

**Environmental Change,  
agricultural development  
and social trends  
in NW Iberia  
from the Late Prehistory  
to the Late Antiquity**

**João Pedro Vicente Tereso**



# UNIVERSIDADE DO PORTO

Faculdade de Ciências, Departamento de Biologia

## ENVIRONMENTAL CHANGE, AGRICULTURAL DEVELOPMENT AND SOCIAL TRENDS IN NW IBERIA FROM THE LATE PREHISTORY TO THE LATE ANTIQUITY

Doctoral Program in Biology/Programa Doutoral em Biologia, FCUP

*Thesis* Submitted in partial fulfillment of the requirements for the degree of  
Doctor in Biology at the Faculty of Science, University of Porto

*Dissertação* apresentada à Faculdade de Ciências da Universidade do Porto  
para obtenção do grau de Doutor em Biologia

### **Thesis Supervisor**

Prof. Dr. Rubim Manuel Almeida da Silva

Auxiliary Professor at the Faculty of Science (Biology Department), and  
Researcher at CIBIO (Centro de Investigação em Biodiversidade e Recursos Genéticos)  
University of Porto, Portugal

### **Thesis co-supervisor**

Prof. Dr. Pablo Ramil Rego

Full Professor of the University of Santiago de Compostela.  
Director of the IBADER (Instituto Universitario de Biodiversidade Agraria e Desenvolvimento Rural).



**To Rita and Artur... my family:**

**the flower, the fruit, the future.**

From sun to sun, from harvest to harvest,  
may the rain refresh our hearts and sprout our love  
every morning, every season,  
for all time.



From the bottom to the top: a dolphin, a narwhal, a cheetah and a zebra, by Artur Gaspar Tereso



**Nature is a language - can't you read?**

Morrissey, The Smiths

**Não se pode ter sol na eira e chuva no nabal.**

You can't have sun in the threshing floor and rain in the turnip field.

Portuguese proverb



## Foreword

According to the number 3 of the 7<sup>th</sup> Article of Regulation of the Doctoral Program in Biology from Faculdade de Ciências da Universidade do Porto (and in agreement with the Portuguese Law Decree Nº 74/2006), the present thesis integrates the articles listed below, written in collaboration with co-authors. The candidate declares that he contributed to conceiving the ideas, compiling and producing the databases and analyzing the data, and also declares that he led the writing of all chapters.

### List of papers:

Chapter 3 - Tereso J., Ramil-Rego P., Álvarez González Y., López González L., Almeida da Silva R. (submitted). Massive storage in As Laias/O Castelo (Ourense, NW Spain) from the Late Bronze Age/Iron Age transition to the Roman period: a palaeoethnobotanical approach. *Journal of Archaeological Science*.

Chapter 6 – Tereso J., Ramil-Rego P., Carvalho T.P., Almeida da Silva R., Vaz, F. C. (Submitted). Crops and fodder: evidence for storage and processing activities in a functional area at the Roman settlement of Monte Mozinho (northern Portugal). *Vegetation History and Archaeobotany*.

Chapter 8 – Tereso J., Ramil-Rego P., Bettencourt A.M.S., Almeida da Silva R. (Submitted). Environmental change and agricultural development in NW Iberia during prehistoric times. *Vegetation History and Archaeobotany*.

Chapter 9 – Tereso J., Ramil-Rego P., Almeida da Silva R. (Submitted). Iron Age agriculture in NW Iberia: cultural and environmental constraints and long-term dynamics. *Journal of Anthropological Archaeology*.

Chapter 10 – Tereso J., Ramil-Rego P., Almeida da Silva R. (Submitted). Roman agriculture in the conventus Bracaraugustanus (NW Iberia). *Journal of Archaeological Science*.

**This thesis was supported by the Portuguese Science Foundation through the PhD grant SFRH/BD/41628 /2007 (QREN-POPH, typology 4.1).**

Este trabalho foi realizado com o apoio da Fundação para a Ciência e Tecnologia, através da bolsa de doutoramento com a referência SFRH / BD / 41628 / 2007 (QREN-POPH, tipologia 4.1).





## **TABLE OF CONTENTS**

FOREWORD	7
ACKNOWLEDGMENTS	13
RESUMO	17
ABSTRACT	19

---

### **SECTION A**

#### **GENERAL INTRODUCTION**

<b>Chapter 1 – Palaeoethnobotany in a threshold</b>	23
1.1. Approaches to the study of agriculture in NW Iberia	24
1.2. Crossing the threshold: objectives of the thesis	29
1.3. Structure of the thesis	32
1.4. References	33
<b>Chapter 2 – Research parameters</b>	39
2.1. Study area	39
2.2. Chronological parameters	41
2.3. Botanical criteria	45
2.4. References	47

---

### **SECTION B**

#### **RESULTS OF THE ARCHAEOBOTANICAL STUDIES**

<b>Chapter 3 - Massive storage in As Laias/O Castelo (Ourense, NW Spain) from the Late Bronze Age/Iron Age transition to the Roman period: a palaeoethnobotanical approach</b>	53
Abstract	53
3.1. Introduction	54
3.2. NW Iberia from the Late Bronze Age to the Roman conquest	55
3.3. General characteristics and chronology of As Laias	57
3.4. Materials and Methods	62
3.5. Results	66

3.6. Discussion	68
3.6.1. Crops in As Laias: regional overview	68
3.6.2. Storage strategies in As Laias	71
3.6.3. Massive storage at As Laias in a regional perspective	73
3.7. Conclusions	76
3.8. References	77
<b>Chapter 4 – Fruits and seeds from an Iron Age combustion area at Lesenho (Boticas/Ribeira da Pena, northern Portugal)</b>	83
Abstract	83
4.1. Introduction	83
4.2. Materials and Methods	86
4.3. Results	88
4.4. Discussion and Conclusions	89
4.5. References	90
<b>Chapter 5 – Fruits and seeds from Iron Age and Roman levels of Citânia de Briteiros (Guimarães, northern Portugal)</b>	93
Abstract	93
5.1. Introduction	93
5.2. Materials and Methods	95
5.3. Results	98
5.4. Discussion and Conclusions	103
5.5. References	104
<b>Chapter 6 – Crops and fodder: evidence for storage and processing activities in a functional area at the Roman settlement of Monte Mozinho (northern Portugal)</b>	107
Abstract	107
6.1. Introduction	108
6.1.1. The site	108
6.1.2. The Sector A – 2008	110
6.2. Materials and Methods	113
6.3. Results and discussion	116
6.3.1. Storage in Compartment 1	116
6.3.2. Storage, food and fodder in Compartment 2	120
6.4. Agriculture in Monte Mozinho	129
6.5. Conclusions	134
6.6. References	135

<b>Chapter 7 – Fruits and seeds from the Roman levels of Castro de São Lourenço</b>	
<b>(Esposende, northern Portugal)</b>	141
Abstract	141
<b>7.1. Introduction</b>	141
<b>7.1.1. The Sector D</b>	143
<b>7.2. Materials and Methods</b>	143
<b>7.3. Results</b>	145
<b>7.4. Discussion and Conclusions</b>	148
<b>7.5. References</b>	149

---

## **SECTION C**

### **CHRONOLOGICAL SYNTHESSES**

<b>Chapter 8 – Environmental change and agricultural development in NW Iberia during prehistoric times</b>	153
Abstract	153
<b>8.1. Introduction</b>	154
<b>8.2. Study area</b>	155
<b>8.3. Materials and methods</b>	156
<b>8.3.1. Palaeoenvironmental data</b>	156
<b>8.3.2. Archaeological and Archaeobotanical data</b>	157
<b>8.3.3. Nomenclature of wheat grains</b>	159
<b>8.4. Results and discussion</b>	160
<b>8.4.1. Phase 1 (4400/4200 cal BC – c. 3300 cal BC)</b>	160
<b>8.4.2. Phase 2 (c. 3300 – c. 1800 cal BC)</b>	165
<b>8.4.3. Phase 3 (c.1800 – 600/500 cal BC)</b>	169
<b>8.5. Conclusions</b>	176
<b>8.6. References</b>	179
<b>Chapter 9 – Iron Age agriculture in NW Iberia: cultural and environmental constraints and long-term dynamics</b>	191
Abstract	191
<b>9.1. Introduction</b>	191
<b>9.1.1. Iron Age Chronological and cultural settings in NW Iberia</b>	192
<b>9.2. Study area</b>	194

9.3. Materials and Methods	195
9.4. Results	197
9.5. Discussion	201
9.5.1. Matches and mismatches between archaeobotanical data and classical texts	201
9.5.2. Combining Archaeobotanical data with the Archaeological and Palaeoecological records	204
9.6. Conclusion	208
9.7. References	209
<b>Chapter 10 – Roman agriculture in the <i>conventus Bracaraugustanus</i> (NW Iberia)</b>	215
Abstract	215
10.1. Introduction	215
10.1.1. The <i>conventus Bracaraugustanus</i> and the Roman presence in northwest Iberia	216
10.2. Study area	218
10.3. Materials and Methods	220
10.4. Results and discussion	222
10.4.1. Crops in <i>conventus Bracaraugustanus</i> according to archaeobotanical data	222
10.4.2. Olive oil and wine in the <i>conventus Bracaraugustanus</i>	227
10.4.3. Signs of continuity and change	229
10.5. Conclusions	233
10.6. References	234

---

## **SECTION D**

### **GENERAL CONCLUSIONS**

<b>Chapter 11 – Agriculture, human societies and environmental change from the Late Pre-history to the Late Antiquity: an overview and recommendations for future work</b>	243
11.1. Trends in agricultural strategies from 4400/4300 cal BC to the 5th century AD	243
11.2. Agriculture, environmental constraints and resilience	258
11.3. Major breakthroughs and future lines of work	263
11.4. References	266

## Acknowledgments

Investigation is a thrilling and fulfilling work because it involves the rewarding sensation of learning something which I can teach others. Furthermore, one of the most satisfying aspects of doing investigation is that it involves contact with other investigators. The contact is more rewarding when those who we contact with are as passionate as we are regarding scientific investigation. Fortunately, I had the opportunity to meet, work and get advices from passionate and open-minded people. Thank you all for that.

First of all, I wish to thank my supervisors, Rubim Almeida da Silva and Pablo Ramil Rego, for the help, the advices and the companionship in a relation that soon became more than a simple supervisor-supervised relation. I am confident that it will continue to be like that in the future. I thank you for believing in me, I thank you for your help in this four years and I thank you for the future.

Francisco Barreto Caldas was initially one of my supervisors and even after his retirement and after ceasing to be officially my supervisor, he never ceased to help in whatever he could and he never stopped being a good companion with who I learned a lot. For all of this, I thank you.

Carlos Alberto Brochado de Almeida believed in this project from the beginning and provided me relevant advices. For all of this, I thank you.

João Honrado was enthusiastic with the introduction of my line of work in his investigation group in CIBIO and without that enthusiasm this project surely would not exist. From him I got advices, good talks, support and friendly words whenever I needed. For all of this, I thank you.

I thank the Faculty of Sciences for admitting me as a PhD student. A special thanks to all the people working in the Botany/Biology Department for the valuable help they provided throughout the thesis' four years. A special word for Armando Machado who, unfortunately, died in the last months of this work.

I thank CIBIO (Research Center in Biodiversity and Genetic Resources), in particular its director Nuno Ferrand, for receiving me in its structure and making this thesis possible.

All my colleagues in CIBIO provided the environment of companionship that allowed this work to be done. With them I had rewarding moments which helped me putting into perspective all my work. With them I learn much about science and much more than science. It is a privilege to work with you. For all of this, I thank you.

The colleagues in IBADER for the warming way they received me in Lugo. In particular Javier Ferreira who opened his house to me. For this, I thank you.

I was allowed to use the reference collection of IGESPAR, for which I had the support of Randi Danielsen. The Division of Inventory, Documentation and Archive of the same institution was particularly helpful in providing data regarding the location of several archaeological sites. For this, I thank you.

Filipe Vaz not only helped me in the laboratory work but he also has been a good friend, listening to me with never-ending patience and providing useful comments and suggestions. For all of this, I thank you.

Cláudia Araújo helped whenever necessary with logistics and much more, with advices and encouraging words. For all of this, I thank you.

Paulo Alves provided determinant botanic and ecological information which allowed me to more accurately understand the results of my work. For this, I thank you.

Cristiana Vieira, Helena Hespanhol and Joana Marques, my laboratory colleagues, had the patience to hear me, help me and tolerate the messy aspects of my laboratory work. More than colleagues, they have been friends. For all of this, I thank you.

Bruno Marcos helped me with the cartography of the thesis, with many computer related issues and, above all, with the countless hours of rewarding conversations, determinant for my evolution in terms of scientific work and knowledge. For all of this, I thank you. In addition, Ana Rita Ferreira and Rita Gaspar also gave me determinant help with the cartography. For this, I thank you.

Carlos Aguiar shared his vast knowledge and sympathy with me, in friendly and always exciting conversations which allowed me to discover new scientific perspectives, solve some problems and, above all, increase my passion for scientific investigation. For all of this, I thank you.

Ana Bettencourt has a profound knowledge of the archaeological reality of northwest Iberia and provided crucial insights, advices and data (some of which unpublished) for this thesis. She was a demanding, fair and passionate participant in this work. For all of this, I thank you.

Several investigators provided me unpublished data and/or considerations which were crucial to understand the available data regarding specific sites they studied: Maria Jesus Sanches,

Xulio Carballo Arceo, António da Silva Pereira, José Flores, Francisco Queiroga and Isabel Figueiral. They enriched this thesis and allowed it to become more substantial. For this, I thank you.

I had the opportunity to meet, talk and learn from many other investigators such as Manuela Martins, Gilda Pinto, Sérgio Monteiro Rodrigues and Luis Gomez Orellana. For this, I thank you.

During the work of this thesis I met with several colleagues in Madrid and Barcelona in salutary meetings during which important debates took place. A special word for Leonor Peña Chocarro for the sympathy with which she received me in Madrid and the clarification regarding data from El Castrelin. A special word for Ferran Antolin for receiving me in Barcelona and for altruistically providing anatomical atlases and other material which helped me throughout this work. A special word for Andrés Teira for the useful data and ideas regarding the archaeological reality of the northwest Iberia that came out of our conversations and for always answering my calls for help. To you all, I stand here grateful.

Archaeological work in Lesenho was coordinated by Gonçalo Cruz, João Fonte and Carla Martins; archaeological work in Briteiros was coordinated by Gonçalo Cruz, Francisco Sande Lemos; archaeological work in São Lourenço was coordinated by Ana Almeida and Carlos Brochado de Almeida; archaeological work in As Lias was coordinated by Yolanda Álvarez González and Luis López González. They not only provided data for this thesis but also participated in it by debating with me and providing their own view over the subject of this work. For all of this, I thank you.

Teresa Pires de Carvalho was responsible for the archaeological work in Monte Mozinho. With her I had some of the most invigorating conversations about archaeology and the Roman presence in northern Portugal. She received me warmly in Monte Mozinho and shared her passion for the site, fortunately contaminating me with it. For all of this, I thank you.

My friends have accompanied me through the epepee of this thesis, giving me advices, motivation, relaxing moments and much more. I thank you all. David Gonçalves witnessed some of the achievements and frustrations of my work, with friendship and patience. He listened whenever necessary and provided fruitful advices. For all of this, I thank you.

To my family, in particular Rita and Artur. This work was only possible because you made it possible. You have been in my mind in every page in every line in every word of this thesis. You are the co-authors of this thesis. You are the co-authors of much more than this thesis.





## Resumo

---

Cruzando dados carpológicos, paleoambientais e arqueológicos, este estudo paleoetnobotânico foca a relação entre o desenvolvimento das práticas agrícolas, as alterações ambientais e as dinâmicas sociais no noroeste da Península Ibérica desde o V milénio cal BC até ao século V d.C. O estudo de material carpológico inédito de Lesenho, Citânia de Briteiros, As Laidas, Monte Mozinho e Castro de São Lourenço, juntamente com uma revisão de outros dados disponíveis, permitiu delimitar quatro grandes fases:

A Fase 1 (4400/4200 cal BC – c. 3300 cal BC, i.e. parte do Neolítico) corresponde à introdução da agricultura na região e a sua assimilação gradual pelas comunidades humanas, ainda que conduzindo a um reduzido impacte sobre os ecossistemas florestais.

Na Fase 2 (c.3300 cal BC – c.1800 cal BC, i.e. do Neolítico final ao Bronze inicial) verificou-se um incremento na desflorestação assim como da intensidade dos fenómenos erosivos, coincidindo com a emergência dos primeiros povoados semi-permanentes, a consolidação das práticas agrícolas e o início do cultivo do linho. A cevada vestida e o trigo nu foram os principais cultivos.

Na Fase 3 (c.1800 cal BC – século I a.C., i.e. o Bronze médio e final e a Idade do Ferro) verificou-se uma tendência de desflorestação sem precedentes, coincidindo com a introdução do milho-miúdo e, enquanto este se afirma nas estratégias agrícolas, com a sedentarização das comunidades. Ao contrário de outras regiões peninsulares, durante a Idade do Ferro os trigos vestidos ganharam particular relevância, o que poderá relacionar-se com constrangimentos ambientais desta região, agravados por fenómenos erosivos, alterações climáticas, a emergência de um novo tipo de povoamento e a sedentarização plena das comunidades humanas.

A Fase 4 (século I a.C. – início do século V d.C., i.e. Época Romana) é um período de crescente desflorestação e erosão de solos. Ainda assim, no que respeita aos povoados de tipologia indígena as únicas diferenças significativas que foram detectadas são o início do cultivo do centeio e da vinha, ambos só documentados nas zonas mais meridionais da área de estudo.

De um modo geral, verificou-se uma tendência de redução das áreas florestais e aumento dos fenómenos erosivos. Estes processos foram mais evidentes em momentos particulares, associados a períodos de mudança ao nível das sociedades. As alterações ambientais de origem antrópica acabaram por elas próprias condicionarem as estratégias agrícolas na região.

**Palavras-chave:** Pré-história recente, Proto-história, Período Romano, carpologia, paleoecologia, arqueologia, desflorestação, erosão, alterações sociais, alterações climáticas, resiliência, adaptação, Lesenho, Briteiros, As Laidas, Monte Mozinho, São Lourenço, Norte de Portugal, Galiza, N.O. peninsular.



## Abstract

---

Contrasting carpological, palaeoenvironmental and archaeological data, this palaeoethnobotanical study underlines the relation between the development of agricultural practices, environmental changes and major social trends in northwest Iberia from the 5<sup>th</sup> millennium cal BC to the 5<sup>th</sup> century AD. The study of original carpological material from Lesenho, Citânia de Briteiros, As Laias, Monte Mozinho and Castro de São Lourenço, together with other available data, allowed the differentiation of four main phases:

Phase 1 (4400/4200 cal BC – c. 3300 cal BC, i.e. part of the Neolithic) corresponds to the moment when agriculture was introduced in the region and gradually assimilated by human communities, still promoting little impact in the forest ecosystems.

Phase 2 (c. 3300 cal BC – c. 1800 cal BC, i.e. from the Late Neolithic to the Early Bronze Age) is a phase of increasing deforestation and soil erosion, coinciding with the first semi-permanent settlements, the consolidation of agricultural practices within the subsistence strategies of human communities and the beginning of flax cultivation. Hulled barley and naked wheat were the main crops.

Unprecedented deforestation took place in phase 3 (c. 1800 cal BC – 1<sup>st</sup> century BC, i.e. the Middle and Late Bronze Age and the Iron Age). It coincides with the introduction of millet and, as it became a staple crop, with the sedentarization of human communities. Contrary to what happened in other Iberian regions, during the Iron Age, hulled wheats became very important crops, which is probably related to local environmental constraints, enhanced by moments of soil erosion, climate worsening, a particular settlement pattern and sedentism.

Phase 4 (1<sup>st</sup> century BC – beginning of the 5<sup>th</sup> century AD, i.e. the Roman Period) is a period of enhanced deforestation and soil erosion. Still, investigation carried out in indigenous-type settlements led to the identification of few significant changes regarding agricultural choices: the cultivation of rye and grapevine, both limited to the southernmost areas.

Overall there was a tendency for increasing deforestation and soil erosion but such processes were enhanced in particular moments, in relation with trends in human societies. Furthermore, such anthropogenic environmental changes seem to have constrained agricultural choices in the region.

**Key-words:** Late Prehistory, Proto-history, Roman Period, carpology, paleoecology, archaeology, agriculture, deforestation, soil erosion, social change, environmental change, resilience, adaptation, Lesenho, Briteiros, As Laias, Monte Mozinho, São Lourenço, northern Portugal, Galicia, northwest Iberia.



**SECTION A**

**GENERAL INTRODUCTION**



# 1

## Palaeoethnobotany in a threshold

---

There are several possible definitions of *palaeoethnobotany*, but probably the most accurate, yet broad, is that which derives from the words of J. Renfrew (1973), assuming palaeoethnobotany to be the study of plants used by humans in the past. In this sense, any study of ancient plant remains, independently of the type of remains, can be integrated within this concept if it assumes an ethnographic approach, i.e., if it is centered in the uses human communities gave to plants (Tereso 2007). The book by J. Renfrew (1973) is one of the most influencing works ever written on plant domestication and carpology, together with major works of Alphonse de Candolle (1908 [1883]) and Daniel Zohary and Maria Hopf (2000[1988]). The fact that Renfrew did not centered the definition of palaeoethnobotany exclusively on the study of fruits and seeds enhances its value and the clear insight of the author.

Still, carpological studies done over carbonized material recovered in archaeological sites have an inherent palaeoethnobotanical interest, mostly because the presence of such remains in archaeological sites and their preservation by carbonization are deeply dependent of the usages given to each species by past human communities (Marinval 1999, Tereso 2007). Nevertheless, there is also a great palaeoecological potential in carpological studies, one that goes beyond the fact that the identification of any plant remains positioned in a time period in a given place is, itself, a palaeoecological information. Carpological remains can help us understand how past human communities related to their surrounding landscape, thus, they can make sense of some trends identified through palaeoecological studies. The integration of carpological data – mostly regarding agricultural activities – in palaeoecological studies in northwest Iberia has been done before (Ramil Rego 1993b, Ramil Rego et al. 2009) and it is clear that it helped understanding the major environmental trends in the region. Likewise, only by integrating palaeoecological data can we fully understand the carpological assemblages. Thus, it seems clear that an approach to the early history of agriculture is both a palaeoethnobotanical and a paleoecological study.

The study presented here focuses on the development of agriculture and its relation with environmental and social changes. Agriculture played a determinant role in the co-evolution of



human societies and the environment (Zeder 2008, Ramil Rego et al. 2009) and the absence of structured studies regarding the early phases of agriculture in northwest Iberia is in clear contrast with other Iberian regions (Buxó and Piqué 2008). Therefore, the pertinence of choosing this subject lies on the fact that there were still many questions to be answered and also many to be asked in this manner. Furthermore, there was a profound conviction that important advances could be achieved regarding such determinant phases of the development of Humanity.

However, for several times this investigation was confronted by the question of its usefulness. The answer to such doubt lays on what is the foundation of scientific research and any kind of knowledge: knowledge is of value itself since it is the more direct opposition to ignorance. This seems to be the best use for knowledge, although it may not meet many peoples' notion of usefulness. Nevertheless, uses of palaeoecological data to face future global challenges have been proposed (Swetnam et al. 1999, Foster et al. 2003, Hayashida 2005, Willis and Birks 2006, Willis et al. 2007). Such proposals are based on the fact that systematic environmental records are recent and many present ecological processes precede them, thus only through data from longer time series can these be understood. In fact, the major environmental processes that are verified today had their origin in time-periods, and developed in time-spans, that are not covered by traditional instrumental data. Only with chronologically wide perspectives can we fully understand and characterize today's situation and predict future changes. This means that the use of palaeoecological data improves the knowledge of present ecological systems and their drivers of change, thus being crucial to the delineation of conservation initiatives.

But to use any paleobotanical data we first need to obtain data, a task even more determinant in (scientific and geographic) areas where that sort of studies are underdeveloped. This first step is crucial to allow advanced approaches in the future. In this sense, this thesis' thematic choice also followed the broader purpose of creating a new phase of development of archaeobotanical studies in Portugal, one which would confirm the role of these approaches in archaeological and environmental investigation.

### **1.1. Approaches to the study of agriculture in NW Iberia**

Since the 19<sup>th</sup> century we find references to the recovery of plant remains in archaeological sites from northern Portugal and northwest Spain but these are too vague and the materials analyzed are not available for confirmation (Dopazo Martínez 1996).

The first investigator that carried out relevant work in archaeological fruits and seeds in Portugal was A. R. Pinto da Silva. From the 1930's to the late 1980's he studied plant remains from several sites, some in northern Portugal (Pinto da Silva 1988). Still, it is clear that the recovery of plant remains was not a regular practice in Portuguese archaeology during those early phases of archaeobotany in Portugal. In this manner, the 1990's gave rise to different strategies in the archaeological investigation and these sometimes included regular sampling (e.g. Sanches 1997, Oliveira 2000). Still, even now few sites are systematically sampled and despite the list of sites with archaeobotanical studies increased significantly, the number of archaeologists that promote such studies remains low.

In Galicia, the early work of López Cuevillas (López Cuevillas 1953, López Cuevillas and Lourenzo Fernández, 1986) was followed only sporadically by Tellez and Ciferri in the 1950's, García Rollán and Vázquez Varela in the 1970's and early 1980's (see synthesis in Dopazo Martínez 1996 and Oliveira 2000). Significant work only began to be done in the region through the efforts of P. Ramil Rego and M. Aira Rodríguez in the late 1980's and throughout the 1990's. These two investigators - Ramil Rego and Aira Rodríguez – would be involved also in the development of carpology in northern Portugal in the 1990's, integrating it in broad palaeoecological studies (including palynology, carpology, charcoal analysis, chronology and sedimentology) covering several biogeographic regions of the Iberian Peninsula.

More recently, paleoethnobotanical data has been obtained in several archaeological sites (e.g. Tereso 2009, Martín Seijo et al. 2010) and data has been integrated in palaeoecological and palaeoclimatic interpretative models (Ramil Rego et al. 2009). However, archaeobotanical work is seldom considered a part of the archaeological work; it is usually not taken into consideration while programming the field work or while establishing a financial plan for the investigation. Despite the great abundance of archaeological work, mostly in the scope of contract archaeology, there has not been a significant increase in archaeobotanical studies.

In this context, a structured study directed to the optimization of the data available together with the gathering of new data can demonstrate that the recovery of samples and their analysis is determinant to understand archaeological realities. Particularly in Portugal, a change is needed, towards a new paradigm of archaeological investigation; one marked by interdisciplinarity from the planning of the field work to the production of syntheses.

Previous studies based on archaeobotanical data have already provided significant insights into past crops and agricultural practices in northwest Iberia from the Neolithic to the Roman

Period. As a result of the increment in carpological and palynological studies during the 1990's, some syntheses were produced (Ramil Rego 1993, Ramil Rego et al. 1996, Dopazo Martínez et al. 1996, Oliveira 2000). Still, the results were still too generic and presented on broad chronological packages, reflecting the limitations created by inappropriate or inexistent sampling strategies in most of the sites and the problems in attributing specific chronologies to the plant remains. These latter problems were originated by deficient archaeological excavations and vague publications.

Moreover, the mentioned syntheses were not sufficiently critic regarding the severe contextual and chronological problems of some sites which, by any circumstances should have been taken into consideration. Table 1.1 shows the list of sites that have been excluded from the present study, together with the reasons for such exclusion.

However, despite the existence of some significant problems in the criteria of selection of the material mentioned and in the establishment of chronologies, these early syntheses had virtues and because of them much scattered information became easily available. These syntheses would set the pace to the upcoming approaches.

Compilations of data and studies focusing crops and agriculture during the Late Prehistory became somehow abundant in recent years (e.g. Bettencourt 1999, 2003, Figueiral and Sanches 2003, Bettencourt et al. 2007, Sanches et al. 2007). These take into consideration the chronological reliability of the plant remains but most focus specific geographic areas or time periods. Most are the result of investigation carried out in northern Portugal.

The contexts from which more data was available in the beginning of this investigation were hillforts with Late Bronze Age, Iron Age, Roman and Medieval chronologies. Still, it is fair to say that the little efforts that were done to gather carpological information regarding agricultural practices during proto-historic times and the Roman period are in clear contrast with the major investigation efforts which took place in the hillforts since the 19<sup>th</sup> century. Moreover, most of the syntheses which focus these periods are those done in the 1990's (*vide supra*).

Regarding proto-historic and Roman times, other palaeoenvironmental approaches have been used to address past agricultural practices (Ramil Rego et al. 1996). These are based on archaeopalynological studies done in several hillforts since the 1980's (e.g. Aira Rodríguez and Ramil Rego 1995). Still, special care must be taken while considering such data, due to the well known limitations of such studies (Martinez Cortizas et al. 1993, Mateus et al. 2003).

Site	References	Chronology, according to references	Reason for excluding
A Graña	Tellez et al. 1990	Roman (1 <sup>st</sup> century AD)	Lack of data, probable unreliable chronological insertion.
Aldeia Nova	Pinto da Silva 1988	Iron Age	Lack of data, probable unreliable chronological insertion.
Baran	López Cuevillas 1953	Late Bronze Age/Iron Age/Roman Period	Vague chronological insertion.
Boimorto	Tellez et al. 1990	Roman (1 <sup>st</sup> century AD)	Lack of data, probable unreliable chronological insertion.
Cameixa	Tellez and Ciferri 1954, Dopazo Martinez 1996	Iron Age	Lack of data, probable unreliable chronological insertion.
Caminha	Dopazo Martinez 1996		Incorrect designation. It is Alto do Coto da Pena.
Castro de Fréan	López Cuevillas 1953	Late Bronze Age/Iron Age/Roman Period	Vague chronological insertion.
Castro de Vigo	Tellez et al. 1990	Roman (1 <sup>st</sup> century AD)	Lack of data, probable unreliable chronological insertion.
Cividade de Terroso	Gomes and Carneiro 2005		No specific chronology is attributed to the carpological remains. The site has Bronze Age, Iron Age and Roman phases.
Corredoiras	Dopazo Martinez et al. 1996	Late Bronze Age/Iron Age/Roman Period	Vague chronological insertion.
Franqueira	López Cuevillas 1953	Late Bronze Age/Iron Age/Roman Period	Vague chronological insertion.
Noville	Dopazo Martinez 1996	Roman	The material attributed to Noville is in fact from Castro de Saceda.
Paderne	Pinto da Silva 1988	Chalcolithic or Bronze Age	Lack of data. Vague and unreliable chronological insertion.
Penices	Oliveira 2000	Roman Period	No reference to chronology in the original source. All levels from the site provided carpological remains (Queiroga, personal information).
Pepim	Pinho 1931	Chalcolithic	Lack of data, probable unreliable chronological insertion due to poor stratigraphic control.
S. Vicente de Chã	Freire 1967-68, Pinto da Silva 1988	Iron Age	Lack of data, probable unreliable chronological insertion due to poor stratigraphic control.
Saceda	Dopazo Martinez 1996 (attributed to Noville)		Samples from unknown provenance within the site.
Trelle	Dopazo Martinez 1996	Late Bronze Age/Iron Age/Roman Period	Unreliable chronological insertion. Sporadic recovery without any stratigraphy (see Rodriguez Gracia 1978).

Table 1.1 –  
Sites excluded  
from the  
present study.

However, it is wrong to assume that all approaches to agricultural practices in northwest Iberia from the Neolithic to the Roman period were based on archaeometric data. In fact, some authors followed linguistics and classical writings to make assumptions regarding the cereals and fruit trees grown and even the role of agriculture in pre-roman and roman societies, usually underestimating it (see a critic to these in Ramil Rego and Fernández Rodríguez 1999).

Nevertheless, more recent approaches have reached good acceptance and these are based not on data from environmental archaeology but rather on empirical analyses of the surroundings of the archaeological sites (e.g. Lemos 1993, Parcero Oubiña and Cobas Fernández 2003).

The following quote from F. Sande Lemos and Gonçalo Cruz (2007: 37) illustrates the principle which supports this kind of approaches: “analyzing the surrounding territory of fortified towns or hillforts is, in itself, the best indicator to reconstruct the economy of these settlements [...]”. The same authors continue by analyzing the settlement Citânia de Briteiros: “To the west and south of Briteiros, in the valley, along the Ave River, there is a riverside forest that supplies a variety of wood, used in construction, in several tools and also as firewood. At the foot of the hill, irrigated by several small affluent of the river, products that grow in humid soil, such as millet [...] and linen [...] were cultivated. In the dry soil, wheat was produced” (Lemos and Cruz 2007: 37).

Not intending to completely undermine such approaches, the fact is that they are over-speculative. The analysis of the surrounding of the settlements is determinant to increase our understanding of them but they must be supported by archaeometric data. The characterization of past agriculture whether in regional syntheses or in site-focused studies is a complex task only possible by crossing data from different disciplines. Still, archaeometric studies offer the main sets of data. In this context, archaeobotanical studies document which crops were consumed and can even provide relevant information concerning agricultural practices (Jones et al. 2010). Furthermore, when results are more modest, particularly in the state of art of carpology in the northwest Iberia, the agronomic characteristics of the crops identified through archaeobotanical studies give relevant insights on the choices made by past human communities, although caution is needed since the agronomic characterization of the species is based on recent crops’ varieties.

Although we must aim at building profound syntheses such as those existing for other Iberian (Buxó and Piqué 2008) and European (Kreuz and Schäfer 2011) regions, the fact is that much work must still be done to gather relevant data in northwest Iberia. Only the already

mentioned change in scientific paradigm can suppress the scarcity of archaeobotanical data. Furthermore, interdisciplinary approaches to archaeological sites and study-regions should put side to side archaeobotany, archaeozoology, traceology, geoarchaeology and other disciplines, in order to allow a proper knowledge of past realities.

## 1.2. Crossing the threshold: objectives of the thesis

As can be deduced from the synthesis above, in the beginning of this thesis, the scenario regarding palaeoethnobotanical data on the agricultural practices from pre-historic times to the Late Antiquity was not a positive one. Despite the existence of some syntheses, the more recent data was scattered throughout several publications. Regarding the regional syntheses that already existed (*vide supra*) these were problematic and were already outdated. Furthermore, from the beginning, it was clear that the duration of this thesis' work was insufficient to level the knowledge of the northwest Iberia to that of other Iberian regions where archaeobotanical investigation is far more advanced.

In this context, the objectives of this thesis, i.e. the problems that were being addressed and the questions that were being answered, right from the start had to be put into perspective. They should be broad and ambitious and lead to the best possible advance in scientific knowledge but, at the same time, they should try to focus on specific issues that were determinant to the understanding of past societies, environment and major trends, in order to set the pace to a new phase of development in the archaeobotany of northwest Iberia and in particular that of northern Portugal. Furthermore, a well supported palaeoethnobotanical approach may have the ability to test interpretative models which propagate general beliefs with no scientific base (see a revision of this subject on Ramil Rego and Fernández Rodríguez 1999).

Overall, this thesis intended to enhance our understanding of how agriculture, environmental changes and social trends were connected in early stages of agricultural development. For such purpose, a palaeoethnobotanical approach was carried out, covering the early stages of agriculture, from the Late Pre-history to the Late Antiquity, in northwest Iberia.

In a basic level of approach, this work intended to characterize agricultural strategies in a time period during which great changes occurred at several scopes. Such characterization was mostly aiming to address some main questions:

- How were agricultural development and social trends related?

It is assumed that changing the subsistence strategy towards a productive system led to significant social and cultural changes (Jorge 2000, Zeder 2008). Thus, the expansion of agriculture was, in some degree, also the expansion of a lifeway, although we can argue at what extent it was fully incorporated by indigenous communities or even if it was incorporated as a whole or partially, rapidly or gradually (Zeder 2008). Therefore, the evolution of productive systems are likely to accompany social changes, whether causing them or resulting from them. Such idea is widely accepted and can be read in work done over contexts in northwest Iberia, regarding the time-span consider in this thesis (e.g. Ramil Rego et al. 1996, Bettencourt 1999, Sanches 2007). Still, the carpological data is insufficiently explored in such studies. Focalized chronological syntheses and a broad perspective are needed.

- Which were the singularities of northwest Iberian agricultural strategies and what caused them? How much was determined by environmental constraints?

Studies done in other Iberian regions (e.g. Buxó and Piqué 2008) provided a great deal of information regarding the crops available in the Iberian Peninsula in the time-period focused in this thesis. Still, north-central and northwestern Iberian regions remain poorly studied. It is necessary to compare data from northwest Iberia with that from other regions that are more profoundly studied in order to understand major differences and similarities regarding agricultural choices, e.g. the trends in crops' preferences and the timing of incorporation of crops.

- How were agricultural strategies, environmental constraints and environmental changes related?

Some authors assume that regional environmental constraints were the main cause for some peculiarities of northern Iberia regarding the first stages of agricultural development (Buxó et al. 1997, Ramil Rego et al. 2009). Thus it is necessary to compare carpological data with palaeoenvironmental data to assess how regional constraints may have actually influenced agricultural choices and how much could have been culturally driven.

At the same time, the development of productive systems may have had significant environmental impacts. These need to be assessed and the way these eventually constrained human communities and agricultural choices needs to be understood.

- Did human communities had strategies to guarantee their resilience?

This question is clearly related to the previous one, since it refers to eventual adaptive behaviors regarding all sort of changes (but mostly environmental) to the local conditions but also to conditions inherent to the region in particular time-periods. Agricultural strategies are analyzed in order to understand whether they had the potential to guarantee the resilience of human communities.

Despite being an ecology-based concept, resilience has been applied to social and social-ecological systems. Social resilience can be defined as the “the ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change” (Adger 2000). More recently, much of the debate on the resilience of social ecological systems led to a more profound definition of resilience, although not in contrast with the previous one: “the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks” (Walker et al. 2004). Both concepts integrate some degree of change.

As Adger (2000) notices, the concept of resilience is highly related to that of vulnerability: “the exposure of groups of people or individuals to stress as a result of the impacts of environmental change”, being “stress” the perturbation in the means of subsistence of a community and the need to adapt to a changing environment. One must add other factors known to directly influence human communities, such as ruptures in trade routes and political changes, among others.

The resilience of human communities is highly connected to the resilience of their social-ecological systems. This justifies the pertinence of evaluating eventual strategies for building resilience by studying the agricultural strategies and the impacts of human communities in the environment (e.g. through deforestation and enhancing soil erosion). Non-resilient systems are those that increase vulnerability.

The above mentioned questions were integrated in the broad objective of understanding the relation between environmental changes, social trends and the evolution of productive systems, namely agriculture. To answer these questions, new data was needed and the previously available data had to be reviewed. It is assumed that the option of focusing on such



particularly relevant issues may lead to true insightful results. This way, a threshold may be crossed in the archaeobotany of the region, centering future attentions in the relevance of interdisciplinary studies in the context of archaeological and environmental realities.

### 1.3. Structure of the thesis

As mentioned before, in order to achieve the objectives of this thesis, new data was acquired and previous available data was reviewed. Thus, the thesis was structured in order to make clear which data was acquired by the author, which data was reviewed and which were the main original ideas originated by the reflection done over the whole data.

The thesis was organized in four sections and eleven chapters:

**Section A** (General Introduction) – The first section consists on an introduction which contextualizes the work done in this thesis. In Chapter 1 a brief history of carpological studies in northwest Iberia is presented and the objectives of the thesis are exposed. In Chapter 2, the main geographic, chronological and nomenclatural settings are presented (Chapter 2).

**Section B** (Results of the archaeobotanical studies) – In the second section, results from our own archaeobotanical studies are presented. These consist of five case-studies, five chapters, one for each archaeological site, organized chronologically: As Lias (Chapter 3), Lesenho (Chapter 4), Citânia de Briteiros (Chapter 5), Monte Mozinho (Chapter 6) and Castro de São Lourenço (Chapter 7). Since there are methodological specificities inherent to each case-study, each chapter has a detail description of the methodology used. Chapters 4 and 5 are not articles presented, or to be presented, in specialized journals but they were organized as such, in order to maintain the section's coherence. Chapter 7 is an adaptation of an article presented in Portuguese.

**Section C** (Chronological syntheses) – In the third section, results of the archaeobotanical work done in the scope of the thesis and the reviews of previous studies are discussed. The discussion was separated in three chronological studies, one covering the Neolithic, Chalcolithic and Bronze Age (Chapter 8), another focusing the Iron Age (Chapter 9) and the last one about the Roman Period (Chapter 10). In these chapters, archaeobotanical data is contextualized in its specific time-period and, whenever is considered useful, comparisons with

other regions are made. Interpretations integrate carpological data, archaeological models and broad palaeoenvironmental data.

**Section D (General conclusions)** – This last section and chapter ([Chapter 11](#)) presents the conclusions of the thesis. In here, a broad diachronic perspective is presented, synthesizing the thesis' main achievements. These are contrasted with the thesis' objectives. Possible future lines of work are presented.

## 1.4. References

Adger W. (2000). Social and ecological resilience: are they related? *Progress in Human Geography*, 24 (3): 347-364.

Aira Rodríguez M. J., Ramil-Rego P. (1995). Datos paleobotánicos del Norte de Portugal (Baixo Minho). Estudio polínico y paleocarpológico. *Lagascalia*, 18 (1): 25-38.

Bettencourt A. M. S. (1999). *A paisagem e o Homem na bacia do Cávado durante o II e o I milénio AC*. PhD thesis, Braga: Universidade do Minho.

Bettencourt A. M. S. (2003). Plant and animal husbandry in the second millennium BC in Northern Portugal. *Journal of Iberian Archaeology*, 5: 199-208.

Bettencourt A., Dinis A., Figueiral I., Rodrigues A., Cruz C., Silva I., Azevedo M., Barbosa R. (2007). A ocupação do território e a exploração de recursos durante a Pré-história Recente do Noroeste de Portugal. In Jorge S.O., 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*, Promontoria Monográfica, 08: 149-164.

Buxó R., Piqué R. (2008). *Arqueobotánica. Los usos de las plantas en la península Ibérica*. Barcelona: Ariel.

Buxó R., Alonso N., Canal D., Echave C., González I. (1997). Archaeobotanical remains of hulled and naked cereals in the Iberian Peninsula. *Vegetation History and Archaeobotany*, 6 (1): 15-23.

de Candolle A. (1908). *Origin of cultivated plants*. New York: D. Appleton and company.

Dopazo Martínez A. (1996). *La dieta vegetal del Noroeste Ibérico durante el Holoceno. Una aproximación a través del análisis paleocarpológico*. Undergraduation thesis. Universidad de Santiago.

Dopazo Martínez A., Fernández Rodríguez C., Ramil-Rego P. (1996). Arqueometría aplicada a yacimientos Galaico-romanos del NW Penínsular: valoración de la actividad agrícola y ganadera. In Ramil-Rego P., Fernández Rodríguez, C., Rodríguez Guitián, M. (Eds.), *Biogeografía Pleistocena - Holocena de la Península Ibérica*, Xunta de Galicia: 317-332.

Figueiral I. (1990). *Le Nord-Ouest du Portugal et les modifications de l'écosystème, du Bronze final a l'époque romaine, d'après l'anthracanalyse de sites archeologiques*. Université des Sciences et Techniques du Languedoc.

Figueiral I., Sanches M.J. (2003). Eastern Trás-os-Montes (NE Portugal) from the Late Prehistory to the Iron Age : the land and the people. In Fouache E. (Eds.), *The Mediterranean World Environment and History*: 315-329.

Foster D., Swanson F., Aber J., Burke I., Brokaw N., Tilman D., Knapp A. (2003). The Importance of Land-Use Legacies to Ecology and Conservation. *BioScience*, 53 (1): 77-88.

Freire O. (1967-1968). O castro de S. Vicente da Chã (Montalegre). Campanhas de escavações de 1965 e 1966. *Trabalhos de Antropologia e Etnologia*, 20 (3-4): 368-375.

Gomes J., Carneiro D. (2005). Subtus Montis Terroso. Património Arqueológico no Concelho da Póvoa de Varzim. Póvoa de Varzim: Câmara Municipal da Póvoa de Varzim.

Hayashida F. (2005). Archaeology, Ecological History, and Conservation. *Annual Review of Anthropology*, 34: 43-65.

Jones G., Charles M., Bogaard A., Hodgson J. (2010). Crops and weeds: the role of weed functional ecology in the identification of crop husbandry methods. *Journal of Archaeological Science*, 37 (1): 70-77.

Jorge S. (2000). Domesticating the land: the first agricultural communities in Portugal. *Journal of Iberian Archaeology*, 2: 43-98.

Kreuz A., Schäfer E. (2011). Weed finds as indicators for the cultivation regime of the early Neolithic Bandkeramik culture? *Vegetation History and Archaeobotany*, 20 (5): 333-348.

Lemos F. (1993). *O Povoamento Romano de Trás-os-Montes Oriental*. PhD Thesis. Universidade do Minho.

Lemos F., Cruz G. (2007). *Citânia de Briteiros. Povoado proto-histórico. The proto-historic settlement*. Guimarães: Sociedade Martins Sarmento.

Lopez Cuevillas F. (1953). *La Civilizacion Celtica en Galicia*. Santiago de Compostela: Porto y Cía. - Editores.

Lopez Cuevillas F., Lourenzo Fernández X. (1986). *Castro de Cameixa. Campaña 1944-46*. Consellería de Cultura e Deportes. Xunta de Galicia.

Marinval P. (1999). Les graines et les fruits: la carpologie. In Bourquin-Mignot C., Brochier, J.-E., Chabal, L., Crozat, S., Fabre, L., Guibal, F., Marinval, P., Richard, H., Terral, J.-F., Théry-Parisot, I. (Eds.), *La botanique*, Paris, Editions Errance: 105-137.

Martín Seijo M., Rico Rey A., Teira Brión A., Picón Platas I., García González I., Abad Vidal E. (2010). *Guía de Arqueobotánica*. Xunta de Galicia.

Martínez Cortizas A., Ramil Rego P., Llana Rodríguez C. (1993). Edafología y palinología: aplicación al estudio de yacimientos al aire libre en Galicia. *Trabalhos de Antropologia e Etnologia*, 33 (1-2): 449-469.

Mateus J., Queiroz P., Van Leeuwarden W. (2003). O Laboratório de Paleoecologia e Arqueobotânica – uma visita guiada aos seus programas, linhas de trabalho e perspectivas. In Mateus J., Moreno-Garcia M. (Eds.), *Paleoecologia Humana e Arqueociências. Um programa multidisciplinar para a arqueologia sob a tutela da Cultura* Lisboa, IPA: 106-188.

Oliveira M. (2000). *O registo paleocarpológico do NO peninsular entre o IIIº e o Iº milénios a.C. Contributo para o estudo da alimentação pré e proto-histórica*. MSc Thesis, Universidade do Minho.

Parcero Oubiña C., Cobas Fernández I. (2004). Iron Age Archaeology of the Northwest Iberian Peninsula. *e-Keltoi*, 6: 1-72.

Pinho J. (1931). Sur des graines trouvées dans la station néolithique de Pepim, Amarante. In *Congres International d'Anthropologie & d'Archeologie Prehistorique*. Librairie E. Nourry: 356-358.

Pinto da Silva A. (1988). A paleoetnobotânica na arqueologia portuguesa. Resultados desde 1931 a 1987. In Queiroga F., Sousa I., Oliveira C. (Eds.), *Palaeoecologia e Arqueologia*: 13-29.

Ramil Rego P. (1993). Paleoethnobotánica de yacimientos arqueológicos holocenos de Galicia (N.O. Cantábrico). *Munibe*, 45: 165-174.

Ramil Rego P. (1993b). Evolución climática e historia de la vegetación durante el Pleistoceno Superior y el Holoceno en las regiones montañosas del Noroeste Ibérico. In Pérez A., Guitián L., Ramil P. (Eds.), *La evolución del paisaje en las montañas del entorno de los Caminos Jacobeos*, Santiago de Compostela, Xunta de Galicia: 25-60.

Ramil Rego P., Dopazo Martínez A., Fernández Rodríguez C. (1996). Cambios en las estrategias de explotación de los recursos vegetales en el Norte de la Península Ibérica. *Férvedes*, 3: 169-187.

Ramil Rego P., Fernández Rodríguez C. (1999). La explotación de los recursos alimenticios en el noroeste ibérico. In García Quintela M. (Eds.), *Mitología y mitos de la Hispania prerromana (III)*, Akal: 296-342.

Ramil Rego P., Gómez-Orellana L., Muñoz-Sobrino C., García-Gil S., Iglesias J., Pérez Martínez M., Martínez Carreño N., Nóvoa Fernández B. (2009). Cambio climático y dinámica del paisaje en Galicia. *Recursos Rurais*, 5: 21-47.

Renfrew J. (1973). *Palaeoethnobotany. The prehistoric food plants of the Near East and Europe*. New York: Columbia University Press.

Rodriguez Gracia V. (1978). Materiales del Castro de Trelle. Toen (Orense). *Boletín Avrense*, 8 323-325.

Sanches M. (1997). *Pré-história Recente de Trás-os-Montes e Alto Douro*. Porto: Sociedade Portuguesa de Antropologia e Etnologia.

Sanches M., Nunes S., Pinto D. (2007). Trás-os-Montes (Norte de Portugal) - As gentes e os ecossistemas, do Neolítico à Idade do Ferro. In Jorge S.O., 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*, Promontoria Monográfica, 8: 189 -206.

Swetnam T. W., Allen C. D., Betancourt J. L. (1999). Applied historical ecology: using the past to manage for the future. *Ecological Applications*, 9 (4): 1189-1206.

Tellez R., Chamorro J., Aranz A. (1990). Analisis discriminante en la identificación de trigos arqueológicos españoles. *Trabajos de Prehistoria*, 47: 291-318.

Tellez R., Ciferri, F. (1954). *Trigos arqueológicos de España*. Madrid: Instituto Nacional de Investigaciones Agronómicas.

Tereso J. (2007). *Paleoetnobotânica do povoado romano da Terronha de Pinhovel (NE Transmontano)*. MSc thesis. Faculdade de Ciências, Universidade do Porto.

Tereso J. (2009). Plant macrofossils from the Roman settlement of Terronha de Pinhovel, northwest Iberia. *Vegetation History and Archaeobotany*, 18 (6): 489-501.

Walker B., Holling C., Carpenter S., Kinzig A. (2004). Resilience, adaptability and transformability in social–ecological systems. *Ecology and Society* 9(9): 5.

Willis K. J., Araújo M. B., Bennett K. D., Figueroa-Rangel B., Froyd C. A., Myers N. (2007). How can a knowledge of the past help to conserve the future? Biodiversity conservation and the relevance of long-

term ecological studies. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 362 (1478): 175-187.

Willis K. J., Birks H. J. B. (2006). What Is Natural? The Need for a Long-Term Perspective in Biodiversity Conservation. *Science*, 314 (5803): 1261-1265.

Zeder M. A. (2008). Domestication and early agriculture in the Mediterranean Basin: Origins, diffusion, and impact. *Proceedings of the National Academy of Sciences*, 105 (33): 11597-11604.

Zohary D., Hopf M. (2000). *Domestication of Plants in the Old World – The origin and spread of cultivated plants in West Asia, Europe, and the Nile Valley*. Oxford: Oxford University Press.



## 2

### Research parameters

---

#### 2.1. Study area

This thesis will focus, generally, on the northwest Iberia, a region broadly defined as the northern Portugal and Galicia. Still, since this work is composed of several thematic and chronological approaches there are some variations concerning the area that is focused in each approach. This is more striking in one of the chronological syntheses and discussions (Chapter 10).

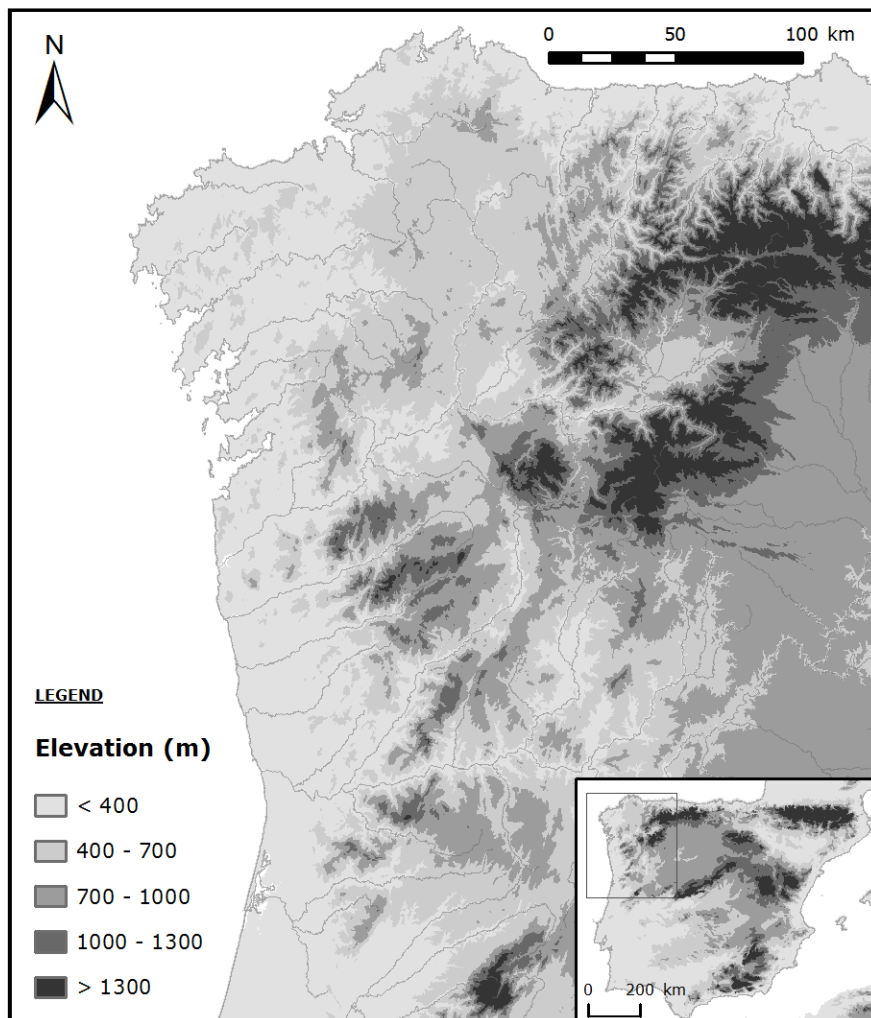


Figure 2.1 – Study area: the northwest Iberia



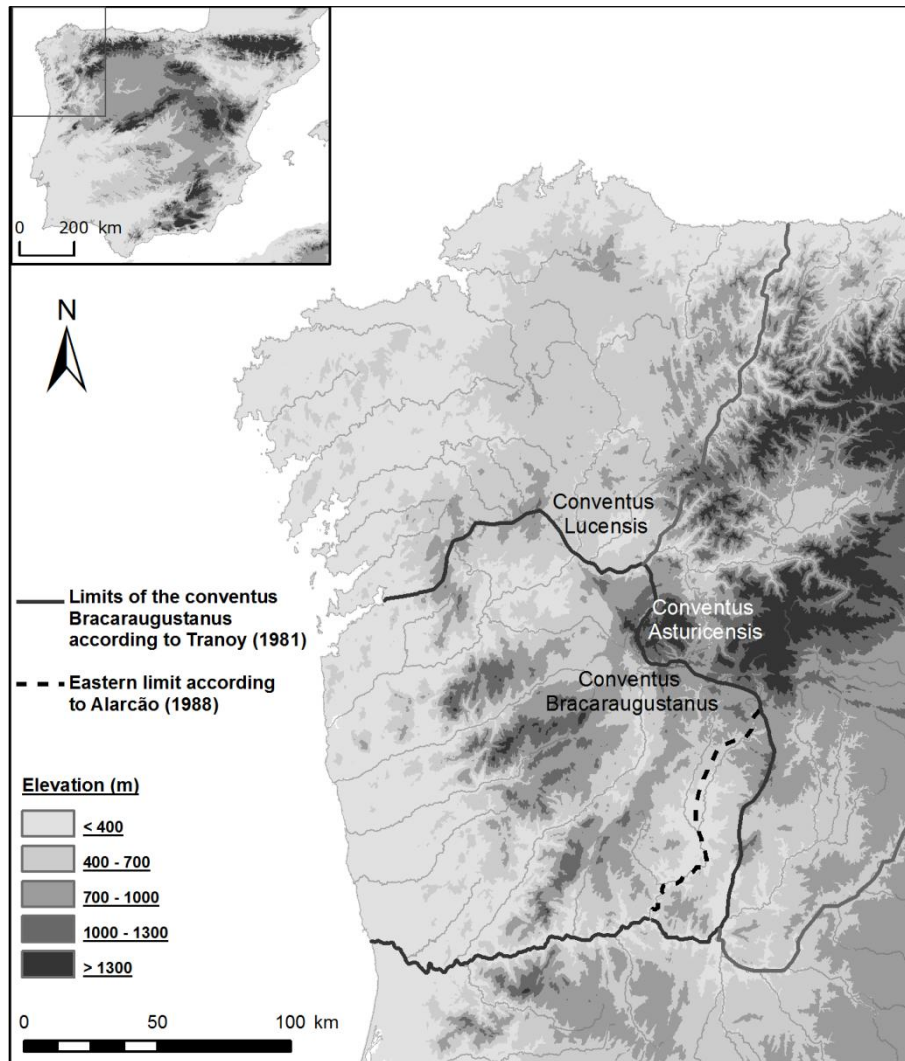


Figure 2.2. Study area of the Roman Period synthesis.

The synthesis that focuses primarily on Late Prehistoric times (Chapter 8) and that of the Iron Age cover all northwest Iberia. Its limits are defined by the Douro basin in Portuguese territory, to the south and, conventionally, the eastern limits of Galicia and the Portuguese border, to the east. To the north and west, the Atlantic Ocean stands as the natural limit.

On the other hand, while analysing the data from Roman contexts it became clear that there were only enough data to study, in a proper way, the *conventus bracaraugustanus*. This region is defined by the political boundaries established by the Romans, but there are some difficulties on defining the actual limits of the *conventus*. Boundaries defined by Tranoy (1981) and Alarcão (1988) (Figure 2.2) were taken into consideration since they are the most consensual and well supported by data. Carpological data from the rest of northwest Iberia

was incorporated to allow comparisons and to still obtain a generic perspective on the evolution of the entire region.

Northwest Iberia is a heterogeneous region with a wide coastal-subcoastal area with shallow valleys and low altitude mountains which link the Cantabrian-Atlantic and the Subatlantic ranges. Small and medium sized mountains that comprise the border of some of the main Iberian mountains (the cantabrian and the Central Massif) stand in the limit between the northwest Iberia and the interior plains. Between both units, ancient sedimentary basins maintain a plain physiognomy (Ribeiro and Lautensach 1995, Ramil-Rego et al. 2005).

The climatic and biogeographic heterogeneity of northwest Iberia has been analysed by several authors, whether based exclusively on the present distribution of plants (Costa et al. 1998, Rivas-Martínez et al. 2002) or by adding also relevant palaeoecological data (Ramil-Rego et al. 2005, Rodríguez Guitián and Ramil-Rego 2007, 2008).

According to these studies, most of the territory is placed in the Atlantic region (Eurosiberian region *sensu* Rivas-Martínez et al. 2002), characterized by the absence of a dry season. Its proximity to the sea, together with its low altitudes, justifies its reduced continentality and the long vegetative period that may extent to 8-9 months. On the other hand, in the rest of the year, abundant frost or snow impose great limitations to the development of vegetation. The southeastern areas are positioned in the Mediterranean biogeographic region being thus characterized by the existence of a dry season of at least three months and possible longer periods of winter frost, when compared with the Atlantic areas. The most suitable areas for agriculture are those from low altitude coastal and subcoastal areas.

## 2.2. Chronological parameters

The understanding of any archaeological material, plant remains included, depends of its correct chronological interpretation. On the other hand, while archaeological remains contribute decisively for the construction of interpretation models for each chronological period, the fact is that they, themselves, can only be interpreted on the light of the knowledge available about the time period when they were produced and the region where they were recovered.

Although this is not the place for a detailed discussion on the theoretical problems concerning the chronological insertion of archaeological remains, when using any chronological parameters these must be clearly mentioned. Chronological terms such as *Neolithic* or *Iron Age* are attached to cultural and chronological realities but they are basically concepts that can be, and in fact are, used differently by different investigators. That problem can be particularly relevant when dealing with a vast region such as the northwest Iberia where asymmetries on the development of human communities are likely to have occurred as well as differences promoted by separate scientific paths followed by Portuguese and Spanish archaeology (see examples in González Ruibal 2003).

For instance, when dealing with concepts such as *Late Bronze Age* and *Iron Age* it is determinant to clearly state the chronological boundaries considered. In fact, the question regarding the beginning of the Iron Age in northwest Iberia is controversial. While some regard the period of c.800-600/500 cal BC as the Early Iron Age (González Ruibal 2003, Parceró Oubiña and Cobas Fernández 2004), others (Bettencourt 2005a) consider this to be a final phase of the Late Bronze Age, although already transitional to the Iron Age. Parceró Oubiña and Cobas Fernández (2004) believe this discrepancy reflects different conceptual approaches to the periodization of archaeological realities, one based on techno-typological criteria and other based on the appearance of a specific type of settlements. Probably one should not put it so straightforwardly. Nevertheless, as a consequence, the period beginning at 600/500 cal BC, is designated differently by distinct authors: Iron Age (Bettencourt 2005a), 2<sup>nd</sup> Iron Age (González Ruibal 2003), Middle Iron Age (González Ruibal 2004) or Late Iron Age (Parceró Oubiña and Cobas Fernández 2004). Therefore, the use of such designations without clearly mentioning the chronological boundaries assumed is likely to lead to important mistakes.

Here we present the chronological boundaries used for contrasting with carpological and palaeoecological data. These derive from archaeological studies only and the archaeological data (radiocarbon dates, artifacts, architecture, settlement patterns, etc.) that stand on the basis of the chronological model will not be addressed here. Considerations on such matter are available on specific works directed to such problems and many of these will be quoted in this thesis.

The parameters for establishing the chronological boundaries and to characterize Late Prehistoric times (Neolithic, Chalcolithic and the Early/Middle Bronze Age) follow the work of

Maria de Jesus Sanches (Sanches 1997, 2000, Sanches et al. 2007), Ana M.S. Bettencourt (2005a, 2005b, 2009), Susana Oliveira Jorge and Vítor Oliveira Jorge (2006) and Sérgio Monteiro-Rodrigues (2008).

The work of Bettencourt (2005a, 2005b, 2009) will be followed to establish the chronology of the Late Bronze Age and the beginning of the Iron Age, an issue of significant controversial (see González Ruibal 2003, Parceró Oubiña and Cobas Fernández 2004 and Bettencourt 2005a). The boundaries and the chronological parameters of major events of the Roman occupation will be based on the work of Jorge Alarcão (1988), Carlos Fabião (1992), Rui Morais (2004), Peña Santos (2005) and Helena Carvalho (2008).

Therefore these are the chronological parameters used in this thesis:

- Neolithic - c. 5000-3200/3000 cal BC
- Chalcolithic - c. 3200/3000-2200 cal BC
- Early/Middle Bronze Age - c. 2200-1200 cal BC
- Late Bronze Age - c. 1200-600/500 cal BC
- Iron Age - 600/500 – late 1<sup>st</sup> century cal BC
  - Iron Age Phase 1 - 600/500 cal BC – late 2<sup>nd</sup> century cal BC
  - Iron Age Phase 2 - late 2<sup>nd</sup> century cal BC – late 1<sup>st</sup> century cal BC
- Roman Period - late 1<sup>st</sup> century BC – beginning of the 5<sup>th</sup> century AD
  - Julio-Claudian Dynasty - late 1<sup>st</sup> century BC-68 AD
  - From the Flavian Dynasty to the 3<sup>rd</sup> century crisis - 68 AD – second half of the 3<sup>rd</sup> century AD
  - Late Roman Empire - second half of the 3<sup>rd</sup> century AD – beginning of the 5<sup>th</sup> century AD (between 409 and 411 AD Germanic people entered in the Iberian Peninsula and established themselves in the northwest)

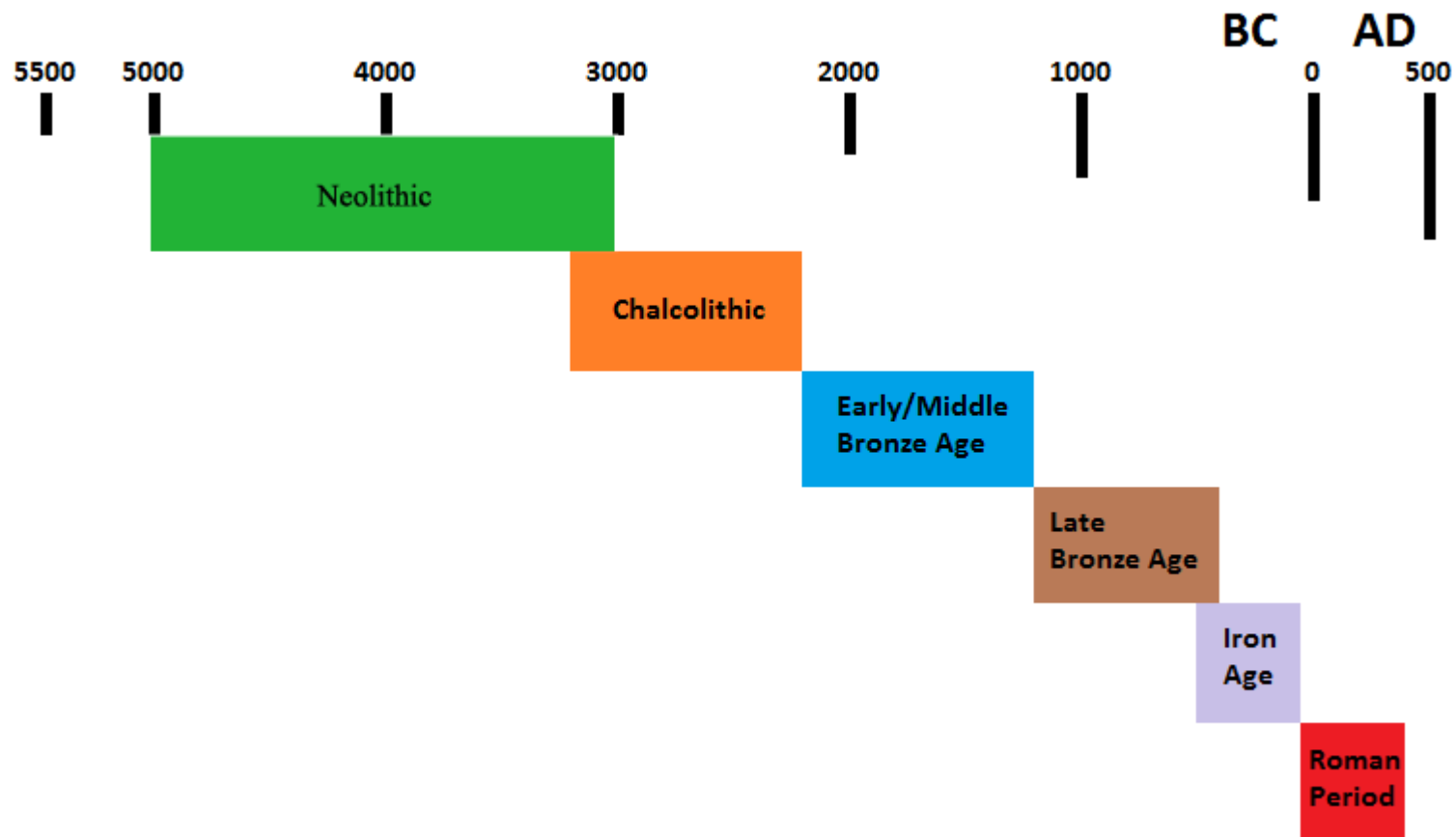


Figure 2.3 – Timeline of archaeological chronological periods in northwest Iberia.

### 2.3. Botanical criteria

This thesis will follow the botanic nomenclature of Flora Ibérica (Castroviejo et al. 1986-2010) and Flora Europaea (Tutin et al. 1964-1980). In what cultivated plants is concern, the proposal of Zohary et al. (2012) will be followed, but advances from other archaeobotanical studies and manuals will be incorporated. Table 2.1 shows the Latin and English designations of the cultivated species and fruit trees (wild and cultivated) mentioned in the text. These will be frequently abbreviated in the text.

Frequently, identification efforts do not allow identifying fruits and seeds to species level. Identification to genus, tribe and family level are frequent. Still, whenever possible, the morphological types will be named after one or more species which most resemble them. This way, they will be ascribed to a specific morphology.

Caution is needed since morphological types are not actual species. Types' designations are attempts to relate specific remains to the morphologies ascribed to the eponymous species, but that can include other species. Given the nature of this work, this is particularly relevant in the case of the grains from the genus *Triticum*, but other problematic groups will be addressed throughout this thesis.

The genus *Triticum* includes several domestic and wild species whose discrimination has been made through the external morphology of the plants, in particularly the inflorescences, or by genetic criteria (Bowden 1959 and 1966, Mac Key 1966 and 1989, Goncharov 2002 and 2005, Goncharov et al. 2009). The morphology of the grains is not the best criterion, but it has been used thoroughly in archaeobotany since frequently it is the only one that can be used. In this case, morphological types have been defined by several authors (Hillman et al. 1996, Buxó 1997, Jacomet 2006) and comparisons between assemblages are possible when the same criteria are used.

Latin designation	English
<b>Cereals</b>	
<i>Avena</i> L.	Oat
<i>Hordeum vulgare</i> L. subsp. <i>vulgare</i>	Hulled barley
<i>Hordeum vulgare</i> L. var. <i>nudum</i>	Naked barley
<i>Panicum miliaceum</i> L.	Broomcorn millet, common millet
<i>Setaria italica</i> (L.) P. Beauv.	Foxtail millet, italian millet
<i>Secale cereale</i> L.	Rye
<i>Triticum aestivum</i> L. subsp. <i>aestivum</i>	Bread wheat
<i>Triticum aestivum</i> L. subsp. <i>compactum</i> (Host) Mackey	Club wheat
<i>Triticum aestivum</i> L. subsp. <i>spelta</i> (L.) Thell.	Spelt
<i>Triticum aestivum</i> L. subsp. <i>sphaerococcum</i> (Perc.) MacKey	Indian dwarf wheat
<i>Triticum monococcum</i> L. subsp. <i>monococcum</i>	Einkorn
<i>Triticum turgidum</i> L. subsp. <i>dicoccum</i> (Schrank) Thell.	Emmer
<i>Triticum turgidum</i> L. subsp. <i>durum</i> (Desf) Mackey	Durum wheat, Macaroni wheat
<i>Triticum turgidum</i> L. subsp. <i>parvicoccum</i> Kislev	-
<i>Triticum turgidum</i> L. subsp. <i>turgidum</i>	Rivet wheat
<b>Other crops</b>	
<i>Lens</i> Mill.	Lentils
<i>Linum</i> L.	Flax
<i>Papaver</i> L.	Poppy
<i>Pisum sativum</i> L.	Pea
<i>Vicia faba</i> L.	Faba bean
<i>Vicia angustifolia</i> L./ <i>Vicia sativa</i> L.	Black-pod vetch, Narrow-leaved vetch/Common vetch
<b>Fruits</b>	
<i>Arbutus unedo</i> L.	Strawberry Tree
<i>Castanea sativa</i> Mill.	Chestnut
<i>Corylus avellana</i> L.	Common hazel
<i>Olea europaea</i> L.	Olive tree
<i>Pinus pinea</i> L.	Stone pine
<i>Pyrus cordata</i> Desv.	Plymouth pear
<i>Pyrus communis</i> L.	Pear
<i>Quercus</i> L.	Oak, Cork oak, Holm oak, Kermes oak, Portuguese oak
<i>Rubus</i> L.	Blackberry/Raspberry/Dewberry
<i>Sorbus aucuparia</i> L.	Rowan
<i>Vitis vinifera</i> L.	Grapevine

Table 2.1 – Designations of the main species identified in the archaeobotanical studies

In this matter, caryopses from naked wheat are the most problematic cases, thus demanding a further clarification. Regular, elongated caryopses from naked wheat will be named as *Triticum aestivum/durum* (see Buxó 1997), a morphological type that includes *T. aestivum* L. subsp. *aestivum*, *T. turgidum* L. subsp. *durum* (Desf.) Mackey, and *T. turgidum* L. subsp. *turgidum*

(nomenclature after Zohary et al. 2012). The short roundish caryopses will be designated as *Triticum* stubby grains (see Jacomet 2006), similar to the Portuguese designation “trigo globiforme” used by Pinto da Silva (1988). Besides the designation created by Pinto da Silva, in local studies, other designations were used to name grains with this morphology: *T. compactum* (e.g. Figueiral and Jorge 2008, Tereso 2009), *T. aestivo-compactum* (Cristina Echave, quoted in Sanches 1997), *T. parvicoccum* (Pinto da Silva 1988) and *T. aestivum* var. *sphaerococcum* (Ramil Rego and Aira Rodríguez 1993). Therefore, three species are usually ascribed to this morphology: *T. aestivum* L. subsp. *compactum* (Host) Mackey, *T. aestivum* L. subsp. *sphaerococcum* (Perc.) Mackey and *T. turgidum* subsp. *parvicoccum* Kislev (Jacomet 2006; nomenclature according to Zohary et al. 2012).

The use of these well known morphological types in our research as well as the homogenization of nomenclature while reviewing published data, facilitates the comparisons between sites studied in different times, by distinct investigators. Still, morphological types only establish a similarity between the archaeobotanical remains and the actual fruits or seeds of some species. The homogenization of nomenclature does not exclude the possibility that each morphological type includes different species; they just cannot be differentiated by the remains that were studied.

## 2.4. References

- Alarcão J. (1988). *O domínio romano em Portugal*. Mem Martins: Publicações Europa-América.
- Bettencourt A. M.S. (2005a). O que aconteceu às populações do Bronze Final do Noroeste de Portugal, no segundo quartel do I milénio AC, e quando começou, afinal, a Idade do Ferro? In *Actas do Colóquio Internacional Castro, um lugar para habitar*, Câmara Municipal de Penafiel: 25-40.
- Bettencourt A. M.S. (2005b). The early farmers and shepherds of North-west Portugal: the Neolithic and the Calcolithic. In Silva I., Mineiro C. (Eds.), *D. Diogo de Sousa. Regional Museum of Archaeology. Guide.*, Lisboa, Instituto Português dos Museus: 28-35.
- Bettencourt A. M.S. (2009). A Pré-história do Minho. Do Neolítico à Idade do Bronze. In *Minho. Traços de Identidade*, Braga, Universidade do Minho: 70-120.
- Bowden W. (1959). The taxonomy and nomenclature of the wheats, barleys, and ryes and their wild relatives. *Canadian Journal of Botany*, 37 657-684.



- Bowden W. (1966). Chromosome numbers in seven genera of the tribe Triticeae. *Canadian Journal of Genetics and Cytology*, 8 130-136.
- Buxó R. (1997). *Arqueología de las Plantas*. Barcelona: Crítica.
- Carvalho H. (2008). *O povoamento romano na fachada ocidental do Conventus Bracarensis*. PhD Thesis, Universidade do Minho.
- Castroviejo S. et al. (Eds.) (1986-2010). *Flora Iberica*. Real Jardín Botánico de Madrid. CSIC.
- Costa J., Aguiar C., Capelo J., Lousã M., Neto C. (1998). Biogeografia de Portugal Continental. *Quercetea*, 0: 5-56.
- Fabião C. (1992). O Passado Proto-Histórico e Romano. In Mattoso J. (Ed.), *História de Portugal, 1, Antes de Portugal*, Círculo de Leitores: 77-299.
- Figueiral I., Jorge S. O. (2008). Man-made landscapes from the third-second millennia BC: the example of Castelo Velho (Freixo de Numão, North-East Portugal). *Oxford Journal of Archaeology*, 27: 119-133.
- Goncharov N. (2002). *Comparative genetics of wheats and their related species*. Novosibirsk: Siberian Branch Press.
- Goncharov N. (2005). Comparative-genetic analysis a base for wheat taxonomy revision. *Czech Journal of Genetics and Plant Breeding*, 41 52-55.
- Goncharov N., Golovnina K., Kondratenko E. (2009). Taxonomy and molecular phylogeny of natural and artificial wheat species. *Breeding Science*, 59 (5): 492-498.
- González Ruibal A. (2003). *Arqueología del Primer Milenio a.C. en el Noroeste de la Península Ibérica*. PhD thesis, Department of Prehistory, Complutense University of Madrid.
- González Ruibal A. (2004). Facing two seas: Mediterranean and Atlantic contacts in the North-West of Iberia in the first millennium BC. *Oxford Journal of Archaeology*, 23 (3): 287-317.
- González Ruibal A. (2009). Cultura de fronteira. O distrito de Vila Real e a zona meridional da província de Ourense na Idade do Ferro. *Revista Aquae Flaviae*, 41: 153-160.
- Hillman G., Mason S., de Moulins D., Nesbitt M. (1996). Identification of archaeological remains of wheat: the 1992 London workshop. *Circaea*, 12 (2): 195-210.
- Jacomet S. (2006). *Identification of cereal remains from archaeological sites*. Archaeobotany Lab, IPAS, Basel University.

- Jorge S., Jorge V. (2006). Agricultores e pastores fixados no território. Do Neolítico Médio ao Bronze Médio. In Almeida C. (Ed.), *História do Douro e do Vinho do Porto. História Antiga da Região Duriense*, Santa Maria da Feira, Edições Afrontamento: 106-163.
- Mackey J. (1966). Species relationships in *Triticum*. *Hereditas*, Suppl. 2: 237-276.
- Mackey J. (1989). Genus *Triticum* and its systematics In Shumny V. (Eds.), *Vavilov's Legacy in Modern Biology*, Moscow, Nauka: 170-185.
- Martínez-Cortizas A., Costa-Casais M., López-Sáez J. A. (2009). Environmental change in NW Iberia between 7000 and 500 cal BC. *Quaternary International*, 200 (1-2): 77-89.
- Monteiro-Rodrigues S. (2008). *Pensar o Neolítico antigo. Contributo para o estudo do Norte de Portugal entre o VII e o V milénios BC*. PhD thesis, Porto: Faculdade de Letras. Universidade do Porto.
- Morais R. (2004). *Autarcia e Comércio em Bracara Augusta no período Alto-Imperial: contribuição para o estudo económico da cidade*. PhD thesis, Braga: Universidade do Minho.
- Muñoz Sobrino C., Ramil Rego P., Gómez Orellana L., Díaz Varela R. (2005). Palynological data on major Holocene climatic events in NW Iberia. *Boreas*, 34 (3): 381-400.
- Muñoz Sobrino C., Ramil Rego P., Rodríguez Guitián M. A. (2001). Vegetation in the mountains of northwest Iberia during the last glacial-interglacial transition. *Vegetation History and Archaeobotany*, 10 (1): 7-21.
- Parcero Oubiña C., Cobas Fernández I. (2004). Iron Age Archaeology of the Northwest Iberian Peninsula. *e-Keltoi*, 6: 1-72.
- Peña Santos A. (2005). Breve síntesis de la prehistoria e arqueología do Eixo Atlântico. In Hidalgo Cuñarro J. (Eds.), *Rutas Arqueológicas do Eixo Atlântico/Roteiro Arqueológico do Eixo Atlântico*, 3-42.
- Pinto da Silva A. (1988). A paleoetnobotânica na arqueologia portuguesa. Resultados desde 1931 a 1987. In Queiroga F., Sousa I., Oliveira C. (Eds.), *Palaeoecologia e Arqueologia*: 13-29.
- Ramil Rego P., Aira Rodriguez M. J. (1993). A palaeocarpological study of Neolithic and Bronze Age levels of the Buraco da Pala rock-shelter (Bragança, Portugal). *Vegetation History and Archaeobotany*, 2 (3): 163-172.
- Ramil Rego P., Iriarte M., Muñoz Sobrino C., Gómez-Orellana L. (2005). Cambio climático y dinámica temporal del paisaje y de los hábitats en las ecorregiones del NW de la Península Ibérica durante el Pleistoceno superior. *Munibe*, 57: 537-551.

Ribeiro O., Lautensach H. (1995). *Geografia de Portugal. I. A posição geográfica e o território*. Lisboa: Edições João Sá da Costa.

Rivas-Martínez S., Díaz T., Fernández-González F., Izco J., Loidi J., Lousã M., Penas A. (2002). Vascular plant communities of Spain and Portugal. Addenda to the Syntaxonomical checklist of 2001. *Itinera Geobotanica* 15 (1-2): 5-922.

Rodríguez Guitián M., Ramil-Rego P. (2007). Clasificaciones climáticas aplicadas a Galicia: revisión desde una perspectiva biogeográfica. *Recursos Rurais*, 1 (3): 31-53.

Rodríguez Guitián M., Ramil Rego P. (2008). Fitogeografía de Galicia (NW Ibérico): análisis histórico y nueva propuesta corológica. *Recursos Rurais*, 4: 19-50.

Sanches M. (1997). *Pré-história Recente de Trás-os-Montes e Alto Douro*. Porto: Sociedade Portuguesa de Antropologia e Etnologia.

Sanches M. (2000). Reflexões sobre o povoamento do Neolítico Inicial do Norte de Portugal (VI-IV mil. A.C. In *Neolitização e Megalitismo da Península Ibérica*, ADECAP: 181-201.

Sanches M., Nunes S., Pinto D. (2007). Trás-os-Montes (Norte de Portugal) - As gentes e os ecossistemas, do Neolítico à Idade do Ferro. In Jorge S.O., Bettencourt A.M.S., Figueiral I. (Eds.) *A Conceção das paisagens e dos espaços na Arqueologia da Península Ibérica, Actas do IV Congresso de Arqueologia Peninsular*, Promontoria Monográfica, 8: 189-206.

Tereso J. (2009). Plant macrofossils from the Roman settlement of Terronha de Pinhovel, northwest Iberia. *Vegetation History and Archaeobotany*, 18 (6): 489-501.

Tranoy A. (1981). *La Galice Romaine: Recherches sur le Nord-Ouest de la Péninsule Ibérique dans l'Antiquité*. Paris: Diffusion E. du Boccard.

Tutin T. et al. (Eds.) (1964-1980). *Flora Europaea*. Cambridge: Cambridge University Press.

Zohary D., Hopf M., Weiss, E. (2012). *Domestication of Plants in the Old World – The origin and spread of domesticated plants in south-west Asia, Europe, and the Mediterranean Basin*. 4<sup>th</sup> Edition. Oxford: Oxford University Press.

**SECTION B**  
**RESULTS OF THE**  
**ARCHAEOBOTANICAL STUDIES**



### 3

## Massive storage in As Laias/O Castelo (Ourense, NW Spain) from the Late Bronze Age/Iron Age transition to the Roman period: a palaeoethnobotanical approach

Tereso J., Ramil-Rego P. Álvarez González Y., López González L., Almeida da Silva R.

Submitted to *Journal of Archaeological Science*.

---

#### Abstract

The highest platforms of As Laias, a settlement located in northwest Iberia, were used for storage during the Iron Age and until the turn of the Era. In this time-span, the whole hilltop – the *croa* – was a walled enclosure exclusively used for storage and due to recurrent fires affecting the settlement's terraces, abundant plant remains were preserved in overlying wattle and daub storage structures.

*Triticum aestivum* subsp. *spelta* was the predominant crop stored in As Laias and was often stored in spikelets. *Panicum miliaceum* and *Vicia faba* were important crops too and the presence of *Quercus* acorns testifies for its storage together with cereals and legumes. Evidence suggests a twofold situation occurred since, in some structures, multiple species were stored while others were possibly filled with a single crop.

The evidence of massive storage, the abundance of charred plant remains and the uniqueness of the storage structures makes As Laias one of the most important Iron Age sites in the whole northwest Iberia. The interpretation of the site, together with other archaeological contexts in the region is controversial and can have major consequences for the interpretative models of the social and economic features of the local Iron Age. The site itself is sufficient to testify for the productivity of Iron Age agriculture, but further considerations must include remarks regarding the social significance of a massive storage place.

**Key-words:** Storage, Iron age, Roman Period, northwest Iberia

### 3.1. Introduction

As Laias, or O Castelo, is located near Ourense, in the Municipality of Cenlle. It is positioned in a spur, 240m high, in the right margin of the river Minho. This position offers a major visual control over a great extension of the river course.

The site was known to Lopez Cuevillas in the 1920's and was excavated by Chamoso Lamas in 1956 who considered the site to be related to mining activities in Roman times due to the presence of artifacts presumably used in such activities and due to the presence of a nearby gold mine, which existence was confirmed recently (Álvarez González and López González 2000).

But it was only in 1997 that the site was again excavated. The archaeological intervention was carried out in the context of the construction of the highway A-52 and was directed by Y. Álvarez González and L. López González. Regardless of the relevance and uniqueness of the site, it was decided that it would be almost completely destroyed without a complete excavation of the affected area. Moreover, despite the abundance of archaeobotanical remains (one of the main features of this site), its complete study was not included in the mitigation or compensation measures.

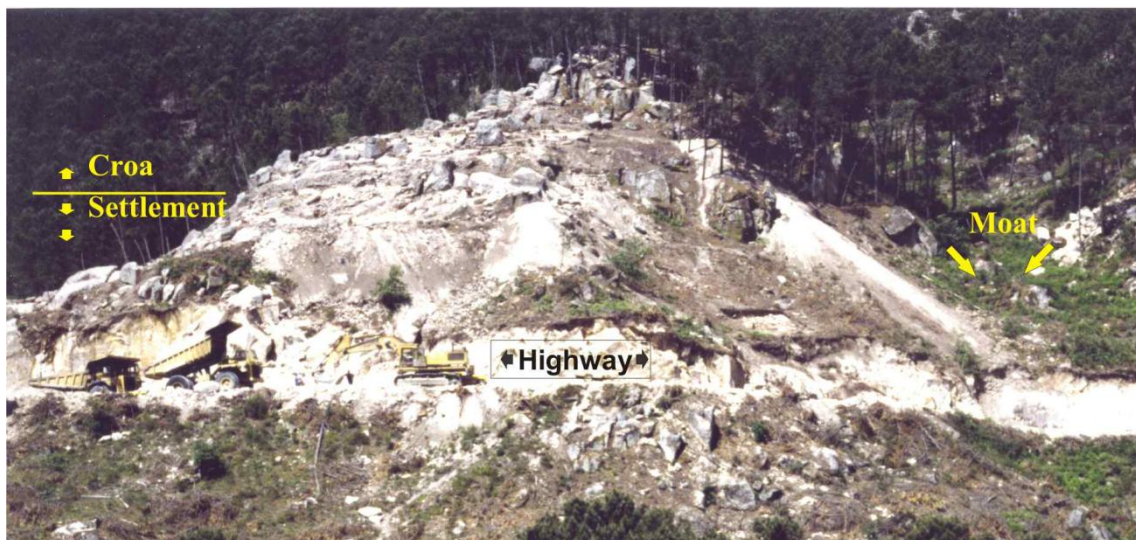


Figure 3.1. – Destruction of As Laias during the construction of the highway A-52.

This excavation was centered mainly on the higher part of the settlement and allowed to define a hilltop fortified area – the *croá* – which assumed rare characteristics in the proto-

history of the northwest Iberia. That fortified area was used exclusively for storage during the Iron Age and the abundant storage structures found did not have, at the time of the excavation, any parallel in the region. Many were found with part of their contents (Álvarez González and López González 2000).

Despite the stratigraphic problems inherent to the site's characteristics and the fact that there were significant problems concerning the sampling strategy applied, the study of As Laid is crucial to understand the Iron Age in all northwest Iberia. In this context, this study intends to optimize problematic data in order to get a general perspective on the crops which were stored in As Laid and to understand the storage strategies and their relevance on a regional level.

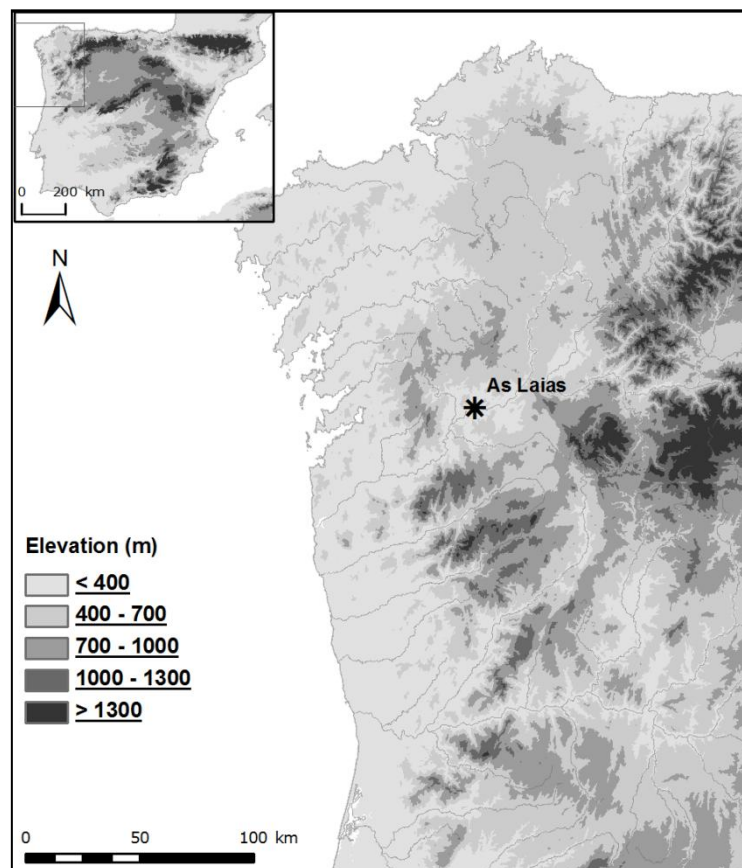


Figure 3.2 – Location of As Laid in northwest Iberia

### 3.2. NW Iberia from the Late Bronze Age to the Roman conquest

In the Late Bronze Age (1200-500/400 cal BC) settlement pattern is significantly diverse. While some settlements are positioned in strategic positions, in hills or mid-altitude spurs controlling



important river basins, others are closer to the valleys (Bettencourt 1999 and 2009). Although stone walls, embankments or wooden palisades are found in some of these settlements, monumentalization is still rare. This period marks a turning point on the landscape level. As populations became more sedentary and connectivity between settlements was enhanced, an unprecedented phase of deforestation began (Muñoz et al. 1997, Ramil et al. 1998, Bettencourt 1999 and 2009).

Major changes occurred somewhere between 600 and 400 cal BC, marking the beginning of the Iron Age. Hillforts – locally known as “castros” - became the only type of settlement. Most are located in defensible locations and present stone walls and/or other kind of defensive systems. Some of these hillforts were founded in the Late Bronze Age but were enlarged and reorganized in this period. Many were founded in the Iron Age, now with stone as the main building material (Martins 1996, Parcero Oubiña and Cobas Fernández 2004). The overall familiarity between settlements in a vast region in northern Portugal and Galicia (northwest Spain) led to generalization of the term “Castros culture”. Still, this designation mistakenly homogenises a far more complex and diverse reality (Martins 1993-1994, González Ruibal 2003).

In the 2<sup>nd</sup> century cal BC several settlements were abandoned and others grew significantly in size and adopted proto-urban models. Many fortifications were renewed (Martins 1996, Peña Santos 2005). The chronology of this territorial organization appears to be related to the first Roman incursions in the region - *D. Iunius Brutus'* campaign of 138-137 BC, reached the river Minho with little resistance. Some authors suggest this change was as a defensive reaction and a prevention regarding future incursions, implying, thus, that the Romans did not get effective control over the area with this first expedition (Alarcão 1992). Peña Santos (2005) admits otherwise; that the Atlantic region between the river Douro and Minho became part of the Roman Empire after that incursion.

Nevertheless, Roman presence in western Iberia dates back to the beginning of the 2<sup>nd</sup> century BC (Fabião 1992). Therefore, local communities were in contact with this foreign influence before any military intervention in the northwest.

During the 1<sup>st</sup> century BC other expeditions occurred mostly to recognize and obtain mineral resources. *C. Iulius Caesar* reached *Brigantium* (A Coruña) in 61-60 BC (Morais, 2004) and the Cantabrian wars which finished the conquest of the Iberian peninsula in 29-19 BC, during Augustus' reign, took place mostly outside the “Castros” culture area (Peña Santos 2005). It is

not clear, thus, when the region became effectively controlled by the Romans, but archaeological data suggests that in the turn of the Era, although the region was politically part of the Empire and the new Roman administration was settled, the hillforts maintained with little differences their Iron Age ways of living (Parcero Oubiña and Cobas Fernández 2004).

### 3.3. General characteristics and chronology of As Laias

As Laias is a settlement with over 10ha. It can be divided in three main areas: the *croa* (the enclosure in the hilltop), the abrupt slope towards the river and a plane area in the bottom of the slope, near the river.

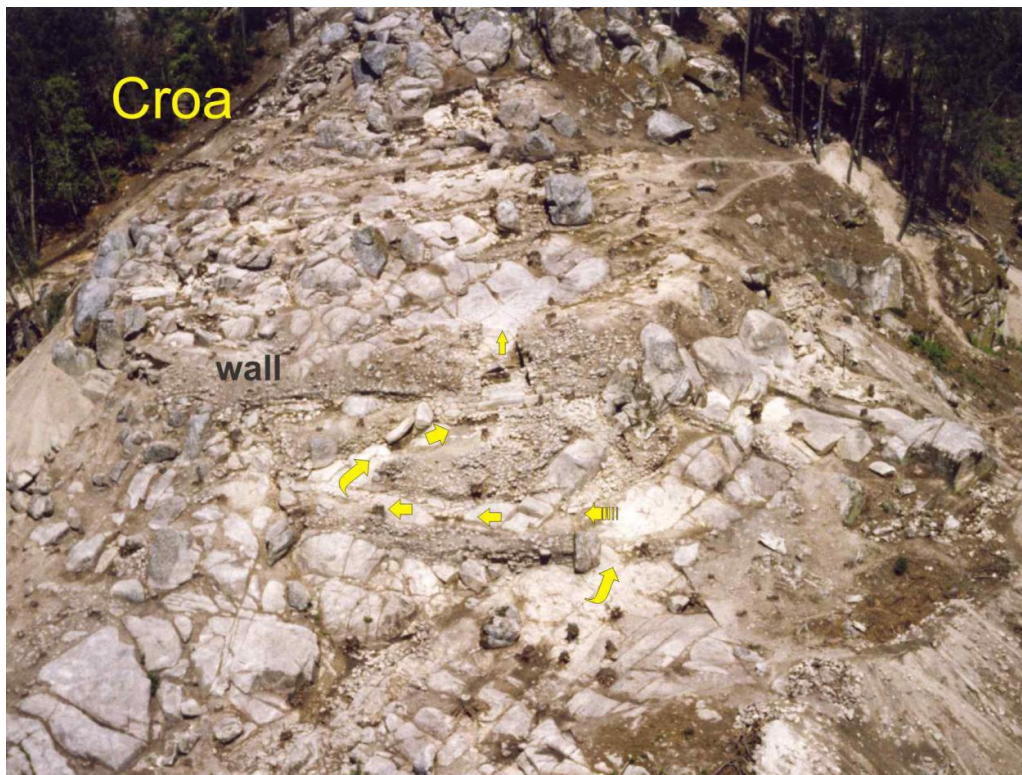


Figure 3.3 – View of the upper areas of As Laias. Yellow arrows show the entrance path to the fortified *croa* where the storage structures were found

The hilltop was fully delimited by an approximately circular stone wall with a single entrance and this enclosure was isolated from the rest of the settlement by an area with no constructions (Álvarez González et al. 2009). Within the wall, embankments were built

between the abundant rocky outcrops. The platforms created by these embankments were used exclusively for storage, since no habitations were found. Most storage facilities were rectangular structures (c. 1m x 1,5m) built above the ground with walls made of small intertwined branches and clay - wattle and daub; the bottom was constituted by two distinct levels, a first level of clay above which wood boards (sometimes cork) were placed (Álvarez González and López González 2000). The boards were made of deciduous oak (*Quercus*) wood and the wattle was made with branches from several species: *Arbutus unedo*, *Erica*, Leguminosae (considering the location of the site it is probably *Cytisus*), *Quercus suber* and *Salix* (Carrión Marco 2003, 2005). The diameter of those branches was mainly comprised between 5-10mm (the shrubby species) and 11-15mm (*Q. suber*) (Carrión Marco 2003).



Figure 3.4 – Excavation work at As Laias

Only two poorly preserved circular storage pits were found as well as two small circular stone constructions probably also used for storage (Álvarez González and López González 2000).

The abrupt sloppy area between the *croa* and the bottom of the hill was vaster than the *croa* itself. This sloppy area seems to have been intensively occupied and it was characterized by the dissemination of stone embankments which created small horizontal areas where huts and water canals were built. Most huts were built with branches and clay – these, as well as, postholes, were identified. In the excavated area, only two stone houses were found. Some of the houses had a central hearth. In this area, a great amount of grindstones were found (Álvarez González and López González 2000).



Figure 3.5 – Perspective with two storage structures



Figure 3.6 – Storage structure

In the lowest part of the settlement artifacts were recovered along the agricultural fields as well as a huge hydraulic infrastructure (Álvarez González and López González 2000).

Radiocarbon dates from As Laidas (see Table 3.1 and Fig. 3.7) demonstrate the settlement was founded during the Late Bronze Age, probably around 800 cal BC. A hiatus preceded the major occupation phase of the site, during the Iron Age (from 500/400 cal BC until the end of the 1<sup>st</sup> century cal BC). The Roman presence is residual, but data demonstrates the site remained occupied until at least the 3<sup>rd</sup> century AD (Álvarez González and López González 2000). The Roman coins found in a destruction level of the wall testify for such late chronology (Martínez Mira 2004-2005). According to Álvarez González et al. (2009), the slopy area was thoroughly abandoned since the turn of the Era as people moved to the lower platform, near the river.

The top enclosure – the *croa* – seems to have been used intensively for storage during the Iron Age. Most radiocarbon dates point to the 5<sup>th</sup>-2<sup>nd</sup> centuries cal BC, although earlier dates of the 8<sup>th</sup>-5<sup>th</sup> centuries cal BC and later dates of 1<sup>st</sup> century cal BC – 1<sup>st</sup> century cal AD and even of the 2<sup>nd</sup>-3<sup>rd</sup> centuries cal AD, extend considerably the time span of this elevation's occupation, being unclear if it was used for storage in the last phase (Álvarez González and López González 2000, Carrión Marco 2003). In what the defensive wall is concerned, Álvarez González and López González (2000) suggest it was built c. 2<sup>nd</sup>-1<sup>st</sup> century cal BC and that previously another kind of structure, perhaps a palisade, existed. This supposition is based on the fact that the inner area was previously used exclusively for storage, suggesting some kind of construction other than a stone wall would delimit such space. Still, a radiocarbon date from a structure directly below a part of the wall (CSIC-1274, see Table 3.1) questions this first interpretation, thus being possible that the wall was built in the beginning of the Iron Age.

Although the data available is sufficient to build this general scenario, some difficulties arise when trying to understand in detail the dynamics within the settlement along this time-span of over 1000 years. This happens due to the structure of the settlement, i.e. the successive platforms supported by stone embankments. In the well preserved platforms, several occupation levels were found. However, when these embankments were destroyed after the abandonment of the site, some layers were mixed (Álvarez González and López González, personal information).

Sample	Lab. Ref.	<sup>14</sup> C dates (BP)	Calibrated 1σ	Calibrated 2σ
LAI 11-97-48	CSIC-1271	2631±51	841-771 cal BC	912-593 cal BC
LAI 13-97-24	CSIC-1272	2604±35	809-777 cal BC	835-597 cal BC
LAI 23-97-47	CSIC-1277	2592±40	810-674 cal BC	831-554 cal BC
LAI 14-97-19	CSIC-1273	2530±35	789-564 cal BC	797-539 cal BC
LAI 20-97-17	CSIC-1274	2435±32	724-413 cal BC	751-405 cal BC
LAI 11-97-47	CSIC-1270	2398±39	519-401 cal BC	748-392 cal BC
LAI 27-97-33	CSIC-1396	2370±27	503-394 cal BC	519-390 cal BC
LAI 23-97-28	CSIC-1276	2325±39	413-262 cal BC	515-231 cal BC
LAI Z21-97-30	CSIC-1275	2280±40	398-234 cal BC	403-208 cal BC
LAI 25-97-18	CSIC-1394	2269±26	393-236 cal BC	397-210 cal BC
LAI 1-97-49	CSIC-1269	2254±39	389-215 cal BC	396-205 cal BC
LAI 27-97-55	CSIC-1397	2223±26	364-210 cal BC	382-204 cal BC
LAI 29-97-225	CSIC-1399	2208±26	358-206 cal BC	369-201 cal BC
LAI 29-97-259	CSIC-1401	2188±26	354-199 cal BC	361-177 cal BC
LAI 25-97-30	CSIC-1395	2083±26	156-53 cal BC	180-41 cal BC
LAI 29-97-45	CSIC-1402	2033±26	88 cal BC-4 cal AD	155 cal BC-49 cal AD
LAI 29-97-107	CSIC-1400	1884±26	72-136 cal AD	67-215 cal AD
LAI 33-97-5	CSIC-1398	1845±26	130-214 cal AD	86-238 cal AD

Table 3.1 – Radiocarbon dates from As Laias (original data from Carrión Marco 2003, recalibrated using Calib. Rev 6.0.1, IntCal09 calibration curve. Dates obtained on charcoal.

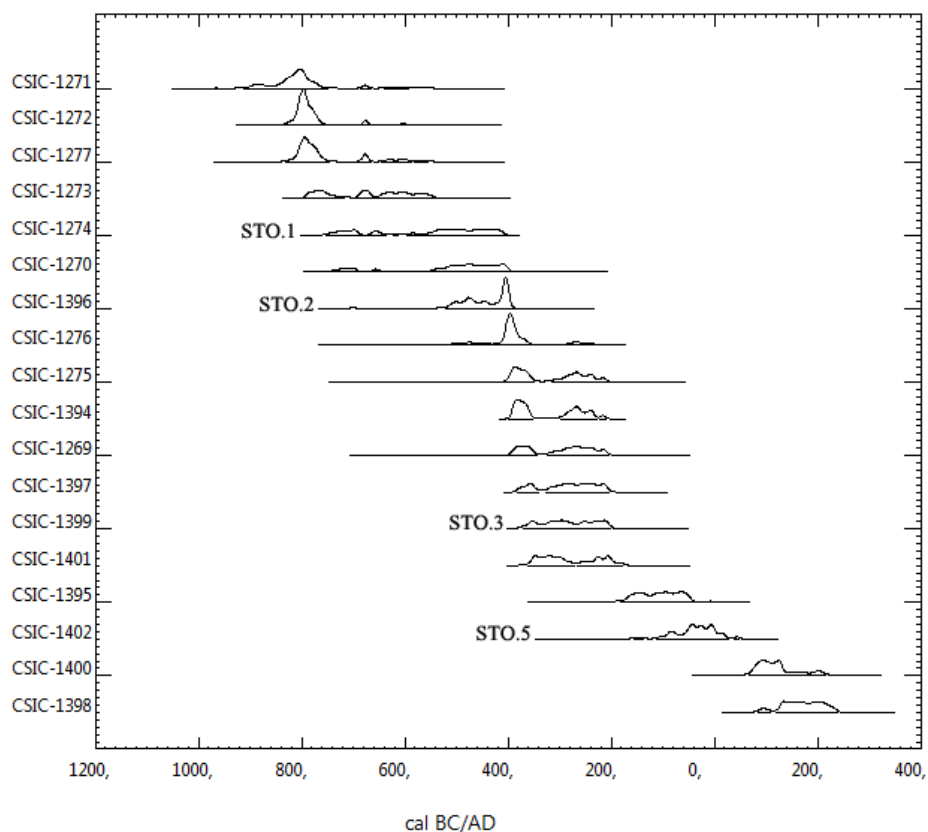


Figure 3.7 – Radiocarbon dates from As Laias, probability plot (original data on Table 3.1)

In addition, the *croa*, having been used exclusively for storage, did not provide many artifacts. In fact, these are rare, making it difficult to infer chronologies which can only be attended by radiocarbon dates. Still, the existence of multiples terraces, each with a specific stratigraphy thus with a specific story, made it difficult (most of the times, impossible) to deduce the chronology of the storage facilities which were not directly dated. It was not possible to get radiocarbon dates from all the structures, since these were too abundant. In the better preserved platforms it was possible to verify that storage facilities were built over each other in at least four sequential phases. Fires must have been frequent since charred plant remains appear abundantly in all phases.

### 3.4. Materials and Methods

This study will focus on the storage structures from the walled enclosure on the top of the hill – the *croa* – and one structure outside the walled area.

As was previously described, storage facilities were built in platforms supported by stone embankments but the destruction of these embankments mixed some of the archaeological levels as well as the storage structures' content. This made it difficult to know the exact number of storage facilities that existed in the excavated area. For the same reasons, the reliable contexts for an archaeobotanical study were limited. As was stated before, radiocarbon dating was necessary to know each context's chronology and special care was needed when selecting contexts to be studied since most structures were partially displaced, due to the destruction of the embankments. Some undated structures placed near others with radiocarbon dates, in well preserved platforms were considered reliable.

Over 100 samples were collected and processed in the field by the archaeological team in 1997. Still the sampling strategy was not appropriate and some relevant information is lacking.

The sediment was sieved using three meshes, of 0,8mm, 0,4mm and 0,2mm and then floated. Unfortunately, there is no information concerning the original volume of the structures' content. Additionally, the collecting of samples inside each structure was done randomly making it difficult to understand the distribution of the different species inside the structure and, in some cases, the real proportion between species.

Still, although these factors pose some limitations to this archaeobotanical study, the uniqueness of this site makes this approach indispensable.

Six storage facilities (STO) were selected to be studied. Five of which were positioned within the walled area and one was partially covered by the wall itself (see Fig. 3.8):

STO.1 (LAI C20-17) – Partially destroyed storage facility, in part covered by the defensive wall. In fact, the stratigraphic relation with the wall justifies the selection of this sample. Branches and clay testify for the typology of the structure and a radiocarbon date (CSIC-1274) points out to a transition phase between the Late Bronze Age and the Iron Age. Unfortunately, the date is not precise, covering a great time span (751-405 cal BC, at  $2\sigma$ ).

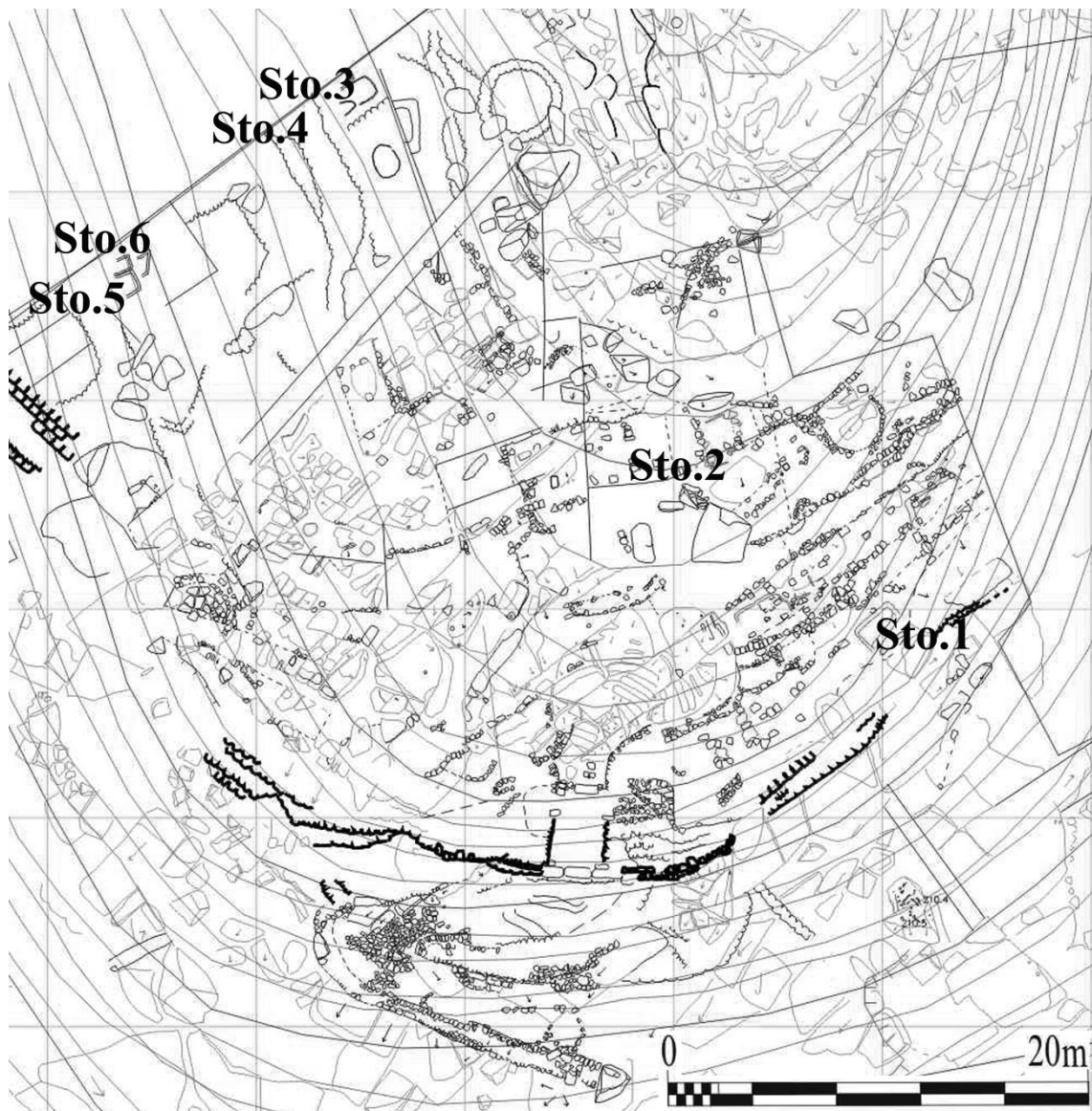


Figure 3.8 – General plan of As Laias indicating the position of the studied structures (STO.)



STO.2 (LAI C27-30/32/33) – Two soil samples were collected in this structure. One (LAI C27-30) corresponds to a dark sediment dispersed inside the structure and the other (LAI C27-32) was collected in the northern limit of the structure, it was a reddish compact layer. These two levels covered wooden boards (LAI C27-33) in the base of the structure. A sample from these boards provided a radiocarbon date from the beginning of the Iron Age (CSIC-1396).

STO.3 (LAI C29-121/172/225) – Two soil samples from successive levels of this structure were collected (LAI C29-121 above C29-172). The last sample (LAI C29-225) corresponds to cork pieces in the base of the structure, which were radiocarbon dated testifying its Iron Age chronology (CSIC-1399).

STO.4 (LAI C29-96) – A small sample from a structure placed in the surroundings of the previous one (STO.3). It is not dated, but the proximity and the fact that it was at a similar altimetry than LAI C29-172 suggests a similar chronology.

STO.5 (LAI C29-45/66/81) – Four soil samples from successive levels of the same structure. LAI C29-45 is the top level, C29-81 is the second level, C29-66 the third and C29-157 the base with seeds and wooden boards. The first level represents the abandonment of the structure and it has a radiocarbon date from the turn of the Era, most probably from the second half of the 1<sup>st</sup> century BC (CSIC-1402).

STO.6 (LAI C29-244) – A small sample from a structure placed in the surroundings of the previous one (STO.5) in the exact same altimetry as LAI C29-81. It is not dated, but it has probably the same chronology as STO.5.

These samples cover the chronology of the site from the Late Bronze Age until the turn of the Era. Only the last phase, the 2<sup>nd</sup>-3<sup>rd</sup> centuries AD, is not included. Preliminary identifications were done in 99 samples and the structures selected for this study include all crops found until now in the whole samples.

The laboratory work has taken place in the IBADER facilities in Lugo, by Pablo Ramil Rego and Luis Gomez Orellana. The larger samples were sub-sampled with the spoon method and identification was carried out in the stereoscope microscope, by comparing the archaeobotanical material with atlases and the reference collection. For the identification of

cereal remains, the criteria of G. Hillman et al. (1996), R. Buxó (1997) and S. Jacomet (2006) were used.

A special word must be said regarding the identification of wheat remains and faba bean.

Although sometimes problematic, the distinction between the morphological types *T. spelta* and *T. aestivum/durum*, and between *T. spelta* and *T. dicoccum* was possible. Grains from *T. spelta* are bigger, slimmer and flatter than those of *T. aestivum/durum*. They are evenly curved in the dorsal side and concave or flattish-concave in the ventral side; the extremities are rarely pointed and most of the times blunted. They frequently correspond to the typical grains of *T. spelta* as described by S. Jacomet (2006), although some can be difficult to distinguish from *T. dicoccum*, whenever the grains are slightly pointed near the embryo. Still, chaff and the presence of spikelets with grains, thoroughly confirmed the identification of *T. spelta*.

Chaff was identified as *T. spelta* on the basis of two main features: the wide and thin section of the lower part of the glumes (as pointed out by Jacomet 2006) and the presence of strong venation in the glumes (Hillman et al. 1996, Buxó 1997, Jacomet 2006). In addition most spikelet forks were massive and had part of the next higher rachis segment.

In what naked wheat is concern, the sparse and fragmented rachis remains did not allow the distinction between species. Grains clearly of this morphological type were found in a single sample and were identified on the basis of the following features: the grains are oval and they present the maximum width in the lower half or near the middle of the grain (Buxó 1997). Generally both extremities are blunt. Contrasting with *T. spelt* grains of the same sample, grains from *T. aestivum/durum* are not slim and they are flattish-convex in the ventral side, having a characteristic swollen aspect.

Seeds from *Vicia faba* are usually short with oval-globular shape. Several designations have been used to name such remains (the most common are *Vicia faba* var. *minor*, *Vicia faba* var. *minuta* and *Vicia faba* var. *equina*) (Pinto da Silva 1988, Dopazo Martínez 1996, Tereso 2009), some synonymous, other not. Still, the differentiation between distinct varieties is not possible to achieve through the morphology of the seeds and, given the current knowledge, it is abusive to assume any correspondence between archaeological material and actual varieties. Thus faba beans will be designated simply as *Vicia faba*.

### 3.5. Results

Results from the carpological study are presented in Table 3.2.

Cereals are the main crops found inside the structures. These include *Avena* (oat), *Hordeum vulgare* var. *nudum* (naked barley), *Hordeum vulgare* subsp. *vulgare* (hulled barley), *Panicum miliaceum* (common millet), *Triticum aestivum/durum* (naked wheat) and *Triticum aestivum* subsp. *spelta* (spelt). Besides the cereals, *Pisum sativum* (pea), *Vicia faba* (faba bean) and acorns from *Quercus* were also found.

It is interesting to notice that *Hordeum vulgare* var. *nudum* and *Triticum aestivum/durum* were only retrieved in the STO.1, the oldest storage structure dated until now in As Lias. The radiocarbon date points out to the transition between the Late Bronze Age and the Iron Age. This storage structure provided the more diverse content, including all the crops found in As Lias - six different cereals and two pulses (Table 3.2). Still, *Hordeum vulgare* subsp. *vulgare* and *Vicia faba* are clearly the predominant crops in STO.1, making this earliest structure the more original of all of those presented here. On the other hand, the similarity between the contents of Iron Age structures and those from the turn of the Era suggest some stability and continuity may have existed in consistence with the general interpretations for these time-periods (*vide supra*).

*T. spelta* is the main crop in Iron Age structures and those from the turn of the Era, STO.2, STO.3, STO.5 and STO.6, followed by *Panicum miliaceum* in STO.2 and STO.5, and followed by *Vicia faba* in STO.3. In STO.4 grains from *Panicum miliaceum* are the more abundant remains. Overall, spelt and common millet are the more frequent crops in the analyzed structures but *Avena*, *Hordeum vulgare* subsp. *vulgare* are also present throughout the time span.

Spelt chaff appears in almost all structures. The exception is STO.4 but a single small sample was retrieved there. The presence and abundance of such remains is an important feature to help us interpret storage strategies in As Lias (*vide infra*).

Garden crops are more frequent in the earliest structures. Faba bean is even the more relevant crop in the STO.1 and the second in STO.3. Peas are always rare. Regarding the presence of wild fruits, acorns from *Quercus* are the only remains. They were stored in STO.2.

Chronology Storage Structure Sample Sample weight (g)	L. Bronze		Iron Age										Turn of the Era									
	1		2				3				4		5						6			
	C20-17		C27-30		C27-32		C29-121		C29-172		C29-96		C29-45		C29-66		C29-81		C29-157		C29-244	
	1863		1242		83		1340		110		68		556		734		1190		150		161	
<b>Cereals (grains)</b>	T	t	T	t	T	t	T	t	T	t	T	t	T	t	T	t	T	t	T	t	T	t
<i>Avena</i>	15,5	0,8					11,5	0,9									3,5	0,3				
<i>Hordeum vulgare</i> var. <i>nudum</i>	5,2	0,3																				
<i>Hordeum vulgare</i> subsp. <i>vulgare</i>	608,5	<b>32,7</b>	22,7	1,8	<1	0,3	2,1	0,2			1,0	1,4					8,2	0,7				
<i>Panicum miliaceum</i>	193,4	10,4	237,0	<b>19,1</b>	3,2	3,9	84,7	6,3	<1	0,4	24,9	<b>36,7</b>	14,8	2,7	73,5	<b>10,0</b>			<1	0,3	<1	0,3
<i>Triticum aestivum/durum</i>	2,9	0,2																				
<i>Triticum aestivum</i> subsp. <i>spelta</i>	21,6	1,2	336,3	<b>27,1</b>	13,0	<b>15,7</b>	417,9	<b>31,2</b>	86,2	<b>78,4</b>	<1	1,3			85,6	<b>11,7</b>	446,8	<b>37,6</b>	53,2	<b>35,5</b>	32,2	<b>20,0</b>
<i>Triticum dicoccum/spelta</i>													1,6	0,3								
<b>Cereals (chaff)</b>																						
<i>Triticum aestivum/durum</i> (rachis frag.)	<1	<0,1																				
<i>Triticum aestivum</i> subsp. <i>spelta</i> (spikelet)			6,5	0,5			12,6	0,9									133,0	11,2				
<i>Triticum aestivum</i> subsp. <i>spelta</i> (spikelet frag.)	2,6	0,1	19,7	1,6			3,5	0,3									248,4	<b>20,9</b>			<1	0,2
<b>Other crops (seeds)</b>																						
<i>Pisum sativum</i>	8,6	0,5	13,3	1,1			34,2	2,6														
<i>Vicia faba</i>	898,9	<b>48,3</b>	24,1	1,9	<1	0,9	290,1	<b>21,7</b>							29,7	4,0			<1	<0,1		
<b>Wild fruits</b>																						
<i>Quercus</i> (cotyledons)			13,3	1,1																		
<b>Sum</b>	1757	94,3	672,9	54,2	16,2	20,7	856,7	63,9	86,2	78,8	25,9	39,4	16,4	3,0	188,8	25,7	839,9	70,6	53,2	35,7	32,2	20,6

Table 3.2 – Results from the samples in As Laias. Legend: Cells in grey - contain aggregated grains; Cells with outer contour marked - main types of remains in the sample; T - estimated weight (g) in the sample; t - estimated weight (g) per 100g.

## 3.6 Discussion

### 3.6.1. Crops in As Laias: regional overview

As pointed out before, *T. spelta* is the main crop in most of the storage facilities studied until now. However, the most relevant fact is its presence in STO.1, dated from a transitional moment between the Late Bronze Age and the Iron Age. Unfortunately, the date is not precise, covering a great time span (CSIC-1274 - 751-405 cal BC, at  $2\sigma$ ) (Table 3.1 and Fig. 3.7). The position of STO.1 beneath the defensive wall suggests this to be earlier than a phase of major changes in the settlement and the general perspective obtained from the available radiocarbon dates and archaeological data suggests there is a hiatus in the site's occupation, between the Late Bronze Age and the beginning of the Iron Age (Álvarez González and López González 2000).

The presence of spelt grains and chaff in all levels of As Laias confirms the idea that this specie was cultivated way before the Roman period, as suggested by R. Buxó (1997) and R. Buxó et al. (1997). In northwest Iberia it was already retrieved in the Iron Age levels of Castrovite (A Estrada) (Rey Castiñeira et al. 2011) and Crasto de Palheiros (Murça) (Figueiral 2008). The presence of spelt in the Chalcolithic levels of Crasto de Palheiros is controversial and needs further confirmation. For now, remains of As Laias are the oldest in the northwest, being among the oldest in all the Iberian Peninsula.

Overall, the relevance of hulled wheats in northwest Iberia since the end of the Late Bronze Age and during the Iron Age and Roman period is suggested by their thorough presence in other settlements, such as Penalba (Campolameiro) (Aira Rodriguez et al. 1990), Castrovite (A Estrada) (Rey Castiñeira et al. 2011), Castrelin de San Juan de Paluezas (Borrenes) (Lopez Merino et al. 2010), Crasto de Palheiros (Murça) (Figueiral 2008) and Terronha de Pinhovel (Macedo de Cavaleiros) (Tereso 2009), among others.

In the same way, the presence of *Avena* in STO.1 is interesting. Oat is considered to have been cultivated in the Iberian Peninsula only since the 5<sup>th</sup> century BC (Buxó 1997, Buxó and Piqué 2008). Oat grains in earlier contexts, since the Neolithic, are considered to belong to wild species. Their thorough presence in As Laias confirms oat was an important crop since, at least, the 5<sup>th</sup> century BC although we cannot exclude the possibility that it was already cultivated since the Late Bronze Age.



Figure 3.9 – Remains of *Triticum aestivum* subsp. *spelta*. Spikelet (above) and grain (below)

Also during the Bronze Age, but in an earlier stage, began the cultivation of *Panicum miliaceum*. The more ancient remains in northwest Iberia are those of Sola (Braga), dating back to the Middle Bronze Age (Bettencourt et al. 2007). But since the Late Bronze Age and during

the Iron Age it was a staple crop. Therefore its relevance in As Lias is perfectly in consonance with the regional scenario now available.

Barleys are important crops in As Lias as well, particularly *Hordeum vulgare* subsp. *vulgare*, a regular crop in proto-historic and Roman times in the region (Ramil Rego 1993, Ramil Rego et al. 1996, Ramil Rego and Fernández Rodríguez 1999, Oliveira 2000). *Hordeum vulgare* var. *nudum* (naked barley) was retrieved only in the oldest sample – STO.1 – and even there it is residual. Having been an important crop in the Neolithic, naked barley lost its relevance in all Iberia since the Chalcolithic and the Bronze Age (Buxó and Piqué 2008). In northwest Iberia, it was detected in the Late Bronze Age levels of Torroso (Mos) (Dopazo Martínez et al. 1996) and the Iron Age levels of Cortegada (Silleda) (Arnanz and Chamorro 1990) and Alto do Castro (Cuntis) (Dopazo Martínez et al. 1996, Parcero Oubiña 2000, Cobas Fernández and Parcero Oubiña 2006).

Regarding the pulses, they were stored in As Lias but most come from the oldest storage structures studied. It would be necessary to date more structures in order to know if such pattern is not a result of any kind of investigation bias. It is not surprising that *Vicia faba* is the main pulse in As Lias, since it is the more frequent garden crop in Proto-historic settlements in the region (Ramil Rego 1993, Ramil Rego et al. 1996, Oliveira 2000).



Figure 3.10 – Grain of *Hordeum vulgare* subsp. *vulgare*

### 3.6.2. Storage strategies in As Laias

Even in the restricted studied storage facilities from the As Laias' *croa*, we can detect differences between structures. It is clear that most structures were used for more than one crop but it is possible that others were not. In STO.6 spelt is almost the only species and the presence of a few grains of *Panicum miliaceum* are more likely the result of previous uses of the same structure. The same may have happened in STO.4, although that is not so clear.

The coexistence of several crops in the same structure is still the more frequent case in As Laias and it is regular in many other contexts from diverse chronological and geographic realities (Buxó and Piqué 2008). But it is not clear if the crops were mixed together in the structures, perishable materials could have been used to separate different crops. Y. Carrión Marco (2003) mentions the presence of a small wooden bowl and evidence of interweaved plant material, possibly some kind of basketry, in As Laias.

The fact is that the structures have crops that need different processing (e.g faba bean and cereals; millet and spelt with spikelets included).

Still, the available information is dubious. All structures provided, in fact, more than one species and in most of them there were at least two crops in significant amounts. On the other hand, in small sized samples (Table 3.2) there is usually a clear preponderance of a crop and secondary crops appear in very small amounts, suggesting some kind of organization could have existed inside the structures.

Proper sampling could have provided relevant information regarding the distribution of crops in the structures. Unfortunately, this question remains open.

A comparison with other sites in the region is difficult since clear storage facilities are rarely found in Late Bronze Age or Iron Age hillforts (Parcero Oubiña and Cobas Fernández 2004) and those with abundant crops are even rarer. Penalba, S. João de Rei and Castrovite are exceptions. In the latter site it is not clear whether crops were stored separately or not (Rey Castiñeira et al. 2011).

In the Late Bronze Age hillfort of Penalba abundant plant remains were found in huts, associated to the ceramic containers where they were stored (Aira Rodríguez et al. 1990, Dopazo Martínez 1996). It is not possible to know if such facilities were used for long term storage. Despite the almost absence of references to the provenience of the plant remains the



homogeneity of the samples which were studied suggests different species were stored separately (Dopazo Martínez 1996).

In the Iron Age storage-pit at S. João de Rei several crops and even *Quercus* acorns were found. Still, *Triticum* grains are main plant remains, followed at a great distance by *Panicum/Setaria* grains. Other remains are occasional (Oliveira 2000). The scarcity of the remains does not allow many considerations but it is possible that only one crop, possibly two, was stored in the last use of the structure.

It is likely that the deposition of crops in storage structures depended on the timing of its use, since experiments with storage pits demonstrated that sealing is crucial to allow preservation (Miret i Mestre 2008). The abundance of storage facilities in As Laias suggests long-term storage, although short term storage for daily uses could have existed too. Moreover, the abundance of chaff and whole spikelets with grains demonstrates that spelt was frequently stored unprocessed, hulled, which also suggests long-term storage. In fact, it is well known that storage of whole spikelets prevents deterioration by fungus and insects (Buxó and Piqué 2008).

Assuming that long-term storage of *Triticum spelta* occurred in As Laias it is likely that the same happened with other species since spelt was stored with other crops and, as mentioned before, sealing is crucial to assure preservation. The timing of the opening should be similar for all species found inside each structure.

The storage of collected wild fruits, namely acorns, is not unique to As Laias in northwest Iberia. It was discovered in Penalba, stored in vessels (Aira Rodriguez et al. 1990, Dopazo Martínez 1996).

As we have seen, in the several moments of destruction/abandonment fire allowed the preservation of great amounts of plant remains in As Laias. This demonstrated that in the several episodes of fires some structures were almost empty while others had plenty of material (STO.1 provided 94,3g of plant material per 100g of sediment). For this remark we count with the preliminary results of samples from other storage facilities, not dated, which provided almost no crops or even no crops at all.

The existence of several episodes of fire which destroyed the crops is itself something which needs to be explained. As pointed out before (*vide supra*) most huts in As Laias were made from perishable materials and these could easily make accidental fires get catastrophic

proportions. However, it is also possible that fires resulted of confrontations and violence since such concentration of stored food could have been tempting for other communities. In the end we cannot exclude the possibility that fires were recurrently instigated by the inhabitants of As Laias in any kind of ritual although the major loss of crops suggests otherwise.

### 3.6.3. Massive storage at As Laias in a regional perspective

In northwest Iberia, during the Late Bronze Age, storage was done in pits, following a prehistoric tendency (Ayán Vila and Parceró Oubiña 2009). Storage-pits vary in size and shape and different materials could help promote further isolation to avoid humidity. In Sola (Braga), cork was found in the bottom of a pit (Bettencourt 2000) and in the Iron Age levels of Castro Grande de Neixón (Boiro) the walls of some pits seem to have been covered with clay (Ayán Vila and Parceró Oubiña 2009).

However, caution is needed since other uses for the pits could have existed and some have already been suggested in specific cases (Luz 2010).

The use of storage-pits continues throughout the Iron Age (e.g. the mentioned Castro Grande de Neixón) and the Roman Period, even in new kind of settlements such as the *vicus* of Agro de Ouzande (Silleda) (Ayán Vila and Parceró Oubiña 2009). The same happened in other regions in northern Iberia (Gracia Alonso 2009). Still, it is not clear whether underground storage continued to be the primordial strategy for long-term preservation of plant food in northwest Iberia. There are not many undisputed storage facilities in Iron Age hillforts. Still, throughout the region there was a reorganization of the settlements, leading to the definition of family compounds within walls, in this period. These are constituted by several buildings and a central terrace. It is usually assumed that one of the compartments was used as a storage facility (Parceró Oubiña and Cobas Fernández 2004) suggesting, thus, the dissemination of above-ground storage in domestic and private contexts.

Before the first divulgation of As Laias (Álvarez González and López González 2000) no storage structures like those of As Laias were documented in the region. As stated before, storage facilities were rectangular wattle and daub structures with wooden boards, also covered with clay, in the bottom.

Recently, data from Castrovite was reevaluated and, after comparing with As Laias, storage structures of the same kind were proposed for that site, substituting earlier suggestions of storage having occurred in ceramic vessels (Rey Castiñeira et al. 2011). Still, the evidence is fragmentary and posing this hypothesis was only possible in the light of the well preserved As Laias' structures. This case suggests that such kind of structures could have existed in other sites but their fragments are being interpreted in other ways. In a small test pit (2mx2m) at Bovinho (Macedo de Cavaleiros) a great amount of burnt clay with marks of branches were found in association with abundant crops. That clay was interpreted as debris of a floor (Mendes 2006) but we must consider the hypothesis that it was part of wattle and daub storage facility undetected in such small excavation area.

As pointed out before, it is possible that most family compounds inside the hillforts had its own storage area. It is not known the scale and time-span of that storage. Still, the storage on a familial level in a multifunctional domestic compound does not exclude the possible existence of large-scale and long-term storage in specific areas of the settlements or in other settlements with different functions on a regional level. As Laias, together with other particular sites, can help us get a different perspective.

The *croa* of As Laias was an enclosure exclusively used for storage. This is not a unique case in northwest Iberia but it clearly stands out due to the magnitude of the area and the kind of storage structures that were used. Overall, a varied assemblage of crops was stored. Having been massively used for storage one can question whether it resulted only from agricultural activities of the people who inhabited the settlement or if other communities stored their crops there. This could have happened for safety reasons, since crops stored together would be easier to defend, but other possible reasons (e.g. political or symbolic) could easily be proposed. This points out to a major question, that is, who owned the crops. Such great number of storage facilities, concentrated in one place, could lead to a simple explanation of the place as a communal storage area. But this is not clear. For sure many families contributed to fill the structures and such resources needed to be managed, a task we do not know was communal or concentrated in specific members of the community.

Related to this issue, next to the only entrance of the *croa*, between two bastions, a set of forty undecorated vessels were uncovered in the pavement level. These are in clear contrast with the lack of archaeological artifacts within walls. The position of those vessels suggests they fell from some kind of shelf placed in the wall. Most presented similar shapes but varied

sizes which led Álvarez González and López González (2000) to suggest these could have been used as some kind of volumetric units of measure related to the storage facilities.

Other Iron Age settlements can be found near As Laias, namely San Cibrán de Las (San Amaro) (López Cuevillas 1922, Álvarez González et al. 2009) and San Trocadero (San Amaro) (Fariña Busto and Xusto Rodríguez 1988). The chance that these settlements and As Laias were related in any way, due to their proximity and their apparent coexistence, allows another possible interpretation: As Laias may have been a storage area for a larger community than that which inhabited its rocky slope and alluvial area. On the other hand, in an area important for its mining activities (Álvarez González and López González 2000), specialized settlements could have existed.

Other Iron Age sites with similar characteristics - massive and centralized storage of crops - are Castrovite (Rey Castiñeira et al. 2011) and Castro Grande de Neixón (Ayán Vila and Parceró Oubiña 2009). In Castrovite several Iron Age levels of fire preserved abundant plant remains, possibly stored in structures similar to those of As Laias (Rey Castiñeira et al. 2011). In Castro Grande de Neixón a central storage area was excavated in the settlements' highest platform. Storage pits were excavated in the bedrock in Late Bronze Age style. Some presented remains of burned clay which probably constituted the inner facing of the pits (Ayán Vila and Parceró Oubiña 2009).

Parceró Oubiña and Ayán Vila (2009) interpret As Laias, Castrovite and Castro Grande de Neixón as places for communal storage, examples of storage in central places which concentrated also the role of redistribution and trade. The interpretation of the vessels in the entrance of the *croas* in As Laias as volumetric units of measure, suggested by Álvarez González and López González (2000), fits well to this model. This suggests the existence of changes in the social structure of northwest Iberian communities towards greater inequality and hierarchy (Ayán Vila and Parceró Oubiña 2009). Still, this is not the only interpretation possible. Álvarez González et al. 2009 suggest each storage structure in As Laias could have belonged to a family. This position assumes that the space where crops were stored – within walls – was communal but each structure was private.

These two interpretations are opposite and are both theoretically possible. This question is mostly dependent of the general interpretation of the social organization of Iron Age societies in northwest Iberia (the archaeological record for Late Bronze Age in As Laias is too fragmentary). Still, the same opposite interpretations exist regarding this subject, as different

interpretative models define these societies as egalitarian or hierarchical (see a revision in Parceró Oubiña and Cobas Fernández 2004).

Independently of these questions, sites such as As Laias confirm that local communities obtained surplus from their fields, at least since the beginning of the Iron Age and possibly since the Late Bronze Age. It does not agree with some interpretative models for the Iron Age that underestimate the role of crops to emphasize animal husbandry as the only staple food provider, in the light of what Strabo wrote (see an early critic to these models in Ramil Rego and Fernández Rodríguez 1999). Following Bakels (1996) and Parceró Oubiña and Cobas Fernández (2004), the existence of surplus is likely to lead to social inequality. In northwest Iberia in the same chronology as As Laias we find the exploitation of mineral resources and warfare. Furthermore, personal gold adornments are some of the most charismatic archaeological materials in the hillforts' archaeology. These evidences suggest some kind of inequality existed (Parceró Oubiña and Cobas Fernández 2004), in the light of which As Laias must be interpreted.

### 3.7. Conclusions

In As Laias/O Castelo evidence of massive storage was found. This allowed the definition of its *croa* as a storage enclosure. Crops were diverse and cereals were predominant, namely *Triticum aestivum* subsp. *spelta*, *Panicum miliaceum*, *Avena* and *Hordeum vulgare* subsp. *vulgare*. *Vicia faba* was also important. Several crops were stored in the same storage facility but it is likely that some of these structures had a single species.

This site is determinant to the understanding of Iron Age in northwest Iberia not only because of the abundance of storage facilities with plant materials, contrasting with the information available for the rest of the region, but also because of the peculiarity of the structures used for storage. These are now leading to the reinterpretation of other archaeological data available for the region.

Still, the implications of As Laias may go well beyond the characteristics of its storage facilities. This site provided early dates for spelt and oat, allowing us to suggest the introduction of these species occurred in a transitional moment between the Late Bronze Age and the Iron Age. The preponderance of spelt since the Iron Age until the turn of the Era, testifies for the importance of hulled wheats in the region, in contrast with other Iberian regions (Buxó and Piqué 2008).

This species appears together with abundant millet (*Panicum miliaceum*), hulled barley and oat comprising an assemblage of cereals well adapted to variable and harsh environmental conditions.

The interpretation of As Laias, together with other sites with storage areas in northwest Iberia, can have many implications in the understanding of social practices and social organization of the Iron Age people. Since the top enclosure of As Laias was used exclusively for massive storage, it was likely to aggregate crops and wild fruits (acorns) from several families. Was this a communal storage place or a private one? If the place was communal, the stored food was communal too, or private but assembled in one place for defensive purposes? The answer to these questions depends on the interpretation of the social organization of these communities but, at the same time, can have great implications on defining that interpretation. Some data suggest that Iron Age societies in northwest Iberia were not fully egalitarian (Parcero Oubiña and Cobas Fernández 2004). In this context, the storage enclosure of As Laias must be interpreted as a surplus storage area, possibly controlled by some preeminent elements in society, in opposition with the family storage occurring in the family compounds in each hillfort.

### 3.8. References

Aira Rodríguez M., Ramil Rego P., Álvarez Nuñez A. (1990). Estudio paleocarpológico realizado en el Castro de Penalba (Campolameiro, Pontevedra. España). *Botânica Complutensis*, 16: 81-89.

Alarcão J. (1992). A evolução da cultura castreja. *Conimbriga*, 31: 39-71.

Álvarez González Y., López González L. (2000). La secuencia cultural del asentamiento de Laias: evolución espacial y funcional del poblado. In *Actas del 3º congreso de Arqueología Peninsular*, 5 - Proto-História, ADECAP: 523-532.

Álvarez González Y., López González L., López Marcos M. (2009). La Ocupación del Espacio Común y Privado en la Citania de San Cibrán de Lás. *Revista Aquae Flaviae*, 41: 195-208.

Arnanz A., Chamorro J. (1990). Estudio de frutos e semillas procedentes de cuatro Castros Gallegos. Problemas de interpretación de los resultados. *Encontros sobre Paleoeconomía e Paleoambiente*.

Ayán Vila J., Parcero Oubiña C. (2009). Almacenamiento, unidades domésticas y comunidades en el noroeste preromano. In García Huerta R., Rodríguez González D. (Eds.), *Sistemas de almacenamiento*

*entre los pueblos prerromanos peninsulares*, Huesca, Ediciones de la Universidad de Castilla-La Mancha: 367-422.

Bakels C. (1996). Growing grain for others or how to detect surplus production? *Journal of European Archaeology*, 4: 329-336.

Bettencourt A. M. S. (1999). *A paisagem e o Homem na bacia do Cávado durante o II e o I milénio AC*. PhD thesis, Braga: Universidade do Minho.

Bettencourt A. M. S. (2000). *O povoado da Idade do Bronze da Sola, Braga, Norte de Portugal*. Braga: Universidade do Minho/Instituto de Ciências Sociais.

Bettencourt A. M. S. (2009). A Pré-história do Minho. Do Neolítico à Idade do Bronze. In *Minho. Traços de Identidade*, Braga, Universidade do Minho: 70-120.

Bettencourt A. M. S., Dinis A., Figueiral I., Rodrigues A., Cruz C., Silva I., Azevedo M., Barbosa R. (2007). A ocupação do território e a exploração de recursos durante a Pré-história Recente do Noroeste de Portugal. In Jorge S.O., 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*, Promontoria Monográfica, 8: 149-164.

Buxó R. (1997). *Arqueología de las Plantas*. Barcelona: Crítica.

Buxó R., Piqué R. (2008). *Arqueobotánica. Los usos de las plantas en la península Ibérica*. Barcelona: Ariel.

Buxó R., Alonso N., Canal D., Echave C., González I. (1997). Archaeobotanical remains of hulled and naked cereals in the Iberian Peninsula. *Vegetation History and Archaeobotany*, 6 (1): 15-23.

Carrión Marco Y. (2003). *Afinidades y diferencias de las secuencias antracológicas en las vertientes mediterránea y atlántica de la Península Ibérica*. PhD thesis, Facultat de Geografia i Història, Universitat de València.

Carrión Marco Y. (2005). Dendrología y arqueología: las huellas del clima y de la explotación humana de la madera. *Avances en Arqueometría. Actas del VI Congreso Ibérico de Arqueometría*: 273-282.

Cobas Fernández I., Parceros Oubiña C. (2006). *Alto do Castro (Cuntis, Pontevedra). Síntesis de resultados y estudio de materiales, campaña 1993*. 37, CSIC - Xunta de Galicia.

Dopazo Martínez A. (1996). *La dieta vegetal del Noroeste Ibérico durante el Holoceno. Una aproximación a través del análisis paleocarpológico*. Undergraduation thesis, Universidad de Santiago.

Dopazo Martínez A., Fernández Rodríguez C., Ramil-Rego P. (1996). Arqueometría aplicada a yacimientos Galaico-romanos del NW Peninsular: valoración de la actividad agrícola y ganadera. In Ramil-Rego P., Fernández Rodríguez, C., Rodríguez Guitián, M. (Eds.), *Biogeografía Pleistocena - Holocena de la Península Ibérica*, Xunta de Galicia: 317-332.

Fabião C. (1992). O Passado Proto-Histórico e Romano. In Mattoso J. (Eds.), *História de Portugal, 1, Antes de Portugal*, Círculo de Leitores: 77-299.

Fariña Busto F., Xusto Rodríguez M. (1988) Coto do San Trocado (San Amaro-Punxín-Ourense). in VVAA, *Arqueoloxía-informes 2. Campaña 1988*. Junta de Galicia.

Figueiral I. (2008). O Crasto de Palheiros (Murça, NE Portugal): a exploração dos recursos vegetais durante o III/inícios do IIº milénio AC e entre o Iº milénio AC e o séc. IIº DC. In Sanches M. (Ed.), *O Crasto de Palheiros. Fragada do Castro. Murça – Portugal*, Município de Murça: 79-108.

González-Ruibal A. (2003). *Arqueología del Primer Milenio a.C. en el Noroeste de la Península Ibérica*. PhD thesis, Departament of Prehistory, Complutense University of Madrid.

Gracia Alonso F. (2009). Producción y almacenamiento de excedentes agrícolas en el NE peninsular entre los siglos VII y II a.C. Análisis crítico. In García Huerta R., Rodríguez González D. (Eds.), *Sistemas de almacenamiento entre los pueblos prerromanos peninsulares*, Cuenca, Ediciones de la Universidad de Castilla-La Mancha: 9-71.

Hillman G., Mason S., de Moulins D., Nesbitt M. (1996). Identification of archaeological remains of wheat: the 1992 London workshop. *Circaea*, 12 (2): 195-210.

Jacomet S. (2006). *Identification of cereal remains from archaeological sites*. Archaeobotany Lab, IPAS, Basel University.

López Cuevillas F. (1922) O castro A Cidade en San Ciprián de Lás, *NÓS* 10, Orense.

Lopez Merino L., Peña-Chocarro L., Ruiz Alonso M., Lopez Saez J., Sanchez Palencia F. (2010). Beyond nature: The management of a productive cultural landscape in Las Medulas area (El Bierzo, Leon, Spain) during pre-Roman and Roman times. *Plant Biosystems*, 144: 909-923.

Luz S. (2010). O Depósito de conchas do sítio arqueológico das Areias Altas (Porto, Portugal). Discussão do enquadramento arqueológico da estrutura 15. *Férvedes*, 6: 141-145.

Martínez Mira I. (2004-2005). Tesorillos del s. III d.C. en la península ibérica (III). *Lvcentvm*, 23/24: 207-236.



Martins M. (1993-1994). Continuidade e mudança no I milénio a.C., no Noroeste Português. Os diferentes cenários de representação do discurso arqueológico. *Cadernos de Arqueologia*, 10-11: 41-64.

Martins M. (1996). Povoamento e habitat no Noroeste português durante o 1º milénio a.C. In *De Ulisses a Viriato. O primeiro milénio a.C.*, Lisboa, MNA: 118-133.

Mendes C. (2006). Povoado Mineiro do Bovinho, Freguesia de Edroso, Resultados preliminares da campanha 2/2005. *Cadernos "Terras Quentes"*, 3: 53-59.

Miret i Mestre J. (2008). L'experimentació sobre sitges tradicionals. Aportacions de l'arqueologia i de l'agronomia. *Revista d'Arqueologia de Ponent*, 18: 217-240.

Morais R. (2004). *Autarcia e Comércio em Bracara Augusta no período Alto-Imperial: contribuição para o estudo económico da cidade*. PhD thesis, Braga: Universidade do Minho.

Muñoz Sobrino C., Ramil-Rego P., Rodríguez Guitián M. (1997). Upland vegetation in the north-west Iberian peninsula after the last glaciation: Forest history and deforestation dynamics. *Vegetation History and Archaeobotany*, 6 (4): 215-233.

Oliveira M. (2000). *O registo paleocarpológico do NO peninsular entre o IIIº e o Iº milénios a.C. Contributo para o estudo da alimentação pré e proto-histórica*. MSc thesis, Universidade do Minho.

Parceros Oubiña C. (2000). Síntesis de los trabajos de excavación en el yacimiento castreño de Alto do Castro (Cuntis, Pontevedra). *Brigantium*, 12: 161-174.

Parceros Oubiña C., Cobas Fernández I. (2004). Iron Age Archaeology of the Northwest Iberian Peninsula. *e-Keltoi*, 6: 1-72.

Peña Santos A. (2005). Breve síntesis de la prehistoria e arqueología do Eixo Atlántico. In Hidalgo Cuñarro J. (Ed.), *Rutas Arqueológicas do Eixo Atlántico/Roteiro Arqueológico do Eixo Atlântico*: 3-42.

Pinto da Silva A. (1988). A paleoetnobotânica na arqueologia portuguesa. Resultados desde 1931 a 1987. In Queiroga F., Sousa I., Oliveira C. (Eds.), *Palaeoecologia e Arqueologia, Vila Nova de Famalicão, 1988*, Vila Nova de Famalicão, Câmara Municipal de Vila Nova de Famalicão: 13-29.

Ramil Rego P. (1993). Paleoethnobotánica de yacimientos arqueológicos holocenos de Galicia (N.O. Cantábrico). *Munibe*, 45: 165-174.

Ramil Rego P., Dopazo Martínez A., Fernández Rodríguez C. (1996). Cambios en las estrategias de explotación de los recursos vegetales en el Norte de la Península Ibérica. *Férvedes*, 3: 169-187.

Ramil Rego P., Fernández Rodríguez C. (1999). La explotación de los recursos alimenticios en el noroeste ibérico. In García Quintela M. (Ed.), *Mitología y mitos de la Hispania prerromana (III)*, Akal: 296-342.

Ramil Rego P., Muñoz-Sobrino C., Rodríguez-Gutián M., Gómez-Orellana L. (1998). Differences in the vegetation of the North Iberian Peninsula during the last 16,000 years. *Plant Ecology*, 138 (1): 41-62.

Rey Castiñeira J., Martín Seijo M., Teira Brión A., Abad Vidal E., Calo Ramos N., Carballo Arceo L., Comendador Rey B., Picón Platas I., Varela Montes A. (2011). CastroBYTE. Un modelo para a xestión da información arqueolóxica. *Gallaecia*, 30: 67-106.

Tereso J. (2009). Plant macrofossils from the Roman settlement of Terronha de Pinhovel, northwest Iberia. *Vegetation History and Archaeobotany*, 18 (6): 489-501.



## 4

# Fruits and seeds from an Iron Age combustion area at Lesenho (Boticas/Ribeira da Pena, northern Portugal)

---

### Abstract

During the 2008 excavation campaign at Lesenho a small combustion area was defined inside a circular house. This was probably related to metallurgic activities and dated back to the late 2<sup>nd</sup> century or 1<sup>st</sup> century BC.

Crops are rare and restricted to poorly preserved hulled wheat (*Triticum dicocum/spelta*) and millet (*Panicum miliaceum*) grains. Thus winter and spring cereals were consumed by local communities. These are undemanding crops in terms of soils and were suitable for the mountainous environment that characterizes Lesenho and its surroundings.

**Key-words:** Iron Age, crops, hulled wheat, millet

### 4.1. Introduction

Lesenho is a hillfort located in the Municipalities of Boticas and Ribeira de Pena (northern Portugal). It is well known for its possible four callaican warriors' statues.

This settlement is positioned in a conic elevation with 1073m altitude (Fig. 4.2 and 4.3); it has three concentric defensive walls and two more at North where access is easier. In the two known entrances to the settlement we can find *chevaux de frise* (Martins et al. 2010), a feature usually identified in northeast Portugal, although the settlement itself is an Iron Age hillfort akin to those of northwest Portugal. As a result, recently it was argued that Lesenho was positioned in a transitional zone between the "castros area", in the west, and the interior eastern area, more related to the Meseta archaeological reality (González Ruibal 2009). Mineral resources are abundant in the region.

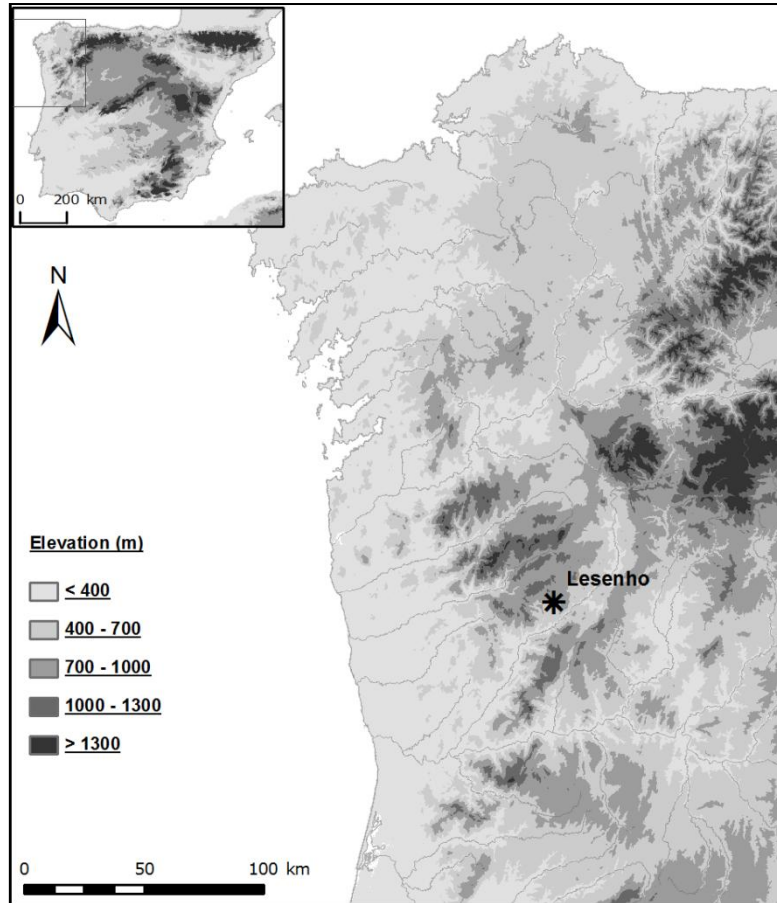


Figure 4.1 – Location of Lesenho in northwest Iberia

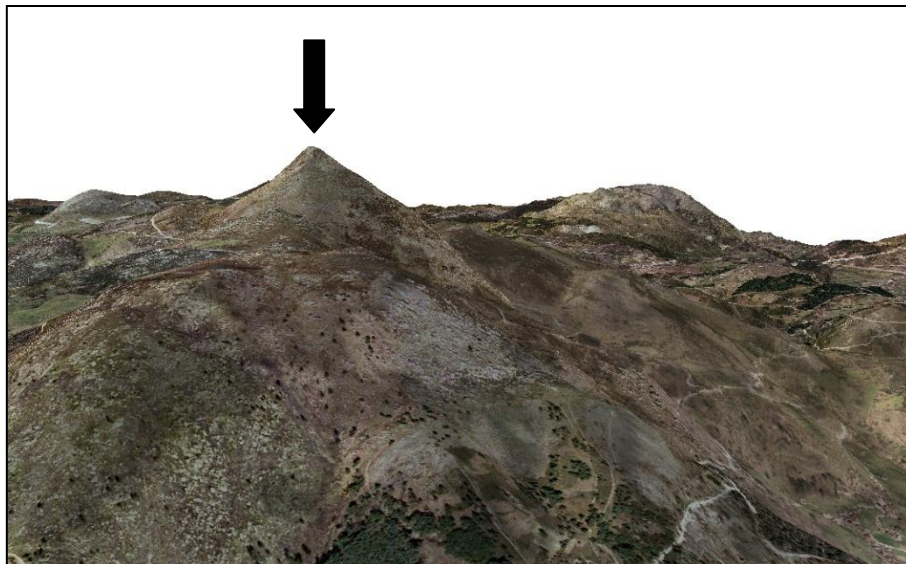


Figure 4.2 – Three-dimensional representation of Lesenho's location (image courtesy of João Fonte, Gonçalo Cruz and Carla Martins)



Figure 4.3 – General view of Lesenho (image courtesy of João Fonte, Gonçalo Cruz and Carla Martins)

Sampling in Lesenho took place in the single campaign of 2008, directed by Carla Braz Martins, Gonçalo Cruz and João Fonte. In this campaign one test pit (3x3m) was excavated in the place where a circular structure was known to exist, with the purpose of obtaining the site's first stratigraphic sequence and understanding the function and chronology of the structure that was already partially visible (Martins et al. 2010). In the test pit, two different structures were defined: the circular structure and a retaining wall. Sampling took place inside the circular structure. The stratigraphy of this context is described in detail by Martins et al. (2010) and can be summarized as follows (from top to bottom):

- Several recent deposits related to the construction of a rural road.
- Destruction levels of the circular structure.
- Floor made of compacted soil
- Occupation level (includes u.s.9)

- Leveling layer used as floor (u.s.10), covering the bedrock and cut by a feature interface (u.s.12) which was filled by u.s.9.

The few ceramics that were found are attributed to the Iron Age, namely to a period between the late 2<sup>nd</sup> century BC and the whole 1<sup>st</sup> century BC (Martins et al. 2010). No radiocarbon date is yet available.

In the context of such limited archaeological work, the purpose of archaeobotanical sampling was to characterize a specific context that was defined during the excavation.

## 4.2. Materials and methods

Sampling in Lesenho was restricted to one unit of stratification, u.s. 9. This dark brown deposit was interpreted as a combustion level, possibly related to metallurgic activities, due to the finding of slag. It is positioned within the circular construction, inside a feature interface (u.s.12) associated to a floor level composed of bedrock and a levelling deposit (u.s. 10) (see Fig. 4.4 and 4.5). This context has the same chronology as the other findings in this test pit: late 2<sup>nd</sup> century – 1<sup>st</sup> century BC. No radiocarbon dates are available.

The deposit was floated in the Museu da Cultura Castreja, in S. Salvador de Briteiros, using the method of bucket flotation. A column of sieves was used, with meshes of 0.5 mm, 1mm and 2mm. Further processing of the samples took place in the Faculty of Sciences, University of Porto.

The identification of the fruits and seeds was made using the reference collection, as well as anatomical atlases (e.g. Jacomet 2006) and other works of specialty (e.g. Buxó 1997).

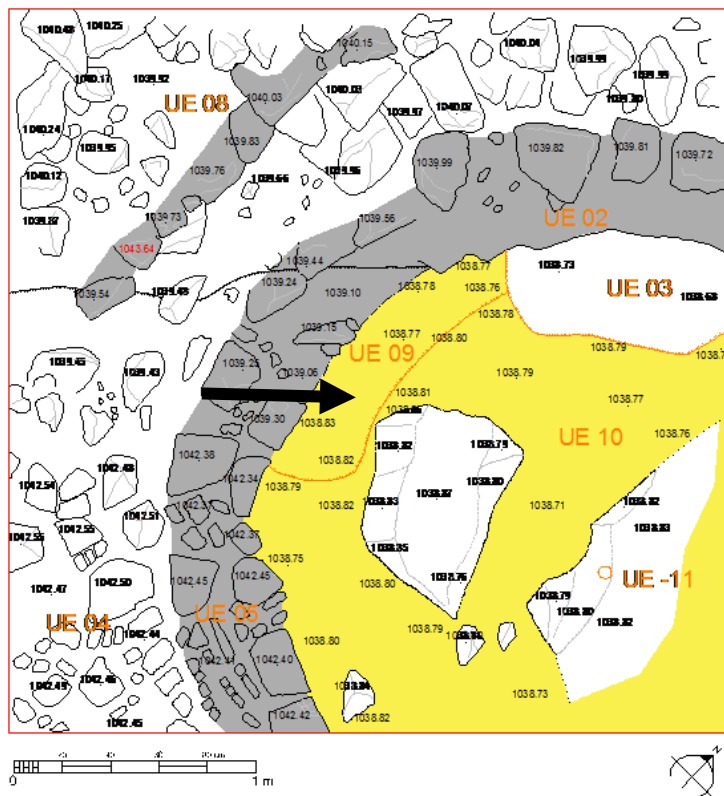


Figure 4.4 - Position of the sampled fireplace (u.s. 9) (image courtesy of João Fonte, Gonçalo Cruz and Carla Martins).



Figure 4.5 – Feature interface (u.s.12) after the excavation of u.s. 9 (image courtesy of João Fonte, Gonçalo Cruz and Carla Martins).



### 4.3. Results

The samples from the fireplace did not provide abundant plant remains (see table 4.1).

Millets are the main crops recovered. Poorly preserved grains were identified as *Panicum/Setaria* and whenever was possible to identify at species level, the grains were from *Panicum miliaceum*. Morphological criteria from Buxó (1997) and Jacomet (2006) were followed.

Lesenho: u.s. 9	TOTAL
<b>Cereals (grains)</b>	
<i>Panicum miliaceum</i>	6
<i>Panicum/Setaria</i>	2
<i>Triticum dicoccum/spelta</i>	3
Triticeae - units	3
Triticeae - fragments	1
<b>Wild plants</b>	
Undetermined	1

Table 4.1 – Plant remains from Lesenho



Figure 4.6 – Grain of *Panicum miliaceum* (scale=1mm)



Figure 4.7 – Grain of *Triticum dicoccum/spelta*

Three wheat grains were identified as *Triticum turgidum* subsp. *dicoccum* or *Triticum aestivum* subsp. *spelta*. Two of these are fragmented. The discrimination between grains of *T. spelta* and *T. dicoccum* is difficult when no chaff is available, although it is possible in typical grains (Jacomet 2006, Tereso 2009). Still, the grains recovered in Lesenho are poorly preserved and too few to risk a positive ascription to a specific morphological type.

Due to poor preservation, other remains were identified simply to the tribe level: Triticeae, i.e. these are all cereals with long caryopses and not millets.

#### 4.4. Discussion and conclusions

The archaeobotanical study of samples associated to an Iron Age fireplace at Lesenho, allowed us to identify two crops – *Panicum miliaceum* and *Triticum turgidum* subsp. *dicoccum* or *Triticum aestivum* subsp. *spelta*. Such crops are frequently found in Iron Age settlements in northwest Iberia (Ramil Rego 1993, Dopazo Martínez et al. 1996, Ramil Rego et al. 1996, Oliveira 2000).

In Lesenho, the connection of these plant remains to a specific fireplace where slag was found is difficult to understand.

This study demonstrates that winter cereals (*T. dicoccum* or *T. spelta*) and spring crops (*Panicum miliaceum*) were consumed at Lesenho. Still, it is not possible to affirm these were cultivated in the surroundings by those who inhabited the settlement. However, Lesenho is located in a mountainous environment (see Fig. 4.2) where good soils are not abundant and millet and emmer are suitable crops for such context.

Millet is a short vegetative cycle crop that adapts well to different soils and climates (Hunt and Jones 2008). Emmer and spelt are high yielding crops in mountain environments, being suitable for depleted soils and cold temperatures, if water is available (van der Veen and Palmer 1997, Troccoli and Codianni 2005).

Still, the remains are sparse as the archaeological intervention was limited to a small area. Future work must continue to include soil sampling for archaeobotany, so that we can understand what crops were being cultivated by local communities.

#### 4.5. References

Buxó R. (1997). *Arqueología de las Plantas*. Barcelona: Crítica.

Dopazo Martínez A., Fernández Rodríguez C., Ramil-Rego P. (1996). Arqueometría aplicada a yacimientos Galaico-romanos del NW Penínsular: valoración de la actividad agrícola y ganadera. In Ramil-Rego P., Fernández Rodríguez, C., Rodríguez Guitián, M. (Eds.), *Biogeografía Pleistocena - Holocena de la Península Ibérica*, Xunta de Galicia: 317-332.

González Ruibal A. (2009). Cultura de fronteira. O distrito de Vila Real e a zona meridional da província de Ourense na Idade do Ferro. *Revista Aquae Flaviae*, 41: 153-160.

Hunt H., Jones M. (2008). Pathways across Asia: exploring the history of *Panicum* and *Setaria* in the Indian subcontinent. *Pragdhara*, 18: 53-68.

Jacomets S. (2006). *Identification of cereal remains from archaeological sites*. Archaeobotany Lab, IPAS, Basel University.

Martins C., Cruz G., Fonte J. (2010). O povoamento na segunda Idade do Ferro. Outeiro Lesenho como um dos povoados centrais. In Martins C. (Ed.), *Mineração e povoamento na antiguidade do Alto Trás-os-Montes ocidental*, Porto, CITCEM: 47-59.

- Oliveira M. (2000). *O registo paleocarpológico do NO peninsular entre o IIIº e o Iº milénios a.C. Contributo para o estudo da alimentação pré e proto-histórica*. MSc thesis, Universidade do Minho.
- Ramil Rego P. (1993). Paleoethnobotánica de yacimientos arqueológicos holocenos de Galicia (N.O. Cantábrico). *Munibe*, 45: 165-174.
- Ramil Rego P., Dopazo Martínez A., Fernández Rodríguez C. (1996). Cambios en las estrategias de explotación de los recursos vegetales en el Norte de la Península Ibérica. *Férvedes*, 3: 169-187.
- Tereso J. (2009). Plant macrofossils from the Roman settlement of Terronha de Pinhovel, northwest Iberia. *Vegetation History and Archaeobotany*, 18 (6): 489-501.
- Trocchi A., Codianni P. (2005). Appropriate seeding rate for einkorn, emmer, and spelt grown under rainfed condition in southern Italy. *European Journal of Agronomy*, 22 (3): 293-300.
- van der Veen M., Palmer C. (1997). Environmental Factors and the Yield Potential of Ancient Wheat Crops. *Journal of Archaeological Science*, 24 (2): 163-182.



## 5

# Fruits and seeds from Iron Age and Roman levels of Citânia de Briteiros (Guimarães, northern Portugal)

---

### Abstract

Several soil samples were recovered in Citânia de Briteiros in order to obtain archaeobotanical data regarding agricultural practices of Iron Age and early Roman communities. These samples were taken in the family compound “House of the Spiral”, in a Platform adjacent to this compound and in a street preparation level, northeast from the other two areas.

Seeds and fruits are not very abundant in the samples and they are generally poorly preserved. Chaff and grain from naked (*Triticum aestivum/durum*) and hulled wheat (*Triticum dicoccum/spelta* and *Triticum dicoccum*) were found, together with grains from millet (mostly *Panicum miliaceum*). Other crops are rare. Pips from *Vitis vinifera* were also recovered in Iron Age and Roman levels.

**Key-words:** Fruits and seeds, naked and hulled wheat, millet, Iron Age, Roman

### 5.1. Introduction

Citânia de Briteiros is one of the more extensive excavated Iron Age hillfort in all northwest Iberia. Its excavation began in the late 19<sup>th</sup> century by Martins Sarmiento (Sarmiento 1903) and was continued intermittently since then (Lemos and Cruz 2007, 2010). Since 2005, yearly campaigns were directed by Francisco Sande Lemos, Maria Manuela Martins and Gonçalo Cruz aiming to better understand the chronology of the human occupation of the settlement and its dynamics. The interventions were restricted to the uppermost area of the site.

The settlement is located at the Municipality of Guimarães, in the S. Romão hill, an elevation of c. 300m altitude. This hill was continuously occupied from the Late Bronze Age until the beginning of the Roman period. In the beginning of the 2<sup>nd</sup> century AD the human presence in the hill was residual (Lemos and Cruz 2007, 2010).

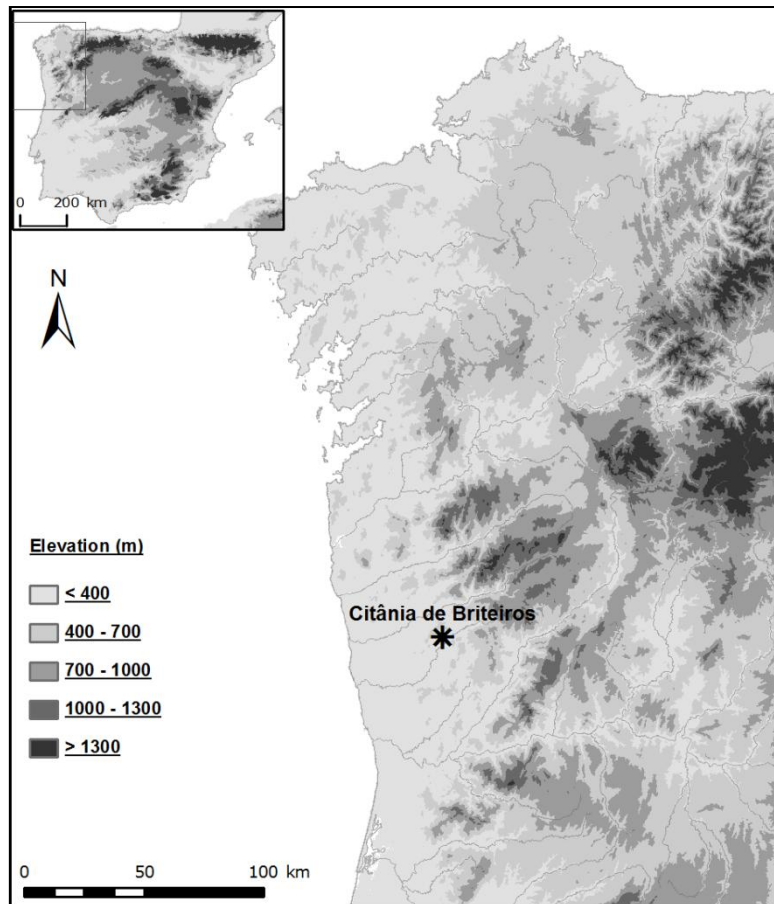


Figure 5.1 – Location of Citânia de Briteiros in northwest Iberia

The best known and more monumental phase corresponds to the end of the Iron Age. During this phase, the settlement would comprise 24ha within walls. There were three set of concentric defensive walls, complemented by a fourth wall and two ditches in the most vulnerable sides. The settlement had clear urban characteristics, almost of orthogonal shape, which helped distinguishing public and private areas. Private areas are mostly family compounds composed of one or several buildings (Lemos and Cruz 2007).

Despite the long history of archaeological interventions in Citânia de Briteiros, no archaeobotanical study was ever made. The only references to plant remains recovered in Briteiros are those of *Quercus* acorns found by M. Sarmiento (1903) and pseudobulbs of *Arrhenatherum elatius* subsp. *bulbosum* (Pinto da Silva 1988), but their chronology is not known.

Recently, sampling was carried out to help understand several aspects regarding the management of plant resources and the evolution of landscape in the surroundings of the settlement. However, this study is restricted to the fruits and seeds, which were studied

mostly to access palaeoethnobotanical information regarding the agricultural practices and the recollection of wild fruits by the human communities that inhabited the hillfort.

## 5.2. Materials and methods

As mentioned before, the most recent archaeological campaigns were restricted to the upper platforms. Still, samples were recovered from units of stratification (u.s.) in three different areas within the acropolis (Fig. 5.3).



Figure 5.2 – General view over the House of the spiral (image courtesy of Gonçalo Cruz)

The House of the spiral is a family compound with several houses. Here samples were taken in five squares:

- In square 99B, an outbuilding of the House of the spiral was excavated. Six samples were taken in dispersed deposits but only three provided plant remains. All the deposits date back to the Iron Age.



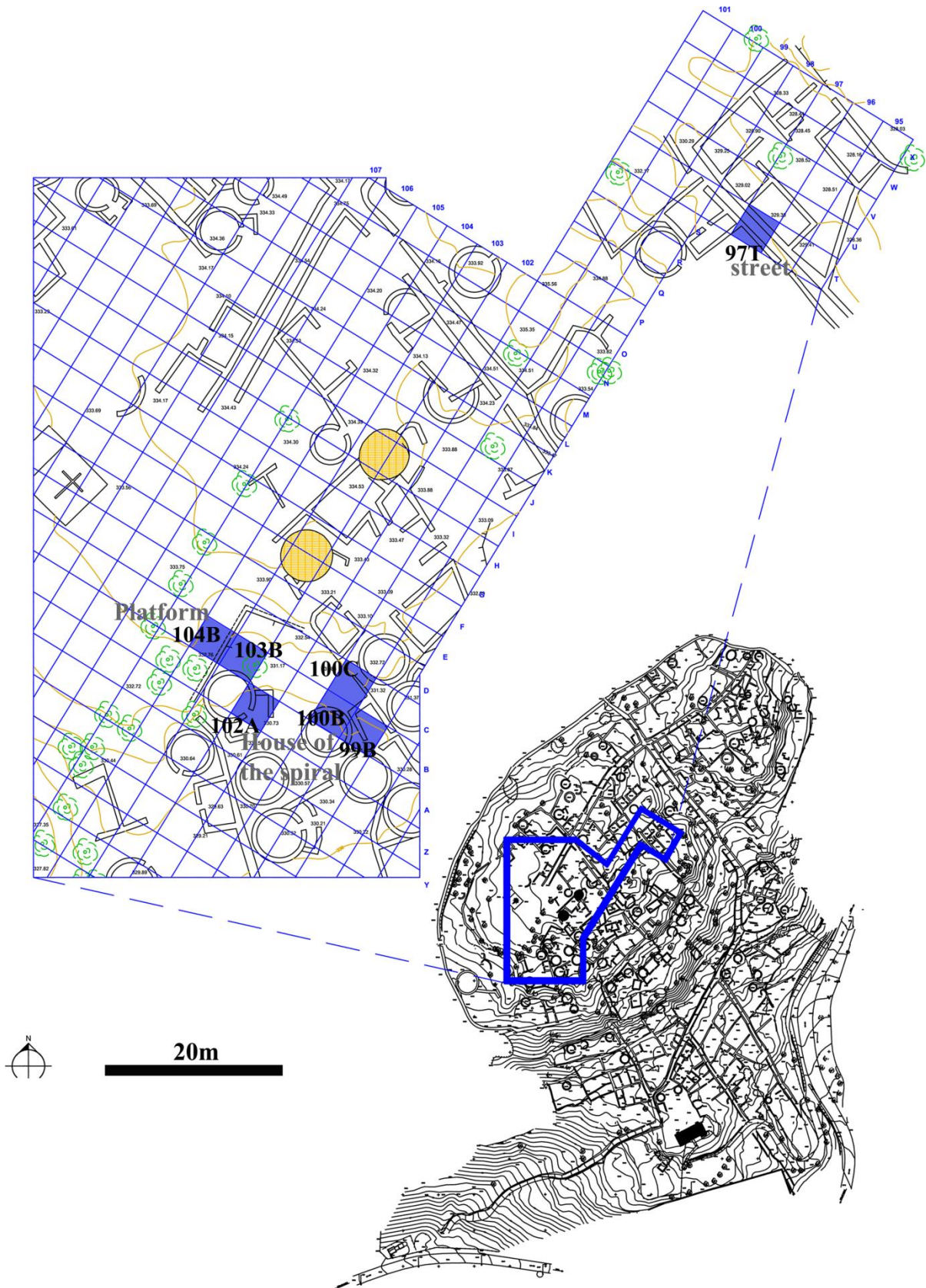


Fig. 5.3 - Location of the sampled squares

- In square 100C there was another outbuilding. Four samples were taken, one from an Iron Age floor (u.s. 644) and three from Roman contexts (Early Empire): u.s. 643 and 647 (destruction levels of the same wall) and u.s. 645 (abandonment level).
- In square 100B no soil samples were taken. Plant remains were handpicked in u.s. 626, an Iron Age deposit related to a circular house.
- In square 102A, the vestibule from a circular house was excavated and five soil samples were taken, all from the Iron Age, probably from the 2<sup>nd</sup> century BC or older. U.s. 338 and 345 were recovered in the same fireplace.
- Square 103B corresponds to an exterior space contiguous to a circular house. Eleven samples were collected, most of them filling the construction trench of that Iron Age house. Two Iron Age floors and two Roman deposits (abandonment levels) were sampled.

In a Platform adjacent to the “house of the spiral”, excavation took place in square 104B. It provided a complex stratigraphy. Samples were taken in several deposits, all from the Iron Age, probably from the 2<sup>nd</sup> century BC or older:

- U.s. 29 and 30 are related to an occupation phase associated to a circular house and u.s. 32 (deposit) is a possible floor.
- U.s. 35, 36 and 37 (all these deposits correspond to another level of floor) and u.s. 41, 53 and 56 (dispersed deposits) are possibly older than the circular house.

The street, a public area of circulation, is located in square 97T, positioned northeast from the two previous areas. This passage area was perpendicular to the main street of the upper platform. After removing the stone pavement, a deep stratigraphic sequence was excavated and intensive sampling was carried out in u.s. 4, 6 and 9

They correspond to the filling of the space between walls for preparing the construction of the pavement, thus archaeological material – artifacts and plant remains – are difficult to interpret chronologically. The filling must have taken place in the end of the 1<sup>st</sup> century BC and while some archaeological artifacts point back to an Iron Age chronology, others are already Roman (late 1<sup>st</sup> century BC).

Sampling and flotation in Citânia de Briteiros occurred prior to the work of this thesis, but the resulting plant remains were never studied. So, this study includes samples from three campaigns (2006-2008). Several sampling approaches took place during the excavation. Most samples are occasional soil recoveries with limited expression, but in the 2008 campaign intensive sampling took place and deposits were almost entirely recovered.

All samples were floated in Museu da Cultura Castreja, in S. Salvador de Briteiros, using the bucket flotation method. In 2006 and 2007 a single 0,5mm mesh was used while in 2008 a column of sieves with 2mm, 1mm and 0,5mm was used.



Figure 5.4 – Excavation work at square 97T (image courtesy of Gonçalo Cruz)

For the identification of the fruits and seeds the reference collection of the Faculty of Sciences, University of Porto was used, as well as anatomical atlases (e.g. Jacomet 2006, Berggren 1981) and several works of specialty (e.g. Buxó 1997).

### 5.3. Results

The samples recovered in Citânia de Briteiros provided few plant remains (Table 5.1).

The House of the Spiral was the area that provided more archaeobotanical remains. Most contexts are from the Iron Age but at least five samples come from Roman contexts. No significant differences exist between the different chronologies, besides those originated by the great discrepancy in the number of samples from each chronology. Squares 103B and 102A are those where more remains were found.

Wheat is the main crop but most grains could only be identified to genus level, because of bad preservation. The same reason prevented the identification of chaff at species level. Grains and rachis fragments of *Triticum aestivum/durum* (naked wheat) (Fig. 5.5) were recovered as well as grains and chaff from *Triticum dicoccum/spelta* (emmer/spelt – hulled wheat). Six grains were identified as *T. turgidum* subsp. *dicoccum* since discriminating features were preserved (Fig. 5.6).



Figure 5.5 – Grain of *Triticum aestivum/durum*



Figure 5.6 – Grain of *Triticum dicoccum/spelta*

The identification of the wheat remains followed the criteria of Hillman *et al.* (1996), Buxó (1997) and S. Jacomet (2006). *Triticum aestivum/durum* grains present a characteristic swollen aspect; they are oval in plan view and their ventral surface is slightly convex in side view. *T. dicoccum* grains are slender in plan view, with the upper end and sometimes the lower end pointed. Ventral surface is concave or flattish-concave in side view.

Still, Jacomet (2006) stressed the difficulty in distinguishing the grains from *T. dicoccum* and *T. spelta* as these are frequently alike. The criteria used allow the identification of morphological types and *T. dicoccum* can include atypical *T. spelta* grains. The presence of chaff should help distinguishing both species but poor preservation does not allow such mission.

Millets are frequent too and only *Panicum miliaceum* was clearly identified (Fig. 5.7, left). Some grains were not possible to distinguish between *Panicum miliaceum* and *Setaria italica*. The morphological criteria followed were those of Buxó (1997) and S. Jacomet (2006): grains from *Panicum miliaceum* are ellipsoidal to roundish in shape, with a roundish hilum. The scutellum is broad, usually oval and barely reaching the half of the grains' length.



Figure 5.7 – Grain of *Panicum miliaceum* (left); seed of *Pisum sativum* (right) (scale=1mm)

The presence of *Avena*, barley (*Hordeum* and *Hordeum vulgare* subsp. *vulgare*) and *Pisum sativum* (Fig. 5.7, right) is sparse.

Sample	47	29	3/43	23/45	10/18	9/11	7	20	8	24	21	4	12	6	5	27	44/46	42	36	32	41	26	1	17	28/35	19/22	16/25	31	30
U.S. varia	9	29	30	32	35	36	37	41	53	56	338	339	343	344	345	626	643	644	645	647	722	724	728	906	907	916	921	924	
Area	Street		Platform									House of the Spiral																	
Square	97T		104B									102A			100B	100C			99B			103B							
Chronology	Iron	Rom.	Iron Age														Rom.	Iron	Roman		Iron Age		Iron	Rom.	Iron Age				

Cereals (grains)																													TOTAL					
<i>Avena</i>																1														3	1			5
cf. <i>Avena</i>					1																										1			2
<i>Hordeum</i>												1																					1	2
<i>Hordeum vulgare</i> subsp. <i>vulgare</i>																											1							1
<i>Panicum miliaceum</i>		1			1	4				5	4		2			1				3			1		3	1	2		1				29	
<i>Panicum/Setaria</i>						4					1					1					1		2							1			10	
<i>Triticum aestivum/durum</i>		1		1						3					1											1	1	1						9
<i>Triticum dicoccum</i>																										2	1	5						8
<i>Triticum dicoccum/spelta</i>																										1								1
<i>Triticum</i>						1				1		2				3										8	14	14			1			44
Cereal - unit		2		3															1						6		2						14	
Cereal - fragment						1		1						2									1						4				9	
Cereals (chaff)																													TOTAL					
<i>Triticum aestivum/durum</i> (nodes)																2																		2
<i>Triticum dicoccum/spelta</i> (spikelet fork)																															1			1
<i>Triticum dicoccum/spelta</i> (glume base)																										1								1
Leguminosae (seeds)																													TOTAL					
<i>Astragalus</i>																1																		1
Genisteeae						1				3			1		2																			12
<i>Ornithopus</i>																				1														1
<i>Pisum sativum</i>																	1																	1
<i>Vicia sativa/angustifolia</i>						1				9			4								1	1					1							17
<i>Vicia/Lathyrus</i>						1																						1						2
cf. <i>Vicia</i>					1													1																2
Other plants																													TOTAL					
<i>Arrhenatherum elatius</i> subsp. <i>bulbosum</i> (pseudobulb)												1																						1
<i>Galium</i> (mericarp)																											1		1					2
Gramineae (grain) - undetermined					1					1			2			1					1					1			2					10
Gramineae (grain) - und. (frag.)																																		1
<i>Montia fontana</i> (seed)																																		1
Polygonaceae (achene)																																		1
Polygonaceae - cf. <i>Fallopia convolvulus</i> (achene)																																	1	1
<i>Quercus</i> (cotyledon) - frag.	1						1																											2
<i>Quercus</i> (cotyledon)	2			1																														3
<i>Rubus</i> (achene)																															1	1		2
<i>Silene</i> (seed)												1																			1			3
<i>Veronica/Asterolinum</i> (seed)																																	1	1
<i>Vitis vinifera</i> (seed)		4				1						1	2			1	2	6	1	1	5					1	4	3	1	1			34	
Undetermined				1	1	5		1	1	18	4	4	2	1	1	1		7		9	1	3	5	1	2	2	1	1					73	
Undetermined - frag.				1																														1

Table 5.1 - Fruits and seeds from Citânia de Briteiros.



Figure 5.8 – Grape pips (*Vitis vinifera*) from the Roman level u.s. 643

On what wild plants is concern, several species were found. Most are ruderal plants eventually associated to agricultural fields. Still, some Leguminosae (types *Adenocarpus*, *Astragalus* and *Genista*) are probably related to wood gathering or fodder.

The presence of *Vitis vinifera* and *Vicia* spp. may have further implications. Charred grape pips appear in Iron Age and Roman levels. Still, these Roman levels are possibly earlier than a full Roman administration. Due to the small number of seeds found it is not possible to know whether they come from domestic or wild plants.

*Vicia* spp. seeds are badly preserved being thus difficult to interpret. Due to their shape and size it is clear they are not from *Vicia faba*. Several *Vicia* species are ruderal but other are cultivated to be used as fodder or for human consumption. Vetch - *Vicia sativa/angustifolia* was probably used for human consumption during prehistoric times (Bouby and Léa 2006) and was a well known fodder, cultivated by the Romans (Columella, Res Rustica Book II, VII, 1). Still, despite its cultivation for fodder continues today (Romero Zarco 1999), they also appear commonly as weeds or bordering agricultural fields (Pinho and Pinho 1998, Romero Zarco 1999).

Samples from the platform adjacent to the “house of the spiral” are all from Iron Age levels. Plant remains are sparse and the main crop is millet (*Panicum miliaceum*). Naked wheat was recovered but hulled wheat no. No chaff was recovered either. Seeds from *Vicia angustifolia* type and *Vitis vinifera* were recovered, as well as occasional *Quercus* acorns.

Only two samples from the street area provided plant remains. These are single grains from *Panicum miliaceum* and *Triticum aestivum/durum*. *Quercus* acorns and *Vitis vinifera* seeds were found.

#### 5.4. Discussion and conclusions

The sparse and poorly preserved remains do not allow significant conclusions. As expected, the richest contexts are those of the habitation unit House of the spiral, a well defined domestic context. On the contrary, samples recovered in the preparation levels for construction of the street provided few plant remains.

Still, despite all limitations, some interesting patterns were identified. Almost all crops were found in Iron Age and Roman levels. No chaff was recovered in Roman levels.

Moreover, the only *Rubus* seeds are Roman and although there are considerable less Roman samples, *Vitis vinifera* seeds are more frequent in Roman levels (20 out of 34). On the other hand, most seeds from *Vicia angustifolia* type were found in Iron Age levels and all *Quercus* acorns are from the Iron Age levels.

The increment of *Vitis vinifera* seeds in Roman times tallies some regional interpretations that suggest the cultivation of vine begun during Roman times (Queiroga 1992, Almeida 1996, 2006), but caution is needed since it is not possible to know if the presence of such remains in the site is a result of cultivation, gathering of wild fruits or commercial activities. *Vitis vinifera* is sparse in Roman carpological assemblages in northwest Iberia and its cultivation is mostly suggested by the presence of specific structures probably related to wine production near the Douro valley.

The absence of *Quercus* acorns in the Roman levels is not relevant and there may have been some sampling bias. Acorn consumption is documented throughout the Roman period and acorns were found in several Roman settlements such as Cruito (Pinto da Silva 1988), Viladonga (Ramil Rego et al. 1996) and Terronha de Pinhovel (Tereso 2009).



Data from Citânia de Briteiros demonstrated that the communities that inhabited this settlement during the Iron Age and Roman Period consumed naked and hulled wheat. The presence of chaff suggests these crops were cultivated by local communities. Moreover, the presence of chaff is exclusive to the domestic unit House of the spiral, suggesting that crops' processing or storage of byproducts occurred in such place.

Ruderal species recovered may have been present inside the settlement but some were probably arable weeds. Other wild species were likely to be consumed by the human communities, *Quercus* acorns and *Rubus* fruits are the most evident cases, but *Vicia sativa* is another possibility.

## 5.5. References

Almeida C. (1996). O cultivo da vinha durante a Antiguidade Clássica na Região Demarcada do Douro. Ponto da situação. *Douro - Estudos & Documentos*, 1 (2): 18-30.

Almeida C. (2006). A villa do Castelum da Fonte do Milho. Uma antepassada das actuais quintas do Douro. *Douro - Estudos & Documentos*, 21: 209-228.

Berggren G. (1981). *Atlas of seeds and small fruits of Northwest-European plant species with morphological descriptions*. . 3. *Salicaceae-Cruciferae*, Swedish Museum of Natural History.

Bouby L., Léa V. (2006). Exploitation de la vesce commune (*Vicia sativa* L.) au Néolithique moyen dans le Sud de la France. Données carpologiques du site de Claparouse (Lagnes, Vaucluse). *Comptes Rendus Palevol*, 5 (8): 973-980.

Buxó R. (1997). *Arqueología de las Plantas*. Barcelona: Crítica.

Columella L. J. M. (1960). *On Agriculture. Res Rustica I-IV. Translation by Ash, H.* Harvard University Press/William Heinemann LTD.

Hillman G., Mason S., de Moulins D., Nesbitt M. (1996). Identification of archaeological remains of wheat: the 1992 London workshop. *Circaea*, 12 (2): 195-210.

Jacomet S. (2006). *Identification of cereal remains from archaeological sites*. Archaeobotany Lab, IPAS, Basel University.

Lemos F., Cruz G. (2007). *Citânia de Briteiros. Povoado proto-histórico. The proto-historic settlement*. Guimarães: Sociedade Martins Sarmento.

Lemos F., Cruz G. (2010). Citânia de Briteiros - perspectivas recentes sobre a romanização. In, *Proceedings of the XV World Congress of the International Union for Prehistoric and Protohistoric Sciences*, 34, BAR Int. Series, 29-36.

Pinho C. F., Pinho C. M. (1998). *As plantas infestantes mais frequentes nas principais culturas da região de Entre Douro e Minho*. IDARN.

Pinto da Silva A. (1988). A paleoetnobotânica na arqueologia portuguesa. Resultados desde 1931 a 1987. In Queiroga F., Sousa I., Oliveira C. (Eds.), *Palaeoecologia e Arqueologia*: 13-29.

Queiroga F. (1992). *War and Castros. New approaches to the northwestern Portuguese Iron Age*. PhD thesis, University of Oxford.

Ramil Rego P., Dopazo Martínez A., Fernández Rodríguez C. (1996). Cambios en las estrategias de explotación de los recursos vegetales en el Norte de la Península Ibérica. *Férvedes*, 3: 169-187.

Romero Zarco C. (1999). 33. Vicia L. In Talavera S., Castroviejo S., Romero Zarco C., Sáez L., Salgueiro F., Velayos M. (Eds.), *Flora Iberica. Plantas vasculares de la Península Ibérica e Islas Baleares*, 7 (1). Leguminosae, Madrid, Real Jardín Botánico, CSIC: 360-417.

Sarmiento M. (1903). Materiaes para a archeologia do concelho de Guimarães. *Revista de Guimarães*, 20 (1): 5-16.

Tereso J. (2009). Plant macrofossils from the Roman settlement of Terronha de Pinhovel, northwest Iberia. *Vegetation History and Archaeobotany*, 18 (6): 489-501.



## 6

# Crops and fodder: evidence for storage and processing activities in a functional area at the Roman settlement of Monte Mozinho (northern Portugal)

Tereso J., Ramil-Rego P., Carvalho T.P., Almeida da Silva R., Vaz, F.C.

Submitted to *Vegetation History and Archaeobotany*

---

### Abstract

Archaeobotanical material was recovered in two contiguous compartments of a compound in Monte Mozinho (Penafiel, northern Portugal). These areas comprise storage facilities from three different typologies – *dolium*, pits and above-ground quadrangular structures in the corner of the compartments. Few carpological materials were found inside the storage structures and all these are cereals which were most likely stored as clean grain. Recovered grains are probably remnants of the last stored crops prior to the abandonment of the area. A radiocarbon date obtained over grains of rye positions this event in a moment within the 3<sup>rd</sup> century and the beginning of the 4<sup>th</sup> century AD.

Outside the structures from compartment 2, abundant crops' processing by-products – mostly weeds and chaff – were recovered. Since traditional agricultural communities tend not to waste such organic material, it is likely that it was kept in the area to be used as fodder. Data is ambiguous regarding the possible existence of fodder crops mixed with those by-products.

Overall, there is a predominance of millets – *Panicum miliaceum* and *Setaria italica* – and rye (*Secale cereale*) but naked wheat (*Triticum aestivum*) is also a relevant crop. The presence of oat (*Avena*) is significant but it is difficult to interpret due to its exclusive presence alongside weeds and chaff. Grape pips (*Vitis vinifera*) were also found, but these are rare.

The Late Roman carpological material from Monte Mozinho is of great relevance on a regional level. It documents and dates the presence of rye and testifies for a multifunctional system in which plant husbandry and animal breeding were intertwined.

**Key-words:** Agriculture, fodder, Monte Mozinho, northern Portugal, Roman Period.

## 6.1. Introduction

Monte Mozinho is one of the most relevant Romanized sites in northwest Iberia, having been excavated for several decades. Mozinho's apparent regional role and the specificities of its chronology have enhanced this site's relevance in the archaeology of the Roman occupation of northwest Iberia as it allowed questioning some of the interpretative models about the Roman reorganization of the territory.

Despite its regional relevance, no archaeobotanical study was ever carried out in the site and the only references to plant remains are the general news regarding the recovery of wheat grains, *Quercus* acorns and chestnuts (Soeiro 1998). Besides these, other evidences of agricultural practices are restricted to the presence of some artifacts, such as grinding stones, sickles and hoes (Soeiro 1984), as well as evidences of a press, used for oil or wine production (Soeiro 1998).

Therefore, it was determinant to get relevant archaeobotanical data to help characterize agriculture carried out by Mozinho's inhabitants. The importance of this archaeobotanical study was enhanced by the specificity of the contexts that were excavated in the 2008 and 2009 archaeological campaigns. In this scope, the study of the plant remains found in those contexts was determinant for the understanding of some specific spaces inside the settlement.

Preliminary results have been presented (Tereso et al 2010) but final results, covering all samples, and true interpretation were still lacking. Moreover, as further analysis to archaeological data was carried out, the previous chronological interpretation of the excavated contexts was reviewed.

### 6.1.1. The site

Monte Mozinho, locally known also as "Cidade Morta" (dead city) is a hillfort positioned in the municipality of Penafiel, northern Portugal. Its hill ranges from 408m to 360m altitude; it offers great visual control over a large area, but in particular over the valley of the river Camba, where the ancient Roman road can be found.

The hillfort has three lines of walls and the longest defines a perimeter of over 2km. The second wall delimitates a densely constructed area near the top of the hill and the third one

defines a small area in the centre of the hilltop with no constructions, possibly for public uses (e.g. games, reunions, trade).

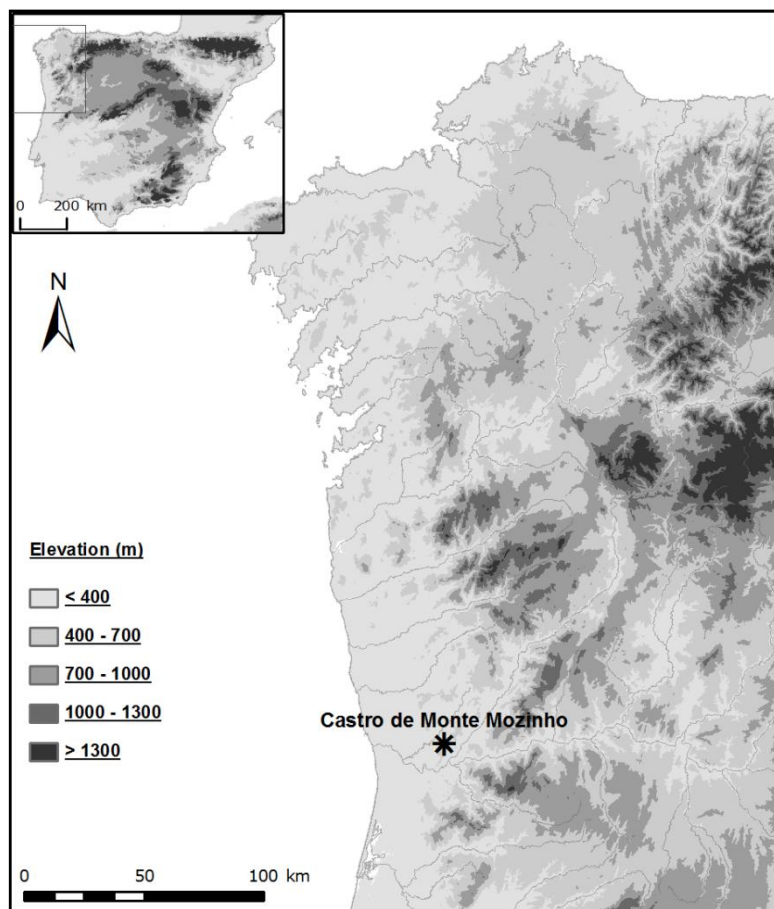


Figure 6.1 – Location of Monte Mozinho

Mozinho is very similar to other hillforts in the region, most of them built during the Iron Age and occupied throughout the Roman period, until at least the 2<sup>nd</sup> or 3<sup>rd</sup> centuries AD. Still, Mozinho was built in the beginning of the Roman occupation in northern Portugal and no signs of any Iron Age preexistence were ever found in several decades of excavations. The settlement was founded around the turn of the Era possibly congregating people from several settlements and was densely occupied during the first half of the 1<sup>st</sup> century AD. In this first phase its inhabitants maintained generally a pre-roman way of living. Only in the reigns of Claudius and Nero there seems to have taken place a further Romanization and imports of goods such as *Terra Sigillata*, glasses and writing instruments appear abundantly (Soeiro 1998).

In the following period, the Flavian dynasty, the settlement was reorganized and indigenous and Roman type of constructions coexisted. Still, it seems that Mozinho lost part of its population and importance in this period, following a general trend in the hillforts of northwest Iberia. The area within the second wall was abandoned in the 2<sup>nd</sup> century AD but the rest of the settlement continued to be occupied. It remained inhabited throughout the Late Empire, until the 5<sup>th</sup> or 6<sup>th</sup> centuries AD (Carvalho 1998, Carvalho and Queiroga 2005).



Figure 6.2 – General view over Monte Mozinho. The arrow points to the location of Sector A - 2008

### 6.1.2. The Sector A -2008

The Sector A - 2008 is positioned inside the perimeter of the longest and outermost wall, at a half distance between this wall and the hilltop. A set of compartments appears to be organized around a central area with no significant structural features. Still, since the excavation in this sector has not yet been finished it is difficult to understand the exact nature of the whole area, being unclear whether it was a place of communal or private use. For now, the plan of this

area is unique in the whole settlement; its buildings are larger than most of those known in the site and their construction less sturdy.

We stress three compartments, which provided significant information (see Fig. 6.3):

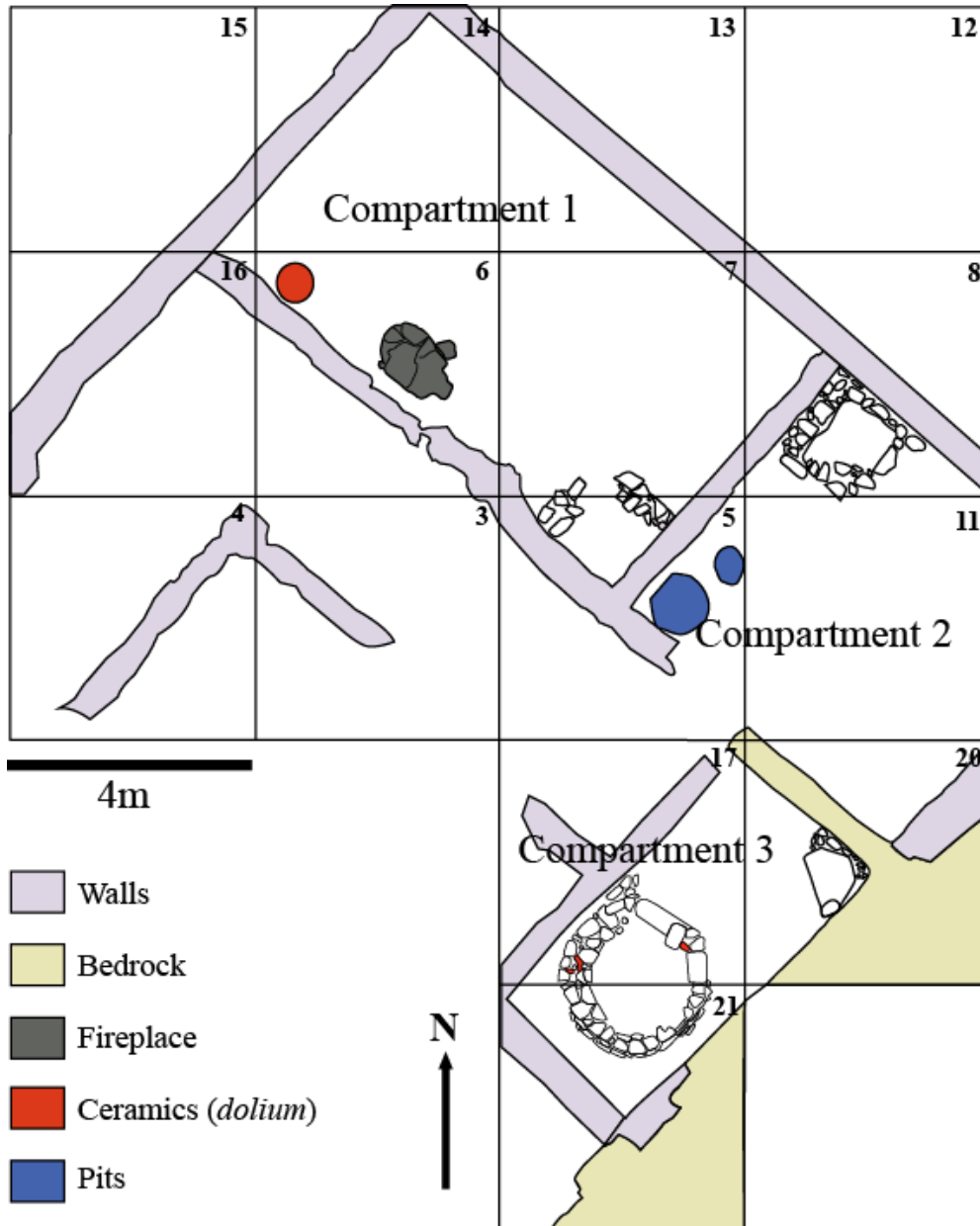


Figure 6.3 – Plan of the Sector A - 2008

- In the Compartment 1, at north, a fireplace was found next to the southwestern wall, constituted by a large granite slab. Nearby sediments had conspicuous carbonized plant materials. West from this context, a *dolium* was found buried in the



ground with its mouth at the floor level. Two small walls, addorsed to the southeastern corner walls, form a quadrangular structure which was initially interpreted as a storage facility. A radiocarbon date was obtained with plant materials from this structure (Table 6.3). The contexts next to the northern wall were excavated in the 1940's with unknown results.

- In the Compartment 2, at East, a rectangular structure, similar to that of the Compartment 1 was found in the northwestern corner. Between this and the southwestern wall, two circular pits were excavated.

- Compartment 3, at South, is a small compartment created with the erection of a wall (its western wall) which was not in the original plan. In the northeastern corner of this compartment we find a structured fireplace (granite slab in the bottom and stone jambs). The rest of the compartment is filled with a circular oven whose typology suggests its use for food preparation (e.g. making bread) and not for the manufacture of artifacts (ceramics, glass, metal).

Although the existence of more than one phase is clear in the architecture of the area, the fact is that there is evidence of a single phase in the sedimentary sequence. In fact, the stratigraphy of the area is characterized by the presence of consecutive destruction levels with abundant stones, covering occupation and abandonment layers which are difficult to define since they appear to be, somehow, mixed with the lowest destruction levels of the walls and roof. Although some overlapping between occupation/abandonment layers was found, they do not correspond in fact to successive and different occupation phases, being interpreted rather as derived from the gradual destruction of the structures after its abandonment.

Regarding the archaeological artifacts, this area is also unique, since, contrary to the rest of the settlement, most of Sector A - 2008 provided few artifacts. Imports are rare and most of the ceramic vessels are common domestic ware. Fragments of *dolia* are rather frequent as well as fragments of round quern stones. The few fragments of *Terra sigillata* provided relevant chronological information, some pointing out to the 2<sup>nd</sup>/3<sup>rd</sup> centuries AD and other to the 4<sup>th</sup> century AD. This matches the radiocarbon date obtained in Compartment 1.

Already in early stages of this sector's interpretation, the specificities of its plan and its architecture led to the suggestion that it was not an area used for habitation purposes (Tereso

et al. 2010). This can justify the rarity of the imported fine ware, glass, and other artifacts, when compared with the rest of the settlement.

## 6.2. Materials and Methods

69 samples were recovered in several units of stratification (U.S.) from Sector A - 2008, mainly covering the compartments 1 and 2 (Fig. 6.3). Here we will address only these two compartments. Sampling strategy and samples' size was limited by the fact that samples were not going to be processed in the site and had to be transported to the laboratory of the Faculty of Sciences, University of Porto, to be floated.

Still, most of the deposits from the destruction and occupation levels were sampled and the amount of sediment recovered in each deposit varied from 7 to 23 liters, depending on the nature of each deposit.

As mentioned before, despite existing different stratigraphic levels, mostly destruction levels, all samples seem to come from a single occupation phase. This is represented by consecutive moments of destruction of structures and deposition of sediments, all occurring after the abandonment of the site and incorporating the remnants of the last phase when the buildings were used. Figure 6.4 illustrates the position of each sampled U.S. in the stratigraphic sequence from each compartment and the interpretation of each U.S.

Flotation was carried out using a column of sieves with 2mm, 1mm and 0,5mm. Subsampling was applied to the sorting of some 1mm and 0,5mm meshes content (see Table 6.1) either because of their great amount of plant remains or because of the lack of material that made complete sorting too time consuming for the information provided. The individual processing of distinct field samples from the same units of stratification led to variations in the percentages of the sorted material from each u.s. Thus, in case of sub-sampling, sorted material ranged from 34% to 88%. Results from these stratigraphic units, presented in the following tables, are estimates.

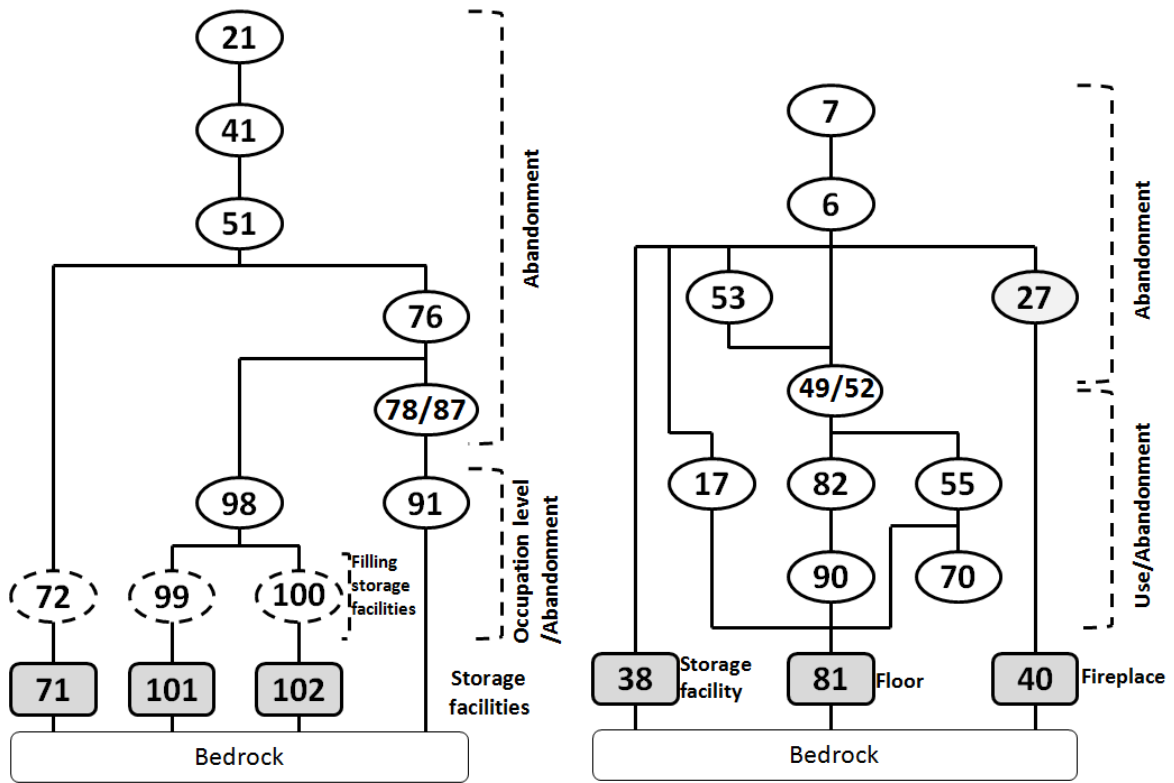


Figure 6.4 – Harris matrix from Compartment 1 (left) and Compartment 2 (right)

U.S.	Mesh	Sub-sample (%)
6	0,5	51
17	0,5	34
21	0,5	43
27	0,5	65
41	0,5	52
51	0,5	39
52	0,5	64
53	1	51
55	1	35
78	0,5	71
	1	88
82	0,5	49
	1	63
87	0,5	34
99	0,5	43

Table 6.1 – Percentage of sorted material from sub-sampled u.s.

The identification of the plant remains was done by comparing them with the reference collection of the Faculty of Sciences, University of Porto, as well as with anatomical atlases (e.g. Jacomet 2006, Fuller 2006, Nesbitt 2006, Berggren 1981) and several works of specialty. It is implicit in this study that designations in text and tables refer to morphological types. This happens because the identification of species from some families may be particularly difficult, mostly due to overlapping morphological criteria. The most paradigmatic case is that of the Gramineae, but some difficulties arise in other families. Within the Gramineae the case of some cultivated cereals must be addressed in detail.

In case of millets, *Panicum miliaceum* and *Setaria italica* are the most common species found in Iberian archaeological sites. Their distinction based on the morphology of the grains can be difficult, depending on the preservation of the remains. Based on the criteria of R. Buxó (1997), D. Fuller (2006) and S. Jacomet (2006) we distinguished grains (sometimes lemma and palea) from four different morphologies:

*Panicum miliaceum* - grains ellipsoidal to roundish in shape, with a roundish hilum. The scutellum is broad, usually oval and barely reaching the half of the grains' length. Surface of the lemma and palea presents a smooth surface with rectangular-shaped cells forming longitudinal lines.

*Setaria italica* - grains smaller than those of *Panicum miliaceum*. They have a narrow but long hilum, reaching more than half of the grain's length. Surface of the lemma and palea presents papillae.

*Panicum miliaceum/Setaria italica* (abbreviated as *Panicum/Setaria* in the tables)– This designation was used whenever millet grains could not be addressed to *Setaria italica* or *Panicum miliaceum*, mostly due to bad preservation or because of overlapped identification morphological criteria.

*Setaria* (undetermined) – grains with this designation are different from the previous type, mostly in the shape of the scutellum (long, as in *Setaria*, but sometimes growing in width towards its end) and the smaller size of the grain. It is likely to include wild species, such as *Setaria faberi*, *Setaria verticillata* and *Setaria pumilla*. It may include also underdeveloped grains of *Setaria italica*. A recent study of Motuzaite-Matuzeviciute et al. (2011) demonstrates great variability in *Panicum miliaceum* grains due to immaturity, thus a similar effect and inherent identification problems may have existed

in the case of *Setaria italica* grains. Nevertheless, in the syntheses tables, *Setaria* – undetermined is considered among the wild Gramineae.

Regarding naked wheat grains, two morphological types were considered. *Triticum aestivum/durum* was defined by R. Buxó (1997) and includes *T. aestivum* L. subsp. *aestivum*, *T. turgidum* L. subsp. *durum* (Desf.) Mackey, and *T. turgidum* L. Subsp. *turgidum*. Grains are oval or oval-roundish, with maximum width in the center or near the scutellum and blunt ends; it has a swollen aspect and is plain-convex in the ventral surface, in side-view. The second morphological type is *Triticum* “stubby grains”, defined by S. Jacomet (2006), referring to grains which are shorter and more roundish than those of the *T. aestivum/durum* type.

Whenever identification was not possible, grains were attributed to *Triticum* or Triticeae, for grains which cannot, without any doubt, be attributed to the genus *Triticum* but are not small-roundish millet type grains. The number of individual grains was calculated by counting whole grains and, within the fragments, those with the scutellum.

The remains of chaff were discriminated by using the criteria of S. Jacomet (2006) and G. Hillman et al. (1996). Rachis internodes of *T. aestivum* are curved and have longitudinal lines (conspicuous or, sometimes, not clearly visible) and nodes have minor or no lumps at all. The rachis internodes of *T. turgidum/durum* are straight, plain and nodes have clear lumps. On the other hand, rachis fragments of *Secale cereale* are smaller, the internode is robust and straight-sided; the small base of the glumes is visible laterally in the node. The counting of rachis fragments was done by enumerating the nodes.

## 6.3. Results and discussion

### 6.3.1 Storage in Compartment 1

Data from Compartment 1 (Table 6.2) points out to a great discrepancy in the results obtained from the different samples. Most of the sampled u.s. provided few fruits and seeds, although they provided significant amounts of charcoal, probably related to the fireplace – a great schist slab - found next to the southern wall. In most of the samples few or even no crops’ remains were recovered.

U.S.	6	6	17	27	49	52	53	55	70	81	82
Square	6	5	6	6	6	7	7	6	6	6	6_14
Weight (g)	8195	8365	14282	8775	10203	15976	7334	7891	7376	9827	10755
Volume (l)	6	6	13,25	7	10	15	6	6,1	5,5	8,5	9,5
<b>Cereals - grains</b>											
<i>Panicum miliaceum</i>		224				2					1
<i>Setaria italica</i>		172				1					2
<i>Panicum/Setaria</i>		188				1			1		2
<i>Secale cereale</i>		47									
Triticeae		10									
<b>Other Gramineae</b>											
<i>Arrhenatherum elatius</i> subsp. <i>bulbosum</i> (pseudobulb)						1					
Gramineae (grain) - undetermined											2
<b>Leguminosae (seeds)</b>											
<i>Astragalus</i>	2										
Genisteae	2				7	12		1	8		140
<i>Vicia sativa/angustifolia</i>		1									
Leguminosae - undetermined	4			1							
<b>Polygonaceae (achenes)</b>											
Polygonaceae - undetermined			3								
<b>Other plants</b>											
<i>Cirsium/Carduus</i> (achene)								1			
<i>Corrigiola litoralis</i> (achene)							2		3		
<i>Montia fontana</i> (seed)		1									
<i>Pinus pinaster</i> (seed)											22
Rosaceae (achene)		2									
<i>Sesamoides</i> (seed)		2				3	6		1		
<i>Spergula arvensis</i> (seed)	2			1		3	1		2		
<i>Vitis vinifera</i> (seed)			2								
Undetermined	3	21	2			2	2		2	1	
<b>Total</b>	13	668	7	2	7	24	11	2	17	1	168
<b>Plant Remains per litre</b>	2,2	111,3	1,2	<1	1,2	4,0	1,8	<1	2,8	<1	28,1

Table 6.2 – Carpological remains from Compartment 1

U.S. 6, from square 5 is in clear contrast with the general scenario. This deposit was found throughout the compartment and it corresponds to an abandonment level. Sample from square 5 was taken inside a quadrangular storage structure in the corner of the compartment. It was the only deposit filling the structure. Results greatly suggest the storage function of this structure: millets (*Panicum miliaceum* and *Setaria italica*) are abundant but grains of rye (*Secale cereale*) were also found (radiocarbon date was obtained from these). *Panicum miliaceum* is the most abundant crop in the storage structure although the distinction between

this and *Setaria italica* was not always easy, particularly in bad preserved, overheated, grains, leading to abundant remains identified as *Panicum miliaceum/Setaria italica*. Even though few of the millets had part of the glumes still adhered, chaff was not thoroughly retrieved, suggesting millets and rye were stored fully processed. Unfortunately, only one soil sample was taken from this context – 6 litters – and the total amount of sediment from u.s. 6 inside this structure was not calculated.

An AMS dating was obtained over grains from *Secale cereale* recovered in this u.s. The results point to a most likely chronology within the 3<sup>rd</sup> century or the beginning of the 4<sup>th</sup> (Table 6.3).

Laboratory Code	Sample	<sup>14</sup> C yr BP	Calibration 1 Sigma	Calibration 2 Sigma
Beta-309441	Grains from <i>Secale cereale</i>	1770±30	[cal AD 228: cal AD 262] 0,429322	[cal AD 137: cal AD 202] 0,119654
			[cal AD 278: cal AD 329] 0,570678	[cal AD 205: cal AD 345] 0,880346

Table 6.3 – Radiocarbon date obtained from rye grains in u.s. 6, inside the storage structure. Calibrated with Calib Rev 6.0.1 (Reimer et al. 2009)

In clear contrast with this storage structure, the u.s. 70, which was recovered inside of a *dolium*, provided few remains: only one millet grain and some seeds from wild plants. This is in consonance with most of the deposits found inside this compartment suggesting that the small assemblage of remains which were found inside the buried vessel was not the result of any storage practice.

The rest of the sampled deposits provided few remains and only in u.s. 82 significant amount of seeds were recovered. This sedimentary context was excavated near the fireplace. Most of the carpological remains are Genisteae (a tribe within the Leguminosae that includes several shrubby species from *Genista*, *Cytisus*, *Adenocarpus* and *Ulex*, very common in the region) and *Pinus pinaster*, contrasting with the few millet grains. Cone scales from *Pinus pinaster* are also very abundant. The abundance of such remains suggests these to be mostly related to the use of the fireplace, since seeds could easily be incorporated in the gathered wood from shrubby Leguminosae (Genisteae) and the cones from *Pinus pinaster*, very appreciated to start fires (Carvalho 2005). Charcoal analyses, still being carried out, testify for the presence of wood from both types.



Figure 6.5 – Leguminosae: 1, *Ornithopus* (segment of loment); 2, *Ornithopus* (seeds); 3, *Vicia sativa/angustifolia* (seed); 4, Genisteae (seed). Scale bar=1mm.

The presence of shrubby leguminosae in other deposits in this compartment seem to testify for its relation with the use of the mentioned fireplace – or even other eventual not structured small fireplaces in the compartment. Seeds from weeds, although rare, may testify for their use as fuel.

Two of the few charred grape pips (*Vitis vinifera*) from this sector were found in u.s. 17, a deposit with abundant charcoal but few seeds, related with the mentioned fireplace.



### 6.3.2. Storage, food and fodder in Compartment 2

The carpological assemblages from compartment 2 are very different from those of Compartment 1. In general, they are richer and more diverse. The compartment is smaller but three storage structures were found: two storage pits and one quadrangular structure in the northwest corner, similar to that of Compartment 1.

In the storage structures, few plant remains were found, suggesting these were not being used when the fire event that allowed plant remains to be preserved occurred. The few carpological remains are probably occasional elements left in the structures after its last use (see Table 6.4). One of the two storage pits – u.s. 102, filled with the deposit 100 – did not provide any carpological remains, and in the other – u.s. 101, filled with the deposit 99 – few remains were retrieved. These are grains of millet (*Panicum miliaceum* and *Setaria italica*) and naked wheat (*Triticum aestivum/durum*); one grape pip (*Vitis vinifera*). Seeds from wild species are rare.

The quadrangular storage structure – u.s. 71, filled with the deposit 72 – provided millet grains (mostly *Panicum miliaceum*) and few grains of rye (*Secale cereale*). Remains from wild species are very rare.

The scarcity of remains in the storage facilities contrasts with its abundance in the destruction levels excavated throughout the rest of the compartment (u.s. 21, 43, 51, 76, 78, 87, 91 and 98) particularly in its centre (square 11) (see table 6.4). In these, cereals are very abundant, namely *Secale cereale* (grains and rachis), *Setaria italica*, *Panicum miliaceum*, *Avena*, *Triticum aestivum/durum* (grains and rachis, including frequent basal rachis internodes) and *Triticum aestivum* (rachis fragments). One poorly preserved spikelet fork from emmer or spelt (*Triticum dicoccum/spelta*) was found as well as carbonized fragments of straw (not quantified fragments of culm). The only pulse eventually cultivated found in this compartment is vetch - *Vicia sativa/angustifolia* (*Vicia angustifolia* = *Vicia sativa* subsp. *nigra*). This Leguminosae is a widely known fodder-crop, although it could have been consumed by humans (Bouby and Léa 2006). Roman agricultural writers such as Columella (Res Rus. II, X, 24-30) mention the use of vetch (*vicia* in the original text) as fodder-crop although we must question to which species (of *Vicia* or even *Lathyrus*) was he referring to. However, we cannot discard the possibility that these seeds belong to ruderal plant communities or weeds, thus not cultivated (Romero Zarco 1999). It is not very abundant in the studied samples.

What is more striking in Compartment 2 is the abundant presence of seeds from wild plants. Despite the predominance of Gramineae and Polygonaceae, there is a considerable diversity of

wild plants. The most common is *Rumex bucephalophorus* type. Regardless of some morphological overlap of the achenes from Polygonaceae and, in particular, from the genus *Rumex*, the shape of these, together with its very small size, makes it very likely to be from the eponymous species of this morphological type. The same happens with *Rumex acetosella*, mostly type 2, smaller than type 1. Both species are very common in grasslands and fallow land but can also be found as weeds in several crops' fields (López González 1990). The other Polygonaceae recorded can be found in these ecological contexts.



Figure 6.6 – Wild Gramineae: pseudobulbs from *Arrhenatherum elatius* subsp. *bulbosum*. Scale bar=5mm.

Regarding the Gramineae, it is difficult to interpret the assemblages since most morphological types were identified at the genus or tribe level. Even the correspondence between morphological types and specific genera is sometimes difficult. As a result, a very relevant group of caryopses was named at the tribe level, namely the type Poaeae-undetermined. This morphological type excludes genera from the same tribe, namely *Vulpia* and *Briza*, with distinct caryopses. Caryopses from type Poaeae-undetermined are similar to that of the genera *Lolium* and *Festuca*, although we cannot exclude other genera.

Moreover, the autochthonous character of some genera named here— such as *Digitaria* and *Lolium*— needs further confirmation from other sources. The problematic identification of Gramineae caryopses makes carpological studies unsuitable to solve such question. Identification at the species level was possible in the case of *Briza maxima*, due to its characteristic caryopses, and *Arrhenatherum elatius* subsp. *bulbosum*, since pseudobulbs from this species were found (caryopses from the morphological type *Arrhenatherum* may be from this species). These genera, together with *Setaria* can be found as weeds in cereal cultures, in

ruderal contexts, grasslands, pastures and clearings in forest areas (Pinho and Pinho 1998, Aguiar 2000, Honrado 2003). Such ecological amplitude makes their interpretation difficult.

Native species from the genus *Vulpia* are common in coastal areas and natural or cultivated pastures.



Figure 6.7 – Caryopses from the tribe Poeae: 1, *Briza maxima*; 2, *Vulpia*; 3, Poeae-undetermined type.

Scale bar=1mm.

Other relevant remains are those of the genera *Plantago* that includes several ruderal species common in pastures and fallow fields in the region as well as several other contexts associated with the presence of humans (Pinho and Pinho 1998, Pedrol 2009); *Ornithopus*, common in grasslands and pastures (Talavera and Arista 2000); *Galium*, common as weeds or in several ruderal contexts and fallow land (Ortega Olivencia and Devesa 2007); *Sesamoides*, usual in pastures, scrubland and heathland (López González 1996). *Anagallis arvensis* can be found as a weed or in fallow land and ruderal contexts (Pujadas 1997) and *Reseda media/phyteuma* are found in similar contexts as well as in scrublands (Valdés Bermejo 1996). *Raphanus raphanistrum* is a common weed in cereal cultures (Hernández Bermejo 1996). In the region of

the Lower Tâmega, not far from Monte Mozinho, it is found nowadays in association with rye (personal observation).



Figure 6.8 – Carpological remains from several wild plants: 1, *Galium* (mericarp); 2, *Raphanus raphanistrum* (siliqua segment); 3, *Sesamoides* (seed); 4, *Plantago* (seed); 5, *Rumex bucephalophurus* (achene). Scale bar=1mm

As we have pointed out, in the assemblages from Compartment 2 we find grains from crops usually cultivated for human consumption (naked wheat, rye and millets), chaff from rye and wheat, an eventual fodder-crop (vetch) and very abundant seeds from weeds and ruderal plants. The latter, together with *Vicia sativa/angustifolia* (included in the calculation due to its ambiguous nature), represent major percentages of all the u.s. sampled, mostly above 80% (see Table 6.5). Thus we must focus on the eventual presence of two origin points for the plant material recovered: on one hand cereals harvest and processing and, on the other, pastureland or fallow land. Still, the two are very difficult to distinguish, since many of the species which are associated with pasturelands and grasslands nowadays can also be found as weeds in agricultural fields or bordering those fields. This happens even with vetch (Pinho and Pinho 1998).

	U.S.	21	41	51	72	76	78	87	91	98	99
Square		8_11	11	11	8	8	11	8_11	11	5	5
Weight (g)		13750	8351	7784	7125	728	21470	22925	8539	1524	13201
Volume (l)		12,5	7,5	6,5	6	0,75	20	21,2	7,5	1,1	10,2
<b>Cereals - grains</b>											
<i>Avena</i>		3	1	21			131				
<i>Hordeum vulgare</i> subsp. <i>Vulgare</i>									1		
<i>Panicum miliaceum</i>		27	9	21	11	3	17	5		3	7
<i>Setaria italica</i>		21	21	54	1		166	6			9
<i>Panicum/Setaria</i>		11	19	9		8	16	2			4
<i>Secale cereale</i>		19	4	60	5	5	184	8	1		
<i>Triticum aestivum/durum</i>		7	4	3			84	1			3
<i>Triticum</i> "stubby grains"							6				
<i>Triticum</i>		3	2				2				
Triticeae		7	5	20	5	4	54	5			
<b>Cereals - chaff</b>											
<i>Secale cereale</i> (node)		51	27	127			932		1		
<i>Triticum aestivum</i> (node)		2	1				271				
<i>Triticum aestivum/durum</i> (node)		1	5	3			361				
<i>Triticum dicoccum/spelta</i> (fork)							1				
<b>Other Gramineae</b>											
<i>Arrhenatherum</i> (grain)		14	9	49			198				
<i>Arrhenatherum elatius</i> subsp. <i>bulbosum</i> (pseudobulb)		1					17				
<i>Briza maxima</i> (grain)		1	1	11			15	1			
<i>Digitaria</i> (grain)		24	27	77			60	8			
<i>Hordeum</i> (grain)							5				
Poeae (grain) - undetermined		65	36	243			54	10			
<i>Setaria faberi/verticillata</i> (grain)			2				37				
<i>Setaria</i> (grain)		1					36				
<i>Vulpia</i> (grain)		47	19	160			393				
Gramineae (grain) - undetermined		89	44	267			217	11	1		1
<b>Leguminosae</b>											
Genisteae (seed)		3		6			5	211	2		3
<i>Ornithopus</i> (seed)		6	12	6			60	12			
<i>Ornithopus</i> (loment segment)			1				7				
<i>Vicia sativa/angustifolia</i> (seed)		2	2	2			14		2		
<i>Vicia hirsuta</i> (seed)							3				
<i>Vicia tenuifolia</i> (seed)		2		6			3				
Leguminosae (seed) - und.							1				

Table 6.4 (1) – Carpological remains from Compartment 2

U.S.	21	41	51	72	76	78	87	91	98	99
Square	8_11	11	11	8	8	11	8_11	11	5	5
Weight (g)	13750	8351	7784	7125	728	21470	22925	8539	1524	13201
Volume (l)	12,5	7,5	6,5	6	0,75	20	21,2	7,5	1,1	10,2
<b>Polygonaceae (achenes)</b>										
<i>Fallopia convolvulus</i>			3			2				
<i>Polygonum aviculare</i>	35	10	4			135				
<i>Polygonum lapathifolium</i>			1			2				
<i>Polygonum persicaria/minus</i>	1		1			2				
<i>Polygonum</i> - lenticular						4				
<i>Rumex acetosa</i>			3			7				
<i>Rumex acetosella</i> type 1 (small)		6	3			1				
<i>Rumex acetosella</i> type2 (large)	13	12	5			88				
<i>Rumex bucephalophorus</i>	587	358	465			1543	8			
cf. <i>Rumex bucephalophorus</i> (achene and perianth)	18	5	33			62				
Polygonaceae - undetermined	87	68	38			265	2			
<b>Other plants</b>										
<i>Anagallis arvensis</i> (seed)	14	36				7				
Chenopodiaceae (seed)	2					10				
<i>Cirsium/Carduus</i> (achene)	3		3			2				
Compositae (achene)		2	8			24				
<i>Corrigiola litoralis</i> (achene)		4	4			1	4			
<i>Galium</i> (mericarp)	6	11			1	1				
<i>Plantago</i> (seed)		5				22				
<i>Raphanus raphanistrum</i> (silique segments)	10	4	19			54	1			
<i>Raphanus raphanistrum</i> (seed)						4				
<i>Reseda media/phyteuma</i> (seed)						1				
<i>Rubus</i> (achene)		1				5				
<i>Sambucus nigra</i> (stone)				1						
<i>Sesamoides</i> (seed)	3	2	3	1		6	5			
<i>Silene</i> (seed)						5				
<i>Solanum</i> (seed)						4				
Umbelliferae (mericarp)	21	3	32			177				
<i>Urtica</i> (achene)	3					4				
<i>Vitis vinifera</i> (seed)										1
Undetermined	138	73	68	3		414	22	1		9
<b>Total</b>	1352	849	1835	27	21	6203	321	9	3	37
<b>Plant Remain per litre</b>	108	113	282	5	28	310	15	1	3	4

Table 6.4 (2) – Carpological remains from Compartment 2 (Cont.)

First we analyze the presence of grains from domestic cereals and its by-products. These by-products certainly included chaff but also weeds. Unfortunately, the presence of several crops in the same samples does not allow us to know which weeds correspond to which crops. Differentiated cultivation and processing of crops surely occurred since wheat and rye, on one

hand, and millets, on the other, demanded different post-harvest processes. This can mislead interpretations regarding the by-products of such processes and prevents the identification of the stage, or stages, of crops' processing represented in the assemblages. Still, while the predominance of carpological remains with sizes between 0,5mm and 1mm (see Table 6.5) could suggest an advance stage of processing, the presence of significant amount of cereal grains as well as basil rachis internodes from wheat suggests otherwise (Jones 1996, Van der Veen and Jones 2006). Thus it is possible that different stages of cereals processing are represented in the assemblages.

Nowadays, pastures and fallow land (many times used as pasture) are the main habitats of many of the wild species identified in Compartment 2, although some can be weeds to some crops.

Rural communities tend not to waste useful by-products, such as weeds and chaff (Foxhall 1996, Jones 1996, Derreumaux 2005). In fact, these can be very valuable as they are used for some specific purposes, determinant for the subsistence of communities, namely as litter, fodder or organic compost to fertilize agricultural fields (Foxhall 1996, Jones 1996, Derreumaux 2005). It is not likely that Compartment 2 was a place for storage of organic compost since this is usually stored outdoors and, even if it occurred indoor it is not likely to occur near storage facilities and a oven. For the same reasons, it is improbable that animals were kept in the area and, even if they were, the frequent presence and the good preservation of cereal grains do not suggest either the presence of dung or the use of these by-products as animal bedding.

Thus, it is more likely that if storage of by-products occurred in this compartment these were to be used as fodder. This compound is placed in an area far from the center of the settlement, not far from the outer wall, thus a stable area could exist in the surroundings. Future work may elucidate such question. Still, the occurrence of many species (most of them wild but one possibly cultivated) usually associated to pasture and fallow land may imply the presence of plants managed and cut for fodder.

Thus, regarding the interpretation of the plant assemblages from the dispersed contexts in Compartment 2 as remnants of fodder, there are three different possibilities to be considered: 1) the assemblages represent a mixture of by-products of crops processing (grains and chaff from several cereals, weeds) and hay; 2) there are only by-products of crops processing and the eventual pastureland species are in fact weeds; 3) it is cultivated mixed fodder. The first and/or second hypotheses seems the most likely to have occurred. As noted before, evidences

suggest the presence of crops' by-products and plants cut from cultivated or natural grasslands (i.e. hay). Still, the ecological amplitude of some species usually associated with grasslands does not allow us to discriminate these from weeds. The third hypothesis is also possible but less likely. Colummela (Res Rus. II, X, 24) refers the cultivation of mixed fodder, mainly composed of barley and oat. Although oat is quite frequent in the samples, only one grain of barley was found. One must not exclude the possibility that other cereals, such as wheat, millet and rye, were used in mixed fodder cultivation strategies but these were not the most usual crops for that effect and the almost absence of barley would be surprising, particularly since this crop was known and cultivated by these communities.

The possibility of fodder having been stored in Compartment 2 makes the interpretation of *Avena* grains difficult. No remains of oat were found inside any storage facility, either pits or quadrangular storage structures, or inside the *dolium*. It is a known fodder crop, mentioned by Columella (*vide supra*), but its human consumption is also frequent. It can also be a weed in other cereals' fields. The presence of oat grains in these samples can derive either from cultivation of fodder or from by-products of cereals processed for human consumption.

As for Genisteeae they are very common in the region, being the main components of vast scrublands; they are recurrent in fallow land and bordering agricultural fields. They were most likely also used as fodder. It remains to be explained why Genisteeae seeds are only abundant in u.s. 87.

In the end, a last question emerges: how are these assemblages related to the storage structures found in the compartment? The first and more straightforward interpretation for the plant remains found in this compartment, in an early stage of the archaeobotanical work, was that the abundant weeds and chaff were related to crops processing and that this occurred prior to storage, since by-products are extremely rare in the storage facilities (Tereso et al. 2010). Some stages of processing could have occurred inside the compartment, which excludes winnowing, but it is not completely clear that these remains represent such early stage, despite the presence of few (not quantified) culms (i.e. straw).

As pointed out, the interpretation of the carpological remains may not be this simple. It is not certain that what was stored in the pits and rectangular structures (here we include also that from Compartment 1) was not to be used as animal fodder since, as G. Jones (1996) suggests, there might not have been real differences between the storage facilities used for those two purposes. In fact, one of the problems in distinguishing fodder crops and those consumed by



humans is that they could be stored together and their processing was not necessarily different. Still, although clean grain could be used to feed animals, human consumption was most likely its primary purpose. We must stress Columella words when referring to those who neglect weeding: “it is no mark of a wise husbandman to be more concerned with fodder for cattle than with food for man” (Res Rust. II, XI, 6-7). G. Jones (1996) stresses that the use given to a particular stored crop could be decided afterwards, dependently of several factors such as grain preservation and the success or not of the following harvest (Jones 1996). Thus clean grain, when stored, could be fed to animals, given certain factors. This only stresses the fact that its primary use was for human consumption. Still, it is clear that the assemblages found outside the structures, spread throughout the compartment 2, were not for human consumption since, although they are grain-rich, there is a major presence of weeds and chaff as well as some vetch seeds. The most likely use for these by-products is as animal fodder.

<b>u.s.</b>	6	21	41	51	78	87
<b>Compartment</b>	1	2	2	2	2	2
<b>1<sup>st</sup> crop</b>	<i>Panicum miliaceum</i>	<i>Secale cereale</i>	<i>Secale cereale</i>	<i>Secale cereale</i>	<i>Secale cereale</i>	-
<b>2<sup>nd</sup> crop</b>	<i>Setaria italica</i>	<i>Panicum miliaceum</i>	<i>Setaria italica</i>	<i>Setaria italica</i>	<i>Triticum aestivum</i>	-
<b>3<sup>rd</sup> crop</b>	<i>Secale cereale</i>	<i>Setaria italica</i>	-	<i>Panicum miliaceum /Avena</i>	<i>Setaria italica</i>	-
<b>1<sup>st</sup> wild</b>	-	<i>Rumex bucephalop.</i>	<i>Rumex bucephalop.</i>	<i>Rumex bucephalop.</i>	<i>Rumex bucephalop.</i>	Genisteae
<b>2<sup>nd</sup> wild</b>	-	Poeae-und.	Poeae-und./ <i>Anagallis arvensis</i>	Poeae-und.	<i>Vulpia</i>	<i>Ornithopus</i>
<b>3<sup>rd</sup> wild</b>	-	<i>Vulpia</i>		<i>Vulpia</i>	Arrhenatherum	Poeae-und.
<b>Crops - grains (%)</b>	95,9	7,3	7,6	10,2	10,6	8,4
<b>Chaff (%)</b>	0	4	3,9	7,1	25,2	0
<b>Wild (%)</b>	4,1	88,7	88,5	82,7	64,1	91,6
<b>Wild Gramineae (%)</b>	0	20,3	18,4	53,2	25,9	10,1
<b>Polygonaceae (%)</b>	0	61,8	61,0	36,6	53,1	3,4
<b>Leguminosae (%)</b>	3,7	1,1	2	1,3	2,3	75,8
<b>Wild - &gt;2mm (%)</b>	0	0,6	12,8	8,5	0,6	0
<b>Wild - 1-2mm (%)</b>	100	9,5	7,1	14,2	18,5	57,1
<b>Wild - 0,5-1mm (%)</b>	0	89,9	80,2	77,3	81	43
<b>Total - 2mm (%)</b>	0	5,6	9,3	13,1	9,7	5,3
<b>Total - 1mm (%)</b>	100	11	15,7	16,5	12,3	54,2
<b>Total - 0,5mm (%)</b>	0	83,1	75	70,4	76,6	40,6

Table 6.5 – Synthesis of the carpological content from Compartments 1 and 2. References to the more abundant crops and wild plants are restricted to species with a minimum of 10 remains.

The eventual storage of crops for human consumption and fodder in the same compartment is not impossible (Jones 1996), still crops inside the storage facilities are residual, suggesting these structures were empty when the compound was abandoned. Even the almost 600 millet grains (*Panicum miliaceum*, *Setaria italica* and *Panicum/Setaria*) found in the rectangular structure from Compartment 1 comprise only c. 0,73g of plant remains in 8365g of sediment. The nature of the event that led to the carbonization of the plant remains is not known. There are no signs suggesting that a fire was responsible for the destruction of these compartments but one cannot exclude punctual fire after the abandonment or before, for cleaning or other purposes unclear today.

#### 6.4. Agriculture in Monte Mozinho

Data from the sampled contexts in the compound of Sector A - 2008 give valuable information regarding the agriculture of the human communities that inhabited this settlement in the 3<sup>rd</sup>-4<sup>th</sup> centuries AD. Still, it is clear that this information is partial. The inexistence of pulses usually cultivated for human consumption must not be overestimated. In Roman sites from northwest Iberia, *Vicia faba* is a very common crop in the region and *Pisum sativum* is also present (Ramil Rego 1993, Ramil Rego et al. 1996, Dopazo Martínez et al. 1996, Oliveira 2000). Their absence in the studied samples from Monte Mozinho is not informative of the agriculture of these communities rather it is informative about the function of the compartments that were studied. Pulses for human consumption may have been processed or stored elsewhere, at least in the last usages of these areas.

Thus, the information available concerns cereal agriculture. In this manner, seven different crops were identified. Grains from millet – *Panicum miliaceum* and *Setaria italica* – are abundant. *Panicum miliaceum* is slightly more abundant than *Setaria italica* in Compartment 1, particularly in the quadrangular storage structure, but the contrary is verified in Compartment 2.

Rye is the most abundant crop in Compartment 2. Grains appear in considerable amounts and chaff is very abundant, suggesting this to have been a relevant crop in this stage. This is in clear contrast with archaeobotanical data from the region and, overall, from the whole Iberian Peninsula, where rye is rare in Roman sites. It has been found in some Late Roman sites in northeast Iberia (Buxó 2005) but it is rare in western Iberia (Tereso et al. 2010). Thus, the

presence of rye in Monte Mozinho is highly relevant although it is difficult to assess the role of this crop on a regional level.



Figure 6.9 – Millets: 1, hulled *Setaria italica*; 2, *Setaria italica* (caryopsis); 3, *Panicum miliaceum* (caryopsis). Scale bar=1mm

Remains from naked wheat were also very significant. Most are rachis fragments but the fact is that the presence of grains is also important. Those rachis fragments which were possible to identify at species level, correspond to the hexaploid species, *Triticum aestivum*. Although it is impossible to demonstrate, due to the morphological similitude of *T. aestivum* and *T. durum* grains, data from chaff suggest that only one naked wheat species was present in the samples studied: *T. aestivum*. The presence of six stubby grains is not considered relevant. It is not likely that these correspond to a different crop. The little amount of grains with this morphology suggests these to be underdeveloped grains from *Triticum aestivum* (interpretation that would be discarded in samples where these grains predominate -Ramil Rego and Aira Rodriguez 1993) or grains severely affected by fire (about the effect of fire in grains morphology see Braadbaart 2008).

Hulled wheat is represented merely by one spikelet fork from emmer or spelt (*Triticum turgidum* subsp. *dicoccum* or *Triticum aestivum* subsp. *spelta*).

The presence of *Avena* is also significant, particularly in Compartment 2. Despite the difficulties in the interpretation of these grains due to the general content of the samples (*vide supra*), oat was an important crop in the region since the Iron Age.

Regarding hulled barley (*Hordeum vulgare* subsp. *vulgare*), only one grain was retrieved in the studied samples. Still this crop seems to have been very important in the region. It was recovered in several Roman sites, such as Terronha de Pinhavelo (Macedo de Cavaleiros) (Tereso 2009), Ermidas (Vila Nova de Famalicão) (Queiroga 1992) and San Cibrán de Las (Ourense) (Unpublished).

Generally speaking, the crops available may indicate the exploitation of different agricultural areas. Naked wheat is considered to be a more demanding crop in terms of soil and climate while rye is well adapted to poor soils and resists well to winter frost. These two crops are usually used complementarily in traditional agricultural systems, in order to make possible the optimization of the territory by using different fields with quite different characteristics in terms of soil and sun exposure. In Tras-os-Montes (Northeast Portugal), traditional farmers in the 1960's used the best soils and those with better sun exposure to cultivate wheat and fields with opposite conditions for rye (Santos Júnior 1977). Different seasonality could be associated with these distinct crops. Hulled wheat could have had a role similar to that of rye and barley is also a crop well adapted to harsh conditions (Smartt and Simmonds 1995). The cultivation of oat may have occurred for animal feeding, for humans or for both. Distinct species of oat are well adapted to different soils and climatic conditions (Smartt and Simmonds 1995).

Due to the fact that different crops and its correspondent weeds are mixed in the same contexts, it is not possible to understand whether they correspond to winter or spring crops by using functional analysis as described by G. Jones et al. (2010) and A. Kreuz and E. Schäfer (2011). Rye is traditionally a winter crop but millets are spring crops. The ecological amplitude of millets makes it difficult to interpret it, but this amplitude was probably one of its advantages. It is a good catch crop and the fact that it is a high yielding spring crop makes it a very useful crop in case of winter crops failure (Vázquez Varela 2000, Hunt and Jones 2008).



Figure 6.10 – Cereals: 1, *Secale cereale* (rachis); 2, *Secale cereale* (caryopses); 3, *Triticum aestivum* (rachis); 4, *Triticum aestivum/durum* (caryopses); 5, *Triticum dicoccum/spelta* (spikelet base). Scale bar=2mm

Few grape pips (*Vitis vinifera*) were found in the studied samples making it impossible to apply discrimination methods to distinguish between wild and cultivated varieties. Despite the presence of grape pips in several sites from northern Portugal, as well as a small number of charcoal fragments in Roman settlements (Figueiral 1990), the cultivation of vine in northwest Iberia as never been demonstrated by palynological data (Ramil Rego et al. 1996). Still, there are no palynological sequences in the southernmost areas, near the Douro River, where

climate would favor such cultivation and where Monte Mozinho is located. In these southern areas, several structures related to wine production have been attributed to the Roman period (Almeida 1996, Morais 2004). While the chronologies of some are problematic (Sousa et al. 2006), others are not, such as that from Rumansil from the 3<sup>rd</sup> century, where grape pips were also found (Coixão and Silvino 2006). In Monte Mozinho, near the hilltop, a structure excavated in the bedrock has been interpreted as an eventual wine or olive press (Soeiro 1998). Unfortunately, contrary to what happened in other regions where chemical analyses and other approaches allowed the identification of wine and olive oil (e.g. Kimpe et al. 2001, Pollard et al. 2007, Barnard et al. 2011), in all northwest Iberia no archaeometric data were ever obtained in structures or artifacts eventually related with such products.

In Roman rural societies, plant husbandry aims not only on feeding humans. It is clear in the writings of Columella (*vide supra*). Some fodder crops were cultivated – such as vetch – but mixed fodder crops included also species consumed by humans, such as barley (Columella, Res Rus. II, X, 24). Furthermore, ethnographic studies demonstrate that some factors could lead human communities to feed animals with crops which were primarily stored for human consumption (Jones 1996). In Monte Mozinho, the most striking evidence of fodder corresponds to crops' by-products.

The use of by-products is not only common but also determinant in rural communities. It is part of a multifunctional system where tasks and products are linked. By-products of post harvest processing of crops were valuable material for rural communities since they were determinant to feed domestic animals. Grain-rich residues, such as the ones recorded in Monte Mozinho were particularly important (Foxhall 1996). The high value of crops by-products, such as chaff, is testified by ethnographic data (Jones 1996) and by archaeological and iconographic evidence of them being stored and traded in ancient Greece (Foxhall 1996). Columella also gives instruction to the proper storage of fodder (Res Rus. I, VI, 9-10). Fodder crops were also crucial to feed domestic animals in agricultural contexts.

The presence of abundant by-products and their nature is of great importance to understand agricultural strategies of the human communities that inhabited Monte Mozinho. By-products included weeds and chaff. Within chaff, rachis fragments of rye and naked wheat were particularly abundant, including basil rachis internodes of wheat. Such assemblage is considered by G. Jones (1996) as evidence of harvesting using sickle, since plucking leaves the weeds in the fields and the basil rachis internodes remain attached to the unharvested straw. For the same author, these different strategies reveal distinct agricultural strategies, namely

concerning the relevance of animal work and animal breeding in general. Harvest done by plucking is typical of systems in which animal breeding and animal work is not relevant, leading to the storage of whole spikes with little or no weeds and straw, while these remain in the fields. By opposition, a system which promotes the recovery of weeds and straw during the harvest tends to produce abundant by-products, usually used as fodder (Jones 1996). This seems to be the system identified in Monte Mozinho.

## 6.5. Conclusions

Through systematic sampling and archaeobotanical study in Monte Mozinho it was possible to shed some light on the interpretation of a compound with several buildings. The two compartments studied provided significant amount of plant remains, some scattered through the compartments, others inside specific structures. A radiocarbon date confirms a chronology comprised between the 3<sup>rd</sup> century and the first half of the 4<sup>th</sup> century AD.

Three different types of storage facilities were used in these two compartments: pits, a *dolium* at the floor level and quadrangular above-ground structures in two corners. One of these quadrangular structures provided significant amount of millet grains and the others had sparse remains. Still, none of these structures were likely to be in use when the area was abandoned.

The few remains found inside some of the structures suggest that cereals were stored as clean grain. Cereals found inside the structures were *Panicum miliaceum*, *Setaria italica*, *Secale cereale* and *Triticum aestivum*. The latter is rare in storage facilities. *Avena* was not found inside storage structures but frequent remains were found alongside chaff and weeds, thus making us question if oat was really cultivated for human consumption. Only further work in Monte Mozinho will allow addressing this question more properly. Grape pips were also found but these are occasional.

Overall, millets and rye are the main crops found in Monte Mozinho. This is in concordance with the general scenario known for the Middle Age in the region of Penafiel – where Monte Mozinho is located. The royal inquiries of 1258 AD mention the predominance of millets (possibly mostly *Panicum miliaceum*) and the significant presence of rye, naked wheat, oat and vine (Marques 1978, Santos 2003). Chestnuts, walnuts, peas and flax were also produced in Medieval times (Santos 2003) but they were not found in the two Roman compartments studied. Nevertheless, the significant presence of *Secale cereale* in Monte Mozinho is very

relevant, due to its rarity in Iberian Roman sites. Despite the prejudice of Pliny regarding the taste of this crop (Pliny, Hist. Nat. 18, 16), the fact that it is high yielding in climatic and edaphic conditions that are unsuitable for many other cereals may have been determinant in the establishment of this crop in the region during the Roman period. Even Pliny recognized that rye "will grow upon any soil, and yields a hundred-fold" (Pliny, Hist. Nat. 18, 16). Still, its rarity in western Iberia suggests it was not a very relevant crop.

The great preponderance of crops' processing by-products in Compartment 2 suggests that these were stored to be used as fodder. The principle that underlines this interpretation is that rural communities tend not to waste by-products which can be very useful for several purposes. The use of these as litter or organic compost is not likely to have occurred in Compartment 2 (*vide supra*). In addition, the presence of vetch – *Vicia sativa/angustifolia* – as well as several seeds from wild plants frequent in pastures and fallow land may result of premeditated cutting for fodder and, eventually, hay production. Still, the ecological amplitude of most of the species – most are also frequent as weeds or bordering agricultural fields – demand caution in this interpretation.

Thus, carpological data from Late Roman contexts in Monte Mozinho give evidence of a diversified cereal agriculture which allowed the exploitation of several territorial units and testify for the optimization of the by-products of such agricultural activities. Data depict a multifunctional system in which plant and animal husbandry were intertwined, as seen in traditional rural communities.

## 6.6. References

- Aguiar C. (2000). *Flora e Vegetação da Serra de Nogueira e do Parque Natural de Montesinho*. Instituto Superior de Agronomia, Universidade Técnica de Lisboa.
- Almeida C. B. d. (1996). O cultivo da vinha durante a Antiguidade Clássica na Região Demarcada do Douro. Ponto da situação. *Douro - Estudos & Documentos*, 1 (2): 18-30.
- Barnard H., Dooley A., Areshian G., Gasparyan B., Faull K. (2011). Chemical evidence for wine production around 4000 BCE in the Late Chalcolithic Near Eastern highlands. *Journal of Archaeological Science*, 38 (5): 977-984.



Berggren G. (1981). *Atlas of seeds and small fruits of Northwest-European plant species with morphological descriptions*. . 3. Salicaceae-Cruciferae, Stockholm: Swedish Museum of Natural History.

Bouby L., Léa V. (2006). Exploitation de la vesce commune (*Vicia sativa* L.) au Néolithique moyen dans le Sud de la France. Données carpologiques du site de Claparouse (Lagnes, Vaucluse). *Comptes Rendus Palevol*, 5 (8): 973-980.

Braadbaart F. (2008). Carbonisation and morphological changes in modern dehusked and husked *Triticum dicoccum* and *Triticum aestivum* grains. *Vegetation History and Archaeobotany*, 17 (1): 155-166.

Buxó R. (1997). *Arqueología de las Plantas*. Barcelona: Crítica.

Buxó R. (2005). L'agricultura d'època romana: estudis arqueobotànics i evolució dels cultius a Catalunya. *Cota Zero*, 20: 108-120.

Carvalho A. (2005). *Etnobotánica del Parque Natural de Montesinho. Plantas, tradición y saber popular en un territorio del Nordeste de Portugal*. PhD thesis, Madrid: Universidad Autónoma de Madrid.

Carvalho T.P. (1998). A Terra Sigillata de Monte Mozinho. Contributo para a história económica do povoado. *Cadernos do Museu*, 3.

Carvalho T.P., Queiroga F. (2005). O Castro do Mozinho: os últimos trabalhos desenvolvidos. *Cadernos do Museu*, 11: 121-154.

Coixão A. S., Silvino T. (2006). O Sítio Arqueológico do Rumansil I (Murça do Douro, Vila Nova de Foz Côa - Portugal). *Côavisão. Cultura e Ciência*, 8: 118-137.

Columella, L. (1960). *On Agriculture. Res Rustica I-IV*. Translation by Ash, H. Harvard University Press/William Heinemann LTD.

Derreumaux M. (2005). How to detect fodder and litter? A case study from the Roman site "Le Marais de Dourges," France. *Vegetation History and Archaeobotany*, 14 (4): 373-385.

Dopazo Martínez A., Fernández Rodríguez C., Ramil Rego P. (1996). Arqueometría aplicada a yacimientos Galaico-romanos del NW Penínsular: valoración de la actividad agrícola y ganadera. In Ramil Rego P., Fernández Rodríguez, C., Rodríguez Guitián, M. (Eds.), *Biogeografía Pleistocena - Holocena de la Península Ibérica*, Xunta de Galicia: 317-332.

Figueiral I. (1990). *Le Nord-Ouest du Portugal et les modifications de l'écosystème, du Bronze final à l'époque romaine, d'après l'anthracanalyse de sites archéologiques*. Université des Sciences et Techniques du Languedoc.

Foxhall L. (1996). Snapping up the Unconsidered Trifles: the Use of Agricultural Residues in Ancient Greek and Roman Farming. *Environmental Archaeology*, 1 (1): 35-40.

Fuller D. Q. (2006). *A millet atlas. Some Identification Guidance*. Institute of Archaeology. University College London.

Hernández Bermejo J. E. (1996). 74. Raphanus L. In Castroviejo S., Aedo C., Gómez Campo C., Laínz M., Montserrat P., Morales R., Muñoz Garmendia F., Nieto Feliner G., Rico E., Talavera S., Villar L. (Eds.), *Flora Iberica. Plantas Vasculares de la Península Ibérica e Islas Baleares*, 4. *Cruciferae-Monotropaceae*, Madrid, Real Jardín Botánico, CSIC: 435-439.

Hillman G., Mason S., de Moulins D., Nesbitt M. (1996). Identification of archaeological remains of wheat: the 1992 London workshop. *Circaea*, 12 (2): 195-210.

Honrado J. (2003). *Flora e Vegetação do Parque Nacional da Peneda-Gerês*. PhD thesis, Porto: Faculdade de Ciências, Universidade do Porto.

Hunt H., Jones M. (2008). Pathways across Asia: exploring the history of Panicum and Setaria in the Indian subcontinent. *Pragdhara*, 18: 53-68.

Jacomet S. (2006). *Identification of cereal remains from archaeological sites*. Archaeobotany Lab, IPAS, Basel University.

Jones G. (1996). Distinguishing Food from Fodder in the Archaeobotanical Record. *Environmental Archaeology*, 1 (1): 95-98.

Jones G., Charles M., Bogaard A., Hodgson J. (2010). Crops and weeds: the role of weed functional ecology in the identification of crop husbandry methods. *Journal of Archaeological Science*, 37 (1): 70-77.

Kimpe K., Jacobs P., Waelkens M. (2001). Analysis of oil used in late Roman oil lamps with different mass spectrometric techniques revealed the presence of predominantly olive oil together with traces of animal fat. *Journal of Chromatography A*, 937 (1-2): 87-95.

Kreuz A., Schäfer E. (2011). Weed finds as indicators for the cultivation regime of the early Neolithic Bandkeramik culture? *Vegetation History and Archaeobotany*, 20 (5): 333-348.

López González G. (1990). 6. Rumex L. In Castroviejo S., Laínz M., López González G., Montserrat P., Muñoz Garmendia F., Paiva J., Villar L. (Eds.), *Flora Iberica. Plantas Vasculares de la Península Ibérica e Islas Baleares*, 2. *Platanaceae-Plumbaginaceae*, Madrid, Real Jardín Botánico, CSIC: 595-634.

López González G. (1996). 2. Sesamoides All. In Castroviejo S., Aedo C., Gómez Campo C., Laínz M., Montserrat P., Morales R., Muñoz Garmendia F., Nieto Feliner G., Rico E., Talavera S., Villar L. (Eds.), *Flora Iberica. Plantas Vasculares de la Península Ibérica e Islas Baleares, 4. Cruciferae-Monotropaceae*, Madrid, Real Jardín Botánico, CSIC: 475-483.

Marques A. H. d. O. (1978). *Introdução à História da Agricultura em Portugal. A questão cerealífera durante a Idade Média*. Lisboa: Edições Cosmos.

Morais R. (2004). *Autarcia e Comércio em Bracara Augusta no período Alto-Imperial: contribuição para o estudo económico da cidade*. PhD thesis, Braga: Universidade do Minho.

Motuzaitė-Matuzevičiūtė G., Hunt H., Jones M. (2012). Experimental approaches to understanding variation in grain size in *Panicum miliaceum* (broomcorn millet) and its relevance for interpreting archaeobotanical assemblages. *Vegetation History and Archaeobotany*, 21 (1): 69-77.

Nesbitt M. (2006). *Identification guide for Near Eastern grass seeds*. London: Institute of Archaeology, UCL.

Oliveira M. (2000). *O registo paleocarpológico do NO peninsular entre o IIIº e o Iº milénios a.C. Contributo para o estudo da alimentação pré e proto-histórica*. MSc thesis, Universidade do Minho.

Ortega Olivencia A., Devesa J. (2007). Galium L. In Devesa J., Gonzalo R., Herrero A. (Eds.), *Flora Iberica. Plantas vasculares de la Península Ibérica e Islas Baleares, 15. Rubiaceae-Dipsacaceae*, Madrid, Real Jardín Botánico, CSIC: 56-162.

Pedrol J. (2009). 1. Plantago L. In Benedí C., Rico E., Güemes J., Herrero A. (Eds.), *Flora Iberica. Plantas vasculares de la Península Ibérica e Islas Baleares, 13. Plantaginaceae-Scrophulariaceae*, Madrid, Real Jardín Botánico, CSIC: 4-38.

Pinho C. F. M. d., Pinho C. M. d. (1998). *As plantas infestantes mais frequentes nas principais culturas da região de Entre Douro e Minho*. IDARN.

Pliny (1999). *Historia Natural*. Translated by Francisco Hernández (Books 1-25) and Jerónimo de Huerta (Books 26-37). Visor Libros, Universidad Nacional de México.

Pollard A., Batt C., Stern B., Young S. (2007). *Analytical Chemistry in Archaeology*. Cambridge: Cambridge University Press.

Pujadas A. (1997). 9. Anagallis L. In Castroviejo S., Aedo C., Laínz M., Morales R., Muñoz Garmendia F., Nieto Feliner G., Paiva J. (Eds.), *Flora Iberica. Plantas Vasculares de la Península Ibérica e Islas Baleares, 5. Ebenaceae-Saxifragaceae*, Madrid, Real Jardín Botánico, CSIC: 57-62.

Queiroga F. (1992). *War and Castros. New approaches to the northwestern Portuguese Iron Age*. PhD thesis, University of Oxford.

Ramil Rego P. (1993). Paleoethnobotánica de yacimientos arqueológicos holocenos de Galicia (N.O. Cantábrico). *Munibe*, 45 165-174.

Ramil Rego P., Aira Rodriguez M. J. (1993). A palaeocarpological study of Neolithic and Bronze Age levels of the Buraco da Pala rock-shelter (Bragança, Portugal). *Vegetation History and Archaeobotany*, 2 (3): 163-172.

Ramil Rego P., Dopazo Martínez A., Fernández Rodríguez C. (1996). Cambios en las estrategias de explotación de los recursos vegetales en el Norte de la Península Ibérica. *Férvedes*, 3 169-187.

Reimer P. B., MGL; Bard, E; Bayliss, A; Beck, JW; Blackwell, PG; Bronk Ramsey, C; Buck, CE; Burr, GS; Edwards, RL; Friedrich, M; Grootes, PM; Guilderson, TP; Hajdas, I; Heaton, TJ; Hogg, AG; Hughen, KA; Kaiser, KF; Kromer, B; McCormac, FG; Manning, SW; Reimer, RW; Richards, DA; Southon, JR; Talamo, S; Turney, CSM; van der Plicht, J; Weyhenmeyer, CE (2009). IntCal09 and Marine09 Radiocarbon Age Calibration Curves, 0–50,000 Years cal BP. *Radiocarbon*, 51: 1111–1150.

Romero Zarco C. (1999). 33. Vicia L. In Talavera S., Castroviejo S., Romero Zarco C., Sáez L., Salgueiro F., Velayos M. (Eds.), *Flora Iberica. Plantas vasculares de la Península Ibérica e Islas Baleares*, 7 (1). *Leguminosae*, Madrid, Real Jardín Botánico, CSIC: 360-417.

Santos M. J. F. d. (2003). *A terra de Penafiel na Idade Média: estratégias de ocupação do território (875-1308)*. MSc thesis, Porto: Faculdade de Letras, Universidade do Porto.

Santos Júnior J. (1977). A cultura dos cereais no leste transmontano. *Trabalhos de Antropologia e Etnologia*, 23 (1): 41-159.

Smartt J., Simmonds N. (1995). *Evolution of crop plants*. Longman Scientific & Technical.

Soeiro T. (1984). Monte Mozinho: Apontamentos sobre a ocupação entre Sousa e Tâmega em época romana. *Boletim Municipal de Cultura*, 1.

Soeiro T. (1998). *Monte Mozinho, Sítio Arqueológico*. Museu Municipal de Penafiel.

Sousa L., Nunes M., Gonçalves C. (2006). O vinho na antiguidade clássica. Alguns apontamentos sobre Lousada. *Oppidum*, 1: 69-85.

Talavera S., Arista M. (2000). 49. Ornithopus L. In Talavera S., Aedo C., Castroviejo S., Herrero A., Romero Zarco C., Salgueiro F., Velayos M. (Eds.), *Flora Iberica. Plantas vasculares de la Península Ibérica e Islas Baleares*, 7 (2). *Leguminosae*, Madrid, Real Jardín Botánico, CSIC: 873-880.

Tereso J. (2009). Plant macrofossils from the Roman settlement of Terronha de Pinhovel, northwest Iberia. *Vegetation History and Archaeobotany*, 18 (6): 489-501.

Tereso J., Carvalho T. P., Almeida da Silva R., Ramil Rego P. (2010). Cultivos e armazenagem em Monte Mozinho: dados preliminares. In Bettencourt A. M. S., Alves M. I. C., Monteiro-Rodrigues S. (Eds.), *Variações paleoambientais e evolução antrópica no Quaternário do Ocidente Peninsular/ Palaeoenvironmental changes and anthropization in the Quaternary of Western Iberia*, Braga, Associação Portuguesa para o Estudo do Quaternário - APEQ e Centro de Investigação Transdisciplinar. Cultura, Espaço e Memória- CITCEM, 149-158.

Valdés Bermejo E. (1996). 1. Reseda L. In Castroviejo S., Aedo C., Gómez Campo C., Laínz M., Montserrat P., Morales R., Muñoz Garmendia F., Nieto Feliner G., Rico E., Talavera S., Villar L. (Eds.), *Flora Iberica. Plantas Vasculares de la Península Ibérica e Islas Baleares*, 4. *Cruciferae-Monotropaceae*, Madrid, Real Jardín Botánico, CSIC: 442-475.

van der Veen M., Jones G. (2006). A re-analysis of agricultural production and consumption: implications for understanding the British Iron Age. *Vegetation History and Archaeobotany*, 15 (3): 217-228.

Vázquez Varela J. (2000). El modelo tradicional de cultivo del mijo (*Panicum miliaceum* L.) en Galicia y su aplicación a la prehistoria. In Vázquez Varela J. (Ed.), *Etnoarqueología: conocer el pasado por medio del presente*, Diputación Provincial de Pontevedra: 65-84.

## 7

# Fruits and seeds from the Roman levels of Castro de São Lourenço (Esposende, northern Portugal)<sup>1</sup>

---

### Abstract

During the 2008 excavation in the roman settlement of Castro de São Lourenço, several soil samples were recovered from 4<sup>th</sup> century AD levels in Sector D, next to the defensive wall. A carpologic study led to the identification of three crops: naked wheat (*Triticum aestivum/durum*), common millet (*Panicum miliaceum*) and probably foxtail millet (*Setaria cf. italica*). Common millet is the most abundant species and also the only one which was found in all samples.

Millet and naked wheat are crops with different traits which could have led to a most efficient use of this settlement's territory, allowing the exploitation of areas with distinct characteristics. All three species could be frequently found in northwest Iberia during the Roman period.

**Key-words:** São Lourenço, roman period, carpology, agriculture.

### 7.1. Introduction

In the 2008 archaeological campaign at Castro de São Lourenço, archaeobotanical soil samples were collected in order to gather relevant information about the agricultural practices of the communities that inhabited the settlement.

---

<sup>1</sup> This chapter follows, with minor changes, the following article:

Tereso J., Almeida A., Almeida C. B. d., Ramil Rego P., Vaz F., Almeida da Silva R. (2010). Estudo carpológico do castro de São Lourenço (Esposende): primeiros resultados. *Estudos do Quaternário*, 6: 67-73.

The settlement of São Lourenço is located on Monte São Lourenço in the Municipality of Esposende, Braga (Fig. 7.1). It is an elevation 203m high, positioned in a platform of the fossil cliff overlooking the coast and the Atlantic Ocean. Like many other hillforts in the region, São Lourenço was first occupied in the Late Bronze Age, between the 7<sup>th</sup> and 6<sup>th</sup> centuries BC. Still, the best known occupation phase of this habitat is that between the 2<sup>nd</sup> century BC and the 1<sup>st</sup> century AD.

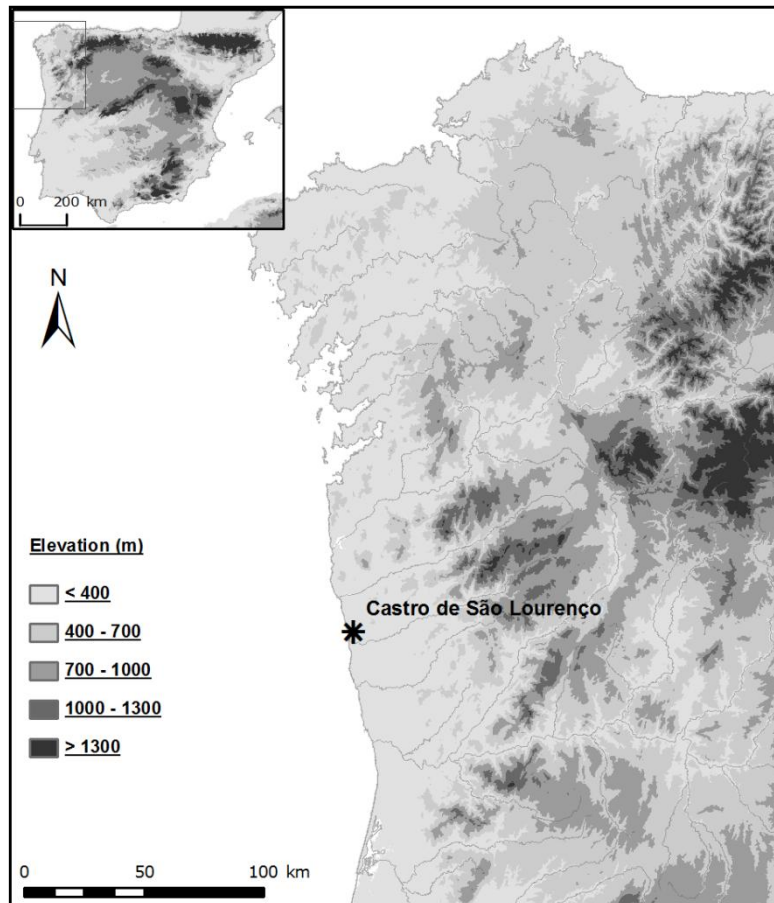


Figure 7.1 – Location of São Lourenço in northwest Iberia

The defensive system consisted of three sets of walls and ditches in the northwest flank of the settlement. It seems to have been consolidated in the 1<sup>st</sup> century AD. The defence system also included a surveillance tower, situated in the hills northwest of the settlement, providing a further dominance over the northern coastal area.

Data suggests the communities that inhabited the hillfort became well adapted to the new realities imposed by the Roman administration. After the 1<sup>st</sup> century AD it was converted into a

*vicus*, a new reality characterized by its urban character and relevant functions in trade and even small administration. The hill was inhabited until the 5<sup>th</sup> century AD.

After a period of abandonment, the hill became occupied again between the 12<sup>th</sup> and 14<sup>th</sup> centuries. During this period, a small castle was built, integrated in the portuguese network of fortifications (Almeida and Almeida 2008).

### **7.1.1. The Sector D**

Sector D is positioned near the first defensive Wall – designated as M1 – which was partially uncovered between 2001 and 2003.

In the interior areas, adjacent to the wall, several buildings were identified whose functions are currently under study. The last level of occupation of this area, which accounts for most of the square and rectangular stone compartments dates back to the Roman Late Empire. The chronology was defined by the presence of coins attributable to the Emperor Constantine the Great, which ruled the Roman Empire between 306 and 337. A 5<sup>th</sup> century occupation cannot be ruled out since the coins could have been circulating some time after the reign of Constantine. This archaeological data remains unpublished.

## **7.2. Materials and methods**

Soil samples were collected for recovering plant macrofossils. The samples will be referred by its location in the excavation area (the site's survey grid) and stratigraphic context (unit of stratification – u.s.).

The soil samples were collected in different squares from Sector D (see Fig. 7.2 and Table 7.1):

- Square D8: two samples were collected in the u.s. 3, a dark gray, compact deposit with no artifacts. It covers the ancient floor. Two samples from this u.s. were recovered, which were designated Am. 1 and Am 2. The Am.1 was collected throughout the whole extension of u.s. 3, while the Am 2 was collected in an area with visible and concentrated plant remains.



- Square K7: five samples were collected in this square but only one, from u.s. 6, provided any plant remain. This sample was recovered from a floor in the southeast part of the square. It is a light brown deposit with domestic ceramics and tiles.

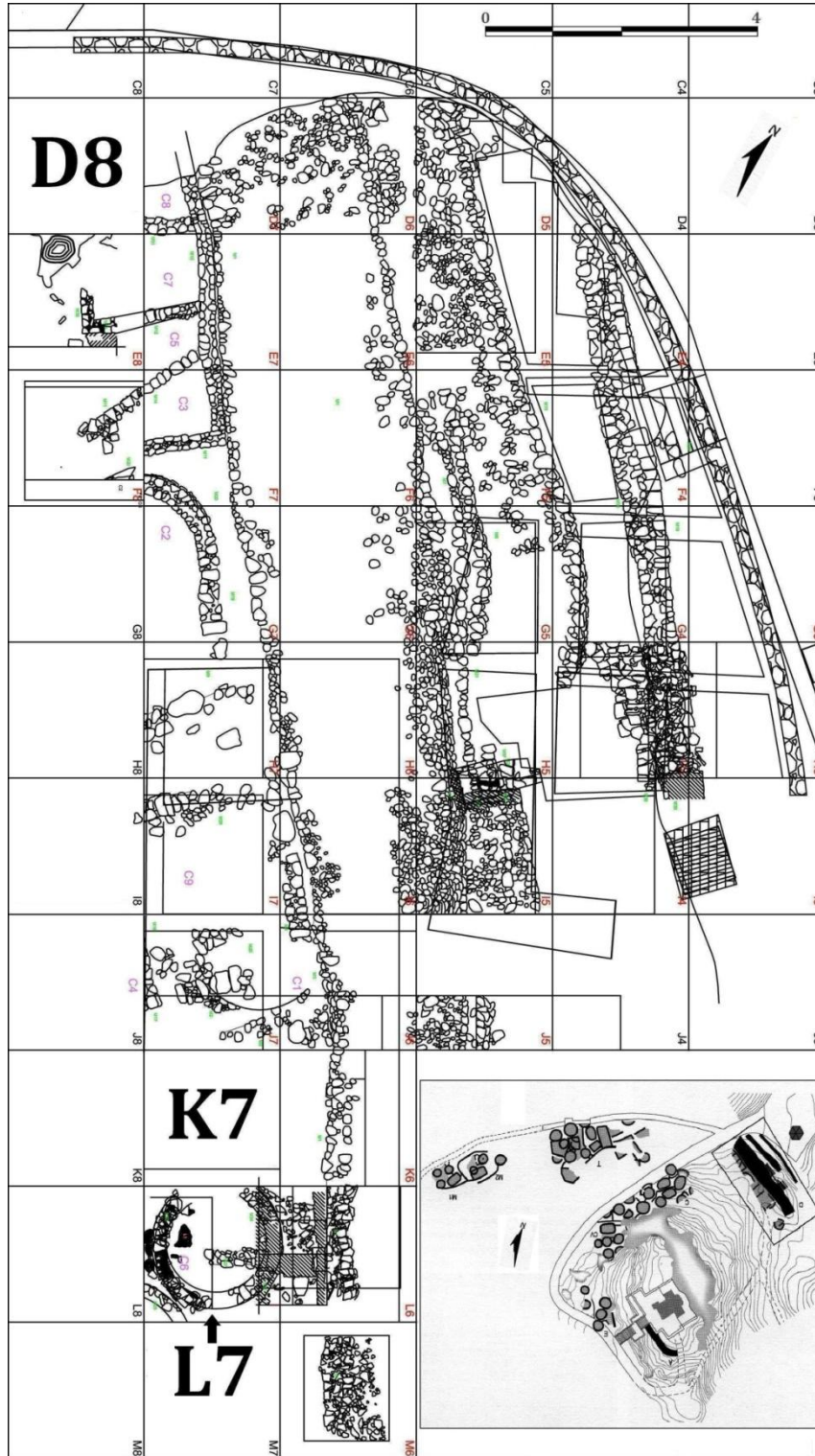


Figure 7.2 – General view over Sector D

- Square L7: five samples were collected in this square and two provided plant remains, one from u.s. 7 and the other from u.s. 12. The u.s. 7 corresponds to a light brown deposit, interpreted as a floor. The u.s. 12 is a gray deposit - an occupation level – and its sample was collected near a fireplace (L1).

From this short collection of samples, only one sample was directly associated with a structure where fire was handled. The remaining are isolated samples in dispersed contexts.

All sampled archaeological contexts are positioned in the last phase of occupation of this sector, from the 4<sup>th</sup> or 5<sup>th</sup> century AD.

Since it was not possible to process the samples in the archaeological site, all soil samples were taken to the Faculty of Sciences, University of Porto. The necessity to transport and store samples limited considerable the amount of soil recovered - between 2 and 15 liters per sample. Small sized samples are difficult to interpret, but they can test the site's potential and help to prepare future campaigns.

The sediment samples were floated through bucket flotation using a column of sieves with meshes of 0.25 mm, 0.5 mm, 1mm and 2mm. The identification of the fruits and seeds was made using the reference collection of the Faculty of Sciences, University of Porto, as well as anatomical atlases (e.g. Jacomet 2006) and several works of specialty (e.g. Buxó 1997).

The naked wheat grains, as well as the small rachis fragments, which were not identified at the species level, were named *Triticum aestivum/durum* (Buxó 1997). Within this designation several species are included: *Triticum aestivum* L. subsp. *aestivum*, *Triticum turgidum* L. subsp. *durum* (Desf.) Mackey, and *Triticum turgidum* L. subsp. *turgidum* (nomenclature after Zohary et al. 2012).

### 7.3. Results

Few seeds and fruits were recovered in the studied samples (see Table 7.1). The plant remains were carbonized but badly preserved, which justifies the significant amount of findings that remain Undetermined (27% of all the assemblage).

Three different crops were identified (see Table 7.1): *Panicum miliaceum*, *Setaria cf. italica* and *Triticum* spp.

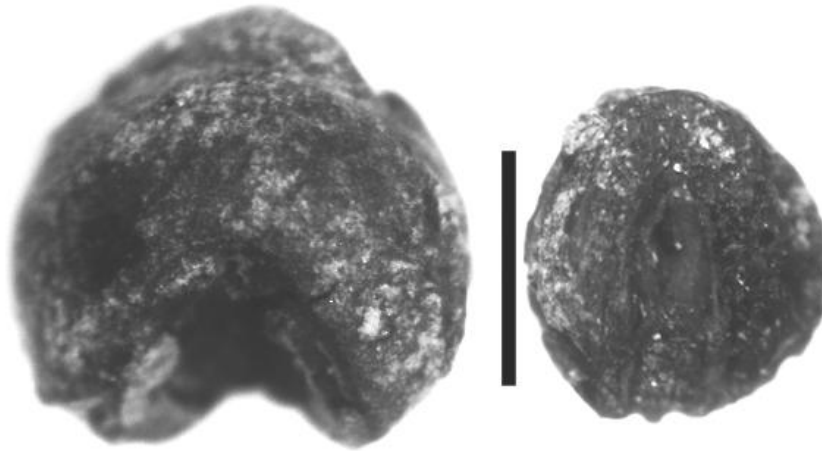


Figure 7.3 – Grains from *Panicum miliaceum* (left) and *Setaria cf. italica* (right)

Distinguishing the two millet species was a difficult task. The morphological criteria that were used were those of R. Buxó (1997) and S. Jacomet (2006):

Grains from *Panicum miliaceum* have an ellipsoidal to roundish shape, with a roundish hilum. The scutellum is broad, usually oval and barely reaching the half of the grains length (Fig 7.3, left).

Grains from *Setaria* are more difficult to identify at the species level. The criteria that allow us to distinguish the cultivated species (*Setaria italica*) from other species of the same genus are sometimes difficult to identify in small and poorly preserved assemblages. *Setaria* grains from São Lourenço are slightly smaller than those of *Panicum miliaceum*, the hilum is narrower but longer, frequently reaching more than half of the grain's length. Thus, *Setaria* grains from São Lourenço are probably *Setaria italica*, although the motives mentioned do not allow us to completely exclude other species from the same genus.

In what *Triticum* remains is concern, it was not possible to determine which wheat specie was cultivated. Still, the morphology of the grains and rachis fragments allow us to determine it was a naked species.

Grains were identified as *Triticum aestivum/durum* (Fig. 7.4). They are oval in plan view; in side view the ventral surface is slightly convex. They present a characteristic swollen aspect (Buxó 1997, Jacomet 2006).

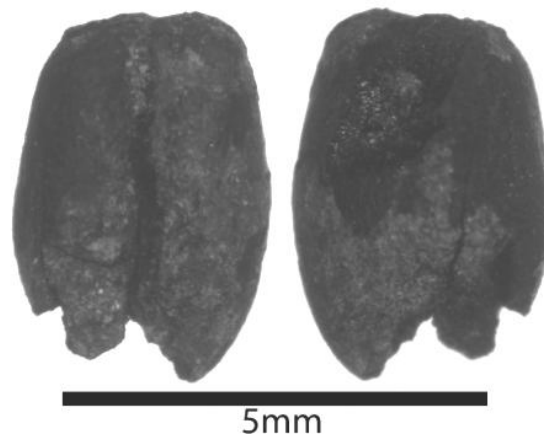


Figure 7.4 - *Triticum aestivum/durum* (grain)

The rachis fragments are known to be the most suitable remains for the discrimination between tetraploid and hexaploid naked wheats (Hillman *et al.* 1996). However, the four remains recovered in the samples from square D8 are small fragments of nodes and the features which are essential for a secure identification are not clearly visible.

Unfortunately, the remains from wild species do not provide relevant information for this study. It was not possible to identify any of the five macroremains to species level (See Table 7.1).

	<b>1</b>	<b>2</b>	<b>7</b>	<b>9</b>	<b>12</b>
<b>Sample</b>					
<b>U.S.</b>	3	3	6	7	12
<b>Sector</b>	D	D	D	D	D
<b>Square</b>	D8	D8	K7	L7	L7
<b>Sample</b>	1	2	5	2	6
<b>Cereals</b>					
<i>Panicum miliaceum</i>	4	2	2	2	13
<i>Panicum/Setaria</i>			1		10
<i>Setaria italica</i>			2		24
<i>Triticum</i>		1	1		
<i>Triticum aestivum/durum</i> (grain)	2				
<i>Triticum aestivum/durum</i> (node)	4				
Triticeae			1		
<b>Wild plants</b>					
Chenopodiaceae	1				
Compositae	1				
Gramineae	1				2
Indeterminado	11	4		2	11

Table 7.1 – Seeds and fruits recovered

## 7.4. Discussion and conclusions

*Panicum miliaceum* is the most abundant species in the samples from São Lourenço and is also the only one that was recovered in all samples, which testifies for its relevance in the period we are studying. *Panicum miliaceum* was an important crop in northwest Iberia, where it was first found in Bronze Age sites (Bettencourt 1999, Bettencourt *et al.* 2007). *Panicum miliaceum* and *Setaria italica* were found together in the Roman settlements of Terronha de Pinhovel (Macedo de Cavaleiros) (Tereso 2007, 2008, 2009) and Monte Mozinho (Penafiel) (Tereso *et al.* 2010).

Millets are spring crops, i.e., are sowed in the spring and harvested few months after, in the end of the summer. These species have short vegetative cycles and are well adapted to different soils and climates, although they demand some soil humidity in the initial growth stages (Chopra and Prakash 2003).

*Panicum miliaceum* and *Setaria italica* can be cultivated and even processed and cooked together (Marinval 1992). They can be used for preparing porridge and bread. Such uses are mentioned by Pliny (*apud* Renfrew 1973) and are still current practice today.

In Castro de São Lourenço, the sample where millets are more abundant is the only one associated to a fireplace, in square L7, u.s. 12. That is the context where plant remains are more abundant. The absence of other cereals there, suggests its homogeneity.

We must stress how fruits and seeds are occasional in the rest of the contexts, suggesting its casual character, contrasting with the sample from the fireplace (u.s. 12, square L7).

In Castro de São Lourenço wheat remains from *Triticum aestivum/durum* are sparse – 4 grains and 4 rachis fragments – and poorly preserved. The existence of by-products of processing activities can have several explanations: grain cleaning may have taken place inside the settlement; grain cleaning was ineffective and some chaff went together with the grains; by-products may have been stored within walls; by-products were transported there to be used as fodder or firewood.

Naked wheats are suitable for areas with temperate climate and their development is limited by frost. They need precipitations of around 500mm, preferably in spring time and can be

negatively affected by excessive heat and lack of water while developing the spike (Chopra and Prakash 2003). There are varieties well adapted to spring sowing.

Fruits and seeds are sparse in the contexts that were studied. That does not allow any detailed interpretation regarding the agricultural practices from the communities that inhabited São Lourenço in the 4<sup>th</sup> or 5<sup>th</sup> century. Anyway, millets (*Panicum miliaceum* and *Setaria italica*) and naked wheat were consumed and possibly cultivated by those communities. By these species' characteristics we know that they would potentiate the agricultural exploitation of different areas of São Lourenço's territory.

Despite the limitations, this study demonstrated that archaeobotanical analyses in São Lourenço can provide significant information if they will continue in the future, provided the conditions for increasing the sampling efforts and sample size.

## 7.5. References

- Almeida A., Almeida C. (2008). *Castro de S. Lourenço - Esposende*. Câmara Municipal de Esposende.
- Bettencourt A. M. S. (1999). *A paisagem e o Homem na bacia do Cávado durante o II e I milénio AC*. PhD thesis, Braga: Universidade do Minho.
- Bettencourt A. M. S., Dinis A., Figueiral I., Rodrigues A., Cruz C., Silva I., Azevedo M., Barbosa R. (2007). A ocupação do território e a exploração de recursos durante a Pré-história Recente do Noroeste de Portugal. In Jorge S.O., 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*, Promontoria Monográfica, 8: 149-164.
- Buxó R. (1997). *Arqueología de las Plantas*. Barcelona: Crítica.
- Chopra V., Prakash S. (2003). *Evolution and Adaptation of Crops*. 1. *Cereals*, Science Publishers Inc, USA.
- Hillman G., Mason S., de Moulins D., Nesbitt M. (1996). Identification of archaeological remains of wheat: the 1992 London workshop. *Circaea*, 12 (2): 195-210.
- Jacomot S. (2006). *Identification of cereal remains from archaeological sites*. Archaeobotany Lab, IPAS, Basel University.
- Marinval P. (1992). Archaeobotanical data on millets (*Panicum miliaceum* and *Setaria italica*) in France. *Review of Palaeobotany and Palynology*, 73: 259-270.

Queiroga F. (1992). *War and Castros. New approaches to the northwestern Portuguese Iron Age*. PhD thesis, University of Oxford.

Ramil Rego P., Aira Rodriguez M. J. (1993). A palaeocarpological study of Neolithic and Bronze Age levels of the Buraco da Pala rock-shelter (Bragança, Portugal). *Vegetation History and Archaeobotany*, 2 (3): 163-172.

Ramil Rego P., Dopazo Martínez A., Fernández Rodríguez C. (1996). Cambios en las estrategias de explotación de los recursos vegetales en el Norte de la Península Ibérica. *Férvedes*, 3: 169-187.

Renfrew J. (1973). *Palaeoethnobotany. The prehistoric food plants of the Near East and Europe*. New York: Columbia University Press.

Tereso J. (2007). Economia agrícola das comunidades romanas do NW peninsular: dados carpológicos da Terronha de Pinhovelo (Bragança, Portugal). *Recursos Rurais*, 1 (3): 13-21.

Tereso J. (2008). Estudo arqueobotânico das estruturas romanas da Terronha de Pinhovelo (NE Portugal). In *Actas de 1 Congreso Internacional de Arqueoloxía de Vilalba*: 69-78.

Tereso J. (2009). Plant macrofossils from the Roman settlement of Terronha de Pinhovelo, northwest Iberia. *Vegetation History and Archaeobotany*, 18 (6): 489-501.

Tereso J., Carvalho T., Almeida da Silva R., Ramil Rego P. (2010). Cultivos e armazenagem em Monte Mozinho: dados preliminares. In Bettencourt A. M. S., Alves M., Monteiro-Rodrigues S. (Eds.), *Varições paleoambientais e evolução antrópica no Quaternário do Ocidente Peninsular/ Palaeoenvironmental changes and anthropization in the Quaternary of Western Iberia*, Braga, Associação Portuguesa para o Estudo do Quaternário - APEQ e Centro de Investigação Transdisciplinar. Cultura, Espaço e Memória-CITCEM: 149-158.

Zohary D., Hopf M., Weiss, E. (2012). *Domestication of Plants in the Old World – The origin and spread of domesticated plants in south-west Asia, Europe, and the Mediterranean Basin*. 4<sup>th</sup> Edition. Oxford: Oxford University Press.

**SECTION C**

**CHRONOLOGICAL SYNTHESSES**





## 8

## Environmental change and agricultural development in NW Iberia during prehistoric times

Tereso J., Ramil-Rego P., Bettencourt A.M.S., Almeida da Silva R.

Submitted to *Vegetation History and Archaeobotany*

---

### Abstract

In northwest Iberia, the study of archaeological, archaeobotanical and palaeoecological data allow us to define the major phases of agricultural development between 4400/4300 cal BC and 600/500 cal BC (i.e. between the Neolithic and the Late Bronze Age). Data concerning landscape evolution in the area seems to agree generally with the interpretative models for ideological, social and economic trends in the time-span considered here.

While first Neolithic production practices had little impact on the landscapes, sedimentary studies document an increase in anthropogenic soil erosion since c. 3300 cal BC, since the end of the Neolithic and during the Chalcolithic. This is coincident with archaeological evidences of major changes in local communities, namely concerning the way human communities interacted with space. By this time, the main crops were *Triticum* “stubby grains”, *Hordeum vulgare* var. *nudum*, *Hordeum vulgare* subsp. *vulgare*, *Vicia faba* and *Pisum sativum*.

However, most pollen sequences in the area document that significant deforestation occurred mostly after c. 1800 cal BC, i.e. since the Middle Bronze Age. During the Bronze Age a new crop – *Panicum miliaceum* – is introduced in the agricultural systems, testifying for significant changes in the subsistence strategies and a shift towards the exploitation of both winter and spring cereals. This scenario fits well into the archaeological models that suggest greater sedentarization and regional settlement reorganization taking place at the time, which resulted in an increase of productivity and improvement of territorial control and connectivity.

**Key words:** NW Iberia, Agriculture, Prehistory, Protohistory, Environmental Change

## 8.1. Introduction

This study focuses on the interrelation between environmental and cultural changes and the development of agriculture in northwest Iberia from the Neolithic to the Bronze Age.

It is usually assumed that agriculture was incipient during the Neolithic, promoting few and swiftly reversible environmental changes (Ramil Rego 1993, Jorge 2000; Sanches 2000a, Monteiro-Rodrigues 2008, 2010). On the other hand, studies from many scopes consider the Bronze Age a moment of shift towards more intensive agricultural practices, leading to highly significant environmental changes (Figueiral 1990, Ramil Rego 1993b, Bettencourt 1999, 2003, Ramil Rego et al. 2009). This study aims to characterize and understand the changes that occurred in this time-span, analysing the palaeoecological, archaeological and palaeoethnobotanical data available for the area. It is assumed that a long-term perspective is necessary in order to properly identify and understand major trends.

Some approaches have been made to gather archaeological and carpological data and even try to correlate these with palaeoecological (palynological and sedimentological) information (e.g. Bettencourt 1999, Figueiral and Sanches 2003, Figueiral and Bettencourt 2004 and 2007, Bettencourt et al. 2007, Sanches et al. 2007, Cardoso and Bettencourt 2008, Martín Seijo et al. 2011). Still, whether environmentally or archaeologically centered, most approaches focus on small areas or particular chronological periods being thus fragmentary, making broader regional and temporal analyses difficult. Other studies, although chronologically and geographically broader, give little relevance to environmental trends and are already outdated (Ramil Rego 1993, Dopazo Martínez et al. 1996, Oliveira 2000). Taking into consideration the limitations of previous studies, the current approach, gathering archaeobotanical, archaeological, palynological and sedimentological data, is particularly relevant to achieve a proper understanding of major trends in past societies and agriculture in northwest Iberia.

In other regions, the correlation between data from different scientific areas has proven to be very effective on promoting a more profound knowledge on how and why human communities induced changes in the landscape and how environmental changes, whether anthropogenic or natural, constrained or hastened social change (An et al. 2004, Brooks 2006).

Understanding the relation between the development of societies and environmental change is inherently an interdisciplinary quest since multiple issues from different scopes are most

certainly involved. To understand social and environmental changes and how these are related, the different factors taking part of it must be properly characterized. Response to change is highly dependent on factors regarding not only the change itself, but also the characteristics of the societies and the territories involved (Dincauze 2000, Bell and Walker 2005).

## 8.2. Study area

Northwest Iberia covers northern Portugal and northwestern Spain (Galicia) (Fig. 8.1 and 8.2). It is a heterogeneous region with a wide coastal-subcoastal area with shallow valleys and low altitude mountains which link the Cantabrian-Atlantic and the Subatlantic ranges. Small and medium sized mountains that comprise the border of some of the main Iberian mountains (the cantabrian and the Central Massif) stand in the limit between the northwest Iberia and the interior plains. Between both units, ancient sedimentary basins maintain a plain physiognomy (Ribeiro and Lautensach 1995, Ramil-Rego et al. 2005).

The climatic and biogeographic heterogeneity of northwest Iberia has been analysed by several authors, whether based exclusively on the present distribution of plants (Costa et al. 1998, Rivas-Martínez et al. 2002) or by adding also relevant palaeoecological data (Ramil-Rego et al. 2005, Rodríguez Guitián and Ramil-Rego 2007, 2008).

According to these studies, most of the mentioned territory is placed in the Atlantic region (Eurosiberian region *sensu* Rivas-Martínez et al. 2002), characterized by the absence of a dry season. Its proximity to the sea, together with its low altitudes, justifies its reduced continentality and the long vegetative period that may extent to 8-9 months. On the other hand, in the rest of the year, abundant frost or snow impose great limitations to the development of vegetation. The southeastern areas are positioned in the Mediterranean biogeographic region being thus characterized by the existence of a dry season of at least three months and possible longer periods of winter frost, when compared with the Atlantic areas. The most suitable areas for agriculture are those from low altitude coastal and subcoastal areas.

### 8.3. Materials and methods

A thorough revision of data was done covering all the study area. Palaeoenvironmental, archaeological and archaeobotanical data was gathered and some nomenclature was reviewed.

#### 8.3.1. Palaeoenvironmental data

Much palaeoenvironmental research has been done in northwest Iberia. In this study we focus mainly the trends of vegetation, landscape and climate.

Changes in vegetation composition and proportion are documented in the abundant pollen analyses done in the area. This made possible the understanding of the main regional trends. The most reliable palaeoenvironmental data available for the region comes from studies in Galicia and the Portuguese northwest border where wetlands are abundant, thus such data stand as the core of the palaeoenvironmental reconstructions of the study-area. Nevertheless, wetlands suitable for such studies are sparse in the Douro basin. In the latter region some relevant information can be depicted from palynological studies done in archaeological sites – whether settlements (e.g. Aira Rodríguez and Ramil Rego 1995, López Sáez et al. 2000) or megalithic monuments (e.g. López Sáez and Cruz 2002, Lopez Sáez et al. 2010) – and other sedimentary sequences (Cordeiro 2004). However, palynological studies done in archaeological sites present severe limitations regarding their capacity to reconstruct regional past vegetation and climatic trends (Turner and Hannon 1988, Sánchez Goñi 1991, Ramil-Rego 1992; Ramil-Rego and Fernández Rodríguez 1996). As such, these studies' reliability to the characterization of past landscape trends is highly dependent of their comparability with other more reliable data, mainly those from northwest Portugal, Galicia and Serra da Estrela (central Portugal).

Sedimentary studies for the region consist on general views and site-specific approaches. The main purpose of including sedimentary data was to detect the main episodes of soil erosion, understand which factors may have caused them and recognize their major consequences in the landscape. The stability/instability cycles, documented by Ramil-Rego (1993b) and Martínez Cortizas et al. (1993), stand as the basis of analyses. Recent approaches continue to use this model (Muñoz Sobrino et al. 2005) and other studies done in the area, despite going in much detail, don't seem to contradict it (Cordeiro 2004, Martínez Cortizas et al. 2009).

Interpretative models for climate fluctuations occurring in northwest Iberia are not always concordant. This is particularly relevant in what Middle and Late Holocene is concern, since geochemical approaches (Martínez-Cortizas et al. 1999 and 2009, Fábregas Valcarce et al. 2003) and pollen and isotopic combined approaches (Muñoz Sobrino et al. 2005, Ramil Rego et al. 2009) have reached models with some differences. The latter allowed the identification of significant climatic variability during this time-span, namely a slightly colder phase during the Mid-Holocene, between c. 5400 – 4300 cal BC. Interpretations congregating pollen sequences with Greenland Isotopic records were followed as data from both seem to agree. These approaches have proven to be suitable to detect important regional differences in northern Spain (Muñoz Sobrino et al. 2005).

### 8.3.2 Archaeological and Archaeobotanical data

The revision of archaeological data available for northwest Spain and northern Portugal included theoretical explanatory models for social and economical changes. Palaeoenvironmental and palaeoethnobotanical data are contrasted with archaeological interpretative models. For such, the chronological parameters associated to concepts such as *Neolithic*, *Chalcolithic* and *Bronze Age* had to be defined, since several parameters can be found in the specialized bibliography. Despite the existence of regional asymmetries, a general chronological sequence covering the main cultural phases can be deduced. Thus, the work of M. J. Sanches (1997, 2000a), A. M. S. Bettencourt (2005a, 2005b, 2009), M. J. Sanches et al. (2007), S. Monteiro-Rodrigues (2008) stand as the chronological parameters for this study:

- Neolithic (c. 5000-3200/3000 cal BC)
- Chalcolithic (c. 3200/3000-2300/2200 cal BC)
- Early/Middle Bronze Age (c. 2300/2200-1200/1100 cal BC – the limit between the Early and Middle Bronze Age is around 1800/1700 cal BC)
- Late Bronze Age (c. 1200/1100-600/500 cal BC).

Some authors refer to the period of c.800-500 cal BC as Early Iron Age (e.g. González Ruibal 2003). Still, the reasons for the extension of the Late Bronze Age until c. 500 cal BC are archaeological and can be well understood in the work of A. M. S. Bettencourt (1999, 2005a,

2009). As Lias (Cenlle, Spain), Penalba (Campolameiro, Spain), Penarrubia (Lugo, Spain), S. Julião Ic and Id (Vila Verde, Portugal), Torroso (Mos, Spain) and Vasconcelos (Braga, Portugal) are the sites with crops positioned in this time-span.

Contrasting with palaeoenvironmental data, archaeobotanical studies are more concentrated in the southern part of the study area, the northern Portugal. This makes regional interpretations difficult. However, relevant conclusions can still be drawn combining the available data.

All reliable carpological data was gathered and synthesised in this study. This excluded occasional references to material with no information concerning their provenience contexts. Furthermore, only charred plant remains were taken into consideration in this study. References to fresh material usually do not include explanation on the specific processes which allowed their preservation making it difficult to exclude recent disturbances. Published references to fresh material for the region only include remains from wild species.

References to the presence of Cruciferae seeds were also not taken into consideration. New observations of the remains from Morcigueira (Toques, Spain) and Santinha (Amares) that have been interpreted as seeds of Cruciferae (*Brassica* or *Sinapis*) allowed us to question the previous identifications, although the true nature of the remains is not yet known. Since the identification criteria were the same used in other studies, together with Morcigueira and Santinha, the seeds of *Brassica/Sinapis* from Prado do Inferno (Muras, Spain), S. Julião, Sola (Braga, Portugal), Alto de S. Bento (Braga, Portugal), S. João de Rei (Póvoa de Lanhoso, Portugal) and Vasconcelos (Braga, Portugal) (see references in the text) were also not included in this synthesis.

Earlier syntheses focused on small regions and most were restricted to specific chronological periods. Galician data are summarized in the work of P. Ramil Rego (1993). Data from prehistorical northeastern Portugal are found in the work of M.J. Sanches (1997) M. J. Sanches et al. (2007) and S. Monteiro-Rodrigues (2008) and syntheses for northwest Portugal can be read in the work of A. M. S. Bettencourt (1999, 2003) and A. M. S. Bettencourt et al. (2007). The only broader studies are those of A. Dopazo Martínez (1996), A. Dopazo Martínez et al. (1996) and G. Oliveira (2000) and are already outdated. The latter presents several problems concerning the contextualization of archaeobotanical data.

### 8.3.3. Nomenclature of wheat grains

The genus *Triticum* includes diverse domestic and wild species. At first, species discrimination was based on the external morphology of the plants, mostly the characteristics of the inflorescences, and later on genetic criteria made the morphological criteria obsolete (Bowden 1959 and 1966, Mac Key 1966 and 1989, Goncharov 2002 and 2005, Goncharov et al. 2009). The morphology of the grains is far from being a very reliable criterion, but frequently it is the only one that can be used in archaeobotanical assemblages. Nevertheless, through time morphological types have been defined in order to allow comparisons between assemblages and some relation between these and specific species is thought to exist, although in some cases it is not possible to establish any connection (Hillman et al. 1996, Buxó 1997, Jacomet 2006).

Regarding the designations of naked wheat grains used in publications focusing the northwest Iberia, a reconversion was done in order to homogenize designations and allow comparisons. Therefore, only two morphological types of naked wheat grains were distinguished:

- the *Triticum aestivum/durum* type. Traditionally, it includes *T. aestivum* L. subsp. *aestivum*, *T. turgidum* L. subsp. *durum* (Desf.) Mackey, and *T. turgidum* L. subsp. *turgidum* (Buxó 1997; nomenclature after Zohary et al. 2012).

- the *Triticum* “stubby grains”. This designation was introduced by S. Jacomet (2006) and refers to grains which are shorter and more roundish than those of the *T. aestivum/durum* type. Three species are usually ascribed to this morphology - *T. aestivum* L. subsp. *compactum* (Host) Mackey, *T. aestivum* L. subsp. *sphaerococcum* (Perc.) Mackey and *T. turgidum* L. subsp. *parvicoccum* Kislev (Jacomet 2006; nomenclature after Zohary et al. 2012). Although, underdeveloped grains (due to their position in the spike) of *T. aestivum/durum/turgidum* can present the same morphological features, this hypothesis that can only be considered when its presence in the archaeobotanical assemblages is sporadic (Ramil Rego and Aira Rodríguez 1993). The need to use a generic morphological designation is due to the impossibility to distinguish between the different species.

In the archaeobotanical references on northwest Iberian sites, several designations have been used to designate this morphotype: *T. compactum* (e.g. Figueiral and Jorge 2008), *T. parvicoccum* (Pinto da Silva 1988), *T. aestivum* var. *sphaerococcum* (Ramil Rego and Aira Rodríguez 1993) and “globiform” wheat (Pinto da Silva 1988). The homogenization of the



nomenclature, by using the designation *Triticum* “stubby grains”, serves a purpose of allowing comparisons between sites studied by different investigators. It must not hide the possibility that different species could have existed in the area during Pre-historic times, but the maintenance of different nomenclatures could create an idea of wheat diversity that is impossible to confirm.

In general, the data that is published is usually vague regarding the criteria used by the different investigators for the discrimination of wheat grains. Therefore, there is a possibility that these were different and contradictory.

## 8.4. Results and discussion

Data allow us to distinguish three main phases in prehistoric agriculture.

### 8.4.1. Phase 1 (4400/4200 cal BC – c. 3300 cal BC)

In terms of the archaeological chronology, this phase 1 is integrated in the Neolithic, which is usually considered to have begun earlier, around 5000 cal BC. Interestingly, radiocarbon dates obtained from animal bones are slightly earlier than those obtained from domestic cereals in Cantabria – beginning of the 5<sup>th</sup> millennium cal BC for the first and second half of the 5<sup>th</sup> millennium cal BC for the latter (Arias et al. 2000, Zapata et al. 2004).

This goes well with data from the northwest, where the first, yet intermittent, palynological evidence for cereals dates back to 4400-4200 cal BC (Ramil-Rego 1992, Muñoz Sobrino et al. 2005, Ramil-Rego et al. 2009) but a growing importance of shrubby vegetation and significant decrease in Arboreal Pollen in some palynological sequences takes place already in a slightly earlier stage. Muñoz Sobrino et al. (2005) indicate abrupt climate change as the main driving force for such early trends, although recently they considered these to have been combined with anthropogenic fires and deforestation (Ramil Rego et al. 2009). These are probably related to the expansion of animal husbandry prior to agricultural practices.

The decrease in arboreal vegetation and the increasing presence of shrubs, ferns, nitrophilous plants (Muñoz Sobrino et al. 2005, Martínez-Cortizas et al. 2009) since the second half of the 5<sup>th</sup> millennium cal BC suggests greater human pressure due to productive practices. The use of

fire played a determinant role in such trend, being the easier and most effective way to promote the deforestation. It is documented in palynological sequences from wetlands in the area (Ramil Rego 1992), in paleosols in archaeological contexts (López Sáez and Cruz 2002, López Sáez et al 2010) and other sedimentary sequences (Cordeiro 2004). The use of fire does not imply slash and burn practices, contrary to what is suggested by Martínez Cortizas et al. (2009). Slash activities are tiring and time consuming, particularly in the case of the limited Neolithic technology. Burning was surely sufficient to promote open landscapes.

Agriculture and pastoralism were favoured by a warm climate (Ramil Rego et al. 2009). This must have been determinant in the adoption of crops adapted to warm Mediterranean climates such as those that characterize the first agricultural assemblages.

The sedimentary sequences testify for significant erosion episodes beginning mostly at the second half of the 5<sup>th</sup> millennium cal BC (Ramil Rego 1993b, Ramil Rego et al. 1998 and 2005, Martínez-Cortizas et al. 1993 and 2009; Muñoz Sobrino et al. 1998, Cordeiro 2004), coincident with evidences of the use of fire and, in the case of northern Portugal, the construction of the first megalithic monuments. Such erosion events are slightly later than the first appearance of *Cerealia* type pollen.

Still, cerealia-type pollen presence in the sequences remain discontinuous through this early agricultural phase and forests maintain their capacity to recover (Muñoz Sobrino et al. 2005), suggesting the incipency of early productive practices.

This seems to confirm local archaeological models according to which human communities continued to be semi-nomads with ways of living similar to those of the Early Holocene (Jorge 2000, Sanches 2000, 2006, Bettencourt 2005b, Sampaio and Carvalho 2006).

Evidence of animal husbandry preceding agriculture as a customary subsistence strategy suggests differential assimilation, on an Iberian level, of the elements usually ascribed to the Neolithic, as proposed by several authors (Jorge 2000, Sanches 2000b, Monteiro-Rodrigues 2008, Monteiro-Rodrigues et al. 2008). Still, caution is needed since archaeological and archaeobotanical data remain sparse. Animal husbandry evidences consist on sparse, sometimes problematic, *Ovis/Capris* remains in few settlements, namely Prazo (Vila Nova de Foz Coa, Portugal) (Monteiro-Rodrigues 2008) and Quebradas (Vila Nova de Foz Coa, Portugal) (Carvalho 1999). Hunting activities are suggested by the presence of *Sus* cf. *scrofa*, *Cervus elaphus* and *Oryctolagus cuniculus* remains in Prazo (Monteiro-Rodrigues 2008).

Evidence for plant macroremains in this early agricultural stage is sparse. In the open-air settlement of Bolada (Celorico de Basto, Portugal) *Vicia faba* was recovered along with *Olea europaea* var. *sylvestris* fruits, grinding stones and ceramics in one large fire pit (Sampaio and Carvalho 2006). Radiocarbon dating points out to the second half of the 5<sup>th</sup> millennium cal BC (Sac-1575, 5510±55 BP - 2σ 4458-4259 cal BC) but was obtained over a piece of a large carbonized trunk, enhancing the possibility of old wood effect. Still, archaeological material tallies this chronology (Sampaio and Carvalho 2006).

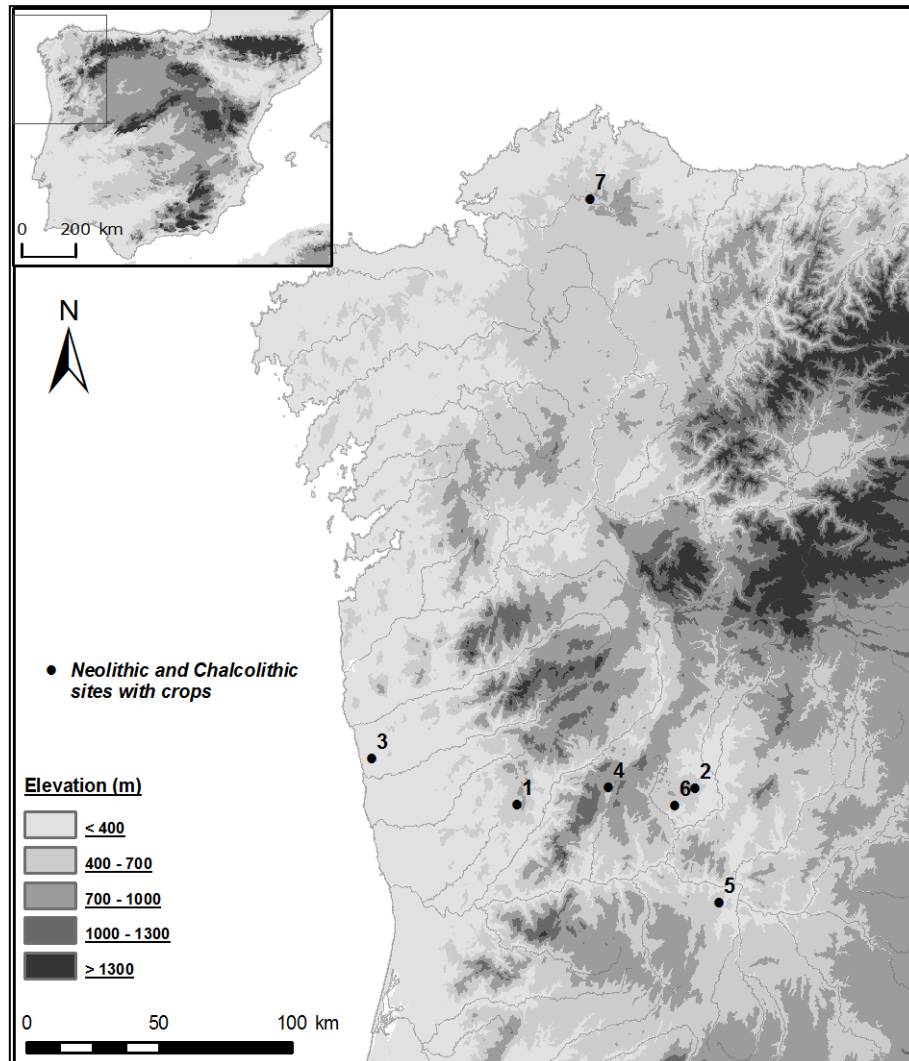


Figure 8.1 – Neolithic and Chalcolithic sites with crops. **Neolithic:** 1 - Bolada; 2 - Buraco da Pala.

**Chalcolithic:** 2 - Buraco da Pala; 3 - Bitarados; 4 - Castelo de Aguiar; 5 - Castelo Velho; 6 - Crasto de Palheiros; 7 - Prado do Inferno

Buraco da Pala (Mirandela, Portugal) is the most important and controversial Neolithic site in the region since it provided crop remains from the first half of the 5<sup>th</sup> millennium cal BC. Buraco da Pala is a cave with several occupation phases, from the Early Neolithic to the

Chalcolithic. Level 4-I dates back to the first half of the 5<sup>th</sup> millennium cal BC and provided one sample with crops, namely *Hordeum vulgare* var. *nudum*, *Triticum* “stubby grains” and few amounts of *Vicia faba* (Cristina Echave cited by Sanches 1997).

The macroremains are sparse but clearly contrast with other data for the region (see above). Still, the radiocarbon date obtained for level 4-I was obtained from charcoal, remaining thus as an indirect chronological evidence. Furthermore, the reliability of the data from Buraco da Pala level 4-I as been questioned by S. Monteiro-Rodrigues (2008), who stresses the fact that several perturbations had been documented by M. J. Sanches (1997) in these layers. S. Monteiro-Rodrigues (2008) suggests that level 4-I and 4-II represent a continuum of occupation difficult to interpret on chronological terms, but generally placed by radiocarbon dates between 4822-4618 cal. BC and 3938-3365 cal. BC.

Further evidence from other archaeological sites or direct radiocarbon dating of Buraco da Pala crops are necessary so to confirm the earliest dates of Level 4-I, suggested by M. J. Sanches (1997).

However, it is clear that in Levels 4-II and 3 plant remains are much more conspicuous than in the previous level. Radiocarbon dating from these levels was also obtained from charcoal and suggest these to represent two sequential phases positioned somewhere between 4000-3250 cal BC. In level 4-II *H. vulgare* var. *nudum* is by far the more abundant crop followed by *Triticum* “stubby grains”. *Hordeum vulgare* subsp. *vulgare* and *Vicia faba* were also recovered from this level. Level III is quite similar to the previous level, although *Triticum aestivum/durum* appears in significant amounts and four *Pisum sativum* seeds were also recovered (Ramil-Rego and Aira-Rodriguez 1993).

The data available suggest that agriculture of cereals (testified by palynological studies) and pulses (*Vicia faba* in Bolada) were coincident in their appearance in the region, during the Neolithic. In the neighboring Cantabrian-Basque region no pulses were found in Early Neolithic contexts yet, but poor sampling as well as conservation and taphonomic issues can justify this absence (Zapata et al. 2004). Poor sampling or ecological factors are possible reasons to justify the lack of free-threshing wheat, only present in El Mirón (Ramales de la Victoria, Spain) (Zapata et al. 2004). These are quite abundant in Buraco da Pala. On the other hand, further studies need to be done in order to assess if the absence of hulled wheat in northwest Iberia during Neolithic is a result of deficient sampling.

	Phase 1 - Neolithic				Phase 2 - Chalcolithic					
	Bolada	Buraco da Pala (4.1)	Buraco da Pala (4.2)	Buraco da Pala (3)	Bitarados	Buraco da Pala (2-1)	Castelo de Aguiar	Castelo Velho	Crasto de Palheiros	Prado do Inferno
<b>Cereals</b>										
<i>Hordeum</i>									+	
<i>Hordeum vulgare</i> var. <i>nudum</i>		++	+++	+++		++++			+	
<i>Hordeum vulgare</i> subsp. <i>vulgare</i>			+	+	+	++++		++++	++	
<i>Panicum miliaceum</i>									+	
<i>Panicum/Setaria</i>									+	
<i>Triticum aestivum</i>							(+)			
<i>Triticum aestivum/durum</i>			+	++		++	+++			+
<i>Triticum</i> - stubby grains		++	++	+++	+	++++	+	++++		
<i>Triticum dicoccum/spelta</i>									+++	
<i>Triticum turgidum</i> subsp. <i>dicoccum</i>									(+)	
<i>Triticum aestivum</i> subsp. <i>spelta</i>									(++)	
<i>Triticum</i>					+			++++	++	
Cereals - undetermined					+					
<b>Other crops</b>										
<i>Linum</i>					+	*				
<i>Papaver</i>						*		*		
<i>Pisum sativum</i>				+		+		+	+	
<i>Vicia faba</i>	*	+	+	+	+	+++			*	
<b>Wild fruits</b>										
<i>Arbutus unedo</i>									++	
<i>Corylus avellana</i>										+
<i>Olea europaea</i>	*								+	
<i>Quercus</i> (cotyledon)			+		++	++				+
<i>Rubus</i>					++					
<i>Vitis vinifera</i>						+				
<b>References</b>	A	B, C	B, C	B, C	D	B, C	E	F	G	H

Table 8.1 – Crops from Phases 1 (Neolithic) and 2 (Chalcolithic) sites. Legend: (+) 1-10; (++) 11-100; (+++) 101-1000; (++++) 1001-10.000; (+++++) more than 10.000; \*unknown amounts; parentheses in the table indicate the presence of chaff. Bibliographic references: A - Sampaio and Carvalho 2002; B - Ramil Rego and Aíra Rodríguez 1993; C - Sanches 1997; D - Bettencourt et al. 2007; E - Jorge 1986; F - Figueiral and Jorge 2008; G - Figueiral 2008; H - Ramil Rego 1993.

Wild fruits are rare in this Phase 1. Hazelnuts are absent, although they were recovered in several contexts from previous chronologies in northern Spain (Ramil Rego 1993, Ramil Rego et al. 1996).

Towards the end of the Neolithic relevant social and economical changes might have occurred as severe anthropogenetic environmental changes took place in the transition to the

Chalcolithic (*vide infra*). This agrees with archaeological data from northeastern Portugal (Sanches 2000, Sanches et al. 2007).

#### 8.4.2. Phase 2 (c. 3300 – c. 1800 cal BC)

Palaeoecological data suggests significant changes in the landscape since c. 3300 cal BC (Ramil Rego et al. 2009). Archaeologically, this corresponds to the transition between the Neolithic and the Chalcolithic. By this time, the impact of deforestation became more visible not only at the level of vegetation cover but also on other landscape features. In fact, a period of enhanced soil erosion known as the E4 started at c. 3300 cal BC and lasted until c. 2450 cal BC, depleting mountain soils and deepening the valleys' soils (Ramil 1993b, Martínez Cortizas et al. 1993, Muñoz Sobrino et al. 2005). Still, this phase of arboreal pollen decrease is not homogeneous in the whole region, as testified by regional (Ramil Rego 1992, Muñoz Sobrino et al. 2005) and local (López Sáez et al. 2000) studies.

On what climate is concern, a slight decrease in temperatures and precipitation may have taken place in this stage (Ramil Rego et al. 2009). Despite such trend, human pressure seems to have been the main driving factor for the erosion phase and the significant landscape changes (Ramil Rego 1992, Martínez-Cortizas et al. 1993, 2009). This erosion event would turn out to be very important on a regional level.

To what archaeobotanical data is concern, Buraco da Pala continues to be the exception due to the amount of carpological material it provided. The two Chalcolithic levels of this cave are sequential and cover almost the entire Chalcolithic period. Radiocarbon dating obtained from seeds position these levels in the first half of the 3<sup>rd</sup> millennium cal BC (Sanches 1997). Level II is very similar to the level III, from the Late Neolithic (see above). Here we find the same species in more or less the same proportions. The exception goes to the presence of *Papaver* and *Linum*, which appear only in this Level II (Ramil and Aira 1993, Sanches 1997).

In Level I, the Chalcolithic's second phase, proportions change significantly while *H. vulgare* subsp. *vulgare* and *Vicia faba* appear in greater quantities, although *H. vulgare* var. *nudum* and *Triticum* "stubby grains" still predominate. In this last phase *Lens culinaris* is a new crop. At the same time, *Vitis vinifera* seeds represent a new recollected species, together with a significant increase in the presence of *Quercus* acorns (Ramil and Aira 1993). The occurrence of grape pips should be considered normal as *Vitis vinifera* subsp. *sylvestris* existed in the local flora, as

suggested by the presence of charcoal in the nearby Neolithic funerary monument of Mamoa da Arcã (Mirandela, Portugal) (Figueiral and Sanches 1998-1999).

In the Chalcolithic levels of the enclosure or settlement of Crasto de Palheiros (Murça, Portugal) hulled wheat (*Triticum turgidum* subsp. *dicoccum* and *Triticum aestivum* subsp. *spelta*) predominate, followed by *H. vulgare* subsp. *vulgare*. *H. vulgare* var. *nudum*, *Lathyrus* and *Vicia faba* are also present, as well as fruits from *Arbutus unedo* and *Olea europaea* fruits (Figueiral 2008).

We must emphasize the presence of *Panicum miliaceum* grains and *T. spelta* chaff in this site's Chalcolithic levels. These species' presence is rather problematic since their cultivation in the rest of the Iberian Peninsula is considered to be more recent (Buxó and Piqué 2008, Bettencourt et al. 2007).

Millet grains (*Panicum miliaceum* and *Panicum/Setaria*) appear only in one of the site's platform both on Chalcolithic and Iron Age levels. 10 millet grains were found in the Chalcolithic levels and over 25000 millet grains were recovered in the Iron Age levels (Figueiral 2008). Chaff from *T. spelta*, together with abundant *T. dicoccum/spelta* grains (Figueiral 2008) were recovered in another platform, in two depressions inside a Chalcolithic hut in an apparently sealed context (Sanches 2008). Furthermore, many disturbances to the Chalcolithic levels are confirmed by several radiocarbon dates obtained over charcoal, pointing out to much recent periods. These dates were considered erroneous by the archaeologist (Sanches 2008) and must lead us to consider with caution the data presented here. Direct radiocarbon dating of problematic material is needed so to confirm such early introduction of these two crops.

No other site provided such diversity of crops (see Table 8.1). In the enclosure of Castelo Velho (Vila nova de Foz Côa, Portugal) *Triticum "stubby grains"* is the most frequent macroremain, followed by hulled barley. *Pisum sativum* is rare (Figueiral and Jorge 2008). In the settlement of Bitarados (Esposende, Portugal) *H. vulgare* subsp. *vulgare*, *Triticum "stubby grains"*, *Linum* and *Vicia faba* are registered (Bettencourt et al. 2007) while in settlements of Castelo de Aguiar (Vila Pouca de Aguiar, Portugal) (Jorge 1986) and Prado do Inferno (Lugo, Spain) (Ramil Rego 1993) only naked wheat was found.

In what animal husbandry is concern, the few data available for northwest Iberia tally archaeobotanical data, suggesting well developed productive practices. Data was obtained in the Douro basin and northeast Portugal (Crasto de Palheiros, Castelo Velho and Castanheiro do

Vento, in Cardoso 2005 and Costa 2008; Vinha da Soutilha and Pastoria in Lopes 1986), the northwest Portugal (Bitarados, in Bettencourt et al. 2007 and Cardoso and Bettencourt 2008) and Galicia (Pala da Vella and Tres Ventanas, in Fernández Rodríguez 2000 and Fernández Rodríguez and Pérez Ortiz 2007). Domestic species predominate in all the assemblages, mainly represented by three species: *Bos taurus* or *Bos* are dominant in most of the sites mentioned above, while *Ovis/Capris* are the main domestic species in Bitarados and Pala la Vella. *Sus* remains appear also in all the sites and, when species are known (e.g. Pala la Vella), are usually domestic. Hunting practices are well testified and *Cervus elaphus* is present in most sites. In levels from the end of the 4<sup>th</sup> millennium BC (transition from the Neolithic to the Chalcolithic) at Pala la Vella remains from several wild species (e.g. *Felis sylvestris*, *Oryctolagus cuniculus* and *Equus ferus*) were recovered, together with evidences of fishing (Fernández Rodríguez 2000, Fernández Rodríguez and Pérez Ortiz 2007). Possible remains of great bustard (cf. *Otis tarda*) were recovered at Castanheiro do Vento (Costa 2008).

In general, during the Chalcolithic there is a preponderance of *H. vulgare* subsp. *vulgare* and *H. vulgare* var. *nudum* and naked wheat, namely the *Triticum* “stubby grains”. Other crops, whether cereals or legumes have little significance and wild fruits, particularly *Quercus* spp. acorns - appear in some sites. Still, the concentration of settlements with archaeobotanical data on the southern part of the region is a clear limitation to a regional overview. Future investigation in Galicia must promote the recovery of plant macroremains.

When comparing with data from other Iberian regions two relevant differences can be detected. Firstly, pulses in other Iberian regions are more diverse (Buxó and Piqué 2008) while in northwest Iberia the only relevant pulse is faba bean. This crop, contrary to other cultivated Leguminosae, is more suitable for humid and sub-humid conditions. Secondly, in northeast Iberia naked barley and naked wheat are the main crops while hulled barley only became relevant in subsequent periods (Buxó and Piqué 2008). By the contrary, in our study area, hulled barley seems to have been a very important crop already during the Chalcolithic. Although naked barley maintains its relevance, hulled barley appears as a more significant crop. Only in Buraco da Pala is the naked variety more abundant than hulled barley, but even at this site there is a great increase of hulled barley when compared with previous levels.

The reasons for replacing the naked species by the hulled one are not completely known. This change is particularly relevant since, despite being less resistant to pests, naked barley is more easily processed, more energetic and protein richer (Buxó 1997). Environmental constraints do



not seem to explain such trend because both species have similar growth conditions (Buxó 1997). For now, this question remains to be answered.

The cultivation of *Linum* is considered to have begun in southern Iberia during the Chalcolithic for oil and textile production (Buxó and Piqué 2008) and it appears in central-coastal Portugal – Vila Nova de S. Pedro (Azambuja) and Zambujal (Torres Vedras) – in the same period (Pinto da Silva 1988). In northwest Iberia the only *Linum* seeds known were recovered in the Chalcolithic levels of Bitarados and Buraco da Pala. In fact, in Buraco da Pala, none of the previous Neolithic levels provided any *Linum* seed (Ramil Rego and Aira Rodríguez 1993) which seems to tally other Iberian data, confirming that flax began to be cultivated in all the Iberian Peninsula during the Chalcolithic.

During the 3<sup>rd</sup> millennium cal BC (mostly in the Chalcolithic) settlement pattern is that of settlements in low or mid altitudes usually near the valleys, sometimes in areas with abundant rock shelters and outcrops (Sanches 1997, Bettencourt 2005b and 2009, Bettencourt et al. 2007). Others seem to be positioned at strategic points where the presence of suitable agricultural soils wasn't the first reason for settling (Fábregas Valcarce et al. 2003). Palynological data suggest evident human pressure at low altitudes, in the valleys and coastal areas, contrasting with an increase in Arboreal Pollen in Cantabrian Mountains (Muñoz Sobrino et al. 2005, Ramil Rego et al. 2009).

Despite the maintenance of perishable settlement strategies during this period, some with fragile stone structures (Jorge 1986, 1990, Sanches 2000, Bettencourt 2009), several changes took place. Such changes are patent on the level of funerary practices (megalithic tombs ceased to be erected), the presence of a great number of settlements and the development of some ceremonial enclosures and settlements with monumental structures. These features are considered evidences of a shift in the way communities perceived their territories and, possibly, an increase in demography, agricultural productivity and animal husbandry during the Chalcolithic (Sanches 1997, Jorge 2000, Fábregas Valcarce et al. 2003, Bettencourt 2005b, 2009, 2010b, Jorge and Jorge 2006, Sanches et al. 2007) despite the climate deterioration suggested by regional models (Ramil Rego et al. 2009). Therefore, changes occurring in several scopes suggest that major trends during the 3<sup>rd</sup> millennium are the result of a combination of ideological, social, economical and environmental factors.

As for the Early Bronze Age, there is no carpological data from archaeological sites. This situation is coincident with some decrease in archaeological data regarding this period

(Bettencourt 1999 and 2009). Nevertheless, A. M. S. Bettencourt (2009) considers that the tendency to occupy the valleys, seen more clearly in the Middle Bronze Age, already happened in the Early Bronze Age.

#### **8.4.3. Phase 3 (c.1800 – 600/500 cal BC)**

In phase 3 unprecedented anthropogenic deforestation clearly marks the palaeoenvironmental history of northwest Iberia. Around 1800 cal BC there is a reduction in the arboreal pollen in many sequences from northern Portugal and Galicia (Ramil-Rego 1992, Van Mourik 1986, Muñoz Sobrino et al. 1997, Muñoz Sobrino 2001) as well as in other northern Iberian mountain areas (Muñoz Sobrino et al. 1997, Muñoz Sobrino 2001). Similar spectra were identified in archaeopalynological (Aira Rodríguez and Ramil Rego 1995) and anthracological (Figueiral 1990, 1993, Figueiral and Sanches 2003, Figueiral and Bettencourt 2007) studies.

In the Ancares Mountains (East Galicia), palynological data suggests greater pressure occurred in the valleys at low altitudes, since *Quercus* curve declines and *Betula* values increase (Muñoz Sobrino et al. 1997). Climatically it corresponds to a slightly colder phase, at first, with temperatures increasing thoroughly until c. 1350 cal BC (Ramil Rego et al. 2009), near the transition between the Middle Bronze Age and the Late Bronze Age. By this time, a phase of warmer temperatures began and would last until c. 750 cal BC, when temperatures decreased again.

During the Middle Bronze Age, human communities seem to continue the tendency to occupy several different areas in low and mid altitudes: small hills, plateaus and spurs near the valleys, usually in low altitudes (Bettencourt 1999, 2000b, 2003, 2005b, 2009, Bettencourt et al. 2007, Carvalho 2004). More permanent settlements coexisted with other smaller and seasonally occupied places (Carvalho 2004, Bettencourt 2009, Ayán Vila and Parceró Oubiña 2009). Some apparently permanent settlements are associated to necropoleis (Bettencourt 1999, 2008, 2009, 2010, Ayán Vila and Parceró Oubiña 2009).

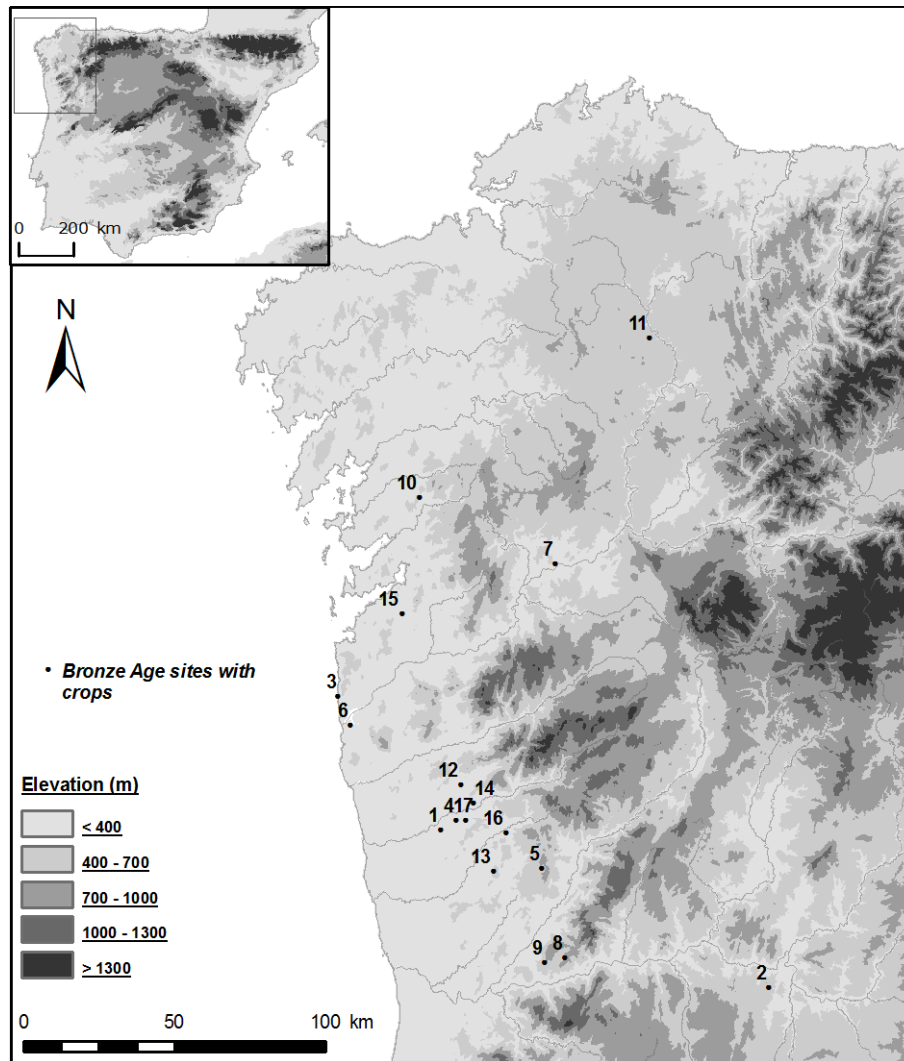


Figure 8.2 – Settlements and ceremonial sites with crops, from phase 3 (Middle/Late Bronze Age).

**Middle Bronze Age:** 1 - Alto de S. Bento; 2 - Castelo Velho; 3 - Portecelo; 4 - Sola; 5 - Tapada da Venda.

**Late Bronze Age:** 6 - Alto do Coto da Pena; 7 As Laias; 8 - Castelo de Matos; 9 – Lavra/Baião; 10 - Penalba; 11 - Penarrubia; 12 - S. Julião; 13 - Santa Catarina; 14 - Santinha; 15 - Torroso; 16 - Vale

Ferreiro; 17 - Vasconcelos

Our tentative interpretation suggests this settlement pattern, profoundly related to the valleys, may have benefited from the E4 erosion event identified by P. Ramil-Rego (1993b) and Martinez et al. (1993), as it coincides with its last stages. In fact, it is possible that, in some areas, Late Chalcolithic and Early/Middle Bronze Age communities chose settlement strategies which allowed them to take advantage of the new soils existing in the valleys. If so, changes in the landscape acted as an opportunity to increase productivity. Detailed and oriented geomorphological and archaeological studies should be done in order to test this possibility.

	Middle Bronze Age					Late Bronze Age													
	Alto de S. Bento	Castelo Velho	Portecelo	Sola (Ib)	Tapada da Venda	A. Coto da Pena	As Laias	Castelo de Matos	Lavra II - Baião	Penalba	Penarrubia	S. Julião (Ia-Ib)	S. Julião (Ic-Id)	S. Catarina	Santinha	Torroso	Vale Ferreiro	Vasconcelos	
<b>Cereals</b>																			
<i>Avena</i>							+++												
<i>Hordeum</i>			*												+				
<i>Hordeum vulgare</i> var. <i>nudum</i>							++										*		
<i>Hordeum vulgare</i> subsp. <i>vulgare</i>		+			*		++++	*	*								*		
<i>Panicum miliaceum</i>				+			+++++			+++++	*	*			+				
<i>Panicum/Setaria</i>								*											
<i>Triticum aestivum/durum</i>						*	(++)		*										
<i>Triticum</i> - stubby grains					*	*			*										
<i>Triticum turgidum</i> subsp. <i>dicoccum</i>										(+++++)									
<i>Triticum aestivum</i> subsp. <i>spelta</i>							(+++)												
<i>Triticum</i>			*				++	*				+		+	++	*			
cf. <i>Triticum</i>	+																		
Cereals - undetermined					*													*	
<b>Other crops</b>																			
<i>Lens</i>		+																	
<i>Pisum sativum</i>		++				+	++					+			+				
<i>Vicia faba</i>				+		*	+++++	*	*			+	+		++			*	
<b>Wild fruits</b>																			
<i>Corylus avellana</i>				+															
<i>Pyrus cordata</i>									*										
<i>Pyrus communis</i>				+															
<i>Pyrus</i>															+				
<i>Quercus</i> (cupule)				*								+			+				
<i>Quercus</i> (cotyledon)			*	+		*				+++++		++	+		++				
<i>Sorbus aucuparia</i>															+			*?	
<i>Vitis vinifera</i>								*											
<b>References</b>	A	B	C	A, D, E, F	G	H	I	J	K	L	M	A, D, E, F	A, D, E, F	I	A, F	M	G	F, M	

Table 8.2 – Crops from phase 3 sites. Legend: (+) 1-10; (++) 11-100; (+++) 101-1000; (++++) 1001-10.000; (+++++) more than 10.000; \*unknown amounts; parentheses in the table indicate the presence of chaff. Bibliographic references: A - Oliveira 2000; B - Figueiral and Jorge 2008; C - Cano Pan and Vázquez Varela 1991; D - Aira Rodriguez and Ramil Rego 1995; E - Dopazo Martínez 1996; F - Bettencourt 1999; G - Bettencourt et al. 2007; H - Pinto da Silva 1988; I - Unpublished; J - Queiroga 1992; K - Pinto da Silva 1988b; L - Aira Rodriguez et al. 1990; M - Dopazo Martínez et al. 1996.

The increase in productivity is clear in the archaeological record since not only many settlements became larger, but also pits, some of them probably used as storage facilities became more frequent. In some settlements of this period, such as Monte de Cabanas (Vigo, Spain), Monte Calvo (Baião, Portugal) (Gonçalves and Bettencourt 2010), Areias Altas (Porto, Portugal) (Luz 2010, Cabral 2010); Sola IIb (Bettencourt 2000), Quinta do Rapido (Barcelos, Portugal) (unpublish); Lavra (Matosinhos, Portugal) (Bettencourt and Fonseca 2011), Cimalha (Felgueiras, Portugal) (Bettencourt 2009), Tapada da Venda (Celorico de Basto, Portugal) (Bettencourt et al. 2002), Azurara (Vila do Conde, Portugal) (Bettencourt 2009) and Bouça do Frade (Baião, Portugal) (Jorge 1988, Bettencourt 2003) several of these pits were excavated. Still, the interpretation of such pits as storage facilities is based on their typology and their stratigraphic characteristics rather than the presence of carpological remains. In some sites, other interpretations were proposed for similar structures (Bettencourt 1999, 2000, 2008, 2009, Parcero Oubiña 1997; Criado Boado et al. 2000, Fábregas Valcarce 2001, Prieto Martínez et al. 2009, Luz 2010, Cabral 2010).

Few sites provided macroremains (see Table 8.2). In Tapada da Venda, *Triticum* “stubby grains” is the most ubiquitous crop but *H. vulgare* subsp. *vulgare* is also present (Bettencourt et al. 2007). In Sola IIb, besides *Vicia faba*, we stress the presence of *Panicum miliaceum* (3 grains), *Corylus avellana* and *Pyrus piraster* (Bettencourt 1999, Oliveira 2000, Bettencourt et al. 2007). The Bronze Age levels of Castelo Velho provided much fewer archaeobotanical remains than the Chalcolithic ones. *Pisum sativum* is the most frequent crop, still only with ten seeds. *Lathyrus*, *Lens* and *H. vulgare* subsp. *vulgare* were also recovered (Figueiral and Jorge 2008).

Still, for now, the small number of sites with archaeobotanical materials as well as the small amount of plant remains recovered in them does not allow further interpretations. The only relevant difference when compared with previous phases is the presence of grains from *Panicum miliaceum* (*vide infra* for further discussion).

These continuing anthropogenetic changes represent a new trend in the environmental history of the region and they document a shift in the human strategies of exploring the resources, towards ever more complex and unsustainable social ecological systems. It seems that, in what settlement patterning concern, major changes occurred on the organization and connectivity levels, mostly since the Late Bronze Age, following a trend initiated in the Middle Bronze Age (Bettencourt 1999, 2009).

Investigations confirm that settlement diversification occurred already in the Late Bronze Age, at least in some areas (Jorge 1988, Bettencourt 1999, 2000b, 2009). Settlements in the hills are found alongside with settlements in the valleys and settlements in mid-altitude spurs controlling the more important river basins (Jorge 1988, Bettencourt 2000b and 2009). Some of these settlements have delimitation structures such as stone walls, embankments or wooden palisades but true monumentalization/fortification is rare during this period (Jorge 1995, Bettencourt 1995, 2005a, 2009).

Rather than diverse settlement strategies, there seems to be a strategy based on the diversity of settlements. This implies that some kind of connection existed between the settlements, as suggested by A. M. S. Bettencourt (1999, 2000b, 2009). This greater connectivity may have led to an increased territoriality based on the complementarity between settlements, according to their strategic location near specific ecosystems and/or soils. This strategy implied a more profound use of the territory thus a greater pressure over it. This is testified by palynological data, as stated before.

Archaeological excavations in the area point to high levels of productivity in this period since structures that are thought to have been mostly used for storage continue to be very abundant in some settlements. Santinha (Amares, Portugal) is a paradigmatic site, since in its upper platform several pits were found inside a hut delimited by post holes and some stones in what was interpreted as a communal area (Bettencourt 2001a).

Due to the great number of excavations done in northern Portugal there are significant Late Bronze Age sites with archaeobotanical remains. As we can see on table 8.2, for many sites no quantitative data are provided in the publications. Still, it is clear that wheat (*Triticum*, *T. aestivum/durum* and *Triticum* “stubby grains”) and *H. vulgare* subsp. *vulgare* are the prevailing cereals, now alongside with *Panicum miliaceum*. The crop that was found in more Late Bronze Age sites is *Vicia faba*, followed by *Pisum sativum*; and the settlement which provided greater crop diversity was Santinha. Wild fruits, mostly acorns, appear to be relevant in some sites.

As Laias, Penalba, Penarrubia, Torroso and Vasconcelos are the more recent sites. Despite the great abundance of storage facilities in As Laias (Álvarez González and López González 2000), the ongoing archaeobotanical study and the available radiocarbon dates only pointed out the existence of one possible Late Bronze Age storage context. Unfortunately, the great time-span of the interval obtained (CSIC-1274: 2435±32 - 751-405 cal BC at 2σ) does not exclude the possibility of an Iron Age chronology. For now, we must consider a chronology within a

transitional period between the Late Bronze Age and the Iron Age. This storage facility provided grains and chaff from *T. spelta* as well as grains from *Avena*. The presence of *Avena* grains in Iron Age sites is very common. They were found in S. João de Rei II (Póvoa de Lanhoso, Portugal) (Dopazo Martínez 1996, Bettencourt 1999), Crastoeiro II (Mondim de Basto, Portugal) (Dinis 1993-94) and in many other sites. Oat and spelt grains from As Laias are probably the earliest evidence of its cultivation in the region. The presence of a single oat grain – identified as *Avena* cf. *strigosa* – in a Calcolithic level of Castelo de Aguiar (Pinto da Silva cited by Jorge 1986) corresponds probably to a wild species, since the cultivation of oat at such early dates was not likely to have occurred, considering the data available for the rest of the Iberian Peninsula (Buxó and Piqué 2008). Still, the main crops in the storage structure from As Laias were *Hordeum vulgare* subsp. *vulgare*, *Vicia faba* and *Panicum miliaceum*.

In Penalba 2kg of *Panicum miliaceum* and 70kg of *T. dicoccum* were recovered (Aira Rodriguez and Ramil Rego 1990). Data from R. Téllez et al. (1990) concerning this settlement is not taken into consideration since the criteria used for the discrimination of *Triticum* caryopses is considered inadequate (Oliveira 2000). Penarrubia only provided *Panicum miliaceum* and in Torroso both *H. vulgare* var. *nudum* and *H. vulgare* subsp. *vulgare* were cultivated (Dopazo Martínez 1996, Dopazo Martínez et al. 1996). We must stress the presence of naked barley in Torroso and As Laias in such late chronology; by this time it was not a staple crop in Iberia (Buxó and Piqué 2008).

Late Bronze Age is the first phase when we have a consistence presence of millet in the region. Until now, only *Panicum miliaceum* was identified. Data from millets of Castro de Palheiros are not reliable and the only Middle Bronze Age millet grains – three grains – come from Sola IIb, a site with no subsequent Late Bronze Age or Iron Age levels to suggest stratigraphic perturbations (Bettencourt 2000). Although for many years millet cultivation in the Iberian Peninsula was considered an Iron Age innovation, recent investigations, mainly in northern Spain, testify for its presence as crops since, at least, the Middle Bronze Age (Buxó and Piqué 2008).

The presence of *Panicum miliaceum*, a spring cereal, in several Bronze Age settlements is highly relevant since it demonstrates the possibility of obtaining two crops a year. It is interesting to notice that it appears in a phase of increasing sedentarization and territorialisation and it can be in some way related to these changes (Bettencourt 1999, 2000b, González-Ruibal 2003). The cultivation of spring crops – as catch crops - is an important strategy to prevent famine in case of any setback affecting the winter crops (Fernández-Posse

and Sánchez-Palencia 1998). Still, although *Panicum miliaceum* is the first clear evidence for spring cultivation, one cannot exclude the possibility that other species such as naked wheat were used as spring crops. R. Buxó and R. Piqué (2008) stress the possible use of *H. vulgare* subsp. *vulgare* as spring crop.

In other Iberian regions – Mediterranean coast and the northeast – a progressive substitution of *H. vulgare* var *nudum* by *H. vulgare* subsp. *vulgare* seems to have happened during the Bronze Age, culminating in the Middle or Late Bronze Age (Buxó and Piqué 2008). As pointed out before (*vide supra*) in northwest Iberia such trend may have taken place already during the Chalcolithic. The only Bronze Age/Iron Age transition settlement with *H. vulgare* var *nudum* is Torroso (c. 850-550 cal BC). Also in eastern Iberia, *Linum* is a recurrent crop during the Bronze Age, while it wasn't identified in any site in the northwest with this chronology.

In sum, crops available in northwest Iberia during the Late Bronze Age included winter and spring crops with different demands in terms of soils, water and sun exposure – functional diversity – which makes us consider a system based on the complementarity between different species which would allow the communities to fully explore their territory and feed a growing population of ever bigger settlements. This fits the interpretative models defined by A. M.S. Bettencourt for the northwest Portugal (Bettencourt 2009) and, more in particular, for the Cávado basin (Bettencourt 1999 and 2000b).

It is clear, thus, that the Bronze Age was a time of increasing pressure over the environment. Such pressure can be deduced from the palaeoenvironmental and archaeological record as forests seem to decrease at the same time as agricultural activities became more important, metallurgy became more developed, societies became more sedentary and connectivity between human communities was enhanced changing the local settlement patterns. This probably coincides with an increase in demography and surplus production (Bettencourt 2009, 2010b). P. Ramil Rego et al. (2009) suggest climatic conditions – an increase in temperature – may have had an important role, favouring the increase in agricultural productivity.

*Quercus* spp. acorns are the only wild fruits consistently present throughout the three phases and are the plant remains that were recovered in more sites. In fact, they were found in several other sites where no crops were recovered (Bettencourt 1999), thus not appearing in Table 8.2. Archaeobotanical sampling is occasional in the region although archaeobotanical materials have been recorded since the first excavations in the 19<sup>th</sup> century (Sarmiento 1903). Not surprisingly, in earlier excavations the more abundant carpological materials found



corresponded to acorns, most probably due to its size. Thus comparison between the number of sites with crops and sites with acorns must take this into consideration. Still, the gathering of wild fruits, particularly acorns, was probably an important complement to agriculture. The exploitation of wild resources by fully agricultural communities fitted in a strategy of resource optimization since they were very abundant in the region.

Zooarchaeological evidence is very sparse due to poor preservation conditions, but the management of diversified resources throughout the Bronze Age is suggested by the presence of domestic and wild mammals, as well as fish and molluscs in few sites (Bettencourt 1999, Fernández Rodríguez 2000 and 2010, Fernández Rodríguez and Pérez Ortiz 2007, Bettencourt et al 2007). In the Middle Bronze Age levels of the Guidoiro Areoso (Illa de Arousa, Pontevedra, Spain), *Bos taurus*, *Ovis aries*/*Capra hircus* and *Sus domesticus* predominate and fish and birds are also found (Fernández Rodríguez and Pérez Ortiz 2007). In archaeological sites from the Douro region in northeast Portugal (Castelo Velho and Fumo, in Antunes 1995, Valente 2004 and Costa 2008) domestic animals also predominate, such as *Bos taurus*, *Capra hircus*, and/or *Ovis aries*, but hunting (e.g. *Cervus elaphus*, *Oryctolagus cuniculus*) and fishing evidences also appear. In the Middle Bronze Age levels of Pala la Vella (Rubiá, Ourense, Spain) the domestic assemblage is similar and evidence of hunting activities are also found (*Cervus elaphus*, *Capreolus capreolus*, *Lepus capensis*, among others) (Rodríguez 2000 and Fernández Rodríguez and Pérez Ortiz 2007). In Late Bronze Age sites from northwest Portugal (Barbudo, S. Julião and Coto da Pena) the same domestic species were found (see synthesis in Bettencourt 1999). The collection of molluscs is testified in the Late Bronze Age levels of the coastal settlement of Coto da Pena (Silva 1986), in the Early/Middle Bronze Age pit of Areias Altas (Cabral 2010) and in Guidoiro Areoso (Rodríguez López in Rey Garcia 2011).

## 8.5. Conclusions

The vast amount of pollen sequences from natural contexts, particularly in northwest Spain, allows us to reconstitute quite well the landscape evolution in northwest Iberia (Muñoz Sobrino et al. 2005, Mighall et al. 2006). Several studies done in this scope, all over the region, document a significant decrease in arboreal pollen occurring in Late Prehistoric times, particularly in the Bronze Age. This trend has been identified both in coastal contexts and interior mountain wetlands and is frequently attributed to changes in human production strategies. Changes in the archaeological records are also documented. There seems to be a

tendency to evolve towards increasing sedentarization and productivity thus implying greater impact in the ecosystems.

The data available suggests that human pressure was the main driving force of landscape change since the 5<sup>th</sup> millennium cal BC (the Neolithic). Throughout the studied time-span, until the end of the Bronze Age, sequential phases of decrease and increase in arboreal pollen are recorded in most palynological sequences in the region, marking a growing tendency which favours open areas (e.g. scrubland and agricultural fields) at the expense of woodlands (Muñoz Sobrino et al. 2005, Ramil Rego et al. 2009). Still, it is clear that major pressure took place in the lowlands (Muñoz Sobrino et al. 1997). At the same time relevant social trends took place and it is possible that some of those changes were in some way related to environmental trends in the region.

Although Early Neolithic archaeological data is sparse, it suggests cereals and legumes were both introduced in northwest Iberia during this period. *Vicia faba* was recovered in Bolada (Sampaio and Carvalho 2002) in the same chronology as the first Cerealia pollen appears in regional diagrams (Muñoz Sobrino et al. 2005). The only possible Early Neolithic cereal remains are those of Buraco da Pala but its chronology is problematic (Monteiro-Rodrigues 2008). In the following phases, Buraco da Pala provides a significant assemblage of naked cereals (mostly *H. vulgare* var. *nudum* and *Triticum* “stubby grains”) and *Vicia faba*.

Still, during the 5<sup>th</sup> and 4<sup>th</sup> millennia cal BC human communities continued to be semi-nomads with a small plot itinerant agriculture (Jorge 2000, Sanches 2000, 2006). Palynological sequences tally this interpretation showing noticeable but yet swiftly reversible impacts in the landscape in which the use of fire seems to have had a significant role. At the same time, Cerealia curve remains discontinuous (Ramil Rego 1992, Muñoz Sobrino et al. 2005).

Since c. 3300 cal BC (the transition from the Late Neolithic to the Chalcolithic) began a new phase in which anthropogenic deforestation and soil erosion led to significant changes in the landscape (Ramil Rego et al. 2009, Muñoz Sobrino et al. 2005, Fábregas Valcarce et al. 2003). This fits with archaeological data. The presence of larger and monumental enclosures during the Chalcolithic demonstrates that human communities took major efforts to create and maintain architectural solutions. This suggests a decrease in their mobility as well as a more pronounced appropriation of space (Jorge 2000, Bettencourt 2005b, Valera 2006).

The archaeobotanical record from 3<sup>rd</sup> millennium cal BC sites (all of them Chalcolithic) testifies for *H. vulgare* subsp. *vulgare* having been preferred to *H. vulgare* var. *nudum*, although the

latter remains an important crop. Hulled wheat and legumes (*Vicia faba* and *Pisum sativum*) have little significance and *Linum* was introduced as a crop.

In the following phase, from c. 1800 until 600/500 cal BC (Middle and Late Bronze Age), *H. vulgare* var. *nudum* is almost absent. *Panicum miliaceum*, *Avena* and *T. spelta* are new crops, the two latter having been probably introduced in the Late Bronze Age/Iron Age transition. Millet, together with *Triticum* “stubby grains”, *H. vulgare* subsp. *vulgare*, *Pisum sativum* and *Vicia faba* are the crops that appear in more sites. The presence of millet testifies for significant changes in agricultural systems and territorial strategies as it is the first clear evidence of a spring crop being cultivated in the region.

Since the end of the 2<sup>nd</sup> millennium and the beginning of the 1<sup>st</sup> millennium cal BC, i.e. during the Late Bronze Age, the existence of settlements in distinct and, probably, complementary locations suggests an increase in territorialization and an improvement in settlements’ connectivity. Enhanced productivity is suggested by the abundant storage facilities in several settlements (Bettencourt 1999). In this sense, agricultural system could have been based on the complementarity of different crops and different - but connected - settlements positioned in distinct locations, exploring distinct resources (Bettencourt 1999, 2000b, 2005a, 2009).

These new, more interconnected and productive social-ecological systems led to new and greater pressure over the environment. This was a crucial stage in the consolidation of the agrarian system.

As a result, during the Bronze Age a new, but unprecedented, phase of environmental changes took place. Arboreal pollen decreases and shrubby and herbaceous communities expand noticeably in many palynological sequences, demonstrating there is a substitution of significant woodland by artificial and open areas, constituted by shrublands, grasslands, agricultural fields.

Overall, the three phases described marked a change in the processes that drive landscape change: the emergence of productive social-ecological systems that, as today, were characterized by intertwined structures and processes linked across spatial and temporal scales (e.g. systems described by Walker et al. 2006).

## 8.6. References

Aira Rodríguez M., Ramil Rego P., Álvarez Nuñez A. (1990). Estudio paleocarpológico realizado en el Castro de Penalba (Campolameiro, Pontevedra. España). *Botânica Complutensis*, 16: 81-89.

Aira Rodríguez M. J., Ramil Rego P. (1995). Datos paleobotánicos del Norte de Portugal (Baixo Minho). Estudio polínico y paleocarpológico. *Lagasalia*, 18 (1): 25-38.

Álvarez González Y., López González L. (2000). La secuencia cultural del asentamiento de Laias: evolución espacial y funcional del poblado. In Jorge V. (Ed.), *Actas del 3º congreso de Arqueología Peninsular*, 5 - Proto-História, ADECAP: 523-532.

An C., Feng Z., Tang L. (2004). Environmental change and cultural response between 8000 and 4000 cal. yr BP in the western Loess Plateau, northwest China. *Journal of Quaternary Science*, 19 (6): 529-535.

Antunes M. (1995). Jazida de Castelo Velho (Freixo de Numão). Elementos Arqueozoológicos. *Actas do I Congresso de Arqueologia Peninsular, V, Trabalhos de Antropologia e Etnologia*, 35 (2): 451-456.

Arias Cabal P., Altuna J., Armendariz A., González J., Ibáñez J., Ontañón R., Zapata L. (2000). La transición al Neolítico en la región cantábrica. Estado de la cuestión. In Jorge V. (Ed.), *Actas do 3º Congresso de Arqueologia Peninsular*, 3: 115-133.

Ayán Vila J., Parceró Oubiña C. (2009). Almacenamiento, unidades domésticas y comunidades en el noroeste preromano. In García Huerta R., Rodríguez González D. (Eds.), *Sistemas de almacenamiento entre los pueblos prerromanos peninsulares*, Huesca, Ediciones de la Universidad de Castilla-La Mancha: 367-422.

Bell M., Walker, M. (2005). *Late Quaternary Environmental Change. Physical and Human Perspectives*. Pearson/Prentice Hall.

Bettencourt A. M. S. (1995). Dos inícios aos finais da Idade do Bronze no Norte de Portugal. In *A Idade do Bronze em Portugal. Discursos de poder*, Lisboa, Secretaria de Estado da Cultura, Instituto Português de Museus, Museu Nacional de Arqueologia: 110-115.

Bettencourt A. M. S. (1999). *A paisagem e o Homem na bacia do Cávado durante o II e o I milénio AC*. PhD thesis, Braga: Universidade do Minho.

Bettencourt A. M. S. (2000). *O povoado da Idade do Bronze da Sola, Braga, Norte de Portugal*. Braga: Universidade do Minho/Instituto de Ciência Sociais.

Bettencourt A. M. S. (2000b). O vale do Cávado (Norte de Portugal) dos finais do III milénio aos meados do I milénio AC: sequências cronológico-culturais. In Jorge V. (Eds.), *Actas do 3º Congresso de Arqueologia Peninsular*. ADECAP, 4: 79-93.

Bettencourt A. M. S. (2001). *O povoado da Santinha, Amares, Norte de Portugal, nos finais da Idade do Bronze* Braga: Universidade do Minho, Instituto de Ciências Sociais.

Bettencourt A. M. S. (2003). Plant and animal husbandry in the second millennium BC in Northern Portugal. *Journal of Iberian Archaeology*, 5: 199-208.

Bettencourt A. M. S. (2005a). O que aconteceu às populações do Bronze Final do Noroeste de Portugal, no segundo quartel do I milénio AC, e quando começou, afinal, a Idade do Ferro? In *Actas do Colóquio Internacional Castro, um lugar para habitar*, Cadernos do Museu, 11, Penafiel, Câmara Municipal de Penafiel: 25-40.

Bettencourt A. M. S. (2005b). The early farmers and shepherds of North-west Portugal: the Neolithic and the Calcolithic. In Silva I., Mineiro C. (Eds.), *D. Diogo de Sousa. Regional Museum of Archaeology. Guide.*, Lisboa, Instituto Português dos Museus: 28-35.

Bettencourt A. M. S. (2008). Life and Death in the Bronze Age of the NW of Iberian Peninsula. In Fahlander F., Oestigaard T. (Eds.), *The Materiality of Death: Bodies, Burials, Beliefs*, Oxford, British Archaeological Reports. International Series 1768: 99-104.

Bettencourt A. M. S. (2009). A Pré-história do Minho. Do Neolítico à Idade do Bronze. In Pereira, P. (Ed.), *Minho. Traços de Identidade*, Braga, Universidade do Minho: 70-120.

Bettencourt A. M. S. (2010). La Edad del Bronce en el Noroeste de la Península Ibérica: un análisis a partir de las prácticas funerárias. *Trabajos de Prehistoria*, 67 (1): 139-173.

Bettencourt A. M. S. (2010b). Comunidades pré-históricas da bacia do Leça: do predador “nómada” ao agricultor sedentário. In Varela J., Pires C. (Eds.), *O Rio da Memória: Arqueologia no Território do Leça*, Matosinhos, Câmara Municipal de Matosinhos: 33-38.

Bettencourt A. M. S., Dinis A., Cruz C., Silva I. (2003). O povoamento Calcolítico do alvéolo de Vila Chã, Esposende (Norte de Portugal). Notas a propósito das escavações arqueológicas de Bitarados. *Portugália*, 24: 29-50.

Bettencourt A. M. S., Dinis A., Figueiral I., Rodrigues A., Cruz C., Silva I., Azevedo M., Barbosa R. (2007). A ocupação do território e a exploração de recursos durante a Pré-história Recente do Noroeste de Portugal. In Jorge S.O., 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*, Faro, Setembro de 2004, Promontoria Monográfica, 08, Faro, Universidade do Algarve: 149-164.

- Bettencourt A. M. S., Fonseca J. (2011). *O povoado da Idade do Bronze de Lavra, Matosinhos. Contributos para o estudo do Bronze Médio do litoral Norte*. Matosinhos: Centro de Investigação Transdisciplinar. Cultura, Espaço e Memória-CITCEM/Junta Freguesia de Lavra.
- Bowden W. (1959). The taxonomy and nomenclature of the wheats, barleys, and ryes and their wild relatives. *Canadian Journal of Botany*, 37: 657-684.
- Bowden W. (1966). Chromosome numbers in seven genera of the tribe Triticeae. *Canadian Journal of Genetics and Cytology*, 8 130-136.
- Brooks N. (2006). Cultural responses to aridity in the Middle Holocene and increased social complexity. *Quaternary International*, 151: 29-49.
- Buxó R. (1997). *Arqueología de las Plantas*. Barcelona: Crítica.
- Buxó R., Piqué R. (2008). *Arqueobotánica. Los usos de las plantas en la península Ibérica*. Barcelona: Ariel.
- Cabral J. (2010). O depósito de conchas do sítio arqueológico das “Areias Altas” (Porto, Portugal). Estudo morfológico e morfométrico das conchas inteiras de moluscos. *Férvedes*, 6: 73-82.
- Cano Pan J., Vázquez Varela J. (1991). La economía de un yacimiento del comienzo del Bronce Final: Portecelo (O Rosal, Pontevedra). In Queiroga F., Dinis A. (Eds.), *Paleoecología e Arqueología 2*, Vila Nova de Famalicão, 205-208.
- Cardoso J. (2005). Restos faunísticos do Crasto de Palheiros (Murça). Contributo para o conhecimento da alimentação no Calcolítico e na Idade do Ferro no Nordeste português. *Portugália*, 26: 65-75.
- Cardoso J., Bettencourt A. (2008) Caça e pastorícia no Calcolítico do NW de Portugal: o caso da estação arqueológica de Bitarados. *Estudos do Quaternário*, 5:79-86
- Carvalho A. (1999). Os sítios de Quebradas e de Quinta da Torrinha (Vila Nova de Foz Côa) e o Neolítico antigo do Baixo Côa. *Revista Portuguesa de Arqueologia*, 2 (1): 39-70.
- Carvalho A. (2004). O povoado do Fumo (Almendra, Vila Nova de Foz Côa) e o início da Idade do Bronze no Baixo Côa (trabalhos do Parque Arqueológico do Vale do Côa). *Revista Portuguesa de Arqueologia*, 7 (1): 185-219.
- Cordeiro A. (2004). *Dinâmica de vertentes em Montanhas Ocidentais do Portugal Central*. PhD thesis, Universidade de Coimbra.
- Costa C. (2008). Aspectos tafonómicos em Castanheiro do Vento (Vila Nova de Foz Côa) com base no estudo da arqueofauna. *Promontoria Monográfica*, 6: 159-222.

Costa J., Aguiar C., Capelo J., Lousã M., Neto C. (1998). Biogeografia de Portugal Continental. *Quercetea*, 0: 5-56.

Criado Boado F., Amado Reino X., Martínez López M. C., Cobas Fernández I., Oubiña P. (2000). Programa de corrección del impacto arqueológico de la gasificación de Galicia. Un ejemplo de gestión integral del patrimonio arqueológico. *Complutum*, 11: 63-85.

Dincauze D. (2000). *Environmental Archaeology. Principles and Practice*. Cambridge University Press.

Dinis A. (1993-1994). Contribuição para o estudo da Idade do Ferro em Basto: o Castro do Crastoeiro. *Cadernos de Arqueologia, Serie 2*, 10-11 261-278.

Dopazo Martínez A. (1996). *La dieta vegetal del Noroeste Ibérico durante el Holoceno. Una aproximación a través del análisis paleocarpológico*. Dissertação de Licenciatura, Universidad de Santiago de Compostela.

Dopazo Martínez A., Fernández Rodríguez C., Ramil-Rego P. (1996). Arqueometría aplicada a yacimientos Galaico-romanos del NW Peninsular: valoración de la actividad agrícola y ganadera. In Ramil-Rego P., Fernández Rodríguez, C., Rodríguez Guitián, M. (Eds.), *Biogeografía Pleistocena - Holocena de la Península Ibérica*, Santiago de Compostela, Xunta de Galicia: 317-332.

Fábregas Valcarce R. (2001). *Los petroglifos y su contexto: un ejemplo de la Galicia meridional*. Vigo: Instituto de Estudios Vigueses.

Fábregas Valcarce R., Martínez Cortizas A., Blanco Chao R., Chesworth W. (2003). Environmental change and social dynamics in the second-third millennium BC in NW Iberia. *Journal of Archaeological Science*, 30 (7): 859-871.

Fernández Rodríguez C. (2000). *Los macromamíferos en los yacimientos arqueológicos del Noroeste peninsular: un estudio económico*. PhD thesis, Santiago de Compostela, Facultade de Xeografía e Historia. Universidade de Santiago de Compostela.

Fernández Rodríguez C. (2010). Faunas arqueológicas en el Noroeste de la Península Ibérica. In Bettencourt A.M.S., Alves M.I.C., Monteiro-Rodrigues S. (Eds.), *Variações Paleoambientais e Evolução Antrópica no Quaternário do Ocidentente Peninsular/Palaeoenvironmental Changes and Anthropization in the Quaternary of Western Iberia*, Braga, Associação Portuguesa para o Estudo do Quaternário-APEQ/Centro de Investigação Transdisciplinar. Cultura, Espaço e Memória-CITCEM: 97-112.

Fernández Rodríguez C., Pérez Ortiz L. (2007). Caza y domesticación en el Noroeste de la Península Ibérica durante la Prehistoria. Datos arqueozoológicos. In Jorge S.O., Bettencourt A.M.S., Figueiral I. (Eds.) *A Conceção das paisagens e dos espaços na Arqueologia da Península Ibérica, Actas IV Congresso de Arqueologia Peninsular*, Promontória Monográfica, 8: 165-176.

Fernández Rodríguez C., Ramil Rego P., Rodríguez López C. (1998). La dieta alimentícia desde la Prehistoria a la Edad Media en el Noroeste Ibérico. In (Eds.), *V e VI Semanas Galegas de História: Morte e sociedade no Noroeste peninsular. Un percorrido pola Galicia cotiá*, Santiago de Compostela, Asociación Galega de Historiadores: 277-312.

Fernández-Posse M., Sánchez-Palencia, F. (1998). Las comunidades campesinas en la Cultura Castreña. *Trabajos de Prehistoria*, 55 (2): 127-150.

Figueiral I. (1990). *Le Nord-Ouest du Portugal et les modifications de l'écosystème, du Bronze final a l'époque romaine, d'après l'anthracanalyse de sites archeologiques*. Université des Sciences et Techniques du Languedoc.

Figueiral I. (1993). Charcoal analysis and the vegetational evolution of North-West Portugal. *Oxford Journal of Archaeology*, 12 (2): 209-222.

Figueiral I. (2008). O Crasto de Palheiros (Murça, NE Portugal): a exploração dos recursos vegetais durante o III/inícios do II<sup>o</sup> milénio AC e entre o I<sup>o</sup> milénio AC e o séc. II<sup>o</sup> DC. In Sanches M. J. (Ed.), *O Crasto de Palheiros. Fragada do Castro. Murça – Portugal*, Muça, Município de Murça: 79-108.

Figueiral I., Bettencourt A. M. S. (2004). Middle/Late Bronze Age plant communities and their exploitation in the Cavado Basin (NW Portugal) as shown by charcoal analysis: the significance and co-occurrence of *Quercus* (deciduous) Fabaceae. *Vegetation History and Archaeobotany*, 13 (4): 219-232.

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 milénio AC. In 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, 14-19 Setembro 2004, Promontoria Monográfica, 8*, Faro, Universidade do Algarve: 177-187.

Figueiral I., Jorge S. (2008). Man-made landscapes from the third-second millennia BC: the example of Castelo Velho (Freixo de Numão, North-East Portugal). *Oxford Journal of Archaeology*, 27: 119-133.

Figueiral I., Sanches M. J. (2003). Eastern Trás-os-Montes (NE Portugal) from the Late Prehistory to the Iron Age: the land and the people. In Fouache E. (Ed.), *The Mediterranean World Environment and History*, Elsevier: 315-329.

Gianotti Garcia C., Cancela Cereijo C. (2005). Testemuña da ocupación humana durante o Neolítico Final e o período Alto-Medieval na Península do Morrazo. In Criado Boado F., Domínguez C. (Eds.), *Obras Públicas e Património: Estudo Arqueolóxico do corredor do Morrazo. Tapa 35*, Santiago de Compostela, Laboratorio de Arqueología da Paisaxe. Instituto de Estudos Galegos Padre Sarmiento, CSIC – Xunta de Galicia: 50-54.



Gómez Fernández A., Fábregas Valcarce R., Méndez Vázquez D., Paz Rodríguez M. S. (2004). Nuevos datos sobre cerâmica Penha en el sur de Galicia. *Sautuola*, 10: 17-33.

Gómez-Orellana L., Ramil Rego P., Muñoz Sobrino C., Bettencourt A.M.S. (2010). El paisaje holoceno en la serra d'Arga (NW Portugal). In Bettencourt A.M.S., Alves M.I.C., Monteiro-Rodrigues S. (Eds.), *Variações Paleambientais e Evolução Antrópica no Quaternário do Ocidentente Peninsular/Palaeoenvironmental Changes and Anthropization in the Quaternary of Western Iberia*, Braga, Associação Portuguesa para o Estudo do Quaternário-APEQ/Centro de Investigação Transdisciplinar. Cultura, Espaço e Memória-CITCEM: 53-59.

Gonçalves A., Bettencourt A. M. S. (2010). *O povoado de Monte Calvo, Baião no contexto da Idade do Bronze do Norte de Portugal*. Braga: Câmara Municipal de Baião/Centro de Investigação Transdisciplinar Cultura, Espaço e Memória-CITCEM.

Goncharov N. (2002). *Comparative genetics of wheats and their related species*. Novosibirsk: Siberian Branch Press.

Goncharov N. (2005). Comparative-genetic analysis a base for wheat taxonomy revision. *Czech Journal of Genetics and Plant Breeding*, 41 52-55.

Goncharov N., Golovnina K., Kondratenko E. (2009). Taxonomy and molecular phylogeny of natural and artificial wheat species. *Breeding Science*, 59 (5): 492-498.

González-Ruibal A. (2003). *Arqueología del Primer Milenio a.C. en el Noroeste de la Península Ibérica*. PhD thesis, Madrid, Complutense University of Madrid.

Gorgoso López L., Fábregas Valcarce R., Acuña Piñeiro A. (2011). Desmontando la Mesa de Montes (Cangas do Morrazo, Pontevedra). Aproximación arqueohistórica a un asentamiento calcolítico en altura. *Zephyrus*, 67: 111-128.

Hillman G., Mason S., de Moulins D., Nesbitt M. (1996). Identification of archaeological remains of wheat: the 1992 London workshop. *Circaea*, 12 (2): 195-210.

Jorge S. (1986). *Povoados da Pré-História Recente da Região de Chaves-Vila Pouca de Aguiar (Trás-os-Montes Ocidental): Bases para o Conhecimento do IIIº e Princípios do IIº Milénios a. C. no Norte de Portugal*. PhD thesis, Porto: Faculdade de Letras, Universidade do Porto.

Jorge S. (1988). *O Povoado da Bouça do Frade (Baião) no Quadro do Bronze Final do Norte de Portugal*. Porto: GEAP.

Jorge S. (1990). Desenvolvimento da hierarquização social e da metalurgia. In Alarcão J. (Ed.), *Nova História de Portugal, Vol 1, Portugal. Das origens à Romanização*, Lisboa, Presença: 163-212.

Jorge S. (2000). Domesticating the land: the first agricultural communities in Portugal. *Journal of Iberian Archaeology*, 2: 43-98.

Jorge S. (2003). Pensar o espaço da Pré-História recente: a propósito dos recintos murados da Península Ibérica. In Jorge S. (Eds.), *Recintos Murados da Pré-História recente*, Porto-Coimbra, Faculdade de Letras da Universidade do Porto, Centro de Estudos Arqueológicos das Universidades de Coimbra e do Porto: 13-50.

Jorge S., Jorge V. (2006). Agricultores e pastores fixados no território. Do Neolítico Médio ao Bronze Médio. In Almeida C. (Ed.), *História do Douro e do Vinho do Porto. História Antiga da Região Duriense*, Santa Maria da Feira, Edições Afrontamento: 106-163.

Jorge V., Muralha J., Vale A., Velho G., Pereira L. (2006-2007). Problemática suscitada pelas escavações do sítio pré-histórico do Castanheiro do Vento (Horta do Douro, Vila Nova de Foz Côa), sobretudo após a campanha de 2005. *Revista da Faculdade de Letras: Ciências e Técnicas do Património*, V-VII: 241-277.

Lopes T. (1986). Análise do material ósseo das estações da Vinha da Soutilha (Mairos) e da Pastoria (Chaves). In Jorge S. (Eds.), *Povoados da Pré-História Recente da região de Chaves – Vª Pª de Aguiar*, 1-B, Porto, Instituto de Arqueologia da Faculdade de Letras da Universidade do Porto: 1099-1123.

López Sáez J., Cruz D. (2002). Orquilha dos Juncais (Vila Nova de Paiva, Viseu). Análises polínicas. *Portugália*, 23: 5-34.

López Sáez J., Cruz D., Gonçalves A. (2010). A Mamoia 1 de Madorras (Sabrosa, Vila Real, Portugal): análises polínicas e datações de Carbono 14. In Bettencourt A.M.S., Alves M.I.C., Monteiro-Rodrigues S. (Eds.), *Variações Paleoambientais e Evolução Antrópica no Quaternário do Ocidente Peninsular/Palaeoenvironmental Changes and Anthropization in the Quaternary of Western Iberia*, Braga, Associação Portuguesa para o Estudo do Quaternário-APEQ/Centro de Investigação Transdisciplinar. Cultura, Espaço e Memória-CITCEM: 41-54.

López Sáez J., López Garcia P., Cruz D., Canha A. (2000). Paleovegetação e impacto humano durante a Pré-história recente na região do Alto Paiva: palinologia do povoado do Bronze final de Canedotes (Vila Nova de Paiva). *Estudos Pré-históricos*, 8: 161-185.

Luz S. (2010). O Depósito de conchas do sítio arqueológico das Areias Altas (Porto, Portugal). Discussão do enquadramento arqueológico da estrutura 15. *Férvedes*, 6: 141-145.

Mackey J. (1966). Species relationships in *Triticum*. *Hereditas*, Suppl. 2: 237-276.

Mackey J. (1989). Genus *Triticum* and its systematics In Shumny V. (Eds.), *Vavilov's Legacy in Modern Biology*, Moscow, Nauka: 170-185.

Martín Seijo M., Figueiral I., Bettencourt A., Gonçalves A., Alves M. (2011). 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 Tereso J., Honrado J., Pinto A., Rego F. (Ed.), *Florestas do Norte de Portugal. História, Ecologia e Desafios de Gestão*, Porto, InBio - Rede de Investigação em Biodiversidade e Biologia Evolutiva.

Martínez Cortizas A., Ramil Rego P., García Rodeja E., Moares C. (1993). Suelos de montaña y ciclos de estabilidad/inestabilidad en las vertientes de Galicia (NW España). In Pérez Alberti A., Guitián Rivera L., Ramil Rego P. (Eds.), *La evolución del paisaje en las montañas del entorno de los Caminos Jacobeos*, Santiago de Compostela, Xunta de Galicia: 107-123.

Martínez-Cortizas A., Costa-Casais M., López-Sáez J. A. (2009). Environmental change in NW Iberia between 7000 and 500 cal BC. *Quaternary International*, 200 (1-2): 77-89.

Martínez-Cortizas A., Pontevedra-Pombal X., García-Rodeja E., Nóvoa-Muñoz J. C., Shotyk W. (1999). Mercury in a Spanish Peat Bog: Archive of Climate Change and Atmospheric Metal Deposition. *Science*, 284 (5416): 939-942.

Mateus J., Queiroz P., Van Leeuwarden W. (2003). O Laboratório de Paleoecologia e Arqueobotânica – uma visita guiada aos seus programas, linhas de trabalho e perspectivas. In Mateus J., Moreno-Garcia M. (Eds.), *Paleoecologia Humana e Arqueociências. Um programa multidisciplinar para a arqueologia sob a tutela da Cultura* Lisboa, IPA: 106-188.

Mighall T., Martínez Cortizas, A., Biester, H., Turner, S. (2006). Proxy climate and vegetation changes during the last five millennia in NW Iberia: Pollen and non-pollen palynomorph data from two ombrotrophic peat bogs in the North Western Iberian Peninsula. *Review of Palaeobotany and Palynology*, 141: 203–223.

Monteiro-Rodrigues S. (2008). *Pensar o Neolítico antigo. Contributo para o estudo do Norte de Portugal entre o VII e o V milénios BC*. PhD thesis, Porto, Faculdade de Letras. Universidade do Porto.

Monteiro-Rodrigues S. (2010). Algumas considerações acerca do processo de neolitização no Norte de Portugal. In Bettencourt A.M.S., Alves M.I.C., Monteiro-Rodrigues S. (Eds.), *Varições Ambientais e Evolução Antrópica no Quaternário do Ocidente Peninsular*, Braga, Associação Portuguesa para o Estudo do Quaternário-APEQ/Centro de Investigação Transdisciplinar. Cultura, Espaço e Memória-CITCEM: 73-82.

Monteiro-Rodrigues S., Figueiral I., López-Sáez J. A. (2008). Indicadores paleoambientais e estratégias de subsistência no sítio pré-histórico do Prazo (Freixo de Numão – Vila Nova de Foz Côa – Norte de Portugal). In *III Congresso de Arqueologia de Trás-os-Montes, Alto Douro e Beira Interior – Debates no Vale do Côa*, 1, Porto: ACDR de Freixo de Numão: 96-119.

van Mourik J. (1986). Pollen profiles of slope deposits in the Galician area (N.W. Spain). *Nederlandse Geografische Studies* 12: 1-171.

Muñoz Sobrino C. (2001). *Cambio climático y dinámica del paisaje en las montañas del noroeste de la península ibérica*. PhD thesis, Lugo: Universidade de Santiago de Compostela.

Muñoz Sobrino C., Ramil-Rego P., Rodríguez Guitián M. (1997). Upland vegetation in the north-west Iberian peninsula after the last glaciation: Forest history and deforestation dynamics. *Vegetation History and Archaeobotany*, 6 (4): 215-233.

Muñoz Sobrino C., Ramil Rego P., Gómez Orellana L., Díaz Varela R. (2005). Palynological data on major Holocene climatic events in NW Iberia. *Boreas*, 34 (3): 381-400.

Muñoz Sobrino C., Ramil Rego P., Rodríguez Guitián M. A. (2001). Vegetation in the mountains of northwest Iberia during the last glacial-interglacial transition. *Vegetation History and Archaeobotany*, 10 (1): 7-21.

Oliveira M. (2000). *O registo paleocarpológico do NO peninsular entre o IIIº e o Iº milénios a.C. Contributo para o estudo da alimentação pré e proto-histórica*. MSc thesis, Braga, Universidade do Minho.

Parceros Oubiña C. (1997). *Documentación de un entorno castreño: trabajos arqueológicos en el área de Cameixa*. Santiago de Compostela: Grupo de Investigación en Arqueología del Paisaje.

Pinto da Silva A. (1988). A paleoetnobotânica na arqueologia portuguesa. Resultados desde 1931 a 1987. In Queiroga F., Sousa I., Oliveira C. (Eds.), *Palaeoecologia e Arqueologia*, Vila Nova de Famalicão, Câmara Municipal de Vila Nova de Famalicão: 13-29.

Pinto da Silva A. (1988b). Os achados de origem vegetal no campo arqueológico da Serra da Aboboreira desde 1982 a 1987. *Arqueologia*, 17: 175-176.

Prieto Martínez M., Martínez Cortizas A., Lante Suárez O., Gil Agra D. (2009). Estudio de la cerámica del yacimiento de fosas de Fraga do Zorro. In (Eds.), *Actas do Congresso Transfronteiriço de Arqueologia (Montalegre, Outubro de 2008)*, Revista Aqva Flaviae, 41: 107-121.

Queiroga F. (1992). *War and Castros. New approaches to the northwestern Portuguese Iron Age*. PhD thesis, Oxford, University of Oxford.

Ramil Rego P. (1992). *La vegetación cuaternaria de las Sierras Septentrionales de Lugo a través del análisis polínico*. PhD thesis, Universidade de Santiago de Compostela.

Ramil Rego P. (1993). Paleoethnobotánica de yacimientos arqueológicos holocenos de Galicia (N.O. Cantábrico). *Munibe*, 45: 165-174.

Ramil Rego P. (1993b). Evolución climática e historia de la vegetación durante el Pleistoceno Superior y el Holoceno en las regiones montañosas del Noroeste Ibérico. In Pérez A., Guitián L., Ramil P. (Eds.), *La evolución del paisaje en las montañas del entorno de los Caminos Jacobeos*, Santiago de Compostela, Xunta de Galicia: 25-60.

Ramil Rego P., Aira Rodríguez M. J. (1993). A palaeocarpological study of Neolithic and Bronze Age levels of the Buraco da Pala rock-shelter (Bragança, Portugal). *Vegetation History and Archaeobotany*, 2 (3): 163-172.

Ramil Rego P., Dopazo Martínez A., Fernández Rodríguez C. (1996). Cambios en las estrategias de explotación de los recursos vegetales en el Norte de la Península Ibérica. *Férvedes*, 3: 169-187.

Ramil Rego P., Fernández Rodríguez C. (Eds.) (1996). Arqueometría y Paleoecología del Norte de la Península Ibérica. Cambios naturales y perturbaciones antrópicas. *Férvedes*, 3.

Ramil Rego P., Gómez-Orellana L., Muñoz-Sobrino C., García-Gil S., Iglesias J., Pérez Martínez M., Martínez Carreño N., Nóvoa Fernández B. (2009). Cambio climático y dinámica del paisaje en Galicia. *Recursos Rurais*, 5: 21-47.

Ramil Rego P., Iriarte M., Muñoz Sobrino C., Gómez-Orellana L. (2005). Cambio climático y dinámica temporal del paisaje y de los hábitats en las ecorregiones del NW de la Península Ibérica durante el Pleistoceno superior. *Munibe*, 57: 537-551.

Ramil Rego P., Muñoz-Sobrino C., Rodríguez-Guitián M., Gómez-Orellana L. (1998). Differences in the vegetation of the North Iberian Peninsula during the last 16,000 years. *Plant Ecology*, 138 (1): 41-62.

Ramil Rego P., Taboada Castro, M.T., Díaz-Fierros, F., Aira, M.J. (1996). Modificación de la cubierta vegetal y acción antrópica en la región del Minho (Norte de Portugal) durante el Holoceno. In Ramil-Rego P., Fernández Rodríguez, C., Rodríguez Guitián, M. (Eds.), *Biogeografía Pleistocena - Holocena de la Península Ibérica*, Santiago de Compostela, Xunta de Galicia: 199-214.

Rey Garcia, J. M. (2011). Guidoiro Areoso (Illa de Arousa, Pontevedra): un pequeño islote con una intensa ocupación entre el Neolítico Final y la Edad del Bronce. In Prito-Martínez M.P, Salanova, L. (Coords.), *Las comunidades campaniformes en Galicia. Cambios sociales en el III y II milenios BC en el NW de la Península Ibérica*, Pontevedra, Diputación de Pontevedra: 201-210.

Ribeiro O., Lautensach H. (1995). *Geografía de Portugal. I. A posição geográfica e o território*. Lisboa: Edições João Sá da Costa.

Rivas-Martínez S., Díaz T., Fernández-González F., Izco J., Loidi J., Lousã M., Penas A. (2002). Vascular plant communities of Spain and Portugal. Addenda to the Syntaxonomical checklist of 2001. *Itinera Geobotanica* 15 (1-2): 5-922.

Rodríguez Guitián M., Ramil Rego P. (2007). Clasificaciones climáticas aplicadas a Galicia: revisión desde una perspectiva biogeográfica. *Recursos Rurais*, 1 (3): 31-53.

Rodríguez Guitián M., Ramil Rego P. (2008). Fitogeografía de Galicia (NW Ibérico): análisis histórico y nueva propuesta corológica. *Recursos Rurais*, 4: 19-50.

Sampaio J., Carvalho A. (2002). Intervenção de salvamento no sítio de Bolada (S. Bartolomeu do Rêgo, Celorico de Basto). *Revista Portuguesa de Arqueologia*, 5 (1): 29-38.

Sanches M. (1995). O povoado da Lavra, serra da Aboboreira. In Cordeiro I., Silva I., Fernandes M. (Eds.), *A Idade do Bronze em Portugal. Discursos de Poder*, Lisboa, S.E.C.: 116.

Sanches M. (1997). *Pré-história Recente de Trás-os-Montes e Alto Douro*. Porto: Sociedade Portuguesa de Antropologia e Etnologia.

Sanches M. (2000). As gerações, a memória e a territorialização em Trás-os-Montes (V<sup>o</sup>-II<sup>o</sup> mil. AC). Uma primeira aproximação ao problema. In Jorge V. (Ed.), *Pré-História Recente. Actas do 3<sup>o</sup> Congresso de Arqueologia Peninsular*, 4, Vila Real, Setembro de 1999, Porto, ADECAP: 123-145.

Sanches M. (2000b). Reflexões sobre o povoamento do Neolítico Inicial do Norte de Portugal (VI-IV mil. A.C. In Jorge V. (Ed.), *Neolitização e Megalitismo da Península Ibérica, Actas do 3<sup>o</sup> Congresso de Arqueologia Peninsular*, 3, Vila Real, Setembro de 1999. Porto, ADECAP: 181-201.

Sanches M. (2006). Sociedades em mudança. Dos caçadores-recolectores aos mais antigos agricultores. In Almeida C. (Eds.), *História do Douro e do Vinho do Porto. História Antiga da Região Duriense*, Santa Maria da Feira, Edições Afrontamento: 80-105.

Sanches M. (2008). *O Crasto de Palheiros. Fragada do Crasto. Murça – Portugal*. Município de Murça.

Sanches M., Nunes S., Pinto D. (2007). Trás-os-Montes (Norte de Portugal) - As gentes e os ecossistemas, do Neolítico à Idade do Ferro. In Jorge S.O., Bettencourt A.M.S., Figueiral I. (Eds.) *A Conceção das paisagens e dos espaços na Arqueologia da Península Ibérica, Actas do IV Congresso de Arqueologia Peninsular, Faro, Setembro de 2004*, Promontoria Monográfica, 08, Faro Universidade do Algarve: 189 - 206.

Sanchez-Goni M. F. (1991). *Analyses palynologiques des remplissages de grotte de Lezetxiki, Labeko et Urtiaga (pays Basque Espagnol). Leur place dans le cadre des séquences polliniques de la côte Cantabrique et des Pyrénées Occidentales*. Paris: Institut de Paléontologie Humaine.

- Sarmiento F. (1903). Materiaes para a archeologia do concelho de Guimarães. *Revista de Guimarães*, 20 (1): 5-16.
- Soepboer W., Sugita S., Lotter A. F., van Leeuwen J. F. N., van der Knaap W. O. (2007). Pollen productivity estimates for quantitative reconstruction of vegetation cover on the Swiss Plateau. *The Holocene*, 17 (1): 65-77.
- Tellez R., Chamorro J., Arnanz A. (1990). Analisis discriminante en la identificacion de trigos arqueologicos espanoles. *Trabajos de Prehistoria*, 47: 291-318.
- Turner C., Hannon G. (1988). Vegetational Evidence for Late Quaternary Climatic Changes in Southwest Europe in Relation to the Influence of the North Atlantic Ocean. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 318: 451-485.
- Valente M. (2004). A fauna mamalógica do povoado do Fumo (Almendra, Vila Nova de Foz Coa). *Revista Portuguesa de Arqueologia*, 7 (1): 221-225.
- Valera A. (2006). *Calcolítico e transição para a Idade do Bronze na Bacia do Alto Mondego: Estruturação e dinâmica de uma rede local de povoamento*. PhD thesis, Porto: Universidade do Porto.
- Valera A., Rebuge J. (2008). Datação de B-OSL para o fosso 1 do sítio Calcolítico do Lugar da Forca (Maia). *Apontamentos de Arqueologia e Património*, 1: 11-12.
- van der Knaap W. O., van Leeuwen J. F. N. (1995). Holocene vegetation succession and degradation as responses to climatic change and human activity in the Serra de Estrela, Portugal. *Review of Palaeobotany and Palynology*, 89 (3-4): 153-211.
- Walker B., Gunderson, L., Kinzig, A., Folke, C., Carpenter, S., Schultz, L. (2006). A Handful of Heuristics and Some Propositions for Understanding Resilience in Social-Ecological Systems. *Ecology and Society*, 11 (1).
- Zapata L., Peña-Chocarro L., Pérez-Jordá G., Stika H.-P. (2004). Early Neolithic Agriculture in the Iberian Peninsula. *Journal of World Prehistory*, 18 (4): 283-325.
- Zohary D., Hopf M., Weiss, E. (2012). *Domestication of Plants in the Old World – The origin and spread of domesticated plants in south-west Asia, Europe, and the Mediterranean Basin*. 4<sup>th</sup> Edition. Oxford: Oxford University Press.

## 9

# Iron Age agriculture in NW Iberia: cultural and environmental constraints and long-term dynamics

Tereso J., Ramil-Rego P., Almeida da Silva R.

Submitted to *Journal of Anthropological Archaeology*

---

### Abstract

It is assumed that human communities in northwest Iberia reached an unprecedented level of demography and development during the Iron Age. Hillforts grew in complexity and territorialities were enhanced. In this context, agricultural systems were based on different cereals, mostly *Panicum miliaceum*, *Avena*, *Hordeum vulgare* subsp. *vulgare*, hulled wheat (*Triticum turgidum* subsp. *dicoccum* and *Triticum aestivum* subsp. *spelta*) and naked wheat (*Triticum aestivum/durum*). The abundance and diversity of crops recovered in archaeological sites contrasts with the classical written sources.

The growing importance of hulled wheats and the predominance of crops adapted to harsh environmental conditions must be interpreted not only on the basis of paleoclimate data that suggest climate worsening in this period but mainly in the context of relevant social and settlement changes. Territorialization required solutions for optimization of the land available, possibly leading to the diversification of agricultural areas, which required undemanding crops.

Therefore, Iron Age agriculture in northwest Iberia shows some relevant differences regarding other Iberian regions. These are mainly the result of long-term dynamics inherent to this region's societies and the adaptation to local environmental constraints.

**Key-words:** Iron Age agriculture, social dynamics, environmental constraints, adaptation.

### 9.1. Introduction

The Iron Age in northwest Iberia is a period of increasing complexity. In the sequence of Late Bronze Age trends, settlements reinforced their position in space and time and human communities developed new ways to relate to their surrounding and to other communities. In



this context, they dealt with distant partners and new foes. In the end, Romans conquered the territory and gave a political body to what was already a noticeable Mediterranean influence in the region.

For historical and political reasons, the Iron Age archaeology in northwest Iberia was particularly developed since the late 19<sup>th</sup> century (González-Ruibal 2003). Still, a proper study regarding the agricultural strategies of these communities remains to be done, despite considerations concerning this subject being present in regional syntheses (Silva 1986, Queiroga 1992, Bettencourt 1999)

Some archaeobotanical studies also addressed this topic (Ramil Rego 1993, Ramil Rego et al 1996, Dopazo Martínez et al. 1996, Oliveira 2000). However, precedent studies fail to fully explain the cultural and environmental settings which constrained agricultural choices and the long-term dynamics that led to Iron Age agricultural strategies. These questions will be addressed here, for which a revision of the data available will be made and new data from specific sites will be presented.

### **9.1.1. Iron Age chronological and cultural settings in NW Iberia**

There is no consensus on the chronological settings of the Iron Age in northwest Iberia. Still, regardless of the designation attributed by different authors - Iron Age (Bettencourt 2005), 2<sup>nd</sup> Iron Age (González Ruibal 2003), Middle Iron Age (González Ruibal 2004) or Late Iron Age (Parcero Oubiña and Cobas Fernández 2004), it is clear that by the mid/late 5<sup>th</sup> century BC or the beginning of the 4<sup>th</sup> century BC, significant changes occurred in northwest Iberia, marking the beginning of a new phase.

Following the model defined by A. Bettencourt(1999, 2005), in this text we assume this change to set the beginning of the Iron Age. Still, it is likely that some regional differences may have existed in the study area (González Ruibal 2003). Apart from the designation, it is this new phase that we propose to study, since it resulted in severe transformations in the local communities, although following a trend that began in previous stages.

The end of the Iron Age corresponds to the beginning of the Roman occupation of the area. Still, there is also no agreement on the definition of this chronological boundary.

In the beginning of the Iron Age the regional pattern of settlement was characterized by the presence of numerous hilltop fortifications – the “castros” - in defensible locations. Some of these were already founded during the Late Bronze Age and remained inhabited. However, their inner spaces were reorganized, as well as its defensive lines, enlarging the habitable area and becoming more solid and complex (Silva 1986, Martins 1996, Parceró Oubiña and Cobas Fernández 2004). The perishable huts were substituted by stone buildings and dwellings became grouped in family compounds delimited by small walls, where domestic activities and food storage was done independently, on a self-sufficiency basis (Parceró Oubiña and Cobas Fernández 2004). At the same time, it was probably in this phase that the use of iron was extended (Teira Brión 2003).

Due to an overall sense of familiarity in the settlements and the archaeological artefacts associated to them, the Iron Age in Northwest Iberia is usually known as the “Castros” culture, a designation which tends to homogenize a far more complex and diverse reality (Martins 1990 and 1993-1994, González Ruibal 2003).

During the 2<sup>nd</sup> century BC began a phase of people concentration in greater settlements, which led to the consolidation of socio-politic units. These included several settlement types, since some small and medium-sized Castros remained occupied. Besides the renewal of the fortifications, these large hillforts suffered major internal reorganizations, assuming a proto-urban structure. It was a phase of economic intensification and important social change towards a greater complexity (Silva 1986, Martins 1990 and 1996, Peña Santos 2005).

However, it isn't clear whether such reality had its origin in pre-Roman or Roman times (for different opinions see Queiroga 1992, Alarcão 1992 and Peña Santos, 2005). Some authors suggest that after *D. Iunius Brutus'* campaign of 138-137 BC, which reached the river Minho with little resistance, the local communities may have felt the need of a territorial reorganization and population concentration, in order to make possible future defensive actions against this enemy (Alarcão 1992). Others stand that after this expedition the Romans gained real control over the area (Peña Santos 2005).

Still, it is highly probable that when these major changes occurred in the 2<sup>nd</sup> century BC, the communities of the northwest Iberia were already in contact with the Romans. In fact, the first military campaigns in this area were carried out after several decades of Roman effective presence in Western Iberia, and way after the Romans had taken over the Semitic trading routes after the Punic wars (González-Ruibal 2004).

Although there is no evidence for the maintenance of any military force north from the Douro as a result of *D. Iunius Brutus'* campaign, this expedition marks the beginning of the Roman presence in the area (Santos Yanguas 1988, Fabião 1992, Morais 2004, Peña Santos 2005). This was followed by a peaceful expedition by *P. Licinius Crassus* in 96-94 BC which main purpose was to identify mineral resources. These resources were also one of the main purposes of *C. Iulius Caesar's* incursion in 61-60 BC which reached *Brigantium*, possibly finishing the conquest of almost all the coastal areas of northwest Iberia (Santos Yanguas 1988, Morais, 2004). The fact is that the Cantabrian Wars (29-19 BC) by which *Augustus* finished the occupation of all Iberia, took place mostly outside this area (Santos Yanguas 1988, Morais 2004, Peña Santos, 2005). Still, by the turn of the Era, despite being politically integrated in the Roman Empire, people from this region continued to live in their Iron Age settlements, maintaining their lifestyles (Parceró Oubiña and Cobas Fernández 2004)

Any approach to Iron Age agriculture in northwest Iberia must take into consideration these chronological parameters. Therefore, we decided to distinguish two main periods in the local Iron age:

Phase 1 (Iron Age) - from the late 5<sup>th</sup> or the beginning of the 4<sup>th</sup> century cal BC to the end of the 2<sup>nd</sup> century cal BC

Phase 2 (Iron Age – Romanization) – covering the end of the 2<sup>nd</sup> century cal BC (*D. Iunius Brutus'* campaign) and the 1<sup>st</sup> century cal BC.

The main purpose of distinguishing these two phases was to detect differences originated by a more effective roman influence in the territory.

## 9.2. Study area

The study area includes the northwest Portugal and most of the Galicia province (northwest Spain). The easternmost part of the area is the more mountainous one. Here we find the western edge of the Cantabrian-Atlantic Mountains with an average altitude of 1500m and maximum altitude of 2000m. This area is connected to the sub-coastal mountains (200-800m altitude) by sedimentary depressions (400-900m) (Muñoz Sobrino et al. 2001). The Douro River defines the southern limit of study area.

The boundaries of the study area are almost completely within the Eurosiberian region (Rivas-Martínez 2003, Costa et al. 1998, Rodríguez Guitián and Ramil-Rego 2007, 2008). It is characterized by a reduced continentality and long vegetative period (8-9 months), as a result of the proximity to the sea and its low altitudes. In the rest of the year, the development of vegetation is constrained by frost or snow.

Mediterranean areas are comprised to the eastern areas of the territory. They are, thus, characterized by the existence of a dry season (at least three months) and long periods of winter frost. Transitional areas exist and these provide the most suitable conditions for agricultural practices.

### 9.3. Materials and Methods

A thorough revision of archaeological and archaeobotanical data was made. The chronological parameters used were those presented in the bibliographic references specific to each site. Whenever the information concerning the provenience or chronology of archaeobotanical material was considered unreliable, those sites were excluded from this synthesis: e.g. Franqueira, Paderne, S. Vicente de Chã, Cameixa, A Graña, Trelle and others, mentioned in previous works (Tellez and Ciferri 1954, Tellez et al. 1990, Ramil Rego 1993, Ramil Rego et al. 1996, Dopazo Martínez et al. 1996, Oliveira 2000).

Unpublished data from three sites was included: As Laias (Ourense, Spain), Briteiros (Guimarães, Portugal) and Lesenho (Boticas, Portugal).

As Laias was excavated in 1997 during extensive contract work and a great number of samples were recovered. Most samples were processed in the site by the archaeological team. This settlement was inhabited from the Late Bronze Age to the Roman Period and, at least during the Iron Age, its uppermost fortified platform was restricted to storage facilities (Álvarez González and López González 2000, Álvarez González et al. 2009). However, an inadequate sampling strategy and the complex stratigraphic context of the abundant storage structures have limited the archaeobotanical study. Data included here is restricted to those storage structures which chronology is assured by radiocarbon dates and where basic recovery techniques were used (flotation with minimum mesh size of 0,5mm).

Sampling in Briteiros took place during three years (2006-2008) in the excavation site near the top of the hill, directed by Francisco Sande Lemos, Maria Manuela Martins and Gonçalo Cruz. Isolated samples were taken in several deposits while other were fully recovered and floated. Overall, sampling strategy was adapted to site conditions and constraints but allowed to characterize properly the archaeological contexts excavated. In the small excavation area of the 2008 campaign at Lesenho, directed by Carla Braz Martins, Gonçalo Cruz and João Fonte, sampling was restricted to a domestic fireplace. In both sites, a mesh of 0,5mm was used during the bucket flotations.

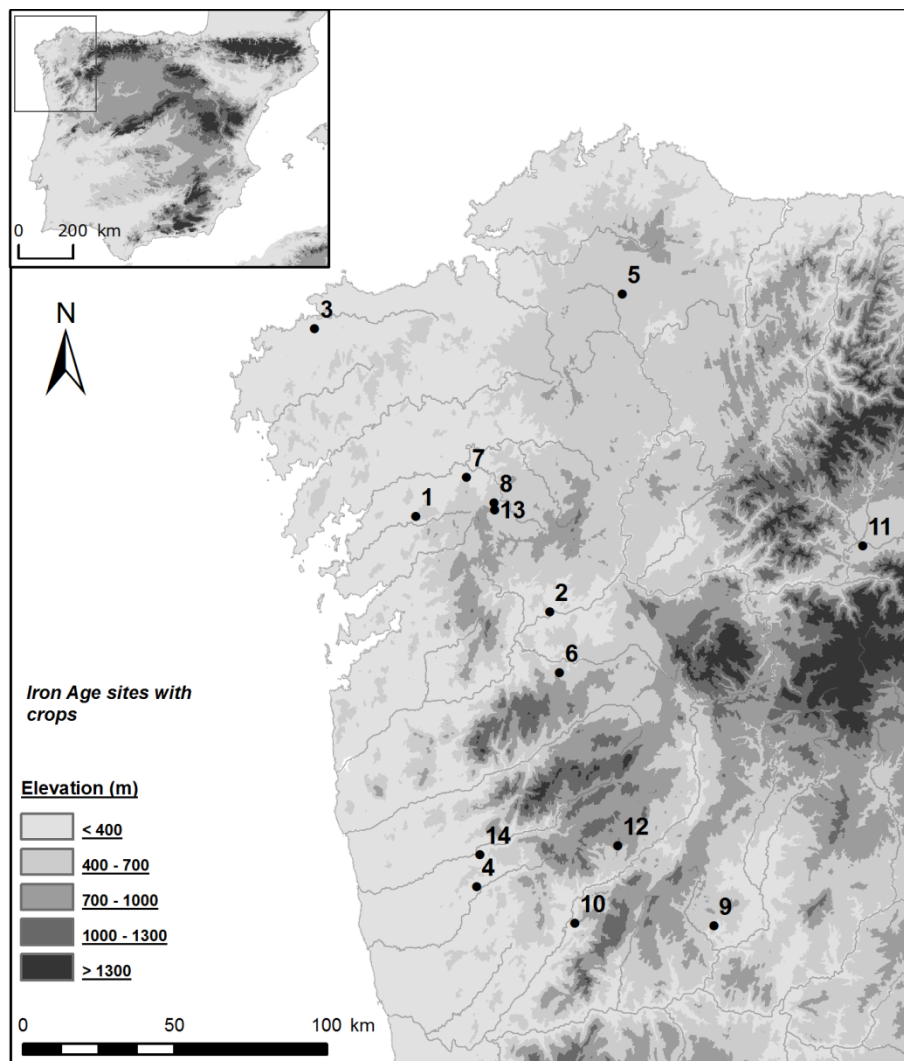


Figure 9.1. – Location of Iron Age sites with crops. Legend: 1 – Alto do Castro; 2 – As Liais; 3 – Borneiro; 4 – Briteiros; 5 – Castro de Vixil; 6 – Castromao; 7 – Castrovite; 8 – Cortegada; 9 – Crasto de Palheiros; 10 – Crastoeiro; 11 – El Castrelin; 12 – Lesenho; 13 – Montaz; 14 – S. João de Rei.

The revision of data was preceded by a homogenization of nomenclature of naked wheat so to allow comparisons. Only two morphological types were considered:

- the *Triticum aestivum/durum* type. Traditionally, it includes *T. aestivum* L. subsp. *aestivum*, *T. turgidum* L. subsp. *durum* (Desf.) Mackey, and *T. turgidum* L. subsp. *turgidum* (Buxó 1997, nomenclature after Zohary et al. 2012). Only chaff-based identifications were considered at species level.

- the *Triticum* “stubby grains”. This designation, introduced by S. Jacomet (2006), refers to grains which are shorter and more roundish than those of the *T. aestivum/durum* type. Three species which cannot be distinguishable from their grain morphology are usually ascribed to this morphology - *T. aestivum* L. subsp. *compactum*, *T. aestivum* L. subsp. *sphaerococcum* (Perc.) Mackey and *T. turgidum* L. subsp. *parvicoccum* Kislev (Jacomet 2006, nomenclature after Zohary et al. 2012) - although underdeveloped grains (due to their position in the spike) of *T. aestivum/durum/turgidum* can present the same morphological features.

## 9.4. Results

Data from Iron Age sites in northwest Iberia document a complex and diverse agricultural system based on different cereals. The cereals which were recovered in more settlements were *Panicum miliaceum*, *Avena*, *Hordeum vulgare* subsp. *vulgare* and hulled wheat (mostly *Triticum turgidum* subsp. *dicoccum* and *Triticum aestivum* subsp. *spelta*). Still, the presence of grains from naked wheat, mostly *Triticum aestivum/durum* type, is very significant. On the other hand, within the pulses, *Vicia faba* is constantly retrieved in the excavations, while *Pisum sativum* is sporadic. Overall, there is little diversity of non-cereal crops, contrasting with other Iberian regions (Buxó and Piqué 2008).

Other cereals, apparently less relevant, were *Hordeum vulgare* var. *nudum* (only in two sites), *Setaria italica*, *Triticum monococcum* and naked wheat with stubby grains (recovered in single sites). With the possible exception of naked barley, the presence of these crops is limited to Phase 1 sites. On the other hand, naked barley from Alto do Castro (Cuntis, Spain) comes from this site's Phase 3 whose radiocarbon date (CSIC-1033: 2100±25BP - 2σ 186-50 BC) (Parcero Oubiña 2000) points out to the transition between our two phases.

	Phase 1							
	North			South				
	Borneiro	Castrovite	Cortegada	As Lias	Crasto de Palheiros	Crastoeiro	Castromao	S. João de Rei - II
<b>Cereals</b>								
<i>Avena</i>		*	*	+++		*	*	++
<i>Hordeum</i>	*							
<i>Hordeum vulgare</i> var. <i>nudum</i>			*					
<i>Hordeum vulgare</i> subsp. <i>vulgare</i>		++++	*	+++	+	*	*	+
<i>Panicum miliaceum</i>		+++++		+++++	++	*	*	+++++
<i>Panicum/Setaria</i>					+			
<i>Secale cereale</i>			*					
<i>Setaria</i>							*	
<i>Triticum aestivum</i>								
<i>Triticum aestivum/durum</i>		*				*	*	
<i>Triticum</i> "stubby grains"						*		
<i>Triticum dicoccum/spelta</i>					*			
<i>Triticum turgidum</i> subsp. <i>dicoccum</i>		(*)	*		(+)	*	*	
<i>Triticum monococcum</i>		(*)						
<i>Triticum aestivum</i> subsp. <i>spelta</i>		(*)		(+++++)	(+)			
<i>Triticum</i>								++++
Cereals - undetermined								+
<b>Other crops</b>								
<i>Pisum sativum</i>				++				
<i>Vicia faba</i>		*		+++				+
<b>Wild - probable food</b>								
<i>Arbutus unedo</i>					+			
<i>Corylus avellana</i>			+					
<i>Quercus</i> (cupule)								
<i>Quercus</i> (cotyledon)		+++	+	+		*		+
<i>Rubus</i>								
<i>Vitis vinifera</i>						*		
<b>References</b>	A	B	C	D	E	F	G	A, H, I

Table 9.1 (1) – Crops from Iron Age sites. Legend: (+) 1-10; (++) 11-100; (+++) 101-1000; (+++++) 1001-10.000; (+++++) more than 10.000; \*unknown amounts; parentheses in the table indicate the presence of chaff. Bibliographic references: A - Bettencourt 1999; B - Rey Castiñeira et al. 2011; C - Arnanz and Chamorro 1990; D - Unpublished; E - Figueiral 2008; F - Dinis 1993-1994; G - Dopazo Martínez et al. 1996; H - Dopazo Martínez 1996; I - Oliveira 2000; J - Parcero Oubiña 2000; K - Cobas Fernández and Parcero Oubiña 2006; L - Ramil Rego 1993; M - Lopez Merino et al. 2010.

	Phase2					Phases 1 and 2		
	North		South			South	North	
	Alto do Castro	Castro de Vixil	As Laias	Lesenho	S. João de Rei - III	Briteiros	El Castrelin	Montaz
<b>Cereals</b>								
<i>Avena</i>	*		+++			+		
<i>Hordeum</i> sp.						+		
<i>Hordeum vulgare</i> var. <i>nudum</i>	*							
<i>Hordeum vulgare</i> subsp. <i>vulgare</i>			++				+	*
<i>Panicum miliaceum</i>			+++++	+		++	+	
<i>Panicum/Setaria</i>				+		+		
<i>Secale cereale</i>								
<i>Setaria</i>								
<i>Triticum aestivum</i>			(+)					
<i>Triticum aestivum/durum</i>						(+)		*
<i>Triticum</i> "stubby grains"								
<i>Triticum dicoccum/spelta</i>				+				
<i>Triticum turgidum</i> subsp. <i>dicoccum</i>	(*)						(+)	*
<i>Triticum monococcum</i>								
<i>Triticum aestivum</i> subsp. <i>spelta</i>			(++++)					
<i>Triticum</i>		+			+++	+	+	
Cereals - undetermined				+			+	
<b>Other crops</b>								
<i>Pisum sativum</i>							+	
<i>Vicia faba</i>		+	+++		+		+	
<b>Fruits</b>								
<i>Arbutus unedo</i>								
<i>Corylus avellana</i>								
<i>Quercus</i> (cupule)		+						
<i>Quercus</i> (cotyledon)		++			+			*
<i>Rubus</i>							+	
<i>Vitis vinifera</i>						+		
<b>References</b>	G, J, K	L	D	D	A, H, I	D	M	C

Table 9.1 (2 – Cont.) – Crops from Iron Age sites. Legend: (+) 1-10; (++) 11-100; (+++) 101-1000; (++++) 1001-10.000; (+++++) more than 10.000; \*unknown amounts; parentheses in the table indicate the presence of chaff. Bibliographic references in legend from Table 9.1(1).



*Secale cereale*, recovered in Cortegada (Silleda, Spain) (Arnanz and Chamorro 1990) is also supposedly from our Phase 1. Still, the presence of rye in this period is controversial since data from several Iberian regions, including Northern Portugal, suggest this crop was introduced in Roman times (Ramil Rego and Fernández Rodríguez 1999, Buxó 2005, Alonso Martínez 2005, Tereso et al. 2010). According to X. Carballo Arceo, responsible for the excavations, there are no doubts regarding the chronology of the archaeological levels of Cortegada, but he still recommends caution while interpreting the data (Carballo Arceo, personal information). Archaeobotanical material from Cortegada must be reviewed in order to confirm the identifications and a radiocarbon date should be obtained directly from the eventual rye grains.

The identification of differences between Phases 1 and 2 was preceded by an effort to identify possible biases related to the archaeological and archaeobotanical approaches carried out in each site. Overall, there seems to have been less sampling endeavours in the 2<sup>nd</sup> Phase's sites.

Probably related to this, the 2<sup>nd</sup> Phase's assemblages have much less fruits and seeds and these are slightly less diverse. As mentioned before, the crops that only appear in the first phase are *Triticum* "stubby grains" and *Triticum monococcum*. Still, these seem to have been minor crops even at this phase.

*Avena* and *Panicum miliaceum* appear consistently during the 1<sup>st</sup> Phase while were only found in two sites from the 2<sup>nd</sup> Phase. The findings of naked wheat follow a similar pattern, since they are only present in one site from the 2<sup>nd</sup> Phase. Still, several sites from this phase provided *Triticum* grains identified to the genus level.

In the sites from the 2<sup>nd</sup> Phase, *Quercus* acorns are the only wild edible fruits retrieved, while in the first phase *Arbutus unedo*, *Corylus avellana*, *Rubus* and *Vitis vinifera* were also found. Interestingly, grape pips were all found in the southern part of the study area (*vide infra*, for discussion on grapevine). Other regional differences may have existed, but the data available is insufficient to completely exclude eventual investigation biases. *Setaria italica* only appears in Castromao (Celanova, Spain), in the southernmost part of the study area but, overall, millets appear less consistently in the northern sites. This is interesting since the earliest finding of millet, namely *Panicum miliaceum*, in northwest Iberia come from the Middle Bronze Age level of Sola (Braga) in northern Portugal (Oliveira 2000, Bettencourt et al. 2007). Most of the sites with naked wheat are from the south. Still, earliest remarks made on the problem of genus level identification of *Triticum* grains are valid here.

## 9.5. Discussion

### 9.5.1. Matches and mismatches between archaeobotanical data and classical texts

The following well known quote of Strabo has been regularly used in the characterization of subsistence strategies of Iron Age people in northwest Iberia:

*“For two-thirds of the year, the mountaineers feed on acorns, which they dry, bruise, and afterwards grind and make into a bread that may be stored for a long period. They also know beer. They drink wine in rare occasions but what they have is quickly consumed in feasting with their relatives. Instead of oil they use butter”<sup>2</sup> (Strabo, Geography, Book III, 3, 7).*

Another quote, from Pliny the Elder addresses the same questions:

*“It is known today that acorns are the wealth of many people, even those who live in peace, who dry them when crops are lacking, and make flour from them, and in the end make bread, and in Spain even serve it as a second course. They are made sweeter when roasted in ashes [...]”<sup>3</sup>. (Pliny, Nat. Hist. 16, 5)*

Strabo mentions the subsistence of the mountaineers, denomination which included a reality vaster than northwest Iberia. This characterization is done by contrast with the Mediterranean triad (cereals, wine and olive oil) characteristic of the Romans. Since the mid-20<sup>th</sup> century, Strabo words gave origin to several interpretations (see synthesis in Ramil Rego and Fernandez Rodríguez 1999 and Pereira Sieso and Garcia Gómez 2002).

---

<sup>2</sup> “Los montañeses, durante dos tercios del año, se alimentan de bellotas de encina, dejándolas secar, triturándolas y luego moliéndolas y fabricando con ellas un pan que se conserva un tiempo. Conocen también la cerveza. El vino lo beben en raras ocasiones, pero el que tienen lo consumen pronto en festines con los parientes. Usan mantequilla en vez de aceite” (Geografía, translation by M<sup>a</sup> José Meana).

<sup>3</sup> “Sabida cosa es ser hoy día también las vellotas riqueza de muchas gentes, aun de las que viven en paz, las cuales secan a falta de mieses, y hazen dellas harina, y finalmente pan, y aun mezclan por Hespaña las segundas mesas. Házense dulces tostadas debaxo de ceniza [...]” (Hist. Nat. translation by Francisco Hernández).

Still, as pointed out before, archaeobotanical data from northwest Iberia testify for a prosperous agriculture with significant crops (cereals and pulses) diversity, thus it is likely that its role in human subsistence was more important than that of the acorns. Still, data suggests that acorns were consumed regularly by Iron Age communities, since cotyledons are found in most of the settlements (Table 9.1 is resumed to the sites where crops were found, there are many settlements where *Quercus* acorns are the only archaeobotanical remains due to lack of proper sampling – see a list at Silva 1986). There are even storage contexts with acorns, as those in the Late Bronze Age/Iron Age settlements of Penalba (Aira Rodríguez et al. 1990) and As Lias (unpublished). A storage context with acorns in S. Vicente de Chã (Santos Júnior and Isidoro 1963) was comprised between the Late Bronze Age and the Roman Period, but it is not possible to integrate in a specific chronology.

Several ways to produce acorn bread were described by Oliveira et al. (1991), based on experiments, and Mason (1992), Mason and Nesbitt (2009), based on ethnographic studies. The fact that so many charred cotyledons were recovered in archaeological sites suggests direct contact with fire while processing the acorns, as Pliny describes (*vide supra*). This could precede the grinding activities or the consumption of the roasted fruit. It is an effective way to eliminate the tannins, but other methods exist (Mason 1992, Pereira Sieso e Garcia Gómez 2002, Mason e Nesbitt 2009). On the other hand, bread is not the only possible use for acorn flour. It could be used for porridge and soup (Mason 1992, Mason e Nesbitt 2009).

Therefore, the consumption of acorns and acorn bread was surely a regular practice among Iron Age communities in northwest Iberia. Still, the role of acorns in the subsistence strategy of these communities must be address differently from Strabo. Strabo says that they depended on acorns to produce bread during two-thirds of the year but archaeobotanical data demonstrates agriculture was well developed and different cereals and pulses were available. Pliny, however, states that acorn was consumed in times of crops scarcity. The consumption of acorns by these agricultural communities was probably relevant, not only to prevent famine in case of crop failures, but as a complement well integrated in the habits of the local communities. In parallel to the consumption of acorns, such habits included the consumption of other wild fruits (carpological remains of *Corylus avellana*, *Arbutus unedo* and *Rubus* were recovered in the settlements – see Table 9.1) as well as wild animals. Despite the existence of only sparse evidences of hunting practices, in great contrast with previous periods (Fernández Rodríguez 2000) abundant remains of molluscs and fish in coastal settlements testify for the

relevance of the exploitation of such resources (Ferré et al. 1996, Rodríguez López and Fernández Rodríguez 1996, Fernández Rodríguez 2000). Thus, it is clear that subsistence strategies included well developed productive practices and the exploitation of wild resources.

Regarding the drinking habits of Iron Age communities we do not have great archaeobotanical information. Contrary to what happens in other European regions (Stika 2011), no trace of malt production was ever found, but one must consider those findings as exceptional thus their absence has no significant meaning.

To what wine consumption is concern, *Vitis* seeds were found in northwest Iberia, but their interpretation is problematic. The cultivation of grapevine is documented since at least the 7<sup>th</sup> century BC in Mediterranean Spain a region where the Phoenician and Greek influence is conspicuous and their presence was more enduring (Buxó and Piqué 2008). In northwest Iberia no Iron Age structure directly related to wine production was ever found, there is no palynological trace of grapevine cultivation from this period and evidence from charcoal is sparse (Ramil Rego et al. 1996).

On the other hand, earlier findings of *Vitis* seeds suggest gathering of wild grapes happened since Prehistoric times. In fact, grape pips were found in the Chalcolithic levels of Buraco da Pala (Mirandela, Northern Portugal), dating back to the mid 3<sup>rd</sup> millennium cal BC (Ramil Rego and Aira Rodríguez 1993) and in the Late Bronze Age levels of Castelo de Matos (Baião, Northern Portugal) from the beginning of the 1<sup>st</sup> millennium BC (Queiroga 1992).

All archaeobotanical findings of *Vitis*, from the Neolithic to the Iron Age, came from the southern part of our study area. Here the climate is more adequate for grapevine growing but also more suitable for wild populations. Still, as pointed out before (*vide supra*), this southernmost region constitutes what González Ruibal (2003) considers a *core area* in the “castros culture”; an area where the hillforts were first and more profoundly developed, showing greater prosperity and monumentalization. This is also the area where we have more evidences of contacts with the Mediterranean world and where those interactions had more influence (González Ruibal 2003). This can either justify early grapevine cultivation in Northern Portugal or the arrival of grapes and/or wine in commerce or other kind of social bond.

Intense contacts are testified by frequent artefacts of Mediterranean origin, mostly originated by Carthaginian commerce (González-Ruibal 2003, 2004). These archaeological evidences, together with historical analogues, has led González-Ruibal (2003) to conjecture that wine may have played an important role in the commercial connections between Mediterranean traders

and local communities. Commercial or other kind of contacts (e.g. violent incursions or social bonding) with neighbouring regions where grapevine was cultivated could also justify the presence of wine in northwest Iberia. For instance, there are many evidences of frequent contacts with the Spanish Meseta (González Ruibal 2003).

With this complex scenario, it is not possible to understand whether the wine consumed in the region, presumably few according to Strabo, was all imported or if any was produced locally. Still, no evidence suggests the existence of local wine production. Gathering activities for fruit consumption could have existed. In the end, the presence of grape pips testifies for the presence of grapes, not wine.

To what olive is concern, in some palynological sequences in northwest Iberia there are episodes of increment of *Olea* during the Holocene which were driven by climate favoring (Muñoz Sobrino et al. 2004). No evidence suggests its cultivation before historic periods.

Olive stones were found in the Early Neolithic site of Bolada (Celorico de Basto) (Sampaio and Carvalho 2002) and the Chalcolithic levels of Crasto de Palheiros (Murça) (Figueiral 2008), both sites in northern Portugal. No fruits were found in Iron Age sites. In this scenario, it is possible that people from the Iron Age in northwest Iberia did not cultivate olive or use olive-oil, as Strabo stated. If any was used it could have foreign origin.

### **9.5.2. Combining Archaeobotanical data with the Archaeological and Palaeoecological records**

Abundant paleoecological studies were carried out in northwest Iberia and palynological sequences cover most of the region. These demonstrate clear anthropogenic deforestation began in northwest Iberia during 5<sup>th</sup> millennium cal BC, i.e in the Neolithic (Ramil Rego et al. 2009). Until the beginning of the 2<sup>nd</sup> millennium cal BC, different phases of deforestation were followed by periodic moments of forest recovery, in a general trend of landscape opening and soil erosion.

But true changes occurred in the Middle and Late Bronze Age (from c. 1800 cal BC onwards) when a phase of recurrent and unprecedented deforestation started and lasted until the 3<sup>rd</sup> century AD (Muñoz Sobrino et al. 2005, Ramil Rego et al. 2009). Social and economical reasons

may justify such trends. Therefore, the Iron Age is a period of marked landscape change as a result of human pressure over the environment.

On what climate is concerned Muñoz Sobrino et al. (2005) and Ramil Rego et al. (2009), using palynological data from several northwest Iberian sequences and comparing it to Greenland isotopic records, suggest that c.500/400 cal BC began a cooling period that would last several centuries, covering the whole Iron Age.

Regarding the zooarchaeological record, there is evidence of a greater development of animal husbandry in detriment of hunting practices. Domestic *Ovis/Capra* (probably there is a predominance of *Ovis aries*) remains predominate in the more coastal settlements followed by the bovines (these are less in number but with greater importance in terms of meat supply). In the more interior settlements, bovines predominate. Pigs are always the third species. In general, evidence suggest domestic animals were exploited for their meat and that they were relatively small in size which, according to Fernández Rodríguez (2000) suggest deficient feeding conditions.

It is in this broad context that some changes regarding the agricultural choices of local communities occurred. The main differences between the Iron Age and previous archaeobotanical assemblages are the great relevance of oat (*Avena*), spelt (*Triticum aestivum* subsp. *spelta*) and emmer (*Triticum turgidum* subsp. *dicoccum*). Hulled barley (*Hordeum vulgare* subsp. *vulgare*) is a very important crop, since the Chalcolithic and millet (*Panicum miliaceum*) is a staple crop since the Late Bronze Age. They maintained their relevance in the Iron Age. Naked wheat (*Triticum aestivum/durum*) is a relevant crop too.

Within the Iron Age, investigation bias could explain differences concerning the abundance of some species as well as the smaller crop diversity of the second phase, although such bias is not clear. Nevertheless, 2<sup>nd</sup> phase's less diversity does not seem to be relevant since the crops that were not found in this phase are rare in Phase 1 sites - *Hordeum vulgare* var. *nudum*, *Triticum* "stubby grains" and *Triticum monococcum*. In northwest Iberia, as in most of the Iberian Peninsula (Buxó and Piqué 2008), naked barley was an important crop during the Neolithic and Chalcolithic but thoroughly lost its relevance since the Bronze Age. Its presence in later sites is sporadic and in northwest Iberia is restricted to Cortegada (see table 9.1). Iron Age findings of einkorn and *Setaria italica* are the oldest ones in northwest Iberia, but in the subsequent periods they were always rare.

On the other hand, the little relevance of *Triticum* "stubby grains" in the Iron Age is in clear contrast to previous periods and can only be explained by a deliberate change. The reasons for that change are difficult to assess.

Regarding regional (north-south) differences, which could result of cultural differences that would be in the origin of the later Roman *conventus*, the most interesting remark is the more frequent presence of millet in the south. This is the area where the oldest regional millet grains were found up-to-now.

Eventual regional and chronological differences can only be detected with further sampling efforts in future archaeological interventions.

Overall, there is an increasing relevance of hulled wheat in the Iron Age, contrasting with previous periods. This trend is in clear contrast with other well studied Iberian regions where the overall tendency is the opposite, towards a greater relevance of free-threshing wheats and a less significant presence of hulled wheats (Buxó and Piqué 2008). There may be a twofold explanation for the peculiarity of the northwest Iberia.

First of all, the increasing importance of hulled wheat has to be interpreted in the light of relevant changes occurring on the social-ecological systems during the Bronze Age, particularly towards its end. Several authors suggest increasing territorialisation to have occurred during the Bronze Age, particularly during the Late Bronze Age (Bettencourt 1999). Related to this trend, the use of winter and spring crops (*Panicum miliaceum* was introduced) implied greater sedentarization. Sedentism was surely a reality in the Iron Age and probably in the Late Bronze Age, and the overall increasing in settlements sizes suggest increasing demographic pressure.

In a region where communities were losing mobility and territorialisation was enhanced, boundaries are likely to have emerged, constraining and regulating human action. Thus, when agricultural soils became weary, mobility was no longer an option and communities were limited to whatever solution their own land would provide. They had to develop ways to restore fertility (e.g. through manuring), adapt their crops and optimize the use of their territory.

In this context, it is possible that a further diversification of agricultural areas occurred and the use of less suitable areas and soils may have been essential, to which hulled wheats were good options. In fact, agronomic studies and archaeological experiments demonstrate that spelt and emmer provide better yielding than naked wheat in poor soils and cold temperatures, being

particularly fitted for high or mid-altitude mountain areas (Rüegger and Winzeler 1993, Nesbitt and Samuel 1996, van der Veen and Palmer 1997, Troccoli and Codianni 2005).

Thus, a combination of sedentism, increasing population, territorialization (emerging boundaries) and a long-term tendency of soil depletion must have challenged human communities to change their social ecological systems in order to maintain their resilience. In this context, not only crops, but also wild fruits, namely *Quercus* acorns must have had a determinant role. The consumption of acorns, as described before, must be seen as a rational choice, in a clear optimization of resources.

On the other hand, being more productive in case of climate deterioration, the use of hulled wheats may have been favoured by the colder climatic conditions that are likely to have existed during the Iron Age. Climate worsening occurred in previous periods with apparently no (or at least not yet detected) significant changes in agricultural systems, suggesting that communities had strategies to cope with climate variations and guarantee their resilience. In the Iron Age, demographic pressure together with territorial issues could have made old solutions become insufficient.

Besides hulled wheats, other main crops are not soil demanding and tolerate moderate to harsh climatic conditions: *Panicum miliaceum*, *Hordeum vulgare* subsp. *vulgare* and *Avena* (Smartt and Simmonds 1995, Hunt and Jones 2008).

It seems clear, thus, that Iron Age agriculture was well adapted to the main regional constraints: environment (climate and soils) and topography. Still, profound site-level studies need to be done to fully understand this reality. Paradoxically, the limitation created by the geomorphologic characteristics of the territories is partially culturally driven, as it is in part the result of choices concerning settlement pattern and the lost of the support services provided by forest ecosystems, which led to soil erosion.

On the other hand, the cultural background as well as the mid and long-distance social and commercial relations of those communities must have had a determinant role in agricultural choices. Still, this is difficult to evaluate with the current set of data.

The preponderance of hulled wheats in northwest Iberia Iron Age settlements is in obvious contrast with central and southern Iberian regions (Buxó 1997, Buxó and Piqué 2008). Being characteristic of the Northwest – and possibly of all North-Atlantic Iberian regions – the origin of such agricultural features is likely to be integrated in a process that began in the Bronze Age,



culminating in the Iron Age. The Roman conquest would not end it completely. It is thus a long-term and complex dynamic which twined cultural choices, settlement trends and environmental constraints.

## 9.6. Conclusion

The second half of the 1<sup>st</sup> millennium cal BC in northwest Iberia – the Iron Age – was a time of growing complexity. This period was also one of significant changes in agricultural systems, privileging crops suitable for adverse environmental conditions, namely hulled wheats. Contrary to what is suggested by classical author Strabo, local communities had a well developed agriculture, suitable for their territory and their time.

However, significant changes began already in preceding periods. In previous work, we have proposed that Late Bronze Age relevant changes in agricultural strategies and productivity and eventual increase in population were connected, in a process of greater territorialisation. Iron Age reality follows these trends in a tendency for increasing complexity of social ecological systems.

The predominance of crops suitable for poor soils and cool climate, suggests the constant use of less suitable areas for agriculture. These may have been a necessity in a context of full sedentary and increasing populations with well delimited territories, when nomadic movements were no longer a possibility. It may also suggest problems in restoring fertility. Moreover, the use of hulled wheats may have been favoured by the climatic conditions. Some climatic models describe this period to have been colder than the precedent (Ramil Rego et al. 2009) and several studies have demonstrated that hulled wheats are more productive than naked wheat in harsh conditions, not only in terms of soils but also on what climate is concern.

The main characteristics of Iron Age agriculture are, thus, a result of long-term dynamics regarding settlement patterns, territorialisation and crops' preferences. Environmental factors such as soils and climate may have acted as significant constraints but we can only reason how these influenced people's choices. The ways communities faced such constraints depended on their accumulated knowledge and experience as well as the degree of connectivity with different realities from which to learn. Many factors could determine communities' preferences regarding crops and ultimately, cultural reasons were likely to be determinant in the communities' choices.

## 9.7. References

Aira Rodríguez M., Ramil Rego P., Álvarez Nuñez A. (1990). Estudio paleocarpológico realizado en el Castro de Penalba (Campolameiro, Pontevedra. España). *Botânica Complutensis*, 16: 81-89.

Alarcão J. (1992). A evolução da cultura castreja. *Conimbriga*, 31 39-71.

Alonso Martínez N. (2005). Agriculture and food from the Roman to the Islamic Period in the North-East of the Iberian peninsula: archaeobotanical studies in the city of Lleida (Catalonia, Spain). *Vegetation History and Archaeobotany*, 14 (4): 341-361.

Álvarez González Y., López González L. (2000). La secuencia cultural del asentamiento de Laias: evolución espacial y funcional del poblado. In Jorge, V. (Ed.), *Actas del 3º congreso de Arqueología Peninsular*, 5 - Proto-História, ADECAP: 523-532.

Álvarez González Y., López González L., López Marcos M. (2009). La Ocupación del Espacio Común y Privado en la Citania de San Cibrán de Lás. *Revista Aquae Flaviae*, 41: 195-208.

Arnanz A., Chamorro J. (1990). Estudio de frutos e semillas procedentes de cuatro Castros Gallegos. Problemas de interpretación de los resultados. In *Encontros sobre Paleoeconomia e Paleoambiente*.

Bettencourt A. M. S. (1999). *A paisagem e o Homem na bacia do Cávado durante o II e o I milénio AC*. PhD thesis, Braga: Universidade do Minho.

Bettencourt A. M. S. (2005). O que aconteceu às populações do Bronze Final do Noroeste de Portugal, no segundo quartel do I milénio AC, e quando começou, afinal, a Idade do Ferro? In (Eds.), *Actas do Colóquio Internacional Castro, um lugar para habitar, 5-6 Novembro 2004, Cadernos do Museu*, 11, Penafiel, Câmara Municipal de Penafiel: 25-40.

Bettencourt A. M. S., Dinis A., Figueiral I., Rodrigues A., Cruz C., Silva I., Azevedo M., Barbosa R. (2007). A ocupação do território e a exploração de recursos durante a Pré-história Recente do Noroeste de Portugal. In Jorge S.O., 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*, Promontoria Monográfica, 8: 149-164.

Buxó R. (1997). *Arqueología de las Plantas*. Barcelona: Crítica.

Buxó R. (2005). L'agricultura d'època romana: estudis arqueobotànics i evolució dels cultius a Catalunya. *Cota Zero*, 20: 108-120.

Buxó R., Alonso N., Canal D., Echave C., González I. (1997). Archaeobotanical remains of hulled and naked cereals in the Iberian Peninsula. *Vegetation History and Archaeobotany*, 6 (1): 15-23.

Buxó R., Piqué R. (2008). *Arqueobotánica. Los usos de las plantas en la península Ibérica*. Barcelona: Ariel.

Cobas Fernández I., Parceros Oubiña C. (2006). *Alto do Castro (Cuntis, Pontevedra). Síntesis de resultados y estudio de materiales, campaña 1993*. CSIC - Xunta de Galicia.

Costa J., Aguiar C., Capelo J., Lousã M., Neto C. (1998). Biogeografía de Portugal Continental. *Quercetea*, 0: 5-56.

Costa Â., Koller E., Wech H.-B., Schuller D. (2007). Triticum spelta L. – Suebian crop? An ethnographic hypothesis on genetic trial. *Poster presented at Congresso Nacional Micro'07 Biotec'07-XXXIII JPG*. Available at <http://repositorium.sdum.uminho.pt/handle/1822/7532>,

Dinis A. (1993-1994). Contribuição para o estudo da Idade do Ferro em Basto: o Castro do Crastoeiro. *Cadernos de Arqueologia, Serie 2*, 10-11: 261-278.

Dopazo Martínez A. (1996). *La dieta vegetal del Noroeste Ibérico durante el Holoceno. Una aproximación a través del análisis paleocarpológico*. Undergraduation Thesis, Universidad de Santiago.

Dopazo Martínez A., Fernández Rodríguez C., Ramil-Rego P. (1996). Arqueometría aplicada a yacimientos Galaico-romanos del NW Peninsular: valoración de la actividad agrícola y ganadera. In Ramil-Rego P., Fernández Rodríguez, C., Rodríguez Guitián, M. (Eds.), *Biogeografía Pleistocena - Holocena de la Península Ibérica*, Xunta de Galicia: 317-332.

Fabião C. (1992). O Passado Proto-Histórico e Romano. In Mattoso J. (Ed.), *História de Portugal, 1, Antes de Portugal*, Círculo de Leitores: 77-299.

Fernández Rodríguez C. (2000). *Los macromamíferos en los yacimientos arqueológicos del Noroeste peninsular: un estudio económico*. PhD thesis, Facultade de Xeografía e Historia. Universidade de Santiago de Compostela.

Ferré M., Rey J., Concheiro A., Vázquez Varela J. (1996). Contribución al conocimiento ictiológico del Castro de "O Achadizo", (Cabo de Cruz, Coruña, Galicia). In Ramil-Rego P., Fernández Rodríguez, C., Rodríguez Guitián, M. (Eds.), *Biogeografía Pleistocena - Holocena de la Península Ibérica*, Xunta de Galicia: 291-296.

Figueiral I. (2008). O Crasto de Palheiros (Murça, NE Portugal): a exploração dos recursos vegetais durante o III/inícios do IIº milénio AC e entre o Iº milénio AC e o séc. IIº DC. In Sanches M. (Ed.), *O Crasto de Palheiros. Fragada do Castro. Murça – Portugal*, Município de Murça: 79-108.

- García Y Bellido A. (1993). *España y los Españoles hace dos mil años*. Espasa Calipe.
- González-Ruibal A. (2003). *Arqueología del Primer Milenio a.C. en el Noroeste de la Península Ibérica*. PhD, Department of Prehistory, Complutense University of Madrid.
- González-Ruibal A. (2004). Facing two seas: Mediterranean and Atlantic contacts in the North-West of Iberia in the first millennium BC. *Oxford Journal of Archaeology*, 23 (3): 287-317.
- Hunt H., Jones M. (2008). Pathways across Asia : exploring the history of Panicum and Setaria in the Indian subcontinent. *Pragdhara*, 18: 53-68.
- Jacomets S. (2006). *Identification of cereal remains from archaeological sites*. Archaeobotany Lab, IPAS, Basel University.
- Lopez Merino L., Peña-Chocarro L., Ruiz Alonso M., Lopez Saez J., Sanchez Palencia F. (2010). Beyond nature: The management of a productive cultural landscape in Las Medulas area (El Bierzo, Leon, Spain) during pre-Roman and Roman times. *Plant Biosystems*, 144: 909-923.
- Mason S. (1992). *Acorns in human subsistence*. PhD, London: Institute of Archaeology, University College.
- Mason S., Nesbitt M. (2009). Acorns as food in southeast Turkey: Implications for prehistoric subsistence in Southwest Asia. In Fairbairn A., Weiss E. (Eds.), *From foragers to farmers*, Oxbow books: 71-85.
- Martins M. (1990). *O povoamento proto-histórico e a romanização da bacia do curso médio do Cávado*. PhD thesis. Braga: Unidade de Arqueologia da Universidade do Minho.
- Martins M. (1993-1994). Continuidade e mudança no I milénio a.C., no Noroeste Português. Os diferentes cenários de representação do discurso arqueológico. *Cadernos de Arqueologia*, 10-11: 41-64.
- Martins M. (1996). Povoamento e habitat no Noroeste português durante o 1º milénio a.C. In *De Ulisses a Viriato. O primeiro milénio a.C.*, Lisboa, MNA: 118-133.
- Morais R. (2004). *Autarcia e Comércio em Bracara Augusta no período Alto-Imperial: contribuição para o estudo económico da cidade*. PhD thesis, Braga: Universidade do Minho.
- Muñoz Sobrino C., Ramil-Rego P., Gómez-Orellana L. (2004). Vegetation of the Lago de Sanabria area (NW Iberia) since the end of the Pleistocene: a palaeoecological reconstruction on the basis of two new pollen sequences. *Vegetation History and Archaeobotany*, 13 (1): 1-22.
- Muñoz Sobrino C., Ramil Rego P., Gómez Orellana L., Díaz Varela R. (2005). Palynological data on major Holocene climatic events in NW Iberia. *Boreas*, 34 (3): 381-400.

Nesbitt M., Samuel D. (1996). From staple crop to extinction? The archaeology and history of the hulled wheats. In Padulosi S., Hammer K., Heller J. (Eds.), *Hulled wheats. Proceedings of the First International Workshop on Hulled Wheats. Promoting the conservation and use of underutilized and neglected crops*, Rome: International Plant Genetic Resources Institute: 41-100.

Oliveira M. (2000). *O registo paleocarpológico do NO peninsular entre o III<sup>o</sup> e o I<sup>o</sup> milénios a.C. Contributo para o estudo da alimentação pré e proto-histórica*. MSc thesis, Universidade do Minho.

Oliveira F., Queiroga F., Dinis A. (1991). O pão de bolota na cultura castreja. In Queiroga F., Dinis A. (Eds.), *Paleoecologia e Arqueologia II*: 251-268.

Parcero Oubiña C. (2000). Síntesis de los trabajos de excavación en el yacimiento castreño de Alto do Castro (Cuntis, Pontevedra). *Brigantium*, 12: 161-174.

Parcero Oubiña C., Cobas Fernández I. (2004). Iron Age Archaeology of the Northwest Iberian Peninsula. *e-Keltoi*, 6: 1-72.

Peña Santos A. (2005). Breve síntesis de la prehistoria e arqueología do Eixo Atlántico. In Hidalgo Cuñarro J. (Eds.), *Rutas Arqueolóxicas do Eixo Atlántico/Roteiro Arqueológico do Eixo Atlântico*: 3-42.

Pereira Sieso J., García Gómez E. (2002). Bellotas, el alimento de la Edad de Oro. *Arqueoweb*, 4 (2).

Pliny (1999). *Historia Natural*. Translated by Francisco Hernández (Books 1-25) and Jerónimo de Huerta (Books 26-37). Visor Libros, Universidad Nacional de México.

Queiroga F. (1992). *War and Castros. New approaches to the northwestern Portuguese Iron Age*. PhD thesis, Oxford: University of Oxford.

Ramil Rego P. (1993). Paleoethnobotánica de yacimientos arqueológicos holocenos de Galicia (N.O. Cantábrico). *Munibe*, 45: 165-174.

Ramil Rego P., Aira Rodríguez M. J. (1993). A palaeocarpological study of Neolithic and Bronze Age levels of the Buraco da Pala rock-shelter (Bragança, Portugal). *Vegetation History and Archaeobotany*, 2 (3): 163-172.

Ramil Rego P., Dopazo Martínez A., Fernández Rodríguez C. (1996). Cambios en las estrategias de explotación de los recursos vegetales en el Norte de la Península Ibérica. *Férvedes*, 3: 169-187.

Ramil Rego P., Fernández Rodríguez C. (1999). La explotación de los recursos alimenticios en el noroeste ibérico. In García Quintela M. (Eds.), *Mitología y mitos de la Hispania prerromana (III)*, Akal, 296-342.

Ramil Rego P., Gómez-Orellana L., Muñoz-Sobriño C., García-Gil S., Iglesias J., Pérez Martínez M., Martínez Carreño N., Nóvoa Fernández B. (2009). Cambio climático y dinámica del paisaje en Galicia. *Recursos Rurais*, 5: 21-47.

Rey Castiñeira J., Martín Seijo M., Teira Brión A., Abad Vidal E., Calo Ramos N., Carballo Arceo L., Comendador Rey B., Picón Platas I., Varela Montes A. (2011). CastroBYTE. Un modelo para a xestión da información arqueolóxica. *Gallaecia*, 30: 67-106.

Rivas-Martínez S., Díaz T., Fernández-González F., Izco J., Loidi J., Lousã M., Penas A. (2002). Vascular plant communities of Spain and Portugal. Addenda to the Syntaxonomical checklist of 2001. *Itinera Geobotanica* 15 (1-2): 5-922.

Rodríguez Guitián M., Ramil-Rego P. (2007). Clasificaciones climáticas aplicadas a Galicia: revisión desde una perspectiva biogeográfica. *Recursos Rurais*, 1 (3): 31-53.

Rodríguez Guitián M., Ramil Rego P. (2008). Fitogeografía de Galicia (NW Ibérico): análisis histórico y nueva propuesta corológica. *Recursos Rurais*, 4 19-50.

Rodríguez López C., Fernández Rodríguez, C. (1996). Una aproximación al estudio de los yacimientos castreños del litoral galaico: dimensiones ambientales y económicas. In Ramil-Rego P., Fernández Rodríguez, C., Rodríguez Guitián, M. (Eds.), *Biogeografía Pleistocena - Holocena de la Península Ibérica*, Xunta de Galicia: 363-375.

Rüegger A., Winzeler H. (1993). Performance of Spelt (*Triticum spelta* L.) and Wheat (*Triticum aestivum* L.) at two Different Seeding Rates and Nitrogen Levels under Contrasting Environmental Conditions. *Journal of Agronomy and Crop Science*, 170 (5): 289-295.

Sampaio J., Carvalho A. (2002). Intervenção de salvamento no sítio de Bolada (S. Bartolomeu do Rêgo, Celorico de Basto). *Revista Portuguesa de Arqueologia*, 5 (1): 29-38.

Santos Júnior J., Isidoro A. (1963). Escavações no Castro de S. Vicente de Chã (Barroso). *Trabalhos de Antropologia e Etnologia*, 19 (2): 178-186.

Santos Yanguas N. (1988). *El ejército y la romanización de Galicia: conquista y anexión del Noroeste de la Península Ibérica*. Oviedo: Universidad de Oviedo.

Silva A. C. d. (1986). *A Cultura Castreja do Noroeste de Portugal*. Paços de Ferreira: Museu Arqueológico da Citânia de Sanfins.

Smartt J., Simmonds N. (1995). *Evolution of crop plants*. Longman Scientific & Technical.

Stika H.-P. (2011). Early Iron Age and Late Mediaeval malt finds from Germany—attempts at reconstruction of early Celtic brewing and the taste of Celtic beer. *Archaeological and Anthropological Sciences*, 3 (1): 41-48.

Strabo (1992). *Geografía. Libros III-IV*. Translation by Meana, M. and Piñero, F. Madrid: Editorial Gredos.

Teira Brión A. (2003). Os traballos agrarios e as ferramentas empregadas na cultura castrexa. *Gallaecia*, 22: 157-192.

Tellez R., Ciferri, F. (1954). *Trigos arqueológicos de España* Madrid: Instituto Nacional de Investigaciones Agronomicas.

Tellez R., Chamorro J., Arnanz A. (1990). Analisis discriminante en la identificacion de trigos arqueológicos espanoles. *Trabajos de Prehistoria*, 47: 291-318.

Tereso J., Carvalho T. P., Almeida da Silva R., Ramil Rego P. (2010). Cultivos e armazenagem em Monte Mozinho: dados preliminares. In Bettencourt A. M. S., Alves M. I. C., Monteiro-Rodrigues S. (Eds.), *Variações paleoambientais e evolução antrópica no Quaternário do Ocidente Peninsular/ Palaeoenvironmental changes and anthropization in the Quaternary of Western Iberia*, Braga, Associação Portuguesa para o Estudo do Quaternário - APEQ e Centro de Investigação Transdisciplinar. Cultura, Espaço e Memória- CITCEM, 149-158.

Troccoli A., Codianni P. (2005). Appropriate seeding rate for einkorn, emmer, and spelt grown under rainfed condition in southern Italy. *European Journal of Agronomy*, 22 (3): 293-300.

van der Veen M., Palmer C. (1997). Environmental Factors and the Yield Potential of Ancient Wheat Crops. *Journal of Archaeological Science*, 24 (2): 163-182.

Zohary D., Hopf M., Weiss, E. (2012). *Domestication of Plants in the Old World – The origin and spread of domesticated plants in south-west Asia, Europe, and the Mediterranean Basin*. 4<sup>th</sup> Edition. Oxford: Oxford University Press.

## 10

# Roman agriculture in the *conventus Bracaraugustanus* (NW Iberia)

Tereso J., Ramil-Rego P., Almeida da Silva R.

Submitted to *Journal of Archaeological Science*.

---

### Abstract

A review of archaeobotanical data, together with new, still unpublished data, from Roman sites in *conventus Bracaraugustanus* suggests the Romanization of the northwest Iberia brought little changes to the agricultural strategies of local communities in indigenous-type settlements. The main crops remain the same as in the Iron Age: *Triticum aestivum/durum*, *Panicum miliaceum*, *Hordeum vulgare* subsp. *vulgare*, *Triticum turgidum* subsp. *dicoccum* and *Triticum aestivum* subsp. *spelta*, *Avena* and *Vicia faba*. The first secure reference for the cultivation of *Secale cereale* in the region comes from a Roman context, suggesting that it was introduced in this period, although it probably remained a minor crop.

It is possible that during Roman times we have the first evidences for the cultivation of vine in the southernmost part of the *conventus*, near the river Douro but there are no signs of olive trees cultivation.

Overall, not all the innovations usually attributed to the Romans are recorded in northwest Iberia. This fits the general scenario of a region which maintained its rural character, although with some differences in territorial organization. However, the fact that almost all the sites with fruits and seeds are indigenous-type settlements (hillforts) demands caution while interpreting the data, namely the proportion between continuity and innovation.

**Key-words:** Roman, agriculture, archaeobotany, *conventus Bracaraugustanus*, northwest Iberia

### 10.1. Introduction

It is widely assumed that the integration in the Roman Empire implied severe changes for the conquered populations. A vast set of social, cultural and economical features are usually



defined as Roman-type and are ascribed to the majority of the imperial territories. Many of those features are easily identified in Iberia. Still, one must question if uniform interpretative models should be used to approach all imperial areas and if that is not an artificial homogenization of a far more complex reality. The Iberian Peninsula is a vast and complex territory with diverse regions with different bioclimatic characteristics, different natural resources and soils. Additionally, in Iberia the Romans found several people with distinct cultural backgrounds. Thus, tentative characterization of agricultural practices in northwest Iberia during Roman times cannot be done by simply extending models from other regions where more data is available – e.g. southern Iberia.

Furthermore, characterizing the economical models of Romanized communities should not be done without integrating archaeobotanical information as well as data from other archaeometric approaches. It is not known if agronomical theories developed by reputed Roman agricultural writers – particularly Columella, born in southern Spain – were fully incorporated by local communities. In fact, acquiring reliable archaeobotanical and archaeological data is the best way to approach this question.

Syntheses of archaeobotanical data from northwest Iberia, including the territory of the *conventus Bracaraugustanus* have been produced before (Ramil Rego 1993, Ramil Rego et al. 1996, Dopazo Martínez et al. 1996, Oliveira 2000) but such studies are generic, outdated and data is usually interpreted with little chronological detail. Furthermore, recent work as been done by the authors of this article (Tereso 2009, Tereso et al. 2010, Tereso et al. 2011, and unpublished material), demanding a new, more insightful, approach.

### **10.1.1. The *conventus Bracaraugustanus* and the Roman presence in northwest Iberia**

The Roman presence in western Iberia dates back to the early 2<sup>nd</sup> century BC (Alarcão 1988, Fabião 1992), however the first references of Roman incursions in the northwest point out to a later chronology, within the second half of the 2<sup>nd</sup> century BC.

The first military expedition to this region occurred in 139 BC, during the war against the Lusitans, and was ordered by *Q. Servilius Caepio*. Later in 138-136 BC, after the pacification and subjugation of the territories south from the river Douro, the governor of Hispânia Ulterior, *D. Iunius Brutus*, organized a second expedition through the littoral, reaching the river Minho

with little resistance (Alarcão 1988, Santos Yanguas 1988, Fabião 1992, Morais 2004). Although there is no evidence for the maintenance of any military force north from the Douro as a result, this expedition marks the beginning of the Roman presence in the area (Alarcão 1988, Santos Yanguas 1988, Fabião 1992, Morais 2004, Peña Santos 2005).

In the first half of the 1<sup>st</sup> century BC, two other expeditions took place in the region, both aiming to obtain mineral resources and identify source areas. These were the peaceful expedition of 96-94 BC by *P. Licinius Crassus* and that of *C. Iulius Caesar* in 61-60 BC which passed the river Minho and reached *Brigantium* (A Coruña) (Santos Yanguas 1988, Fabião 1992, Morais 2004). It is not clear whether the Romans got effective control over the region after these incursions (for different opinions see Alarcão 1992 and Peña Santos 2005).

The Cantabrian Wars (29-19 BC) by which *Augustus* finished the occupation of all Iberia, took place mostly outside the callaican area (Santos Yanguas 1988, Martins 1990, Morais 2004, Peña Santos 2005). Still, this direct intervention of the emperor was the turning point for western and northern Iberia, after which instability and rebellions became occasional (Alarcão 1988, Carvalho 2008).

It was in Augustus' reign that the administrative efforts began in the northwest Iberia and particularly in what would be the *conventus Bracaraugustanus* (Morais 2004). This emperor founded the cities of *Bracara Augusta* (Braga), *Lucus Augusti* (Lugo) and *Asturica Augusta* (Astorga) in the late 1<sup>st</sup> century BC. Each would become the head of a *conventus*. The chronology of creation of the *conventus* is not consensual but may have happened already in Augustus reign, early in the 1<sup>st</sup> century AD (Morais 2004).

The northern Portugal and the area of *Bracara Augusta* were first included in the Province of Lusitania but soon became part of the Province of Tarraconensis (Alarcão 1988, Fabião 1992, Carvalho 2008). The consolidation of the Roman administration occurred in the Flavian dynasty. In this period, the urban centers in northwest Iberia were renewed, new cities were founded and the territorial connection was enhanced (Carvalho 2008). A progressive abandonment of the characteristic Iron Age hillforts – locally known as Castros - began already in the early 1<sup>st</sup> century AD but this process was hastened in the end of that same century and the beginning of the following, i.e., the Flavian period. Meanwhile, Roman rural settlements such as *villae* and small farms appeared in the region mostly connected to the main roads and the cities (Morais 2004, Carvalho 2008). Although it is difficult to characterize how the regional models for territorial exploitation and organization changed, the establishment of these new

settlements implied severe changes at the property regime (Carvalho 2008). Changes were surely not uniform in all the *conventus's* territory and those typical Roman settlements are only common in the western areas, where the influence of the urban centre, *Bracara Augusta*, was more evident. In the eastern regions, the establishment of unfortified settlements inhabited by several families – villages - some small, other with several hectares (Alarcão 1998, Lemos 1993), suggests the territory was structured differently. At the same time, all over the *conventus*, many hillforts continued to be inhabited throughout all the Roman period, most of them losing much of its population. In general, the territory was mainly rural.

Nevertheless, the 1<sup>st</sup> century AD was a phase of economical and structural development in the city and *conventus* of *Bracara Augusta*, one which was not clearly disrupted in the following century (Morais 2004). The city of *Bracara Augusta* acted not only as a political centre, it had an important role in importing and redistributing goods in the region and it was an important production centre for several kinds of utilities. The rural areas in the surroundings of the city were surely structured regarding their role as suppliers but, at the same time, the rural character of the region conditioned the city's dynamics (Morais 2004).

The 3<sup>rd</sup> century was a period of disturbance in the empire but it is not clear the real impact the political and economical crises had in the region. Later in this century, *Bracara Augusta* would even become the head of a new province – *Callaecia* (Alarcão 1988, Fabião 1992, Morais 2004). In the beginning of the 5<sup>th</sup> century (409-411 d.C.), during the internal wars between pretenders to the imperial throne, Vandals, Suebi and Alans entered the Iberian Peninsula and ended up establishing themselves in northwest Iberia (Alarcão 1988, Fabião 1993).

## 10.2. Study area

The study area corresponds to the *conventus Bracaraugustanus*. Its limits are not fully known but broadly it included northwest Portugal and southwest Galicia. The map in figure 10.1 shows the limits as defined by Tranoy (1981) and Alarcão (1988). Limits are merely hypothetical and only the southern boundary can be regarded as fully consistent. According to Tranoy (1981), mountain ranges of Suído and Testeiro and the valley of the river Sil would delimitate this *conventus* at north. The Atlantic Ocean constituted the western limit and to the East, the boundary was positioned in the mountains of Queixa, La Segundera, Nogueira and Bornes and the valley of the river Sabor. Alarcão (1988) believes the eastern limits, in the current

Portuguese territory, would follow the river Tua and a line somewhere between the rivers Rabaçal and Tuela.

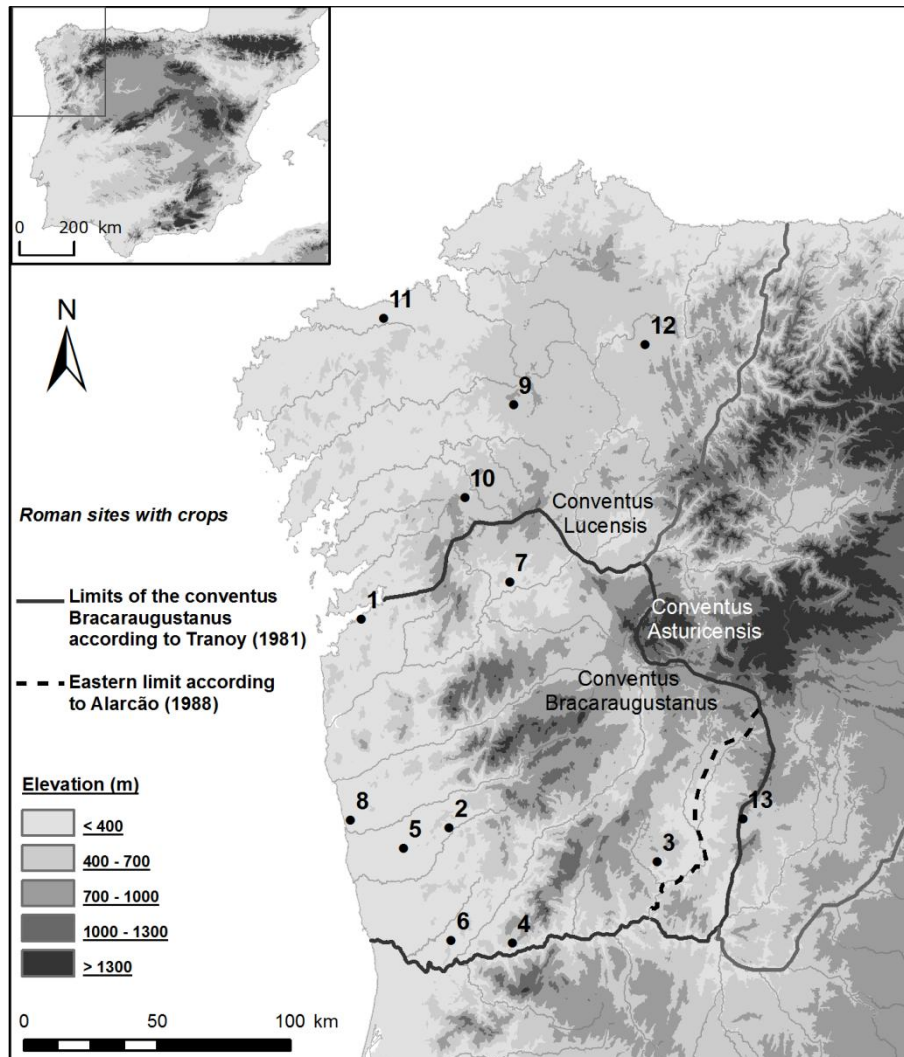


Figure 10.1 – Location of the Roman sites with crops mentioned in the text. Legend: 1 – Areal, Vigo; 2 – Briteiros; 3 – Crasto de Palheiros; 4 – Cruito; 5 – Ermidas; 6 – Monte Mozinho; 7 – San Cibrán de Las; 8 – São Lourenço; 9 – Castro Pedro; 10 – Montaz; 11 – Petón do Castro; 12 – Viladonga; 13 – Terronha de Pinhovo

This area is characterized by the presence of several interior mountain ranges (the Galician-Portuguese or Galician-Minho Mountains), more or less with a NE-SW orientation, with altitudes above 1200m (from North to South: Peneda with 1416m, Gerês/Xurés with 1548m, Cabreira 1262m, Alvão 1283 and Marão with 1415m). To the West of these mountains we find the coastal platform, cut by some of the region's main rivers (Minho, Cávado, Lima and Ave). To the South and Southeast the area is characterized by the alternation between plateaus and the valleys of the Douro hydrographic basin.

On climatic and biogeographic terms, the territory is almost completely placed in the Eurosiberian region (Costa et al. 1998, Rodríguez Guitián and Ramil-Rego 2007, 2008). This region is characterized by the absence of a dry season, a reduced continentality and a long vegetative period that may extent to 8-9 months, favored by the proximity to the sea. In the rest of the year, at higher altitudes, abundant frost or snow imposes severe limitations to the development of vegetation. The southeastern part of the area is positioned in the Mediterranean biogeographic region (Costa et al. 1998), characterized by the existence of a dry season of at least three months and long periods of winter frost.

### 10.3. Materials and Methods

Data available on the bibliography was reviewed and only those archaeobotanical materials with reliable references to context and chronology were considered. This criterion led to the exclusion, for instance, of the archaeobotanical data from Penices (Buxó quoted in Figueiral 1990, Oliveira 2000), Cividade de Terroso (Gomes and Carneiro 2005) and Boimorto and Castro de Vigo (Tellez et al. 1990).

The revision of data included references to other sites in different *conventus* in northwest Iberia. This allowed us to properly position our study area in a broader context, making it possible to compare data and analyze tendencies in a more accurate way. In this revision, data from Noville, a Roman *villa* in northern Galicia, were not taken into consideration. Ineffective storage of the archaeological soil samples misled archaeobotanists to consider some samples to have been recovered in Noville when they were in fact recovered in a pre-roman archaeological site in the region. Therefore, data obtained by Dopazo Martínez (1996) and referred by several authors thereafter (e.g. Dopazo Martínez et al. 1996, Ramil Rego et al. 1996, Ramil Rego and Fernández Rodríguez 1999, Oliveira 2000, Teira Brión 2010) are not from Noville. Furthermore, remains of *Brassica/Sinapis* from Petón do Castro (Dopazo Martínez 1996) and Viladonga (Dopazo Martínez et al. 1996) were not included in this synthesis since a revision of the *Brassica/Sinapis* seeds from other contexts in the region allowed us to question the criteria used for such identification, although the true nature of such remains is not yet known.

There are difficulties in understanding if contexts chronologically attributed to the turn of the Era correspond to Roman or Iron Age contexts. This is a result of the wide interval of the

radiocarbon dates of this phase, the imprecise chronology of the Roman conquest and the (cultural and archaeological) continuity between the Iron Age and the first Roman phases. This suggests that such division is somehow artificial, making it necessary to regard each context individually. That happened with As Lias (Ourense), S. João de Rei (phase III) (Póvoa de Lanhoso) and San Cibrán de Las (Ourense). Only the latter was considered a fully Roman context. As Lias (Ourense), dating back to the turn of the Era (CSIC-1402 - 2033±26 BP, 155 cal BC – 49 cal AD at 2σ), was not included in Table 10.1 because there are no clear signs of Romanization in this phase. In the case of S. João de Rei III, the Radiocarbon date suggests also a chronology of the turn of the Era (CSIC-1148 - 2006±26 BP, 83 cal BC – 63 cal AD at 2σ) but Ana M.S. Bettencourt refers there are no signs of Romanization (Bettencourt 1999). Nevertheless, the archaeobotanical materials from these sites are referred in the text. On the other hand, the inclusion of the data from the level III-2 from Crasto de Palheiros (Murça) despite M. J. Sanches considering it an Iron Age level (Sanches 2008) is due to its late dates. The author herself, based on abundant radiocarbon dates and archaeological artifacts, suggests the fire which preceded the abandonment of the site, at the end of this phase, happened in the end of the 1<sup>st</sup> century AD.

Furthermore, this study includes references to unpublished material from San Cibrán de Las (Ourense, Spain), Briteiros (Guimarães, Portugal) and Monte Mozinho (Penafiel).

In San Cibrán de Las, some sporadic carpological material was handpicked during the 2003 excavations at the interior of a patio of a domestic compound, a Roman context dating back to the turn of the Era (Y. Álvarez González personal information). San Cibrán de Las was inhabited from the 2<sup>nd</sup> century BC to the 2<sup>nd</sup> century AD (Álvarez González et al. 2009); the archaeological excavations were directed by Y. Álvarez González and L. López González.

In Briteiros, strategic sampling and flotation took place during three archaeological campaigns (2006-2008) directed by F. Sande Lemos, M. Manuela Martins and Gonçalo Cruz. Most samples come from Iron Age contexts but some date from the beginning of the Roman presence in the area. Citânia de Briteiros was inhabited from the Late Bronze Age to the 2<sup>nd</sup> century AD (Lemos and Cruz 2010).

In Monte Mozinho, systematic soil sampling was carried out in the excavations coordinated by Teresa Pires de Carvalho, in 2008 and 2009. Studied samples come from levels dated by radiocarbon to the 3<sup>rd</sup>-first half of the 4<sup>th</sup> centuries AD. Monte Mozinho is a hillfort founded in Augustus time, occupied until the 5<sup>th</sup>-6<sup>th</sup> century (Soeiro 1998).

Regarding the crops mentioned in the bibliography, the revision of data included a revision of nomenclature. This way, the morphological type *Triticum compactum* used in the archaeobotanical study of Terronha de Pinhovelo (Tereso 2007a, 2007b, 2008, 2009a and 2009b) and the “globiform wheat” and *Triticum parvicoccum*, used by Pinto da Silva in the study of Cruito (Pinto da Silva, unpublished report of 1987, provided by António da Silva Pereira) are here designated as *Triticum* “stubby grains”, following S. Jacomet (2006). This refers to roundish grains, shorter than those of *Triticum aestivum/durum*, and can include three species that cannot be distinguishable from their grain morphology: *T. aestivum* subsp. *compactum*, *T. aestivum* subsp. *sphaerococcum* and *T. parvicoccum*. Underdeveloped grains of other naked wheat species (included in the morphological type *T. aestivum/durum*) can present the same morphological features.

The *Triticum aestivum/durum* type includes *T. aestivum* L. subsp. *aestivum*, *T. turgidum* L. subsp. *durum* (Desf.) Mackey, and *T. turgidum* L. subsp. *turgidum* (Buxó 1997, nomenclature after Zohary et al. 2012). Regarding naked wheat, only chaff-based identifications were considered at species level.

## 10.4. Results and discussion

### 10.4.1. Crops in *conventus Bracaraugustanus* according to archaeobotanical data

It is clear by the list of sites with carpological remains (see Table 10.1) that they correspond, with only one exception, to hillforts. Most of these settlements were built during the Iron Age but, as mentioned before, continued to be inhabited in the beginning of the Roman period. Many were abandoned during the 2<sup>nd</sup> century AD but other remained inhabited. Much of the archaeology of northwest Iberia was directed to the study of this kind of sites, justifying this scenario regarding archaeobotanical data. This way, it is not surprising that most of the data come from contexts covering a time-span from the turn of the Era to the 2<sup>nd</sup> century AD.

The data from carpological remains recovered in Roman levels from hillforts located in the *conventus Bracaraugustanus* demonstrates there is a clear predominance of cereals, in particular naked wheat (*Triticum aestivum/durum*), *Panicum miliaceum* and *Hordeum vulgare* subsp. *vulgare*. The presence of hulled wheat - mostly *Triticum turgidum* subsp. *dicoccum* and *Triticum aestivum* subsp. *spelta* - and *Avena* is also important. Other cereals are found in fewer sites: *Hordeum vulgare* var. *nudum*, *Setaria italica* and *Secale cereal*.

Site Chronology		<i>Conventus Bracaraugustanus</i>						
		San Cibrán de Las	Briteiros	Crasto de Palheiros	Cruito	Ermidas	Monte Mozinho	São Lourenço
		1 <sup>st</sup> BC/1 <sup>st</sup> AD	1 <sup>st</sup> BC/1 <sup>st</sup> AD	1 <sup>st</sup> AD	1 <sup>st</sup> AD	1 <sup>st</sup> AD	3 <sup>rd</sup> /4 <sup>th</sup>	4 <sup>th</sup> /5 <sup>th</sup>
<b>Cereals</b>								
<i>Avena</i>		+				+++		
cf. <i>Avena</i>				+				
<i>Hordeum</i>			+++					
<i>Hordeum vulgare</i> var. <i>nudum</i>				+				
<i>Hordeum vulgare</i> subsp. <i>vulgare</i>	++	+	(++++)		+	+		
<i>Panicum miliaceum</i>		+	+++++		++++	+++	++	
<i>Panicum/Setaria</i>		+	+++		+++	+++	++	
<i>Secale cereale</i>				++		(++++)		
<i>Setaria italica</i>						+++	++	
<i>Setaria</i>					+++			
<i>Triticum aestivum</i>						(+++)		
<i>Triticum aestivum/durum</i>		+		*	+++	+++	+	
<i>Triticum</i> "stubby grains"				*		+		
<i>Triticum dicoccum/spelta</i>			+++++			(+)		
<i>Triticum turgidum</i> subsp. <i>dicoccum</i>		+	(*)	*				
<i>Triticum aestivum</i> subsp. <i>spelta</i>			(*)					
<i>Triticum</i>		++	++++		+	+	+	
Cereals - undetermined			*		+	+++		
<b>Pulses</b>								
<i>Pisum sativum</i>	+							
<i>Vicia faba</i>	+		+++	+				
<i>Vicia</i>		+				++		
<b>Fruits</b>								
<i>Arbutus unedo</i>			*					
<i>Olea europaea</i>					+			
<i>Pinus pinea</i>			+					
<i>Prunus</i>				+				
<i>Pyrus communis</i>								
<i>Quercus</i> (cupule)				+				
<i>Quercus</i> (cotyledon)				*		+		
<i>Rubus</i>		+			++	+		
<i>Vitis vinifera</i>		++		+		+		
<b>References</b>	A	A	B	C, D	E	F, A	G	

Table 10.1 – Carpological remains from Roman settlements in *Conventus Bracaraugustanus*. Legend: (+) 1-10; (++) 11-100; (+++) 101-1000; (++++) 1001-10.000; (+++++) more than 10.000; \*unknown amounts; parentheses in the table indicate the presence of chaff. Bibliographic references: A - unpublished; B - Figueiral 2008; C - Pinto da Silva 1988; D - Pinto da Silva 1988b; E - Queiroga 1992; F - Tereso et al. 2010b; G - Tereso et al. 2010.



When adding sites that date back to the transition from the Iron Age to the Roman period, like As Laias and S. João de Rei, as well as data from settlements of other *conventus* in northwest Iberia (see Table 10.1), the scenario remains the same. In As Laias, the main crop was spelt, followed by *Panicum miliaceum* but oat and hulled barley were also present (Tereso, unpublished). The relevance of hulled wheats is also clear in Castro Pedro (Criado Boado 1991), in the 4<sup>th</sup> or 5<sup>th</sup> centuries levels of Terronha de Pinhovel (Tereso 2009) and in the unfortified settlement of Agro de Ouzande (Silleda), near the eventual northern limit of the studied *conventus*. In this latter, microbotanical and traceological evidence suggests the grinding of *T. dicoccum*, together with naked wheat, *Panicum miliaceum* and *Quercus* acorns (Juan-Tresserras and Matamala 2002). As for oat, it was recovered also in Petón do Castro and Viladonga (Dopazo Martínez et al. 1996).

Regarding garden crops, *Vicia faba* is the most relevant crop, being the only with a significant presence in the Roman archaeobotanical assemblages of the *conventus Bracaraugustanus*. It is present also in As Laias (unpublished) and S. João de Rei (Oliveira 2000) and in sites of the other *conventus*. Finds of *Pisum sativum* are restricted to a single seed found in San Cibran de Las (San Amaro). Outside this *conventus*, it was recovered in Petón do Castro (Dopazo Martínez et al. 1996). In Agro de Ouzande, several evidence of Brassicaceae was found in one vessel (sclereids, epidermal and parenchymatous tissue and sterols) and one storage facility (seed coats) (Juan-Tresserras and Matamala 2002). Seeds from vetch - *Vicia sativa/angustifolia* (*Vicia angustifolia* = *Vicia sativa* subsp. *nigra*) were found in Monte Mozinho. This species could have been cultivated for fodder, as stated by Columella (Res Rustica Book II, VII, 1). Still, its presence among crops' by-products (chaff and weeds), together with its known ecological amplitude (Pinho and Pinho 1998, Romero Zarco 1999) makes it possible that it simply bordered agricultural fields or was, itself, a weed. The concentration of by-products in one compartment, in Monte Mozinho, led to the conclusion that they were used as fodder (Tereso unpublished). This means that plant husbandry and animal husbandry were intertwined and were both a part of the same complex system.

The only Roman assemblage in northwest Iberia with *Linum* is Petón do Castro (Dopazo Martínez 1996) making it difficult to understand the relevance of such crop in the region. Its cultivation began in the Chalcolithic - Buraco da Pala (Mirandela) (Ramil Rego and Aíra Rodríguez 1993) and Bitarados (Esposende) (Bettencourt et al. 2007) –, but it was not found in any Bronze Age or Iron Age site. Still, Pliny mentions the flax produced by the *Zoelae* (Pliny, Nat. Hist., 19, 1): "Recently [the flax] from the Zoelae came from Spain to Italy. It is very good

to manufacture nets<sup>4</sup>. The *Zoelae* (and the *Civitas Zoelarum*) are known to have been part of the *conventus asturicensis* (Tereso 2008, 2008b). They bordered the *conventus Bracaraugustanus* in Eastern Portugal and in the Spanish province of Zamora (from the sites mentioned, only Terronha de Pinhovel is likely to have been a *Zoelae* settlement).

Site	<i>Conventus Lucensis</i>				<i>C. Asturicensis</i>
	Castro Pedro	Montaz	Petón do Castro	Viladonga	Terronha de Pinhovel
	Chronology	1 <sup>st</sup> BC/1 <sup>st</sup> AD	1 <sup>st</sup> AD	2 <sup>nd</sup>	4 <sup>th</sup> /5 <sup>th</sup>
<b>Cereals</b>					
<i>Avena</i>			++	*	
<i>Hordeum</i>			++		
<i>Hordeum vulgare</i> subsp. <i>vulgare</i>					+++
<i>Panicum miliaceum</i>		*			++
<i>Panicum/Setaria</i>			+++		
<i>Setaria italica</i>					+
<i>Triticum aestivum/durum</i>					+++
<i>Triticum</i> "stubby grains"					+++
<i>Triticum dicoccum/spelta</i>					++
<i>Triticum turgidum</i> subsp. <i>dicoccum</i>					(+++)
<i>Triticum monococcum</i>					(++)
<i>Triticum aestivum</i> subsp. <i>spelta</i>	(+)				(+++)
<i>Triticum</i>			+++++	*	++++
Cereals - undetermined					++
<b>Pulses</b>					
<i>Pisum sativum</i>			++		
<i>Vicia faba</i>			++++		+++
<b>Other crops</b>					
<i>Linum</i>			++++		
<b>Fruits</b>					
<i>Pyrus communis</i>				*	
<i>Quercus</i> (cotyledon)				*	+
<b>References</b>	A	B	C	D, E	F, G

Table 10.2 – Carpological remains from Roman settlements in *Conventus Lucensis* and *Conventus Asturicensis*. Legend: (+) 1-10; (++) 11-100; (+++) 101-1000; (++++) 1001-10.000; (+++++) more than 10.000; \*unknown amounts; parentheses in the table indicate the presence of chaff. Bibliographic references: A - Criado Boado 1991; B - Aranz and Chamorro 1990; C - Dopazo Martínez 1996; D - Dopazo Martínez et al. 1996; E - Ramil Rego et al. 1996; F - Tereso 2007; G - Tereso 2009.

<sup>4</sup> "De poco acá há venido de Hespaña a Italia el zoélico, muy bueno para redes" (Hist. Nat. translation by Francisco Hernández).

Despite Pliny's words, it is difficult to address the economical significance of flax in the region since the same author points out other regions in Iberia and the Mediterranean producing flax, some of which (e.g. Egypt), closer and with great commercial activities with Rome (see discussion at Tereso 2008b).

It is difficult to compare data with other regions in northern Iberia since only in Catalonia abundant archaeobotanical studies have been carried out (Buxó 2005). In Atlantic areas few archaeobotanical data is available. Differences between the *conventus Bracaraugustanus* and Catalonia are expected due to several geographic and climatic aspects which distinguish these two regions but also because the latter was one of the first areas influenced by Mediterranean trends – Greek, Phoenician and Roman (Buxó 2008). The main difference between the archaeobotanical assemblages of these regions are the higher diversity of pulses and fruits identified in the northeast and the little relevance of millets, which became residual crops (Buxó 2005). In the northwest Iberia, millets, mainly *Panicum miliaceum*, continue to be very important crops in the region as they were in the Iron Age. Oat was probably a more important crop in the northwest than in Catalonia. Still, other features of both regions' agriculture are similar: the predominance of *Triticum aestivum/durum* and hulled barley; the residual presence of naked barley and *Triticum* "stubby grains". Emmer was a relevant crop in Catalonia but spelt is not recorded. Rye is more frequent in Catalonia, especially in late dates, in transition towards the Middle Ages.

Regarding the presence of fruits and fruit trees (wild or domestic) in Roman sites in northwest Iberia, the data available is very sparse. The only site in all northwest Iberia with significant presence of cultivated fruits is Areal, a salt pan and an ancient port area in Vigo (Martin Seijo and Teira Brión 2010, Teira Brión 2010) but the available data regarding the archaeological context is still sparse making it difficult to evaluate this carpological assemblage with no parallel in the region.

Wild fruits are not common in Roman sites from the *conventus Bracaraugustanus*. Only *Rubus* seeds and *Quercus* cotyledons were retrieved in a significant number of sites. Acorns were found in other sites with no crops, thus not present in Tables 10.1 and 10.2, such as the 1<sup>st</sup> century AD level of S. João de Rei (Póvoa de Lanhoso) (Oliveira 2000). The consumption of acorns was recurrent in Iron Age settlements in northwest Iberia, thus it is not surprising that such habit continued in Roman times.

#### 10.4.2. Olive oil and wine in the *conventus Bracaraugustanus*

Fruits from *Olea europaea* were recovered in the Roman levels of Ermidas (Vila Nova de Famalicão) (Queiroga 1992), still they are few. In northeast Iberia, near the Mediterranean, the presence of olive stones in archaeological sites is more conspicuous. In the area of the *conventus Bracaraugustanus*, the presence of olive stones in pre-roman contexts is confirmed. In fact, the recovery of such remains in the Early Neolithic settlement of Bolada (Celorico de Basto) (Sampaio and carvalho 2002) and in the Chalcolithic levels of Crasto de Palheiros (Murça) (Figueiral 2008) tallies palynological data assuring wild olive is native to the region. However it was not a predominant species, being more prone to expand in Mediterranean bioclimatic regions.

Strabo says, referring to the mountain people from northern regions, at the time of the Cantabrian wars by which Augustus finished the conquest of Iberia: “*Instead of oil they use butter*”<sup>5</sup> (Strabo, Geography, Book III, 3, 7). Caution is needed while interpreting Strabo writings since they are ideologically conditioned (Fabião 1992), but it is possible that these words were true. In fact, Ruis Morais (1997/1998, 2004) mentions a notorious scarcity of Roman oil amphorae, which, together with the palynological data, sparse archaeobotanical data and the words of Strabo, suggests animal fat was preferred to olive oil.

As for other archaeological data, there are references to two eventual structures related to olive oil extraction. In Fonte do Milho (Peso da Régua), a *villa* next to the river Douro, remains of two *molae oleariae* were found, but its chronology is uncertain. The site was founded in the turn of the Era, but the mentioned structures may be ascribed to the Late Roman Empire (Morais 1997-98, Almeida 2006). An eventual olive mill was found also in the coastal *villa* of Fontão (Matosinhos) (Brun 1997, Morais 2004) but the data available regarding this site is clearly insufficient.

Pips from *Vitis vinifera* are not abundant in the archaeobotanical assemblages but they were recovered in several sites, suggesting they were not uncommon, since a preservation bias can theoretically lead to an underrepresentation of this species in archaeological sites (Tereso 2008b). They were recovered in Briteiros (Guimarães), Cruito (Baião) and Monte Mozinho (Penafiel). Briteiros is the settlement where they are more frequent and even here only 20 pips were found in Roman levels, together with 14 in Iron Age levels (unpublished).

---

<sup>5</sup> “Usan mantequilla en vez de aceite” (Geografía, translation by M<sup>a</sup> José Meana).

Interestingly, in all northwest Iberia, grape pips and olive stones were only recovered in sites from the *conventus baracaugustanus*. This is the most southern area in northwest Iberia – in the southern regions of the *conventus asturicensis* (northeast Portugal) few archaeological and archaeobotanical work has been done until now.

Climatic reasons may justify the exclusive presence of grapes in this southern area, although the social background of local communities could have been a significant factor. Grape pips were found in Iron Age and even in Chalcolithic and Late Bronze Age sites in northern Portugal (Tereso et al. 2011) but none was found in northwest Spain. *Vitis vinifera* is a native species to the Mediterranean and the early remains from the Chalcolithic levels at Buraco da Pala (Ramil Rego and Aira Rodríguez 1993) suggests its gathering. Iron Age remains may be a result of gathering, trade or cultivation. It is clear that vine could be more easily cultivated in the southernmost regions but, at the same time, these were the more developed regions during the Iron Age and those with more direct and influencing contacts with the Mediterranean world (González Ruibal 2003). Thus it is possible that in these southern regions the habit of drinking wine was more established before the Roman conquest, than in the north.

However, the remains of grapes, namely the pips, are not direct evidence of wine production or consumption. Ultimately, they are evidences of the presence and consumption of grapes. In our study area, evidences for wine consumption in Roman times are restricted to amphorae. These are common in the beginning of the Roman period in this region and testify for the great relevance of wine imports from several origins, mostly *Baetica* (southern Spain), in the end of the 1<sup>st</sup> century BC and throughout the 1<sup>st</sup> century AD (Morais 1997/1998, 2004). The relevance of such imports is used to suggest the absence of wine production in the region and, consequently, the decrease in wine imports in the 2<sup>nd</sup> century AD should mean that wine production was already well established in the region by that time (Morais 1997/1998, 2004). Still, such assumption needs to be verified by other sources, since trading routes could have been altered and other vessels could have been used.

The interpretation of some feature interfaces in Rúa Ferreiría, in the city of Pontevedra (northwest Spain) (Teira Brión 2010, fig. 4) as structures related with vine cultivation is questionable and should be supported by archaeometric data.

Regarding the eventual presence of wine presses in the region, these were mostly recorded in the southernmost area, near the river Douro. Most of these structures lack the proper archaeological context and their chronology is uncertain (Coixão 2002, Sousa et al. 2006). Still,

structural evidences of a wine press were found inside the *villa* of Rumansil (Vila Nova de Foz), near the *conventus bracargustanus*, south from the river Douro, dating back to the 3<sup>rd</sup> century AD. Grape pips were also found (Coixão and Silvino 2006). In the Late imperial villa of Fontão do Milho (Peso da Régua) near the river Douro, a *cella vinaria* was recorded (Almeida 2006). In Monte Mozinho a possible wine or olive press was found near the centre of the settlement (Soeiro 1998). Several structures have been mentioned for other sites in the Douro region and others located far to the north (Almeida 1996). Thus, wine production in this *conventus* was likely to have occurred, mostly in the southern areas and probably in late periods, but it is not possible to know whether it was economically relevant.

The discussion regarding the production of wine and oil should be improved in the future by acquiring data from structures or artifacts through chemical analyses and other techniques. Different approaches were carried out successfully in Eastern Mediterranean and Near Eastern sites (e.g. Kimpe et al. 2001, Pollard et al. 2007, Barnard et al. 2011).

#### 10.4.3. Signs of continuity and change

It is difficult to fully characterize the impact of Romanization in the agricultural strategies of people in the area of the *conventus Bracaraugustanus* and in all northwest Iberia. As we have pointed out, data obtained derive mainly from indigenous-type of settlements, the hillforts, and no data is available for roman-type establishments.

Overall, there is a general sense of continuity regarding the Iron Age in northwest Iberia. The predominant crops are the same: naked (*Triticum aestivum/durum*) and hulled wheat (*Triticum turgidum* subsp. *dicoccum* and *Triticum aestivum* subsp. *spelta*), hulled barley (*Hordeum vulgare* subsp. *vulgare*), broomcorn millet (*Panicum miliaceum*), oat (*Avena*) and faba bean (*Vicia faba*). Thus, it is likely that agricultural systems did not change much, at least for those communities who continued to live in the hillforts.

The maintenance of hulled wheats – emmer and spelt – as relevant crops is not surprising, even considering the new political dominance. Columella stated that no farmer should rely on only one crop but rather should adequate the set of crops to the diversity of farm fields within its properties: “these kinds of wheat and emmer should be kept by farmers for this reason, that seldom is any land so situated that we can content ourselves with one kind of seed” (Res Rust. 2, 6, 4).

This rationality may justify the spread of rye throughout the Roman Empire, despite the prejudice towards its taste demonstrated by Pliny, who says “It is the worst kind of bread and it is only useful to prevent famine”<sup>6</sup> (Plin. Nat. Hist. 18. 16). Still, Pliny, itself, adds that “It grows in any land, yields a hundred-fold and [its straw] is employed also as manure”<sup>7</sup>. This justifies the cultivation of rye, regardless of its (subjective) unappreciated taste. It grows where other cereals do not, being, thus, extremely useful for communities or households to maintain their resilience. In this sense, the introduction of rye on northwest Iberia met the objectives of subsistence in an area with significant topographic and edaphic constraints which had already limited agricultural choices during the Iron Age. Its role was similar to that of the hulled wheats.

Rye was recovered in two sites, separated from each other by only 23km, Monte Mozinho and Cruito (Fig. 10.1). Interestingly, despite being indigenous-type of settlements, Cruito and Monte Mozinho were founded in Roman times, contrary to all other hillforts with crops in *conventus Bracaraugustanus*. Up to now, it is not possible to know if there is any relation between this chronological peculiarity and the cultivation and consumption of rye.

In the settlement of Monte Mozinho, chaff and grains of rye were recovered in abundance. Some grains were directly radiocarbon dated to the 3<sup>rd</sup> – beginning of the 4<sup>th</sup> centuries AD (Tereso unpublished). On what Cruito is concern, data is more problematic since it has a much earlier chronology. A radiocarbon date obtained on charcoal provided a wide interval covering the transition of the Era (Figueiral 1990, Oliveira 2000) but archaeological materials led to the consideration of a 1<sup>st</sup> century AD chronology (Pereira and González 1988). The site provided a simple stratigraphy with only one clear occupation phase, suggesting later intrusions to be improbable.

However, the presence of rye in only two sites from this *conventus* suggests it was not a very relevant crop in the region. Still, evidence for the cultivation of rye is important since it represents a change in the set of crops available. References regarding the presence of rye in northern Portugal before the Roman period (see Pinto da Silva 1988b and Oliveira 2000) are not reliable, their chronology is uncertain, thus must not be taken into consideration.

---

<sup>6</sup> “[...] el género de pan más malo de todos, y solamente bueno para remedio de el hambre” (Hist. Nat. translation by Francisco Hernández).

<sup>7</sup> “Nace en qualquiera tierra. Da cien granos por uno, y sirve ella misma de estiércol” (Hist. Nat. translation by Francisco Hernández).

Regarding other cereals, the abundant presence of *Setaria italica* in Monte Mozinho has no equivalent in northwest Iberia, but it seems that its presence in Roman sites (Monte Mozinho, São Lourenço and a single grain in Terronha de Pinhavelo) is more frequent than in Iron Age settlements. It is possible that the cultivation of this cereal was incremented in the Roman period, possibly not at an early stage, taking into consideration the chronology of the mentioned settlements.

Another difference between Iron Age and Roman contexts is the presence of more sites with *Vitis vinifera*, suggesting a shift towards an eventual cultivation of vine. However, the difficulties in addressing this question have been stressed before (*vide supra*).

The few signs of changes must be stressed but they do not change the general idea of continuity, being unclear the eventual bias of exclusive archaeobotanical studies in hillforts. Still, archaeobotanical data must be analysed together with other archaeological data and must be included in the general trends that have been identified and discussed by classical archaeology in Northern Portugal and Galicia.

Following Rui Morais (1997/1998) we consider that in the beginning of the Roman dominance in northwest Iberia, namely the first imperial dynasty, persisted, with little changes, the Iron Age settlement pattern (i.e., hillforts in hills and spurs) and its correspondent agrarian system. In these circumstances, it is normal to find signs of continuity between Iron Age and Roman agricultural choices in the hillforts, particularly when most of the data comes from 1<sup>st</sup> century AD contexts. One example of change – *Secale cereale* – comes from 1<sup>st</sup> century contexts in Cruito and 3<sup>rd</sup>-4<sup>th</sup> centuries' contexts in Monte Mozinho. Both sites were founded in Roman times.

However, changes occurred in the region throughout the Roman period and these included new forms of settlements. The available data is not sufficient to understand, besides mere assumption, how the changes in settlement patterning and type during the 2<sup>nd</sup> century AD were reflected in agriculture. By this time, many hillforts were abandoned and new Roman-type settlements were built and spread in the region (*villae*, farms, *vicus*), although not in an entirely homogeneous way. These must have had some impact on territorial organization and probably also on the economy of local communities. Naturally, the foundation of cities and specialized establishments, such as *mutationes* and great mining exploitations, required the existence of settlements to supply them. Still, there is a complete lack of knowledge regarding the productive strategies and eventual specialization of local *villae* and farms making it



impossible to know how they integrated regional networks as suppliers and at what level they needed to be supplied.

Nevertheless, Martin Millet (2001) stresses the existence of few cities and the small sized *villae* in the region, in order to suggest the underdevelopment of typical Roman settlement patterning. Perez Losada (2000) proposes that instead of the traditional Roman scheme city-*villae*, in northwest Spain there was a *villae*-secondary agglomerate scheme, which worked out quite differently. Other authors describe another, smaller, level of settlement for inland northern Portugal, namely small unfortified villages (Alarcão 1998, Lemos 1993) which had productive systems directed to their self-sufficiency, with some, but minor, trade on a local level. Some hillforts that remained inhabited, usually with less population, may have had the same role as these villages (Pérez Losada 2000). Thus, territorial organization was far more complex than the *villae*/farm-city scheme and, overall, the territory was rural, although in the surroundings of *Bracara augusta* things could have been somehow different.

The lack of archaeobotanical studies in the new forms of settlements makes it impossible to identify eventual changes on crops and agricultural strategies. In this context, it is important to look at other facets of human subsistence, such as animal husbandry. Unfortunately, there is almost no zooarchaeological data for the *conventus Bracaraugustanus* so we must analyze the data available for the whole northwest Iberia, mostly from the work of Carlos Fernández Rodríguez (2000). This author documented several differences between Iron Age and Roman settlements, but these are not conspicuous in indigenous-type settlements. This is clear in the patterns of pig (*Sus domesticus*) consumption, much more important in the cities than in the Iron Age or Roman levels of the hillforts. Favoring the consumption of pigs is considered a Roman feature (Fernández Rodríguez 2000). Differences exist also regarding the size of the animals - *Bos taurus*, *Ovis aries*, *Sus domesticus* – bigger in the Roman-type settlements than in the Iron Age or Roman levels of the hillforts. Roman sites show a greater variety of animal species (domestic and wild). Thus, it is assumed that the Roman presence influenced significantly the patterns in meat consumption and that these changes are more visible in typical Roman settlements than in indigenous-type settlements, possibly suggesting the presence of some foreign people but mostly foreign influences.

Still, despite relevant differences were identified on animal husbandry, it is not correct to assume that differences on such degree existed also on the level of plant crops. The zooarchaeological data simply suggests caution is needed while analyzing archaeobotanical

data, since we only have reliable data from indigenous-type of settlements, even if some were founded in Roman times.

## 10.5. Conclusions

Archaeobotanical data from the *conventus Bracaraugustanus* and northwest Iberia demonstrate the main crops were naked wheat (*Triticum aestivum/durum*), millet (mostly *Panicum miliaceum*), hulled barley (*Hordeum vulgare* subsp. *vulgare*) and faba bean (*Vicia faba*), followed by hulled wheat (mostly *Triticum turgidum* subsp. *dicocum* and *Triticum aestivum* subsp. *spelta*) and oat (*Avena*). Minor crops were naked barley (*Hordeum vulgare* var. *nudum*), *Setaria italica*, rye (*Secale cereal*), peas (*Pisum sativum*) and possibly *Vicia sativa/angustifolia*. Regarding the pulses, one cannot exclude the existence of eventual preservation biases.

The mentioned crops, together with archaeological data for the region, suggest the existence of continuity and innovation in the process of Romanization. In fact, the main crops from the Roman sites are, with few differences, the same as in Iron Age sites. Nevertheless, there are some significant novelties such as the first indisputable presence of rye, although it is not clear if rye had any relevant role; and the eventual cultivation of vine in the southernmost areas of the *conventus*. However, not all the innovations usually attributed to the Romans throughout the imperial provinces are recorded in northwest Iberia. There are no clear signs that *Olea europaea* was cultivated in this region and, if it was, it probably had no economical relevance.

Still, the proportion between innovation and continuity is difficult to assess since only indigenous-type settlements were studied. Continuity seems to be a characteristic of the hillforts in Roman times and, overall, the studied territory seems to have maintained its rural character, probably with a new Roman influenced kind of organization and connectivity.

Future excavations in Roman-type settlements should incorporate systematic sampling for archaeobotanical studies. Only after acquiring new data from different kind of settlements can we really understand agriculture in Roman times at the *conventus Bracaraugustanus*. Furthermore, such studies would allow us to appreciate at what level the Roman written agronomical knowledge was known and incorporated by local communities.

## 10.6. References

- Alarcão J. (1988). *O domínio romano em Portugal*. Mem Martins: Publicações Europa-América.
- Alarcão J. (1992). A evolução da cultura castreja. *Conimbriga*, 31: 39-71.
- Alarcão J. (1998). A paisagem rural romana e alto-medieval em Portugal. *Conimbriga*, 37: 89-119.
- Almeida C. B. d. (1996). O cultivo da vinha durante a Antiguidade Clássica na Região Demarcada do Douro. Ponto da situação. *Douro - Estudos & Documentos*, 1 (2): 18-30.
- Almeida C. (2006). A *villa* do *Castelum* da Fonte do Milho. Uma antepassada das actuais quintas do Douro. *Douro - Estudos & Documentos*, 21: 209-228.
- Álvarez González Y., López González L., López Marcos M. (2009). La Ocupación del Espacio Común y Privado en la Citania de San Cibrán de Lás. *Revista Aquae Flaviae*, 41: 195-208.
- Arnanz A., Chamorro J. (1990). Estudio de frutos e semillas procedentes de cuatro Castros Gallegos. Problemas de interpretación de los resultados. In *Encontros sobre Paleoeconomia e Paleoambiente*.
- Barnard H., Dooley A., Areshian G., Gasparyan B., Faulk K. (2011). Chemical evidence for wine production around 4000 BCE in the Late Chalcolithic Near Eastern highlands. *Journal of Archaeological Science*, 38 (5): 977-984.
- Bettencourt A. M. S. (1999). *A paisagem e o Homem na bacia do Cávado durante o II e o I milénio AC*. PhD thesis, Braga: Universidade do Minho.
- Bettencourt A., Dinis A., Figueiral I., Rodrigues A., Cruz C., Silva I., Azevedo M., Barbosa R. (2007). A ocupação do território e a exploração de recursos durante a Pré-história Recente do Noroeste de Portugal. In Jorge S.O., 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*, Promontoria Monográfica, 08: 149 - 164.
- Bouby L., Léa V. (2006). Exploitation de la vesce commune (*Vicia sativa* L.) au Néolithique moyen dans le Sud de la France. Données carpologiques du site de Claparouse (Lagnes, Vaucluse). *Comptes Rendus Palevol*, 5 (8): 973-980.
- Brun J.-P. (1997). Production de l'huile et du vin en Lusitanie Romaine. *Conimbriga*, 36: 45-72.
- Buxó R. (1997). *Arqueología de las Plantas*. Barcelona: Crítica.

Buxó R. (2005). L'agricultura d'època romana: estudis arqueobotànics i evolució dels cultius a Catalunya. *Cota Zero*, 20: 108-120.

Buxó R. (2008). The agricultural consequences of colonial contacts on the Iberian Peninsula in the first millennium. *Vegetation History and Archaeobotany*, 17 (1): 145-154.

Carvalho H. (2008). *O povoamento romano na fachada ocidental do Conventus Bracaraensis*. PhD thesis, Universidade do Minho.

Coixão A. S. (2002). Lagares e Lagaretas nas Áreas de Freixo de Numão e Murça do Douro (Concelho de Vila Nova de Foz Coa). *Côavisão. Cultura e Ciência*, 4: 57-71.

Coixão A. S., Silvino T. (2006). O Sítio Arqueológico do Rumansil I (Murça do Douro, Vila Nova de Foz Côa - Portugal). *Côavisão. Cultura e Ciência*, 8: 118-137.

Columella, L. (1960). *On Agriculture. Res Rustica I-IV*. Translation by Ash, H. Harvard University Press/William Heinemann LTD.

Costa J., Aguiar C., Capelo J., Lousã M., Neto C. (1998). Biogeografia de Portugal Continental. *Quercetea*, 0: 5-56.

Criado Boado F. (1991). *Arqueología del paisaje. El área Bocelo - Furelos entre los tiempos Paleolíticos y Medievales (Campañas de 1987, 1988 y 1989)*. Xunta de Galicia.

Dopazo Martínez A. (1996). *La dieta vegetal del Noroeste Ibérico durante el Holoceno. Una aproximación a través del análisis paleocarpológico*. Undergraduation thesis, Universidad de Santiago.

Dopazo Martínez A., Fernández Rodríguez C., Ramil-Rego P. (1996). Arqueometría aplicada a yacimientos Galaico-romanos del NW Peninsular: valoración de la actividad agrícola y ganadera. In Ramil-Rego P., Fernández Rodríguez, C., Rodríguez Guitián, M. (Eds.), *Biogeografía Pleistocena - Holocena de la Península Ibérica*, Xunta de Galicia: 317-332.

Fabião C. (1992). O Passado Proto-Histórico e Romano. In Mattoso J. (Ed.), *História de Portugal, 1, Antes de Portugal*, Círculo de Leitores: 77-299.

Fabião C. (1993). A Antiguidade tardia e a desagregação do Império. In Medina C. (Ed.), *História de Portugal dos tempos pré-históricos aos nossos dias, 3, Amadora*, Ediclube: 11-32.

Fernández Rodríguez C. (2000). *Los macromamíferos en los yacimientos arqueológicos del Noroeste peninsular: un estudio económico*. PhD thesis, Santiago de Compostela: Universidade de Santiago de Compostela.

Figueiral I. (1990). *Le Nord-Ouest du Portugal et les modifications de l'écosystème, du Bronze final à l'époque romaine, d'après l'anthracanalyse de sites archéologiques*. Université des Sciences et Techniques du Languedoc.

Figueiral I. (2008). O Crasto de Palheiros (Murça, NE Portugal): a exploração dos recursos vegetais durante o III/inícios do IIº milénio AC e entre o Iº milénio AC e o séc. IIº DC. In Sanches M. (Ed.), *O Crasto de Palheiros. Fragada do Castro. Murça – Portugal*, Município de Murça: 79-108.

Fuller D. Q. (2006). *A millet atlas. Some Identification Guidance*. Institute of Archaeology. University College London.

Gomes J. M. F., Carneiro D. (2005). *Subtus Montis Terroso. Património Arqueológico no Concelho da Póvoa de Varzim*. Póvoa de Varzim: Câmara Municipal da Póvoa de Varzim.

González-Ruibal A. (2003). *Arqueología del Primer Milenio a.C. en el Noroeste de la Península Ibérica*. PhD thesis, Madrid: Complutense University of Madrid.

Hillman G., Mason S., de Moulins D., Nesbitt M. (1996). Identification of archaeological remains of wheat: the 1992 London workshop. *Circaea*, 12 (2): 195-210.

Jacomet S. (2006). *Identification of cereal remains from archaeological sites*. Archaeobotany Lab, IPAS, Basel University.

Juan Tresserras J., Matamala J. (2002). Análisis de materia orgánica. In Prieto Martínez M., Aboal Fernández R., Ayán Vila J. (Eds.), *Arqueología en la ACEGA 1: el yacimiento galaicoromano de Agro de Ouzande (Silleda, Pontevedra)*. CAPA: cadernos de arqueoloxía e patrimonio, 16:43-45.

Kimpe K., Jacobs P., Waelkens M. (2001). Analysis of oil used in late Roman oil lamps with different mass spectrometric techniques revealed the presence of predominantly olive oil together with traces of animal fat. *Journal of Chromatography A*, 937 (1–2): 87-95.

Lemos F. (1993). *O Povoamento Romano de Trás-os-Montes Oriental*. PhD thesis, Universidade do Minho.

Lemos F., Cruz G. (2010). Citânia de Briteiros - perspectivas recentes sobre a romanização. In (Eds.), *Proceedings of the XV World Congress of the International Union for Prehistoric and Protohistoric Sciences*, 34, BAR Int. Series: 29-36.

Martín Seijo M., Teira Brión A. (2010). Análise dos restos arqueobotánicos das saíñas do Areal (Vigo, Pontevedra). In Martín Seijo M., Rico Rey A., Teira Brión A., Picón Platas I., García González I., Abad Vidal E. (Eds.), *Guía de Arqueobotánica*, Xunta de Galicia:

- Martins M. (1990). *O povoamento proto-histórico e a romanização da bacia do curso médio do Cávado*. PhD thesis. Braga: Unidade de Arqueologia da Universidade do Minho.
- Millet M. (2001). Roman interaction in North-western Iberia. *Oxford Journal of Archaeology*, 20 (2): 157-170.
- Morais R. (1997-98). Sobre a hegemonia do vinho e a escassez do azeite no Noroeste Peninsular nos inícios da romanização. *Cadernos de Arqueologia*, 14-15: 175-182.
- Morais R. (2004). *Autarcia e Comércio em Bracara Augusta no período Alto-Imperial: contribuição para o estudo económico da cidade*. PhD thesis, Braga: Universidade do Minho.
- Nesbitt M. (2006). *Identification guide for Near Eastern grass seeds*. Institute of Archaeology, UCL.
- Oliveira M. (2000). *O registo paleocarpológico do NO peninsular entre o III<sup>o</sup> e o I<sup>o</sup> milénios a.C. Contributo para o estudo da alimentação pré e proto-histórica*. MSc thesis, Universidade do Minho.
- Peña Santos A. (2005). Breve síntesis de la prehistoria e arqueología do Eixo Atlântico. In Hidalgo Cuñarro J. (Eds.), *Rutas Arqueológicas do Eixo Atlântico/Roteiro Arqueológico do Eixo Atlântico*, 3-42.
- Pereira A., González C. (1988). Castro do Cruito. *Arqueologia*, 17: 151-158.
- Pérez Losada F. (2000). *Poboamento e ocupación rural romana no noroeste peninsular (Núcleos agrupados romanos secundarios en Galicia)*. PhD thesis, Santiago de Compostela: Universidade de Santiago de Compostela.
- Pinho C. F. M. d., Pinho C. M. d. (1998). *As plantas infestantes mais frequentes nas principais culturas da região de Entre Douro e Minho*. IDARN.
- Pinto da Silva A. (1988). Os achados de origem vegetal no campo arqueológico da Serra da Aboboreira desde 1982 a 1987. *Arqueologia*, 17: 175-176.
- Pinto da Silva A. (1988b). A paleoetnobotânica na arqueologia portuguesa. Resultados desde 1931 a 1987. In Queiroga F., Sousa I., Oliveira C. (Eds.), *Palaeocologia e Arqueologia*, 13-29.
- Pliny (1999). *Historia Natural*. Translated by Francisco Hernández (Books 1-25) and Jerónimo de Huerta (Books 26-37). Visor Libros, Universidad Nacional de México.
- Pollard A., Batt C., Stern B., Young S. (2007). *Analytical Chemistry in Archaeology*. Cambridge: Cambridge University Press.
- Queiroga F. (1992). *War and Castros. New approaches to the northwestern Portuguese Iron Age*. PhD thesis, University of Oxford.

Ramil Rego P. (1993). Paleoethnobotánica de yacimientos arqueológicos holocenos de Galicia (N.O. Cantábrico). *Munibe*, 45: 165-174.

Ramil Rego P., Aira Rodríguez M. J. (1993). A palaeocarpological study of Neolithic and Bronze Age levels of the Buraco da Pala rock-shelter (Bragança, Portugal). *Vegetation History and Archaeobotany*, 2 (3): 163-172.

Ramil Rego P., Dopazo Martínez A., Fernández Rodríguez C. (1996). Cambios en las estrategias de explotación de los recursos vegetales en el Norte de la Península Ibérica. *Férvedes*, 3: 169-187.

Ramil Rego P., Fernández Rodríguez C. (1999). La explotación de los recursos alimenticios en el noroeste ibérico. In García Quintela M. (Ed.), *Mitología y mitos de la Hispania prerromana (III)*, Akal: 296-342.

Ramil Rego P., Gómez Orellana L., Muñoz Sobrino C., Tereso J. (2011). Dinâmica natural e transformação antrópica das florestas do noroeste ibérico. In Tereso J., Honrado J., Pinto A., Rego F. (Eds.), *Florestas do Norte de Portugal. História, Ecologia e Desafios de gestão*, InBio - Rede de Investigação em Biodiversidade e Biologia Evolutiva.

Rodríguez Guitián M., Ramil Rego P. (2007). Clasificaciones climáticas aplicadas a Galicia: revisión desde una perspectiva biogeográfica. *Recursos Rurais*, 1 (3): 31-53.

Rodríguez Guitián M., Ramil Rego P. (2008). Fitogeografía de Galicia (NW Ibérico): análisis histórico y nueva propuesta corológica. *Recursos Rurais*, 4: 19-50.

Romero Zarco C. (1999). 33. Vicia L. In Talavera S., Castroviejo S., Romero Zarco C., Sáez L., Salgueiro F., Velayos M. (Eds.), *Flora Iberica. Plantas vasculares de la Península Ibérica e Islas Baleares*, 7 (1). Leguminosae, Madrid, Real Jardín Botánico, CSIC: 360-417.

Sampaio J., Carvalho A. (2002). Intervenção de salvamento no sítio de Bolada (S. Bartolomeu do Rêgo, Celorico de Basto). *Revista Portuguesa de Arqueologia*, 5 (1): 29-38.

Sanches M. J. (2008). *O Crasto de Palheiros. Fragada do Crasto. Murça – Portugal*. Murça: Município de Murça.

Santos Yanguas N. (1988). *El ejército y la romanización de Galicia: conquista y anexión del Noroeste de la Península Ibérica*. Oviedo: Universidad de Oviedo.

Soeiro T. (1998). *Monte Mozinho, Sítio Arqueológico*. Museu Municipal de Penafiel.

Sousa L., Nunes M., Gonçalves C. (2006). O vinho na antiguidade clássica. Alguns apontamentos sobre Lousada. *Oppidum*, 1: 69-85.

Strabo (1992). *Geografía. Libros III-IV*. Translation by Meana, M. and Piñero, F. Madrid: Editorial Gredos.

Teira Brión A. (2010). Wild fruits, domesticated fruits. Archaeobotanical remains from the Roman saltworks at O Areal, Vigo (Galicia, Spain). In Delhon C., Théry-Parisot I., Thiébault S. (Eds.), *Des hommes et des plantes. Exploitation du milieu et gestion des ressources végétales de la préhistoire à nos jours. XXX<sup>e</sup> rencontres internationales d'archéologie et d'histoire d'Antibes*, Éditions APDCA: 199-207.

Tellez R., Chamorro J., Arnanz A. (1990). Analisis discriminante en la identificación de trigos arqueológicos españoles. *Trabajos de Prehistoria*, 47: 291-318.

Tereso J. (2007). *Paleoetnobotânica do povoado romano da Terronha de Pinhovelo (NE Transmontano)*. MSc thesis. Faculdade de Ciência, Universidade do Porto.

Tereso J. (2007b). Economia agrícola das comunidades romanas do NW peninsular: dados carpológicos da Terronha de Pinhovelo (Bragança, Portugal). *Recursos Rurais*, 1 (3): 13-21.

Tereso J. (2008). Estudo arqueobotânico das estruturas romanas da Terronha de Pinhovelo (NE Portugal). In *Actas de 1 Congreso Internacional de Arqueología de Vilalba*: 69-78.

Tereso J. (2008b). A região de Macedo de Cavaleiros na Civitas Zoelarum: dados de investigações recentes. In *Actas de 1 Congreso Internacional de Arqueología de Vilalba*: 431-440.

Tereso J. (2009). Plant macrofossils from the Roman settlement of Terronha de Pinhovelo, northwest Iberia. *Vegetation History and Archaeobotany*, 18 (6): 489-501.

Tereso J. (2009b). Estudo paleoetnobotânico das estruturas romanas da Terronha de Pinhovelo (Macedo de Cavaleiros). *Cadernos "Terras Quentes"*, 6: 81-90.

Tereso J., Almeida A., Almeida C. B. d., Ramil Rego P., Vaz F., Almeida da Silva R. (2010). Estudo carpológico do castro de São Lourenço (Esposende): primeiros resultados/Fruits and seeds from Castro de São Lourenço (Esposende, northwest Portugal): first results, *Estudos do Quaternário*, 6: 67-73.

Tereso J., Carvalho T., Almeida da Silva R., Ramil Rego P. (2010b). Cultivos e armazenagem em Monte Mozinho: dados preliminares. In Bettencourt A., Alves M., Monteiro-Rodrigues S. (Eds.), *Variações paleoambientais e evolução antrópica no Quaternário do Ocidente Peninsular/ Palaeoenvironmental changes and anthropization in the Quaternary of Western Iberia*, Braga, Associação Portuguesa para o Estudo do Quaternário - APEQ e Centro de Investigação Transdisciplinar. Cultura, Espaço e Memória-CITCEM: 149-158.

Tereso J., Ramil Rego P., Almeida da Silva R. (2011). A exploração de recursos alimentares silvestres e seu enquadramento nas dinâmicas económicas e sociais das comunidades agrícolas desde a Pré-história à época romana. In Tereso J., Honrado J., Pinto A., Rego F. (Eds.), *Florestas do Norte de Portugal. História, Ecologia e Desafios de gestão*, InBio - Rede de Investigação em Biodiversidade e Biologia Evolutiva



Tranoy A. (1981). *La Galice Romaine: Recherches sur le Nord-Ouest de la Péninsule Ibérique dans l'Antiquité*. Paris: Diffusion E. du Boccard.

Zohary D., Hopf M., Weiss, E. (2012). *Domestication of Plants in the Old World – The origin and spread of domesticated plants in south-west Asia, Europe, and the Mediterranean Basin*. 4<sup>th</sup> Edition. Oxford: Oxford University Press.

**SECTION D**

**GENERAL CONCLUSIONS**



# 11

## Agriculture, human societies and environmental change from the Late Pre-history to the Late Antiquity: an overview and recommendations for future work

---

### 11.1. Trends in agricultural strategies and societies from 4400/4300 cal BC to the 5<sup>th</sup> century AD

An overview of agricultural strategies from 4400/4300 cal BC to the 5<sup>th</sup> century AD (i.e., archaeologically, from the Neolithic to the Late Antiquity) is difficult to achieve due to the lack of data concerning some chronological periods. The Neolithic (c. 5000-3200/3000 cal BC) and the Early Bronze Age (c. 2200-1800/1700 cal BC) are the periods for which less data is available. Nevertheless, four main phases of agricultural development and palaeoenvironmental evolution can be differentiated.

#### Phase 1 - 4400/4200 cal BC – c. 3300 cal BC (corresponding to a part of the Neolithic)

Palinological data suggest a late introduction of agriculture in NW Iberia. The first clear presence of Cerealia type pollen appears in several palynological sequences in the region around 4400-4200 cal BC (Muñoz Sobrino et al. 2005; Ramil-Rego et al. 2009), more than a thousand years after the first evidence of crops in Mediterranean Spain (Zapata et al. 2004, Buxó and Piqué 2008). Still, archaeobotanical data is not as clear. There are only two archaeological sites with crops. Data from Bolada (Celorico de Basto) agree, chronologically, with palynological data (Sampaio and Carvalho 2002). In this site, *Vicia faba* (faba bean) was recovered. However, most archaeobotanical data regarding the Neolithic comes from Buraco da Pala (Mirandela). The oldest radiocarbon date points out to a chronology within the first half of the 5<sup>th</sup> millennium cal BC (Sanches 1997) but such evidences are controversial and the reliability of such levels has been questioned before (Monteiro-Rodrigues 2008). Furthermore, this rock shelter has evidences of its use for storage during the Chalcolithic (Ramil Rego and

Aira Rodriguez 1993, Sanches 1997). *Hordeum vulgare* var. *nudum* (naked barley), *Triticum* “stubby grains” and *Triticum aestivum/durum* (naked wheat) are the main crops found in Buraco da Pala, followed by *Hordeum vulgare* subsp. *vulgare* (hulled barley), *Vicia faba* and *Pisum sativum* (peas) in minor quantities (Ramil Rego and Aira Rodriguez 1993, Sanches 1997).

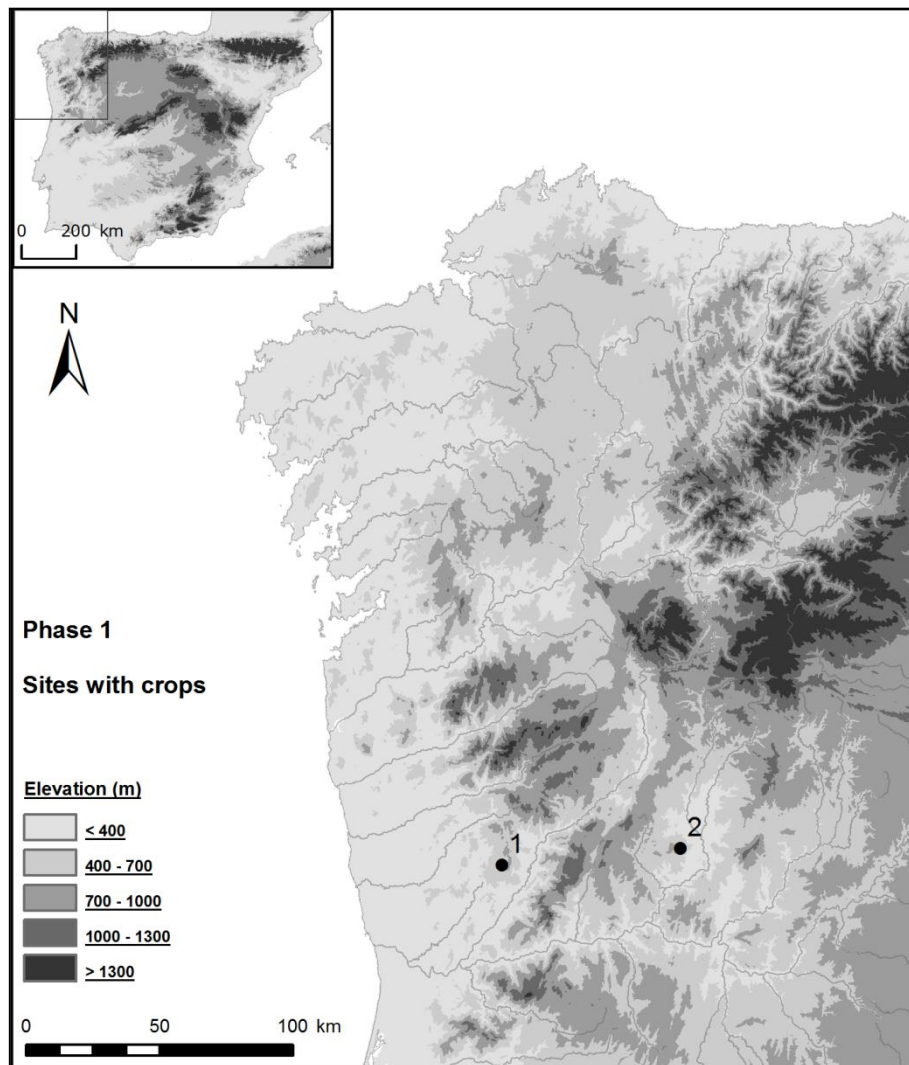


Figure 11.1 – Phase 1: sites with crops. Legend: 1 – Bolada; 2 – Buraco da Pala

Since only Buraco da Pala provided significant amount of carpological remains, it is not possible to characterize Neolithic agriculture in the region. The predominance, in this site, of naked barley and naked wheat is in concordance with data from other sites, in other Iberian regions, such as the southern Spain (Zapata et al. 2004, Buxó and Piqué 2008). The lack of sites with data demand caution while interpreting the absence of hulled wheats in northwest

Iberian Neolithic contexts as well as their rarity during the Chalcolithic. *Triticum monococcum* (einkorn) and, mostly, *Triticum turgidum* subsp. *dicoccum* (emmer) are very common in the rest of the Iberian Peninsula during the Neolithic (Zapata et al. 2004, Buxó and Piqué 2008). No environmental constraints seem to justify the absence of hulled wheats in northwest Iberia. By the contrary, these species seem to be very suitable for a region such as these, since they are very resistant to harsh climatic conditions and are yielding in poor soils (Nesbitt and Samuel 1996, van der Veen and Palmer 1997, Troccoli and Codianni 2005). They were found in Neolithic archaeological sites in the Cantabrian-Basque Mountains as well as the Pyrenees (Zapata et al. 2004, Zapata 2005-2006). Since only two Neolithic sites provided crops, one cannot discard the possibility that hulled wheats were cultivated in northwest Iberia and were not yet found but it is also possible that human communities in this region opted not to use these crops. Only further archaeological work and archaeobotanical sampling will allow us to obtain relevant data regarding this subject.

The few available archaeobotanical data points out to a chronologically coincident introduction of cereals and pulses in northwest Iberia, as in other southern and northern (northeast) Iberian regions (Buxó and Piqué 2008). In the Cantabrian-Basque region pulses were not found in Early Neolithic contexts yet, but data is still sparse (Zapata et al. 2004, Zapata 2005-2006). On the other hand, only peas and faba beans were retrieved from northwestern Iberian Neolithic sites, contrasting with the wide range of pulses found in other regions, which included also *Lens culinaris*, *Vicia ervilia/sativa* and *Lathyrus* (Zapata et al. 2004, Buxó and Piqué 2008). This tendency for the little variety of pulses is maintained throughout the whole time-span studied. The more frequent legume in northwest Iberia, faba bean, is adapted to humid and sub-humid conditions.

Palynological data demonstrate that Neolithic productive activities had little environmental impacts and *Cerealia* type pollen curve remained discontinuous in most sequences until the transition towards the Chalcolithic (Muñoz Sobrino et al. 2005; Ramil-Rego et al. 2009). Nevertheless, soil erosion increased already in the beginning of the Neolithic due to forest clearings (Ramil Rego 1993, Ramil rego et al. 1998, Martinez-Cortizas et al. 1993 and 2009, Muñoz Sobrino et al. 2005).

	Neolithic	Chalcolithic	Middle Bronze Age	Late Bronze Age	Iron Age	Roman Period
<b>Cereals</b>						
<i>Avena</i>				+	+++	++
<i>Hordeum</i>			+	+	+	+
<i>Hordeum vulgare</i> var. <i>nudum</i>	+++	++		+	+	+
<i>Hordeum vulgare</i> subsp. <i>vulgare</i>	+	+++	+	++	+++	+++
<i>Panicum miliaceum</i>		?	+	+++	+++	+++
<i>Panicum/Setaria</i>		?		+	+	+++
<i>Secale cereale</i>						+
<i>Setaria italica</i>					+	+
<i>Triticum aestivum</i>		+			+	+
<i>Triticum aestivum/durum</i>	++	++		+	++	+++
<i>Triticum</i> - stubby grains	+++	+++	+	+	+	+
<i>Triticum turgidum</i> subsp. <i>dicoccum</i>		?		+	+++	++
<i>Triticum aestivum</i> subsp. <i>spelta</i>		?		+	++	++
<i>Triticum dicoccum/spelta</i>		?			+	++
<i>Triticum monococcum</i>					+	+
<i>Triticum</i>		++	+	++	++	+++
cf. <i>Triticum</i>			+			
Cereals - undetermined			+	+	+	++
<b>Other crops</b>						
<i>Lens</i>			+			
<i>Linum</i>		+				+
<i>Papaver</i>		+				
<i>Pisum sativum</i>	+	+	+	++	+	+
<i>Vicia angustifolia/sativa</i>						+
<i>Vicia faba</i>	++	++	+	+++	++	+++
<b>Fruits</b>						
<i>Arbutus unedo</i>		+			+	+
<i>Castanea sativa</i>						+
<i>Corylus avellana</i>		+	+		+	+
<i>Ficus carica</i>						+
<i>Juglans regia</i>						+
<i>Olea europaea</i>	+	+				+
<i>Pinus pinea</i>						+
<i>Prunus avium</i>						+
<i>Prunus insititia</i>						+
<i>Prunus persica</i>						+
<i>Prunus</i>						+
<i>Pyrus cordata</i>				+		
<i>Pyrus communis</i>			+			+
<i>Pyrus</i>				+		
<i>Quercus</i> (cupule)			+	+	+	+
<i>Quercus</i> (cotyledon)	+	++	+	+++	+++	++
<i>Rubus</i>		+			+	++
<i>Sorbus aucuparia</i>				+		
<i>Vitis vinifera</i>		+		+	+	++

Table 11.1 – Crops and wild species: archaeological sites in NW Iberia from the Neolithic to the Roman Period. Legend: + present; ++ relevant presence; +++ (Red cells) very relevant presence. Blue cells: probable introduction of species in the region (not including Neolithic introductions). Relevance is calculated empirically taking into consideration, above all, the number of sites in which each crop was found and, secondly, the relevance of each crop in each site.

During this first phase, the Neolithic, human communities continued to be semi-nomads and megalithic monuments were stable human features in the landscape, being argued that they had a determinant role in legitimating and marking territories which were somehow fluctuant (Jorge 2000, Sanches 2000). Important deforestation in mid-altitude mountains is chronologically coincident with this phase of monuments' construction (Cordeiro 2004) and it must be interpreted as part of a shift in the way landscapes were perceived. Such shift may be somehow related with the increasing relevance of productive activities since *Cerealia* pollen curve becomes continuous since the 4<sup>th</sup> millennium cal BC (Muñoz Sobrino et al. 2005). Plant husbandry was probably an important feature of these communities' subsistence, but it is possible that animal husbandry had a more determinant role, at least in an early stage.

Phase 2 - c. 3300 cal BC – c. 1800 cal BC (including the whole Chalcolithic period and the Early Bronze Age)

Concerning the investigation in Chalcolithic archaeobotany, Buraco da Pala continues to be the site with more carpological remains. Nevertheless, data from other sites is also relevant, particularly that from Castelo Velho (Foz Côa) (Figueiral and Jorge 2008). Crasto de Palheiros (Murça) (Figueiral 2008) provided also abundant remains but stratigraphic problems demand caution while interpreting such data. Regarding the available information for the Iberian Peninsula, it is not likely that *Panicum miliaceum* (broomcorn millet) and *Triticum aestivum* subsp. *spelta* (spelt) were introduced in the region already in the Chalcolithic.

Some relevant changes seem to have occurred during the Chalcolithic, regarding the choices in terms of crops. There is a growing relevance of hulled barley. This cereal and *Triticum* "stubby grains" were the main crops during this period. Naked barley may have continued to be an important crop, but since few sites provided crops, this is a possibility that needs further investigation. The general Iberian scenario points to a gradual replacement of naked barley by hulled barley during the Late Prehistory, having hulled barley supplanted the naked variety in the Bronze Age (Buxó and Piqué 2008). Nevertheless, in northwest Iberia hulled barley seems to have supplanted naked barley earlier, already in the Chalcolithic.

The presence of poppy (*Papaver*) and flax (*Linum*) in the Chalcolithic levels at Buraco da Pala, and their absence in the previous – Neolithic – levels (Ramil Rego and Aira Rodríguez 1993) may imply these crops were not cultivated before. If such assumption is not controversial to what flax is concern, due to the chronology of its presence as a domestic species in the Iberian



Peninsula, it may not be that simple in what poppy is concern. Poppy was probably the first crop consumed in southern Europe which was domesticated in a region other than the Near-East, probably in the western Mediterranean. It was found in Neolithic archaeological sites in southern Spain (Buxó 1997, Zapata et al. 2004, Buxó and Piqué 2008) and early cultivation may have occurred for its oily seeds or for narcotic uses. It might have been cultivated in northwest Iberia already in the Neolithic but there is no evidence to support that. It has not been found in archaeological sites in the Cantabrian-Basque Mountains.

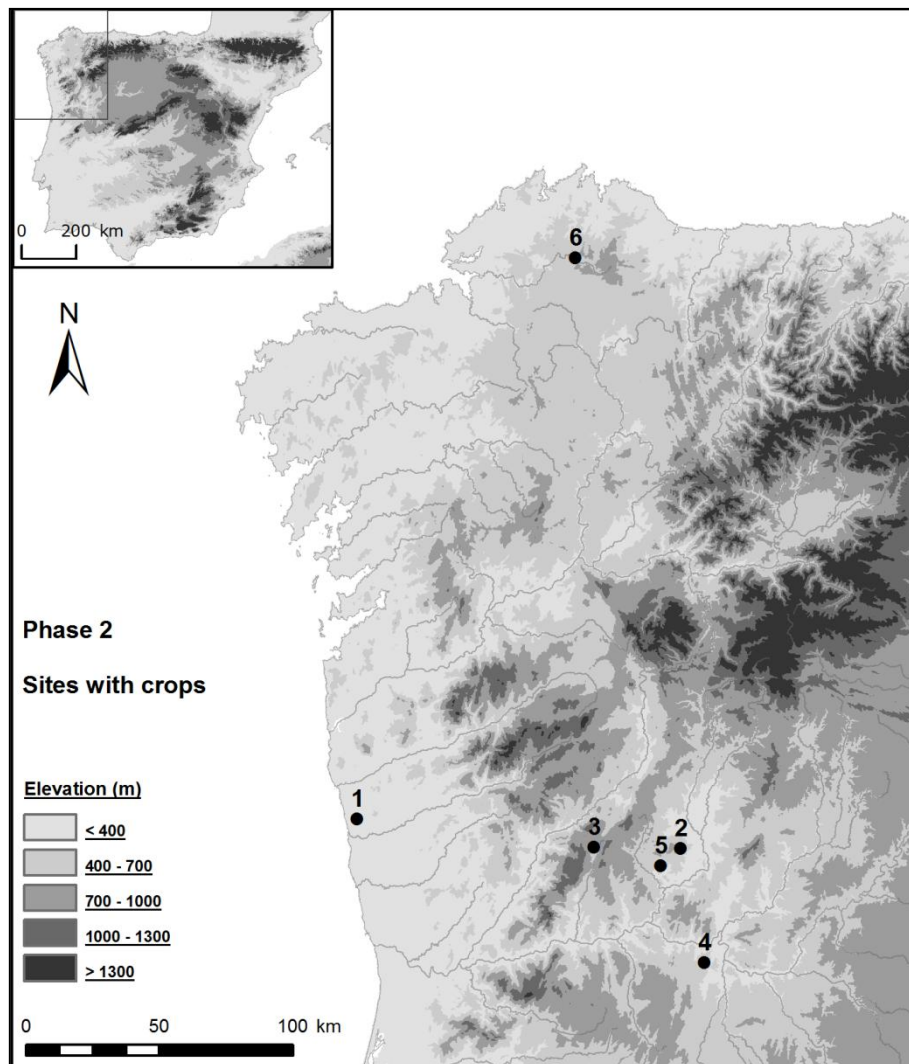


Figure 11.2 - Phase 2: sites with crops. Legend: 1 – Bitarados; 2 - Buraco da Pala; 3 - Castelo de Aguiar; 4 - Castelo Velho; 5 - Crasto de Palheiros; 6 - Prado do Inferno

The combined interpretation of archaeological, carpological and broad palaeoenvironmental data suggests that changes in productive systems and in the human influence over the local environment began in the transition between the Late Neolithic and the Chalcolithic and were enhanced throughout the Chalcolithic and the Early Bronze Age. However, data regarding the Late Neolithic is sparse and data regarding the Early Bronze Age is sparser (no carpological data is available).

Furthermore, it is clear that changes in the Chalcolithic were much more important than what is perceived in the archaeobotanical record. These included new ways to relate with the landscape, not only in terms of subsistence (as seen in the carpological record – chapter 8 of this thesis), but also in terms of territorialization (as seen in the archaeological record, testified by the construction of great enclosures – Jorge 2003, Sanches et al. 2007, Bettencourt 2009). As a result, impacts over the environment were more visible as deforestation and soil erosion increased significantly (as seen in the palaeoecological record – Ramil Rego 1993, Martinez-Cortizas et al. 1993 and 2009, Ramil rego et al. 1998, Muñoz Sobrino et al. 2005). However, deforestation is not a continuous process throughout the whole Phase 2. The overall scenario perceived by the reading of most of the palynological sequences in northwest Iberia (references above) and, more to the south, in Serra da Estrela (van der Knaap and van Leeuwen 1995) demonstrates the existence of consecutive phases of deforestation and forest recovery. This is in concordance with the interpretative model of M. J. Sanches (Sanches 2000, Sanches et al 2007) according to which human communities were not fully sedentary although they would maintain themselves in a given territory for longer time periods than during the Neolithic. It is possible that soil fertility was an importance factor in determining the time-span of occupation in a given place and the lapse of time until it was reoccupied.

### Phase 3 - c. 1800 cal BC – 1<sup>st</sup> century BC (corresponding to the Middle and Late Bronze Age and the Iron Age)

This phase covers three distinct archaeological periods which can be characterized has clearly different stages in archaeological terms and some differences are also clearly visible in terms of agriculture. Thus, despite being a single phase in terms of landscape evolution, the overall scenario of agricultural and social development demand each of these archaeological phases to be considered an individual sub-phase.

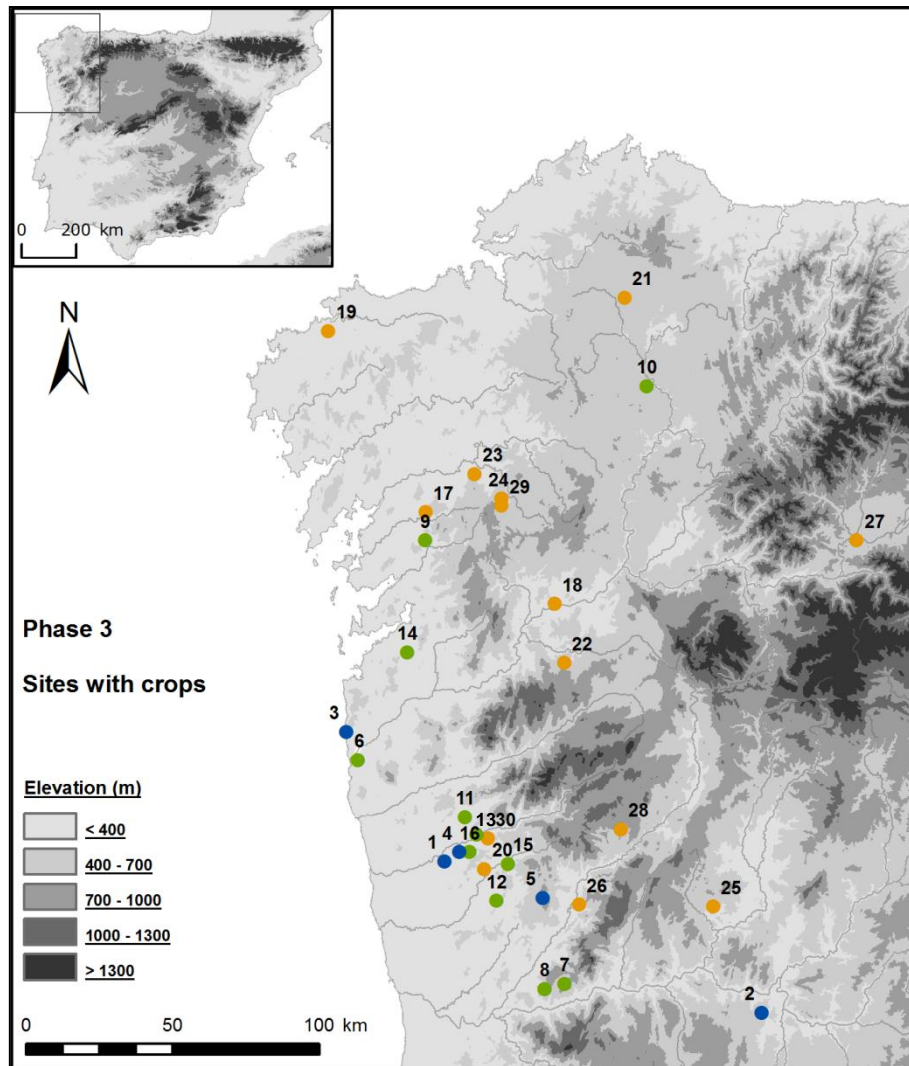


Figure 11.3 - Phase 3: sites with crops. Legend: **Middle Bronze Age** (in blue), 1 – Alto de S. Bento; 2 - Castelo Velho; 3 – Portecelo; 4 – Sola; 5 - Tapada da Venda. **Late Bronze Age** (in green), 6 - Alto do Coto da Pena; 7 - Castelo de Matos; 8 – Lavra (Baião); 9 – Penalba; 10 – Penarrubia; 11 - S. Julião; 12 - Santa Catarina; 13 – Santinha; 14 – Torroso; 15 - Vale Ferreiro; 16 – Vasconcelos. **Iron Age** (in orange), 17 - Alto do Castro; 18 - As Laias; 19 – Borneiro; 20 – Briteiros; 21 - Castro de Vixil; 22 – Castromao; 23 – Castrovite; 24 – Cortegada; 25 - Crasto de Palheiros; 26 – Crastoeiro; 27 - El Castrelin; 28 – Lesenho; 29 – Montaz; 30 - S. João de Rei.

There are few archaeobotanical data from Middle Bronze Age contexts. This does not allow us to characterize agricultural practices during this time-period. Nevertheless, one important fact must be mentioned: the oldest millet grains (three grains of *Panicum miliaceum*) from the whole northwest Iberia were retrieved in the Middle Bronze Age levels of Sola (Bettencourt 1999, Oliveira 2000). The introduction of millet, being a spring crop, is of great relevance. It

demonstrates the presence of spring crops and, eventually, two harvest periods, two crops per year. This demanded a further step towards sedentarization. Furthermore, it is a crop which adapts well to several soils and climates (Smartt and Simmonds 1995, Vázquez Varela 2000, Hunt and Jones 2008). Still, it is rare in the region in such early dates and although data is sparse, demanding caution in any deductions, it is not likely that it was thoroughly cultivated yet.

However, despite the sparse archaeobotanical data, relevant archaeological investigation done in northern Portugal makes possible further interpretations regarding the development of agriculture and its relation with social changes. During the Middle Bronze Age there seems to have been some continuity regarding the Early Bronze Age settlement strategies in order to allow human communities to take full advantage of the valleys. This, together with the archaeological evidences that suggest increasing demography and productivity (Bettencourt 1999), allows us to question whether the important E4 erosion phase that occurred since the Late Neolithic and throughout part of the Chalcolithic (Ramil Rego 1993, Martinez-Cortizas et al. 1993, Muñoz Sobrino et al. 2005) contributed in any way for such pattern. The deep and fertile soils that became available in the valleys and in the lower part of the slopes may have created a chance for increasing productivity, one that was necessary in a context of increasing demography, whether to support it or to provoke it. Thus, environmental changes may have contributed for economical and social changes.

It is not clear how major changes that occurred during the Late Bronze Age were related to previous trends described for the Middle Bronze Age, but it is possible that the increasing complexity and demography suggested by the bigger settlements, some in strategic places for territorial control (Bettencourt 1999, 2009), was made possible by the economical trends in the beginning of the Bronze Age which in its turn may have been favored by environmental changes. If this scenario is correct, anthropogenic landscape changes could have had an important role in the major social changes. Such possibility is suggested here for the first time and it needs to be tested by further interdisciplinary investigation, directed to specific study-cases.

As human communities became sedentary in the Late Bronze Age and territoriality was enhanced. The result of it in terms of agricultural choices became visible in the end of this period but trends can be better understood when analyzed together with Iron Age data. The crops which were retrieved in greater number of sites were broomcorn millet and faba bean.

Wheat might have been as important, but in most sites identification was made only at the genus level. Hulled barley and peas also appear consistently.

Hulled wheats were identified in Penalba (*Triticum turgidum* subsp. *dicoccum*) (Aira Rodríguez et al. 1990) and As Lias (*Triticum aestivum* subsp. *spelta*) (this thesis) in late chronologies, already in a transitional phase towards the Iron Age. Both species were recovered in the Chalcolithic enclosure of Crasto de Palheiros (Figueiral 2008) but such early presence of spelt and millet (few grains of *Panicum miliaceum*) in northern Portugal is unlikely in the light of what is known about the introduction of such crops in the Iberian Peninsula (Buxó and Piqué 2008). Likewise, oat grains (*Avena*) from the Chalcolithic levels of Castelo de Aguiar (Pinto da Silva, quoted in Jorge 1986) are probably from a wild species. Thus, the oldest levels of As Lias, despite the great interval of the available radiocarbon date, correspond to the earliest findings of oat and spelt in the region and are among the earliest in all Iberia.

The presence of hulled wheat (mostly emmer and spelt) is much more relevant in Iron Age sites and oat became a very important crop, contradicting the general idea (see Oliveira 2000) that only in the Medieval times it became a staple crop. Additionally, *Triticum* stubby grains were recovered in only one site. These are the most relevant changes that occurred in the Iron Age. Besides hulled wheat and oat, the most important crops in this time-period, according to the archaeobotanical record, were hulled barley and broomcorn millet. It is possible that naked wheat lost some of its relevance in the Iron Age. This is coincident with an almost absence of stubby wheat grains.

We do not know which species correspond to the *Triticum* “stubby grains” although they were thought to have been naked wheat species – *Triticum aestivum* subsp. *compactum*, *Triticum aestivum* subsp. *sphaerococcum* (Ramil Rego and Aira Rodríguez 1993) or *Triticum parvicoccum* (Pinto da Silva 1988). It is clear that such species of wheat were very relevant in the earliest stages of agricultural development in northwest Iberia, namely since the Neolithic, until the Bronze Age. Such idea was already stressed by Pinto da Silva (1988). In the Iron Age, it almost disappears from the archaeobotanical record. As pointed out before, such trend is coincident with other changes in agricultural strategies.

Grains of *Setaria italica* (foxtail millet) were recovered in Castromao (Dopazo Martínez et al. 1996) and there is no reference for its presence in sites from earlier chronologies, at least in reliable contexts, despite its presence in other Iberian regions, alongside broomcorn millet, since the Bronze Age (Buxó and Piqué 2008). It is not clear if foxtail millet was cultivated for

the first time in northwest Iberia in the Iron Age. The differentiation of millets is a sensitive issue and since morphological criteria used in the identifications of millet grains are not usually mentioned in publications we cannot evaluate possible wrong identifications.

<u>Free-threshing Wheat</u>	<u>Hulled Wheat</u>
Soil demanding	Exploration of marginal areas
Better yielding under favourable conditions	Only in unfavourable years can achieve higher yielding than common wheat
Growth slows and yielding diminish with winter heavy rains	Not suitable for drought conditions.
Easier post-harvest processes	Time-consuming post-harvest processes
Suitable for leavened bread	Suitable for long-term storage

Figure 11.4 - An analysis of the complementarity of naked and hulled wheats

Relevant data concerning Iron Age agriculture and storage practices was obtained through the study of As Lias. However, the studies of Briteiros and Lesenho were also important in order to consolidate the idea that a shift towards the cultivation of hulled wheats occurred. Such change in agricultural strategies, as well as the almost abandonment of wheat stubby grains, were not identified in previous studies. Here it is tentatively related with broad environmental changes and with the major changes in societies which occurred in the Late Bronze Age and Iron Age. As a result of a broader process of territorialization which dates back to the Neolithic (construction of megalithic monuments), continued in the Chalcolithic (construction of enclosures) and culminated in the Late Bronze Age and Iron Age (construction of great hillforts), human communities became sedentary. To such change contributed relevant advances in agriculture (e.g. the introduction of spring crops, such as broomcorn millet) but, at the same time it turned out to be a major challenge for human communities. These had to deal with the confinement in more strict territorial boundaries. In other words, they had to manage with whatever their own territory provided. In a region where good agricultural soils are not abundant, restoring fertility is likely to have become a problem. In the past, such problem could easily be solved with mobilization, but territorialization and sedentism excluded such possibility. This context allows us to understand changes in agricultural strategies that

occurred in the Iron Age, as described before. Major crops cultivated in this period are not soil demanding and are resistant to harsh climatic conditions. Furthermore, crops diversity seems to correspond to functional diversity which was determinant for human communities to take full advantage of their territory and maintain their agricultural productivity without nomadic movements. Hulled wheats are less soil demanding than naked wheats and are resistant to heavy rains, which might have been an important feature if, as local models suggest (Muñoz Sobrino et al. 2005, Ramil Rego et al., 2009), Iron Age was a period of climate worsening. They are complementary (Fig. 11.4) but it seems that only after sedentarization were hulled wheats considered really necessary.

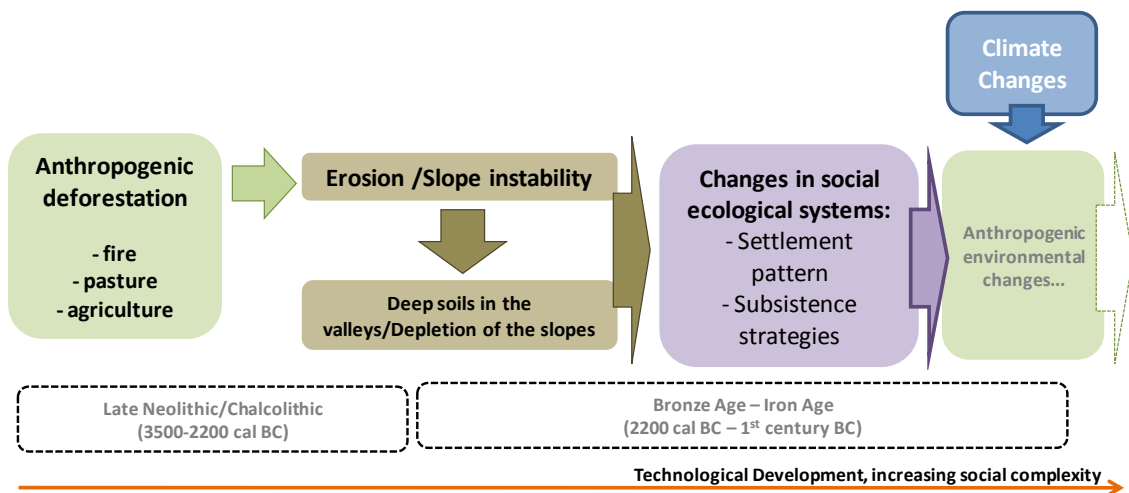


Figure 11.5 – Schematic representation of the eventual relation between environmental changes and trends in the social ecological systems

Phase 4 – 1<sup>st</sup> century BC – beginning of the 5<sup>th</sup> century AD (corresponding to the Roman Period)

Despite entering a new palaeoenvironmental phase, as deforestation was once more enhanced, after the Roman conquest of the region there were no significant changes in the agricultural strategies of the people that continued to live in indigenous-type settlements. Naked wheat (*Triticum aestivum/durum*) was an important crop, as well as millet (mostly *Panicum miliaceum*), hulled barley and faba beans. However, oat and hulled wheats (mostly emmer and spelt) were also relevant crops. Minor crops were rye (*Secale cereale*), foxtail millet, naked barley, einkorn (*Triticum monococcum*), *Triticum* stubby grains, peas, vetch (*Vicia sativa/angustifolia*) and flax. When identification of naked wheat at the species level was

possible – only in Monte Mozinho - it corresponded to *Triticum aestivum* as in all other sites in northwest Iberia in the entire time-span of this thesis. No *T. turgidum* subsp. *durum*/*T. turgidum* subsp. *turgidum* rachis fragments were found.

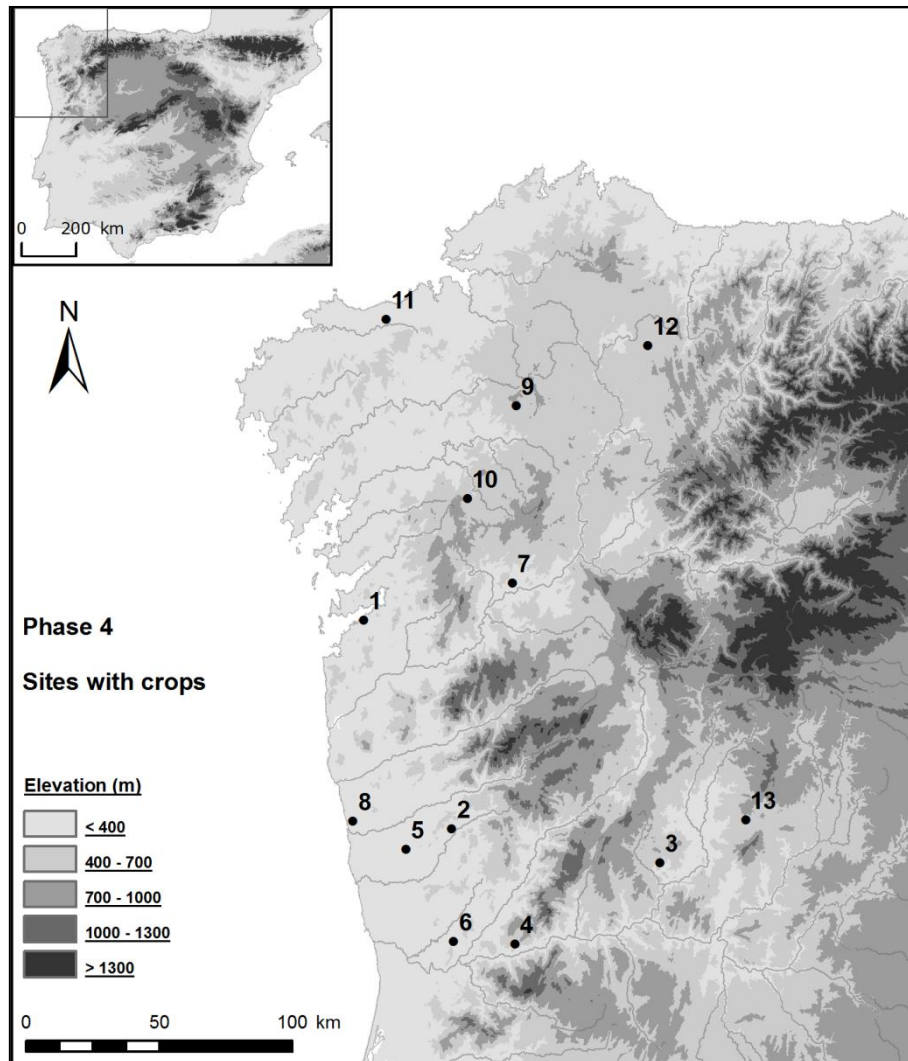


Figure 11.6 – Phase 4: sites with crops. Legend: 1 - Areal (Vigo); 2 – Briteiros; 3 - Crasto de Palheiros; 4 – Cruito; 5 – Ermidas; 6 - Monte Mozinho; 7 - San Cibrán de Las; 8 - São Lourenço; 9 - Castro Pedro; 10 – Montaz; 11 - Petón do Castro; 12 – Viladonga; 13 - Terronha de Pinhovel

There is not enough data to suggest that the cultivation of olive trees (*Olea europaea*) and the production of olive oil occurred or if it was significant in the region, during Roman times. On the other hand, in what wine production is concern, archaeological data suggests it occurred in the southern part of the study area, near the river Douro. Grape pips have been found in



several sites and structures related with wine production were found in some settlements. Nevertheless, it is not possible to assess whether wine production was economically relevant. Few grape pips were recovered in archaeological sites and these do not prove wine production, rather grape consumption. Furthermore, most of the archaeological structures related with wine production recorded in the Douro valley (Almeida 1996, Sousa et al. 2006) are difficult to integrate in specific chronologies and their relation with such practices should be attested by archaeometric analysis.

The cultivation of vine and the production of wine is one of the main changes brought by Roman agriculture and it is likely to have occurred only in northern Portugal. There are no clear signs of vine cultivation during Roman times in northwest Spain. Other innovation is the presence of rye, although it probably was not a staple crop in most of the study area. It was found and radiocarbon dated in Monte Mozinho (3<sup>rd</sup> century – first half of the 4<sup>th</sup> century AD). In this site, storage of fodder is likely to have occurred, testifying for a multifunctional agrarian system combining animal husbandry and agriculture.

Work done in Monte Mozinho is highly important since the archaeobotanical samples recovered became the most relevant carpological assemblage in the investigation of the Roman agriculture in northwest Iberia. Such relevance is due to the nature of its archaeological contexts but also because of the crops that were found. It is the Roman site with higher amounts of rye and naked wheat chaff in all northwest Iberia and it is the first where fodder was identified.

The presence of rye in Monte Mozinho and Cruito is relevant in archaeobotanical terms, since it documents the availability of such crop in Roman times. However, since it is restricted to those two sites, it is not likely that it was a relevant crop in the region. Its presence, despite the prejudice Pliny demonstrates regarding its taste (Plin. Nat. Hist. 18. 40), was justified, like Pliny himself states, by the fact that it was high yielding in mountain areas with poor soils and it was resistant to winter frost.

It remains to be understood how rye became such an important crop in Medieval times (Marques 1978). Somehow, between the end of the Roman period and the transition between the Early and High Middle Ages, rye became predominant in the region. One can only reason about this matter, since there is not enough data to fully understand such trend. At the end of the Roman Empire, this region became inhabited by the Suebi and Visigoths. By the time these Germanic people came to the Iberian Peninsula, rye was already a staple crop in their

homelands (Behre 1992), thus it is possible that they were responsible for the increasing production of this cereal in northern Iberian Peninsula, where it would be more yielding than most of the other cereals that were cultivated. It would take the place of hulled wheats, cultivated in the region throughout the Roman period due to their adaptability to mountain areas.

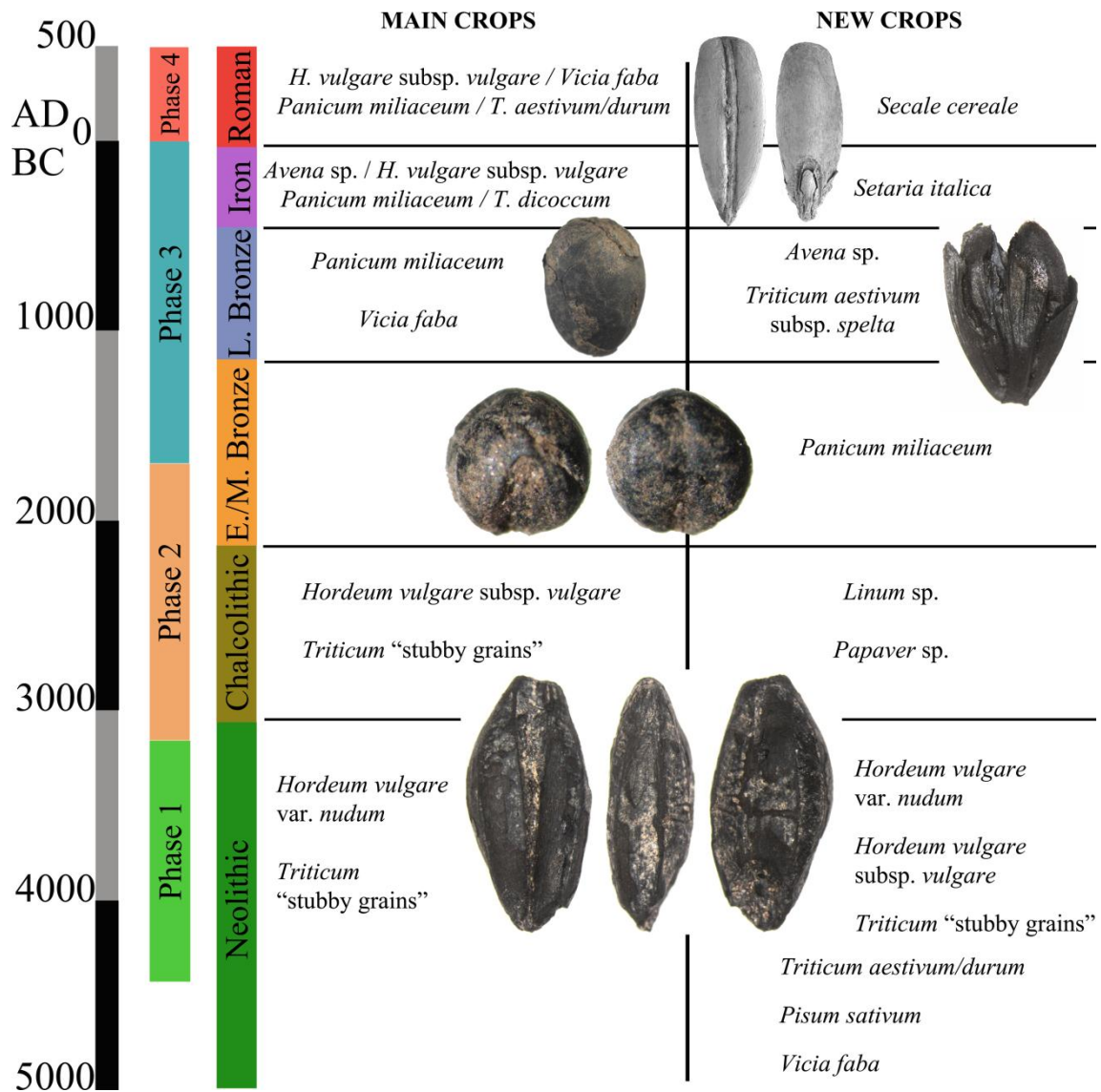


Figure 11.7 – Main crops and the introduction of crops through time in northwest Iberia, according to palaeoenvironmental phases and archaeological periodization.

## 11.2. Agriculture, environmental constraints and resilience

Since the Neolithic, until the Roman Period, there was an overall tendency for deforestation and increasing soil erosion (Fig. 11.8). Nevertheless, there were periods in which such processes were enhanced or decreased, mostly due to Human factors. Thus, three major erosion episodes were documented in the time-span studied, although previous events, related to environmental changes on the transition between the Last Glacial Period and the current Interglacial, had a determinant role in shaping our study area (Munõz Sobrino et al. 2005). These three events are coincident with phases of relevant changes in Human societies (Munõz Sobrino et al. 2005):

**E<sub>5</sub>** - 1950–1348 Cal. BP – Roman Period/Late Antiquity (integrated in our Phase 4)

**E<sub>4</sub>** - 5283–4472 Cal. BP – Late Neolithic/Chalcolithic (integrated in our Phase 2)

**E<sub>3</sub>** - 6305–5709 Cal. BP – Neolithic (integrated in our Phase 1)

In terms of forest cover, there is great fluctuation in the percentages of arboreal pollen, but there are two critical moments when levels decrease: one during the Bronze Age (our Phase 3) and the other in the Roman Period (our Phase 4) (Munõz Sobrino et al. 2005, Ramil Rego et al. 2009). In the transition towards the Middle Ages there is a phase of significant forest recovery.

Despite the fluctuation in the percentages of arboreal pollen, there is a general tendency towards deforestation, more pronounced since the Bronze Age (our Phase 3). Before that, in our Phases 1 and 2, deforestation and forest recovery phases are sequential but percentages of arboreal pollen are still relatively high. In this early moment, two great erosion episodes occurred (Martinez-Cortizas et al. 1993, Muñoz Sobrino et al. 2005). As noticed before, these are coincident with the palynological evidences of cereal agriculture and the profusion of megalithic monuments, in a first moment (Middle/Late Neolithic – Phase 1), and the construction of enclosures, in a second (Chalcolithic – Phase 2). The erosion episode E<sub>5</sub> is clearly related with the Roman occupation (Phase 4). Thus erosion episodes and deforestation phases are related with trends in human societies although in an early stage, in the Early Holocene and possibly also during the Neolithic, climate had an important role in these dynamics (Muñoz Sobrino et al. 2005).

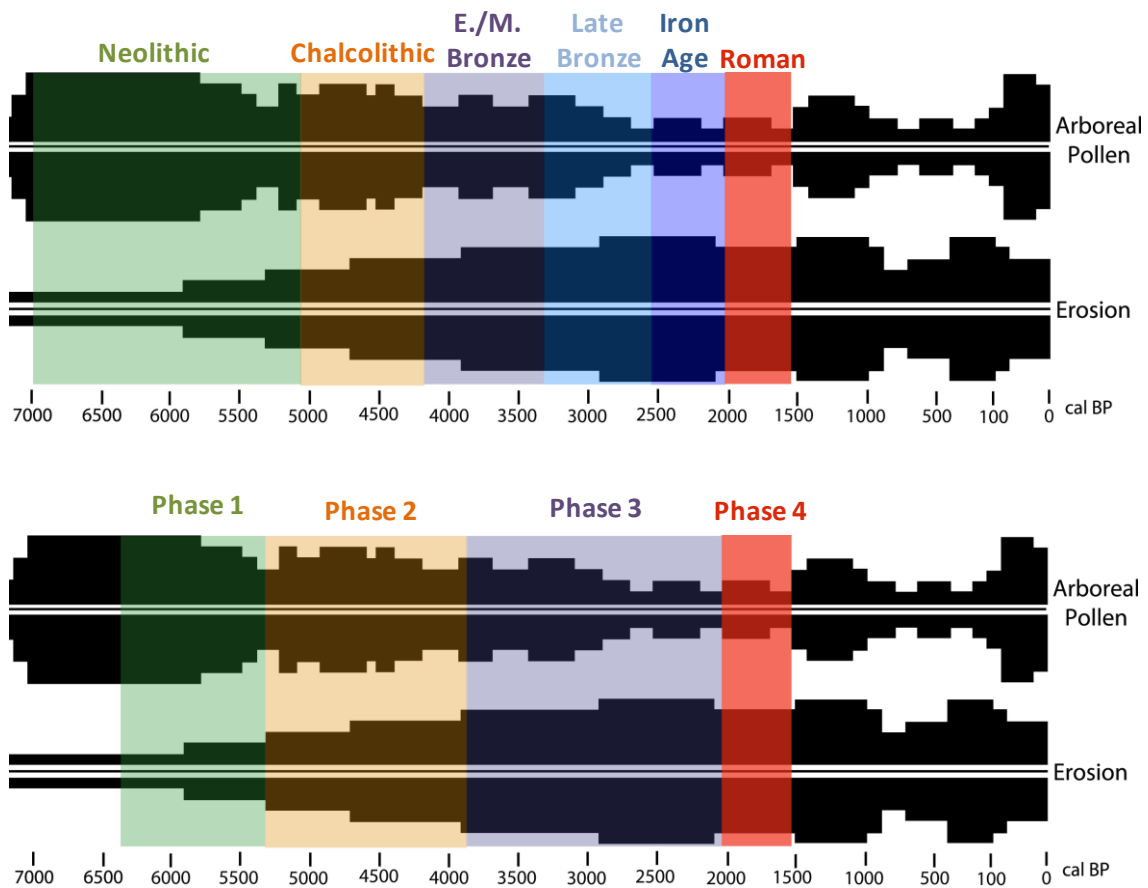


Figure 11.8 – General perspective of the co-evolution of forest cover and soil erosion in NW Iberia, contrasting with archaeological chronology (above) and with our four Phases (below) (adapted from Ramil Rego 1993)

Phases 1 and 2, the Neolithic and the Chalcolithic/Early Bronze Age, are characterized by an alternation between phases of deforestation and phases of forest recovery and the maintenance of a relatively high percentage of arboreal pollen. Furthermore, palynological data suggest a late introduction of agriculture in northwest Iberia (later than animal husbandry) and a slow implementation of plant husbandry in the subsistence of human communities (Muñoz Sobrino et al. 2005; Ramil-Rego et al. 2009). The existence of a continuous curve of *Cerealia* pollen type in the palynological sequences is coincident with the erosion episode E<sub>4</sub>, although the first *Cerealia* pollen type appears earlier. This general perspective is crucial to understand archaeological and archaeobotanical data from northwest Iberia. Human communities seem to have maintained a semi-nomad way of living during the

Neolithic (Jorge 2000, Sanches 2000, Sampaio and Carvalho 2006, Sanches et al. 2007). In the Chalcolithic, people would be settled for longer time-periods in semi-permanent settlements, putting some effort in their construction, only to move from it several years (decades?) after (Sanches et al. 2007). This latter strategy created greater pressure over the environment, enhancing deforestation and soil erosion. It is also associated with an increase in agricultural productivity. It is possible that the cycles of settling and abandonment were related with the cycles of fertility of the soils. In this period, naked wheat and hulled and naked barley were the main crops, flax and, probably, poppy were introduced as crops.

A clear change occurred in the Bronze Age since an unprecedented phase of deforestation began and would last until most of the Roman period. Still, most changes regarding the archaeological record and the settlement patterns occurred in the Late Bronze Age (Bettencourt 1999, 2009). In the beginning of the Bronze Age, settlements are positioned in order to take full advantage of valleys' resources. Many valleys had, by that time, deeper and more fertile soils, as result of the erosion episode that occurred since c. 3300 cal BC. Middle Bronze Age was a period of increasing agricultural productivity in which broomcorn millet was introduced (Bettencourt 1999). Although one cannot exclude the possibility of some crops, like naked wheat and hulled barley, were already being used as spring crops, the presence of millet is the first clear evidence of a spring crop, so it must be consider a mark in the history of agriculture in the region. The use of winter and spring crops implies the existence of two harvests per year. Millets are easily integrated in rotation systems (Vazquez Varela 2000) and are very useful catch-crops in case of winter crops failure. Thus they can be regarded as part of a strategy to maintain the resilience of human communities, allowing its growth. Not surprisingly, the Early and Middle Bronze Age were transitional phases towards a new stage in which great changes occurred in several scopes.

In the Late Bronze Age (c. 1200-600/500 cal BC), sedentism is a determinant social change. In the same time, it corresponds to a phase of unprecedented deforestation in the region. In several palynological sequences from northwest Iberia, the percentages of arboreal pollen decrease dramatically and these remain low during the Iron Age (Muñoz et al. 1997 and 2005, Ramil et al. 1998 and 2009). Together with archaeological data, this suggests an increasing demography and its consequential pressure over the natural resources as the need for pasture lands, agriculture fields and firewood increased significantly in order to fulfill the human communities' needs.

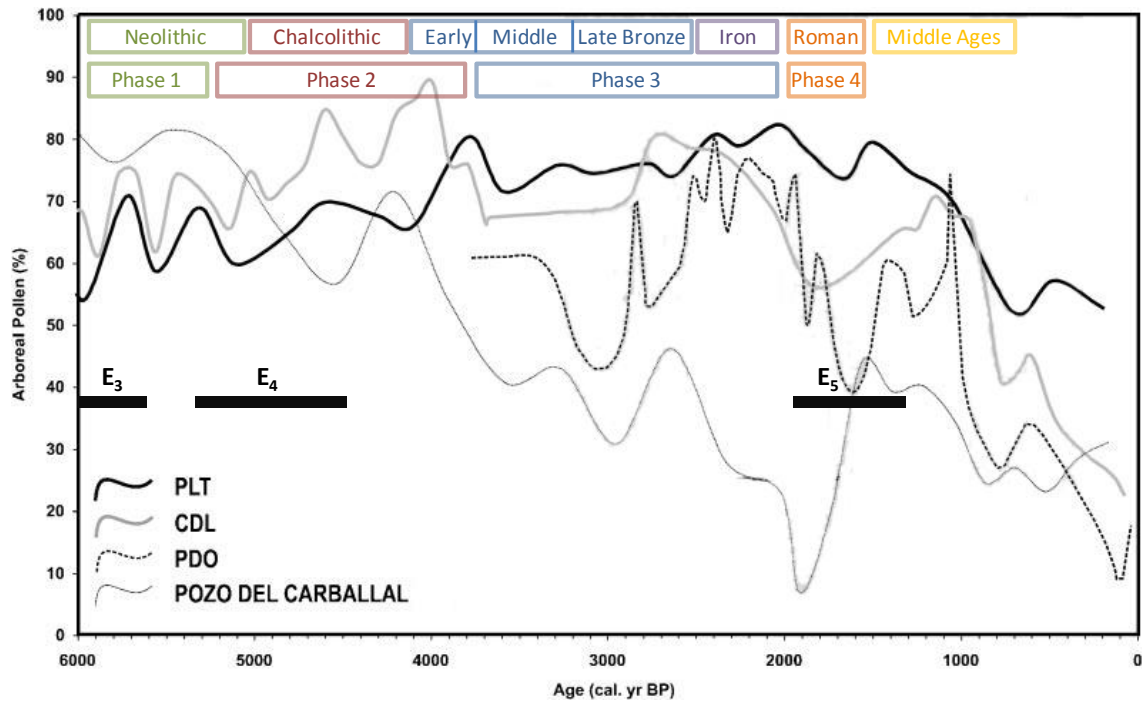


Figure 11.9 – Fluctuation of arboreal pollen and major erosion events, contrasting with archaeological chronology and our four phases (adapted from Muñoz Sobrino et al. 2005). PLT, Puerto de los Tornos – 1; CDL, Chan do Lamoso; PDO, Penido Vello.

In the Late Bronze Age, millet was for the first time a very relevant crop. Other cereals already important in the previous periods continued to be very relevant. But during the Iron Age, constraints originated by sedentism are deduced from the carpological assemblages recovered in archaeological sites. In these two periods, settlements, now fortified and/or ditched, are positioned in middle and low altitude elevations controlling vast landscapes and/or passage areas sometimes away from the best agricultural fields (Parcero Oubiña and Cobas Fernández 2004, Bettencourt 2009). Thus, social trends (sedentism and changes in settlement pattern), anthropogenic environmental changes (erosion and depletion of slopes' soils) and climate worsening (in the Iron Age climate became wetter and colder) acted as major constraints for agricultural practices in this period. Since nomadic movements were no longer a possibility, human communities opted for less demanding crops in order to guarantee productivity and guarantee social resilience. This seems to be the most likely explanation for the increasing relevance of hulled wheats in the Iron Age, in contrast with what happened in the rest of the Iberian Peninsula (Buxó and Piqué 2008). Comparison between hulled and naked wheats (Fig. 11.4) demonstrates how the hulled forms were a crucial choice in the context of the regional constraints. Furthermore, the strategy for building resilience included a significantly diverse

assemblage of crops, with several different cereals, with different traits. This would diminish vulnerability, since environmental setbacks would not affect in the same way different crops in an assemblage with some functional diversity.

The fact that little changes occurred in the Roman period in settlements of the same typology as those from the Iron Age, regarding agricultural choices, suggests that at least some of the constraints continued to exist and/or there was a general cultural continuity. One cannot forget that, despite environmental constraints had a role in the agricultural choices, in the end, the way human communities adapted to such constraints is mostly culturally driven. It depended on the local, regional and supra-regional interactions and also on the previous experiences of the community, i.e. the *memory* in the panarchy model (Walker et al. 2006).

Still, the introduction of rye in the region, yet with little relevance in a first stage, reveals another strategy for taking advantage of the local conditions and keeping resilience in the face of major constraints. The introduction of rye is probably related with the environmental history of the region but its affirmation as a relevant crop is likely to be related with the political, cultural and social history of the region. In the Roman Period culminates the sequential phases of deforestation and soil erosion (Ramil Rego 1993, Ramil rego et al. 1998 and 2009, Martinez-Cortizas et al. 1993 and 2009, Muñoz Sobrino et al. 2005) and this crop is suitable for mountain environments with depleted soils and is resistant to winter frost. It would become the most relevant crop in the Middle Ages (Marques 1978) and it is possible that Germanic people had a determinant role in this transition, since rye was established as a crop in central Europe way before the Roman period (Behre 1992, Kreuz and Schäfer 2008).

Thus it seems clear that agricultural strategies in crucial phases of social change were adapted to regional constraints in order to assure the human communities' resilience. Constraints were environmental (growing soil erosion, climate change) and social (changes in settlement pattern, sedentism). Some environmental constraints were culturally driven in the sense that they were promoted by human communities (soil erosion) but also because choices in terms of settlement pattern conditioned the availability of proper agricultural soils near the settlements. But the fact that human communities tended to grow in demography and complexity suggests they were resilient. Agricultural strategies were a part of the strategy to maintain such resilience.

### 11.3. Major breakthroughs and future lines of work

Despite the existence of previous syntheses regarding environmental changes, archaeobotanical data and the evolution of human societies (e.g. Ramil Rego 1993b, Dopazo Martínez et al. 1996, Bettencourt 1999, Oliveira 2000, Sanches et al. 2007), these were limited and failed to fully integrate interdisciplinary data. This thesis meant to achieve a proper integration of data from several disciplines. It was well known that human societies had a determinant role in the landscape evolution during the Holocene (Ramil rego et al. 1998 and 2009, Muñoz Sobrino et al. 2005, Martinez-Cortizas et al. 2009,) but its relation with agricultural practices was not well known.

Furthermore, with this work it became clear that anthropogenic environmental impacts created challenges to the human communities and that the evolution of societies, itself, enhanced such challenges. Societies coped with it by adapting their productive strategies. In fact, one of the main achievements of this thesis is the understanding of how past agriculture fitted with the patterns of settlement and mobility of ancient human communities and also with the regional environmental constraints. In this sense the questions “How were agricultural development and social trends related?”, “How were agricultural strategies, environmental constraints and environmental changes related?” and Did human communities had strategies to guarantee their resilience? were tentatively answered. During the process, some peculiarities of northwest Iberian agricultural strategies during the studied time-periods were identified and were interpreted as being the result of the adaptation to regional environmental constraints and regional specificities in the evolution of societies. Thus the work done allowed us to get some insights about “Which were the singularities of northwest Iberian agricultural strategies and what caused them? How much was determined by environmental constraints?”

One of the main achievements of this thesis was the further insight on the interrelation between environmental constraints, sedentism and productive practices in the rising complexity of the Late Bronze Age and Iron Age. However, the periods that preceded and followed this important milestone in social development in the region, also became more profoundly understood and the chronology of the introduction of species after the Neolithic was reviewed as well as the social and environmental context in which it took place.



Overall, although some questions proposed in the beginning of the thesis were not fully answered – one would not expect that to happen - the work that was done produced further knowledge regarding the subjects and interpretations were proposed and will face the inquiry of future investigation in the area.

Carpological investigation done in Lesenho, Briteiros, As Laidas, Monte Mozinho and São Lourenço contributed to the achievements of the thesis, although it is clear that As Laidas and Monte Mozinho were the most crucial. As Laidas is one of the most remarkable sites in northwest Iberian Iron Age and clearly the one with richer carpological assemblages. It allowed us to obtain relevant data regarding storage of agricultural products and also about the chronology of the introduction of spelt and oat. Monte Mozinho provided the most relevant Roman carpological assemblage in all northwest Iberia due to its magnitude, the species that were recovered and the interpretative possibilities that it allowed. The presence of rye and the radiocarbon date obtained from rye grains and the tentative identification of fodder are the most crucial aspects of the work done in this site. However, the archaeobotanical work in Monte Mozinho will continue and many more relevant data are already arising, reinforcing the relevance of such site.

Data obtained on Lesenho and Briteiros, although limited, are relevant since when integrated in the regional syntheses it reinforced the idea of the predominance of hulled wheats in the Iron Age. As for São Lourenço, further studies are needed but its potential became clear after the work that was done.

With the work done in these sites and the interpretations that result from it as well as with the revision of previous work, one threshold was definitely crossed in the regional palaeoethnobotany, in concordance with other investigation that is currently being carried out by other investigators in the region: it became clear the need for adequate and more detailed work regarding the morphology of cereals as well as the unreliability of generalist interpretations regarding the carpological assemblages that do not take into consideration the different characteristics of each species, mostly regarding the different wheats.

However, if some questions were tentatively answered, others were raised. The identification of some data gaps must also be regarded as an achievement. As a consequence of the work that was done, the doubts that were raised and the main gaps that were identified, future lines of work can be delineated.

The earliest phase of agriculture development is one of assimilation of a foreign novelty. For this phase – the Neolithic – data is very sparse. Data is needed in order to verify if there is in fact a late assimilation of agricultural practices by human communities in the region and to characterize these earlier stages. The inexistence of hulled wheats in Neolithic contexts in the region is in clear contrast with other Iberian regions and needs further clarification. Moreover, the Early and Middle Bronze Age are determinant phases in the development of agriculture and the increasing pressure over the natural resources and they remain poorly known. Pits have been interpreted as storage facilities but few carpological remains were retrieved in the sites.

Regarding the Roman Period, the sites with crops are, with one exception, indigenous-type settlements, which causes several difficulties in understanding agriculture in that phase. Sampling *villae*, farms and even cities is necessary in order to properly understand agricultural production and consumption. It would possibly clarify the role of rye in subsistence, in that period. Other problematic issue such as wine and olive oil production and consumption need broad interdisciplinary approaches to obtain relevant data and carpology is surely one of the disciplines that need to be involved.

Beyond the purposes of this thesis, it is clear that there is a blur in the knowledge regarding the transition towards the Middle Ages and that is not restricted to archaeobotanical investigation and agricultural practices. Written sources such as the 13<sup>th</sup> century inquiries describe a reality significantly different from that of the Roman Period in terms of crops, mostly dominated by rye and with no clear reference to hulled wheats (Marques 1978). Chestnuts and walnuts are recurrent. Understanding what happened between the 5<sup>th</sup> century and the 13<sup>th</sup> century is crucial to understand the evolution of agricultural practices and landscapes in northwest Iberia and, generally, in western Iberia.

The proper knowledge of the co-evolution of environment, agricultural practices and human communities in broad time-spans is determinant to understand how today's landscapes were formed and the underlying processes that, through time, have been determining their evolution. Nowadays, the real challenge is to develop an Applied Palaeoethnobotany, one that can join the controversial but cautionary debates on environmental changes and human adaptive behaviors. The first stage is to get data and produce plausible interpretations. This thesis was one step in a long but rewarding path.

## 11.4. References

- Aira Rodriguez M., Ramil Rego P., Alvarez Nuñez A. (1990). Estudio paleocarpológico realizado en el Castro de Penalba (Campolameiro, Pontevedra. España). *Botânica Complutensis*, 16: 81-89.
- Almeida C. (1996). O cultivo da vinha durante a Antiguidade Clássica na Região Demarcada do Douro. Ponto da situação. *Douro - Estudos & Documentos*, 1 (2): 18-30.
- Behre K.-E. (1992). The history of rye cultivation in Europe. *Vegetation History and Archaeobotany*, 1 (3): 141-156.
- Bettencourt A.M.S. (1999). *A paisagem e o Homem na bacia do Cávado durante o II e o I milénio AC*. PhD thesis, Braga: Universidade do Minho.
- Bettencourt A.M.S. (2009). A Pré-história do Minho. Do Neolítico à Idade do Bronze. In *Minho. Traços de Identidade*, Braga, Universidade do Minho: 70-120.
- Buxó R. (1997). *Arqueología de las Plantas*. Barcelona: Crítica.
- Buxó R., Piqué R. (2008). *Arqueobotánica. Los usos de las plantas en la península Ibérica*. Barcelona: Ariel.
- Cordeiro A. (2004). *Dinâmica de vertentes em Montanhas Ocidentais do Portugal Central*. PhD thesis, Universidade de Coimbra.
- Dopazo Martínez A., Fernández Rodríguez C., Ramil-Rego P. (1996). Arqueometría aplicada a yacimientos Galaico-romanos del NW Peninsular: valoración de la actividad agrícola y ganadera. In Ramil-Rego P., Fernández Rodríguez, C., Rodríguez Guitián, M. (Eds.), *Biogeografía Pleistocena - Holocena de la Península Ibérica*, Xunta de Galicia: 317-332.
- Figueiral I. (2008). O Crasto de Palheiros (Murça, NE Portugal): a exploração dos recursos vegetais durante o III/inícios do IIº milénio AC e entre o Iº milénio AC e o séc. IIº DC. In Sanches M. (Eds.), *O Crasto de Palheiros. Fragada do Castro. Murça – Portugal*, Município de Murça: 79-108.
- Figueiral I., Jorge S. O. (2008). Man-made landscapes from the third-second millennia BC: the example of Castelo Velho (Freixo de Numão, North-East Portugal). *Oxford Journal of Archaeology*, 27: 119-133.
- Hunt H., Jones M. (2008). Pathways across Asia : exploring the history of Panicum and Setaria in the Indian subcontinent. *Pragdhara*, 18: 53-68.

Jorge S. (1986). *Povoados da Pré-História Recente da Região de Chaves-Vila Pouca de Aguiar (Trás-os-Montes Ocidental): Bases para o Conhecimento do IIIº e Princípios do IIº Milénios a. C. no Norte de Portugal*. PhD thesis, Porto: Faculdade de Letras, Universidade do Porto.

Jorge S. (2000). Domesticating the land: the first agricultural communities in Portugal. *Journal of Iberian Archaeology*, 2: 43-98.

Jorge S. (2003). Pensar o espaço da Pré-História recente: a propósito dos recintos murados da Península Ibérica. In Jorge S. (Eds.), *Recintos Murados da Pré-História recente*, Porto-Coimbra, 13-50.

Kreuz A., Schäfer E. (2008). Archaeobotanical consideration of the development of Pre-Roman Iron Age crop growing in the region of Hesse, Germany, and the question of agricultural production and consumption at hillfort sites and open settlements. *Vegetation History and Archaeobotany*, 17 (0): 159-179.

Marques A. H. d. O. (1978). *Introdução à História da Agricultura em Portugal. A questão cerealífera durante a Idade Média*. Lisboa: Edições Cosmos.

Martínez Cortizas A., Ramil Rego P., García Rodeja E., Moares C. (1993). Suelos de montaña y ciclos de estabilidad/inestabilidad en las vertientes de Galicia (NW España). In Pérez Alberti A., Guitián Rivera L., Ramil Rego P. (Eds.), *La evolución del paisaje en las montañas del entorno de los Caminos Jacobeos*, Santiago de Compostela, Xunta de Galicia: 107-123.

Martínez-Cortizas A., Costa-Casais M., López-Sáez J. A. (2009). Environmental change in NW Iberia between 7000 and 500 cal BC. *Quaternary International*, 200 (1-2): 77-89.

Monteiro-Rodrigues S. (2008). *Pensar o Neolítico antigo. Contributo para o estudo do Norte de Portugal entre o VII e o V milénios BC*. PhD thesis, Faculdade de Letras. Universidade do Porto.

Muñoz Sobrino C., Ramil-Rego P., Rodríguez Guitián M. (1997). Upland vegetation in the north-west Iberian Peninsula after the last glaciation: Forest history and deforestation dynamics. *Vegetation History and Archaeobotany*, 6 (4): 215-233.

Muñoz Sobrino C., Ramil Rego P., Gómez Orellana L., Díaz Varela R. (2005). Palynological data on major Holocene climatic events in NW Iberia. *Boreas*, 34 (3): 381-400.

Nesbitt M., Samuel D. (1996). From staple crop to extinction? The archaeology and history of the hulled wheats. In Padulosi S., Hammer K., Heller J. (Eds.), *Hulled wheats. Proceedings of the First International Workshop on Hulled Wheats. Promoting the conservation and use of underutilized and neglected crops*, International Plant Genetic Resources Institute: 41-100.

- Oliveira M. (2000). *O registo paleocarpológico do NO peninsular entre o III<sup>o</sup> e o I<sup>o</sup> milénios a.C. Contributo para o estudo da alimentação pré e proto-histórica*. MSt. thesis, Universidade do Minho.
- Parcero Oubiña C., Cobas Fernández I. (2004). Iron Age Archaeology of the Northwest Iberian Peninsula. *e-Keltoi*, 6: 1-72.
- Pinto da Silva A. (1988). A paleoetnobotânica na arqueologia portuguesa. Resultados desde 1931 a 1987. In Queiroga F., Sousa I., Oliveira C. (Eds.), *Palaeoecologia e Arqueologia*: 13-29.
- Pliny (1999). *Historia Natural*. Translated by Francisco Hernández (Books 1-25) and Jerónimo de Huerta (Books 26-37). Visor Libros, Universidad Nacional de México.
- Ramil Rego P. (1993). Evolución climática e historia de la vegetación durante el Pleistoceno Superior y el Holoceno en las regiones montañosas del Noroeste Ibérico. In Pérez A., Guitián L., Ramil P. (Eds.), *La evolución del paisaje en las montañas del entorno de los Caminos Jacobeos*, Santiago de Compostela, Xunta de Galicia: 25-60.
- Ramil Rego P. (1993b). Paleoethnobotánica de yacimientos arqueológicos holocenos de Galicia (N.O. Cantábrico). *Munibe*, 45: 165-174.
- Ramil Rego P., Aira Rodríguez M. J. (1993). A palaeocarpological study of Neolithic and Bronze Age levels of the Buraco da Pala rock-shelter (Bragança, Portugal). *Vegetation History and Archaeobotany*, 2 (3): 163-172.
- Ramil Rego P., Muñoz-Sobrino C., Rodríguez-Guitián M., Gómez-Orellana L. (1998). Differences in the vegetation of the North Iberian Peninsula during the last 16,000 years. *Plant Ecology*, 138 (1): 41-62.
- Ramil Rego P., Gómez-Orellana L., Muñoz-Sobrino C., García-Gil S., Iglesias J., Pérez Martínez M., Martínez Carreño N., Nóvoa Fernández B. (2009). Cambio climático y dinámica del paisaje en Galicia. *Recursos Rurais*, 5: 21-47.
- Sampaio J., Carvalho A. (2002). Intervenção de salvamento no sítio de Bolada (S. Bartolomeu do Rêgo, Celorico de Basto). *Revista Portuguesa de Arqueologia*, 5 (1): 29-38.
- Sanches M. (1997). *Pré-história Recente de Trás-os-Montes e Alto Douro*. Porto: Sociedade Portuguesa de Antropologia e Etnologia.
- Sanches M. (2000). As gerações, a memória e a territorialização em Trás-os-Montes (V<sup>o</sup>-II<sup>o</sup> mil. AC). Uma primeira aproximação ao problema. In Jorge, V. (ed.) *Actas do 3<sup>o</sup> Congresso de Arqueologia Peninsular*, 4: 123-145.

Sanches M., Nunes S., Pinto D. (2007). *Trás-os-Montes (Norte de Portugal) - As gentes e os ecossistemas, do Neolítico à Idade do Ferro*. In *A Conceção das paisagens e dos espaços na Arqueologia da Península Ibérica, Actas do IV Congresso de Arqueologia Peninsular, Promontoria Monográfica 08*: 189 -206.

Smartt J., Simmonds N. (1995). *Evolution of crop plants*. Longman Scientific & Technical.

Sousa L., Nunes M., Gonçalves C. (2006). O vinho na antiguidade clássica. Alguns apontamentos sobre Lousada. *Oppidum*, 1: 69-85.

Trocchi A., Codianni P. (2005). Appropriate seeding rate for einkorn, emmer, and spelt grown under rainfed condition in southern Italy. *European Journal of Agronomy*, 22 (3): 293-300.

van der Knaap W. O., van Leeuwen J. F. N. (1995). Holocene vegetation succession and degradation as responses to climatic change and human activity in the Serra de Estrela, Portugal. *Review of Palaeobotany and Palynology*, 89 (3-4): 153-211.

van der Veen M., Palmer C. (1997). Environmental Factors and the Yield Potential of Ancient Wheat Crops. *Journal of Archaeological Science*, 24 (2): 163-182.

Vázquez Varela J. (2000). El modelo tradicional de cultivo del mijo (*Panicum miliaceum* L.) en Galicia y su aplicación a la prehistoria. In Vázquez Varela J. (Ed.), *Etnoarqueología: conocer el pasado por medio del presente*, Diputación Provincial de Pontevedra: 65-84.

Walker B., Gunderson, L., Kinzig, A., Folke, C., Carpenter, S., Schultz, L. (2006). A Handful of Heuristics and Some Propositions for Understanding Resilience in Social-Ecological Systems. *Ecology and Society*, 11 (1).

Zapata L., Peña-Chocarro L., Pérez-Jordá G., Stika H.-P. (2004). Early Neolithic Agriculture in the Iberian Peninsula. *Journal of World Prehistory*, 18 (4): 283-325.

Zapata Peña L. (2005/2006). Agricultura prehistórica en el País Vasco litoral. *Munibe*, 57: 553-561.