QUANTIFICATION IN CHARCOAL ANALYSIS? YES, BUT NOT ALWAYS. EXAMPLES FROM PROBLEMATIC PORTUGUESE SITES

CUANTIFICACIÓN EN ANTRACOLOGÍA, SI PERO NO. CASOS SINGULARES EN YACIMIENTOS PORTUGUESES

I. Figueiral[1]
1. Centre de Bio-Archéologie et d'Ecologie, UMR 5059, Institut de Botanique, Montpellier.

ABSTRACT

Palaeo-environmental reconstructions have been achieved in Western Europe, based on the study of large numbers of archaeological charcoal. Absolute / relative frequencies of taxa are translated into diagrams. Work carried out has shown that these reconstructions are only valid when based on dispersed charcoal representing wood collection during a large time span. However, quantification does not seem applicable to all cases, as shown by data obtained in several Portuguese sites, namely S. Julião (Vila Verde) and Monte do Trigo (Idanha-a-Nova), where the analysis of large numbers of dispersed charcoal does not equal maximum ecological information. Interpretation must therefore favour presence / absence and ubiquity of taxa.

KEYWORDS: Archaeology, Charcoal, Portugal, Quantification, Bias

RESUMEN

En Europa occidental, los datos paleoambientales más significativos obtenidos por antracología se basan en la identificación botánica de un amplio conjunto de carbones, a partir de los cuales se cuantifican las frecuencias absolutas y relativas de los taxones que se representa en formas de diagramas.

Los trabajos realizados han demostrado que los resultados ecológicamente fiables se obtienen a partir de la identificación de un número significativo de carbones que se encuentren dispersos por los sedimentos y responda a un periodo de tiempo relativamente largo. No obstante, este método de cuantificar no se puede aplicar a todos los yacimientos. Así en los yacimientos portugueses de S. Julião (Vila Verde) y Monte do Trigo (Idanha-a-Nova) se ha demostrado que el análisis de un número elevado de carbones dispersos no da la máxima información ecológica. En estos casos, la interpretación se debe basar sobretudo en presencia/ausencia y en la ubicuidad de los taxones.

PALABRAS CLAVE: arqueologia, carbon, Portugal, cuantificación, 'distorsion'

INTRODUCTION

The study of archaeological charcoal is currently used to identify variations concerning plant cover and availabity of wood resources through time. The interpretation of data obtained so far is carried out following two ways of approach (for summary see Figueiral and Mosbrugger, 2000): on one side, are those who consider that charcoal data is heavily biased because of human behaviour and therefore, not suitable for quantification (Willcox 1974; Smart and Hoffman, 1988); on the other side, stand those who believe that provided that specific requirements are met, charcoal is highly suitable for quantification and for the study of former environments (Badal and Heinz, 1991; Badal, et al. 1994; Chabal, 1997; Chabal, et al. 1999, and references cited therein). In order to avoid sampling bias, exhaustive sieving / flotation of sediments must be carried out. A thorough distinction concentrated / scattered material must be effectuated and a large number of charcoal fragments must be identified per stratigraphic level/unit in order to obtain statistically significant results. The distinction between dispersed and concentrated material is crucial as interpretation of data depends on it. In fact, available data show that dispersed charcoal provides reliable palaeoenvironmental information while concentrated charcoal is usually heavily biased by human behaviour (Chabal, et al. 1999; Ntinou, et al. 1999, among others).

Quantification has been consistently used by the author of this article in the study of charcoal fragments from archaeological sites located in different European countries. The careful distinction between concentrated and dispersed charcoal has strengthened our knowledge of vegetation history and our understanding of how human populations have changed their surrounding landscape. In some sites, where the taphonomic assignment of material was doubtful, or where only a restricted amount of material was available a "conciliation" approach was followed, combining presence/absence, ubiquity and quantification.

The study of 6 settlements (Late Bronze Age) from the Beira Baixa region, plus another site (Late Bronze Age / Iron Age) from the Minho region (**Fig. 1**) alerted us to the need of a more critical approach of some of the data obtained.

This manuscript aims at (1) presenting results obtained and questions posed, (2) illustrating some of the problems faced when dealing with archaeological charcoal.

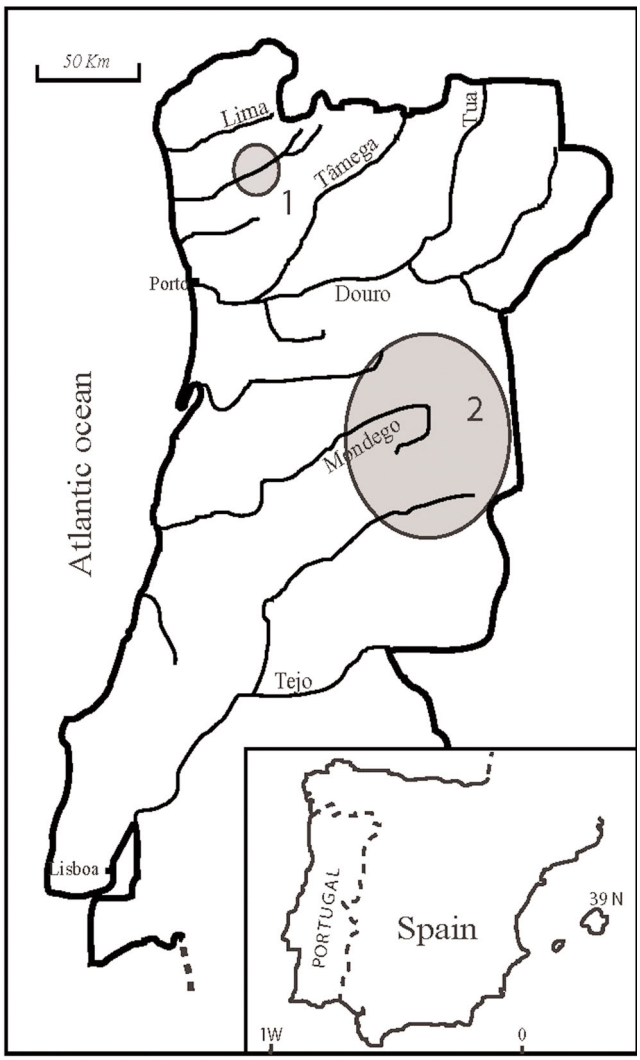

Fig. 1. Location of S. Julião in the Minho region (1) and of the Beira Baixa region (2) where the other six sites are situated.

SITES UNDER STUDY AND THEIR ECOLOGICAL BACKGROUND

Castro de São Julião located near Vila Verde (Minho, NW Portugal) occupies the summit of a low hill, dominating the surrounding landscape. According to the phyto-ecological map (Albuquerque, 1982) this area belongs to the ecological zone Atlantic-Mediterranean/Atlantic, characterized by a climacic vegetation composed of *Castanea sativa* (Chestnut-tree), *Pinus pinaster* (cluster pine), *Pinus pinea* (umbrella pine), *Quercus robur* (deciduous oak) and *Quercus suber* (Cork oak). More recent and complex work (Costa, et al. 1999) includes this area in: Region: Eurosiberian, Subregian: Atlantic-Medioeuro-pean, Superprovince: Atlantic, Province: Can-tabro-Atlantic, Superdistrict: Coastal Miniense. According to the authors the potential climacic vegetation comprises meso- and thermo-temperate oak groves belonging to the *Rusco aculeati-Quercetum roboris quercetosum suberis*. Extensive scrub vegetation is dominated by endemic *Cytisus* and *Ulex* species.

At present, the site is actually surrounded by cluster pines and eucalyptus, recently planted. *Quercus suber* grows on the southern slope. Scrub vegetation develops everywhere: *Ulex*, *Daphne*, Cistaceae. Ferns (*Pteridium aquilinum*) are particularly abundant. Agriculture is restricted to the valley, especially grapes, olives, chestnuts and corn.

The vegetation from the Beira Baixa region is quite distinct. Further away from the ocean influence, this area is included in the Mediterranean region, and presents thus Mediterranean-type vegetation. Five of the sites studied (M. Frade, Moreirinha, Alegrios, Monte do Trigo, Cachouça) are included in the province Luso Extremadurence, Sector Toledano-Tagano, superdistrict Cacerence, while the last site (Castelejo) further north, is included in the province Carpetano-Ibérico-Leonesa, superdistrict Altibeirense (Costa, et al. 1999).

The first zone is characterized by a climax vegetation belonging to the *Pyro bourgaenae-Querceto rotundifoliae,* while the second area is included in the *Genisto falcatae-Quercetum pyrenaicae.* This climax vegetation has greatly disappeared and replaced by scrub vegetation. In the first zone we notice the presence of legumes (*Cytiso multiflori-Retametum sphaerocarpae*), Cistaceae (*Genisto hirsutae-Cistetum ladaniferi*) and *Quercus coccifera* (*Rhamno fontqueri-Quercetum cocciferae*. In the second zone we have elements belonging to the *Lavandulo*

sampaioanae-Cytisetum multiflori and heathers of the *Halimietum alyssoido-ocymoidis* and *Genistello tridentatae-Ericetum aragonensis* (Costa, et al. 1999).

MATERIAL STUDIED

Field work at S. Julião (under de supervision of A. Bettencourt, Univ. Minho) has allowed the recovery a very large amount of charcoal. Charcoal fragment were abundant in all contexts, with relatively large dimensions (mostly 1-4mm) and thus easily observable even during excavation work.

The distinction concentrated/dispersed charcoal was systematically effectuated. On the whole 3005 charcoal fragments were analysed.

Material studied from the sites of the Beira Interior region (under the supervision of R. Vilaça, Univ. Coimbra) was much less abundant than that from S. Julião, as a result of a less systematic sampling. This is particularly true concerning sites Alegrios, Castelejo, Monte do Frade. However, sampling at Moreirinha, Cachouça and Monte do Trigo, was carried out more exhaustively, especially concerning archaeological level 02 from the last settlement.

DISCUSSION OF THE PROBLEMATIC RESULTS OBTAINED

Data from S. Julião have been published previously (Figueiral, 2000). Two main characteristics are noticed (**Table I**): (1) the overwhelming abundance of Fabaceae, (2) the lack of reliability of the distinction concentrated/dispersed charcoal effectuated during excavation work. In fact, as seen in **table I**, the reliable distinction concentrated / dispersed is only achieved in the laboratory, during identification. Sampled labelled as dispersed could reveal reduced taxonomic diversity, and present clear characteristics of a concentrated assemblage. Some taxonomic lists are reduced to two taxa, always, Fabaceae and deciduous oak. Previous work in north-western Portugal pinpointed the co-occurrence of *Quercus* deciduous and Fabaceae, the two major vegetation elements, up at least the end of the roman period. However, the very high frequencies of Fabaceae at S. Julião are particularly surprising. As a result two hypotheses may be considered:

- the environment around S. Julião was particularly open, with a massive disappearance of oak woodland
- the majority of the material studied should in fact be considered as concentrated, and illustrating sporadic choice of Fabaceae

In our case we believe the second hypothesis to be the most plausible one. It is possible that at least some of the material might represent the remains of light construction work, such as roofing or fencing, impossible to detect during excavation.

We could argue that material available from some samples is not very representative (<100 fragments). However, during identification, it was always possible to discriminate a sample of scat-

Table I. Absolute frequencies of taxa in some samples from S. Julião, illustrating difficulties in assenssing the real "status" of samples. Samples with "dispersed" charcoal may have less taxa than those from concentrations

S. Julião											
	Profile 3B		Profile 7			Profile 3A				Profile 6	
	C	D	D	D	C	C	D	D	D	D	C
Context	OOO6	OO25	13	1	2	OOO5		OOO9		OOO5a	
	B2	A2	B7/A1	B7/B1	B7/A2	C1	D4	on paving	under paving	under paving	C6
Alnus cf. *glutinosa*		3								3	
Castanea sativa		1									
Corylus avellana		2								1	1
Fraxinus cf. *angustifolia*		15								11	2
Fabaceae	46	6	33	42	2	60	11	28	66	86	37
Ilex aquifolium										2	
Quercus (deciduous)	9	20	26	8	13	34	39	65	18	52	25
Quercus (evergreen)						2		1		14	3
Rosaceae Maloideae		3								1	
Salix sp.					3	2			6	5	
Sambucus cf. *nigra*						1				8	1
Total	**55**	**50**	**59**	**50**	**18**	**99**	**50**	**94**	**90**	**183**	**69**

(simplified data, indeterminable fragments not included; C = concentrated charcoal, D = dispersed charcoal)

tered material. In fact, the majority of taxa were always identified with less than 50 fragments identified, as illustrated in **figure 2**.

Data from sites located in the Beira Baixa region (Figueiral, 1996 and unpublished) present another interpretation challenge (**Tables II** and **III**).

Data from Alegrios and Castelejo (**Table II**), with the overwhelming presence of *Pinus pinaster* have been interpreted as resulting from two probably linked reasons:

- sampling carried out only when charred material was visible during excavation (i.e. structures), which biased the data This explains the reduced taxonomic spectrum identified. Data from Alegrios is based on the analysis of 255 fragments and Castelejo on 222 fragments

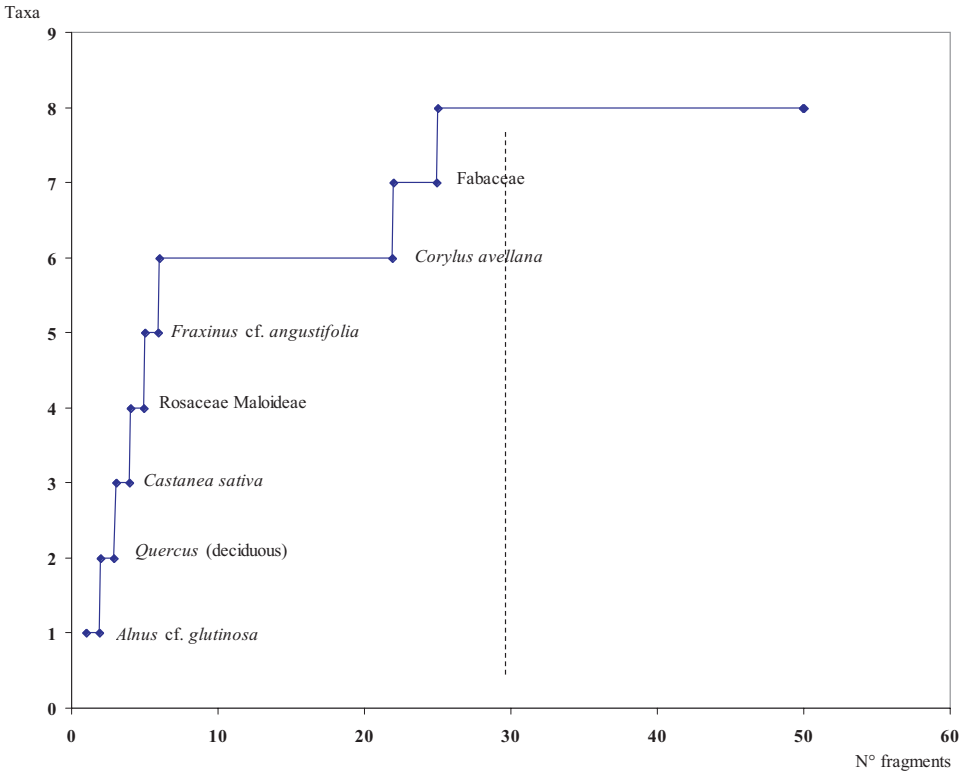

Fig. 2. Example of a sample with dispersed charcoal (S. Julião, profile 3B, context 0025). Seven taxa are already identified when only 30 fragments have been observed.

Table II. Presence / Absence of taxa in sites from the Beira Baixa
(dark grey = predominant; light grey = present)

Taxa	Alegrios	M. Frade	Moreir.	Cach.	Castel.
Arbutus unedo					
Cistaceae					
Erica					
Fabaceae					
Pinus pinaster					
Quercus (deciduous)					
Quercus (evergreen)					
Quercus suber					
Rosaceae Maloideae					
N° fragments	255	176	417	627	222

However, a reduced taxonomic spectrum is also recorded in the other sites where material was sampled via random flotation of sediments (Moreirinha=294 fragments, Monte do Frade=325, Cachouça=627) (**Table II**). Plant taxa identified include Cistaceae, *Erica*, Fabaceae, evergreen *Quercus*, *Arbutus*, and *Pinus pinaster*. Rosaceae and *Quercus* (deciduous) are noticed more sporadically. The absence of riparian taxa is particularly striking. Taking into account that the sites have direct access to streams, this becomes even more surprising.

It was first suggested that the results were due to insufficient sampling. This is why the study of material from Monte do Trigo promised to be more significant (**Table III**). Three archaeological levels were distinguished (similar chronology). Fragments from layers 04 and 03 were scarce but layer 02 provided a considerable amount of samples and charcoal fragments. As seen in **table III**, 83 fragments from layer 04 allowed the identification of *Quercus* (evergreen), *Erica* and *Arbutus*, while Cistaceae are also identified when studying 120 fragments in layer 03. In terms of dispersed charcoal this is already a very short taxonomic list, for such a number of fragments observed. It was normal to expect that an identification effort in layer 02, for which 900 fragments were identified, would enrich dramatically the taxonomic list, and would include riverine taxa. Unfortunately, things turned out to be rather disappointing. As seen in **table III**, the analysis of 900 fragments allowed the identification of only three more taxa, all reaching frequencies inferior to 1%. Bearing in mind that from these taxa only one is a riverine species (*Fraxinus* cf. *angustifolia*) while the others had been previously identified in the other sites, we must recognize that our knowledge concerning available wood resources in the region has not improved significantly. Also, the relative frequencies reached by the main taxa may be considered unusual concerning Portuguese sites studied by the author. In fact, similar frequencies are shared by *Quercus* (evergreen) (29,9%), Cistaceae (26,5%) and *Erica* (26,2%). None of the taxa distinguished is clearly dominant.

It may important to explain that reference to taxa identified has been simplified in the text. As seen in **table III**, for example, *Quercus suber* is present but not referred to elsewhere in the text. In fact the distinction *Quercus suber-Quercus rotundifolia-Quercus coccifera* is seldom carried out. So for our purposes, we include all these species under the nomination *Quercus* (evergreen). Also, taxon Cistaceae/Ericaceae is not considered, for obvious reasons.

Results so far do not seem to provide evidence that human communities were taking profit of all wood resources available locally. We can argue that this is unlikely to be the result of a selective collection of wood, even when nearby resources are plentiful; It is more likely to represent unidentified taphonomic and / or filed sampling bias. However, we can not ignore the hypothesis that, at least in some cases behaviour rather than availability might condition the gathering of wood resources.

Table III. A very short taxonomic list is identified even when observing 900 fragments of dispersed charcoal

Monte do Trigo	L.04	L.03	L. 02
Taxa	%	%	%
Arbutus unedo	35	10,8	11,8
Cistaceae	1,7		26,5
Cistaceae / Ericaceae			2
Erica arborea		12	1,4
Erica sp.	9,2	60,2	24,8
Fabaceae			0,6
Fraxinus cf. *angustifolia*			0,7
Pinus pinaster			0,7
Quercus (evergreen)	50,8	16,9	28,4
Quercus suber			1,2
Indeterminable	3,3		1,9
N° fragments	120	83	900

CONCLUSION

Evidence from archaeological contexts is likely to be subjected to diverse biasing factors, not all obvious to us at present. The examples presented here illustrate the difficulties faced by charcoal analysis, as important factors remain unknown.

As a result, particular care must be taken when interpreting data, as the charcoal record understandably incomplete, may prove in some cases deceptive, or difficult to interpret correctly.

REFERENCES

ALBUQUERQUE, J.P.M. 1982. Carta Ecológica, Fito-edafo-climática de Portugal, Comissão Nacional do Ambiente, Lisboa (Portugal).

BADAL, E. y HEINZ, C. 1991. "Méthodes utilisées en anthracologie pour l'étude des sites prehistoriques", pp. 17-40 In : Recent developments in Western Mediterranean Prehistory vol. I: Archeological Techniques, Technology & Theory. 2nd Deya Conference, Maiorca (Spain), Ed.W.H. Waldren, J.A. Ensenyat and R.C. Kennard, Br. Archaeol. Rep. Br. Ser, 573.

BADAL, E., BERNABEU, J., VERNET, J.L. 1994. "Vegetation changes and human action from the Neolithic to the Bronze Age (7000-4000 BP) in Alicante, Spain, based on charcoal analysis". Veget. Hist. Archaeobot. 3, 155-166.

CHABAL, L. 1997. "Forêts et sociétés en Languedoc (Néolithique final, Antiquité tardive). L'anthracologie, méthode et paléoécologie". DAF, 63, Paris, MSH., 189 p.

CHABAL, L., FABRE, L., TERRAL, J.-F., THÉRY-PARISOT, I. 1999. "L'anthracologie". pp. 43-104, In: A. Ferdière, (Dir.) La botanique. Coll. "Archéologiques", Errance (Ed.), Paris (France).

COSTA, J.C., AGUIAR, C., CAPELO, J.H., LOUSÃ, M., NETO, C. 1998. "Biogeografia de Portugal Continental", Quercetea 0, ALFA, Bragança (Portugal).

FIGUEIRAL, I. 1996. "O Bronze final da Beira Interior. As informações fornecidas pela antracologia" pp. 48–486 .In: R. Vilaça. Aspectos do Povoamento da Beira Interior (Centro e Sul) nos finais da Idade do Bronze. Trabalhos de Arqueologia 9.

FIGUEIRAL, I. 2000. "O povoado de S. Julião (Vila Verde, Braga): contributos da antracologia" pp. 151-157. In: A.M.S. Bettencourt. "O povoado de S. Julião, Vila Verde, Norte de Portugal, na Idade do Bronze e na Transição para a Idade do Ferro", Cadernos de Arqueologia, Monografias 10, Unidade de Arqueologia, Universidade do Minho (ed), Braga (Portugal).

FIGUEIRAL, I., Mosbrugger, V. 2000. "A review of charcoal analysis as a tool for assessing Quaternary and Tertiary environments: achievements and limits". Palaeogeog., Palaeoclimat., Palaeoecol. 164, 397-407.

NTINOU, M., BADAL, E., HEINZ, C. 1999. "Resultados preliminares del proyecto etnoarqueológico de Sarakini (Tracia, Grecia). Comparación con la antracología prehistórica", pp.179-191, Geoarqueologia i Quaternari litoral, Memorial M.P. Fumanal, Univ. València (Spain).

SMART, T.L., HOFFMAN, E.S. 1988. "Environmental interpretation of archaeological charcoal", pp. 167-205 In: C.A. Hastorf, and V.S. Popper (eds) "Current Paleoethnobotany analytical methods and cultural interpretations of archaeological plant remains". Univ. Chicago Press, Chicago (USA).

WILLCOX, G. 1974. "A history of deforestation as indicated by charcoal analysis of four sites in Eastern Anatolia". Anat. Studies 24, 117-133.