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## Evidence of paleogeographic constraints on woodlands on the shores of a coastal lagoon during Antiquity: charcoal analysis of the Prés-Bas villa and Le Bourbou (Loupian, Hérault)

Lucie Chabal, Isabel Figueiral, Christophe Pellecuer, Iouri Bermond

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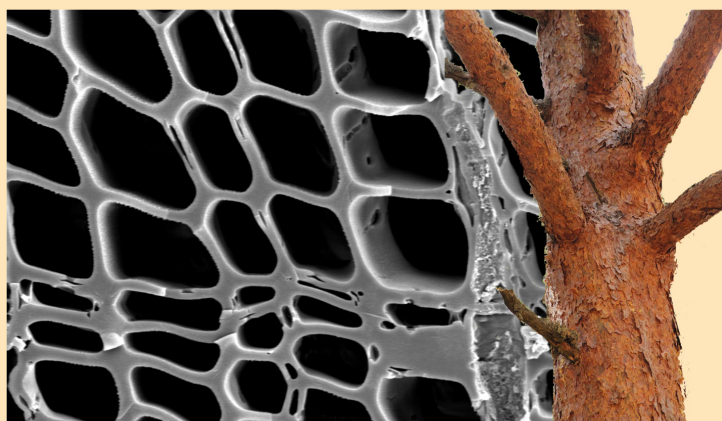
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# SAGVNTVM

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  
D VALÈNCIA

FACULTAT DE GEOGRAFIA I HISTÒRIA

**Departament de Prehistòria i d'Arqueologia**

2012



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## EVIDENCE OF PALAEOGEOGRAPHIC CONSTRAINTS ON WOODLANDS ON THE SHORES OF A COASTAL LAGOON DURING ANTIQUITY: CHARCOAL ANALYSIS OF THE PRÉS-BAS VILLA AND LE BOURBOU (LOUPIAN, HÉRAULT)

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**Summary:** *During Antiquity, the mixed oak woodland and the vegetation of the alluvial plain developing on the shores of the Thau lagoon were exploited as a source of wood fuel, as shown by charcoal remains from the villa of Prés-Bas and the pottery workshop of Le Bourbou. Taking into account the local ecology and the vegetation transformations during the second part of the Holocene, charcoal data exemplify the long term opposition between the northern and the southern shores of this lagoon.*

**Key words:** *Roman villa, Antiquity, palaeobotany, coastal environment, effects of human activities.*

### INTRODUCTION

The purpose of this study is to understand the environmental evolution and exploitation, on a coastal lagoon during Antiquity. This work is based mainly on charcoal analysis carried out at the roman *villa* of Prés-Bas and the nearby pottery workshop of Le Bourbou, located beside the Mediterranean Sea in southern France. The two sites provide complementary information on six centuries of human occupation and can be understood due to a larger archaeological and palaeoenvironmental background, provided by other studies, as cited in the following sections of the article.

Fortunately, the margins of the Thau lagoon, occupied since the early Neolithic, provided abundant archaeological, palaeobotanical and palaeogeographic information. The long term coastal morphological evolution and vegetation history (based on geomorphology, palynology, archaeobotany) are used as reference in an attempt to distinguish the role of physical conditions and human incentive.

### GEOGRAPHICAL CONTEXT: A COASTAL LOCATION

The *villa* of Prés-Bas is located at Loupian

(Hérault) (13 m a.s.l.), an area once included in the Roman Narbonnaise (Fig. 1). During Antiquity, the *villa* was situated *c.* 1.2 km from the northern shore of the Thau lagoon, on the Mio-Pliocene plain delimited by the Jurassic limestone substrate of La Gardiole. The site of Le Bourbou – a pottery workshop, a harbour and a small village – was located on the very edge of the lagoon. The absence of a permanent river in the northern coast explains the very slight sedimentary infilling of the lagoon. Only the temporary streams draining the limestone reliefs, away from the lagoon, bring sediments to the northern shore. The very slight strength of these streams explains why Bronze Age sites were found in the lagoon under a very thin layer of sediment.

The Thau lagoon, 5 km large, includes an offshore sand bar, overlying an isthmus, linking two limestone reliefs: the Mont Saint-Clair, at Sète, and the Mont

Saint-Loup (ancient volcano of Agde). At present, narrow passages link the lagoon to the sea. During the Holocene, the Mont Saint Clair had a continental setting first, becoming an island afterwards as a consequence of rising sea level. Probably a perched lagoon existed temporarily. Finally, the expansion of the offshore bar separated the sea from the actual lagoon, shortly after 7500 BP (Court-Picon *et al.* 2010).

### ARCHAEOLOGICAL CONTEXT: A PROSPEROUS GALLO-ROMAN *VILLA*

Middle/Late Bronze Age communities occupied both the northern and the southern shores of the lagoon (Leroy *et al.* 2003) while all known Gallo-roman sites are located on the northern shore.

The excavation of the *villa* of Prés Bas (supervised by Christophe Pellecuer and Iouri Bermond) showed that the main building area occupied a surface of *c.* 1ha, from which only 1/3<sup>rd</sup> was excavated.

The *villa* was occupied from 50 BC to 600 AD. Built first as a modest farm (phase I: 50 BC/50 AD) it was later transformed into a rich patrician domain (phase II: 50/350 AD) with *thermae* and a courtyard with colonnade. The cellar (315 m<sup>2</sup>), with a capacity for 1500 hl provides evidence of an economy based on viticulture. The amphorae for the *villa* were produced by the lagoon at Le Bourbou, active between 50 and 425 AD. The five kilns of the pottery workshop also produced domestic pottery and construction materials, such as tiles. During the 4<sup>th</sup> century, the *villa* was partially rebuilt as a rural residence (Phase IIIa: 350/375 AD). Under the residential apartments, a complex underground heating system was installed. The *thermae* complex includes warm / hot chambers and a *piscina* whose walls were heated by hot air transported from the furnace via a system of terracotta pipes. The *pars rustica* was extended. During the 5<sup>th</sup> century, the *villa* was transformed into a magnificent residence (Phase IIIb and IIIc: 375/6<sup>th</sup> AD) with rich polychrome mosaic floors (Bermond and Pellecuer 1997; Pellecuer 2000).



Figure 1. Location of sites.



## CHARCOAL SAMPLING AND DATA

Charcoal was sampled from the domestic deposits of the *villa*, the hypocaust and the pottery kilns by dry sieving (4 mm mesh), to ensure the reliability of data, their paleoenvironmental representativity and the correct identification and interpretation of the area targeted for wood collecting (Chabal 1997).

The paleoenvironmental interpretation is mostly based on the charcoal diagram representing the study of 4600 charcoal fragments from domestic residues sampled in the *villa* (Fig. 2). Further interpretations are based on other contexts, such as the hypocaust deposits of Phase IIIa and the kilns from Le Bourbou.

## DIAGRAM RESULTS

Charcoal analysis provided a large plant spectrum with 33 species, at least (Fig. 2).

Evidence of an evergreen oak (*Quercus ilex*) dominated woodland is recorded during all the occupation. Very low frequencies of deciduous oak, most probably *Quercus pubescens*, are recorded. We know by now that the exploitation of the Mediterranean oak forest favours *Quercus ilex*, which resprouts better than *Quercus pubescens* (Chabal 1997). Our results seem to illustrate this type of woodland, exploited by the occupants of the *villa*.

The abundance of *Olea europaea* and the presence of *Cupressus*, *Vitis vinifera*, *Juglans regia* are particularly noted. The abundance of *Olea* is quite unexpected. In the flatlands of the Languedoc this species usually appears very sporadically. This may indicate good local thermic conditions, as also suggested by palynology (Court-Picon *et al.* 2010). *Cupressus*, probably introduced, is infrequently identified in France. During Antiquity it is mostly present in burial contexts.

Other species, associated with humid conditions (*Fraxinus*, *Ulmus*, *Tamarix*, *Acer*) are little represented. This is quite surprising as even now, when little natural vegetation is left, a fringe of mesophilous vegetation well adapted to the lowlands, is still observed.

More precisely, in present-day woodlands, *Fraxinus oxyphylla* and *Ulmus minor* grow near *Quercus ilex* which takes over when topography rises a little.

Key-observations from this diagram can be summarized as follows:

- In a context of Mediterranean oak woodlands, the dominance of evergreen oak is considered as a normal result of wood exploitation.
- The very low representativity of the mesophilous woodlands is however surprising as the *villa* is located at a very low altitude. It is clear that the land was exploited for vine growing and other economic activities. The plain was certainly partly deforested. But these alone can not explain the very low representativity of the exploited alluvial woodlands during this period. Even now, when the area is almost completely deforested, *Ulmus* and *Fraxinus* still survive further west, as residual groves on alluvial soils.

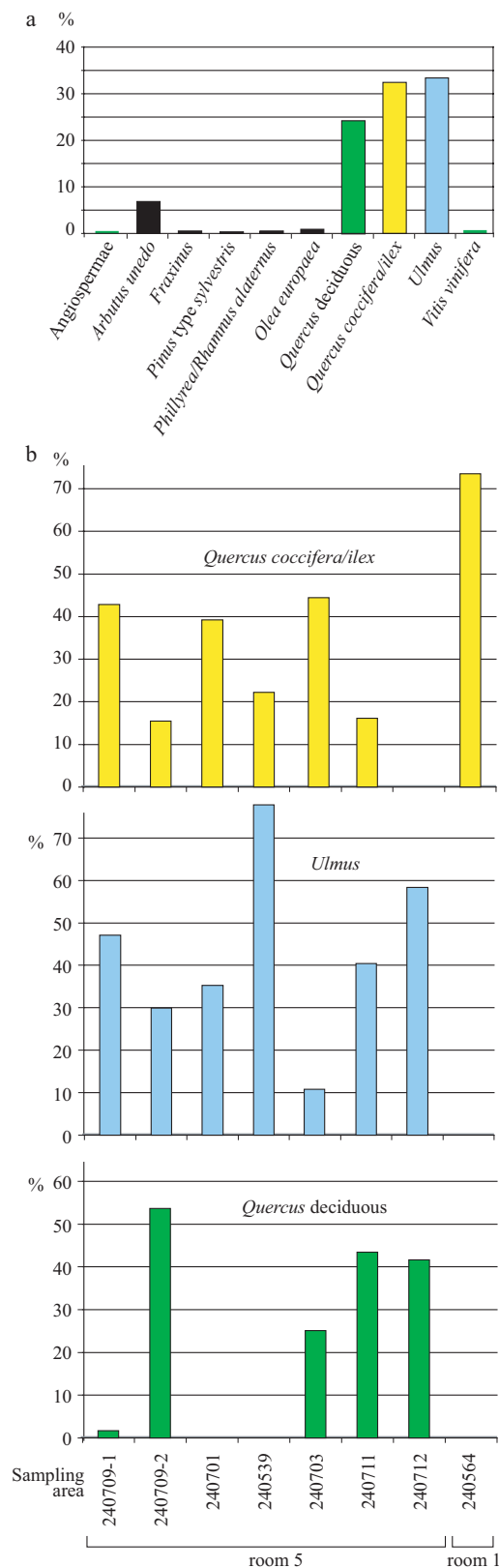
The other contexts studied may provide an explanation for our results, as we will explain next.

## CONCENTRATED CHARCOAL FROM THE HEATING SYSTEM (HYPOCAUST)

In the *villa*, data from the underground heating system of two rooms (300/375 AD) reveal the use of diverse species (9 taxa for 540 charcoal fragments) (Fig. 3a): *Quercus* (deciduous), *Quercus coccifera/ilex* and *Ulmus* predominate (and not only *Quercus coccifera/ilex* as in the domestic fuel). Their frequencies vary slightly according to the 8 sampling areas, i.e. *prae-furnium* (furnace) or hypocaust pipes (Fig. 3b).

Do these frequencies result from a representativity chance due to the type of deposit? Indeed we know that charcoal coming from concentrations (instant deposits), very often represent only the last fires (Chabal 1997). Is this the case in these deposits? Frequency of the three main taxa varies very slightly in the different sampling areas of the room 5. A single locus contains almost only *Quercus coccifera/ilex*, in room 1.





Thereby, results from the hypocaust are very different from those of the domestic fuel, showing that mesophilous woodlands were also well exploited. Two questions should be answered to explain this difference:

- Is the wood used in the heating system subject to selection? Intentional selection appears as an unlikely explanation, as the three main species identified in the hypocaust are hardwoods, with similar behaviour during combustion (Théry-Parisot 2001; Théry-Parisot *et al.* 2010).

- Are different woodland areas exploited for the domestic area and for the heating system? Coppices of holm oak, providing most of the domestic fuelwood, could have been exploited on the hills behind the *villa*, beyond the cultivated areas, and even further away. A more reduced area of ancient woodland could have provided a separate provision of fuelwood for the hypocaust. This mixed or alluvial woodland, older than the oak coppices, could have provided wood of a larger calibre, more appropriate for the slow and continuous heating of the hypocaust. This seems to be the most likely explanation.

### THE POTTERY KILNS OF LE BOURBOU

Five pottery kilns, which functioned from 50 to 425 AD, provided a large amount of charcoal fragments. From these, 3500 fragments have been analysed. We must however draw attention to the fact that some samples, collected in nearby deposits, may not belong to the kilns, as they were associated with domestic or metallurgical artefacts. The potters from the Bourbou used 23 species, at least. Fragments of *Quercus coccifera/ilex* and associated species predominate; this result is similar to that obtained in the domestic contexts of the *villa*.

Figure 3. Charcoal analysis of the heating system of the villa, rooms 1 and 5, phase IIIa: 350-375/400 AD): (a) Percentages of the 10 taxa identified (total). (b) Percentages of the 3 main taxa, in 8 sampling areas.



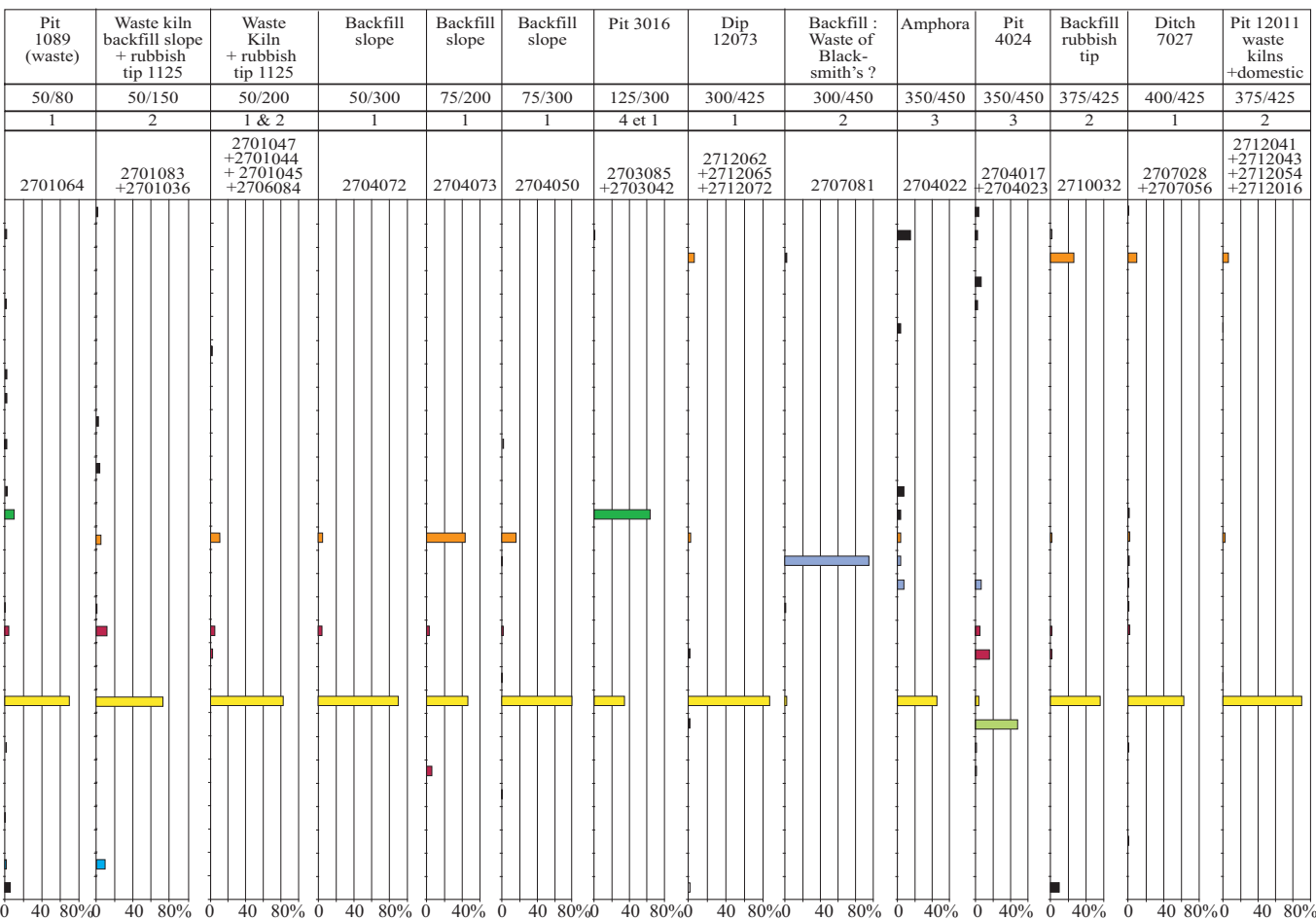


Figure 4. Le Bourbou (pottery kilns): charcoal identification (50 / 425 AD).

The great diversity of species used is not surprising. It has been observed previously in other pottery kilns, such as those of Sallèles d'Aude (Hérault, France) (Chabal 2001). Wood calibre and humidity seem important factors to take into account for this activity, while the species used seems to be of no consequence.

As the deposits are not directly correlated with the phases identified in the *villa*, and the chronological intervals are difficult to match, data are presented as a bar graph, sample by sample, organized by chronological order (Fig. 4). Dominant taxa characterize woodlands rich in *Quercus ilex*, associated with shrubby Mediterranean species such as *Arbutus unedo*, *Phillyrea* or *Rhamnus*, *Pistacia lentiscus*, *Rosmarinus officinalis*. Mesophilous taxa (*Fraxinus*, *Ulmus*, *Juglans regia*...) appear sporadically.

Two anomalies are noticed: the abundance of *Olea europaea* in the pit of one kiln, and of *Pinus* type *halepensis* in the waste from an iron kiln. These frequencies may result from deposit alias. We must however consider that *Olea* and *Pinus* are both rich in flammable compounds; the possibility of a selection based on calorific power must therefore be taken into account, even considering that charcoal is the most adapted fuel for iron smelting.

## LONG TERM TRANSFORMATIONS OF THE COASTLINE

Our results seem to indicate that vegetal landscapes from the northern shore have not changed noticeably during the six centuries of human occupation.

Based on the species identified (Holm oak woodlands, cultivated species and plants from the alluvial plain) it appears reasonable to think that the supply area must have included the very near proximity, on the northern shore only.

*Quercus coccifera/ilex* (probably Holm oak) and associated species are the main components of the fuelwood used both in the *villa* and in the pottery workshop. Coppices of holm oak probably covered

the hills behind the *villa*. The wood supply must have been well organized, using all species available without discrimination. Calibre and humidity may have been the factors mainly taken into account.

Inside the *villa*, differences between the domestic areas and the heating system are observed. The observed differences may reflect different supply areas. Deciduous *Quercus* and *Ulmus* could have been the dominant species of ancient alluvial woodlands situated close to the northern shore of the lagoon.

The ecological connotation of this interpretation is supported by our current knowledge of the long term transformations of the coastline.

Geomorphological studies were the first to highlight the complex paleogeographic evolution of this coastal area during the Holocene (Vella and Provansal 2000; Court-Picon *et al.* 2010).

A recent pollen diagram from the southern shore (SETIF) covering the last 7500 years illustrates the Holocene warming (Court-Picon *et al.* 2010). Since the early Neolithic, the stability of the relief (Mont Saint-Clair) favoured the development of a very early Mediterranean thermophilous vegetation, with a continuous curve of *Quercus ilex* and an initial peak of *Phillyrea*, a pioneer species. From the Neolithic to the present, the Mediterranean mixed oak woodland, rapidly becomes dominated by holm oak and xero-thermophilous matorrals. This thermophilous vegetation characterizes this coastal shore. Unstable environments (sand bar, lagoon banks) and human activities are also perceived.

Other studies, as cited below, include abundant organic macro-remains recovered from the Late Bronze Age dwellings built on the shores of the lagoon, when the sea level was *c.* -2 m a.s.l.

On the southern shore, archaeobotanical data (wood, charcoal, seeds and fruits) from La Fangade show that the majority of the agrarian activities and wood cutting took place in the xero-thermophilous areas, i.e. on the southern shore (lido and Mont Saint-Clair) (Bouby *et al.* 1999; Chabal *et al.* 2010).

On the northern shore, only mesophilous spe-

cies are recorded when identifying 89 posts from Montpenède (*Ulmus*, *Quercus* deciduous, *Populus*, *Fraxinus*, *Salix*), while data from La Conque identify two contrasting habitats: the alluvial/mesophilous areas with deciduous *Quercus*, *Ulmus*, *Fraxinus*, *Juglans* and the drier areas colonised by *Quercus coccifera/ilex* (Leroy *et al.* 2003). At La Conque, fruits and seeds from alluvial/mesophilous areas were the most represented (Bouby *et al.* 1999; Leroy *et al.* 2003). Thus, in the northern shore, the nearby plant environment is also represented in the archaeobotanical remains.

Based on the information obtained in all these studies, we believe that, during the Bronze Age, very different landscapes existed in the northern and southern shores of the lagoon, as a result of local conditions. On the northern shore, a slight alluvial sedimentation was sufficient to allow a fringe of alluvial forest to settle. On the southern shore, the south-facing thermophilous conditions of Mont Saint-Clair preserved during and after the Bronze Age the holm oak woodlands and the thermophilous vegetation. This complex history can be summarized as follows (Fig. 5):

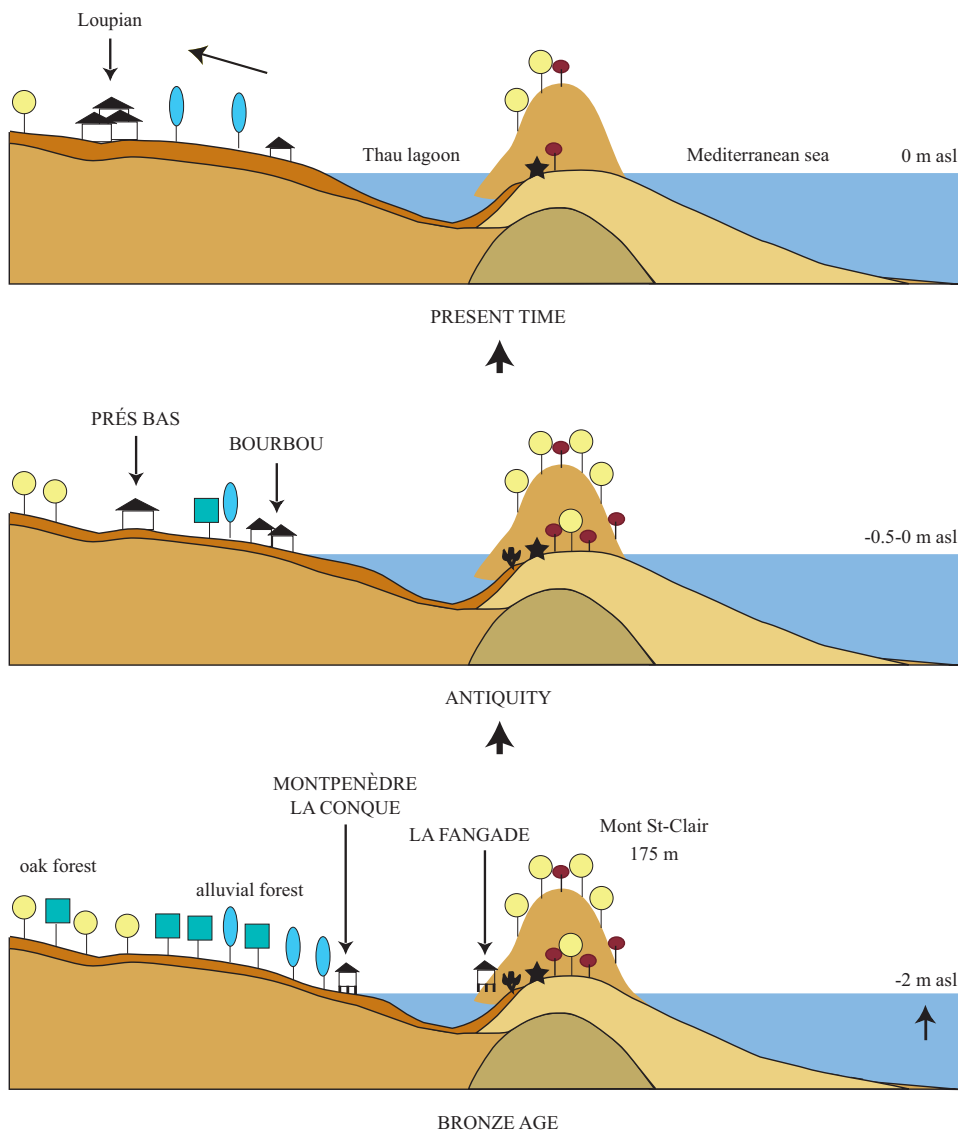


Figure 5. Long term woodland transformations on the shores of the Thau lagoon.

- During the Bronze Age, the rise of sea level slowed down and a fringe of alluvial vegetation developed on the northern shore (but not on the southern shore which is rocky and sandy). This spread of the alluvial vegetation is also recorded in other sites of the Languedoc located in similar settings (Chabal 1997; Cavero and Chabal 2010).

- During Antiquity, the sea level was *c.* 1.5 m higher than during the Bronze Age. As a result, in the northern shore, the alluvial plain may have been partially submerged. The mesophilous forest may also have been cleared for agriculture during the Iron Age. As a result, oak dominated areas may have become the main available woodlands. This would explain the little representativity of mesophilous / hygrophilous species in our two sites. However, they would not have disappeared completely as they are identified in the hypocaust.

In mixed woodlands, the exploitation of wood would rapidly favour *Quercus ilex* over *Quercus pubescens* (Chabal 1997). People living in the *villa* exploited the drier areas of the low hills, as well as the more humid areas / older stands. This was complemented by a more opportunistic supply (pruning of cultivated trees).

- After Antiquity, sedimentation started again, via water runoff and temporary streams. This is why, on the northern shore, we notice at present, a narrow fringe of alluvial vegetation, narrow because the land has not progressed towards the lagoon. Furthermore, in the last decades, the migration of alluvial species towards more inland areas has been noticed, which may suggest that during Antiquity, the lowlands were drier (better drainage) than at present.

## CONCLUSIONS

Our perception of local woodlands based on fuel used during Antiquity is in conformity with the ecology characterising the northern shore of the lagoon and its long term evolution. Especially, it reflects the differences noted since the Bronze Age, taking into

account the rise of sea level and the alluvial deposits on the northern bank. Based on the species identified (plants from the oak forest, from the alluvial plain, or cultivated species) it appears reasonable to think that the supply area must have included the very near proximity.

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