Firewood and timber exploitation during the 3rd and 2nd millennia BC in the Western façade of the Iberian Northwest: wooden resources, territories and *chaîne opératoire*

María Martín-Seijo[1], Ana M.S. Bettencourt[2] & Emilio Abad-Vidal[3]

1) University of Santiago de Compostela. Dep. Historia I. GEPN/USC. E-mail: maria.martin.seijo@gmail.com; 2) University of Minho. CITCEM/UM. E-mail: anabett@uaum.uminho.pt; 3) Foundation Centro de Supercomputación de Galicia. E-mail: eav@cesga.es

Introduction

The exploitation of wooden resources in the past was determined by the relationship established between the communities and their environment; and this is reflected in the archaeobotanical record. The samples were recovered in 4 open-air settlements with hearths, pits and structures made of perishable materials (huts) occupied during the 3rd and 2nd millennia BC (Chalcolithic and Bronze Age). The charcoal analysis results aim to contribute to the knowledge of the exploitation of wooden resources, of the territories where these resources were collected, and of the firewood and timber production process (*chaîne opératoire*).

The exploitation of wooden resources is conditioned by different factors, such as availability and proximity, and also by social and economic factors (settlement type, duration of occupation, group size, technological development, etc.). During the first half of the 3rd millennium BC communities were probably less mobile than in the Neolithic; this increased sedentism linked to the development of cereal agriculture and animal husbandry in territories that were geographically and conceptually more circumscribed (Jorge 1999, Bettencourt 2009). During the 2nd millennium, from 3.500 BP there was evidence of sedentary populations occupying the valley lowlands. These communities probably developed a farming system based on the rotation of cereals and legumes, animal husbandry and metallurgical techniques (Jorge 1999; Bettencourt 1999, 2003; Figueiral & Bettencourt 2007) with palynological analysis revealing a consequent impact on forest cover (Ramil 1993).

Sites

The archaeobotanical samples analyzed were recovered from sites occupied during the first half of the 3rd millennium BC: Bitarados (Esposende) and Lamas de Abade (Santiago de Compostela); Monte Calvo (Baião), Lavra (Matosinhos) and Lamas de Abade occupied during the first half of the 2nd millennium and finally Lamas de Abade occupied from the 13th to 11th centuries BC (Figueiral 2003; Martín Seijo *et al*. in press).

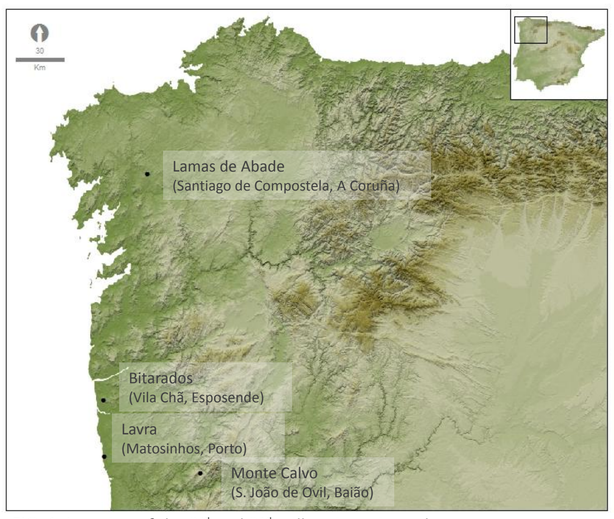

FIG. 1. Location of the 3rd and 2nd millennium sites where archaeobotanical samples were analyzed.

Material and methods

All the charcoal samples analyzed were preserved by carbonization. The fragments (*n=1882*) were first identified taxonomically during the microscopic study, with the anatomical patterns of the wood identified on the three sections (cross, tangential, radial). The dendrological and taphonomic characteristics of the charcoals were observed and registered on a total of 675 fragments from 3 sites (Lamas de Abade, Monte Calvo and Lavra). We considered the following aspects: part of the plant, presence of tyloses, minimum diameter, season of cutting, and also different types of alterations -related with the combustion process (radial cracks, vitrification, cellular collapse, etc.), with the plant conditions of growth (scars, compartmentalization, reaction wood etc.) and with the taphonomic processes (fragmentation, erosion, biological action, etc.). We also analyzed indirect archaeobotanical evidences, such as clay impressions or post holes to recover different data on timber or wattle manufacture.

The spatial distribution of the resources in the territory was estimated by the presence of riverine forests species, actually associated to water courses because of their hydric requirements. To calculate the models of distance costs from the settlement to the resources (in this case to the nearest water course) we used surfaces of anisotropic costs. The digital terrain model ASTER [1] was the base mapping used to calculate the speed of movement using Tobler's [2] procedures. The GIS used in the calculations was ArcInfo version of ArcGIS 9.2 and the commands applied were slope, aspect and path distance. We calculated the isochrones for 15, 30, 60 and 120 minutes and the distances of 1 and 2 km from the settlement.

Wooden resources and production process (*chaîne opératoire*)

In order to study the firewood and timber production process we used the concept of *chaîne opératoire* to organize the archaeological and archaeobotanical record (Gosselain 2010-2011). We distinguish four main stages in this process: raw material procurement (supply), preparation (transport and configuration), product preparation (storage, drying and shaping) and final product (energy or structures/objects).

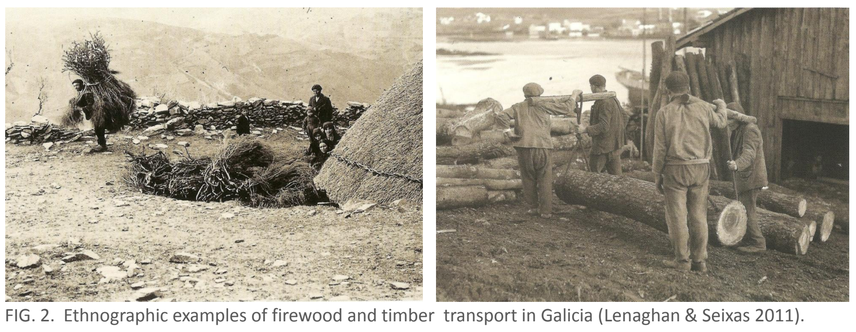

FIG. 2. Ethnographic examples of firewood and timber transport in Galicia (Lenaghan & Seixas 2011).

The **wood fuel** consumption patterns is related with the nature of the supply sources (availability) and their location (accesibility). These two factors conditioned the distance and time invested for these communities in firewood gathering. Firewood supply took place in the surroundings of the settlements occupying the lowlands and the river valleys. These locations favoured the exploitation of temperate mixed forest (*Quercus* sp. deciduous, Rosaceae/Maloideae and *Corylus avellana*) and riverine forest (*Salix* sp./*Populus* sp.) taxa (Fig. 3). The intensive burning and/or advanced states of vegetation disturbance preventing forest regeneration in the surroundings of the settlements, favored the presence and exploitation of the scrubland formations (Fabaceae, Cistaceae, *Cistus* sp. and Ericaceae). Twigs and branches are the firewood preferred (identification of the plant part and ring curvature) (Fig. 4) probably as result of the harvesting of dead wood and coppicing or pruning of lower and small branches of some trees and shrubs. This kind of gathering requires a simple technology: firewood can be collected by hand, using a rope or simple cutting tools. The trees and the forest vary with a seasonal rhythm, as do the energy demands of cooking and heating, so the work invested in gathering firewood probably varied during the year and was higher during the autumn and winter.

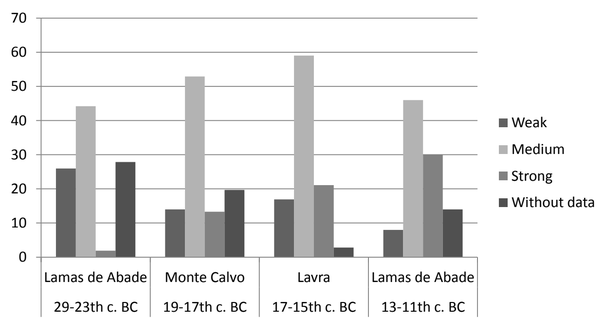

FIG. 4. Ring curvature observed in the fragments of charcoal studied.

FIG. 5. Post holes documented during the excavation at Lavra (Bettencourt & Fonseca in press).

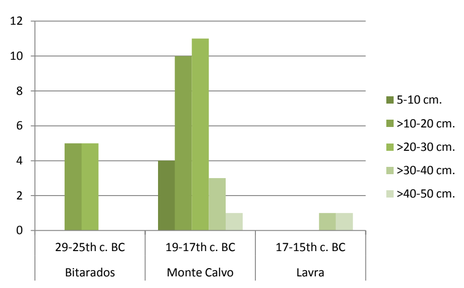

FIG. 6. Maximum diameter of the post holes.

Site	Bitarados		Lamas de Abade				Monte Calvo		Lavra		Lamas de Abade	
	3rd Millennium						2nd Millennium					
Chronology	29th-25th c. cal. BC		29th-23th c. cal. BC		20-18th c. cal. BC		19th-17th c. cal. BC		17th-15th c. cal. BC		13th-11th c. cal. BC	
	Nb.	%	Nb.	%	Nb.	%	Nb.	%	Nb.	%	Nb.	%
Temperate mixed forest												
Quercus sp. deciduous	713	59,1	85	81,73	47	94	212	70,67	15	21,13	19	38
Rosaceae/Maloideae	31	2,57	3	2,88			10	3,34	4	5,63	5	10
Corylus avellana	80	6,63					3	1	1	1,41	12	24
Quercus sp.	29	2,4	1	0,96							1	2
Ilex aquifolium							1	0,34	1	1,41		
Quercus sp. evergreen	22	1,82										
Quercus suber	10	0,83										
Prunus sp.					2	4						
Quercus/Castanea			1	0,96								
Riverine forest												
Salix sp./Populus sp.	17	1,41	2	1,92			1	0,34	6	8,45	4	8
Alnus sp.	7	0,58	12	11,54			4	1,34				
Betula sp.									2	2,82	1	2
Frangula alnus	1	0,08							1	1,41		
Fraxinus sp.	63	5,22							6	8,45		
Sambucus sp.	10	0,83										
Scrubland												
Fabaceae	181	15,0					65	21,67	30	42,25	6	12
Cistaceae	1	0,08										
Cistus sp.									1	1,41		
Compositae	2	0,17										
Erica sp.	5	0,41										
Erica arborea	1	0,08										
Pinus tp. *pinea/pinaster*	1	0,08							4	5,63		
Clematis vitalba	1	0,08										
Quercus/Clematis (root)	1	0,08										
Cork	1	0,08										
Undetermined											1	2
Undterminable	29	2,4			1	2	3	1				
Number of taxa	16	-	6	-	2	-	7	-	11	-	6	-
Number of fragments	1207	100	104	100	50	100	300	100	71	100	50	100

FIG. 3. Absolute and relative frequencies of the samples analyzed.

This daily activity contrasts with the punctual demand of **timber and other wooden resources for construction**. In this case the distance and time invested in the supply of this raw material is probably high. The fire documented in Bitarados favored the preservation of wooden materials used in construction. In this site, the wooden beams were made of oak (*Quercus* sp. deciduous) and the coverage of *Fabaceae* branches and twigs. The presence of branch impressions in clay suggest that wattle and daub walls were used to enclose the structures, probably made of straight and long branches of species such as *Corylus avellana* or *Salix* sp./*Populus* sp., etc. The maximum diameter of the wooden beams, on the basis of the post holes diameters at Bitarados, Monte Calvo and Lavra (Fig. 5), was from 6 to 50 cm., but the most common diameter was between 10 to 30 cm. (Fig. 6). The construction of the huts required a high investment of time and work, with multiple stages: selection of the plant (species, diameter) and the plant part (trunk, branches), felling the tree or pruning the branches, transport to the settlement, shaping and erection into place. It is probable that there was also a seasonal organization of work: trees felled during the autumn or winter, branches cut during the spring to favor the formation of scar tissue, etc.

Territories

In all the analyzed sites the wooden resources exploitation territory was between 15 and 30 minutes, and between 1 to 2 km if we consider the nearest river courses to the settlements nowadays. Although the climatic conditions during the 3rd and 2nd millennia BC were dryer and colder than today (Martínez-Cortizas *et al*. 2009), the distribution of these species probably did not suffer great variations.

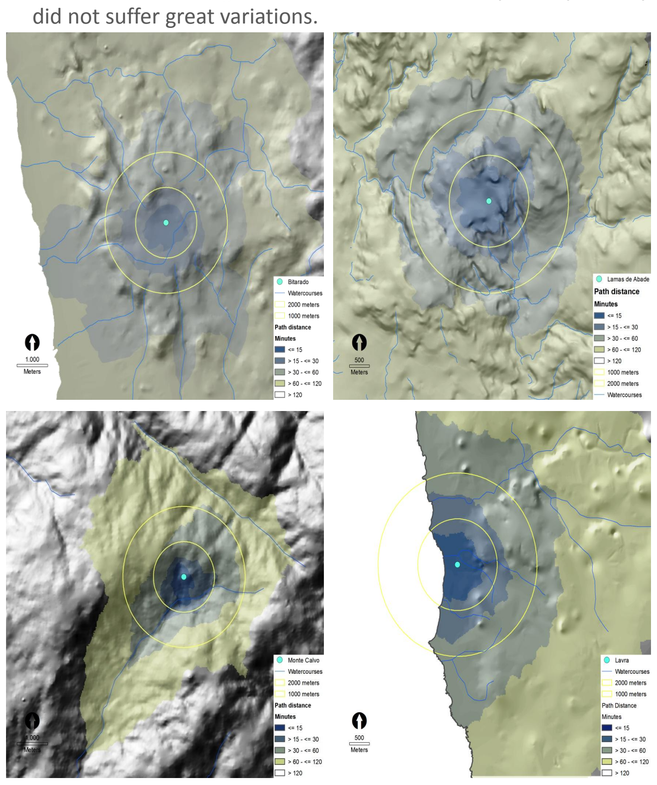

FIG. 5. Path distances from the sites: minutes and meters.

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Notes

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References

BETTENCOURT, A.M.S. (1999.) A Paisagem e o Homem na bacia do Cávado durante o II e o I milénios AC. 5 vols. Braga: Universidade do Minho (PhD dissertation).

BETTENCOURT, A.M.S. (2003). "Plant and animal husbandry in the Second Millennium BC in Northern Portugal", Journal of Iberian Archaeology, vol. 5, pp.199-208

BETTENCOURT, A. M. S., DINIS, A.; FIGUEIRAL, I.; RODRIGUES, A. ; CRUZ, C., SILVA, I.S.; SOUSA, I.; AZEVEDO, M.; BARBOSA, R. (2007). "A ocupação do território e a exploração de recursos durante a Pré-História Recente do Noroeste de Portugal".Jorge, S.; Bettencourt, A. M. S.; Figueiral, I. (. (eds.) A concepção das paisagens e dos espaços na Arqueologia da Península Ibérica. Actas do IV Congresso de Arqueologia Peninsular, Centro de Estudos de Património, Departamento de História, Arqueologia e Património, Fac. de Ciências Humanas e Sociais, Universidade do Algarve: 149 -164.

BETTENCOURT, A.M.S.; DINIS, A.; CRUZ, C.; SOUSA E SILVA, I. (2003). "O povoamento Calcolítico do alvéolo de Vila Chã, Esposende (Norte de Portugal). Notas a propósito das escavações arqueologicas de Bitarados". Portugália. Nova Série, XXIV: 25-44

BETTENCOURT, A. M.S.;&FONSECA, J. (in press). "O povoado da Idade do Bronze de Lavra, Matosinhos. Contributos para o estudo do Bronze Médio do litoral Norte". Maia: Câmara Municipal da Maia

FIGUEIRAL, I. 2003. Restos vegetais carbonizados do povoado calcolítico de Bitarados (Esposende). Montpellier (unpublished report).

FIGUEIRAL, I. & BETTENCOURT, A. M. S (2007). "Estratégias de exploração do espaço no Entre Douro e Minho desde os finais do IV aos meados do I milénios AC". In S. O. Jorge, A. M. S. Bettencourt & I. Figueiral (eds.) A concepção das paisagens e dos espaços na Arqueologia da Península Ibérica. Actas do IV Congresso de Arqueologia Peninsular. Faro: Centro de Estudos de Património, Departamento de História, Arqueologia e Património, Faculdade de Ciências Humanas e Sociais, Universidade do Algarve: 177 - 187.

GOSSELAIN, O.; (2010-11). Technologie des vestiges matériels. Notes de cours. Université Libre de Bruxelles. 62 pp.

JORGE, S.O. 1999. Domesticar a terra. As primeira comunidades agrárias em território português. Lisboa: Gradiva. 160p.

LENAGHAN, P.; SEIXAS, M.A. (2011). Unha mirada de antaño. Fotografías de Ruth Matilda Anderson en Galicia. A Coruña: Fundación Caixa Galicia. 518 pp.

MARTÍN SEIJO, M. (in preparation). A xestión do bosque e do monte dende a Idade do Ferro a época romana no noroeste da península Ibérica: consumo de combustibles e produción de manufacturas en madeira. Universidade de Santiago de Compostela (PhD dissertation).

MARTÍN SEIJO, M.; FIGUEIRAL, I.; BETTENCOURT, A. M. S.; GONÇALVES, A. H. B.; ALVES, M. I. C. (in press). "A floresta e o mato. Exemplos da exploração dos recursos lenhosos pelas comunidades da Idade do Bronze Inicial e Médio do Noroeste de Portugal". In J. Tereso (ed.) Florestas do Norte de Portugal. História, ecologia e perspectivas de futuro, Porto: CIBIO - Faculdade de Ciências do Porto.

MARTÍNEZ-CORTIZAS, A.; COSTA, M.; LÓPEZ-SÁEZ, J.A. (2009). "Environmental change in NW Iberia between 7000 and 500 cal BC". Quaternary International, 200: 77-89

RAMIL, P. (1993). "Evolución climática e histórica de la vegetación durante el Pleistoceno Superior y el Holoceno en las regiones montañosas del Noroeste Ibérico". In: A. Pérez-Alberti; L. Guitián; P. Ramil (eds.), La evolución del paisaje en las montañas del entorno de los caminos jacobeos. Santiago: Xunta de Galicia. pp. 25–60.

[1] http://asterweb.jpl.nasa.gov/gdem.asp
[2] http://www.geodyssey.com/papers/tobler93.html