SAGVNTVM

PAPELES DEL LABORATORIO DE ARQUEOLOGÍA
DE VALENCIA
EXTRA-13

WOOD AND CHARCOAL
EVIDENCE FOR HUMAN AND NATURAL HISTORY

ERNESTINA BADAL – YOLANDA CARRIÓN – MIGUEL MACÍAS – MARÍA NTINOU
(COORDINATORS)

VNIVERSITAT DE VALÈNCIA
FACULTAT DE GEOGRAFIA I HISTÒRIA
Departament de Prehistòria i d'Arqueologia

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Wood charcoal analyses from the Muge shell middens: results from samples of the 2010/2011 excavations at Cabeço da Amoreira (Santarém, Portugal)

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***Summary**: Wood charcoal analyses were carried out at Cabeço da Amoreira (Muge shell middens), a Mesolithic settlement dated from 8100 to 7500 cal BP. The charcoals were scattered in the sediments and samples were collected from different areas of the site. Here we present the results of the analysis of 1601 charcoal fragments retrieved during the 2010/2011 excavations from three different contexts. The results reveal a clear predominance of pine and conifer wood in the assemblage. Evergreen and deciduous* Quercus *are also present as well as one fragment of* Arbutus unedo *in one of the contexts.*

***Key words**: Charcoal analyses, Cabeço da Amoreira, Mesolithic, Muge shell middens,* Pinus.

INTRODUCTION/BACKGROUND

The Muge valley is located near the confluence of River Tagus and the Atlantic Ocean, 60 km north-east from Lisbon (Fig. 1). During the early Holocene, the landscape was affected by the rise of the sea level that transformed the Muge valley into an estuarine basin. Palaeogeographical studies in the Muge valley floor allow the understanding of its formation. These studies record a sudden drowning of the valley floor around 8200 cal BP (Shriek *et al*. 2008; Bicho *et al.* 2010). Regarding vegetation, Mediterranean taxa increased and occupied the areas upstream of the valley floor, the terrace levels, but the valley would have also been a refuge for more thermophilous taxa. Oak and pine forest developed but also herbaceous taxa, promoting an open landscape (Shriek *et al*. 2008).

Cabeço da Amoreira is a Mesolithic site, dated from 8100 to 7500 cal BP that integrates into the Muge shell midden complex. It was discovered in 1863 by Carlos Ribeiro and since then several teams have been investigating this site and other shell middens from the Muge valley, being the Mesolithic period one of the main research subjects in Portugal (Corrêa 1933; Roche and Veiga Ferreira 1967; Ribeiro 1884; Cardoso and Rolão 1999/2000). In 2008, within the framework

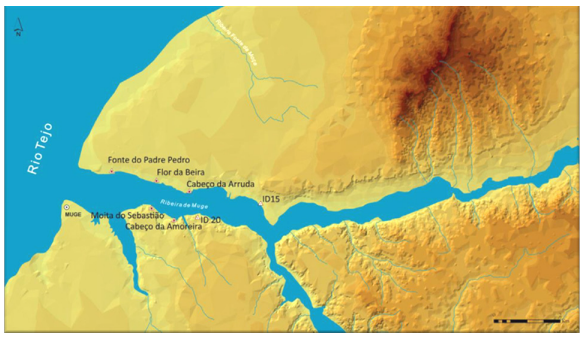


Figure 1. Location of Cabeço da Amoreira and Muge shell middens in Muge valley (Bicho *et al*. 2011).

of a new project named "The last hunters and gatherers of Muge valley" the excavation at Cabeço da Amoreira begun, aiming to investigate the complexity of society during the Mesolithic. The team, lead by one of the authors (NB), initiated investigations from an interdisciplinary perspective (zooarchaeology, physical anthropology, lithic technology, archaeobotany, SIG, DNA, etc.) in a new area of the shell middens (Bicho *et al*. 2011).

In previous archaeobotanical studies charcoal remains from the excavation of José Rolão were analysed and both *Pinus* sp. and *Quercus* sp. were identified (Wollstonecroft *et al*. 2006). In the study here presented, samples from the 2010 and 2011 excavation seasons at Cabeço da Amoreira that form part of the above-mentioned archaeological project, were analysed. Fire and the exploitation of woodland resources are important matters in the economy of past societies. Charcoal is the anthropogenic mark of these activities. In this sense, it becomes a very important tool in order to know how the Muge Mesolithic societies exploited their landscape and the available resources.

MATERIAL AND METHODS

The samples presented here come from three areas of Cabeço da Amoreira:

1) The North Profile in the area previously excavated by Jean Roche –this profile was recently (2010) cleaned and dated (7610-7850 cal BP at the base, 7570-7800 cal. BP at the top)– and 9 scattered charcoal samples (795 fragments >2 mm) that were retrieved from the sieved sediment;

2) The funerary context of a female burial found in the recent excavations of the shell midden and dated to *c*. 7600 cal BP. This charcoal material was found in a well preserved context. Various fragments (n=733) were individually handpicked and their three-dimensional location was registered with a total station together with the other artefacts and layers that covered the skeleton;

3) Squares in the main open area of the excavation. These samples were recovered through flotation and their analysis is still in progress therefore, the results presented here are preliminary. The low number of analyzed fragments is justified by the small size of the recovered charcoal material, with only 73 fragments near the required dimensions. This problem also affected the observation of the sections and that is why the identification of the pines was only carried out at the genus level.

Charcoal fragments >2mm were analysed with an incident-light microscope observing the three main sections (transversal, longitudinal tangential and longitudinal radial). The identification was made by comparing the archaeological wood with modern charcoal from the reference collection (UPV/EHU) and wood anatomy atlases (Shweingruber 1990; Vernet *et al*. 2001; García Esteban 2002).

The identification of the *Pinus* taxa was mainly based on the observation of the radial section: 1) in the case of *Pinus* cf. *pinaster* heterogeneous rays with conspicuously dentate walls were observed (Fig. 2); 2) in the case of *Pinus* cf. *pinaster/pinea* we recognized smooth dentate walls in the heterogeneous rays (Fig. 3). Due to the similarity between *Pinus pinaster* and *Pinus pinea* and the difficulty to confirm the absence of conspicuously dentate walls the identification remains as *Pinus* cf. *pinaster/pinea*; 3) in the case of *Pinus* cf. *sylvestris* tp. heterogeneous rays with fenestri-

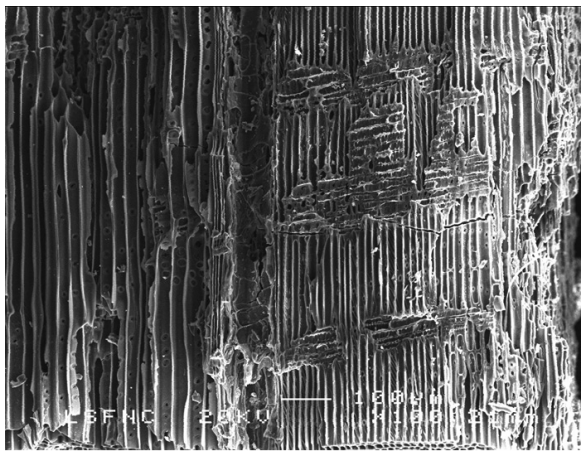


Figure 2. SEM image of the radial section of *Pinus* cf. *pinaster* from the North Profile.

Figure 3. SEM image of the radial section of *Pinus* cf. *pinaster/pinea* from the North Profile. Conservation problems may be observed.

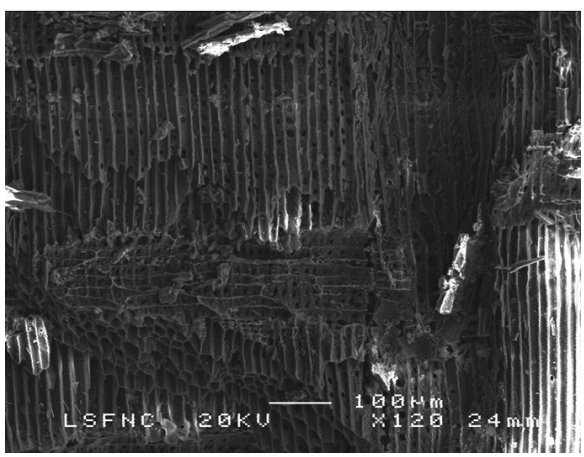


Figure 4. SEM image of the radial section of *Pinus sylvestris* tp. from the North Profile. Fenestriform apertures may be observed.

form apertures (window type) and dentate walls were observed (Fig. 4). There were some difficulties in determining different pine species due to their anatomical similarities and the general small size of the fragments which in many cases limited the observation of the radial section. Different types of alterations were also observed (degradation, vitrification, intrusions).

RESULTS

The results are presented in Table 1 and Figures 5 and 6. A total of 1601 wood charcoal fragments were analysed. The assemblages are dominated by different *Pinus* and *Quercus* taxa. Regarding the conifers, we identified *Pinus* cf. *pinaster, Pinus* cf. *pinaster/pinea* and *Pinus sylvestris* tp. Fragments identified as *Pinus* sp. and Gymnosperm are abundant. Among the Angiosperms, both evergreen (*Q. ilex / Q. coccifera*) and deciduous or semi-deciduous oaks (*Quercus subg. Quercus*) were identified. A single fragment of the strawberry tree (*Arbutus unedo*) was recognized in the burial context.

	North Profile	Burial	Open area
Pinus sp.	256	236	27
Pinus cf. *pinaster*	131	66	-
Pinus cf. *pinaster/pinea*	42	-	-
Pinus sylvestris tp.	13	103	-
Gymnosperm	234	207	18
Quercus subg. *Quercus*	2	9	3
Quercus ilex/Q. coccifera	10	18	6
Quercus sp.	3	-	-
Arbutus unedo	-	1	-
Angiosperm	19	25	5
Indeterminate	85	61	14
TOTAL	795	733	73

Table 1. Absolute numbers of the identified species in the three analysed contexts.

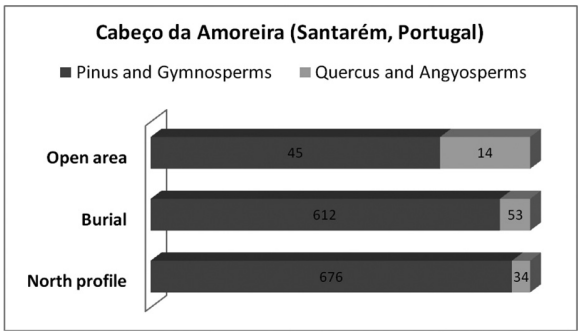


Figure 5. Summary of the results of wood charcoal analyses from the three areas (Mesolithic site of Cabeço da Amoreira). Gymnosperms and Angiosperms have been grouped for each area. Indeterminate specimens have been ignored.

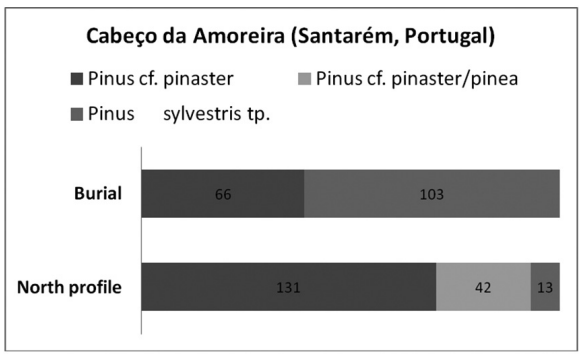


Figure 6. Relative importance of the main *Pinus* taxa identified in the North Profile and the burial (Mesolithic site of Cabeço da Amoreira).

As we can see, there is a clear predominance of pine and conifer wood in the contexts (over 90% in the North Profile and the burial, Fig. 5). Only in the samples from the general area, does angiosperm wood present a percentage over 20%. However, we must take into account that only 59 fragments were identified thus percentages may not be very reliable.

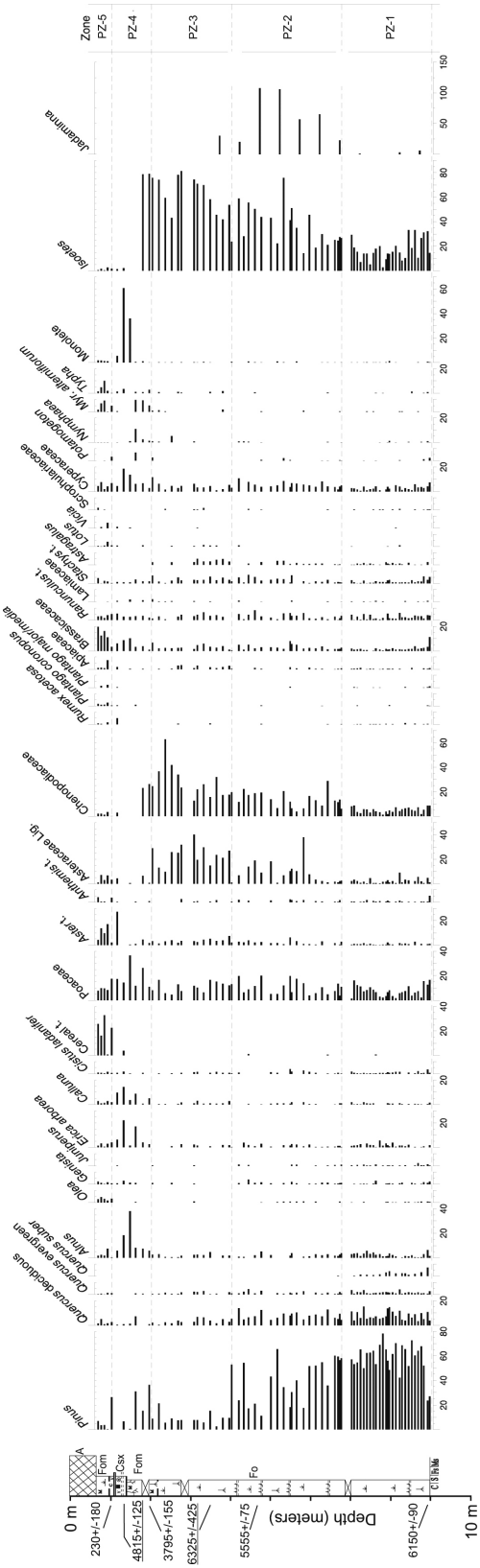
Regarding the relative importance of the different pine taxa identified, first we must consider that many fragments had a limited anatomical resolution. Many fragments were identified as *Pinus* sp. and indeterminate gymnosperms were also very frequent. Taking into consideration only those fragments identified as *Pinus* cf. *pinaster, Pinus* cf. *pinaster/pinea* and *Pinus sylvestris* tp., we can see that *Pinus sylvestris* tp. is quite important in the burial (103 fragments, 61%, Fig. 6) whereas in the North Profile, *Pinus* cf. *pinaster* is the most abundant (131 fragments, 70%, Fig. 6).

Among the angiosperms, both evergreen (*Quercus ilex*/*Q. Coccifera*) and deciduous type oaks (*Quercus* subg. *Quercus*) are present in the samples. The former are more abundant according to fragment number. The identification of one single fragment of *Arbutus* in the samples at least shows the presence of this tree in the vicinity.

DISCUSSION

The first point of the discussion must focus on the data and underline some limitations of the results. The general small size of the fragments, especially in the flotation and in the North Profile samples, restricted more precise identifications. Moreover, samples were not recovered with the same methodology and only in one area they were processed through flotation as it is usually recommended (Alonso *et al*. 2003). In spite of this, the three areas (North Profile, burial and general area) show a big similarity in the identified taxa and in their relative importance (Table 1, Fig. 5). Samples were scattered in the sediment and both for the North Profile and the open area we assume a likely origin as domestic fuelwood. In the North Profile the use of *Pinus* cf. *pinaster* is remarkable. More difficult to interpret is the burial context since the wood here might be connected with more specific activities (funerary, ritual, symbolic). Still, the genus *Pinus* (especially *Pinus sylvestris* tp.) is the most represented wood. *Arbutus unedo* is also present exclusively in the burial context. Oaks, although rare in all samples, are more frequent in the open area than in the other contexts.

Especially relevant for this study are previous studies carried out with wood charcoal and pollen since they allow us to compare different archaeobotanical data. Charcoal analysis from Cabeço da Amoreira shows the important presence of pine wood in the three contexts. Although identifications of spe-



cies were not possible in general, we may suggest the presence of two types of pines: Scots pine type (*Pinus sylvestris*) and Mediterranean pines (*Pinus pinaster/P. pinea*). The long history of Mediterranean pines in Portugal is attested by previous charcoal analyses which record their presence in Estremadura in Palaeolithic and Mesolithic sites (Figueiral 1995). *Pinus* tp. *sylvestris*, already established during the Lateglacial, resisted the Holocene environmental changes in the surroundings of the Muge valley. The taxon was also identified in Epipalaeolithic and Mesolithic contexts from Estremadura (Figueiral and Carcaillet 2005) and later along the country, proving its resilience.

Different palaeoenvironmental data from pollen, geoarchaeology and micropalaeontology studies give us an idea of the past environment of the Muge area (Schriek *et al*. 2008) and allow reconstructing the evolution of the floodplain and the surroundings where the vegetation would have grown. In the pollen diagram by F. Franco Mugica (Schriek *et al*. 2008: 145) we can see that during the period contemporary to Mesolithic Cabeço da Amoreira (PZ-2), *Pinus* is the most abundant taxon, followed by different types of *Quercus* (deciduous, evergreen and *Q. suber*), *Alnus, Olea, Juniperus* and different shrubby taxa (Fig. 7) which were not identified in our samples of macroremains (*Genista, Erica arborea, Calluna, Cistus ladanifer*). Non arboreal taxa probably indicate an open or semi-open landscape. During this period pine woodlands suffer progressive losses and more open spaces alternate with regeneration episodes.

In agreement with the pollen information, the most abundant taxa in the vicinity of the site (*Pinus, Quercus*) were also the ones used by the inhabitants of the site. We must take into account that, in spite of similarities, pollen and charcoal analyses provide different sets of data. Differential pollen rain, human selection of fuels, the different scales of the data (pollen may have a regional input and charcoal tends to be very

Figure 7. Pollen diagram from the Muge valley bottom (F. Franco Múgica in Shriek *et al*. 2008: 145).

local) are only some of the issues that may explain differences. In order to understand the preference for *Pinus* and *Quercus* in Cabeço da Amoreira, apart from the clear availability of these genera, we must consider that conifers tend to produce more dead wood. Dead wood would most probably have been preferred, as we can see in other archaeological examples (e.g., Théry-Parisot 2001). Deciduous forests produce less wood and disintegration is faster (Peterken 1996). Also, regarding their burning properties, the combination of conifer wood with oak might have been particularly efficient.

CONCLUSIONS

A total of 1601 charcoal fragments were analysed in this study. Charcoal was retrieved from different contexts of Cabeço da Amoreira, both habitation and burial. Pine and conifer wood, more precisely *Pinus* cf. *pinaster, Pinus pinaster/pinea* and *Pinus* tp. *sylvestris* were identified in the samples. Evergreen and deciduous *Quercus* were also present in all contexts. According to the fragments identified with higher resolution, the burial context might reflect a higher representation of *Pinus sylvestris* tp. and it is also the only one where *Arbutus unedo* was present.

According to pollen information (F. Franco Mugica in Schriek 2008), the most abundant taxa in the vicinity, *Pinus* and *Quercus*, are also the ones mostly used by the inhabitants of the site. However, our samples do not record the presence of other arboreal and shrubby taxa which are very abundant in the pollen record (*Alnus, Olea, Juniperus, Genista, Erica, Calluna*) and reflect the existence of open areas. Whether this is the result of: a) human selection, b) taphonomic questions related for example with a different behaviour of these taxa during combustion, or c) a different scale of both types of analyses with pollen including a regional component. This is something that will have to be assessed in the future under the light of the analysis of more plant macroremains from habitation areas.

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