	Vegetation levels	samples	number of plant remains	<i>Abies alba</i>	<i>Corylus avellana</i>	<i>Malus sp.</i>	<i>Prunus mahaleb</i>	<i>Prunus spinosa</i>	<i>Prunus sp.</i>	<i>Quercus sp.</i>	<i>Rubus sp.</i>	<i>Sambucus</i>	<i>Sambucus cf. racemosus</i>	<i>Vitis vinifera</i>	References	
PERIOD 1: 2800-2000 BC																		
7	Cova del Sardo	Boí, Lleida	Mm	4	47	4							1		1		Antolín, 2013	
PERIOD 2: 2000-1300 BC																		
3	Cova 120	Sales de Llierca, Girona	Mm	1	27			1				1					1	Buxó, 1997
46	Ereta del Castellar	Vilafranca, Castelló	Sm	10	4644				3		4	18		1				Pérez Jordà, 2013
8	Institut de Manlleu	Manlleu, Barcelona	Sm	15	225												1	Buxó, 1997
				26				1	3		4	19		1		2		
PERIOD 3: 1300-800 BC																		
4	Bauma del Serrat del Pont	Tortellà, Girona	Mm	33	130							19					1	Buxó and Català, 1997
1	Llo-Lo Lladre	Llo, Pyrénées Orientales	Mm	5	13428		3											Ruas <i>et al.</i> , 2009
				38			3					19					1	
PERIOD 5: 600-200 BC																		
12	Sant Esteve	Olius, Lleida	Sm	36	5493					1		1						López, 2008

	Part used		Mode of consumption
	Leafs/stems	Seeds/fruits	
<i>Abies alba</i>		•	Cones for a beverage
<i>Arbutus unedo</i>		•	Raw, jam, liqueur, cooked
<i>Capparis spinosa</i>	•	•	Floral buds, unripe fruits, young shoots, pickled, crushed
<i>Corylus avellana</i>		•	Raw, dried
<i>Ficus carica</i>		•	Raw, dried, in pies, beverages, marmalades
<i>Malus</i> sp.		•	Raw, liqueur, juice
<i>Myrtus communis</i>		•	Raw, marmalade, liqueur
<i>Olea europaea</i>		•	Oil, salt-brined
<i>Pinus halepensis</i>		•	Raw
<i>Pinus pinea</i>		•	Raw
<i>Pinus</i> sp.		•	Raw
<i>Pistacia lentiscus</i>	•	•	Branches with leaves, fruits for flavouring olives, oil, pies, sausages
<i>Prunus avium/cerasus</i>		•	Raw, liqueur
<i>Prunus mahaleb</i>		•	Raw
<i>Prunus spinosa</i>		•	Raw, liqueur
<i>Quercus</i> sp.		•	Raw, roasted, boiled, flour
<i>Rubus fruticosus</i>		•	Raw, jam
<i>Rubus idaeus</i>		•	Raw, liqueur
<i>Sambucus</i> sp.	•	•	Herbal tea, liqueur, jam
<i>Sorbus</i> sp.		•	Raw
<i>Vitis vinifera</i>	•	•	Raw, liqueur, pickled (leaves), cooked