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Food plants from late Bronze Age lagoon sites in Languedoc, southern France: reconstruction of farming economy and environment

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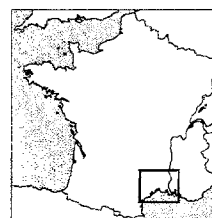
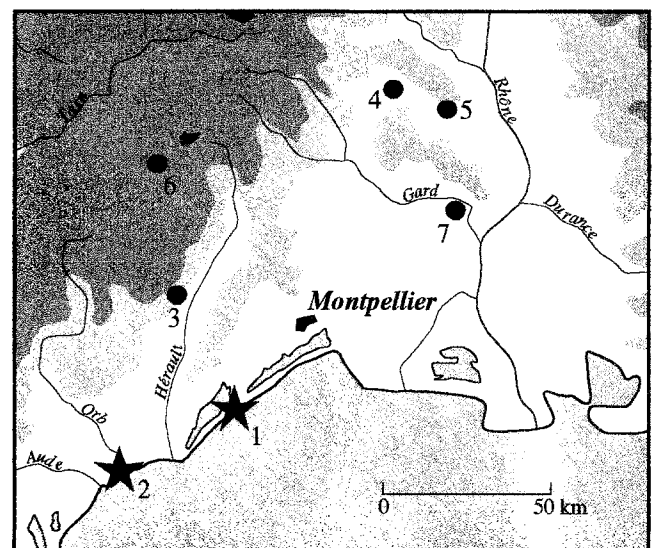
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Abstract. During the late Bronze age, settlements in Languedoc, southern France, were located on the shore of lagoons lining the Mediterranean, while, in the hinterland, settlements were mainly in the form of villages or cave sites. Information on food plants has been restricted, until now, to sites in the hinterland. In this paper, the archaeobotanical results obtained from two lagoon-shore settlements, La Fangade at Sète, and Portal Vielh at Vendres, are reported. The former provides the first waterlogged assemblage for this period in the French Mediterranean while the latter consists of a dry settlement. Emmer and hulled, six row barley are the most common cereals occurring at the two sites. Other cereals are less frequent, although einkorn chaff is common at La Fangade. Flax, and especially opium poppy, are well represented while faba bean is the only pulse of some importance. Many wild fruits were gathered, especially acorns. Comparison with data from the hinterland suggests that the main difference lay in the cultivation of opium poppy and flax in the lagoon sites. However, may be largely an impression resulting from the differences in manner of preservation at hinterland and lagoon sites. Local production as distinct from importation of crops is considered and the conclusion is drawn that, at least at La Fangade, hulled barley was grown locally. The arable weed flora indicates that sowing took place during both autumn and spring at La Fangade.

Key words: Crop production – Food plants – Lagoon sites – Late Bronze Age – Southern France

Introduction

In Languedoc, a string of lagoons of variable size and salinity is sheltered from the Mediterranean behind a sandy, often narrow, offshore bar (Fig. 1). The zone is highly disturbed by urban and tourist developments but some semi-natural dune and salt-marsh vegetation is



- 1 La Fangade, Sète (Hérault)
- 2 Portal-Vielh, Vendres (Hérault)
- 3 Abri de St-Etienne-de-Gourgas
St-Etienne-de-Gourgas (Hérault)
- 4 Grotte du Prével Supérieur,
Montclus (Gard)
- 5 Grotte du Hasard, Tharoux (Gard)
- 6 Baume Layrou, Trèves (Gard)
- 7 Oppidum du Marduel, St-Bonnet-
du-Gard (Gard)

Fig. 1. Location of late Bronze Age sites

present on the offshore bar and associated salt-marshes that includes *Sarcocornia fruticosa*, *Arthrocnemum macrostachyum*, *Atriplex* sp., *Puccinellia* sp., *Suaeda* sp. and *Salsola soda* [Bournérias et al. 1992; plant names are after Flore de France (Guinochet and de Vilmorin 1973-84)]. Today, these salt-marshes are best preserved in Camargue, in the Rhône delta. On the plain behind the lagoons, vineyards are common. These were planted at

Table 1. Main features of the La Fangade samples

Trench Zone Layer	S1					S2					
	SO C5	NO C5	NO C5	NO C5	NO C5	SO C1	SO C2	SO C3	NO C3	NO C5	NE C5
Sample volume (l)	3	1.8	2.2	1	1	1	1.9	0.6	0.9	2.4	4.8
Initial processing (some samples) (4 and 2-mm mesh)	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Second processing (all samples) (2, 0.5 and 0.25 mm mesh)											
2-mm fraction (cm ³)	1500	900	1000	600	600	500	1100	200	400	1400	2400
Percentage analysed	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
0.5-mm fraction (cm ³)	500	200	210	220	200	170	150	200	120	150	750
Percentage analysed	65%	100%	100%	100%	100%	100%	100%	50%	100%	100%	50%
0.25-mm fraction (cm ³)	110	60	100	100	80	30	25	20	25	30	120
Percentage analysed	65%	65%	80%	80%	65%	65%	65%	65%	100%	65%	65%
Concentration (no. of items/l)	924	454	315	415	1584	615	667	4483	441	352	3024

the end of the last century, after the phylloxera epidemic. Prior to that the lowland meadows were traditionally used as winter pasture (Trochet 1993).

The hinterland is composed of a succession of limestone plateaux that lead to the southern margins of the Massif-Central. The soils are mainly calcareous. The climate is Mediterranean with hot and dry summers, cool winters and rain mainly in autumn and spring. The vegetation, which is much degraded, consists of evergreen oak forest, i.e. garrigue *sensu lato* (Rameau et al. 1989; Dupias and Molinier 1968) with *Quercus ilex*, *Q. coccifera*, *Cistus* sp., *Phillyrea angustifolia*, *Thymus vulgaris*, *Rosmarinus officinalis*, *Lavandula* sp. and also including very dry meadow species. Traditionally, agriculture, consisting mainly of winter cereals and fruit-trees, was pursued in the basins, slopes and alluvial plains, while the plateaux were used for cattle grazing. Thus, the Languedoc landscape contains various and contrasting environments within a rather small area. Agriculture was traditionally adapted to this diversity in that it successfully exploited the wide variety of habitat in the region.

The first human settlements on the lagoon-shores lining the Mediterranean coast are reported from late Bronze Age II (1200-950 B.C.; B.C. dates are calibrated). At the same time, settlements are known in the hinterland from caves and village sites (Dedet and Roudil 1994). During late Bronze Age IIIb (ca. 850-700 B.C.), the number of sites increases in both areas and we see the emergence of the Mailhacien I culture in western and central Languedoc. This appears to indicate demographic growth (Py 1993). The settlements on the plain, principally on the lagoon-shores, are more frequent than in the former period. In the hinterland, caves were still occupied but the main feature is the appearance of hilltop villages. Relying on archaeological data, Py (1990,

1993) has proposed a model where the coastal settlements were only seasonally occupied while the main occupation was located in the hilltop villages. It is envisaged that all settlements were involved in an inclusive management of the various landscapes and habitats and relied on a semi-settled system that involved seasonal movement of cattle. The main agriculturally productive areas lay in the hinterland while lagoon-sites would have been dedicated to seasonal cattle herding, probably during summer, and activities involving exploitation of the local aquatic resources.

When the above model was proposed, fruit and seed assemblages from archaeological contexts dating to the late Bronze Age in the Languedoc region were limited. Moreover, information from hinterland sites frequently related only to limited areas and small-scale excavations, and palaeoethnobotanical data were unavailable from lagoon-shore settlements. Several excavations on the sites of the Mauguio lagoon, for instance, failed to reveal any seed or fruit (Dedet and Py 1985).

The two studies reported here, i.e. from La Fangade at Sète and Portal Vielh at Vendres, provide the first evidence for the plant food of the lagoon settlements. The presence of a waterlogged assemblage is of special interest because, until now, such assemblages relating to this particular period have not been reported from the French Mediterranean.

Although our data relate mainly to late Bronze Age II and the model proposed by Py relates to late Bronze Age IIIb, it is relevant insofar as it sheds light on the agricultural production within the lagoon settlements. The basic question to be answered is: were the food plants grown locally or was importation from elsewhere, possibly the hinterland, involved? By comparing the archaeobotanical evidence from the two areas we can begin to formulate a reliable answer to this question.

Sites investigated

La Fangade

The site at La Fangade (43°25'N, 3°41'E) is located on the southern shore of the Thau basin, a large lagoon of 7400 ha that has an opening to the sea at the foot of the Mont Saint-Clair, a limestone hill 175 asl, now the site of the modern town of Sète (Fig. 1). The site lies 0.8 to 2 m below the level of the lagoon, on a small hillock, 250 m from the shore. The shore is much disturbed by urban constructions so that the late Bronze Age shore could not be identified and its position in relation to the settlement is unknown. In the period in question, however, sea levels were probably low (Bazile 1987).

The purpose of the excavation in 1997, which was led by F. Leroy, was to carry out an initial assessment of the overall conditions at the site and also to establish the chronology. The underwater excavation involved cutting two small trenches (S1 and S2), each 2 sq. m in area. Beneath disturbed overlying layers, four, well preserved, organic cultural layers were found. Abundant pottery enabled the deposit to be assigned to late Bronze Age II. Many wooden posts were also retrieved, especially in S1. Unfortunately, all are of evergreen oak and so are unsuitable for dating by dendrochronology. A wooden post gave a radiocarbon date of 2980±40 B.P. (ARC 1706) (1375-1055 cal. B.C.).

Portal Vielh

The settlement at Portal Vielh was located on a small promontory on the northern shore of Vendres lagoon (2000 ha; situated at 43°16'N, 3°13'E), nearly 10 km to the south of Béziers (Fig. 1). The excavations, conducted by A. Burens and L. Carozza in 1996 and 1997, covered an area of 1200 sq. m. On the basis of pottery types, the features encountered may be assigned to two phases of occupation. A cultural layer, two storage pits, and a possible elevated storehouse with postholes are attributed to the late Bronze Age II/IIIa. During late Bronze Age IIIb (Mailhac I culture), there were some changes in the settlement. Traces of a peripheral fortification composed of a ditch surrounding a palisade have been uncovered and, of particular note, are the remains of two pottery kilns. The settlement, being located above sea and lagoon level, is a dry site and so bears only carbonized plant remains.

Methods

On both sites, sampling was not fully satisfactory. At La Fangade, because the small scale and limited aims of the excavation, no specific sampling was carried out for archaeobotany. Samples of 0.5-5 l volume were randomly taken from each layer (S1 and S2) and processed on site with 4 and 2-mm-mesh sieves that inevitably lead to loss of material. Eleven samples (five samples of 9 l and six samples of 11.6 l from S1 and S2, respectively) were selected for analysis, including two samples that were not pre-sieved at the site (Table 1). All samples are

from well preserved and dated organic layers. In the laboratory, a second fine sieving using successively mesh of 2, 0.5 and 0.25 mm, was carried out. When bulky, the 0.5-mm fraction was only half or two thirds analysed. The 0.25-mm fraction was two thirds investigated in most instances. In cases of partial investigation, the total number of items in the whole sample is adjusted on the basis of the fraction of the sample that was investigated.

At the Portal Vielh site, two types of sampling was carried out. Large samples, consisting of tens of litres (exact volumes unknown), were coarse sieved on site with a 2-mm mesh. Botanical remains have been analysed in ten of these samples, five dated to late Bronze Age II/IIIa (BF II/IIIa) and five to late Bronze Age IIIb (BF IIIb). Eight samples of 8 to 19 l were fine sieved in the laboratory with 2 and 0.5-mm meshes (samples from BF II/IIIa of 64 l, and five, 27-l samples from BF IIIb). These samples have been fully investigated for botanical remains. Material from the 1996 campaign only is available, so sampling is still fairly limited for the Portal Vielh site. All analyses were carried out by the first author in the palaeoethnobotanical laboratory of the Centre d'Anthropologie.

Results

La Fangade

How much material was lost in the case of samples that were sieved on-site is not easy to evaluate. The two samples that were processed in the laboratory only, are from comparable contexts. These yielded 415 items/l and 48 taxa, and 1584 items/l and 54 taxa, respectively. Two samples that were initially sieved on site yielded 454 items/l and 51 taxa, and 316 items/l and 53 taxa, respectively (Table 1). The number of remains per litre is somewhat lower in the on-site sieved samples but the number of taxa appears to be unaffected. Thus, the loss of material appears to be less than might have been expected. The aim of the first sieving was not a full processing of the samples but rather removal of larger elements such as wood fragments, shells, etc. During fine sieving in the laboratory, unprocessed aggregates of clay and organic remains were frequently observed. A lot of small seeds may have remained trapped in these aggregates which may explain the lower than expected loss of material. However, in these samples, the number of items retrieved may not accurately reflect the frequency of seeds in the deposit. Comparisons between samples, especially when comparing frequency of particular remains, should therefore be undertaken with due caution especially when dealing with small sized seed, etc.

The site of La Fangade provided more than 25 340 items, 18.5% of which were carbonized, and 107 taxa. Carbonized remains came mainly from the S2 area where the cultivated plant remains were more abundant. The plants have been arranged in ecological groups as proposed by Brombacher (1997; Table 2; Fig. 2). Emphasis is placed on plants of economic importance and species related to agricultural activities. Cultivated plants represent 42% and 98% of non-carbonized and carbonized re-

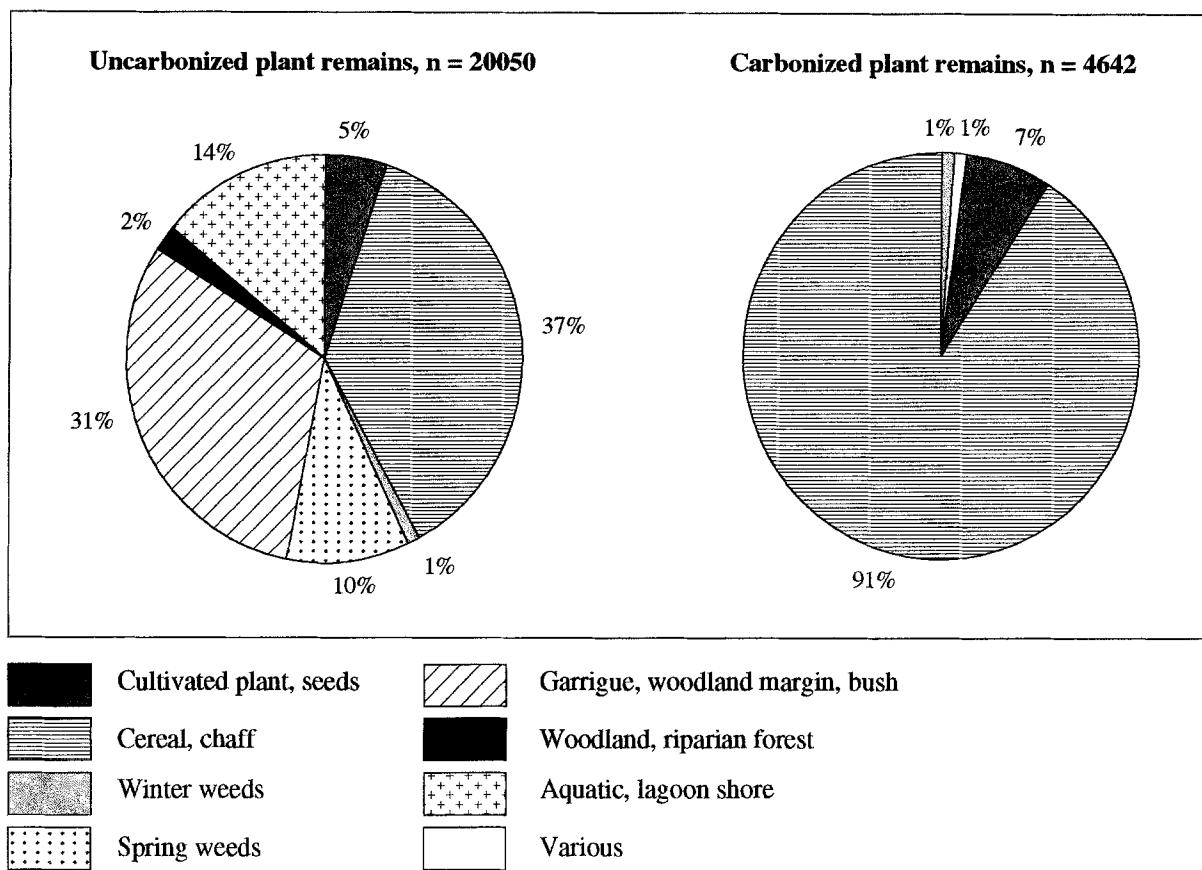


Fig. 2. Percentage representations of plant remains at La Fangade

mains, respectively. Ten domesticated plants are recorded, including five cereal species. The proportions of cultivated plants are illustrated in Fig. 3.

Cereals. As a rule, chaff remains are much more numerous than entire or fragmented cereal grains. On the basis of both frequency and number of records, the two major cereals are hulled barley (*Hordeum vulgare*) and especially emmer (*Triticum dicocum*; Fig. 4). Of the barley, carbonized remains constituted 452 whole and 222 broken rachis internodes while only 45 whole and 29 fragmented grains were recorded. Einkorn (*Triticum monococcum*) is fairly well represented but only by chaff and mainly from the S2 area (Fig. 4). On the other hand, remains of naked wheat (*Triticum aestivum/durum/turgidum*) and broomcorn millet (*Panicum miliaceum*) are very scarce. Unfortunately, rachis segments of naked wheat were not retrieved. It is impossible therefore to establish if it belongs to a hexa- or tetraploid type. As regards naked wheat and broomcorn millet, it is impossible to say if they were cultivated as crops or if they are merely contaminants.

Other cultivated plants. A single carbonized seed of grass pea (*Lathyrus cf. sativus*) was retrieved. This constitutes the only find of a pulse. Given such low frequency, it is difficult to decide if grass pea had a role other than a contaminant. On the other hand, flax (*Linum usitatissimum*) exploitation is well documented by the

presence of seeds and capsule fragments, both in carbonized and uncarbonized form (Fig. 4). Opium poppy (*Papaver somniferum*) occurs, mainly as uncarbonized seeds, in 90% of the samples. A single seed of dill (*Anethum graveolens*) was recovered from area S2. Dill was possibly cultivated as early as the Neolithic period in Switzerland (Jacomet 1988; Brombacher 1997).

Equally interesting is the presence in 80% of the samples (total no. of specimens: 28) of dyer's rocket or weld seeds (*Reseda luteola*). The plant is a traditional source of yellow dye and is probably indigenous to the eastern Mediterranean basin and south-west Asia (Zohary and Hopf 1994). Presuming that weld is an introduced species in southern France, then the records from La Fangade suggest the plant had been introduced and was probably being cultivated by the late Bronze Age. Further macrofossil evidence is desirable, however, before definitive conclusions as to status and use of dill and weld are drawn.

Wild plants. The identification of plants that may have thrived as weeds in cultivated fields is based on studies of recent weed floras in France, and especially investigations by Montégut (1997) and Jauzein (1995). The prehistoric weed floras may, of course, have differed from those of today (cf. Behre and Jacomet 1991). For example, some perennial or biennial plants classified as pasture or dry grassland in Table 1 could have grown as weeds during the late Bronze Age and may be absent in later periods as a result of more intensive tilling. Typical

Table 2. Plant remains recorded at La Fangade

Area		S1		S2		TOTAL	
		No. of remains	Freq.	No. of remains	Freq.	Total no. of remains	Freq. all samples
		5		6		11	
		9000		11600		20600	
Non-carbonized plant remains							
Cultivated plants							
<i>Hordeum vulgare</i>	Rachis internode	1	1	9	1	10	2
	Rachis internode fr	-	-	15	1	15	1
<i>Triticum dicoccum</i>	Spikelet fork	14	5	1089	6	1103	11
	Glume base	8	2	684	6	692	8
<i>Triticum monococcum</i>	Spikelet fork	-	-	41	3	41	3
	Glume base	-	-	11	1	11	1
<i>Triticum dicoccum/monococcum</i>	Spikelet fork	6	3	1422	4	1428	7
	Glume base	65	5	3858	6	3923	11
	Rachis internode	-	-	1	1	1	1
	Ear base	1	1	2	1	3	2
<i>Cerealia</i>	Straw fr	6	2	1	1	7	3
	Chaff	2	1	11	2	13	3
<i>Panicum miliaceum</i>	Seed/fruit	-	-	1	1	1	1
	Seed/fruit fr	-	-	2	1	2	1
	Glume	-	-	2	1	2	1
<i>Linum usitatissimum</i>	Seed/fruit	1	1	18	2	19	3
	Seed/fruit fr	-	-	21	3	21	3
	Capsule fr	-	-	363	3	363	3
<i>Papaver somniferum</i>	Seed/fruit	272	5	583	5	855	10
	Seed/fruit fr	102	5	92	3	194	8
Segetal/winter weeds							
<i>Adonis annua</i>	Seed/fruit	2	2	2	2	4	4
	Seed/fruit fr	2	1	1	1	3	2
<i>Ajuga chamaepitys</i>	Seed/fruit	8	4	11	5	19	9
	Seed/fruit fr	3	1	5	2	8	3
<i>Ammi majus/visnaga</i>	Seed/fruit	85	5	73	6	158	11
	Seed/fruit fr	8	3	18	3	26	6
<i>Arenaria cf. serpyllifolia</i>	Seed/fruit	-	-	1	1	1	1
<i>Ballota nigra</i>	Seed/fruit	2	1	11	3	13	4
<i>Bromus cf. arvensis</i>	Seed/fruit	-	-	1	1	1	1
<i>Legousia cf. speculum-veneris</i>	Seed/fruit	2	1	1	1	3	2
<i>Lolium multiflorum/rigidum</i>	Glume fr	-	-	4	1	4	1
<i>Papaver cf. rhoeas</i>	Seed/fruit	1	1	-	-	1	1
<i>Reseda alba</i>	Seed/fruit	-	-	1	1	1	1
<i>Reseda phyteuma</i>	Seed/fruit	1	1	-	-	1	1
<i>Stachys annua</i>	Seed/fruit	1	1	2	1	3	2
<i>Viola tricolor</i>	Seed/fruit	1	1	-	-	1	1
	Seed/fruit fr	1	1	-	-	1	1
Ruderal, spring weeds							
<i>Amaranthus lividus</i>	Seed/fruit	2	1	-	-	2	1
<i>Anagallis arvensis</i>	Seed/fruit	12	3	19	1	31	4
	Seed/fruit fr	-	-	18	3	18	3
<i>Anethum graveolens</i>	Seed/fruit	-	-	4	1	4	1
<i>Atriplex patulus/hastatus</i>	Seed/fruit	34	5	128	5	162	10
	Seed/fruit fr	15	3	8	2	23	5
<i>Carduus cf. crispus</i>	Seed/fruit	-	-	1	1	1	1
<i>Carduus pycnocephalus</i> type	Seed/fruit	-	-	1	1	1	1
<i>Chenopodium album</i>	Seed/fruit	640	5	273	6	913	11
	Seed/fruit fr	104	4	84	6	188	10
<i>Chenopodium cf. bonus-henricus</i>	Seed/fruit	-	-	6	1	6	1
<i>Chenopodium hybridum</i>	Seed/fruit	-	-	4	2	4	2
	Seed/fruit fr	3	1	-	-	3	1

Area	No. of samples	Volume (cm ³)	S1		S2		TOTAL	
			5	6	6	11		
			9000	11600	20600			
			No. of remains	Freq.	No. of remains	Freq.	Total no. of remains	Freq. all samples
<i>Chenopodium polyspermum</i> agg.	Seed/fruit		18	3	30	3	48	6
<i>Cirsium arvense</i>	Seed/fruit		5	3	8	3	13	6
<i>Cirsium vulgare</i> type	Seed/fruit		2	2	-	-	2	2
<i>Fumaria officinalis</i>	Seed/fruit		-	-	1	1	1	1
	Seed/fruit fr		1	1	3	1	4	2
<i>Heliotropium europaeum</i>	Seed/fruit		55	5	51	6	106	11
	Seed/fruit fr		24	5	32	5	56	10
<i>Hyosciamus albus/niger</i>	Seed/fruit		2	2	-	-	2	2
<i>Malva parviflora</i>	Seed/fruit		-	-	5	1	5	1
<i>Polygonum aviculare</i>	Seed/fruit		30	5	10	5	40	10
	Seed/fruit fr		11	3	6	3	17	6
<i>Polygonum cf. persicaria</i>	Seed/fruit		1	1	-	-	1	1
<i>Potentilla reptans</i>	Seed/fruit		22	4	10	3	32	7
<i>Ranunculus repens</i>	Seed/fruit		1	1	1	1	2	2
<i>Reseda lutea</i>	Seed/fruit		66	5	39	3	105	8
	Seed/fruit fr		6	3	5	2	11	5
<i>Reseda luteola</i>	Seed/fruit		14	5	14	4	28	9
<i>Rumex cf. longifolius</i>	Seed/fruit		-	-	2	1	2	1
<i>Ruta graveolens</i>	Seed/fruit		-	-	1	1	1	1
<i>Silene alba</i>	Seed/fruit		12	3	8	5	20	8
	Seed/fruit fr		16	3	14	3	30	6
<i>Solanum nigrum</i>	Seed/fruit		6	3	14	2	20	5
<i>Sonchus asper</i>	Seed/fruit		2	2	9	1	11	3
<i>Stellaria media</i>	Seed/fruit		1	1	-	-	1	1
<i>Urtica urens</i>	Seed/fruit		19	4	31	4	50	8
	Seed/fruit fr		1	1	7	1	8	2
<i>Verbena officinalis</i>	Seed/fruit		7	2	1	1	8	3
Pasture, dry grassland, dry places								
<i>Agrimonia eupatoria</i>	fruit cup fr		-	-	2	1	2	1
<i>Agropyron repens/pungens</i> type	Seed/fruit		1	1	-	-	1	1
<i>Ajuga cf. genevensis</i>	Seed/fruit		1	1	-	-	1	1
<i>Carex cf. flacca</i>	Seed/fruit		-	-	2	1	2	1
<i>Carex hirta</i>	Seed/fruit		5	3	1	1	6	4
cf. <i>Plantago lagopus</i>	Seed/fruit		-	-	4	1	4	1
cf. <i>Poa pratensis/trivialis</i>	Seed/fruit		2	2	-	-	2	2
<i>Euphorbia pithyusa</i>	Seed/fruit		3	1	-	-	3	1
<i>Galeopsos cf. ladanum</i>	Seed/fruit		2	2	-	-	2	2
<i>Herniaria</i> sp.	Seed/fruit		20	1	-	-	20	1
<i>Linum bienne</i>	Seed/fruit		-	-	1	1	1	1
<i>Linum strictum</i>	Seed/fruit		7	2	4	1	11	3
<i>Medicago minima</i>	Pod		-	-	1	1	1	1
<i>Sanguisorba minor</i>	Seed/fruit		-	-	2	1	2	1
<i>Silene cf. italica</i>	Seed/fruit		-	-	1	1	1	1
<i>Teucrium chamaedrys</i>	Seed/fruit		2	1	8	3	10	4
<i>Verbascum</i> sp.	Seed/fruit		3	2	-	-	3	2
Garrigue, woodland margin, bush								
<i>Ficus carica</i>	Seed/fruit		433	5	836	6	1269	11
	Seed/fruit fr		221	5	383	6	604	11
<i>Juniperus oxycedrus</i> type	Seed/fruit		-	-	2	1	2	1
	Seed/fruit fr		-	-	1	1	1	1
<i>Juniperus phoenicia</i>	Seed/fruit		-	-	1	1	1	1
	Branch fr		53	4	67	6	120	10
<i>Pistacia lentiscus</i>	Seed/fruit		10	4	90	5	100	9
	Seed/fruit fr		7	5	119	6	126	11
<i>Prunus spinosa</i>	Seed/fruit		-	-	1	1	1	1
<i>Rosa</i> sp.	Seed/fruit		-	-	28	2	28	2
	Seed/fruit fr		2	1	6	3	8	4
<i>Rosa/Rubus</i>	prickle		4	2	2	1	6	3

Area	No. of samples	Volume (cm ³)	S1		S2		TOTAL	
			No. of remains	Freq.	No. of remains	Freq.	Total no. of remains	Freq. all samples
			5		6		11	
			9000		11600		20600	
<i>Rubus fruticosus</i>	Seed/fruit		325	5	1715	6	2040	11
	Seed/fruit fr		372	5	1431	6	1803	11
<i>Sambucus ebulus</i>	Seed/fruit		-	-	3	2	3	2
<i>Sambucus</i> sp.	Seed/fruit fr		1	1	2	2	3	3
Woodland, riparian forest								
<i>Corydalis type intermedia</i>	Seed/fruit		3	1	-	-	3	1
	Seed/fruit fr		1	1	-	-	1	1
<i>Corylus avellana</i>	nutshell fr		-	-	2	1	2	1
<i>Physalis alkekengi</i>	Seed/fruit		1	1	1	1	2	2
	Seed/fruit fr		-	-	2	1	2	1
<i>Pinus sylvestris</i>	Seed/fruit		-	-	1	1	1	1
<i>Populus</i> sp.	Seed/fruit		27	5	6	3	33	8
	Seed/fruit fr		27	4	6	3	33	7
<i>Quercus</i> sp.	undevelopped acorn		17	4	2	2	19	6
	hilum		2	2	17	4	19	6
	cup fr		11	4	10	1	21	5
	Tegument fr		17	3	169	5	186	8
<i>Salix</i> sp.	Seed/fruit		1	1	-	-	1	1
<i>Vitis vinifera</i> ssp. <i>sylvestris</i>	Seed/fruit		3	2	34	5	37	7
	Seed/fruit fr		7	4	65	5	72	9
	pedicle		-	-	13	3	13	3
	undevelopped berry		-	-	2	1	2	1
Aquatic, lagoon shore								
<i>Carex</i> cf. <i>riparia/vesicaria</i>	Seed/fruit		3	2	2	2	5	4
<i>Carex</i> type <i>elata</i>	Seed/fruit		1	1	6	1	7	2
<i>Ceratophyllum</i> sp.	Seed/fruit fr		-	-	21	3	21	3
<i>Chara</i> sp.	oogonia		11	4	-	-	11	4
<i>Cyperus fuscus</i>	Seed/fruit		3	2	-	-	3	2
<i>Glaucium flavum</i>	Seed/fruit		974	4	13	3	987	7
	Seed/fruit fr		299	4	-	-	299	4
<i>Juncus</i> sp.	Seed/fruit		508	5	596	6	1104	11
	Seed/fruit fr		9	2	2	1	11	3
<i>Mentha</i> cf. <i>aquatica</i>	Seed/fruit		1	1	-	-	1	1
<i>Najas minor</i>	Seed/fruit		2	1	-	-	2	1
<i>Polygonum lapathifolium</i>	Seed/fruit		1	1	-	-	1	1
<i>Ranunculus aquatilis</i>	Seed/fruit fr		1	1	-	-	1	1
<i>Rumex</i> type <i>conglomeratus</i>	Seed/fruit		-	-	1	1	1	1
<i>Ruppia maritima</i>	Seed/fruit		10	4	22	4	32	8
	Seed/fruit fr		1	1	7	4	8	5
<i>Salicornia</i> sp.	Seed/fruit		13	4	5	2	18	6
<i>Scirpus</i> cf. <i>holoschoenus</i>	Seed/fruit		4	1	-	-	4	1
<i>Scirpus lacustris</i>	Seed/fruit		3	1	13	3	16	4
<i>Spergularia salina</i>	Seed/fruit		9	4	1	1	10	5
<i>Suaeda maritima</i>	Seed/fruit		147	5	66	5	213	10
	Seed/fruit fr		40	4	49	4	89	8
<i>Typha angustifolia</i>	Seed/fruit		2	1	-	-	2	1
<i>Typha latifolia</i>	Seed/fruit		1	1	-	-	1	1
Other								
<i>Ajuga</i> sp.	Seed/fruit fr		1	1	2	1	3	2
Brassicaceae	Seed/fruit		3	3	1	1	4	4
<i>Bromus</i> cf. <i>hordeaceus/secalinus</i>	Seed/fruit fr		-	-	8	1	8	1
<i>Bromus</i> sp.	Seed/fruit fr		-	-	4	1	4	1
<i>Carex</i> sp.	Seed/fruit		5	1	6	2	11	3
	Seed/fruit fr		-	-	1	1	1	1
Caryophyllaceae	Seed/fruit		2	1	-	-	2	1
cf. <i>Agrostis</i> sp.	Seed/fruit		-	-	4	1	4	1
Chenopodiaceae	Seed/fruit		61	5	13	4	74	9
	Seed/fruit fr		8	3	1	1	9	4

Area		S1		S2		TOTAL	
		No. of remains	Freq.	No. of remains	Freq.	Total no.of remains	Freq. all samples
		5		6		11	
		9000		11600		20600	
<i>Chenopodium</i> sp.	Seed/fruit	-	-	3	2	3	2
Cyperaceae	Seed/fruit	4	2	-	-	4	2
	Seed/fruit fr	-	-	1	1	1	1
<i>Cyperus</i> type	Seed/fruit	1	1	-	-	1	1
Fabaceae	Pod fr	2	1	-	-	2	1
<i>Galium</i> sp.	Seed/fruit	1	1	-	-	1	1
Lamiaceae	Seed/fruit	1	1	-	-	1	1
Poaceae	Seed/fruit	5	3	3	2	8	5
	Seed/fruit fr	-	-	1	1	1	1
<i>Ruta</i> type	Seed/fruit	2	1	2	2	4	3
<i>Scirpus</i> type	Seed/fruit	-	-	7	1	7	1
<i>Silene</i> sp.	Seed/fruit	2	2	4	1	6	3
	Seed/fruit fr	-	-	1	1	1	1
<i>Stellaria</i> sp.	Seed/fruit fr	1	1	-	-	1	1
Faeces, goat/sheep type	Faece	23	1	10	3	33	4
	Faece fr	21	3	7	3	28	6
Faeces rodent type	Faece	-	-	4	1	4	1
Unidentified		76	5	-	-	76	5
Total non-carbonized		5504		15135		20639	
Carbonized plant remains							
Cultivated plants							
<i>Hordeum vulgare</i>	Seed/fruit	17	4	28	4	45	8
	Seed/fruit fr	8	3	21	5	29	8
	Rachis internode	5	4	447	5	452	9
	Rachis internode fr	2	1	220	2	222	3
	Ear base	-	-	2	1	2	1
	undeveloped floret	-	-	29	1	29	1
<i>Lathyrus</i> cf. <i>sativus</i>	Seed/fruit	-	-	1	1	1	1
<i>Triticum aestivum/durum/turgidum</i>	Seed/fruit	1	1	1	1	2	2
<i>Triticum dicoccum</i>	Seed/fruit	14	4	13	4	27	8
	Seed/fruit fr	6	4	8	3	14	7
	Spikelet fork	30	5	341	5	371	10
	Glume base	25	5	446	5	471	10
<i>Triticum monococcum</i>	Spikelet fork	3	2	119	4	122	6
	Glume base	1	1	26	3	27	4
<i>Triticum dicoccum/monococcum</i>	undevel. Spikelet	1	1	1	1	2	2
	Spikelet fork	33	5	234	4	267	9
	Glume base	73	4	409	5	482	9
	Rachis internode	3	2	25	2	28	4
	Ear base	-	-	30	2	30	2
<i>Triticum</i> sp.	Seed/fruit	6	3	2	2	8	5
	Seed/fruit fr	7	3	18	4	25	7
<i>Cerealia</i>	Seed/fruit fr	41	5	105	6	146	11
	Chaff	29	4	1668	4	1697	8
	Straw fr	-	-	17	2	17	2
<i>Linum usitatissimum</i>	Seed/fruit	-	-	10	2	10	2
	Seed/fruit fr	-	-	28	1	28	1
	Capsule fr	-	-	17	1	17	1
<i>Papaver somniferum</i>	Seed/fruit	4	1	-	-	4	1
Segetal, winter weeds							
<i>Avena</i> sp.	Seed/fruit	-	-	8	2	8	2
	Awn fr	1	1	2	1	3	2
<i>Lolium multiflorum/rigidum</i>	Seed/fruit	5	3	33	3	38	6
	Seed/fruit fr	-	-	5	2	5	2
	Glume fr	-	-	2	1	2	1
Pasture, dry grassland, dry places							
<i>Bromus</i> cf. <i>hordeaceus</i>	Seed/fruit	-	-	2	1	2	1

Area	No. of samples	Volume (cm ³)	S1		S2		TOTAL	
			No. of remains	Freq.	No. of remains	Freq.	Total no. of remains	Freq. all samples
			5		6		11	
			9000		11600		20600	
Garrigue, woodland margin, bush								
<i>Juniperus phoenicia</i>	Branch fr		11	5	8	2	19	7
<i>Pistacia lentiscus</i>	Seed/fruit		-	-	2	1	2	1
Woodland, riparian forest								
<i>Quercus</i> sp.	Tegument fr		1	1	3	1	4	2
	Hilum		-	-	1	1	1	1
Other								
<i>Carex</i> sp.	Seed/fruit		1	1	-	-	1	1
Poaceae	Seed/fruit		-	-	4	2	4	2
	Seed/fruit fr		6	3	23	1	29	4
Faeces (goat/sheep type)	Faeces fr		-	-	1	1	1	1
Unidentified	Seed/fruit		2	1	7	1	9	2
	Heap		-	-	2	1	2	1
Total carbonized remains			336		4371		4707	
Overall total			5840		19506		25346	

fr, fragment

weeds in today's sense include 44 taxa that are often represented by small numbers of records though some are frequent and abundant (especially *Ammi majus/visnaga*, *Ajuga chamaepitys*, *Atriplex patulus/hastatus*, *Chenopodium album*, *Heliotropium europaeum* and, to a less extent, *Polygonum aviculare*, *Reseda lutea*, *Silene alba* and *Urtica urens*). They are classified in two groups on an ecological basis, i.e. segetal winter weeds and ruderal spring weeds. The first, characteristic of autumn-sown cereals, includes 14 taxa, and the second, associated with spring-sown crops, includes 30 taxa.

Other ecological plant groups that are recognised are: 1) pasture, dry grassland, 2) plants of garrigue and woodland margins, 3) plants of riparian forest, and 4) aquatic and lagoon shore plants (Fig. 2). The group consisting of garrigue, woodland margin and bush plants is well represented and constitutes 31% of uncarbonized plant remains. The main component of this group consists of uncarbonized fig (*Ficus carica*) and blackberry (*Rubus fruticosus* agg.) remains. The former generally thrives in somewhat dry places. The high frequencies of fig and blackberry suggest that the fruit were collected and brought to the settlement. *F. carica* is usually regarded as occurring naturally and there is no evidence to suggest that it was cultivated during the late Bronze Age in southern France. Other fruit remains that probably result from gathering include *Pistacia lentiscus*, *Prunus spinosa*, *Rosa spec.*, *Sambucus ebulus*, *Corylus avellana*, *Physalis alkekengi*, *Quercus* sp. and *Vitis sylvestris*. This applies in particular to *P. lentiscus* and *Quercus* for which there are a few carbonized remains. Grape may have been more important than our data might suggest

(Fig. 4). J. Erroux (unpublished) identified some twenty years ago 130 grape pips from an earlier excavation of the settlement.

Plants classified in the pasture and dry grassland group do not necessarily indicate the presence of pasture as such. Plants preferring dry and, sometimes, stony places are largely dominant. This group probably indicates open places in the garrigue, possibly artificially maintained for cattle grazing, but, overall, it is poorly represented in the samples.

Portal Vielh

Due to the lack of waterlogged conditions, only carbonized plant remains are recorded at this site. The coarse sieved samples are largely dominated by seeds of crops (Table 3) while the fine sieved fractions contained chaff and small seeds (Table 4). No real difference is observed between the two periods of occupation. Figure 5 provides data obtained from the fine sieved fraction. Chaff remains, in the form of emmer and possibly einkorn spikelet forks and glume bases, are frequent (19%). Crop seeds (42%) and woodland and riparian forest vegetation (37%) are even more important, while ruderal spring weeds and other ecological groups are poorly represented. The strong representation of crop seeds, and woodland and riparian forest vegetation, results partly from considerable fragmentation of crop seeds and acorns.

Seven domesticated plants have been identified. Only those present in coarse sieved samples are included in Fig. 6. Based on the data from these samples, the major crops were hulled barley, emmer and faba bean (*Vicia*

faba; Fig. 4). Faba bean is reported only from a single archaeological feature, a pottery kiln, dated to late Bronze Age IIIb, where it was common. Einkorn seems to have been unimportant. On the other hand, the importance of broomcorn millet and opium poppy, only present in fine sieved samples, is difficult to assess. The numbers of specimens are not distinctly lower than those of emmer and barley in these samples. Moreover, numerous additional seeds of *Papaver* sp. cannot be identified with certainty because of their poor preservation but *P. somniferum* is probably represented.

Weeds are not numerous nor very diverse. Only oat (*Avena* sp.) and ivy-leaved speedwell (*Veronica hederaefolia*) might be assigned to segetal winter weeds. Ruderal spring weeds include four species, i.e. *Chenopodium album*, *C. hybridum*, *Echinochloa crus-galli* and *Portulaca oleracea*. Plants of the garrigue and woodland groups may well have been collected for their edible fruit. Acorns (*Quercus*), which are presumably gathered, were numerous in a late Bronze Age IIIb rubbish context. Possibly also gathered were *Vitis sylvestris*, *Corylus avellana*, *Prunus* sp. and *Sambucus* sp.

Discussion and conclusions

La Fangade and Portal Vieilh as producer sites?

Bearing in mind the economic model constructed by Py (1990, 1993) for late Bronze Age IIIb society, what evidence do we have from the late Bronze Age II lagoon sites that indicates importation as distinct from local food production? Discerning production from consumption sites using plant remains always poses problems and two models, discussed by Van der Veen (1991), have been proposed. The first relies on ethnographic observations on crop processing by archaic agricultural societies. Crop processing sequences have been described from Turkey by Hillman (1981, 1984) and the Amorgos island, Greece, by Jones (1984). After each stage of processing the composition of the product is altered so it should be possible, studying the composition of palaeoethnobotanical samples, to identify various products and by-products of crop processing. In this way, and dealing mainly with glume wheat processing, Hillman provides details of composition of the products and by-products in different components of straw, chaff, grain and weed seeds. Jones uses a more accurate quantification that relies principally on the categories of weed seeds occurring in the samples at different stages of the processing sequence of free-threshing cereals and pulses.

The model proposed by Jones (1985) is based on his own studies of Iron Age and Romano-British sites in the upper Thames valley. He observed that the difference in the topographic position of the sites is mirrored by a difference in the cereal grain, chaff and weed seeds components of assemblages of carbonized plant remains, as shown by triangular scattergrams. The assemblage at some sites is dominated by cereal grain while, at others, it is dominated by weed seeds and chaff. According to Jones, the grain is the part of the harvest least likely to be treated as waste material. The most likely place for

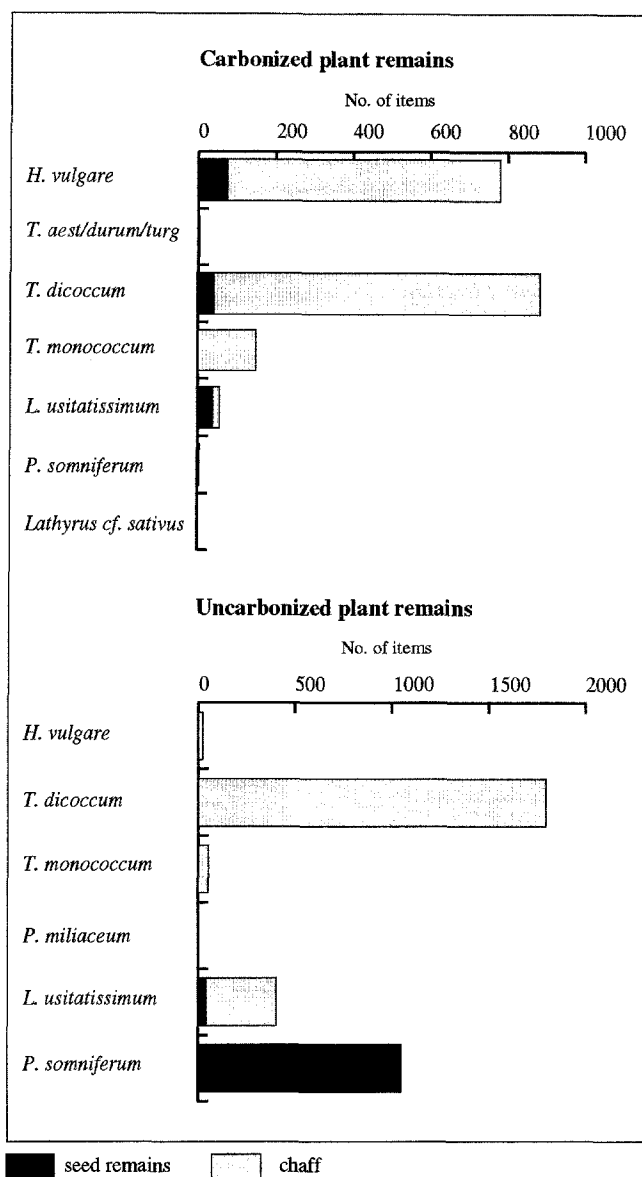


Fig. 3. Cultivated plant remains recorded at La Fangade

this to occur would be at its place of production because farming settlements can be inundated by grain during harvesting period, a situation that could lead to assemblages rich in grain. The increase in the value of the grain with further processing and transportation would inevitably lead to reduction of the possibility that it be treated as waste material in consumer sites. Therefore, assemblages dominated by grain can be expected at producer sites while those dominated by weeds and chaff would suggest non-producer or consumer sites. Such conclusions may be strengthened by a range of environmental and archaeological data obtained in and about the sites.

Our analysis of production versus consumption in the lagoon shore settlements is based mainly on La Fangade from which much more data are available. Data from Portal Vieilh are, however, also considered for comparison. The model by Jones, which is elaborated on the basis of results from sites of younger age and also pertains to an environment rather different from Mediterranean

Table 3. Plant remains recorded at Portal-Vielh (coarse sieving, 2-mm mesh)

Period No. of samples		BFII/IIIa	BF IIIb	TOTAL	
		5	5	10	10
		no. of remains	no. of remains	total no. of remains	freq. all samples
Cultivated plants					
<i>Cerealia</i>	seed/fruit fr	75	1829	1904	10
<i>Hordeum vulgare</i>	seed/fruit	15	115	130	10
	seed/fruit fr	34	385	419	9
<i>Triticum aestivum/durum/turgidum</i>	seed/fruit	3	7	10	5
	seed/fruit fr	-	3	3	1
<i>Triticum dicoccum</i>	seed/fruit	2	137	139	7
	seed/fruit fr	-	206	206	5
<i>Triticum monococcum</i>	seed/fruit	-	1	1	1
<i>Triticum spec.</i>	seed/fruit	4	4	8	4
	seed/fruit fr	14	541	555	9
<i>Vicia faba</i>	seed/fruit	-	149	149	1
	cotyledon	-	162	162	1
	seed/fruit fr	-	2000	2000	1
Woodland, riparian forest					
<i>Quercus spec</i>	seed/fruit	-	2	2	1
	cotyledon	-	51	51	1
	seed/fruit fr	-	601	601	2
	hilum	-	1	1	1
<i>Vitis vinifera ssp. sylvestris</i>	seed/fruit	2	2	4	2
	seed/fruit fr	2	1	3	2
Segetal, winter weeds					
<i>Veronica hederaefolia</i>	seed/fruit	-	1	1	1
Other					
Poaceae	seed/fruit fr	-	1	1	1
TOTAL		151	6199	6350	

fr, fragment

France, cannot be readily applied to late Bronze Age sites in southern France. Moreover, preservation of our assemblage is very different from that at the British settlements and there is also some uncertainty as to precise numbers of remains at La Fangade. It is therefore more appropriate to prefer the ethnographic-based model and to use presence/absence or approximate quantification of selected remains.

Hillman (1981) has stressed that the crop processing sequence is very specific to the type of crop grown, especially in the case of glume wheats or free-threshing cereals. It is therefore necessary to choose data linked to a specific crop when looking for evidence of processing and this is particularly so in a site where many different crop remains occur as mixed assemblages. Here we will try to determine if the two main cereals identified, glume wheats (emmer and einkorn) and hulled barley, were locally cultivated or imported. The evidence relied on consists, above all, of chaff remains which can be clearly identified, i.e. rachis internodes, spikelet forks, glume bases and awn fragments. Remains that cannot be precisely identified, like glume or straw fragments, or which cannot be closely associated with the crop plant,

like weed seeds, are used with caution. Only segetal winter weeds which are certainly associated with cereals will be considered. The crop processing sequences described by Hillman (1981, 1984) and Jones (1984) are summarized and the retrieved plant remains that can be used as archaeological evidence of processing stages are listed in Figs. 7 and 8. In the following paragraph we will refer to the main processing stages represented in these simplified sequences.

Reliable evidence of local crop cultivation comes from the early stages of crop processing, i.e. stages that occur before bulk storage. From his observations of glume wheat processing in Turkey, Hillman (1981, 1984) argues that storage occurs before dehusking, i.e. as semi-cleaned spikelets, in areas with wet summers, with further processing being carried out, as required, on a daily basis throughout the year. On the other hand, in areas with dry summers, bulk storage would be as semi-clean grain, after dehusking, winnowing and sievings. The Languedoc climate is of typical Mediterranean type, with generally dry summers (often less than 30 mm of rain in July). Nevertheless, the cultural choice of late Bronze Age people may have led them to store glume

Table 4. Plant remains recorded at Portal-Vielh (fine sieving, 0.5-mm mesh)

Period		BFII/IIIa	BF IIIb	TOTAL	
		5	3	8	
No. of samples					
Volume in litres		64	27	91	
		no. of	no. of	total no.	freq. all
		remains	remains	of remains	samples
Cultivated plants					
<i>Cerealia</i>	seed/fruit fr	240	442	682	8
<i>Hordeum vulgare</i>	seed/fruit	8	12	20	6
	seed/fruit fr	53	61	114	7
<i>Panicum miliaceum</i>	seed/fruit	15	8	23	5
	seed/fruit fr	4	-	4	1
<i>Triticum aestivum/durum/turgidum</i>	seed/fruit	-	5	5	1
<i>Triticum dicoccum</i>	seed/fruit	7	15	22	6
	seed/fruit fr	9	5	14	3
	spikelet fork	45	47	92	8
	glume base	15	19	34	5
<i>Triticum dicoccum/monococcum</i>	spikelet fork	26	16	42	7
	glume base	236	126	362	8
<i>Triticum cf. monococcum</i>	spikelet fork	2	-	2	1
<i>Triticum</i> spp.	seed/fruit	3	10	13	4
	seed/fruit fr	52	167	219	6
<i>Papaver somniferum</i>	seed/fruit	17	1	18	2
	seed/fruit fr	8	-	8	1
Fabaceae	seed/fruit fr	-	4	4	1
Segetal, winter weeds					
<i>Avena</i> spec.	awn fr	7	1	8	4
Ruderal, spring weeds					
<i>Chenopodium album</i>	seed/fruit	4	3	7	5
	seed/fruit fr	15	8	23	4
<i>Chenopodium hybridum</i>	seed/fruit	1	-	1	1
<i>Chenopodium</i> spec.	seed/fruit fr	8	5	13	6
<i>Echinochloa crus-galli</i>	seed/fruit	-	3	3	2
<i>Portulaca oleracea</i>	seed/fruit	-	2	2	1
Garrigue, woodland margin, bush					
cf. <i>Prunus spinosa/padus</i>	seed/fruit fr	1	-	1	1
<i>Sambucus ebulus</i>	seed/fruit	1	-	1	1
<i>Sambucus</i> spec.	seed/fruit fr	1	-	1	1
Woodland, riparian forest					
<i>Corylus avellana</i>	seed/fruit fr	-	1	1	1
<i>Quercus</i> spec.	cotyledon	-	6	6	1
	seed/fruit fr	-	1000	1000	1
	hilum	-	1	1	1
Aquatic, lagoonshore					
<i>Scirpus lacustris</i> type	seed/fruit	1	-	1	1
Other					
cf. <i>Phalaris</i> spec.	seed/fruit	3	-	3	1
	seed/fruit fr	1	-	1	1
Cyperaceae	seed/fruit	2	-	2	2
<i>Glaucium</i> type	seed/fruit fr	1	-	1	1
Lamiaceae, <i>Lamium</i> type	seed/fruit	1	-	1	1
<i>Lolium</i> spec.	seed/fruit	-	1	1	1
	seed/fruit fr	-	2	2	1
Panicaceae	seed/fruit	4	1	5	3
	seed/fruit fr	18	4	22	4
<i>Papaver</i> spec.	seed/fruit	89	6	95	3
	seed/fruit fr	48	-	48	1
Poaceae	seed/fruit	5	-	5	4
	seed/fruit fr	6	6	12	7
<i>Polygonum</i> spec.	seed/fruit fr	-	1	1	1
TOTAL		957	1989	2946	

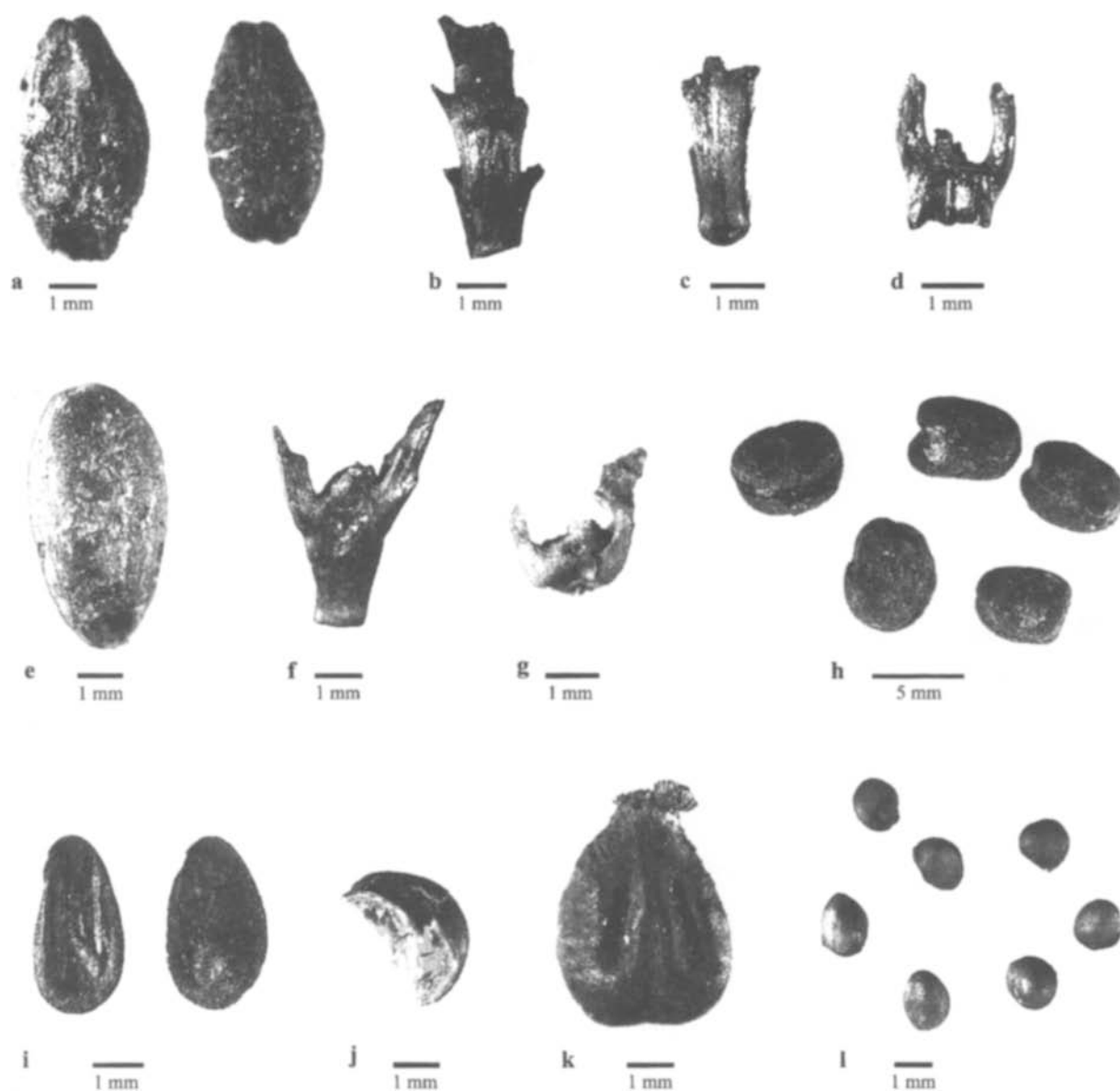


Fig. 4. Seeds, fruits and chaff, *Hordeum vulgare* from La Fangade (a-c), *Triticum monococcum* from Portal Vielh (d), *Triticum diocuccum* from Portal Vielh (e), *T. dicoccum* from La Fangade (f, g), *Vicia faba* from Portal Vielh (h), *Limum usitatissimum* (i, j), *Vitis vinifera* ssp. *sylvestris* (k) and *Ficus carica* from La Fangade

wheats as spikelets. To show local production, reliance may be appropriately placed on demonstrating the very early stages of processing, before dehusking. The most widely retrieved glume wheat remains at La Fangade consist of spikelet forks and glumes bases. They are very typical waste products of the late stages of processing (second winnowing and subsequent sievings) and cannot be considered as signs of local crop growing. Records of occasional awn fragments and rarer examples of undeveloped spikelets may be indicative of remains generally produced during the first stages of processing (threshing, winnowing and coarse sieving). A few straw nodes and some glume fragments may also related to these stages, but their identification is not precise enough to be used as reliable signs. Lastly, in the limited area that has been

investigated, the early stage waste products of glume wheat processing are insufficient to prove local wheat production.

Processing of barley is generally performed up to, or even after, the fine sieving stage before bulk storage (Fig. 8). To demonstrate local production, reliance should be placed on the waste products of the threshing, winnowing and coarse sieving stages. The main indicator is the large amount of carbonized rachis internodes mostly retrieved in S2. There are also some awn fragments and a few undeveloped florets that are typical waste products of these stages. The straw and glume fragments referred to above in relation to glume wheat processing may also originate in the threshing and the winnowing of hulled barley. The very light and small weed seeds that are typically winnowed are poorly repre-

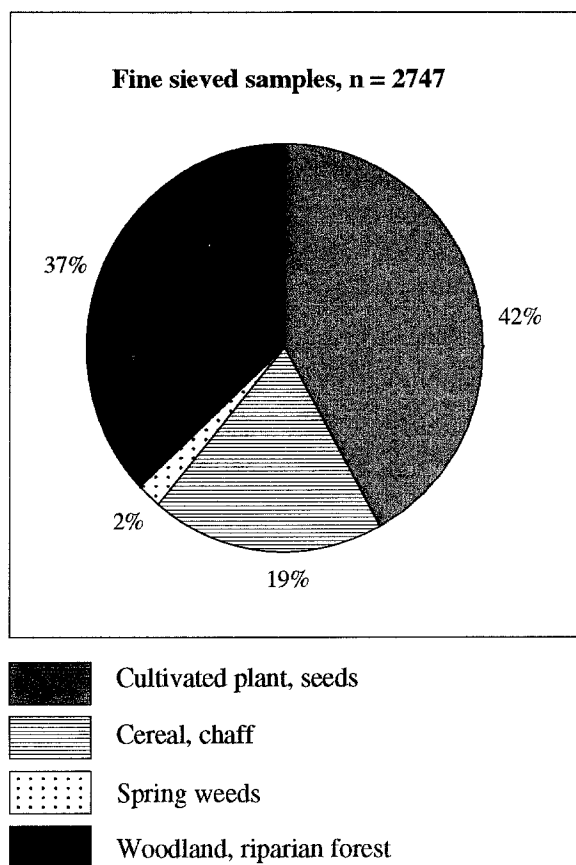


Fig. 5. Percentage representation of plant remains at Portal Vielh (fine sieved samples)

sented. These include *Arenaria* cf. *serpyllifolia*, *Legousia* cf. *speculum-veneris*, *Papaver* cf. *rhoeas* and *Viola tricolor*. Some weed seeds slightly larger or heavier than the above may also have been removed from the prime product during winnowing, and particularly *Ammi majus/visnaga*, which is very well represented, *Ballota nigra*, *Bromus* cf. *arvensis* and *Reseda alba*. Early stages of barley processing provide much better evidence than glume wheats, thanks to the presence of rachis internodes. However, straw remains are scarce and it is not impossible that bulk storage was practised in the form of whole ears that could have been imported. Studies of grain caches cast light on how barley storage was carried out by late Bronze Age people in Languedoc. A first approximation is proposed in the study by Erroux (Erroux and Fages, in press) of the late Bronze Age II settlement and foodstuff cache of La Baume Layrou, a cave located in the hinterland (Fig. 1). Erroux mentions hulled barley grains but no rachis internodes but it is not clear what sampling methods were used at this site. From the available evidence, however, it seems that storage involved hulled grains and not whole ears. An assemblage, that may represent a small cache, recovered from the middle Bronze Age cave of La Grotte des Cazals, Sallèles-Cabardès, western Languedoc (Gasco 1983), was examined without sieving, and appears to be largely dominated by carbonized grains of six-row barley (Van Zeist et al. 1983). The number of

rachis internodes was very low in relation to grains. One may therefore assume that already, during the middle Bronze Age in Languedoc, barley was stored as hulled grains.

Finally, rachis internodes and other discrete signs of the early stages of processing probably signify barley production. Numerous uncarbonized and a few carbonized flax capsule fragments also support the idea of flax threshing in the site. At La Fangade, therefore, the inhabitants were certainly growing their own crops, but what about Portal Vielh? Because only carbonized remains are preserved and only a part of the samples were fine sieved, remains indicative of the early stages of crop processing are much less numerous in this site. The principal cereal crops are emmer and barley but no rachis internodes, awn, glume, and straw fragments have been retrieved and winter weed seeds are scarce. Only emmer and possibly einkorn spikelet forks and glume bases are indicative of the last stages of glume wheat processing. Definitive conclusions for or against local production at Portal Vielh cannot therefore be drawn. Perhaps the presence of two storage pits, which is exceptional for the late Bronze Age in southern France, and which date from the first period represented at the site indicate local crop production.

The cultivated land and the agricultural system

The presence of both winter and spring weeds suggests that sowing was carried out in the vicinity of La Fangade in both autumn and spring. People possibly lived on the site throughout the year, tilling and sowing between autumn and spring, and harvesting during summer. Probably largely as a consequence of the type of preservation, only a small number of weeds were recorded at Portal Vielh but the two ecological and seasonal groups appear to be represented. Ecological preferences of weeds can be expected to be indicative of the soil conditions

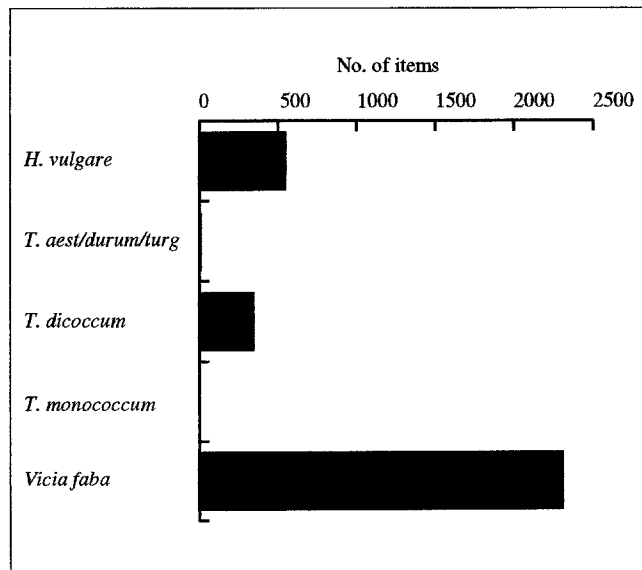


Fig. 6. Carbonized remains of cultivated plants in coarse sieved samples from Portal Vielh

Table 5. Economic plants recorded from sites in the hinterland

Site no.		1	2	3	4	5
Period		BF II	BF II	BF II	BF II	BF IIIb
Type of site		Rock shelter	Cave	Cave	Cave	Hilltop village
Context		Hearth	Hearth	Cultural layer	Storage	Filling layer
Sampling		small	Small	Small	Important	Small
Fine sieving		No	No	No	No	Yes
Cereals						
<i>Hordeum vulgare</i>	seed/fruit	X	XXX	X	XX	X
<i>Hordeum vulgare var. nudum</i>	seed/fruit	X	XX	-	-	-
<i>Panicum miliaceum</i>	seed/fruit	-	-	-	XX	-
<i>Triticum aestivum/durum/turgidum</i>	seed/fruit	-	X	X	XX	X
<i>Triticum dicoccum</i>	seed/fruit	XX	XX	XXX	XXX	X
	spikelet fork	-	-	-	X	X
<i>Triticum monococcum</i>	seed/fruit	X	-	X	-	-
Pulses						
<i>Lathyrus cicera</i>	seed/fruit	-	-	-	X	-
<i>Lens esculenta</i>	seed/fruit	-	-	-	-	X
<i>Vicia ervilia</i>	seed/fruit	-	-	-	X	-
<i>Vicia faba</i>	seed/fruit	-	-	-	XX	-

BF, Late Bronze Age; X, scarce, XX, occasional, XXX, dominant

Key to sites: 1, St-Etienne-de-Gourgas (St-Etienne, Hérault, studied by H. Helbaek, Erroux 1981); 2, Gotte du Prével Supérieur (Montelus, Gard, studied by J. Erroux, Roudil 1972); 3, Grotte du Hasard (Tharoux, Gard, studied by J. Erroux, Roudil 1972, Erroux 1993); 4, Baume Layrou (Trèves, Gard, studied by J. Erroux, Erroux and Fages forthcoming); 5, Oppidum du Marduel (St-Bonnet-du-Gard, Gard, studied by P. Marinval, Marinval 1988)

relating to the arable land. It is only at La Fangade, however, that the number of weed taxa is large enough to be indicative in this respect. The segetal winter weed assemblage is strongly dominated by plants preferring dry and calcareous soils. Winter cereal cultivation was consequently taking place on calcareous fields situated above the humid lowlands, probably on the Mont St-Clair slopes that dominate the site. Weeds of winter cereals appear to be related to the glume wheats or possibly hulled barley. Most of the winter weeds are not high-growing and so the records suggest a fairly low height of reaping, i.e. at less than 50 cm.

Within the spring ruderal weed assemblage, ecological preferences are much more diverse. Most plants have a preference for nutrient-rich soils, but some indicate dry soils, while others indicate more humid conditions. It is likely that all spring weeds were not from the same arable environment. The plants preferring dry soils possibly indicate spring sowings on the Mont St-Clair slopes. Moreover, this group includes all the calcareous indicators within the spring group (*Ruta graveolens*, *Reseda lutea*, *Reseda luteola* and *Heliotropium europaeum*). Other spring weeds, all preferring nutrient rich and some moist soils, were possibly growing in fields located in the lowlands.

Economic plants in the coastline plain and hinterland

Our investigations also provide information on the late Bronze Age economic plants of the Languedoc coastal plain and it is now possible to make comparisons with

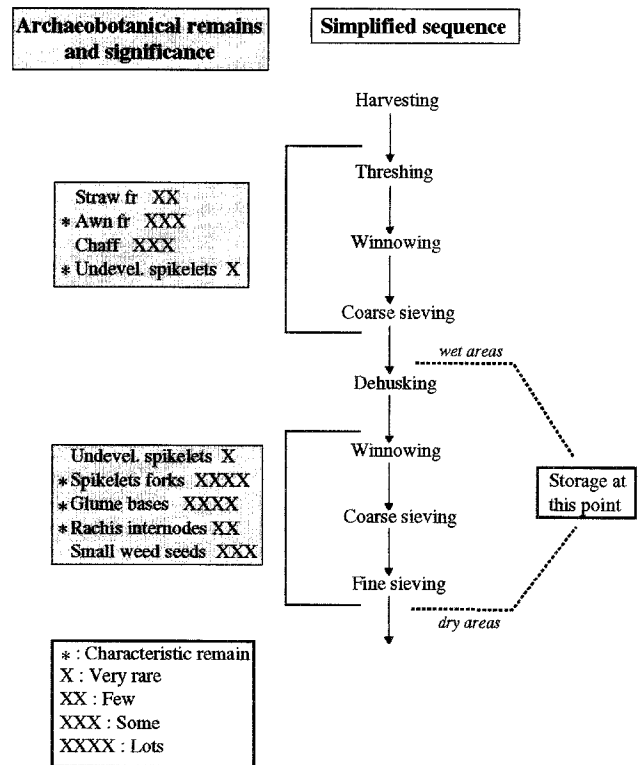


Fig. 7. Steps in processing of cereals and key indicators in the archaeobotanical record at La Fangade (after Hillman 1981, 1984)

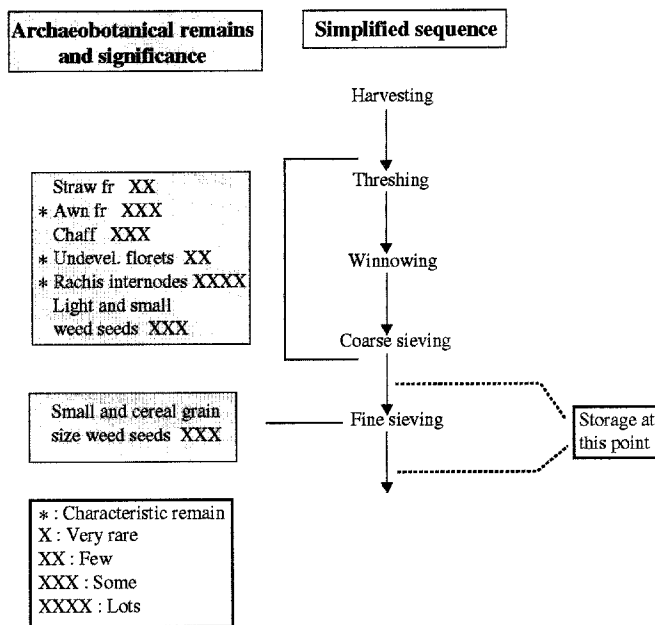


Fig. 8. Steps in processing of cereals and key indicators in the archaeobotanical record at La Fangade (after Jones 1984, Hillman 1981)

the information available for hinterland sites (see Table 5). Two settlements in western Languedoc, namely Font Juvénal (Conques-sur-Orbiel, Aude; Marinval 1988) and Carsac (Carcassonne, Aude; Erroux 1986), are not included in Table 5 since the information that they yielded is limited.

It has been shown that the two main cereals of the two lagoon sites are emmer (*T. dicoccum*) and hulled six row barley (*H. vulgare*). The same cereals were favoured in the hinterland. The increasing preference for hulled barley in place of the naked form is a well known feature of late Bronze Age agriculture in southern France (cf. Marinval 1988). The minor cereals of the lagoon sites (*T. monococcum*, *T. aestivum/durum/turgidum* and *P. miliaceum*) are equally present in some hinterland sites, but generally in small amounts. Einkorn occurs most frequently at La Fangade. The record for broomcorn millet in the Baume Layrou cache is of some interest as this is the only incontrovertible evidence for its cultivation in Languedoc during the late Bronze Age. It should, however, be pointed out that fine sievings have been carried out at only one of the hinterland settlements so the small caryopses of broomcorn millet may have been lost as a result of inadequate sieving.

Pulses are not abundant on the two lagoon sites. Faba bean exploitation is well documented in Portal Vielh while the single seed referred to *L. cf. sativus*, that was retrieved at La Fangade, does not furnish definite proof of cultivation of grass pea. The scarcity of pulses in La Fangade may be imputed to the waterlogged conditions at this settlement. There is a certain diversity in the pulses reported from the hinterland but it is worth noting that it is only at Baume Layrou that considerable quantities of pulses were retrieved and these consisted of faba bean. Grass pea does not occur in any one of the

Languedoc hinterland sites but numerous seeds of *L. cf. sativus* have been retrieved in Les Gandus (St-Ferréol-Trente-Pas, Drôme), a late Bronze Age hillfort village near the Rhône valley (Marinval 1988), some 120 km distant from La Fangade.

There is no striking difference in cereal and pulse growing between littoral plain and hinterland sites. The major characteristic feature of the lagoon sites seems to be flax and opium poppy growing. It is worth noting that *P. somniferum* has not been previously reported from prehistoric settlements in southern France. The oldest reference comes from the Greek city of Massalia (Marseille, Bouches-du-Rhône; Bouby and Marinval, unpublished). Further investigations, however, are required before definitive conclusions can be drawn regarding the significance of failure to record flax and opium poppy in the hinterland sites. As for broomcorn millet, absence may be an artefact resulting from lack of fine sievings. It should also be pointed out that the lack of waterlogged assemblages may contribute to the failure to record *L. usitatissimum* and *P. somniferum* in the hinterland. In the Zürich lake dwelling sites, carbonized seeds never constitute more than a few percent of the total poppy seeds during both the Neolithic and Bronze Ages (Jacomet et al. 1989). About Zürich and other Swiss Neolithic and Bronze Age lake dwellings, Jacomet et al. (1991) point out that flax material is found in over 90% in an uncarbonized state and so using carbonized records only would have led to underestimation of flax cultivation.

As it has already been stated, good evidence exists for fruit gathering at La Fangade and Portal Vielh, especially *Quercus* (acorns), *R. fruticosus* agg., *F. carica* and *V. sylvestris*. On the other hand, Languedoc hinterland sites have failed to deliver any wild edible fruit remains. This should not be regarded as a real difference between littoral plain and hinterland settlements but may be attributable to restricted sampling. Much of the identified wild edible fruit from littoral plain sites is reported from the late Bronze Age or sites of approximately this age in other areas of southern France (e.g. Marinval 1988; Ruas and Marinval 1991). Nevertheless, fruit remains are generally rather scarce in most late Bronze Age carbonized seed assemblages. The diversity of edible fruit in La Fangade is obviously due to the preservation of large amount of uncarbonized remains. The presence of numerous fig (*F. carica*) achenes should, however, be emphasized. Even if thought indigenous in Mediterranean France, fig remains are very scarce in archaeological sites before Greek and, particularly, Roman times. A single carbonized achene has been retrieved from a 5th century B.C. layer in the Marduel oppidum (St-Bonnet-du-Gard, Gard; Marinval 1988) and charcoal is reported from the same site as early as the late Bronze Age (Chabal 1997). La Fangade, therefore, is important in that it provides evidence for the use of this typical Mediterranean species as a food plant in Languedoc prior to classical Greek and Roman times.

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