

**RESSOURCENKULTUREN 29**

# A GOOD PLACE TO LIVE?

THE MANAGEMENT OF LIVESTOCK RESOURCES IN  
THE LOWER GUADALQUIVIR BASIN IN SOUTHERN  
IBERIA DURING THE 3<sup>RD</sup> MILLENNIUM BC



Javier Escudero Carrillo

TÜBINGEN  
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**A Good Place to Live? The Management of Livestock  
Resources in the Lower Guadalquivir Basin in  
Southern Iberia during the 3rd Millenium BC**

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**zur**

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Martin Bartelheim and Thomas Scholten

Javier Escudero Carrillo

## A GOOD PLACE TO LIVE?

The Management of Livestock Resources in the  
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To my parents and my sons



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## Abstract

The main objectives of this work are to determine the temporality and period of use of Valencina-Castilleja, the assessment of the importance of livestock as part of the primary ResourceComplex for the social-economical development of the human group settled in the Lower Guadalquivir Basin during the 3<sup>rd</sup> mill. BC and, with the help of conventional zooarchaeological protocols and novel techniques, the understanding of herd management strategies, including mobility patterns of each domestic stock at an intra- and inter-site level. Three research questions were posed:

- (1) Was there a relationship of dependence between the small settlements located in the Lower Guadalquivir Basin and the larger settlements?
- (2) Was the economic and social system of the Lower Guadalquivir settlements based on livestock management?
- (3) Is the Centre-Periphery Model applicable to the groups that inhabited the Lower Guadalquivir during the 3<sup>rd</sup> mill. BC?

The study is based on zooarchaeological and isotopic analyses from two different areas: the estuary of the Lower Guadalquivir River, where Valencina-Castilleja is the main site of study, and the Corbones River Valley, with the sites of Carmona and La Loma del Real Tesoro as the secondary focus of study. Other sites, such as Parque Miraflores, Poblado Calcolítico, and El Amarguillo II, which are located in different environments in southwestern Iberia, were also incorporated into the comparative analysis to investigate similarities and differences in the exploitation of biotic resources.

The two major features that can be mentioned as diagnostic of this husbandry strategy are homogeneity and self-sufficiency. Results showed a similar species spectrum for all sites with a clear dominance of the domestic stocks.

The three major economic stocks, cattle, caprines (sheep and goat), and pig, seem to be homo-

geneously represented, their shifting relevance depending on the abundance estimator chosen for analysis. In this way, pig is the main stock in terms of the number of identified specimens (NISP), whereas in terms of the minimum number of individuals (MNI) caprines (mostly sheep) dominate, and cattle are always first when weight is considered. Despite slight differences, the proportion among these three stocks is similar in all three settlements. The results have demonstrated the permanent character of the analysed settlements, as well as the type of relationship between the sites. Furthermore, they have shown that the application of the Centre-Periphery Model for the Lower Guadalquivir Basin seems inapplicable.

In terms of diet, the  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  data from Valencina-Castilleja and Carmona showed cattle, caprines, pigs, and dogs all exhibiting different  $\delta^{15}\text{N}$  values, thus different diets. The  $\delta^{13}\text{C}$  results further evidenced that, although all the sites are located in a predominant  $\text{C}_3$  plant-rich environment due to agricultural practices, cattle and caprines evidence consumption of  $\text{C}_3$  and  $\text{C}_4$  plants. Given that the Guadalquivir Valley is rich in  $\text{C}_4$  plants in their wild form, it is evident that these stocks were being kept in a free-roaming or a semi-stabled regime at the very least, and this would explain their size. This free/semi-stabled regime of the domestic ruminants gets further confirmation in that the  $\text{C}_3$  plants consumed did not all derive from similar environments. In this way,  $\text{C}_3$  plants from open areas are documented in cattle and caprines from El Amarguillo II and La Loma del Real Tesoro II, whereas at Poblado Calcolítico, the  $\text{C}_3$  plants derive from a dense forest environment.

The  $^{87}\text{Sr}/^{86}\text{Sr}$  and  $\delta^{18}\text{O}$  analyses, aiming at a better assessment of the mobility of these domestic stocks, reinforced and enlarged the scope of the dietary data. These studies showed that all of the analysed herds had quite restricted mobility patterns that best suited the domestic (farming) economies.



## Zusammenfassung

Die Hauptziele dieser Arbeit sind die Bestimmung der Temporalität und des Nutzungszeitraums von Valencina-Castilleja, die Untersuchung der Bedeutung der Viehzucht als Teil des hauptsächlichlichen Ressourcenkomplexes für die sozioökonomische Entwicklung der Bevölkerungsgruppe, die im unteren Guadalquivir-Tal während des 3. Jt. v. Chr. siedelte, sowie das Verständnis der Herdenmanagementstrategien, einschließlich der Mobilitätsmuster der einzelnen Haustierbestände innerhalb und zwischen den Fundorten. Dabei sollen drei Fragen beantwortet werden:

- (1) Gab es ein Abhängigkeitsverhältnis zwischen den kleinen Siedlungen im unteren Guadalquivir-Tal und den größeren Siedlungen?
- (2) Basierte das Wirtschafts- und Sozialsystem der Siedlungen im unteren Guadalquivir Tal auf Viehwirtschaft?
- (3) Ist das Zentrum-Peripherie Modell auf die Gruppen anwendbar, die das untere Guadalquivir-Tal während des 3. Jt. v. Chr. bewohnten?

Die Studie basiert auf der zooarchäologischen und isotopechemischen Untersuchung der Faunenfundstücke aus zwei verschiedenen Regionen: die Mündung des unteren Guadalquivirs, mit Valencina-Castilleja als Hauptuntersuchungsgebiet, und das Corbones-Flusstal, mit den Gebieten Carmona und La Loma del Real Tesoro. Weitere Fundstellen, wie Parque Miraflores, Poblado Calcolítico und El Amarguillo II, die in unterschiedlichen Regionen im Südwesten der Iberischen Halbinsel liegen, wurden ebenfalls in die vergleichende Analyse einbezogen, um Ähnlichkeiten und Unterschiede bei der Nutzung natürlicher Ressourcen zu untersuchen.

Die beiden wesentlichen Merkmale, mit denen die Tierhaltungsstrategie beschrieben werden kann, sind Homogenität und Selbstversorgung. Die Ergebnisse zeigten ein ähnliches Artenspektrum für alle Orte mit einer deutlichen Dominanz der Haustiere.

Die drei wichtigsten wirtschaftlich genutzten Tierbestände (Rinder, Schafe/Ziegen und Schweine) scheinen gleichermaßen vertreten zu sein, wobei sich ihre Bedeutung verschiebt, je nachdem, welche Art der Mengenschätzung der Auswertung

zugrunde liegt. So ist das Schwein der wichtigste Tierbestand in Bezug auf die NISP (number of identified specimens), während bei der Ermittlung des MNI (minimum number of individuals) Ziegen (meist Schafe) dominieren. Rinder stehen immer an erster Stelle, wenn das Fundgewicht betrachtet wird. Trotz leichter Unterschiede ist das Verhältnis zwischen diesen drei Tiergruppen in allen drei Siedlungen ähnlich. Die Ergebnisse zeigen, dass die untersuchten Siedlungsplätze permanent genutzt wurden und es Beziehungen zwischen den Orten gab. Darüber hinaus stellte sich heraus, dass die Anwendung des Zentrum-Peripherie Modells für das untere Guadalquivir-Tal nicht geeignet zu sein scheint.

Was die Ernährung betrifft, so zeigten die Unterschiede in den  $\delta^{15}\text{N}$ -Signaturen aus Valencina-Castilleja und Carmona, dass Rinder, Schafe/Ziegen, Schweine und Hunde unterschiedliche Nahrungsressourcen nutzten. Die  $\delta^{13}\text{C}$ -Werte zeigten weiter, dass Rinder und Schafe/Ziegen auch  $\text{C}_4$ -Pflanzen konsumierten, obwohl alle Fundplätze in Regionen liegen, die durch landwirtschaftlich genutzte  $\text{C}_3$ -Pflanzen geprägt sind. Angesichts der Tatsache, dass das Guadalquivir Tal aber reich an wilden  $\text{C}_4$ -Pflanzen ist, ist es naheliegend, dass diese Tierbestände freilaufend (oder teilweise in Stallhaltung) gehalten wurden, was auch ihre Größe erklären würde. Diese Haltungsstrategie der Hauswiederkäuer wird noch dadurch bestätigt, dass die konsumierten  $\text{C}_3$ -Pflanzen nicht alle aus ähnlichen Habitaten stammen. So belegen die  $\delta^{13}\text{C}$ -Werte der Rinder und Schafe/Ziegen aus El Amarguillo II und La Loma del Real Tesoro den Konsum von  $\text{C}_3$ -Pflanzen aus offenen Habitaten, während in Poblado Calcolítico die konsumierten  $\text{C}_3$ -Pflanzen aus einer dichten Waldumgebung stammen.

Die Ergebnisse der  $^{87}\text{Sr}/^{86}\text{Sr}$ - und  $\delta^{18}\text{O}$ -Analysen, die auf eine bessere Beurteilung der Mobilität dieser Haustierbestände abzielten, unterstützen und ergänzen die Ernährungsdaten. Die  $^{87}\text{Sr}/^{86}\text{Sr}$ - und  $\delta^{18}\text{O}$ -Werte zeigten, dass alle untersuchten Herden eine ziemlich eingeschränkte Mobilität aufwiesen, was am ehesten auf eine Subsistenzwirtschaft hindeutet.



## 1 Introduction

### 1.1 Background

This work is following the SFB 1070 Ressourcen-Kulturen definition of resources that '[r]esources may be understood as a category for analysis, serving to expand the semantic horizon of the term by the use of a comparative perspective. Resources generally are seen as means to create, sustain and alter social relations, units and identities within the framework of cultural ideas and practices. It is assumed that resources are variable not only culturally, but chronologically as well, and are affected by historical change' (Hardenberg et al. 2017, 16). For some authors, such as Niemann, resources are 'the totality of existing raw materials on earth, in which human society has an interest' (Niemann 2006, 11). According to Hardenberg et al. (2017, 15), such a definition of resources would not be applicable from a socio-cultural point of view since resources present values defined by cultural concepts and specifications.

The combination of several resources used for a common purpose forms ResourceComplexes. For example, a ResourceComplex focused on textiles requires raw materials (wool, fibres etc.) and tools to make the fabrics (needles, looms) and is connected to other ResourceComplexes (livestock for wool, bones for the manufacture of needles, agriculture for fibres etc.). Specifically, the objective of this research is to investigate the animal as a resource and the ResourceComplex of husbandry practices. Therefore, animals have been traditionally envisioned as food resources or raw material, which reduces them to being merely objects. Recent analyses have investigated human and animal interaction in past societies to demonstrate that animals played a key role in the history of evolution (deFrance 2009; Monks 2005; Arbuckle 2012, 302; Hill 2013, 117). According to deFrance (2009, 105 f.), as well as being the source of meat and sub-products, animals were a key factor for the development and survival of complex societies.

According to Arbuckle (2012, 302), increase in herd size creates status symbols within communities and also allows for the development and exploitation of other resources such as meat or fat. Authors such as Dincauze (2000, 506) indicate the use of labour force or even company as a resource for animals.

From an economic point of view, the development of a given ResourceComplex involves the creation of new complexes which, at the same time, will help to improve and develop the primary complex and the creation and development of new ones. As with primary and secondary resources, it is possible to differentiate between primary and secondary ResourceComplexes. In the case of primary complexes, these are the complexes that are basic and necessary for the advancement and socio-economic development of a human group. In the case of agricultural and livestock ResourceComplexes, which provide food resources to survive, these would be basic primary resources for the development of a prehistoric society. Secondary complexes such as metallurgy, which can improve tools for agricultural practices and consolidate these more basic complexes. The consolidation of a secondary ResourceComplex generates the emergence of new ResourceComplexes dependent on that secondary complex. In the case of the collapse of a secondary complex, the economic advancement of society would be slowed down, but it would not mean the disappearance of the established system. The collapse of a primary ResourceComplex would imply important economic and social changes and the non-continuity of the established system.

From a social point of view, the evolution of a certain ResourceComplex would imply a further specialisation of part of a society, that could in turn stimulate new kinds of social differences; differences which can be observed already in the 3<sup>rd</sup> mill. BC as seen in the case study presented in this work.

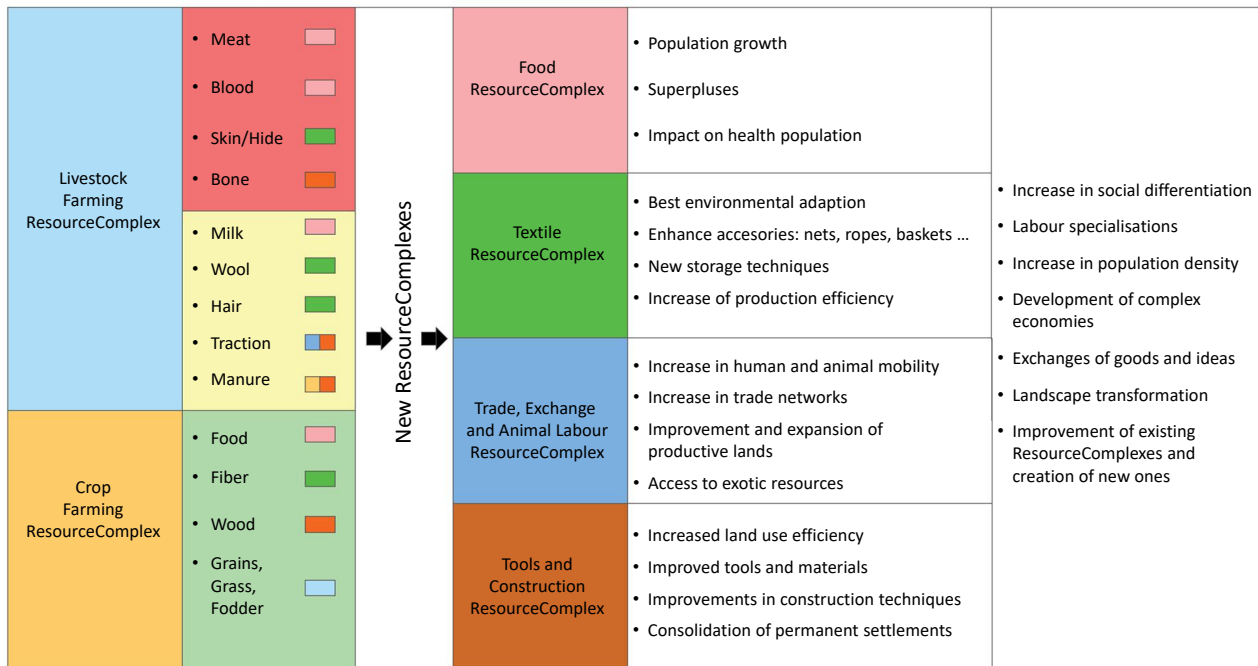


Fig. 1. The ResourceComplex of husbandry practices.

The development of different ResourceComplexes can be summarised with an image (fig. 1). If the main focus is on the husbandry practices, this produces several products such as meat, blood, leather, wool, sinews or milk, but when it produces bone, for example, this could, among many other things, be converted into tools and, along with the use of metals, could create a different ResourceComplexes of weaving, pottery, woodcarving, weaponry etc. To stay with the example, bone as a tool could be used to procure other food sources, such as marine resources, or to produce textiles. From animal sub-products such as wool, leather, feather, or fur, you can also produce textiles or clothing. Husbandry provides traction as well, which could imply that trade, and therefore the exchange of ideas, information, and resources, could have taken place. When husbandry is linked to agricultural practices, this could imply food, traction, and fertiliser, but also fibre and textile clothing as well, and become a new ResourceComplex.

World-systems theory (WST) was developed by Wallerstein in the 1970s (Wallerstein 1974). It arises from the perspective of today’s capitalist world and was applied to archaeology in the late 1970s by Pailes/Whitecotton (1979) for different periods and

areas. WST argues that different cultural groups did not exist in isolation but maintained, either directly or indirectly, constant contacts, affecting the groups that were involved in exchange networks (Kardulias 2009, 56). Harding differentiates between WST and DT (Dependency Theory), which ‘is based on the principle that there are core polities or states and peripheral ones, and that resources flow from the latter to the former, enriching one at the expense of the other’ (Harding 2013, 382).

The Lower Guadalquivir Basin is presented as one of the most fertile territories with the greatest variability of resources on the Iberian Peninsula, making it the appropriate area to analyse the importance of resources and ResourceComplexes for the socio-economic evolution of the groups that populated the territory during the 3<sup>rd</sup> mill. BC.

Two different theories, defended by different researchers, apply the Centre-Periphery Model to the socio-economic situation in the Lower Guadalquivir.

The first one defends a political model based on the incipient state capitalised by the Valencina-Castilleja site and based on a class society with a strong hierarchy where the elites accumulated the agricultural surplus coming from the settlements located in the periphery, which were maintained

through a coercive system (Nocete Calvo 2001; Nocete Calvo et al. 2005; Arteaga Matute/Cruz-Auñón Briones 1999a; 1999b; López Aldana/Pajuelo Pando 2001; Mejías García 2017, 3).

The second model defends the non-existence of a state where the site of Valencina-Castilleja emerges as a place of temporary aggregations of a non-permanent nature for the celebration of rituals and exchanges of the nearby populations, whose economic system would be based on a redistributive egalitarian communalist system with an incipient social differentiation, in which the figure of a 'big man' controls the community (Márquez Romero/Jiménez Jáimez 2010; García Sanjuán 2013, 2017; Costa Caramé et al. 2010; García Sanjuán/Murillo-Barroso 2013). García Sanjuán argues that the site of Valencina-Castilleja represents an economic system where livestock played a major economic role and within it, pigs and cattle played the main role with their reflection in the symbolic world (García Sanjuán 2017, 243). For García Sanjuán, pigs, kept in a regime of freedom in the pasture grounds, would play a main role in the accumulation of wealth that would translate into an increase in social differentiation (García Sanjuán 2017, 244). Likewise, the author defends that in the case of Valencina-Castilleja, only certain anatomical parts were brought to the settlement so that the presence of domestic animal bones does not imply the occupation of the site, thus justifying a non-permanent settlement model.

According to deFrance (2009, 122), groups in positions of power in hierarchical societies acquire the best products for their own consumption by different means. High status individuals in complex societies differ from the rest of the population in the use they make of animals, which is not necessarily limited to consumption, as well as in the difference in how animals are consumed.

Through taxonomic analyses, studies of anatomical portions, skeletal frequencies, sex, and age profiles, as well as health assessments and isotope analyses, the existence or not of differences in the use of animals will be analysed to confirm the existence of elites or hierarchical groups in the Lower Guadalquivir Basin.

Through zooarchaeological analysis, it is possible to identify social differences based on differential consumption and access to certain animal portions in complex societies (deFrance 2009, 133). Likewise, through the analysis of the mobility of the main domestic livestock, the permanent or seasonal character of the sites will be analysed, as well as how the degree of mobility of livestock reflects the economic and social organisation of the groups that populated the Lower Guadalquivir Basin during the 3<sup>rd</sup> mill. BC. In connection with this, Cribb (1982) distinguishes four pastoral groups:

Type 1 includes groups whose economic base is purely agricultural with minimal pastoralism and where all members of the group have a direct or indirect relationship with agricultural production (Cribb 1982; Sadr 1991, 4). This type is completely sedentary (Cribb 1982).

According to some authors, settlements of a purely agricultural nature are characterised by their permanent character, either in long term settlements or in villages of a dispersed and more ephemeral nature. In both cases, both models have the same characteristics of occupying the more fertile areas of a territory and there are no settlements of a seasonal nature related to livestock practices in the vicinity. Likewise, the material culture is related to agricultural practices, where macro-botanical remains or grind stones or adzes predominate and an abundance of pottery of different types is present on the site (Sadr 1991, 14).

Agricultural populations inhabit nucleated, long-lived villages or live in more dispersed and short-lived hamlets and homesteads. They should be identifiable by the distribution of all sites in the more fertile areas and by an absence of seasonal herder campsites. Grinding stones, macro-botanical remains, and abundance and variety of pottery serve to support the settlement pattern data (Sadr 1991, 14).

Type 2 is characterised by permanent groups where agriculture plays the main role and livestock is characterised by its small size, intended to supply basic domestic needs. The herds require a limited amount of movement around the settlement.

Type 3 is characterised by a system in which both agriculture and livestock play major roles in the community's productive regime. The size of the herds is large enough to require movement in search of pastures. For Geddes, transhumant pastoralism is part of a single broad economic system that encompasses agricultural practices (Geddes 1983, 51).

According to some authors, transhumant movements of domestic livestock, mainly sheep, goats, and cattle, occur between summer pastures, located in the more mountainous areas, and winter pastures, located in the lower areas (Ehlers/Kreutzmann 2000, 16). Other authors, such as Chang and Koster, argue that transhumant practices in the Mediterranean area are often seen as a response to agricultural pressure (Chang/Koster 1986). Such movements may range from a few kilometres to several hundred (Walker 1983, 37).

Chang/Koster (1986, 103), Lewthwaite (1981), and Walker (1983) have argued against the existence of transhumance during the Neolithic period and Bronze Age in the Mediterranean. They claim that models of transhumance are invariably based on examples of medieval state-controlled systems that cannot be demonstrated for earlier periods. They view transhumance as a response to specific conditions in the medieval world economy. Walker's argument is made directly against Higg's (1976) assertion that Spanish megaliths are associated with traditional routes of large-scale transhumance and were probably related to similar pre-historic patterns of pastoral movement.

The specialisation of pastoralism in mixed economies should not be seen as nomadism since they are part of a division of labour within the same group. Pastoralism and agriculture can be integrated in various ways, with the domestic economy being the most basic level. This is usually the case in groups where agriculture predominates over small-scale farming, as is the case in type 2 (Cribb 1991, 16–25).

In the case of types 2 and 3, there are two possibilities. Either the entire population in a given society is involved in both agriculture and pastoralism, or specialised groups within the society exist that devote themselves primarily, or even exclusively, to pastoralism, alongside groups that are

primarily occupied with agriculture (Khazanov 1984, 20; Cribb 1991, 25; Barth 1973).

Agropastoral societies like those of types 2 and 3 should ideally exist at a medium level of social organisation: one wherein production and exchange are coordinated at an intra-regional scale.

Unlike transhumant agropastoral groups, which require some degree of social stratification, mixed economies can occur in all types of societies (Sadr 1991, 9).

A mixed economy society could conceivably exist in any type of society, from tribal and band societies to state type societies. It is the only level of relationship possible for small-scale, unstratified societies. If it occurs in a highly stratified society with complex organisation, it represents a less than optimal use of the available organisational resources: essentially, a case of non-participation in the regional economy (Sadr 1991, 9).

Mixed economies, like Cribbs' agricultural economy, may inhabit nuclear villages or dispersed households for long or short time periods. The main population centres are located in arable lands, but generally have an associated series of satellite herding camps dispersed at distances generally no further than 15 to 20 km from the main settlements; such distances represent half-day trips for the herd.

For Barth (1973) and Monod (1975), there is a difference between: 1) ethnic groups composed of mixed economy households, with families both cultivating and herding domestic animals, and 2) ethnic groups composed of two distinct segments, of which one specialises in agriculture and the other one in pastoralism.

Type 4 is exclusively pastoral, with a nomadic system. According to Khazanov, pastoral nomadism or pure pastoralism is defined as 'a distinct form of food-producing economy in which extensive mobile pastoralism is the predominant activity and in which the majority of the population is drawn into periodic pastoral migrations' (Khazanov 1984, 7). According to Arnold and Greenfield (2006, 7), nomadic pastoralism involves the movement of people and animals within a large and well-defined geographic area. Whittaker (1988, 1) maintains that pastoralism has never existed in a pure form. For this kind of pastoralism, settlement patterns are characterised

by small sites with few artefacts and some domestic animal remains, often interpreted as camps of mobile herders (Connor 1984). Sometimes sites contain features such as tent outlines and stone alignments, or other more diagnostic features such as animal enclosures (Hole 1974; Chang/Koster 1986; Shimada/Shimada 1985). In pastoral groups, power and authority are limited and widely diffused (Salzman 2004, 44). According to Khazanov, for pure pastoralism societies, agriculture does not play a role, even in supplementary capacity (Khazanov 1984, 19). Species composition along with age and sex structure of herds is determined by factors such as the biology of the species and the specifics of the geographic conditions. These same factors will affect whether animals are utilised for primary or secondary products. In addition, economic, social, political, and cultural factors are also influential (Khazanov 1984, 27). The development of nomadism is attributed to the increased complexity of social, political, and economic systems (Sadr 1991, 9). The herds are usually composed of only one species, complemented by a few other secondary animals (Vega Toscano et al. 1998).

## 1.2 Objectives

The main objective of this work project is to investigate the Copper Age Resource Complex of the southwest of Iberia, specifically the Lower Guadalquivir Basin, and in particular, the exploitation of biotic resources as the decisive factor fostering economic and social changes on the southern Iberian Peninsula during the Copper Age.

The study is based on archaeozoological and isotopic analyses recovered from two different basins. The estuary of the Lower Guadalquivir River, with Valencina-Castilleja as the main site of study, and the Corbones Basin, with Carmona and La Loma del Real Tesoro (Guadajoz) as the focus of study. The sites of Poblado Calcolítico (Aznalcollar), Parque Miraflores (Seville), and El Amarguillo II (Los Molares) have been used for comparative purposes to understand the reasons behind the similarities and differences in the exploitation of biotic resources during the 3<sup>rd</sup> mill. BC.

The selection of sites was based on their geological location. All sites are located in different geological areas and environmental conditions.

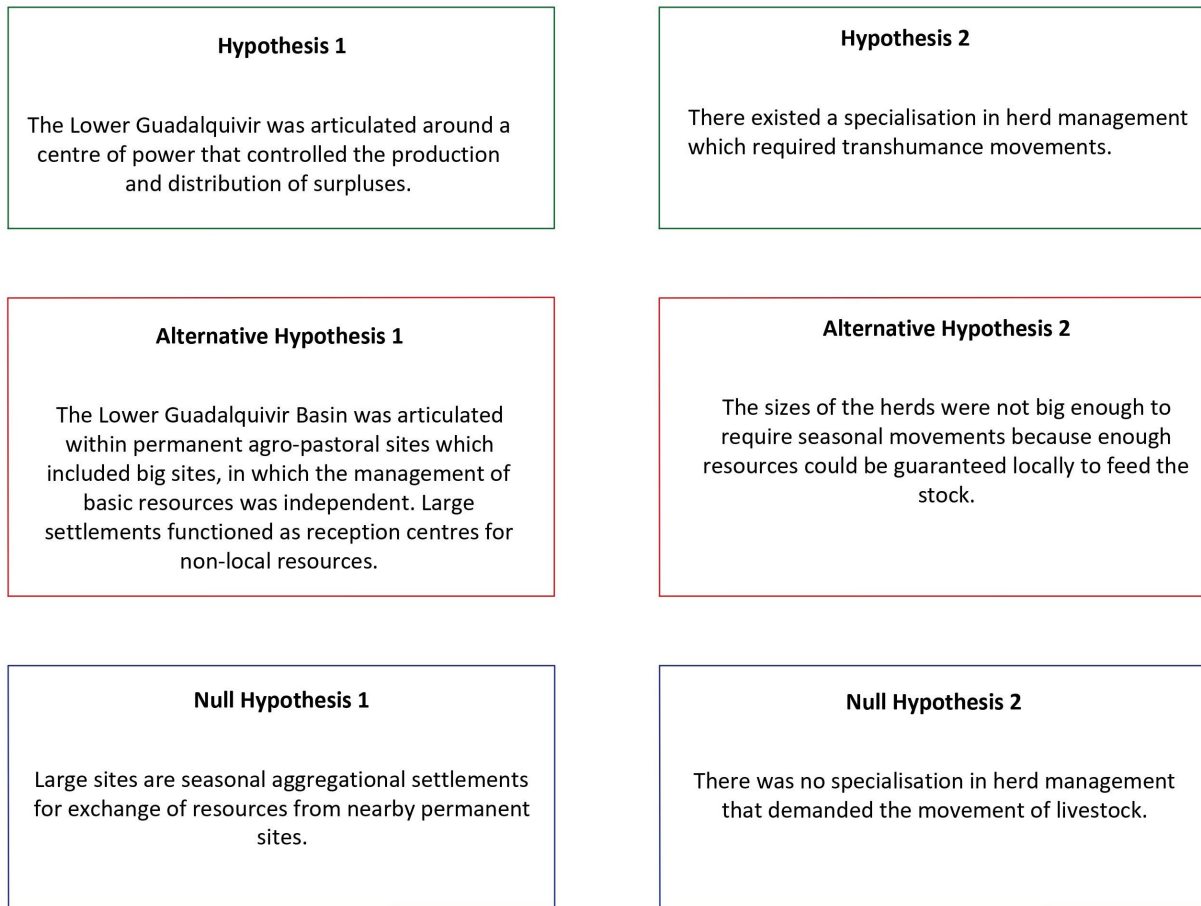
Overall, this work aims to address the following four objectives:

- To investigate the exploitation and significance of the biotic resources in the Lower Guadalquivir Basin and their relation to the evolution of the socio-economic dynamics.
- To assess the relationship existing between the site of Valencina-Castilleja and other sites located in the periphery.
- To identify the type of socio-economic groups according to differences in their use of animals.
- To investigate the degree of mobility of Copper Age populations (permanent vs. non-permanent sites) and its relation to the settlement patterns in the Lower Guadalquivir Basin during the 3<sup>rd</sup> mill. BC.

## 1.3 Research Questions

To date, the interpretation of socio-economic systems in the Lower Guadalquivir has focused on two divergent opinions. The first, defended by authors such as Cruz-Auñón Briones/Arteaga Matute (1999), Nocete Calvo (2001, 95), Nocete Calvo et al. (2005), and López Aldana/Pajuelo Pando (2001, 217), considers Valencina-Castilleja to represent a centre of power with an (*sic*) ‘incipient class society’ sustained by a ‘state’ in which elites settled on the mainly fortified centres exploited the smaller peripheral communities through physical and ideological coercion, the former exemplified by the payment of taxes. The main argument put forward by authors such as Cruz-Auñón Briones/Arteaga Matute (1999) to justify Valencina-Castilleja as a centre of power is the sheer abundance of structures called ‘silos’, presumably used to harbour surplus agricultural productions.

The second traditional interpretation of Valencina-Castilleja postulates it to be a site that emerged as a burial ground rather than as the settlement of a sedentary community. In this interpretation, the site fostered recurrent population aggregations of local groups inhabiting the Lower Guadalquivir Basin with the purpose of creating social relations (García Sanjuán 2017; García



**Fig. 2.** Hypotheses to be tested in this research.

Sanjuán et al. 2017; 2018). García Sanjuán argued that rapid processes of social and economic differentiation would explain a pig breeding strategy based on a regime of semi-free herds, as would be the case of the *montanera* system, pigs became an important social and economic resource (García Sanjuán 2013; 2017).

To achieve the aims and objectives described above, the following hypotheses have been proposed for testing (*fig. 2*).

The present work has been set up with several research questions in mind related to these hypotheses:

- Was there a relationship of dependence between the small settlements located in the Lower Guadalquivir and the larger settlements?
- Was the economic and social system of the Lower Guadalquivir settlements based on livestock management?

- Is the Centre-Periphery Model applicable to the groups that inhabited the Lower Guadalquivir during the 3<sup>rd</sup> mill. BC?

#### 1.4 Significance of the Research

The analysis of the contribution of livestock as a basic resource for the socio-economic and cultural development of societies during the Copper Age in southwestern Iberia is still not well understood.

Traditionally, two opposing socio-political models have been proposed for the Lower Guadalquivir Basin, both based on the Centre-Periphery System. This research aims to contribute to this debate by examining the meaning of livestock practices in relation to society and economic systems, and whether the Centre-Periphery Model can be applied to the area of analysis.

The main problem associated with this research has been the lack of published faunal analyses and reports from 3<sup>rd</sup> mill. BC sites located in the Lower Guadalquivir Basin. Another difficulty is the interpretation of sites like La Loma del Real Tesoro II due to the poor preservation of faunal remains and the lack of comparable sites in the Iberian Peninsula.

### **1.5 Structure of the Book**

The book is divided into eight chapters. Chapter 1 is the introduction and chapter 2 focuses on the description of the geological and environmental conditions of the research area. Chapter 3 provides information on the settlement and funerary practices during the 3<sup>rd</sup> mill. BC in the Lower Guadalquivir

Basin. Chapter 4 describes the methods and materials used. Chapter 5 presents the sites used for this research with special attention paid to the main site of analysis, La Loma del Real Tesoro. Chapter 6 summarises the results. Chapter 7 includes the discussion, wherein different topics are discussed regarding the permanent and non-permanent character of the sites, husbandry strategies, subsistence patterns, and economic systems, and the mobility patterns and herd management strategies as well as the ResourceComplex management in the Lower Guadalquivir Basin during the Chalcolithic period. The last chapter, chapter 8, summarises the general conclusions and points out issues of interest for future research.

Supplementary materials are included in the online Appendices 1 to 7, <http://dx.doi.org/10.15496/publikation-104226>.



## 2 The Geological and Environmental Contexts in the Lower Guadalquivir Basin

### 2.1 The Lower Guadalquivir Basin

The Guadalquivir River has a hydrographic basin of 57,377km<sup>2</sup>, the largest of the southern Iberian Peninsula and one of the most important fluvial systems of the Mediterranean. It is articulated on a quadrangular depression with a NE-SW orientation that drains towards the Atlantic Ocean. It is fringed northwards by the southern foothills of the Hercynian basement (Iberian Massif) and southwards by the alpine mountain range of the Baetic System (Baena Escudero/Caro Gómez 1994, 52; Baena Escudero/García Martínez 1995, 9; García Martínez 2015, 112; Borja Barrera/Borja Barreda 2016). The basin developed during the Neogene over a substrate of marls and sands that belong to the Cenozoic basin of the Baetic system and has a post-orogenic character.

The Lower Guadalquivir Basin comprises the provinces of Huelva, Cádiz, Seville, and the western part of Córdoba, and covers an area of 45,189km<sup>2</sup>. From a geographic standpoint, the three most characteristic elements are the Sierra Morena, the Depression of the Guadalquivir River, and the Sub-Baetic *Serranías* (Valdés Castrillón et al. 1987, 11) (fig. 3).

### 2.1.1 The Iberian Massif

The Iberian Massif occupies the central and western part of Iberia from the north of the Guadalquivir Basin to the Cantabrian Chain and Pyrenees mountain (Pereira et al. 2015). Originally formed during the Hercynian orogeny, between the Precambrian and the Paleozoic, it is composed of a set of metamorphic (slate, quartzite, and marble limestone) and plutonic (granite and granite-related rock) rocks. It is characterised by isolated detrital aquifers and, to a lesser extent, by calcareous aquifers of restricted development and low permeability, unfit for soil formation. The lithological variety of the *sierra*, coupled with the NW-SE orientation of the fluvial courses – that became torrential since the post-Pliocene deformation – fostered a strong differential erosion of the oldest materials which subsequently started to fill the Guadalquivir depression (Valdés Castrillón et al. 1987, 12; Martín de la Cruz et al. 2000, 216).

According to Colmenero et al. (2002, 106), the Iberian Massif includes three units: the southeastern-central Iberian area, the Sierra Morena, and the sub-Portuguese area.

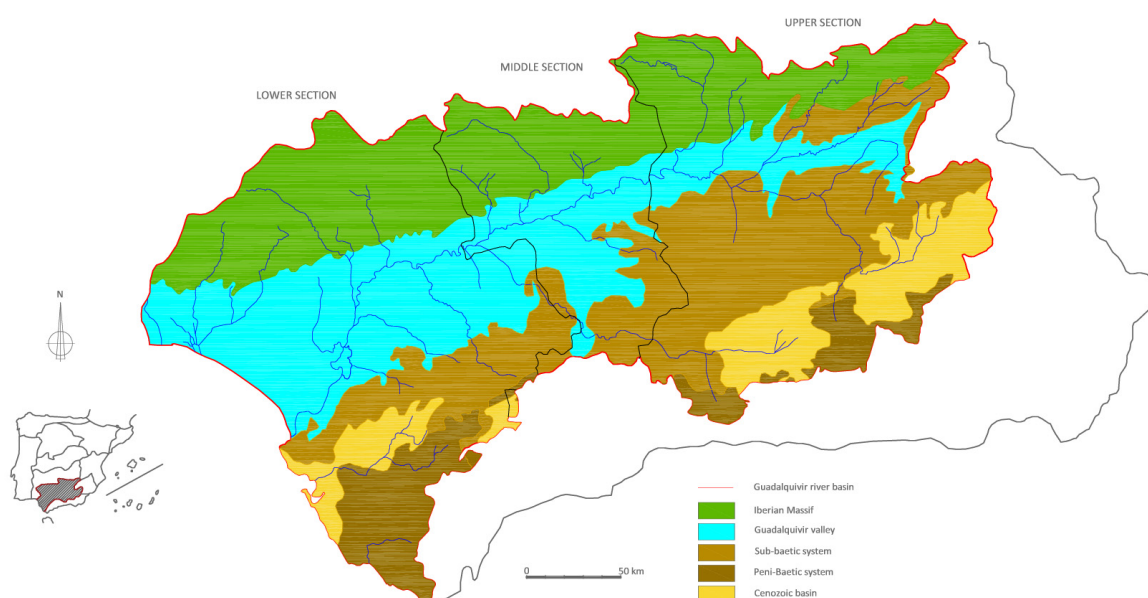


Fig. 3. The Guadalquivir Basin.

The southeastern-central Iberian area is the largest unit and is characterised by the presence of intrusive igneous rock, where granite and metamorphic batholiths of slate, greywacke, sandstone, and quartzite dominate. In the region of Almadén (Ciudad Real) deposits of tin, wolfram, and uranium exist in addition of those of copper, lead, silver, zinc, and mercury (Colmenero et al. 2002, 106).

The Sierra Morena occupies part of the mountain ranges in the north of the provinces of Seville, Córdoba, and Huelva, and has an average altitude of 600m.a.s.l. This unit is characterised by high petrographic diversity, among which Precambrian and Carboniferous materials, mainly metamorphic gneiss, schist, amphibolite, quartzite, slate, metavolcanite, and black quartzite, are prominent (Galán et al. 2008, 91; Junta de Andalucía 2004). The area of Ossa Morena has a great diversity of mineralisation processes and ore deposits including iron, zinc, copper, gold, silver, antimony, nickel, manganese, tungsten, barite, variscite, uranium, and coal. It also incorporates two mercury ore deposits at Usagre (Badajoz). These deposits are at the La Sultana and La Mariquita mines, which were in use until 1971. Variscite was also found in the area near Cazalla de la Sierra (Seville) (Tornos et al. 2004; Apalategui et al. 2007). From an edaphological point of view, the main soil types are luvisols and cambisols. Luvisols are fertile and suitable for agricultural practices. These characteristically occur on low hills and are associated with oaks (*Quercus*). Cambisols are also good quality agricultural soils suited to all types of crops as well as to the *dehesa* (savannah-type) system for caprines and pig husbandry (IUSS Working Group WRB 2007).

The sub-Portuguese area, which is situated in the southwestern corner of Portugal, includes the northeastern zone of the province of Seville and the central part of the province of Huelva. It is mainly composed of Devonian-carboniferous rocks of both sedimentary and igneous character (i.e. turbidities of clay, sand, and conglomerates, as well as slate, quartzite greywacke, and metabasite, along with with granodiorite). This area features the so-called Iberian Pyrite Belt (FPI) which is characterised by a large concentration of minerals including large deposits of pyrite and poly-metallic sulphide, copper, lead, and zinc as well

as minor elements such as manganese, silver, and gold (Villalobos Mejía/Pérez Muñoz 2006; Junta de Andalucía 2004; Borja Barrera/Borja Barrera 2016; Galán et al. 2008, 92).

### 2.1.2 The Sub-Baetic System

The Sub-Baetic System is an alpine folding that originated in the Cenozoic, during the Miocene, and extends approximately 600km south and southeast along the depression of the Guadalquivir, from the province of Cádiz to Valencia (Junta de Andalucía 2004). It is divided into three sub-units, the Peni-Baetic, Pre-Baetic, and Sub-Baetic Systems. The abundance of natural passages between the valley of the Guadalquivir and the Meseta facilitated communication between the two zones (Martín de la Cruz et al. 2000, 216).

The Sub-Baetic System is characterised by an abrupt and rugged relief that stands out for its aridity and poor agricultural performance. Soils are composed of permeable materials, mainly limestones, marls, and clays. In Seville, the formation reaches to altitudes between 500 and 1000m, compared with the Sierra de Grazalema in Cádiz, of the same formation, that reaches up to 1500m.

From an edaphological point of view, the Sub-Baetic System is composed of leptosols and regosols. Leptosols are not suitable for any kind of crops but are optimal for husbandry practices. This type of soil is linked to coniferous forests. Regosols have poor amounts of organic material and thus are not good soils for agricultural purposes (IUSS Working Group WRB 2007, 83–91).

### 2.1.3 The Guadalquivir Valley

The Guadalquivir Valley is characterised by tertiary stratigraphic facies formed by almost exclusively marine sediments (marls, silts, calcarenites, and marine limestones) and Quaternary accumulations, with some Triassic outcrops on its northern margin (Valdés Castrillón et al. 1987, 12).

The Guadalquivir Basin, as well as the Baetic System, developed as part of the Alpine orogeny at the beginning of Miocene. The orogenic movements formed a marine corridor between the

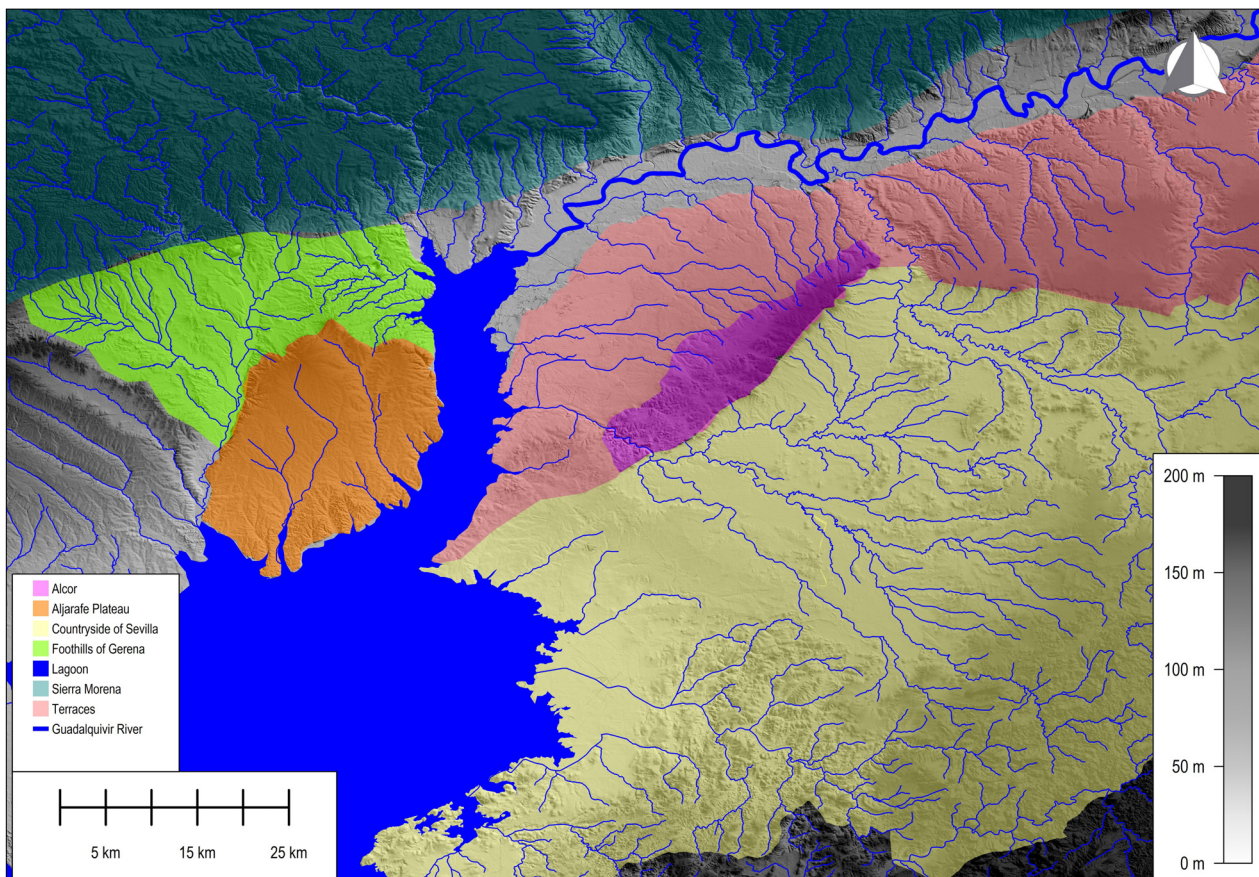
Sets	Terrace	Altitude	Location
Very high terraces	T1–T4	+200–215/+142–145m	Middle basin
High terraces	T5–T9	+130–139/+73–75m	Left bank
Middle terraces	T10–T12	+45–55/+35–40m	Both banks
Low/very low terraces	T13–T14	+13–14m/Current river	Current river

**Table 1.** List of terraces of the Guadalquivir River according to Baena Escudero/Caro Gómez 1994, 53.

Atlantic Ocean and the Mediterranean Sea that filled up with marine sediments (Valdés Castrillón et al. 1987, 12).

Postpliocene movements increased the elevation of the Baetic system and created a fluvial network in Sierra Morena, with a NW-SE orientation, whose mostly torrential nature facilitated a strong differential erosion of the oldest materials and settled out the dragging materials filling up the Guadalquivir Basin. This process generated a large estuarine cone with a diluvial terrace system of 14 levels of tiered terraces grouped into

four units (Valdés Castrillón et al. 1987, 12; Martín de la Cruz et al. 2000; Baena Escudero/Caro Gómez 1994, 53) (*table 1*). The mouth of the Guadalquivir River used to be wider than the current one. According to different authors, it developed a large gulf at the time of its maximum expansion during the Flandrian transgression around 6000 BP. This gulf started to fill up during the Late Neolithic. The former mouth of the Guadalquivir River, located next to Alcalá del Río, defined a 30km long and 5km wide paleo-estuary that connected the Guadalquivir River to the marine shore (Arteaga



**Fig. 4.** Different areas and features of the landscape in the Lower Guadalquivir Basin.

Matute et al. 1995, 112 f.; Borja Barrera 2013; Arteaga Matute et al. 2016a; 2016b; Barragán Mallofret 2016). From 4200 BP onwards, the marine influence in the estuary decreased and the formation of deltaic structures, due to climatic and anthropic sedimentation processes, favoured the filling up process of the estuary (Rodríguez Ramírez et al. 1996, 1086 f.; Borja Barrera/Borja Barrera 2016). The Lower Guadalquivir Basin features three units: the Aljarafe Plateau, the foothills of Gerena, and the countryside around Seville (fig. 4).

### 2.1.3.1 The Aljarafe Plateau

This is a small plateau, tilted 3 to 7% in a N-S direction. It was created by the Alpine orogeny during the middle and late Tertiary and is sedimentary limestone in nature. It is limited to the east by the escarpments of the Guadalquivir fault and to the west by the Guadimar Basin. The maximum level is located in the northern area where it reaches 187m.a.s.l. before sloping downwards to the Guadalquivir marshes. The base was formed by argillaceous blue marls of the Upper Messinian followed by an alternation of clay-silt layers and at the bottom there are red silty-sandy soils of ferruginous character and poor agricultural quality (Mudarra Gómez 1988, 24; Borja Barrera/Borja Barrera 2016).

Small calcareous elevations are frequent features of this landscape (Borja Barrera/Borja Barrera 2016; Mudarra Gómez 1988, 24).

### 2.1.3.2 The Foothills of Gerena

This is an area framed to the south by the Aljarafe plateau, to the north by the foothills of the Sierra Morena mountain range, to the west by the Guadimar River, and to the east by the right bank of the Guadalquivir and the Rivera de Huelva (Vargas Jiménez 2003, 126).

The area is characterised by a flat morphology with gentle undulations of rich agricultural soils. From a geological point of view, soils are composed

of grey loams of Mio-Pliocene clay and are, in some cases, slightly silty (Vargas Jiménez 2003, 126).

The area is also characterised by the presence of multiple streams and seasonal waters from the Sierra Morena and the Aljarafe Plateau, which flow into both the Guadalquivir and the Guadimar River.

### 2.1.3.3 The Countryside around Seville

This occupies a substantial portion of the Guadalquivir depression and is characterised by flat and gently rolling hills formed in the Post-orogenic depression of the Guadalquivir Valley. It is composed of limestone sedimentary materials of secondary and tertiary origin such as sands, silts, clays, gravels, and pebbles in the areas close to the river and by marl channels, calcarenites, sands, and limestones in the interfluves. It is located between the Sub-Baetic system and the Guadalquivir River.

Within the countryside of Seville, the Alcores represents a Late Pliocene outcrop of inclined tabular formations ca. 30km in length, with a NE-SW orientation and widths between 1km in the north and 10km in the south. The unit has a maximum height of 200m.a.s.l. in the north and 50m.a.s.l. in the south. It is framed by the left margin of the Corbones River Basin and the Guadaira River to the east and south and by the alluvial deposits that make up the terraces of the Guadalquivir in the north. The base of this formation is constituted by blue and gray marls. The crust of the Alcores formation is made of late Messinian massive yellowish detrital calcarenites, sandstones, and yellow silts (Llargo López/Ubera Jiménez 2008, 2370 f.; Perea Torres/González Fernández 2005, 977). Next to the Alcores, it is the Corbones River Basin which makes up the soils of the Carmona countryside. These are shallow vertisol soils of high productivity, characterised by their great water retention capacity due to a high percentage of clays (Perea Torres/González Fernández 2005, 980). The Corbones River links the Antequera and the Sierra de Ronda zones, located in the Baetic Mountain Range, with the Guadalquivir Valley (Fernández Caro/Gavilán Ceballos 1995, 56).

## 2.2 Environmental Conditions: Climate and Vegetation

The location of the Guadalquivir Basin, situated between the Mediterranean Sea and the Atlantic Ocean, offers conditions of high botanical diversity where the flora is mostly comprised of Atlantic species. The rainfall regime, despite being substantial, remains a typically Continental Mediterranean climate. It is characterised by long, arid summers with hyper-arid months (July and August) and rainy winters. Due to the maritime influence, frosts are scarce (Rivas Martínez 1988). The first half of the Holocene was characterised by an increase in humidity and temperature that resulted in the proliferation of Mediterranean ecosystems characterised by oak (*Quercus* sp.) and pine (*Pinus* sp.).

The second half of the Holocene corresponds to a cold period with episodes of marked aridity that reach to present times (Pantaleón-Cano et al. 2003; Goy et al. 1996; Zazo et al. 2008; Jimenez Moreno et al. 2015; Borja Barrera/Borja Barrera 2016, 46). Between 8000 and 5000 BP, humidity diminished, giving way to far more arid conditions related with the 8.2 event (Asensi/Díez Garretas 1987; Cacho et al. 2010, 17). From the 4.2 ka BP climatic event onwards, aridity increased, mostly in the south of the Iberian Peninsula. These environmental changes, along with the overexploitation of resources, were the main reason for the crisis in the Late Copper Age (Cacho et al. 2010, 20).

The vegetation of the Guadalquivir Valley corresponds to the climatic dominion of the Oleo-Ceratonion that is present in lands below 400m in the north of the Guadalquivir. The natural forest of this Mediterranean area would correspond to a 'maquia' or high scrub vegetation but in the case of the Guadalquivir Basin, due to the oceanic influence, the vegetation includes riparian forests as well as thermo-Mediterranean and meso-Mediterranean basophilic forests of holm and cork oaks on siliceous substrates, with occasional wild olive trees over vertisols. Carob trees (*Ceratonia siliqua* L.) are also present and arboreal species feature mostly as shrubs (Rivas Martínez 1988; Asensi/Díez Garretas 1987; Mudarra Gómez 1988; Serruto Bellido/Villamil Prieto 1990).

The high scrub is represented by *Asparageto-Rhamnetum* in association with other species such as *Asparagus albus* L., *Rhamnus oleoides* L., *Ceratonia siliqua* L., *Chamaerops humilis* L., *Pistacia lentiscus* L., *Asparagus stipularis*, *Osyris lanceolata*, *Myrtus communis* L., *Phlomis purpurea* L., *Clematis cirrhosa* L., *Aristolochia boetica* L., *Lonicera etrusca* L., and *Capparis spinosa* L.

The low scrub is formed by species such as *Coridothymion capitatus*, *Helianthemum Thymifolium*, *Phlomis purpurea*, and *Asperula hirsuta*.

Grasses are represented by species of high value for livestock such as *Scorpiurus sulcata*, *Scorpiurus subvillosa*, and *Astragalus stella*. In loamy soils, species such as *Hedysarum coronarium*, *Hedysarum capitatum*, and *Malope malacoides* are present.

In deep loamy soils *Scolymo-Kentrophyllion* as well as *Brachypodium phoenicoides*, *Foeniculum piperitum*, *Medicago ciliaris*, and *Medicago sativa* L. are the predominant specimens (Rivas Martínez 1988; Mudarra Gómez 1988, 31; Serruto Bellido/Villamil Prieto 1990).

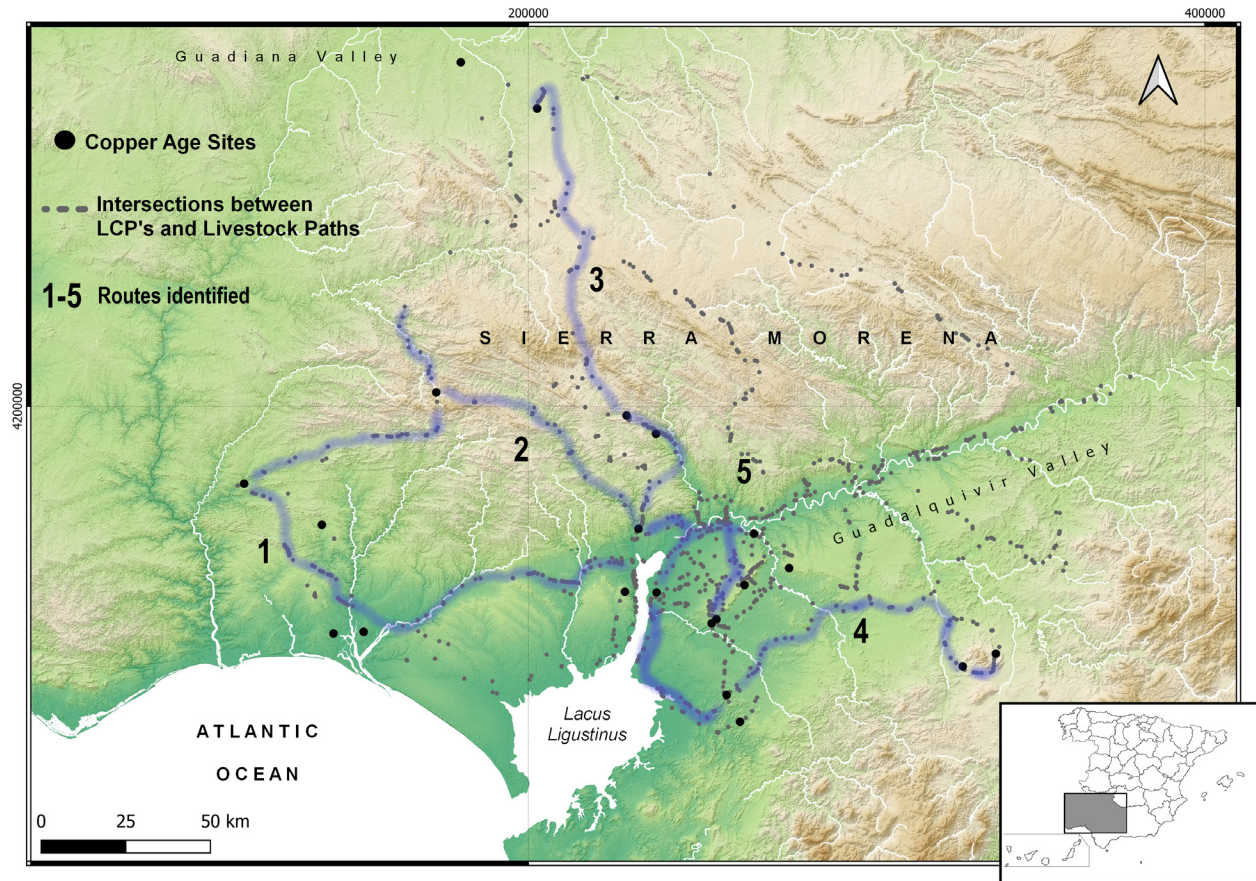
## 2.3 Cattle-Tracks in Southwestern Spain

According to Spanish legislation, a cattle-track is a route or itinerary through which livestock traditionally circulate (B.O.E. Ley 3/1995).<sup>1</sup> They are classified according to the width of the droves into *Cañadas* (up to 75m), *Cordeles* (up to 37.5m), *Vereadas* (up to 20m), and *Coladas* (any livestock track with a width of less than 20m). They are all interconnected through tracks of smaller width called branches and castings. Throughout the route, support elements such as troughs, resting places, and pens for flocks are routinely placed.

Due to transhumant grazing, which sought the cyclical use of pastures located in distant areas, an extensive network of pastoral routes was created.

The cattle trails in southern Spain span over 33,000km. Already from the 1<sup>st</sup> cent. BC onwards, there were the so-called *pastorum streets* as well

<sup>1</sup> Boletín Oficial del Estado núm. 71, de 24 of March of 1995, 9206–9211.



**Fig. 5.** Identified corridors in southwestern Iberia during the Copper Age according to Díaz-Zorita Bonilla et al. 2022a.

as the *viae*, *iter*, and *aestus* for the passage of cattle and carriages. The main roads run in a N-S direction. Transhumant movement that often starts in the spring goes from the southwest towards the north (Manzano Baena/Casas 2010, 74).

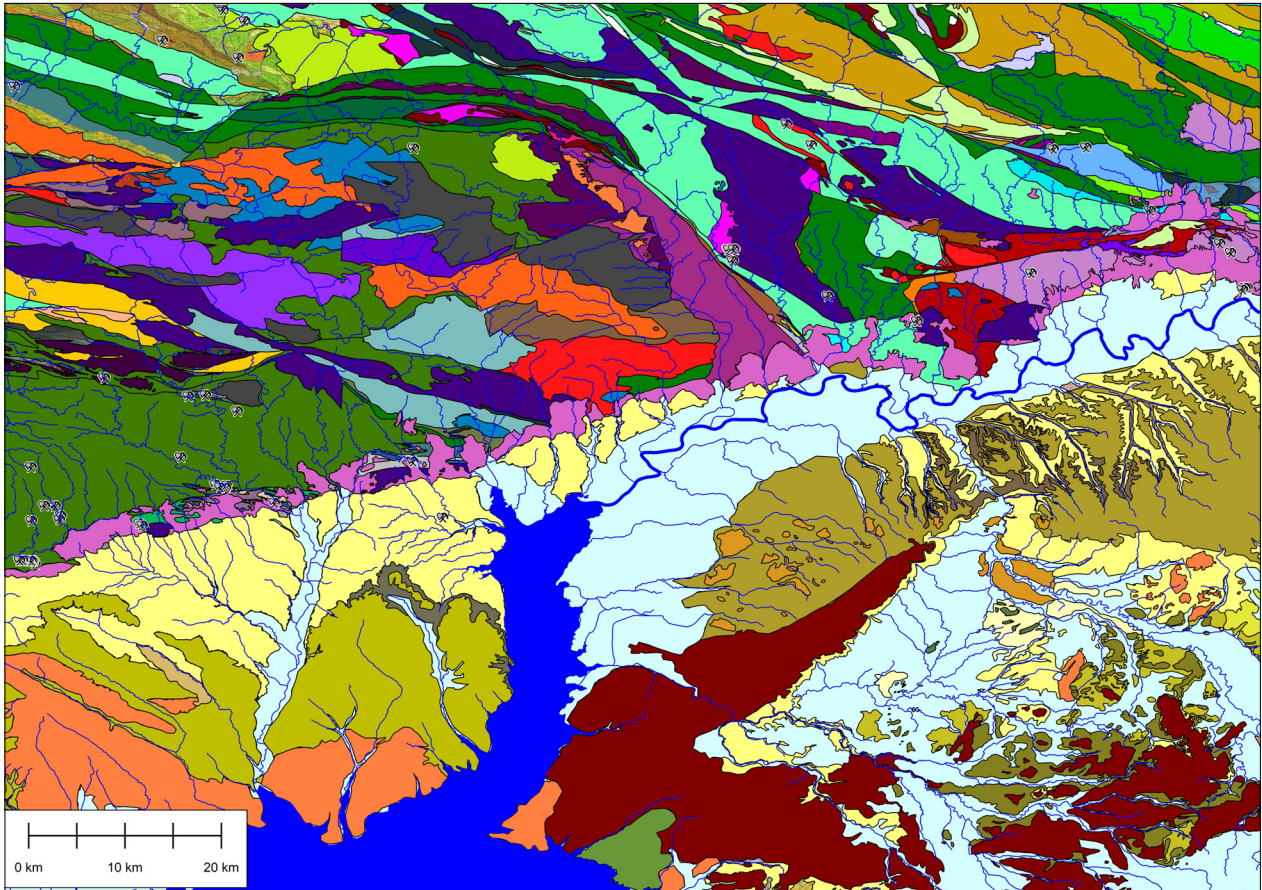
The origin of livestock routes is controversial. Some authors defend that the old routes come from the temporary migrations made by large herbivores at the end of the last Glaciation. These routes have typical characteristics for the passage of quadrupeds, such as crossing steep sloped valleys (Garzón Heydt 1993; Gómez Sal/Lorente 2004; Manzano Baena/Casas 2010, 79).

With the rise of domestic stock, wild animals would have been replaced by livestock perpetuating the routes and movement patterns (Manzano Baena/Casas 2010, 79).

The oldest existing documentation on livestock trails in Spain and their relationship with pastoral practices can be traced back to the Roman conquest, but some authors, such as Sánchez-Corriendo Jaén (1997), argue for the southwestern Bronze Age *stelae* as winter pasture markers linked with transhumance movements.

Livestock trails contribute to the development of commercial activities by connecting the resources as well as the habitats in any area (Cruz-Auñón Briones et al 1992, 132; Manzano Baena/Casas 2010,77; Díaz-Zorita Bonilla et al. 2022a).

Recent work has demonstrated the presence of possible routes or passageways dating back to the Copper Age and continued throughout the Bronze Age, based on settlement patterns (Díaz-Zorita Bonilla et al. 2022a) (*fig. 5*).



**Fig. 6.** Geological variability and prehistoric copper mines distribution in the Lower Guadalquivir Valley according to Hunt Ortiz (2003a) and Díaz-Zorita Bonilla et al. (2022b). Modified from Mapa Geológico de España E. 1:50.000. Segunda Serie (MAGNA).

#### 2.4 Rivers, Streams, and Water Access

The Retortillo, Guadalbarcal, Rivera de Huéznar, Rivera de Huelva, and Viar rivers, originating in Sierra Morena, are the main tributaries on the right bank of the Guadalquivir River. On the left bank, the main tributaries are the Genil, Corbones, and Guadaira rivers (García Martínez 2015, 139) as well as Miraflores and Tamarguillo streams.

In addition, a multitude of small streams and temporary watercourses are located throughout the area between the Sierra Morena and the Vega de Gerena.

#### 2.5 Abiotic Resources

The Sierra Morena offers a great variety of lithic resources and copper ores as previous works in the area have shown (Hunt Ortiz 2003a; Costa Caramé 2010). In 2016, as part of the project A 02 ‘Viel Erz und wenig Wasser. Sozio-kultureller Wandel in Verbindung mit Ressourcennutzung in der jüngeren Vorgeschichte der iberischen Halbinsel’ within DFG funded SFB 1070 RessourcenKulturen directed by Martin Bartelheim (which this work is part of), an archaeomineral survey was carried out in the Sierra Norte of Seville and Huelva, under the direction of Díaz-Zorita Bonilla and Mark Hunt Ortiz (Díaz-Zorita et al. 2022b) (*fig. 6*).



### 3 Settlement Patterns in Southwest Spain

#### 3.1 Introduction

The increase in radiocarbon dating in recent years allows the Chalcolithic period in southwest Spain to be dated between ca. 3200 and 2200 calBC (Lull Santiago et al. 2015, 369; Castro Martínez et al. 1996, 89; García Sanjuán 2013; 2017; García Sanjuán et al. 2018). According to Márquez Romero/Jiménez Jáimez (2010, 12), during the initial Chalcolithic period (ca. 3200–2500 BC), there is a continuity of the settlement patterns recorded in the 4<sup>th</sup> mill. BC. From the second half of the 3<sup>rd</sup> mill. BC, changes will have their reflection in society, and the first hierarchical societies and social inequalities appear and will develop until the appearance of the chiefdom in the Bronze Age. The 3<sup>rd</sup> mill. BC is characterised by the consolidation of socio-economic changes that started in the middle of the 4<sup>th</sup> mill. BC. Those changes began to have their reflection on the archaeological record from the last quarter of the 4<sup>th</sup> mill. BC. Throughout the 3<sup>rd</sup> mill. BC, there is a population increase that is reflected by an increase in the number and size of the settlements, both inland and in the coastal areas around the paleo-estuary of the Guadalquivir (Cruz-Auñón Briones et al. 1992, 130). The first substantial concentrations of populations with a stable character appear at sites such as La Pijotilla with 80ha, Valencina-Castilleja with 460ha, and Marroquíes with 113ha. These large sites were occupied almost continuously throughout the 3<sup>rd</sup> mill. BC. In contrast, the smaller settlements were occupied for shorter time spans (Hurtado Pérez 1999; Vargas Jiménez 2003; 2004; Zafra de la Torre et al. 1999; Díaz del Río Español 2004, 88; Lull Santiago et al. 2015, 369).

From 2200 BC onwards, there is a fall in the demographic indicators and a new form of social relationship appears, which points to an increase in social differentiation due to a sudden cultural collapse (Lull Santiago et al. 2015, 269; Valera 2015, 422). According to Fernández Gómez (2011, 31), the climatic change from the Atlantic to the Sub-boreal

stage, marked by more arid conditions, had important effects on the way of life of these communities.

From an economic point of view, the introduction of the plough, as well as the use of other secondary products such as traction or fertilisers, allowed people to increase the yield of lands with low quality soils for agricultural practices. As a consequence, there seems to be a higher productivity and the accumulation of surpluses mainly from the second half of the 3<sup>rd</sup> mill. BC onwards (Lazarich González 2005, 366; Greenfield 2010, 30; García Sanjuán/Murillo Barroso 2013, 119). This increase in agricultural practices is evidenced by a higher proportion of elements related to agricultural production such as grind stones, adzes, and sickle elements, as well as an increase in bovine remains in the archaeological records that indicate their use as work force. Likewise, the presence of elements related to the exploitation of secondary products derived from caprines, such as the so-called cheese weights or loom weights, are documented for the first time.

Despite the consolidation of a permanent way of life focused mostly on agricultural practices, according to Lull Santiago et al. (2015, 369), spatial mobility was also practiced. This mobility is reflected in both the social and economic organisation of settlements as well as by the overall settlement patterns. The use of animal traction also reduced the difficulty of transporting people, as well as goods and ideas, over long distances (Greenfield 2010, 30). Throughout the 3<sup>rd</sup> mill. BC, there was an increase and intensification of the exchange networks both at the regional and supra-regional level. This is confirmed by elements of long-distance exchange such as ivory from Africa and Asia, and ostrich eggs and amber from Sicily (Murillo Barroso et al. 2018).

According to Martín de la Cruz et al. (2000, 223), at the beginning of the Chalcolithic, settlements were located in lowlands or slightly elevated areas near water and fertile lands, a pattern that lasted until the Late Chalcolithic.



**Fig. 7.** Fortified access to the San Blas settlement (left) (Cheles, Badajoz) (after Hurtado Pérez 2004b, 146). Fortification and cistern in Cabezo Juré (Alosno, Huelva) (right) (after Nocete Calvo 2006, 649).

However, from the Middle Copper Age onwards, there was a change in settlement patterns which is attributed to a demographic increase. From this period onwards, some settlements were fortified and strategically located to control the cattle tracks and fertile lands.

Sierra Morena offers a great variety of resources and this resulted in a rather intense population for geostrategic reasons. This area is rich in terms of agricultural, forestry, mining, and lithic resources. According to Martín de la Cruz et al. (2000, 225), sites are close to rivers in abrupt or mountainous, easy to defend, areas.

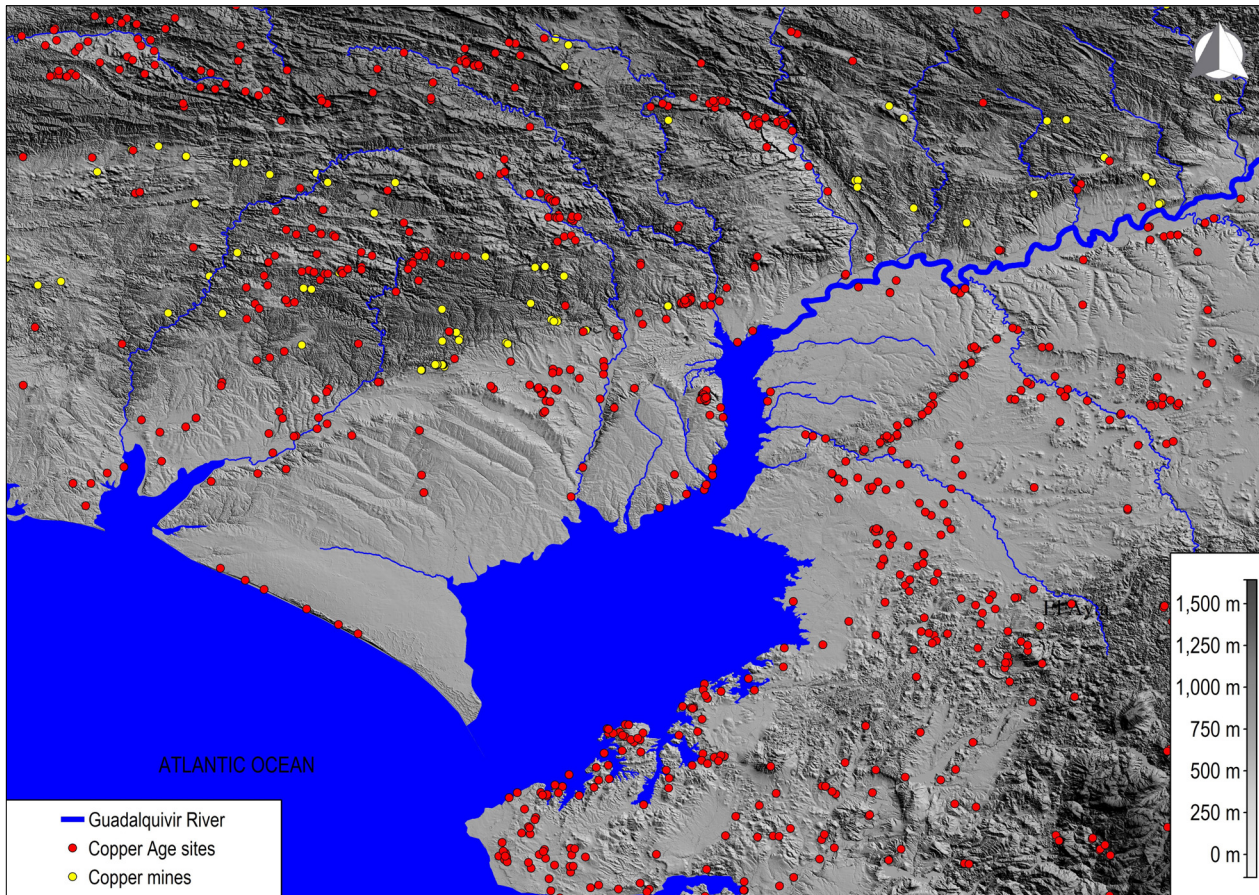
Rodríguez Fernández (1992) divides open air settlements into two groups based on the geophysical features of the soil:

- (1) settlements located on sedimentary soils whose structures are dug into the soils as is the case at Valencina-Castilleja, El Amarguillo II, and Carmona (Rodríguez Fernández 1992, 7 f.);
- (2) settlements located on rocky areas where lithic resources are abundant and used for the construction of structures such as Cabezo Juré (Nocete Calvo 2006; Abril López 2012) and San Blas (Hurtado Pérez 2004a; 2004b) (fig. 7).

### 3.2 Types of Settlements

The debate on the level of settlement permanence in the southern peninsula is a widely discussed topic (Hurtado Pérez 2006; Díaz del Río Español 2013; Gaydarska/Chapman 2022). For some authors, such as García Sanjuan, sites like Valencina-Castilleja were a non-permanent settlement of population aggregation for the performance of rites, mainly funerary ones (García Sanjuan 2017). In contrast to this interpretation, authors such as Nocete Calvo defend the permanent character of this type of settlement as centres of state power that control the territory at a state level (Nocete Calvo et al. 2008).

Settlement patterns incorporate a variety of environmental and topographical conditions (e.g. mountain and plain areas, open places and caves) that suggest a high diversity of lifeways during this time (García Sanjuán/Murillo Barroso 2013, 124; Lull Santiago et al. 2015, 366). However, most of the sites were of small size (less than 0.5ha) and in open areas (Lull Santiago et al. 2015) (fig. 8). Larger sites were occupied for nearly a millennium, whereas smaller sites may have been occupied



**Fig. 8.** Location of 3<sup>rd</sup> mill. BC Copper Age sites in the Lower Guadalquivir Basin.

for only a few centuries or even decades (Lull Santiago et al. 2015, 369). During the first half of the 2<sup>nd</sup> mill. BC, these sites were abandoned and new habitation zones emerged.

In the case of the Guadalquivir Valley, the proportion of settlements fortified with stone walls, was considerably lower in number than in the mountainous area. This may be due to the easier accessibility of stone as construction material in the mountainous areas. Likewise, the lower proportion of arable land and pasture areas in the settlements located in the mountains would produce greater conflict over access to resources, which would require more effective defensive measures. Conversely, settlements located in the Guadalquivir Valley, where the proportion of arable land and pasture is higher, would exhibit less inter-community conflict.

Settlements located in the Guadalquivir Basin can be classified into pit fields, ditch enclosures, and walled enclosures. The lack of geophysical

surveys, which are more affected by agricultural work, makes it more difficult to identify possible settlements with defensive systems. Most of the settlements have been identified during pedestrian surveys, and therefore their actual extent and configurations remains unknown.

### 3.2.1 Pit Fields

The first research on pit fields dates back to the early 19<sup>th</sup> century. These sites are the most abundant category in the Late Prehistory of the Iberian Peninsula.

They start in the Early Neolithic, reaching their heyday between the Late Neolithic and the Copper Age (Márquez Romero/Jiménez-Jáimez 2010, 110–112). These sites are characterised by aggregations of pits and basins without any spatial organisation and lacking ditches and trenches (Márquez Romero/Jiménez Jáimez 2010, 17; Márquez Romero/



**Fig. 9.** SET Parralejo (Vejer de la Frontera, Cádiz) (Photo: Juan Jesús Cantillo Duarte).

Mata Vivar 2016, 42) (*fig. 9*). The first interpretations took these negative structures as belonging to small settlements with economies based on agricultural practices (Márquez Romero/Jiménez Jáimez 2010, 20). Márquez Romero/Mata Vivar argue that these types of sites were not permanent, but instead reflected a seasonal exploitation of some very specific resources (Márquez Romero/Mata Vivar 2016, 43).

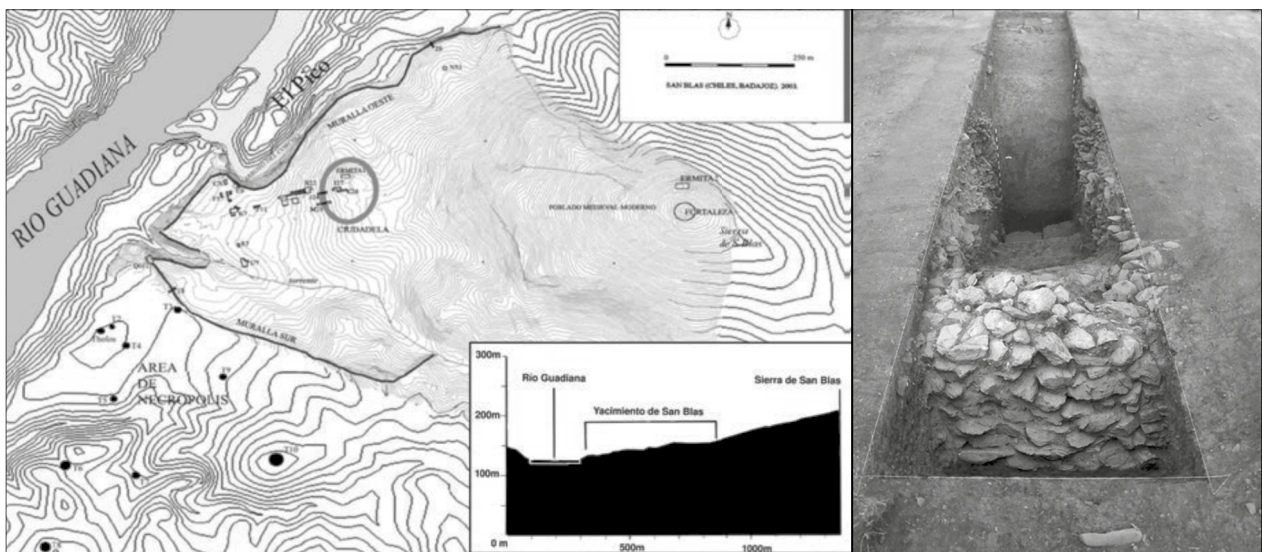
**3.2.2 Walled Enclosures**

Walled enclosures are mostly found in central and southern Portugal (Gonçalvez et al. 2013, 77). These kinds of settlements are not well known in the Lower Guadalquivir Valley, having only been

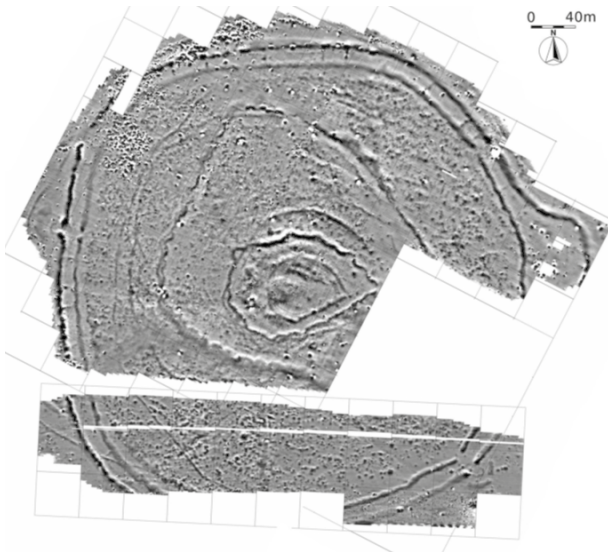
identified on the Cerro de San Pedro and Marinaleda (Caro Gómez et al. 2004; Hurtado Pérez 2004a, 242).

The chronological framework of the walled enclosures spans from the 4<sup>th</sup> to 2<sup>nd</sup> mill. BC (Jorge 2003a, 15). In southwestern Iberia, they date from the end of the 4<sup>th</sup> mill. BC to the end of the 3<sup>rd</sup> mill. BC, but reach their heyday in the first half of the 3<sup>rd</sup> mill. BC (Jorge 2003b, 103). These settlements are often less than 1ha in size, although larger settlements such as Los Millares with 19ha (of which 13ha correspond to the funerary area) or San Blas with 30ha exist (Jorge 2003a, 15; Molina González et al. 2004, 143; Hurtado Pérez 2004a; 2004b) (*fig. 10*).

According to different authors, walled enclosures appeared due to inter-community conflict for political, territorial, and resource control (Gonçalvez et al. 2013; Jorge 2003a, 97). Recent studies have questioned the defensive function of these structures and types of settlements, instead attributing to them a role in delimiting the functionality of spaces for certain social practices (García Sanjuán/Murillo Barroso 2013, 123). For Gonçalvez et al. (2013, 37), the defensive purpose may have changed through time with these structures taking on new functions as power or social and territorial partitions. This author defends that most of these walled enclosures do not meet the minimum conditions for defensive tasks (Jorge 2003a, 19).



**Fig. 10.** The walled enclosure at San Blas (after Hurtado Pérez 2004b).



**Fig. 11.** Perdigoes (Reguengos de Monsaraz, Portugal) (after Márquez Romero et al. 2011, 180).

### 3.2.3 Ditched Enclosures

This type of settlement is documented throughout Europe, with those belonging to the Linearbandkeramik (LBK) of the final phase of the Danubian Neolithic culture being the oldest ones documented and associated with permanent settlements (Márquez Romero 2001, 209). They are generally designed as concentric rings of continuous or discontinuous ditches and numerous scattered pits, which are rare or absent at walled sites (Márquez Romero/Jiménez Jáimez 2010; 2012; 2013). Their time of use spans from ca. 3500–2500 until ca. 2250 BC. In most of the cases, the domestic structures documented in these sites are restricted to pits and basins that some authors identify as short-lived storage pits and huts (Márquez Romero 2001, 209). Three main interpretations of these types of sites have been postulated. The first considers monumental settlements to be the result of a spatial and social hierarchical process (Earle 1991). The second interprets them as seasonal aggregation spots to carry out social activities (exchange, rituals etc.) in mobile or semi-mobile groups (Thomas 1999). The third interpretation by Díaz del Río Español (2003) considers them to be production settlements that, in contrast to the postulates defended by Earle, do not reflect any particular hierarchy of a territory (Díaz del Río Español 2003, 64).

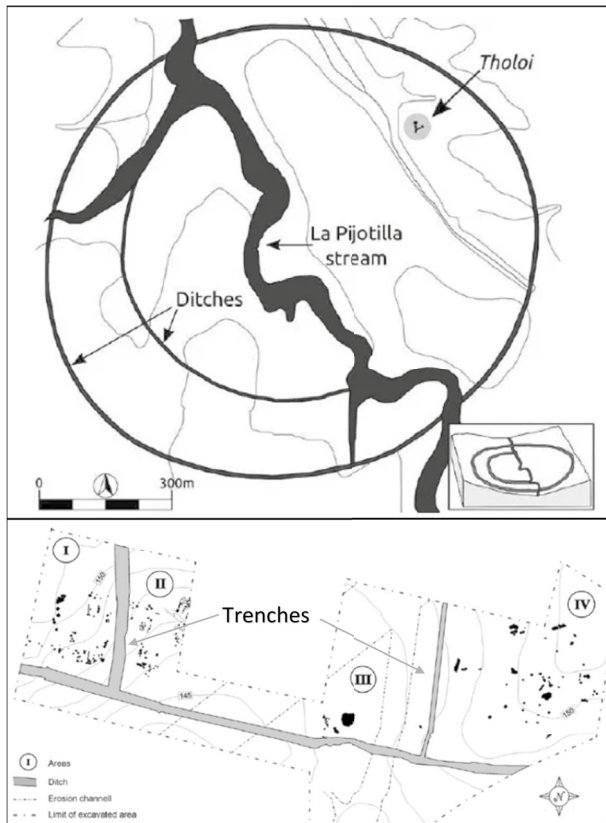
In addition, according to Rodrigues (2014), features located in ditched enclosures evidence productive activities, depositional acts, and food consumption, as well as mortuary practices and rituals. Furthermore, there are some authors who argue that ditched enclosures such as Perdigoes (fig. 11) are more often associated with ritual activities, more variable in size, location, occupation duration with different roles than those documented for walled sites (Valera 2015, 416; Márquez Romero/Jiménez Jáimez 2010).

## 3.3 Types of Domestic Structures

Most of the structures documented during this period are characterised by being fully or partially dug into the substrate. In the case of the Lower Guadalquivir Valley, the absence of stones makes it difficult to infer functionality from the documented structures.

According to García Sanjuán/Murillo-Barroso (2013, 123), the descriptions in the literature of negative structures, often described as ‘silos’, ‘hut floors’, or ‘dumps’, has generated widespread debate (Márquez Romero 2004; 2006; Márquez Romero/Jiménez Jáimez 2010; Jiménez Jáimez/Márquez Romero 2006; Cámara Serrano et al. 2011). The terminology applied to these types of structures has been traditionally based on a putative functionality that empirical data seldom supports. On the other hand, negative structures could have been made with different purposes before ultimately being used as dumps, making it difficult to assign a straightforward function. Following Márquez Romero/Jiménez Jáimez (2010, 7), here two categories are considered based on their form rather than their functionality: negative linear and negative circular structures.

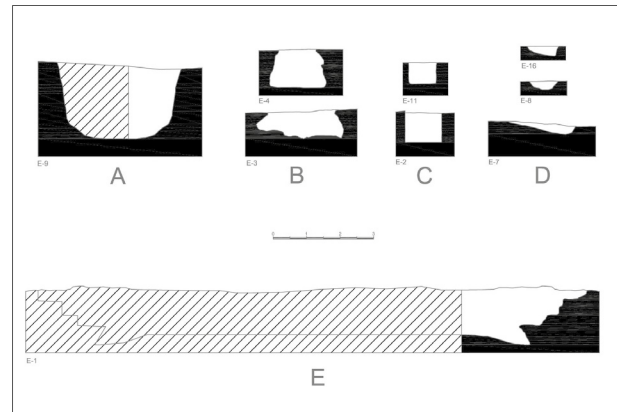
Regarding the negative linear structures, this category includes longitudinal structures, such as ditches or trenches. They have ‘U’ or ‘V’ shaped sections and depths ranging between 7m at Valencina-Castilleja (Fernández Gómez/Oliva Alonso 1985) and less than 1m documented at Peñón Gordo (Perdigones Moreno/Guerrero Misa 1987). In fact, although the average depth is between 2 and 3m and the widths between 2 and 4m, some



**Fig. 12.** (A) Ditched enclosure of La Pijotilla (after Jiménez Jáimez/Márquez Romero 2016, 64) (above) and (B) general plant of the smelting quarter in Valencina-Castilleja (modified from Nocete Calvo et al. 2008, 719) (below).

trenches are less than 1m wide while others exceed 20m (Márquez Romero/Jiménez Jáimez 2013, 452). These structures are extremely variable and irregular in shape and depth, even within themselves (Márquez Romero 2001, 210). Although linear and circular types exist, the lack of geophysical analyses and large scale excavations, along with a lack of knowledge of the complete path of the structures, explains why they are mostly described as ‘ditches’ or ‘trenches’.

Fernández Gómez/Oliva Alonso (1985) interpret these structures in the site of Valencina-Castilleja as drainage systems later used for defensive purposes, whereas Márquez Romero (2001, 210) insists on the ritual character of this type of construction. Within this category, linear structures which delimit a closed space are referred to as ditches (fig. 12A). The functionality assigned to these types of structures includes defensive



**Fig. 13.** Typology of negative structures (after Escudero Carrillo et al. 2017, 265).

functions (Cruz-Auñón Briones/Arteaga Matute 1999, 605; Cámara Serrano/Lizcano Prestel 1996, 382), water drainage systems (Fernández Gómez/Oliva Alonso 1985, 114), and spaces to strengthen social links inside a site (Nocete Calvo 1989). Linear structures that divide two spaces are referred to as trenches. These trench structures, the direction of which is always straight, are documented at PP-Matarrubilla (Valencina-Castilleja) (Hurtado Pérez 2003, 244; Nocete Calvo et al. 2008) (fig. 12B). Trenches have been interpreted as compost deposits (Bernáldez Sánchez et al. 2013), garbage dumps, fences, drainage systems, and water channels (Hurtado Pérez 2003, 247; Fernández Gómez/Oliva Alonso 1980; 1985; 1986).

Regarding the negative circular structures, this category includes structures with a circular or ovoid shape that is further subdivided into pits, basins, and shafts.

The depth of pits ranges from 1 to 2m and the diameter is often below 2m, being deeper than they are wide. Pits are divided into two types: cylindrical, when the mouth of the structure has the same diameter as the base (fig. 13A) (the depths of which are normally below 1m), and conical, when the base has a larger diameter than the mouth, defining a beaker profile (fig. 13B). The conical type has been traditionally called ‘silo’. They have often been assigned an original storage function followed by a use as garbage dumps, despite the fact that no analyses were carried out to establish their function.



**Fig. 14.** Shaft located at Cerro de la Cabeza (Valencina-Castilleja) (after Fernández Gómez 2011, 46).

Basins are structures that are wider than they are deep. They may feature straight walls, although the norm here is a slightly beaker-shaped cross section. There are also structures combining both cross sections (i.e. straight and beaker). A distinction can be made between the two types according to the construction of the walls. Basin depths range from 1 to 2m and their diameter is often larger than 2m (in some cases up to 5m). Traditionally, this type of structure has been referred to in the literature as a 'hut floor' (*fig. 13D*).

Shafts are structures of circular or ovoid shape where the depth is always more than 1m and the diameter less than 1m, and are therefore, as a rule, deeper than they are wide. In Valencina-Castilleja, a total of five shafts with a diameter of 1m were documented in the excavations of the La Perrera sector, two of which reached to almost 10m below ground (Fernández Gómez/Oliva Alonso 1986, 23) (*fig. 14*).

For Fernández Gómez (2011, 23), shafts serve to obtain water. But there is evidence of other uses, for example when deposits with human and animal remains have been found. This is the case of the structure located in Matababras street at Valencina de la Concepción (Castro Fernández et al. 2018), where the reuse of a shaft has been documented.

### 3.4 Funerary Patterns in Southwestern Spain

According to Acosta Martínez (1995, 60), individual burials are typical for the Neolithic but from the second half of the 4<sup>th</sup> mill. BC onwards, the custom turns toward collective burials. The dominant procedure is primary inhumation. Corpses are placed in a left or right lateral decubitus position with lower limbs flexed. Non-articulated human remains being mixed with articulated ones seems to be common practice due to the reuse of funerary spaces by the same communities through time (Díaz-Zorita Bonilla 2013, 46; 2017; Lacalle Rodríguez/Guijo Mauri 2010, 14). In some cases, partial cremations have been documented. These are possibly related to the cleaning processes of the monument or to different sorts of ritual practices (Díaz-Zorita Bonilla 2017).

From 2500 to 2200 BC, a change in the mortuary practices is documented so that, over time, funerary rituals shift towards a personalisation of certain individuals. From monumentalised collective burials, a change towards individual tombs can be observed (Blanco-González et al. 2018; Valera 2015). Bell-Beaker graves are characterised by single burials in caves or reused *tholoi* and megalithic tombs. Individuals were associated with objects typical for the Bell-Beaker period such as Beaker vessels, copper daggers, and wrist guards (Garrido Pena 2007, 3).

#### 3.4.1 Types of Funerary Structures

According to Ferrer Palma (1982), Cruz-Auñón Briones (1983–1984), and Díaz-Zorita Bonilla (2017), funerary structures can be divided into megalithic and non-megalithic graves.

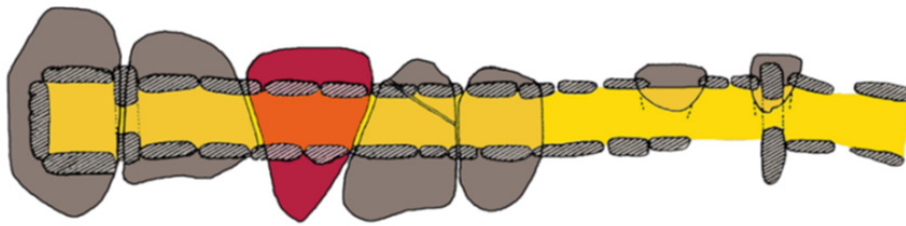


Fig. 15. Plan of Viera dolmen (after Bueno Ramírez et al. 2013, 255).

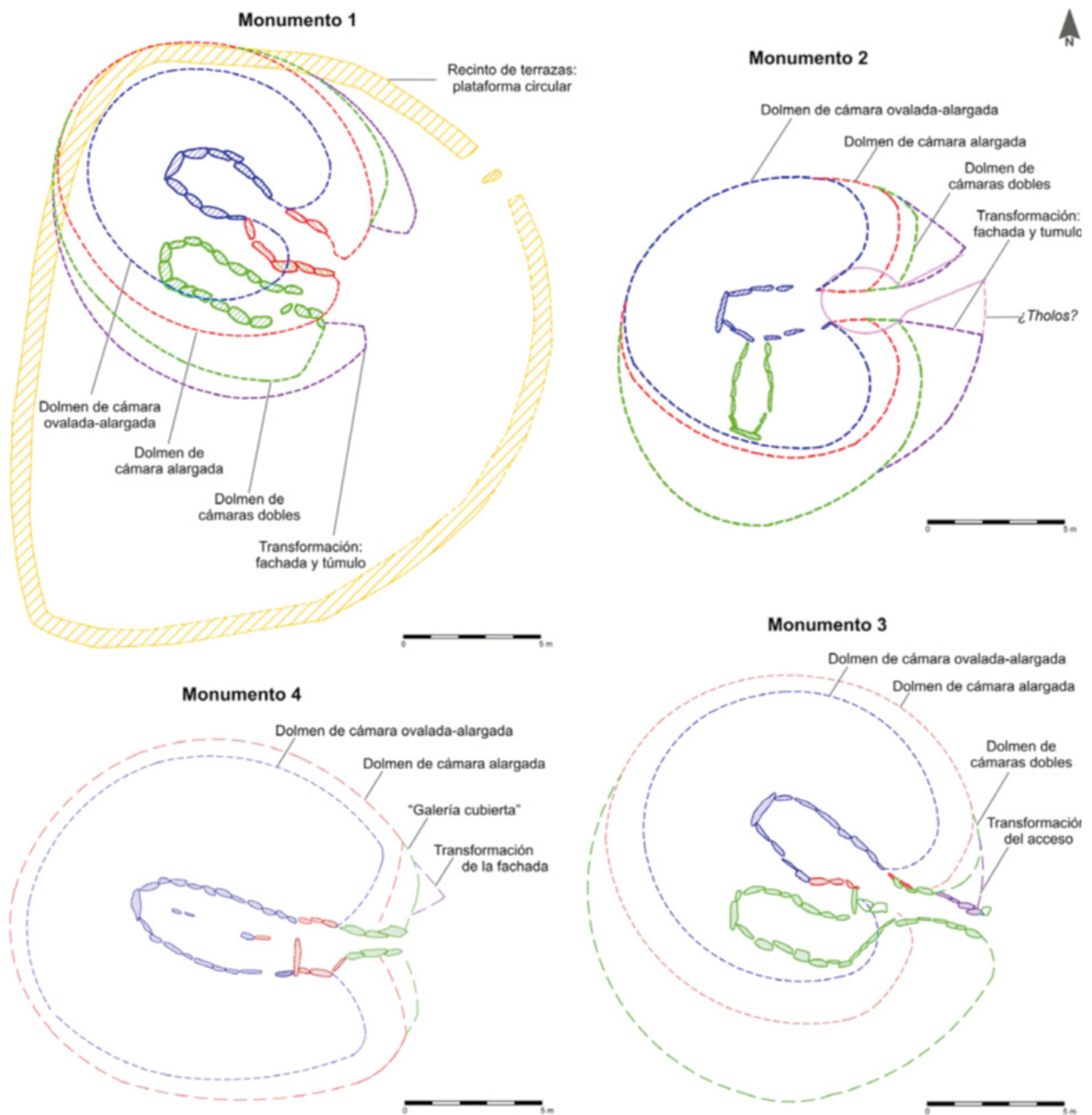


Fig. 16. Plan of Los Llanetes megalithic monuments (El Pozuelo, Huelva) (after Linares Catela 2018, 527).

### 3.4.1.1 Megalithic Structures

Megalithic structures are characterised by the use of large stones, their typology includes three types: The first type consists of chambered tombs which are structures built with large stones, although in some cases a drystone wall technique is used. They feature two sectors: The first one is a corridor which leads into the second sector, the chamber. The chamber can have a variety of shapes (Ferrer Palma 1982, 122) (*fig. 15*).

The second type are the passage graves which have no differences between the main chamber and the passage (Ferrer Palma 1982, 123) (*fig. 16*).

The third type, the *tholoi*, is characterised by a passageway which leads into a main circular chamber that is carved into the bedrock. The passageway is covered with large or middle-sized stones cemented with clay. The chamber is excavated into the bedrock and there is a stone plinth or a coating of slate slabs attached. In some cases, as in the *tholos* in the Plan Parcial 4-Montelirio sector at Valencina-Castilleja, *tholoi* with two different chambers have been documented (Fernández Flores et al. 2016; Mora Molina et al. 2013). The presence of niches in a chamber is not unusual. The cover of the chamber is a false dome made by an approach of stone courses. The entire structure is covered by a *tumulus* made of small stones and earth. The earliest *tholoi* have been dated to the beginning of the 3<sup>rd</sup> mill. BC but were reused in later times (García Sanjuán/Hurtado Pérez 2001; García Sanjuán et al. 2011; Ferrer Palma

1982, 124). Human remains were deposited in the main chambers but have been also documented in the passageways such as in the Montelirio *tholos* and the Matarrubilla dolmen in Valencina-Castilleja (Collantes de Terán 1969; Fernández Flores/Aycart Luengo 2013; Fernández Flores et al. 2016).

### 3.4.1.2 Non-Megalithic Structures

Non-megalithic structures are excavated into the bedrock. According to Díaz-Zorita Bonilla (2013, 44), some authors have interpreted these types of structures as ‘huts’, ‘storage pits’, or ‘shafts’. Since these structures had different uses during their lifetime, a terminology based on their possible function should be avoided.

Non-megalithic structures can be divided into:

(1) artificial caves which are characterised by being completely excavated into the bedrock without incorporating the basic elements characteristic of the megalithic structures (López Aldana/Pajuelo Pando 2017, 81; Ferrer Palma 1982, 126);

(2) pits and shafts where burials are located.

Most of these structures concentrate on the left bank of the Guadalquivir (López Aldana/Pajuelo Pando 2017, 81). This can be explained by a preference for sedimentary terrains that are easier to excavate (Juárez Martín/Moreno Alonso 2010, 229).

In the Lower Guadalquivir Valley, most artificial caves feature a simple circular chamber with



**Fig. 17.** (A) Artificial cave UE5 documented at Calle Dinamarca (after Pajuelo Pando/López Aldana 2013, 287) (left). (B) Human burial associated with the skull of a cow, identified at structure 4 at Valencina-Castilleja (after Castro Fernández et al. 2018, 4849) (right).

a vaulted profile (*fig. 17A*), in some cases, they can have straight walls. The dimensions of the chambers vary between 0.75m and 3m in diameter and between 0.8 and 1.7m in height. The roof is vaulted and the entrances are most often located in the central area that may be covered by a stone slab. At places such as El Acebuchal and Campo Real, interconnected chambers as well as vertical access corridors next to the walls of the chambers have been documented (Ribero Galán 1986, 387 f.;

López Aldana/Pajuelo Pando 2017, 81; Pajuelo Pando et al. 2013; Ferrer Palma 1982, 126).

Burials in shaft-type structures, such as structure 4 on Matababras street where six individuals, three of them in anatomical position with a large collection of faunal remains were documented, have been recorded at the Valencina-Castilleja site (*fig. 17B*). This structure is more than 3m deep and 1.2m wide (Castro Fernández et al. 2018, 48).

## 4 Materials and Methods

### 4.1 Introduction

Archaeozoological studies on the Iberian Peninsula, unlike in other European countries where the discipline began in the mid-19<sup>th</sup> cent., have had a late development, as pointed out by several authors (Morales Muñiz 2002; Grau-Sologestoa/García 2018; García Viñas/Bernaldez Sánchez 2013). In the case of the Iberian Peninsula, it was not until the second half of the 20<sup>th</sup> cent. that the first studies were carried out by German researchers from the Munich school (Grau-Sologestoa/García 2018). Throughout the 60's and 70's of the 20<sup>th</sup> cent., the first Archaeozoology laboratories were founded by Jesús Altuna in the Basque Country and by Arturo Morales at the Autonomous University of Madrid, increasing faunistic studies (Morales Muñiz 2002; Grau-Sologestoa/García 2018). In the 1980's, Jordi Estévez founded the laboratory at the Autonomous University of Barcelona.

In the case of the south of the Iberian Peninsula, archaeozoological studies are still scarce and the discipline is not fully consolidated.

This chapter presents the different methods applied during fieldwork and laboratory analyses. In the case of La Loma del Real Tesoro, fieldwork included micro-pedestrian survey, geophysical survey, and archaeological excavation. The analysis of materials focused on the study of the faunal remains from the various excavated structures. A Study of the ceramic and lithic remains was also conducted, along with palynological, carpological, and phytolith analyses. Finally, isotopic analyses and radiocarbon dating were performed on selected samples following excavation.

In the cases of Valencina-Castilleja and Carmoña, the analyses focused on the zooarchaeological study of selected structures. Isotopic analyses were also carried out. The sampling of bone materials for isotopic analysis from El Amarguillo II, Parque Miraflores, and Poblado Calcolítico was performed

in order to compare results and to interpret them within a larger framework of reference.

#### 4.1.1 Mapping

For the geological characterisation of the sites, the Geological National Map of Spain from the Spanish Geological Survey (IGME) at 1:50.000 scale (2<sup>nd</sup> series) has been used. Aerial orthophotographs derived from the flight undertaken in 2013 and the interministerial flights conducted between 1973 and 1986 were provided by the National Center for Geographic Information of Spain (CNIG).<sup>2</sup> The scale is 1:18.000. The Digital Elevation Model has a resolution of 25 to 50 cm/pixel. In specific areas, a digital elevation model was generated from LiDAR data provided by the National Plan of Aerial Photography (PNOA) of the Ministry of Public Works, Department of Agriculture, Fisheries and Food, Ministry of Finance, and official publications and data sources from the regional governments of Extremadura and Andalusia. These data have a density of 0.5points/m and the hypsometric precision is above 20cm. The coordinate reference system used in the cartographical data is ETRS89. Spatial analysis and cartographical models were generated in QGIS 2.18.6 with Grass 7.2.0.

#### 4.1.2 Organisation of Sites

Settlement location information has been compiled from the Andalucía Heritage Database,<sup>3</sup> as well as archaeological reports, publications, and regional archaeological maps.

<sup>2</sup> <<https://pnoa.ign.es/web/portal/pnoa-imagen/productos-a-descarga>> (last access: 21.04.2020).

<sup>3</sup> <<https://guiadigital.iaph.es/>> (last access: 21.04.2020).

### 4.1.3 Livestock Routes and Streams

Data from the Inventory of Livestock Trails associated sites (watering holes and resting points) and the surface water datasets for Andalusia have been provided by the Andalusian Environmental Information Network (Consejería de Medio Ambiente y Ordenación del Territorio, Junta de Andalucía).<sup>4</sup>

## 4.2 Archaeological Research at La Loma del Real Tesoro

The main objective of the project is to better understand the economic system of the region during the 3<sup>rd</sup> mill. BC and to analyse the possible relationship between control and access to resources. In addition, the project aims to identify similarities and differences in the evolution of the socio-cultural dynamics based on access to specific resources from each site.

The selection of La Loma del Real Tesoro as the main site of study is explained by its geostrategic location between two different ecosystems, which grant access to a wide variety of resources. Northwards, the Sierra Morena offers lithic and mining resources, including copper. To the south lie the fertile lands of the Vega del Corbones.

The site is located close to a potential ancient ford of the Guadalquivir that would have controlled access to both the Sierra and the Vega del Corbones. In addition, the location would have allowed control over the Cordel de Cerro Gordo cattle route which traverses it.

### 4.2.1 Micro-Pedestrian Survey at La Loma del Real Tesoro

The main objective of the micro-pedestrian survey was to analyse the total extension of the site and the dispersion of materials in order to record

two possible different functional areas: La Loma del Real Tesoro I and La Loma del Real Tesoro II (hereafter LRT-I and LRT-II). The archaeological work was carried out in two phases. During the first phase, undertaken in 2016, the focus was on the southern sector of LRT-I and the northern sector of LRT-II. The second phase, conducted in 2017, focused on the northern sector of LRT-I.

All finds were documented and georeferenced with three GPS devices: the Garmin GPSmap 62 st, the Garmin Etrex Vista, and the Garmin Monterra. Pottery fragments with special features or diagnostic elements were described according to decoration and form. Lithics were classified according to type, possible functionality, and raw material. Team members were distributed across 5m broad transects, with 1m of separation between each surveyor. Orientation of transects was established by considering crop lines, which usually ran in a S-N direction (*fig. 18*).

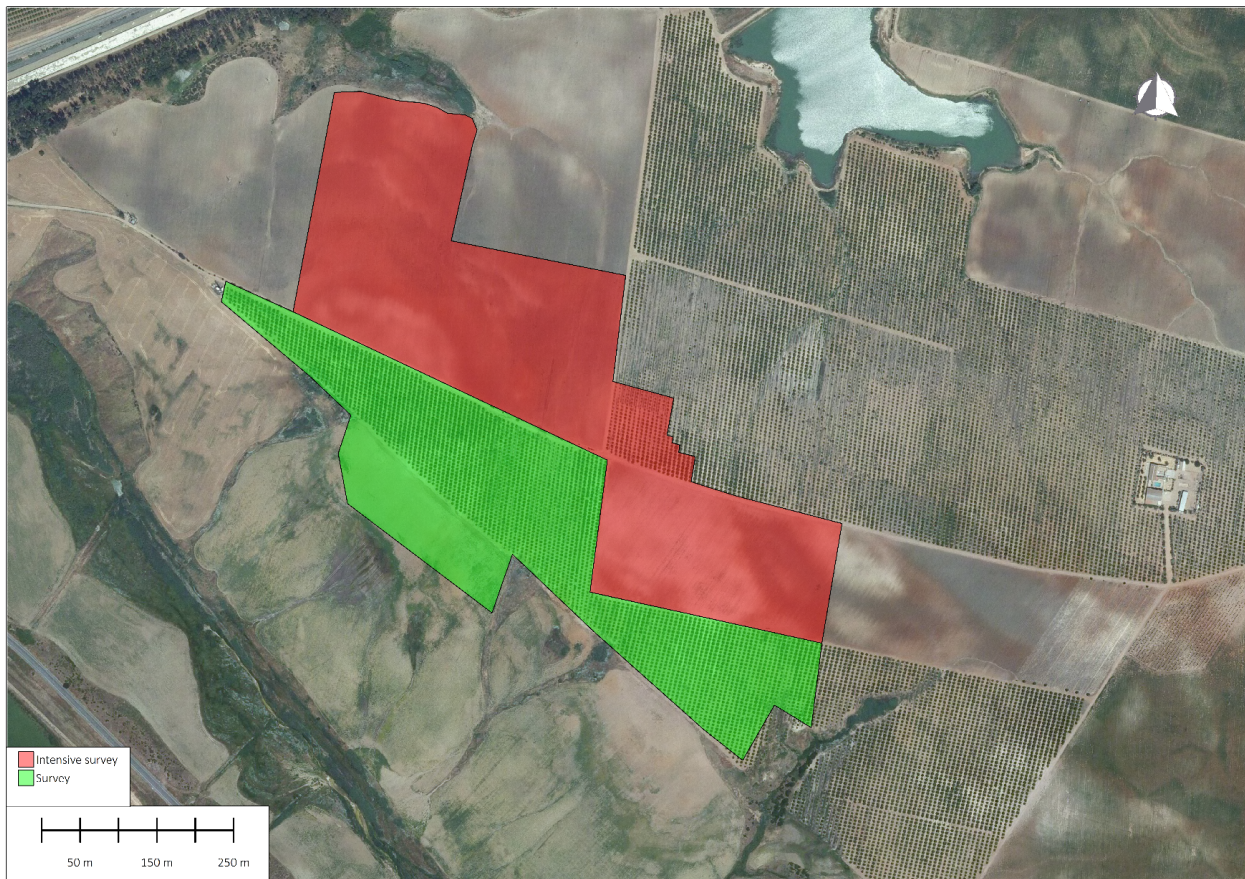
### 4.2.2 Geophysical Survey

A Cs-magnetometry survey was carried out by Helmut Becker from Becker Archaeological Prospection© in 2015 at La Loma del Real Tesoro. A second field season was undertaken in 2018 by Jason Herrmann from the University of Pennsylvania.

The main objectives of the geophysical survey were to identify the extension of the La Loma del Real Tesoro I and II sites and to identify areas promising for archaeological work. The survey was carried out during two field seasons in 2015 and 2018. A total of 12.534ha were surveyed (*table 2*).

During fieldwork in July 2015, three survey areas (1–3) were divided into 40m<sup>2</sup> square georeferenced grids, and each square was further sub-divided into 1m wide transects following the actual crop lines. A Geometrics G-858G caesium-magnetometer system was used together with Scintrex Smartmag SM4G-special CS2 sensors in a dual setting, with a separation between each sensor of 0.5m and 10 picoTesla sensitivity. The result was a digital picture produced by the magnetogram with a resolution of 10 x 50cm and 12nT (nanoTesla) dynamics in greyscale. White colour

<sup>4</sup> <<http://www.juntadeandalucia.es/medioambiente/site/portalweb/menuitem.d1a35641276b2bf2490a9d105510e-1ca/?vgnnextoid=fa99193566a68210VgnVCM10000055011ea-cRCRD>> (last access: 21.04.2020).



**Fig. 18.** Surveyed areas in La Loma del Real Tesoro I and II.

Area	Size (ha)	Location	Year
1	2.052	La Loma del Real Tesoro II	2015
2	1.311	La Loma del Real Tesoro I	2015
3	0.807	La Loma del Real Tesoro I	2015
4	3.175	La Loma del Real Tesoro II	2018
5	2.642	La Loma del Real Tesoro II	2018
6	0.64	La Loma del Real Tesoro II	2018
7	0.64	La Loma del Real Tesoro I	2018
8	0.118	La Loma del Real Tesoro I	2018
9	1.149	La Loma del Real Tesoro I	2018
Total	12.534		

**Table 2.** Surveyed areas including size of the survey and the year conducted.

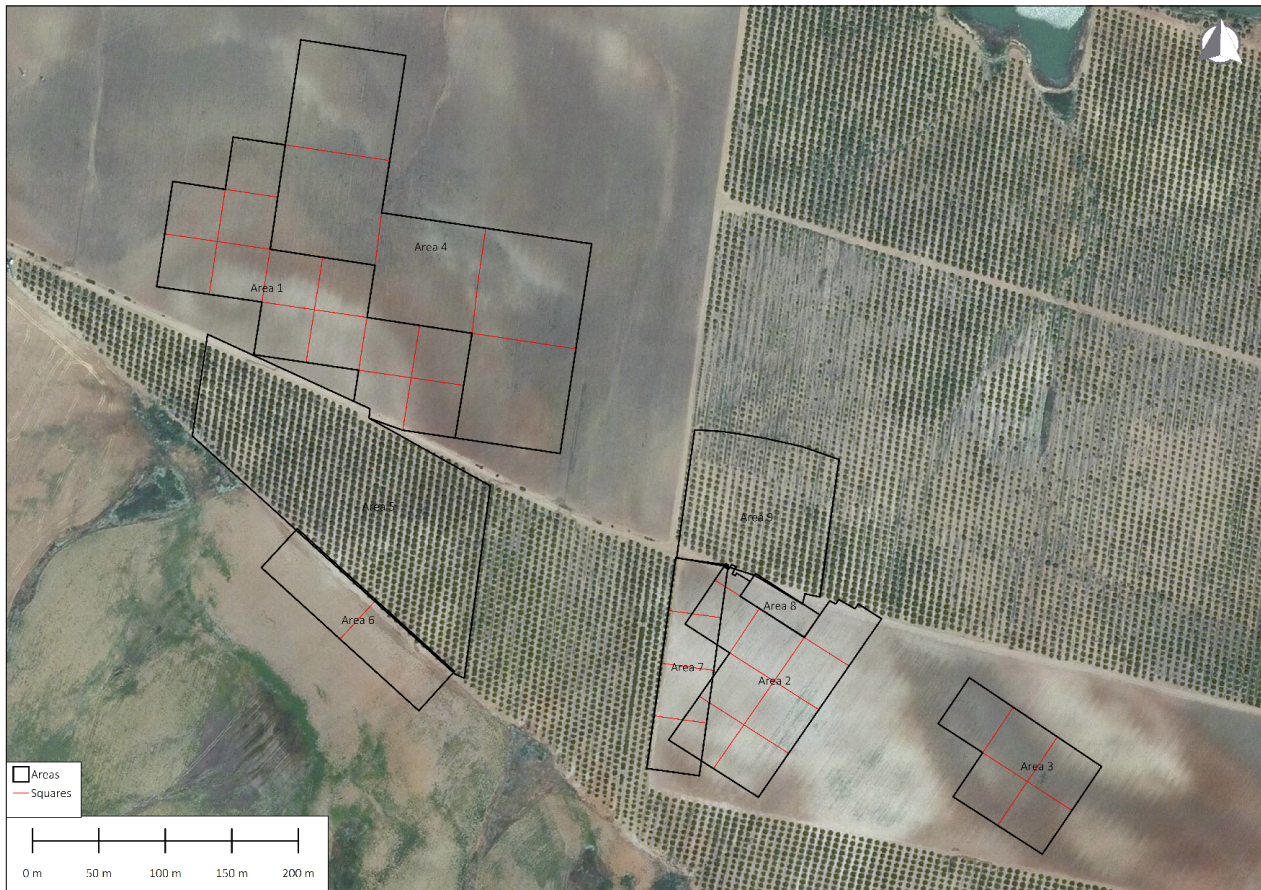
means minimum negative and black is the maximum positive.

A second field season was undertaken in September 2018, in areas where fieldwork could not

be carried out in 2015. The survey area was divided into six sectors (4–9) (*fig. 19*).

A Foerster gradiometer array with four sensors and a FEREX STD data logger were used. Data was collected using 10cm sample spacing along transects and a 50cm transect separation. The gradiometers were mounted on a wheeled cart and sample spacing along transects was regulated by an odometer. Each sweep of the cart represents a 2m wide strip of data.

Patterns of survey during September 2018 were controlled using a Leica Viva RTK GPS rover, with corrections from the EUREF GNSS Network station in Cordoba (station: COBA00ESP). For much of the survey, the grid orientation used the reference system from the 2015 survey, which was oriented north on the Universal Transverse Mercator (UTM) grid. These survey areas, which included Area 4 and Area 8, covered open fields. Area 7, which also covered open fields, was oriented to the 2015 magnetometry grid that aligns with the road rather than the UTM coordinate system.



**Fig. 19.** Survey area with sectors and squares.



**Fig. 20.** Olive saplings supported by an aluminium wire in sector 5 of LRT-II.

Area 6 was oriented towards the road that limits the property at the south. Data in these fields was collected in blocks that were generally 40 x 80m or 80 x 80m areas.

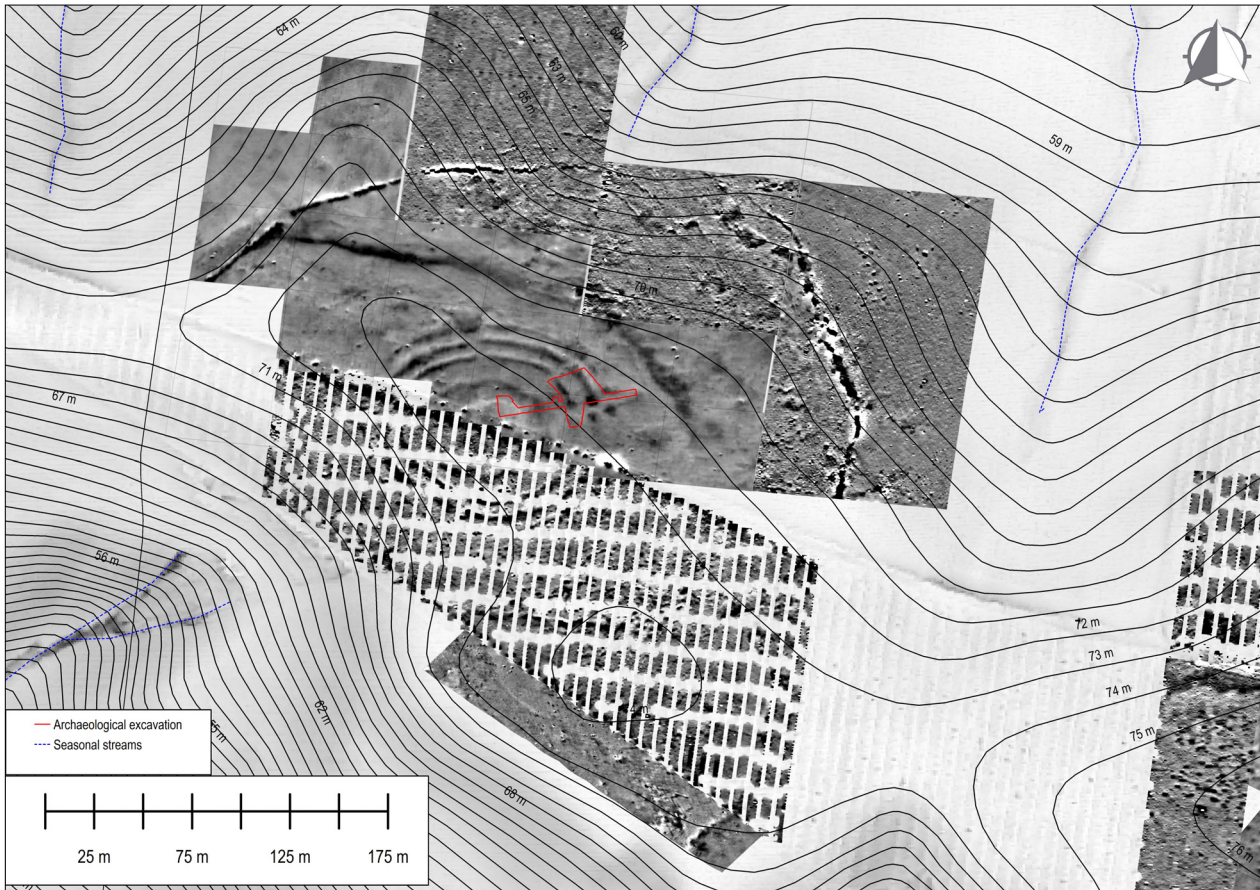
Areas 5 and 9 had aluminium wire supports fixed by iron hardware (*fig. 20*). Individual 'grids', each of which represented a single row between olive trees, were set. The start and end points of

each grid were recorded with GPS, and each one was saved and georeferenced individually. Individual survey areas termed 'lines' varied in length but were uniformly 4m wide. An underground irrigation system that runs the length of the road with occasional outlets featuring iron and steel hardware was also present. All data was processed with QGIS and Adobe Photoshop.

#### 4.2.3 Archaeological Excavation

An archaeological excavation in LRT-II was carried out between December 2015 and January 2016. The main objective was a first assessment of the archaeological record to get information about resources and to investigate the dynamics of the occupation and duration of the site.

Excavations were planned based on the geophysical survey results. Initially, a 50m long x 3m wide trench with a northeast-southwest orientation that started in the central area of the site



**Fig. 21.** Archaeological excavation at LRT-II.

was made. This trench cut through the LRT-II complex from the central feature to enclosure 3; it also covered one of the ditch gaps or visible intervals on enclosure 2. Afterwards, the topsoil was removed to the north of the central structure, as well as to the north and south of enclosure 2 and to the north of enclosure 3, to test the layout of the ditches. This resulted in a total excavation area of 517m<sup>2</sup> (fig. 21). Topsoil was removed with machinery, with structures becoming readily visible at 20 to 30cm depth.

Archaeological recording was carried out based on stratigraphic units, following Harris (1991). Each stratigraphic unit was numbered and described according to its physical composition, colour, compactness, granulometric composition, thickness, and its stratigraphic relationship with other units.

Levels were recorded with a Leica NA720 theodolite, and topographical services from Arqueocad S.L. were used for planimetry and 3D photodocumentation. The coordinate system used was UTM Huso 30 European Datum 1950 Elipsoid

Hayford. The photographic recording was made with a Nikon D60 digital camera.

### 4.3 Laboratory Analyses

#### 4.3.1 Zooarchaeological Analysis

Faunal material from three different archaeological sites was analysed: Valencina-Castilleja, Carmona, and La Loma del Real Tesoro II (table 3).

The study was performed according to the type of structure and stratigraphic units. The selection of the structures was made based on chronology and morphology.

Most of the fragments were cleaned with water and a soft brush; due to the fragility of certain fragments, some were cleaned only with a soft brush and wooden sticks to remove most of the soil. After recording the data, all identified fragments were packed in individualised plastic bags with their corresponding ID number.

Site	Test pit	Structure	Structural Unit	Type
<b>Valencina-Castilleja</b>				
Pabellón Cubierto		115	122, 123	Basin
		116	121, 124	Basin
<b>Carmona</b>				
C/Ronda del Cenicero-S.Teodomiro Bravo	A	24	21, 22, 29	Basin
	A	55	56	Basin
<b>Loma Real Tesoro II</b>				
LRT-II		E1	10, 24, 52, 55, 56, 60	Macro Negative Structure
		S1A	53	Basin
		E2	22, 30, 31	Cylindrical Pit
		E3	28, 38	Conical Pit
		E4	4, 36	Conical Pit
		E7	29	Basin
		E8	8	Basin
		E9	18, 37, 54, 57/64	Ditch
		E11	40	Cylindrical Pit
		E12	42	Ditch
		E17	26, 49	Ditch
		E18	59	Pit

**Table 3.** Sites of analysis and structures.

#### 4.3.1.1 Taxonomic Identification, Classification, and Recording System

Specimens were identified using a personal reference collection as well as that from the University of Tübingen (Germany). When the use of reference collections was not feasible, osteoarchaeological atlases were used for mammal identification (Schmid 1972; Frances 2009; Pales/Lamber 1971a; 1971b; Pales/García 1981a; 1981b; Barone 1987; Latorre Reviriego et al. 1995; Vázquez Autón et al. 1995; Callou 1997). For juvenile domestic animals, Amorosi (1989) was consulted, as well as Prummel (1987a; 1987b; 1988; 1989) in the case of fetuses and neonatal individuals. Bird bones were identified following Cohen/Serjeantson (1996). Mammal teeth were identified using Hillson (2005).

Whenever identification to species level was not possible, the most inclusive taxonomic

category was sought. In those cases, identification is presented as the genus, 'sp'.

The works by Zeder/Pilaar (2010), Halstead et al. (2002), Prummel/Frisch (1986), Boessneck (1969), and Barone (1987) were used to separate sheep from goat. In the cases where it was not possible to do so, we allocated these to caprines.

Unidentified mammals and birds were divided into three groups according to the corporal weight of living specimens (*table 4*).

Type	Size	Weight
Size 1	Small mammals	Rabbit (<22.68kg)
Size 2	Medium mammals	Pig (22.68–113.40kg)
Size 3	Large mammals	Red deer (113.41–907.18kg)

**Table 4.** Categories of unidentified mammals.

Fig. 22. Database developed by Harland et al. 2003 employed for data recording.

Due to the difficulties of identifying ribs, vertebrae, and limb bone diaphyses of species in highly fragmented specimens, an overrepresentation of these anatomical parts exists in the undetermined group.

All fragments were included in a database which recorded archaeological site, structure, stratigraphic unit, sector, level, bag, species, skeletal element, side, number of fragments, zones, weight, maximum linear dimension, sex and age estimation, taphonomic and paleopathologic data, and measurements. Diagnostic zones follow Dobney/Rielly (1988). Each bone was split into numbered, identifiable morphological zones (fig. 22). In the case of complete bones, all areas were registered. For representation of species, the figures produced by ArcheoZoo.org (Licence CC BY NC SA 4.0 International) have been used.

Those fragments or skeletal elements with characteristic features, such as cut marks, non-metric signs, or pathologies, were graphically documented using a Dino lite digital microscope model Premier AM4113T and a photographic camera Nikon D60.

#### 4.3.1.2 Sex Determination

Due to the extensive degree of fragmentation, sexual differentiation was difficult in most cases. Morphological criteria, such as differences in size and shape of the canines in the case of pigs, and horn cores, mandibles, and pubic morphology in the case of ruminants, were used to determine sex (Armitage 1982; Bull/Payne 1982; Grigson 1982a; 1982b). In the case of carnivores, the baculum served to identify males.

#### 4.3.1.3 Age Determination

Two methods were used for skeletal age estimation of mammals: tooth eruption and dental wear, and epiphyseal fusion in long bones.

Mammals have two different dentitions during their lives. Lacteal or deciduous dentition is replaced by permanent dentition (Chaix/Ménial 2001; Hillson 2005). The sequence of eruption of deciduous teeth follows Habermehl (1975) for caprines and Silver (1969) for cattle and pigs.

	Infantile	Juvenile	Juvenile-Subadult	Subadult	Subadult-adult	Young adult	Adult	Old adult	Senile
Horse	0–5	5–9	9–12	12–30	30–48	48–54	54–120	120–180	+180
Cattle	0–2	1–8	8–18	18–30	30–36	36–48	48–72	72–96	+96
Caprine	0–2	2–6	6–12	12–24	24–36	36–48	48–72	72–96	+96
Pig	0–4	4–12	12–24	24–36	24–36		36–150		+150

**Table 5.** Age cohort in months established by UAM's Zooarchaeological laboratory.

In the case of cattle, caprines, and pigs, mandibular tooth eruption and wear stages from dP4, P4, M1, M2, and M3 were recorded following Grant (1982). Bone epiphyseal fusion occurs in different stages, whose chronological order is well known for domestic animals. Three different stages of fusion based on Reitz/Wing (1999) were used.

- Open: Epiphysis and diaphysis not fused.
- Semi-fused: Epiphysis and diaphysis are fused, but fusion line is still visible.
- Fused: Epiphysis and diaphysis are fused, and fusion line is not visible.

Age of fusion in equids, cattle, caprines, and pig bones, as well as age ranges established by the zooarchaeological laboratory at the Universidad Autónoma de Madrid were used (*table 5*).

Foetal and juvenile domestic animals in which epiphyses and diaphyses remain unfused have been assigned ages following the data developed by Amorosi (1989) and Prummel (1987a; 1987b; 1988).

#### 4.3.1.4 Size

For the estimation of size, the correlation factors compiled by von den Driesch/Boessneck (1974) have been applied (*table 6*).

#### 4.3.1.5 Pathology and Taphonomy

Information on bone changes due to taphonomic factors was recorded whenever available. Reference atlases and specific taphonomic methodologies were used to identify the different marks (Fernández-Jalvo/Andrew 2016; Lyman 1994; Behrensmeyer 1978). Butchery marks were described by type (cut, chop, sawing) and location (i.e. proximal epiphysis, diaphysis, distal epiphysis).

Animal	Reference factor
Cattle	Matolcsi 1970
Horse	Kiesewalter 1888
Sheep	Teichert 1975
Goat	Schramm 1967
Pig	Teichert 1969
Dog	Koudelka 1885
Red deer	Godynickis 1965

**Table 6.** Estimation of size according to different species.

Pathologies were recorded following Baker/Brothwell (1980) and Bartosiewicz/Gál (2013).

#### 4.3.1.6 Number of Identified Specimens (NISP)

This value is the total number of fragments of identified species. It includes the total of identified fragments *per taxon* (NISP) and was calculated following Klein/Cruz-Urbe (1984).

#### 4.3.1.7 Weight

All fragments have been weighed with a precision balance and expressed in grams (g) with two aims: to estimate the biomass and to analyse the proportion between identified and unidentified fragments.

#### 4.3.1.8 Minimum Number of Individuals (MNI)

MNI has been calculated using the most represented 'non-repeatable' zones for each element. Laterality, sex, and age were considered for MNI

calculations according to Clason’s methods and diagnostic zones according to Dobney/Rielly’s methods (Clason 1972; Dobney/Rielly 1988). Skeletal elements have been considered ‘non-repeatable’ if more than 50% of the zone was present.

**4.3.1.9 Minimum Number of Elements (MNE)**

To reduce the distortion caused by fragmentation and overrepresentation, the Minimal Number of Elements (MNE) was calculated by assigning every identifiable fragment to a specific bone and anatomical region, taking into account diagnostic zones, side, age, and sex (Lyman 1994).

**4.3.1.10 Skeletal Completeness**

The analysis of skeletal completeness follows Reitz/Zierden (1991). This method uses the formula:

$$d = (\log_e X) - (\log_e Y)$$

where ‘d’ is the logged ratio, ‘X’ is the NISP percentage of a given skeletal element in the archaeological collection, and ‘Y’ is the percentage of the same skeletal element in a standard skeleton. Positive values of d indicate an over-representation of a given skeletal element when compared to the standard skeleton, whereas negative values indicate the under-representation of that skeletal portion.

The rate of fragmentation by species has been calculated based on the NMI/NISP ratio for each of the identified species. Percentage of completeness for each skeletal element has been calculated following Morlan (1994). The method considers the diagnostic zones of the skeletal elements based on the formula:

$$\%CN = 100 \left( \frac{PP}{NISP} \right) / PD$$

where PP is the sum of the diagnostic zones present for a given archaeological skeletal element, NISP is the number of fragments of a skeletal element identified, and PD is the total diagnostic zones of a skeletal element. Dividing PP by NISP yields the average number of portions per skeletal element of a specimen. Dividing this average by the number of portions defined (PD) gives the percentage of completeness (%CN).

**4.3.1.11 Skeletal Frequencies**

Skeletal frequencies were calculated based on NISP, MNE, and MAU (Minimal Animal Units). MNE was obtained by taking into account diagnostic zones, laterality, sex, and age. MAU was obtained by dividing MNE by the number of this anatomical element present in a living animal following Klein/Cruz-Urbe (1984). %MAU was calculated by taking the most abundant skeletal unit as 100%. Anatomical regions were divided according to table 7.

Anatomical region	Bones
Cranial	Antler, horn, skull, mandibles, dentition, and hyoid
Axial	Vertebrae, ribs, sternum, pelvis, sacrum, and baculum
Forelimb	Scapula, Humerus, radius, and ulna
Forefoot	Carpal, metacarpal
Hindlimb	Femur, patella, tibia, and fibula
Hindfoot	Tarsal, metatarsal, astragalus, calcaneus
Feet	Unidentified carpal/tarsal, unidentified metapodia, sesamoids, Phalanx I, Phalanx II, and Phalanx III

**Table 7.** Anatomical regions and related bones.

#### 4.3.1.12 Dietary Contribution

Estimation of the biomass follows Kubasiewicz (1956) and Reed (1963). This method analyses the input of meat based not on the MNI but on the total weight of each identified species. Meat weight is estimated assuming that skeletal weight of large mammals is approximately 7.5% of their total weight and that edible meat is 50% of their total weight, assuming that skin, bones, and viscera are inedible (Reitz/Wing 1999, 224).

Formula:

$$\frac{\text{skeletal weight (Kg)}}{\text{Total weight}} = \frac{\text{archaeological specimen weight (Kg)}}{X}$$

$$\text{Edible meat weight} = \text{Total weight} \times 0.5$$

According to Uerpmann (1973, 316), meat from the fore limb and hind limb bones, such as the humerus or femur, does not supply the same amount of meat as other anatomical parts (e.g. feet). For this reason, the weight of the fore and hind limbs in terms of dietary contribution have been considered. Quality and quantity of meat contribution changes depending on the anatomical part (e.g. femora and metapodia do not have the same quantity and quality of meat). For this reason, meat value was calculated following Uerpmann's classification (table 8). Teeth and horns have not been considered.

#### 4.3.1.13 Osteometry

Bone measurements were taken on any individual older than a juvenile. Bones that were burned, worked, or that exhibited pathologies were not analysed. Measurements were taken with a Powerfix profi+ electronic digital caliper. Measurements follow von den Driesch's criteria (von den Driesch 1976).

#### Log Ratios

A log ratio technique was employed in order to compare the size of the individuals from different sites to a standard. According to Meadow (1999), this technique is used to compare the relative

Contribution	Anatomical part	Skeletal element
High	Axial	Vertebrae
	Forelimbs	Scapula
		Humerus
Hindlimbs	Pelvis	
	Femur	
Medium	Cranial	Cranial bones
		Mandible
	Axial	Ribs
	Forelimb	Radio
		Ulna
	Hindlimb	Tibia
Fibula		
Low	Cranial	Horn/antler
		Hyoid
	Forefoot	Carpal
		Metacarpal
	Hindfoot	Astragalus
		Calcaneus
		Tarsal
		Metatarsal
	Feet	Metapodia
		Phalanx I
Phalanx II		
	Phalanx III	

**Table 8.** Meat value adapted from Uerpmann (1973).

(rather than the absolute) dimensions of animals from archaeological contexts using individuals of known size as a standard.

The logarithm of each measurement was calculated according to Davis (1996) using this formula:

$$\text{ratio} = \log_{10}(x/y)$$

where x is the value of an archaeological measurement and y is the measurement from the same skeletal element of a 'standard'. This process was repeated for every available measurement and the resulting log ratio value was plotted into a histogram, with the standard being 0. Only fully fused bones were included.

This method was also employed in order to differentiate between domestic and wild species. In the case of suids, unimproved Durrington pig measurements were employed as a standard (Albarella/Payne 2005). For caprines, unimproved adult female Shetland sheep were used as a standard (Davis 1996). The values for Period II from the Late Iron Age site of Elms Farm were employed as a standard for cattle (Johnstone/Albarella 2015).

The measurements can be seen in appendix 1.

### 4.3.2 Material Culture

This section shows the different analytical methodologies applied to material recovered during the excavation process at the La Loma del Real Tesoro site.

#### 4.3.2.1 Analysis of Pottery

All pottery fragments were cleaned with water and a soft brush. All diagnostic sherds were numbered, labelled, and incorporated into a database. They were described according to their shape, rim, thickness, temper, weight, diameter, burning, external and internal treatment, and decoration. Formless fragments were counted and weighed according to stratigraphic units. Diagnostic elements like decoration, bases, and rims were photographed, drawn, and digitalised.

Four categories based on the morphology of the diagnostic elements have been implemented. It includes dishes, bowls, pots, and other vessels.

#### 4.3.2.2 Analysis of Lithics

Identification and technical classification were done by Sánchez Liranzo (2017), from the University of Seville. The methodology used followed the Logical Analytic System for lithic functional classification according to Mora et al. (1991) and Terradas (1995), but traditional lithic typologies (Bordes 1961; Laplace 1964; 1975; 1986; Fortea 1973; Bago-lini 1968 and Merino 1994) were also used.

Provenience of lithic raw material analysis was established by José Antonio Lozano and Juan

Cárdenas Párraga (2019), from the Department of Mineralogy and Petrology of the University of Granada (Spain).

For the mineralogical identification and description, a series of thin sections were made on selected samples. Samples were extracted with a scalpel and, in the case of hard rocks, with a Hinhellsb 401/1 table drill with a Widia 7mm hollow drill or a water-cooled 8mm diamond drill. Samples were cut and polished with abrasive files and glued with polyester resin onto a glass slide. Finally, each sample was cut and polished to a thickness of 30µm. The analysis of the thin sections was carried out with an Olympus BHT optical microscope.

#### 4.3.2.3 Phytolith Analysis and Infrared Spectrometry (FTIR)

A total of twelve samples from nine structures and twelve different stratigraphic levels from La Loma del Real Tesoro II were selected for phytolith analysis and infrared spectrometry (appendix 2: *table A.2.1*). Three samples of the superficial soil were taken for control. Analyses were carried out by Michael Toffolo, from the Institut für Naturwissenschaftliche Archäologie of the University of Tübingen.

Phytoliths were extracted from each sediment sample and counted using the rapid extraction method (Katz et al. 2010). The identification of different morphotypes was carried out following the standard literature (Twiss et al. 1969; Mulholland/Rapp 1992; Madella et al. 2005) and with a reference collection of archaeological and modern samples (Albert et al. 2016). Phytoliths were studied using a Zeiss Axioscope AX10 petrographic microscope at 200x and 400x magnifications.

A few milligrams of sediment were homogenised and ground in an agate mortar and pestle. About 0.1mg were left in the mortar, mixed with approximately 0.5mg of KBr (FT-IR grade, Sigma-Aldrich), and pressed into a 7mm pellet using a hand press (PIKE Technologies). Infrared spectra were obtained at 4cm<sup>-1</sup> resolutions in 32 scans within the 4000–400cm<sup>-1</sup> spectral range using an Agilent Technologies Cary 660 spectrometer. Phase identification was performed using OMNIC v.9,

standard literature (Farmer 1974; van der Marel/Beutelspacher 1976), and the reference collection of FTIR spectra of standard materials provided by the Kimmel Center for Archaeological Science (Weizmann Institute of Science<sup>5</sup>).

#### 4.3.2.4 Palynological Analysis

Eleven samples of soil from La Loma del Real Tesoro II were analysed by López-Sáez in the palynological unit of the archaeobiology lab of the Spanish Research Council in Madrid, following the usual methodology for archaeopalynological studies (Burjachs et al. 2003) (appendix 2: *table A.2.2*). Sediment was treated with hydrochloric acid to eliminate carbonates. Afterwards, it was treated with Sodium hydroxide to eliminate organic matter and with hydrofluoric acid to destroy silicates. Liquor of Thoulet was applied to distinguish microfossils (Goëury/De Beaulieu 1979). The resulting sediment was preserved in a glycerine jelly inside Eppendorf tubes. Finally, samples were placed in slides with cover slips and sealed with *histolaque*. Pollen was then distinguished from non-pollen with an optical microscope with 60x and 40x magnification.

#### 4.3.2.5 Geomorphological Analysis

A geomorphological analysis at La Loma del Real Tesoro II was carried out by Francisco and Cesar Borja Barrera (2018) from Huelva University.

An initial morphological analysis of the settlement through orthophotographs and paleogeographical data of the surrounding area was done to examine the morpho-topographical features and environmental dynamics of the area.

In order to obtain information about depositional dynamics and infill formation processes, as well as to understand the depth and section of the central structure and enclosures 1, 2, 3, 4, and

6, mechanical core drills were taken at different points of the excavation area. An extra core drill carried out in the bedrock between enclosure 2 and 3 was done to contrast data (*fig. 23*).

The analysis of the superficial formations distinguished sediments, floors, and anthropic superficial formations following Dewolf/Bourrié (2008) and Borja Barrera (1993).

Soil levels recovered from the different drill cores have been described according to physical features such as colour, texture, phosphate and calcium carbonate quantity, conductivity, and organic material as well as Ph-level and humidity, in order to distinguish between edafo-sedimentary units. Magnetic susceptibility analysis was carried out on some soil samples to examine the proportion of organic material and floor formation processes, as well as their relationship with human occupation intensity.

Malacological materials recovered from core drills were used for environmental reconstruction as well as to establish the anthropogenic impact on the area. Identification was done with 3x and 10x magnifying glasses, and a reference atlas (Fechter/Falkner 1993; Ruiz Ruiz et al. 2006).

#### 4.3.2.6 Carpological Analysis

Carpological analysis was done by Simone Riehl from the Institut für Naturwissenschaftliche Archäologie of the University of Tübingen. Seven soil samples from different structures were analysed (appendix 2: *table A.2.3*).

The sediment flotation work was carried out at the Casa de la Cultura in Valencina de la Concepción. Three sieves with different mesh-sizes were used: 2mm, 1mm, and 0.5mm.

#### 4.3.2.7 Anthracological Analysis

Anthracological analysis of the charcoal fragments recovered in geological drills was done by Oliva Rodríguez Ariza at the Institute of Iberian Archaeology, University of Jaén (Spain) (appendix 2: *table A.2.4*).

<sup>5</sup> <<http://www.weizmann.ac.il/kimmel-arch/infrared-spectra-library>> (last access: 23.01.2020).

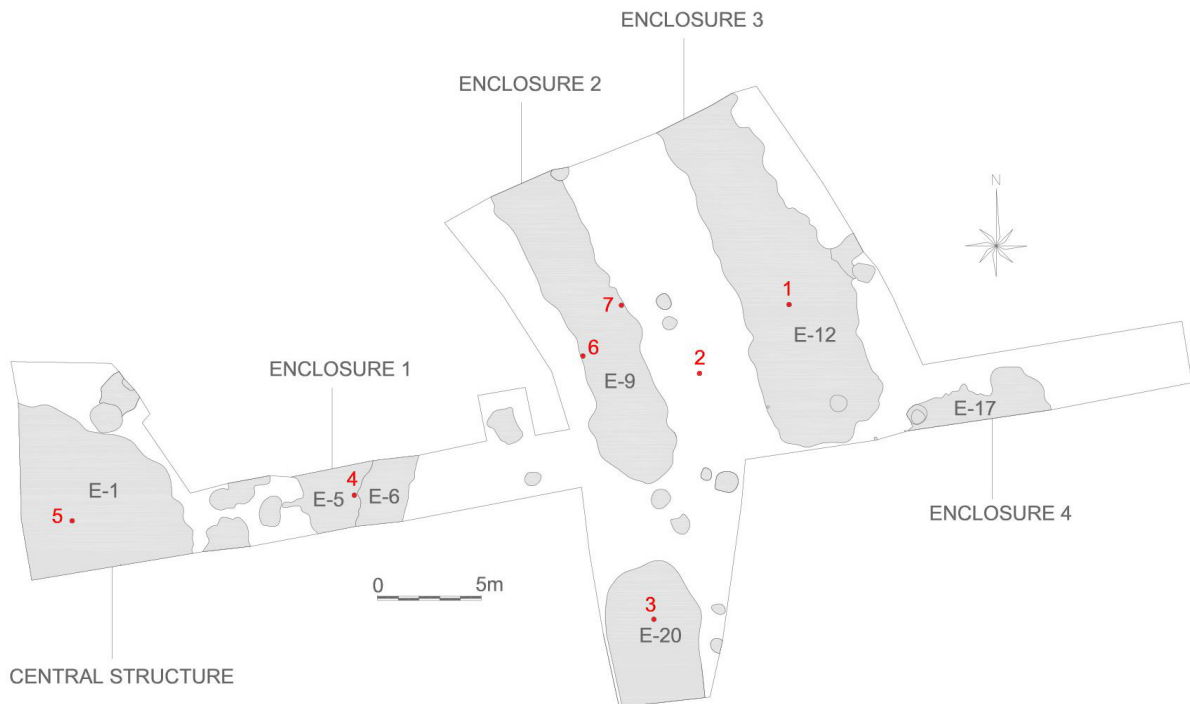


Fig. 23. Mechanical core drill locations.

#### 4.4 Radiocarbon Dates

A total of 68 samples from La Loma del Real Tesoro and seven samples from Valencina-Castilleja were sent to the National Accelerators Center (CNA) in Seville (Spain), and five samples to the Swiss Federal Institute of Technology (ETH) (Switzerland). All samples were measured using AMS (appendix 2: *table A.2.5*).

The collagen extraction of the samples ETH-86513, ETH-86514, ETH-86515, and ETH-93271 from Valencina, and ETH-86516, ETH-88794, CNA-4295, and CNA-4296 from La Loma del Real Tesoro measured by ETH and CNA was carried out by the Department of Geoscience at the University of Tübingen following the method described by Longin (1971), DeNiro/Epstein (1981), and Bocherens et al. (1997). The measurement method for ETH samples can be found in Bonani et al. (1987), Synal et al. (2007), and Hajdas (2008). The CNA follows the pretreatment protocols established by Longin (1971), Arslanov/Svezhentsev (1993), and Piotrowska/Golsar

(2002) which uses ultrafiltration prior to combustion and graphitisation of the samples (Santos Arévalo et al. 2009), which were measured following Klein et al. (2006; 2007).

Radiocarbon dates were calibrated using the internationally agreed atmospheric curve, IntCal13 (Reimer et al. 2013), and the OxCal v4.2 computer program (Bronk Ramsey 2001; 2009). Calibrated ranges were obtained using the probability method (Stuiver/Reimer 1993). End points were rounded off by ten years when the error was greater than, or equal to, twenty-five years and by five years when the error was below twenty-five years (Stuiver/Polach 1977; Millard 2014).

#### 4.5 Isotopic Analyses

Stable isotope analyses were performed with two aims.

To investigate the subsistence practices of the animal populations through carbon and nitrogen ( $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ ) in bone collagen. The combination

of  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  was used to investigate the amount of protein consumption. The carbon ( $\delta^{13}\text{C}_{\text{ap}}$ ) of the carbonate fraction from tooth enamel was also analysed to investigate dietary practices regarding to the whole diet, not just the protein part, as for  $\delta^{13}\text{C}$  in bone collagen.

To infer mobility patterns and possible seasonal movements, strontium ( $^{87}\text{Sr}/^{86}\text{Sr}$ ) and oxygen ( $\delta^{18}\text{O}$ ) isotope analyses in tooth enamel were conducted.

#### 4.5.1 Sampling Strategy

MNI was the criterion used to select samples for paleodietary and mobility analysis, as this strategy ensured that no individual would be double sampled. The total sample included 37 bones (drawn from four specimen of cattle, eleven of caprine, eleven of pig, four of dog, three of red deer, one of aurochs, one of horse, and two mesomammals), as well as 97 teeth (drawn from 25 specimen of cattle, 21 of caprine, 46 of pig, three of dog, one of aurochs, and one of horse).

#### 4.5.2 Methods

##### 4.5.2.1 Carbon and Nitrogen ( $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ )

The combination of  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  was used in order to investigate the consumption of proteins (Whelan et al. 1970; Schoeninger/DeNiro 1984). For this analysis, ca. 500mg of bone was used for collagen extraction for each individual. This analysis was conducted at the Fachbereich Geowissenschaften at the University of Tübingen following standard methods (DeNiro/Epstein 1981; Bocherens et al. 1997). An NC2500 CHN elemental analyser coupled to a Thermo Quest Delta + XL mass spectrometer was used to measure stable isotopes. Values of  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  are reported according to the international V-PDB standards, atmospheric air (AIR). The reproducibility for elemental composition of carbon and nitrogen was 0.1% and 0.03%. The reproducibility for  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  measurements was  $\pm 0.1\text{‰}$  and  $\pm 0.2\text{‰}$ . In-house tests with modern camel (*Camelus dromedarius*) and

Type	Environment	$\delta^{13}\text{C}_{\text{ap}}$	$\delta^{13}\text{C}_{\text{col}}$
C <sub>3</sub>	Forest canopy	-25 to -14‰	-34 to -24‰
	Open forest	-14 to -8‰	
C <sub>3</sub> /C <sub>4</sub>	Open area	-8 to -1‰	-23 to -12‰
C <sub>4</sub>	Grasslands	-1 to 5‰	-19 to -6‰

**Table 9.** Summary of isotope ranges according to photosynthetic pathway of plants (after van der Merwe 1982; Ranson/Thomas 1960; Richards/Hedges 1999; Smith/Epstein 1971; Smith 1972; Chisholm 1989).

elk (*Alces alces*) collagen standards showed that elemental contents of carbon and nitrogen were reproducible to 0.2% for both isotopes. The list of samples can be seen in appendix 2: table A.2.6.a.

In addition, the carbon ( $\delta^{13}\text{C}_{\text{ap}}$ ) of the carbonate fraction of enamel was analysed to investigate dietary practices. The results of this analysis can provide us with all the components of a diet, not just proteins, as is the case for  $\delta^{13}\text{C}$  bone collagen (Ambrose/Norr 1993).

There are three groups of plants, according to their photosynthetic pathways: C<sub>3</sub>, C<sub>4</sub>, and CAM. C<sub>3</sub> includes all trees, woody shrubs, cereal such as wheat, barley, oat, rye, fruit, vegetables, and most temperate climate grasses. C<sub>4</sub> plants include some grasses, most of the *poaceae* and ruderal plants, and tropical grasses like maize, millets, or sorghum. The CAM group includes all succulent plants like pineapple or cactus. Algae and lichens are also included in this group.

The ranges established for environment types C<sub>3</sub>, C<sub>4</sub>, or CAM plants follow the classical works cited in the table 9.

##### 4.5.2.2 Strontium and Oxygen ( $^{87}\text{Sr}/^{86}\text{Sr}$ and $\delta^{18}\text{O}$ ) Analyses

Mobility patterns were analysed with reference to  $^{87}\text{Sr}/^{86}\text{Sr}$  and  $\delta^{18}\text{O}$  isotope ratios in dental enamel. Samples of ca. 12mg of tooth enamel were extracted using a Dremel© device. Organic material was removed using 2% NaOCl solution for 24 hours, after which samples were placed in a 0.1M Ca-acetate acetic acid buffer solution for another 24 hours and then rinsed; finally, the sample was

dried (Bocherens et al. 1996). Samples were analysed at 70°C using a ThermoFinnigan Gasbench II on a Finnigan Delta Plus XL CFIRMS at the University of Tübingen for  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  values of the carbonate fraction of bioapatite. Isotopic abundances are expressed as  $\delta$  (delta) values in parts per mil (‰), as follows:  $\delta^{13}\text{C} = (^{13}\text{C}/^{12}\text{C}_{\text{sample}}/^{13}\text{C}/^{12}\text{C}_{\text{standard}} - 1) \times 1000$  and  $\delta^{18}\text{O} = (^{18}\text{O}/^{16}\text{O}_{\text{sample}}/^{18}\text{O}/^{16}\text{O}_{\text{standard}} - 1) \times 1000$ . The standards used are the marine carbonate V-PDB for carbon and oxygen and V-SMOW for oxygen. For fossil samples, the analytical error is 0.1–0.2‰ for  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$ , based on multiple isotopic analysis of modern tooth enamel of Elephant (*Loxodonta africana*) and hippopotamus (*Hippopotamus amphibius*) prepared and analysed at the same time.

Strontium separation and analysis of aliquots of the pre-treated samples was conducted at the Curt Engelhorn Center for Archaeometry GmbH, Mannheim, Germany. Samples of ca. 5mg of enamel were dissolved in 250µl of  $\text{HNO}_3$  under clean-lab conditions. Teflon columns with Eichrome Sr-Spec resin were preconditioned with 500µl of 3 N  $\text{HNO}_3$ , loaded with samples, and washed with 3 x 400µl of 3 N  $\text{HNO}_3$ . The Sr was eluted with 1.5ml of 0.4 N  $\text{HNO}_3$  (0.5ml + 1ml steps). Sr concentrations were determined by Quadrupole-Inductively Coupled Plasma-Mass Spectrometry (Q-ICP-MS), and the solutions diluted for strontium isotope analysis by High-Resolution Multi Collector-ICP-MS (Neptune). Raw data were corrected according to the exponential mass

fractionation law to  $^{88}\text{Sr}/^{86}\text{Sr} = 8.375209$ . Blank values were lower than 10pg Sr during the whole clean lab procedure. The NBS 987 and Eimer & Amend (E & A) standards ran along the samples yielded  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios of  $0.71026 \pm 0.00003$ ,  $2\sigma$ ;  $n = 19$  and  $0.70804 \pm 0.00002$ ,  $2\sigma$ ;  $n = 26$ , respectively. The certified  $^{87}\text{Sr}/^{86}\text{Sr}$  ratio of NBS-987 is  $0.71034 \pm 0.00026$  [95 % confidence interval]. The inter-laboratory comparative value for AMES (Eimer & Amend) is  $0.708027 \pm 0.000035$  (1 SD) (Müller-Sohnius 2007). The isotope ratios of the standards run with the samples were within the expected ranges. The list of samples can be seen in appendix 2.6: table A.2.6.b.

In the case of establishing the local ranges of Sr, the standard methodology already applied by Price et al. (2002), Bentley and Knipper (2005) has been followed, whereby the local range is established based on two standard deviations above the mean of all the fauna analysed and based only on the use of dental enamel. For this purpose, previous work carried out at the same site by Díaz-Zorita Bonilla (2017) has been considered, where the local range was already established and has now only been confirmed.

To avoid the ‘overestimation’ of outliers, two different levels of analysis have been carried out: all the fauna together and then each of the herds.

One of the special contributions of this work is the large amount of samples analysed and the possibility of intra-species mobility patterns and herding strategies.



## 5 The Sites

### 5.1 Site Selection Strategy Analyses

This chapter introduces the archaeological sites from which material has been analysed. Three main sites have been selected for analysis:

- (1) La Loma del Real Tesoro
- (2) Carmona
- (3) Valencina-Castilleja

Three other sites (Amarguillo II, Poblado Calcolítico, and Parque Miraflores) along the Guadalquivir Basin have also been analysed for comparison of the isotopic analysis.

The selection of the sites was done according to several factors:

- the geological location, in order to be able to compare the animal mobility baseline isotopic signature;
- the environmental conditions;
- the strategical positions;

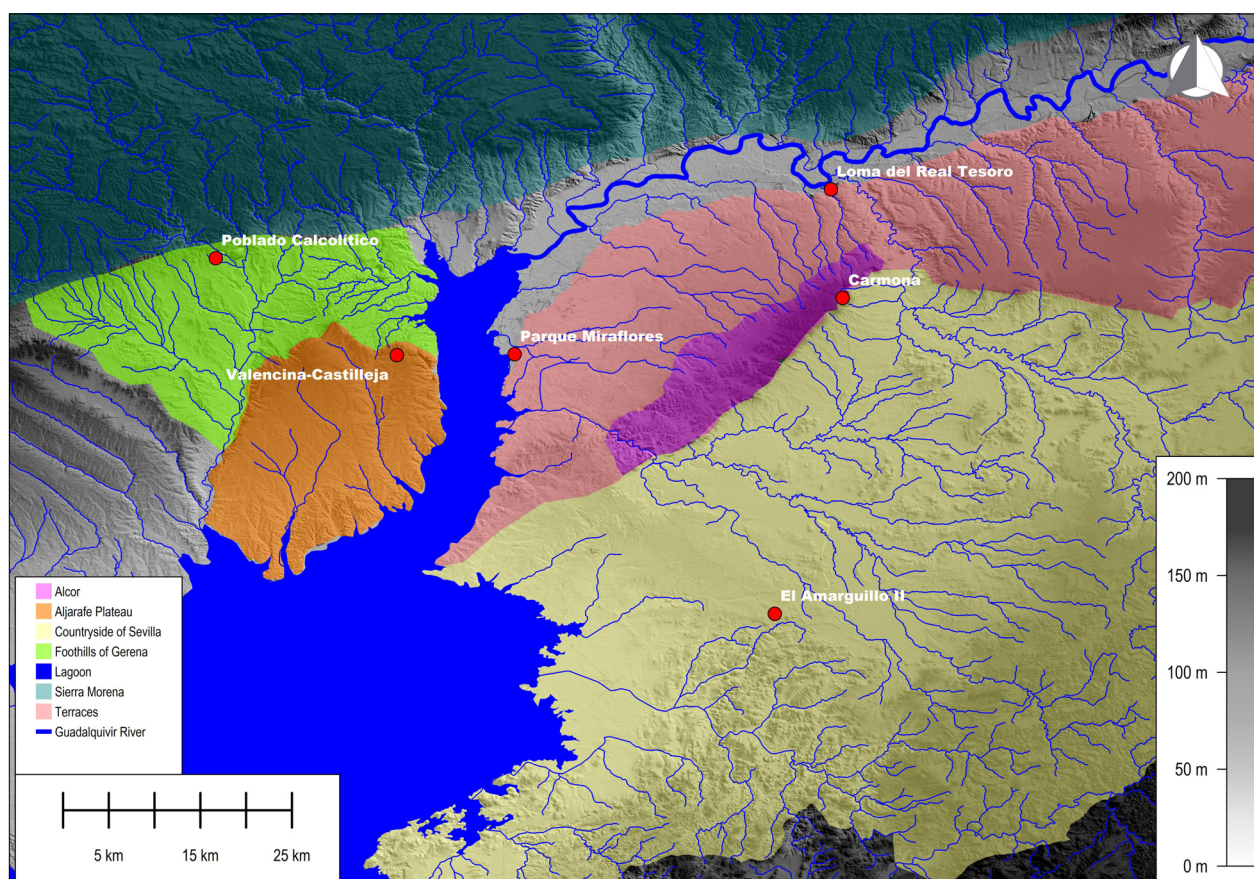
- chronology (contemporaneity);
- the availability of information and a closed collaboration with the archaeologist who excavated the sites.

Therefore, there are six different geomorphological areas (*fig. 24*):

- (1) the foothills of Sierra Morena,
- (2) the Aljarafe plateau,
- (3) the meadow,
- (4) the Guadalquivir terraces,
- (5) the alluvial area of the Guadalquivir Basin,
- (6) the Alcores.

All sites are located in different geological areas in order to identify possible livestock movements based on the different isotopic ratios according to the geological background.

In the case of La Loma del Real Tesoro, this is presented as a new settlement. It is located at the confluence of the Guadalquivir and the Corbones



**Fig. 24.** Sites and geomorphology.

Rivers; this is a strategic control point for the passageways towards the Vega del Corbones from the Sierra. Its location close to the lithic and mining resources in the mountains, as well as its proximity to the fertile lands of the Vega de Corbones, make it an ideal site for analysis.

Carmona, which is strategically located in the Alcores, allows visual control of the valley of the Corbones River. Carmona was selected because the similarities between its location and that from Valencia-Castilleja allow differences and similarities between the two to be identified.

The third site is Valencia-Castilleja. Its large size and strategic location close to the top of the Aljarafe plateau, which offers ample visual control of the Vega del Guadalquivir and the Pyrite Belt, as well as its proximity to the estuary, make it a suitable site for analysis.

Amarguillo II, Poblado Calcolítico, and Parque Miraflores have been selected for analysis to compare the isotopic data. El Amarguillo II, which is located in the Seville countryside, has been

selected due to its position close to the passageways to the Vega del Corbones from the south. Poblado Calcolítico has been selected for its strategic position near the mountains and a copper mine. In the case of Parque Miraflores, it has been selected based on its proximity to the settlement of Valencia-Castilleja as one of the objectives of the project was to identify possible relationships between large sites and small settlements located in the surrounding areas.

## 5.2 La Loma del Real Tesoro

### 5.2.1 Location

The site of La Loma del Real Tesoro is located close to the northern end of the district of Carmona on the left bank of the middle section of the Guadalquivir River basin, 2km east of the village of Guadajoz (*fig. 25*). There are two different sectors to the site, named La Loma del Real

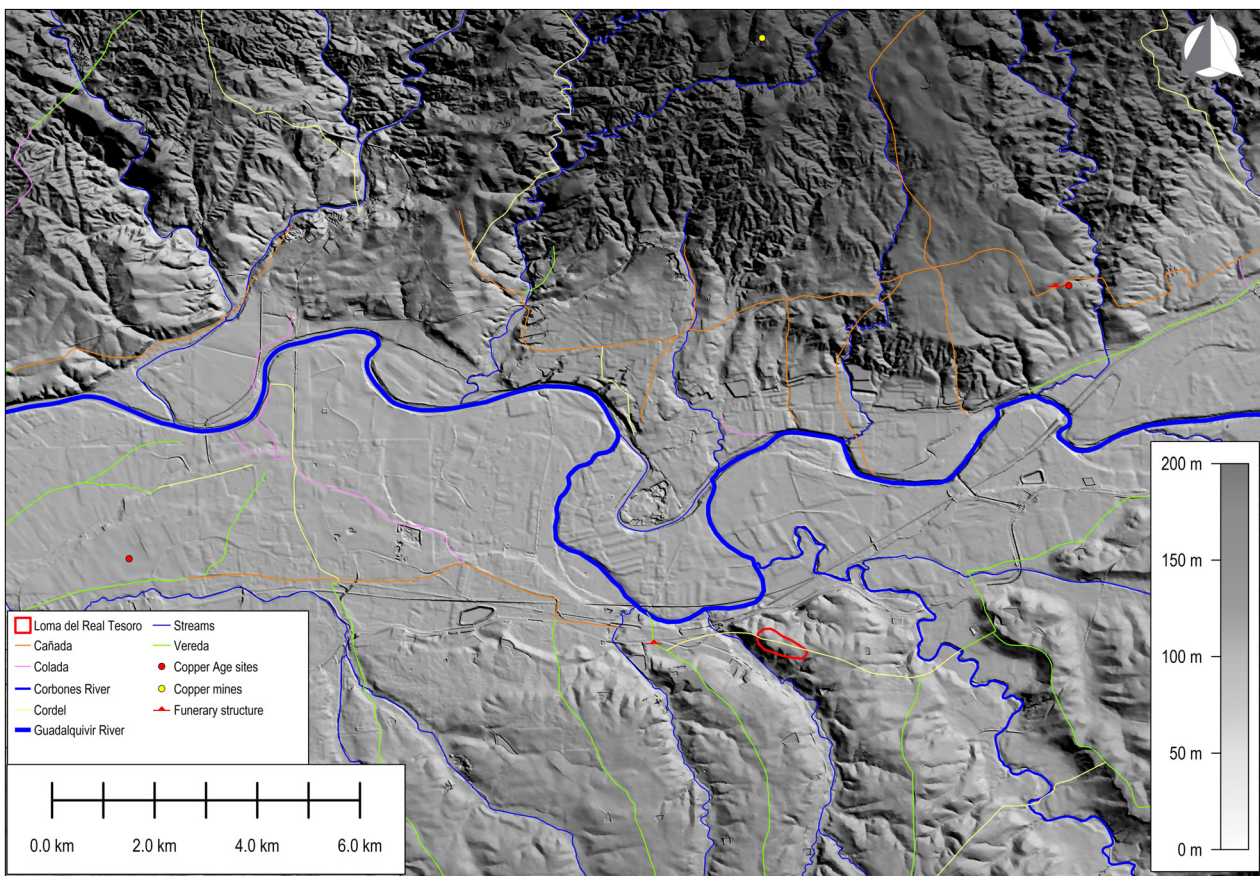


Fig. 25. Location of La Loma del Real Tesoro.

Tesoro I and La Loma del Real Tesoro II (henceforth LRT-I and LRT-II). It is located on an elongated hill 80m.a.s.l. which has a high visibility and offers control over the mid-low stretch of the fertile plain of the Guadalquivir and the mouth of the Corbones River. This area is surrounded by the Guadalquivir River to the north, the Las Adelfas stream to the west, and the Corbones River to the east, so fresh water supplies are guaranteed (Escudero Carrillo et al. 2017).

From a geomorphological point of view, the site of La Loma del Real Tesoro is located on the so-called medium and high terrace complexes (Caro Gómez et al. 2011; Borja Barrera/Borja Barrera 2018). The soils are Tertiary deposits from the Lower and Middle Pleistocene. Edaphologically, these are calcium luvisols and cambisols, and chromic luvisols with calcareous regosols. Luvisols are clay soils with a high silt content which makes them very suitable for agriculture. The low areas are ideal for cereal cultivation and the higher areas for extensive grazing. Calcium cambisols are most conducive for agriculture, grazing, and forestry. Regosols are soils of low agricultural productivity, thus often dedicated to extensive grazing (IUSS Working Group WRB 2015).

## 5.2.2 History of Research

The site of La Loma del Real Tesoro was found in 2002 during works undertaken for the revision, updating, and generic inscription of the inventory of archaeological sites of the municipal district of Carmona (Seville), commissioned by the Provincial Delegation of Culture of Seville. During 2015, 2016, and 2017, archaeological works were carried out, such as a geomagnetic, an intensive survey, and an excavation (Escudero Carrillo et al. 2017). In 2017, a second intensive pedestrian survey and geomagnetic survey were carried out.

### 5.2.2.1 Microsurvey

A first campaign was carried out in 2015. The southern sector of LRT-I was intensively surveyed. The northern sector could not be surveyed

because the crops obstructed visibility. In the case of LRT-II, only the northern half of the field could be surveyed because, as was the case with LRT-I, crops obstructed the visibility of the terrain.

Due to the change of crop in 2017, a second intensive surveying was carried out. This survey concentrated on the northwestern half of LRT-I after only isolated findings of interest were recorded in the southern half of LRT-II.

A total of 1366 finds have been documented in LRT-I and LRT-II (*fig. 26* and *fig. 27*). 1119 of these are pottery fragments and 338 are lithic fragments; there is also one loom weight and one adobe fragment. Other stones of non-local character, such as slate, rock crystal, basalt, and granite, have been identified in both sectors. The presence of slate is documented as being concentrated mostly in the eastern zone of the settlement in LRT-I and in the southeastern zone of LRT-II. Granite is concentrated mostly in LRT-I, while rock crystal is concentrated mostly in LRT-II.

In LRT-I, a total of 1060 findings have been documented, of which 813 are pottery fragments and 246 are lithics. One loom weight and one adobe fragment were also found. The dispersion of finds covers a total area of 5.7ha, with the highest concentration located in the central part of the settlement (*fig. 28*).

There is a clear predominance of almond-edged plates over other pottery shapes. There is a predominance of smoothed surfaces over burnished ones. With the exception of one fragment, Bell-Beaker pottery is practically absent. The dispersion of pottery types can be seen in *fig. 29*.

A large amount of flakes and core remains have been documented. The presence of mill stones and grinders, as well as axes and adzes, is also significant (*fig. 30*).

In the case of LRT-II, a total of 306 finds have been documented, of which 214 are pottery fragments and 92 lithics. The finds are distributed over an area of approximately 11.8ha (*fig. 31*).

Among pottery shapes, the absence of dishes and open shapes is remarkable. As in LRT-I, smoothing predominates over burnishing. A higher presence of elements with Bell Beaker decoration of maritime linear type and geometric points is documented in this sector (*fig. 32*).

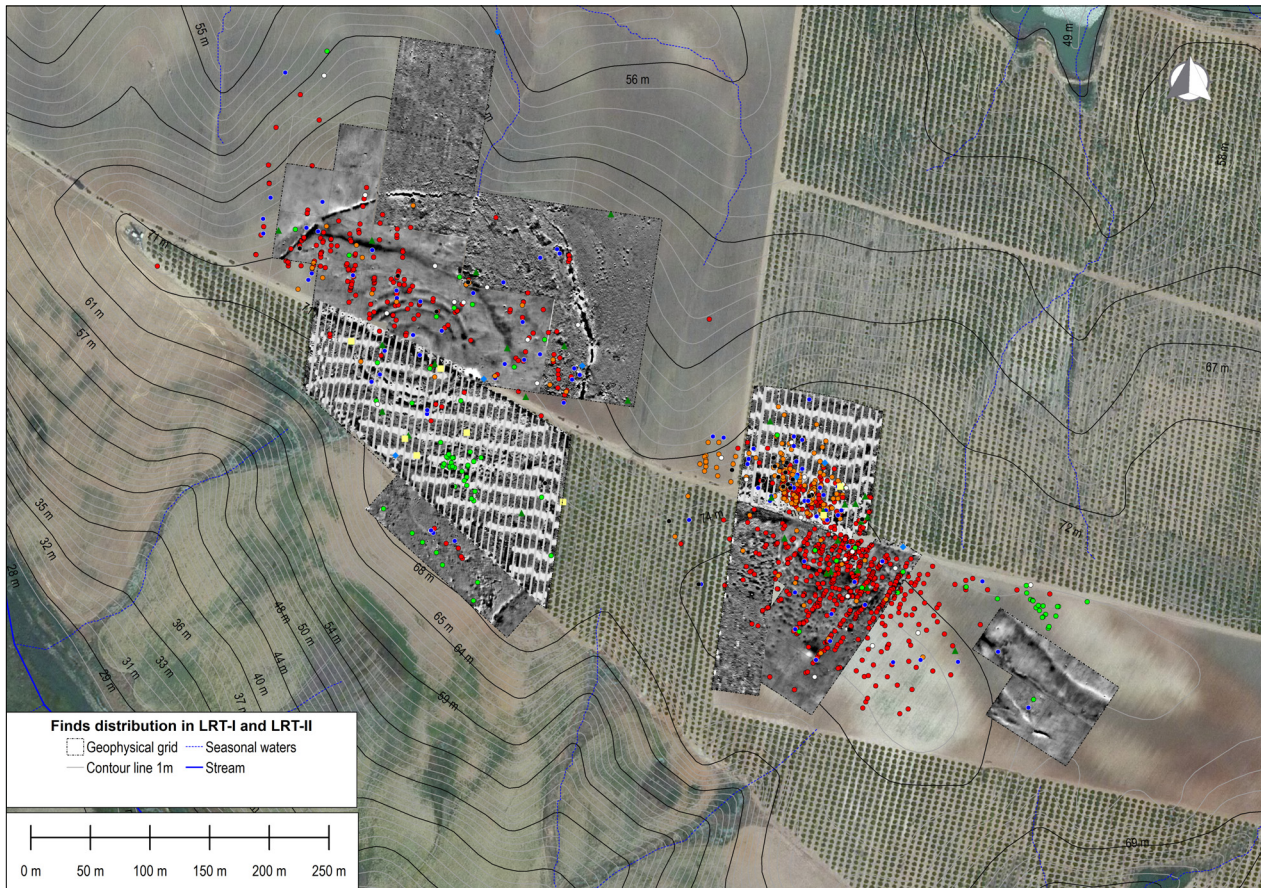


Fig. 26. Finds distribution in LRT-I and LRT-II.

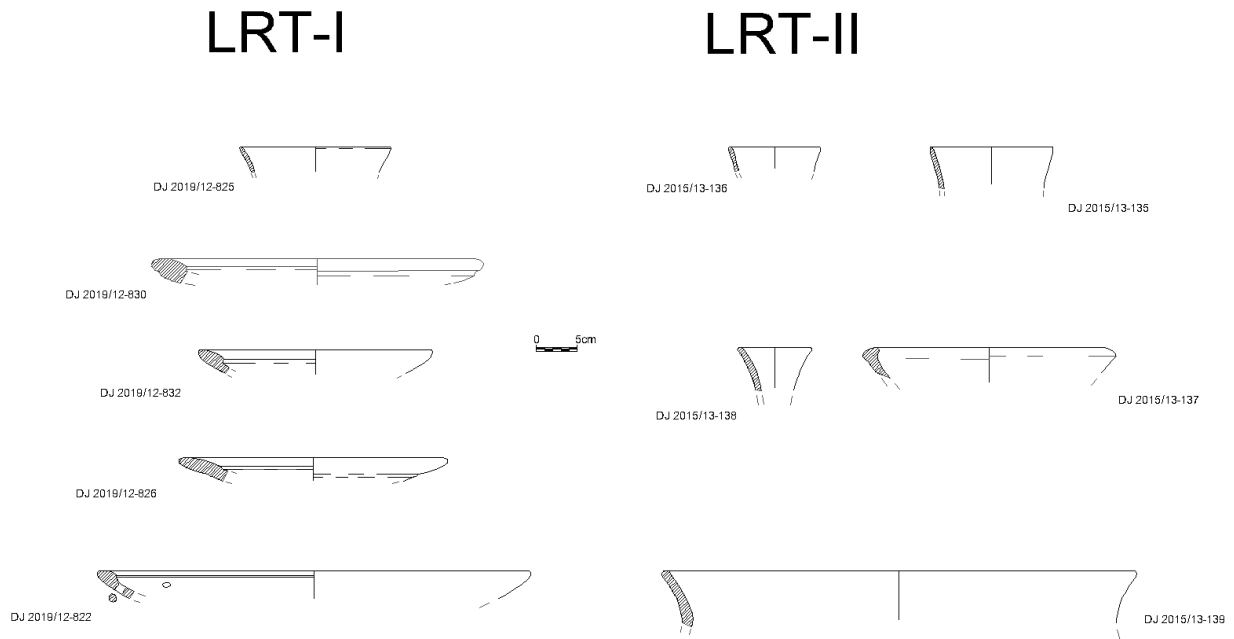


Fig. 27. Pottery found during survey in LRT-I and LRT-II.

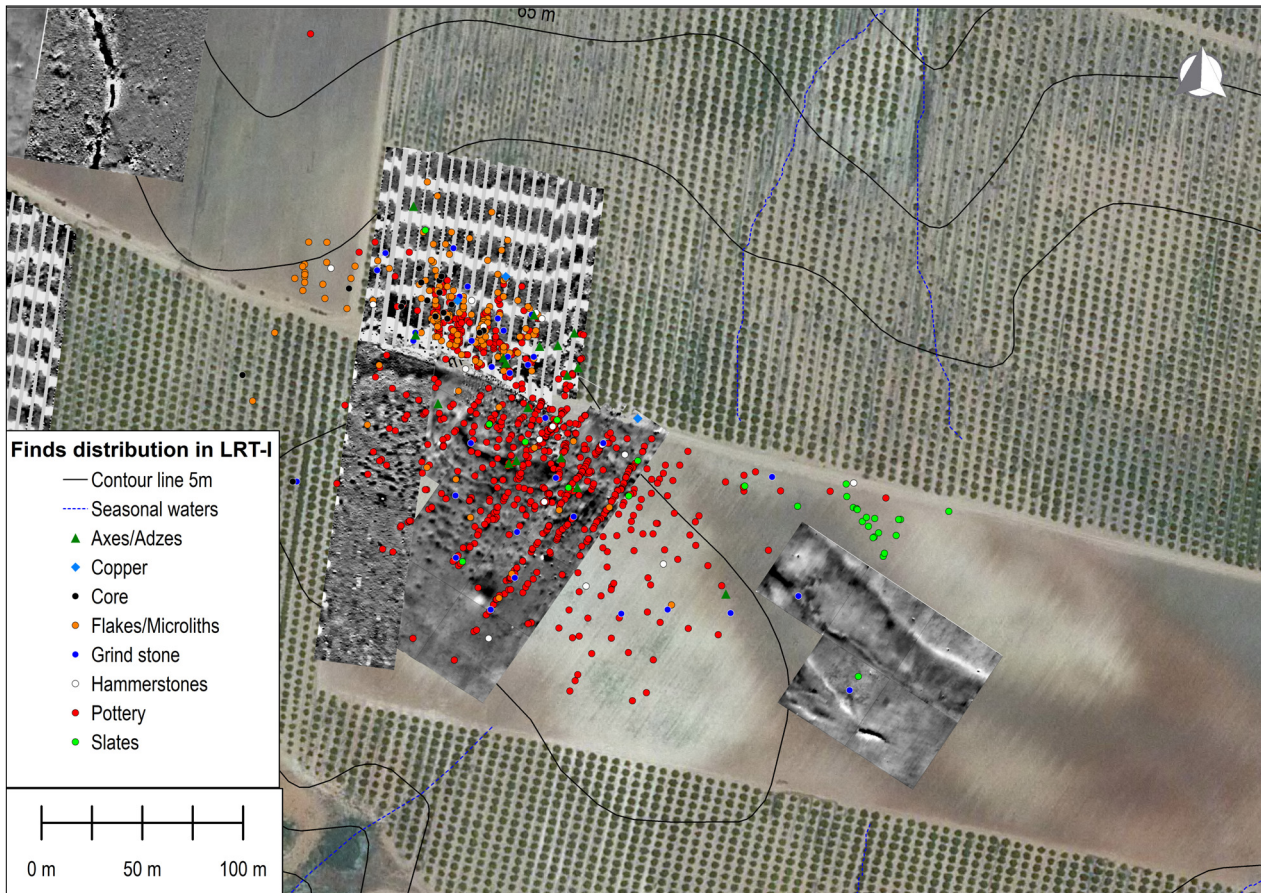


Fig. 28. Finds distribution in LRT-I.

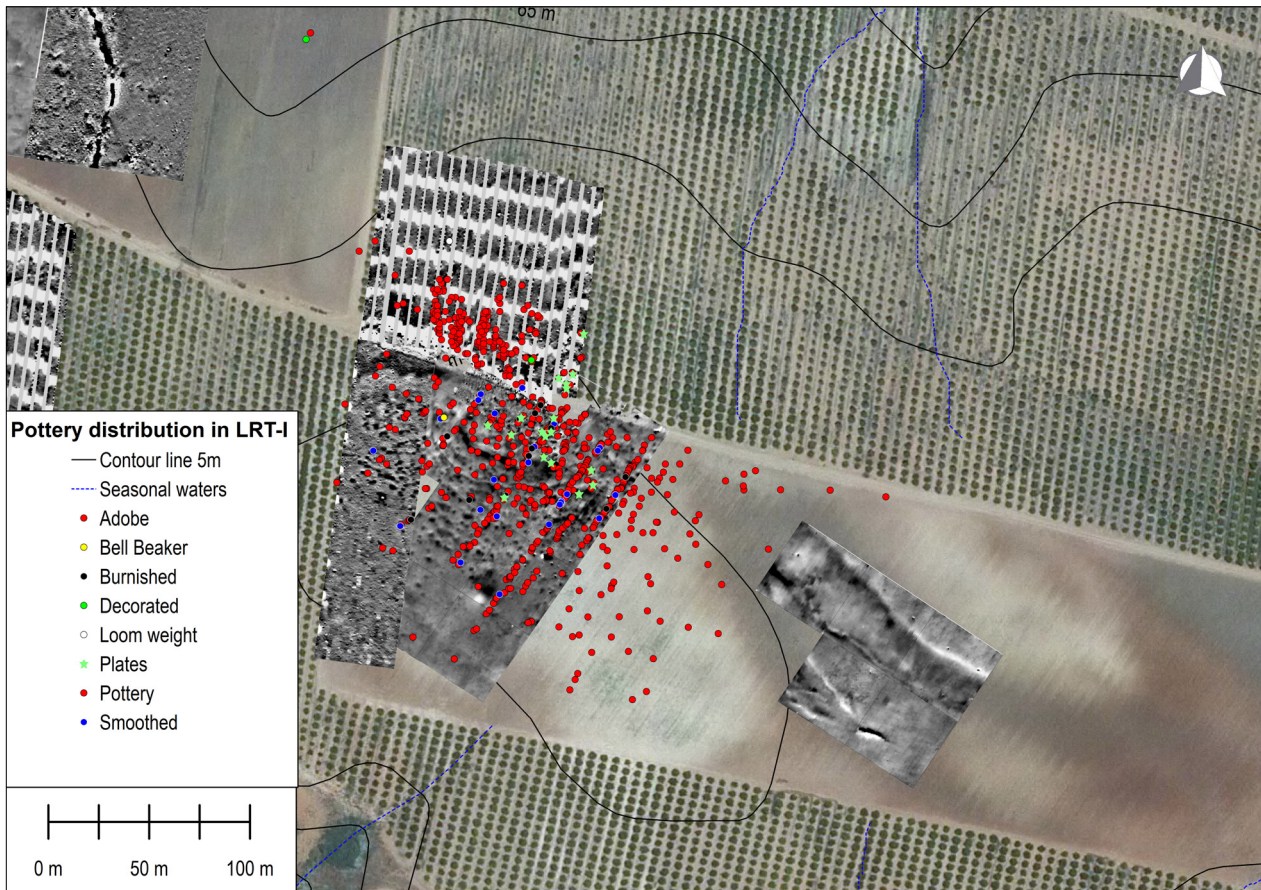


Fig. 29. Pottery distribution in LRT-I.



Fig. 30. Lithic distribution in LRT-I.

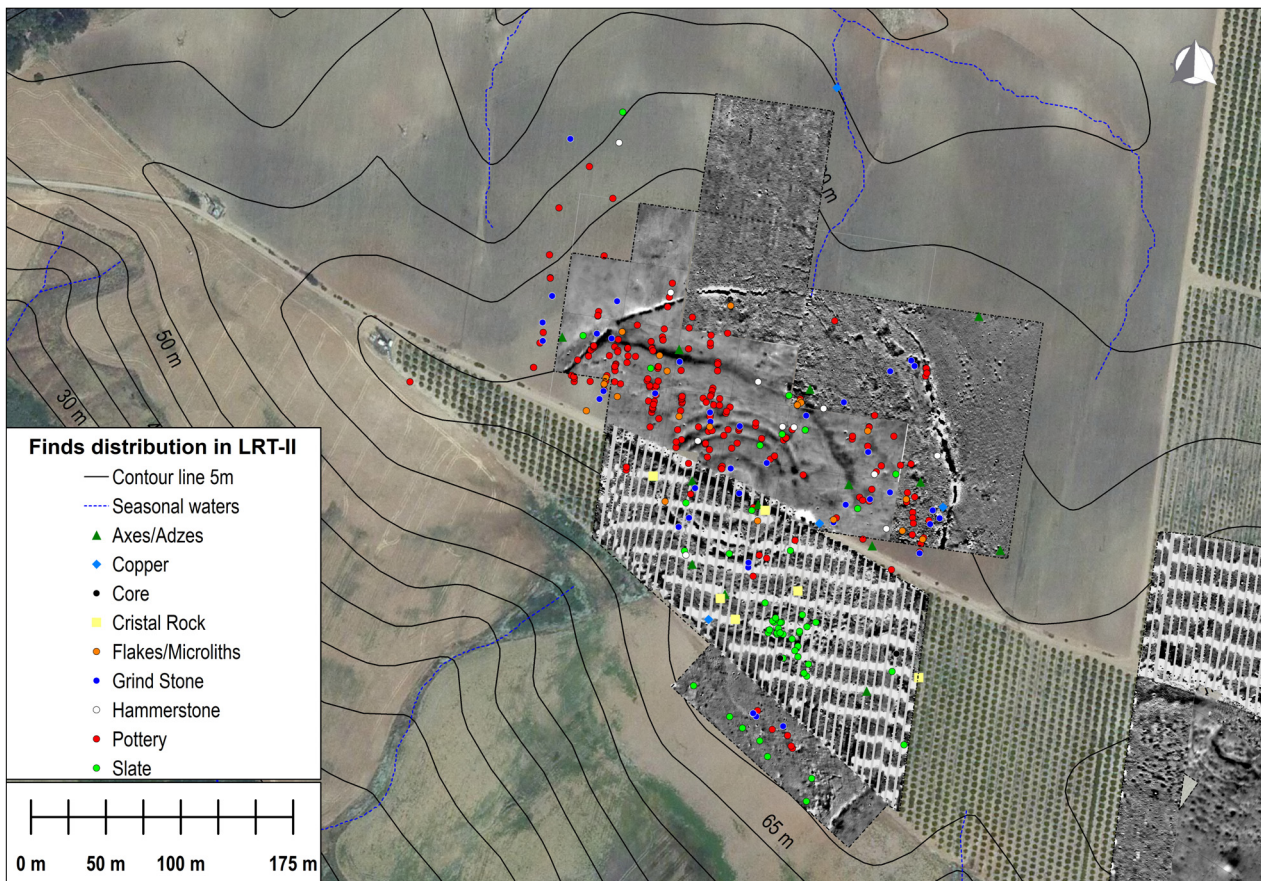


Fig. 31. Finds distribution in LRT-II.

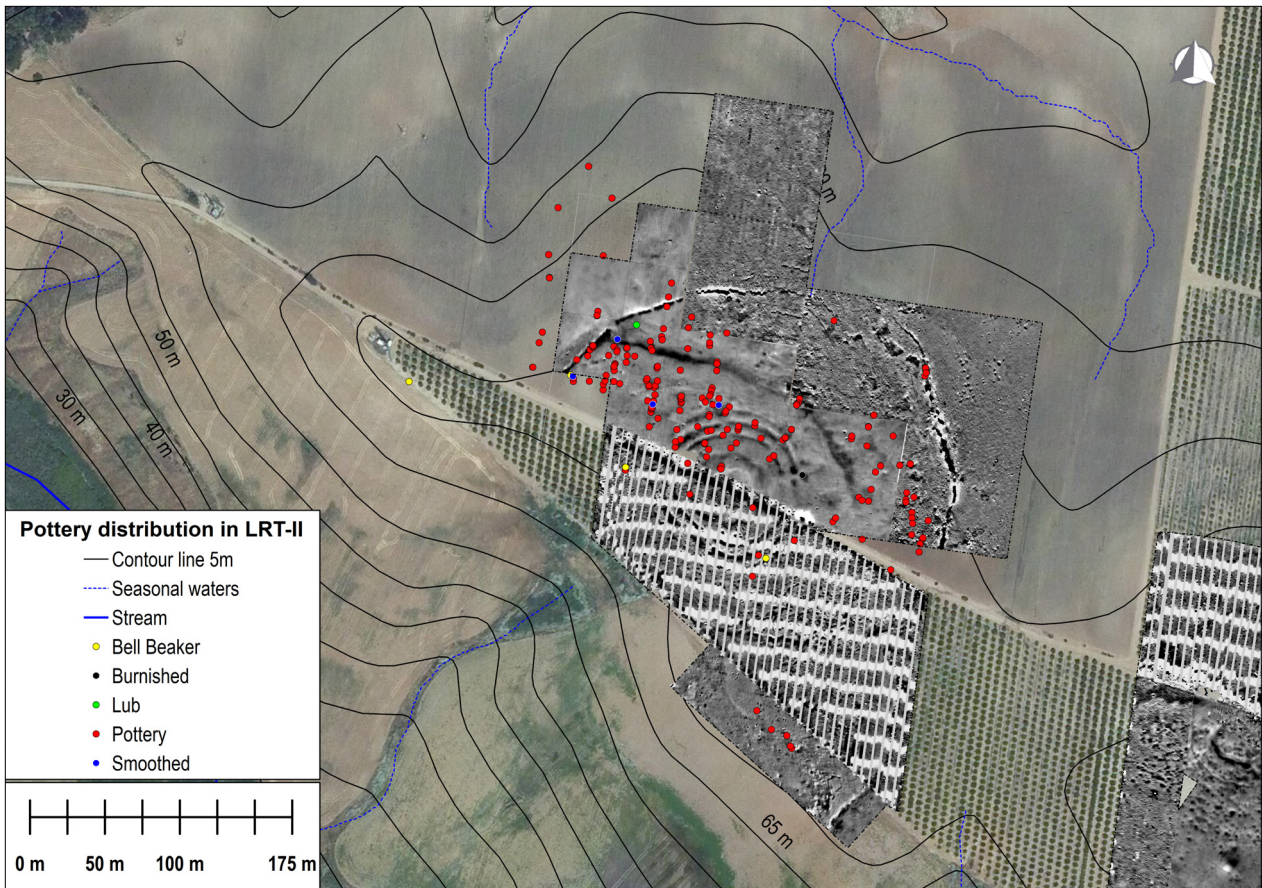


Fig. 32. Pottery distribution in LRT-II.

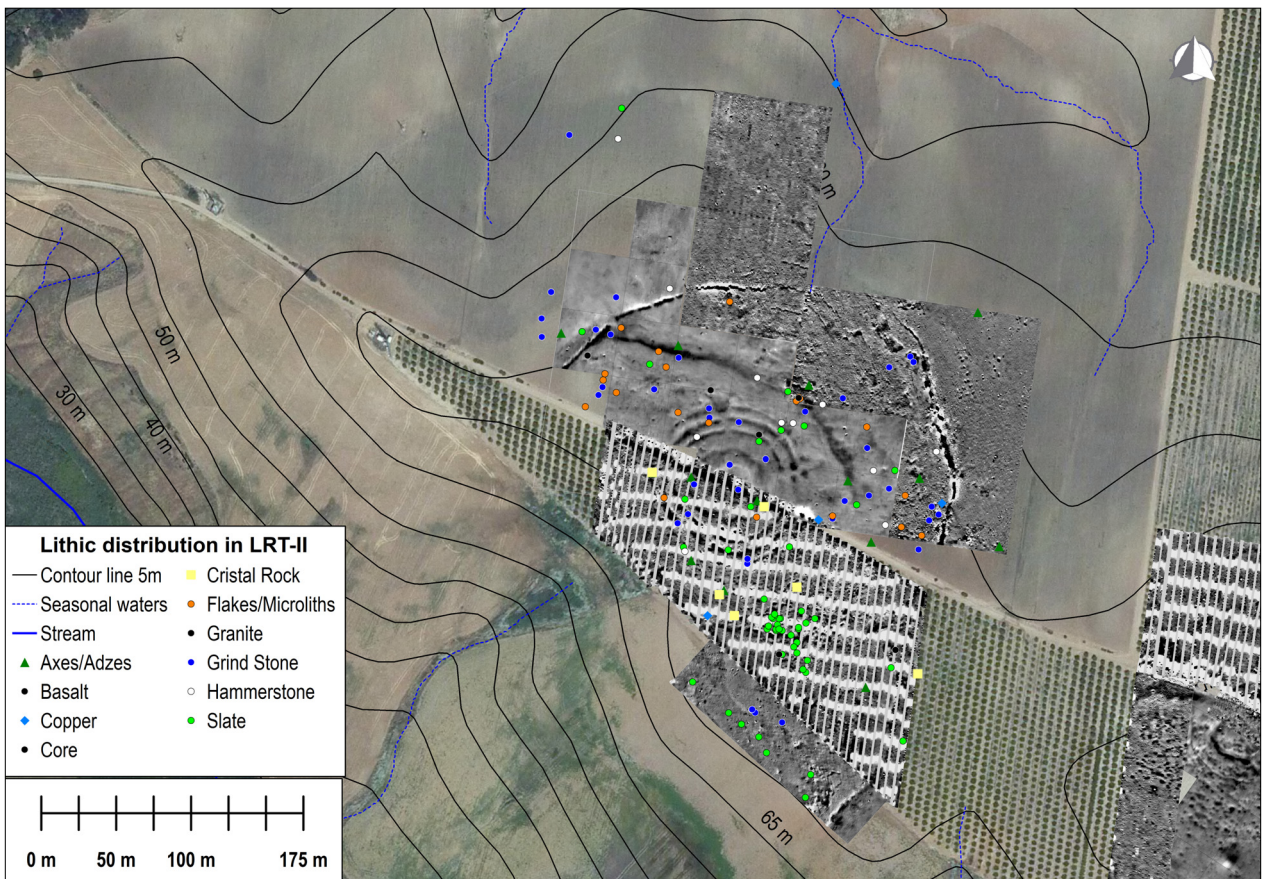


Fig. 33. Lithic distribution at LRT-II.

For the lithics, there is a clear predominance of elements related to agricultural practices, such as mill stones, axes, and adzes, as well as micro-lithic elements (*fig. 33*). The number of identified cores is scarce compared to LRT-I.

### 5.2.2.2 Geophysical Analyses

The geophysical studies carried out in 2015 and 2017 analysed a total of 12.5ha. In LRT-I, a total of 3.84ha were surveyed compared to 8.71ha in LRT-II. The results have shown two different sectors, as already indicated by the dispersion of surface materials, with completely different dispositions (*fig. 34*).

The magnetic image of LRT-I confirms the existence of a total of seven concentrically arranged circular ditches labelled enclosures A through G. The estimated average width of the ditches varies between 0.5 and 4m.

Despite not having magnetic images that cover the extent of the site, it is possible to estimate that it covers approximately 6.5ha (*fig. 35*).

South-facing access points have been identified for enclosures B and E. The alignment of these access points suggests that both enclosures were planned together. In the case of enclosure E, the magnetogram seems to indicate that it is a 1m wide ditch for a palisade. Additionally, enclosure B also has an access point oriented to the northwest which aligns with an access point in enclosure D. In most cases, the ditches are cut at breaks 7 to 8m wide.

Several small enclosures, with diameters of approximately 20m, are also evident. Most of these have their accesses oriented to the south.

The superposition of structures reveals the presence of different construction phases.

Both inside and outside the enclosures, an accumulation of magnetic signals with sizes ranging from 1 to 3m in width are documented. These seem to correspond with negative pit-like structures common in this type of settlement at the time. These structures are also seen at Valencina-Castilleja (García Sanjuán/Díaz-Zorita Bonilla 2013), Venta de Rapa (Lechuga Chica et al. 2014), Carmona (Conlin Hayes 2006), Perdigoões (Márquez Romero et al. 2011), and Casetón de la Era (Crespo et al. 2015).

These pits seem to be disorganised at first sight, but are connected by more subtle areas of magnetic intensity that group them into circular shaped patterns that are no more than 20m in diameter. The fact that these features are all roughly on the same alignment and are not aligned to the modern field features, nor to the survey direction, supports their interpretation as possible footer trenches or ring ditches surrounding structures. The whole complex seems to be closed on its northern slope by structures H and I. This interpretation should be taken as a point for further investigation rather than a definitive statement.

In the eastern area, circular structures with an average diameter of 10m were identified (*fig. 35*). The high concentrations of slate, together with the scarce amount of pottery recovered on the surface, could indicate a possible funerary use. Three linear structures with northwest-southeast orientation were found; these are most likely linked to an ancient livestock track. Due to the presence of a traditional cattle route, the ascription of a date of these paths contemporary to the settlement is doubtful. In the case of the central track, it could be contemporary to the settlement because it changes its course to avoid one of the circular structures.

The magnetic image in LRT-II reveals the existence of six circular ditches arranged concentrically around a large central structure labelled, from the centre outwards, enclosures 1 to 6.

The full size of the settlement is unknown, but the known area covers approximately 10ha (*fig. 36*).

Seven access points have been documented in enclosures 2, 3, and 4. Each access point is about 4m wide. In enclosure 1, the magnetic signal is not uniform, but it has been possible to identify at least one access oriented to the south.

The alignment of the access points suggests that the central structure and the first 4 enclosures were planned and built synchronously.

The central structure has an approximate diameter of 20m. The centre of the structure presents a magnetic anomaly due to either biogenic magnetisation processes or to a collapsed underground wood-adobe construction. This structure is surrounded by a quite sharp negative anomaly which could be caused by a limestone wall.

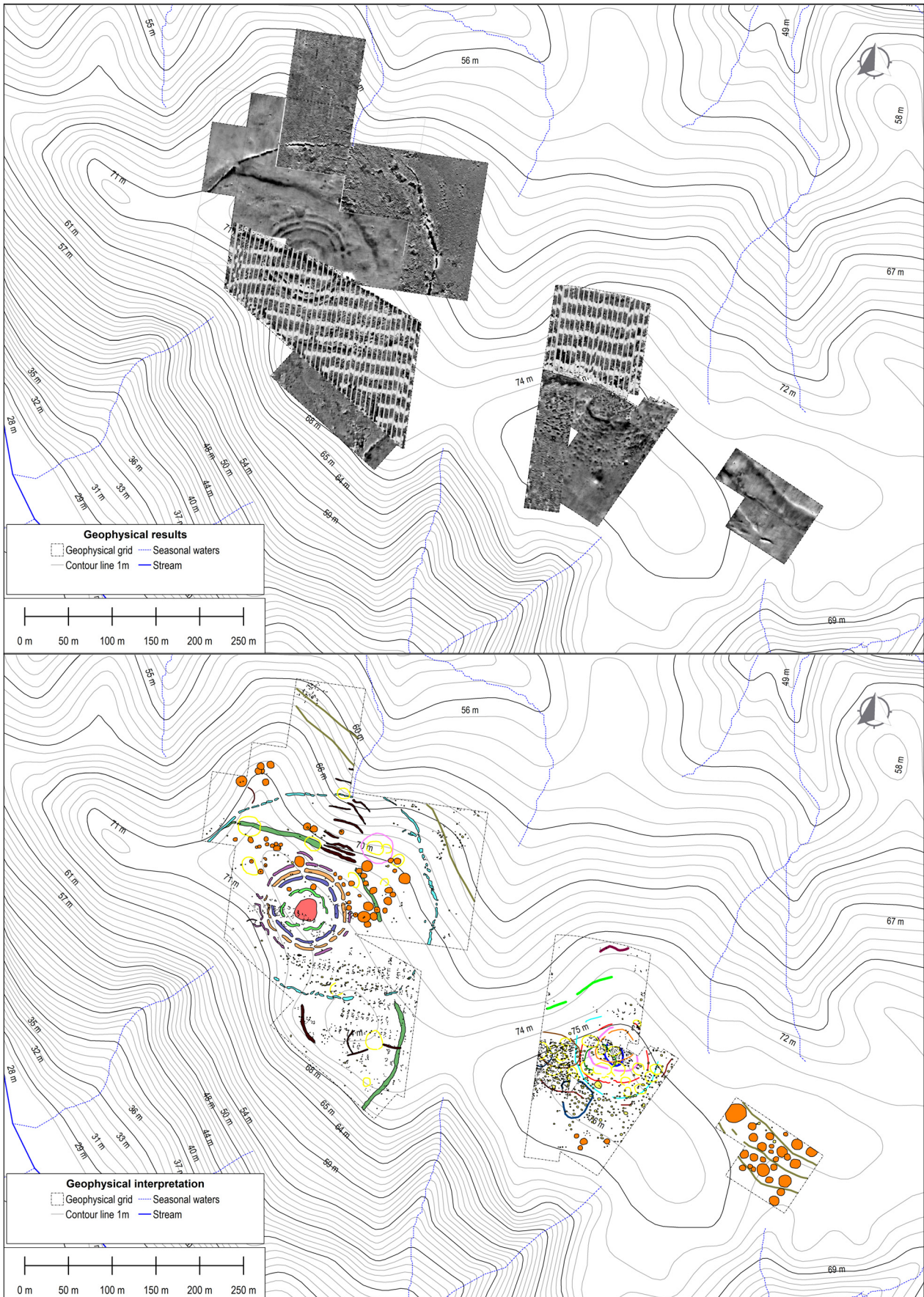


Fig. 34. Geophysical results (a) and interpretation (b) in LRT-I and LRT-II.

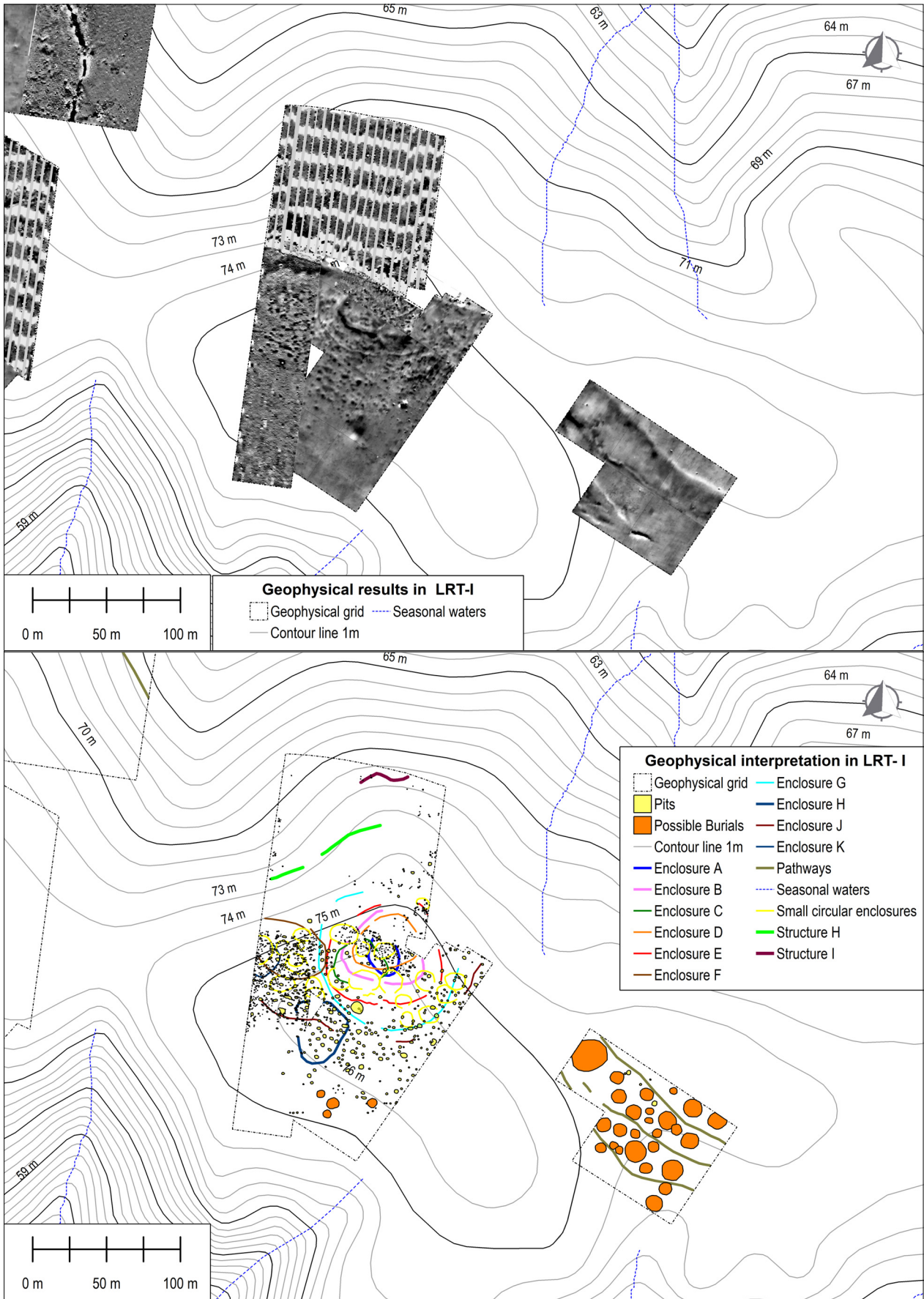


Fig. 35. Geophysical results (a) of LRT-I and interpretation (b) in LRT-I.

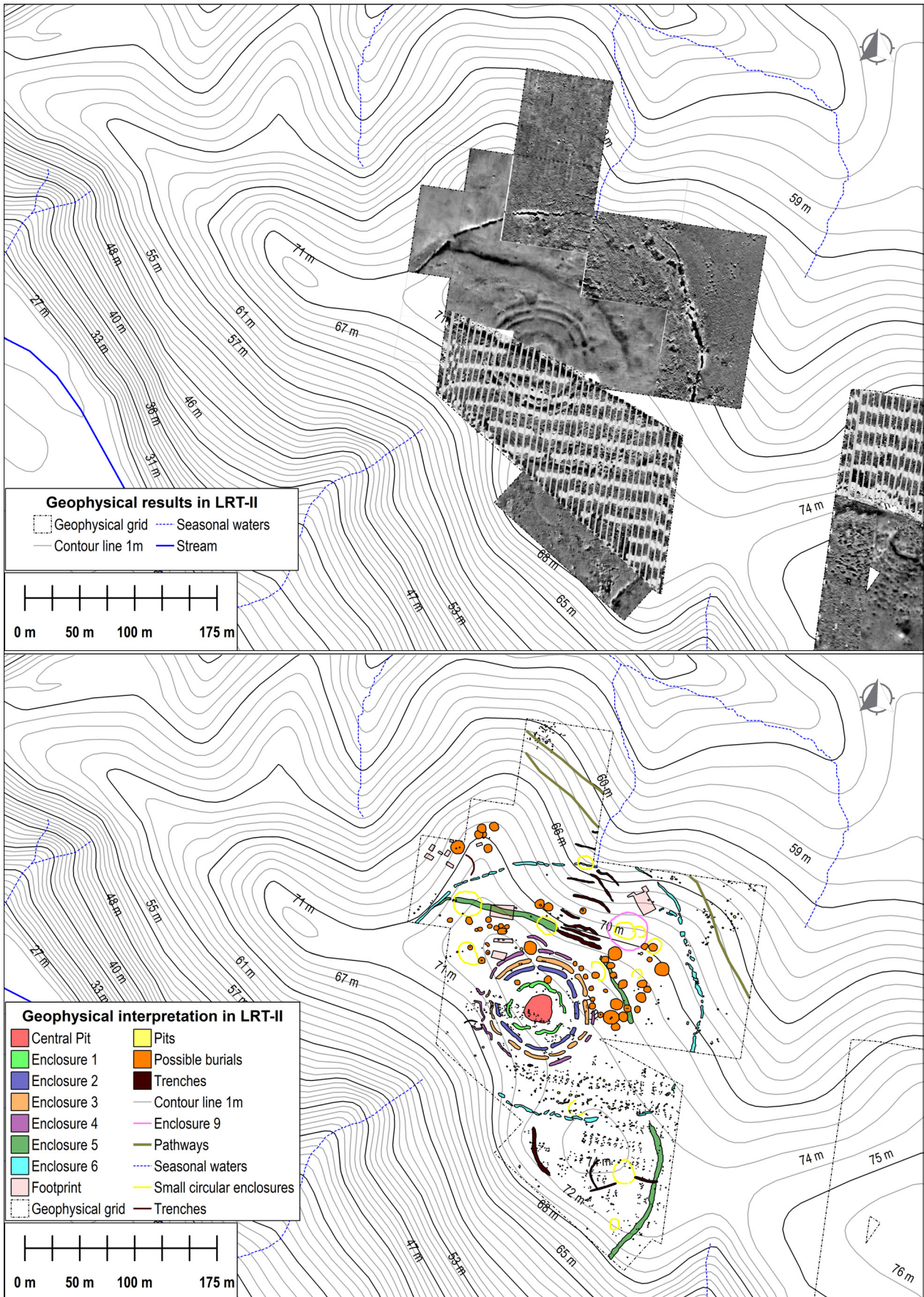


Fig. 36. Geophysical results (a) and interpretation (b) in LRT-II.

In the case of the first enclosure, it presents a sinuous layout. This type of sinuous ditches has been widely documented in Portugal at sites such as Perdigões (Márquez Romero et al. 2011), Xancra (Valera 2008; Valera/Becker 2011), Santa Vitória and Outeiro Alto 2 (Valera/Filipe 2010), Charneca, Folha do Ouro (Valera/do Pereiro 2013), Alcalar (Morán Hernández 2010; 2014), and Borralhos (Valera/do Pereiro 2019). In Spain, this type of sinuous ditch has also been identified, but to a lesser extent; this is mainly due to the lack of geophysical research. Even so, it has been possible to document them in sites such as Marroquíes (Hornos et al. 1998), Papa Uvas (Martín de la Cruz et al. 1990) and Venta del Rapa (Lechuga Chica et al. 2014).

Enclosure 2 has a diameter of 73m and a perimeter of 242m. Its ditch is divided into eight segments of variable length (between 15 and 21m each segment) and 3m width.

Enclosure 3 has a diameter of around 90m and a perimeter of 323m. Its ditch is also divided into four segments between 20 and 37m long and approximately 4m wide. Enclosure 4 has an approximate diameter of 109m and a 359m perimeter. According to geophysics, the northern part of the enclosure is divided into four transects of 30m each forming three different access points.

The outer enclosure is called enclosure 5. It has a sectioned layout, mainly in the northwest sector, and loses continuity in the northern sector. The magnetic contrast of the filling must be extremely high, which would cause the very clear magnetic 'shadow' to the north; this is typical for a burnt structure like a wooden wall.

A possible access has been identified in the southeast area, where a concentration of negative hole-like structures has been documented. The proportion of this type of structure is lower than in LRT-I. In the case of LRT-II, two accumulations of pits were identified. One is located in the southeast area of the settlement and one in the northeast area in the external area of the outer enclosure.

Between the set of concentric pit enclosures and the outer enclosure, small circular enclosures have been also identified (fig. 36).

Two pathways have been documented to the northwest of the site which may be related to those documented in LRT-I.

## 5.3 Carmona

### 5.3.1 Location

The Carmona settlement is located on a poly-lobed plateau with a maximum elevation of 257m.a.s.l. defined by large slopes to the north, south, and east. This plateau has five peripheral elevations. Due to its location on the cornice of the Alcores, the plateau was probably affected by a strong erosive process which would have changed its topography from prehistoric times to the present (fig. 37).

The site is located on calcarenite from the Upper Miocene. These are very porous dendritic limestones that allow a phreatic mantle in the lower levels. The predominant vegetation are forests of holm oaks (*Quercus rotundifolia*), olive trees (*Olea europea*), and carob trees (*Ceratonia siliqua*) (Llargo López/Ubera Jiménez 2008, 2371 f.).

Pollen analyses carried out on samples from the excavation of Calle Calatrava 4 showed an anthropogenic, deforested landscape with a predominance of herbaceous vegetation rather than trees and shrubs typical of the Mediterranean forest (pines, holm oaks, cork oaks, kermes oaks, wild olive trees, rockrose, and heather). This phenomenon increases over time (Llargo López/Ubera Jiménez 2008, 2381).

The samples showed a high presence of cereals and ruderal grassland that would indicate the existence of cereal crops and cattle herding (Llargo López/Ubera Jiménez 2008, 2382).

Finds from the 3<sup>rd</sup> mill. BC can be found all over the plateau. The highest concentration of these finds is documented in the highest altitude area near the northern escarpment (fig. 38).

The site of Carmona would have been a permanent settlement towards the last quarter of the 4<sup>th</sup> mill. BC. This stability was based on an agricultural economy, focused on crop cereals and goat farming, which reached its peak in the middle of the 3<sup>rd</sup> mill. BC (Conlin Hayes 2006, 1627). However, when interpreting this site, it has to be taken into account that erosion and urban construction have considerably affected it in the last twenty years (Conlin Hayes 2003).

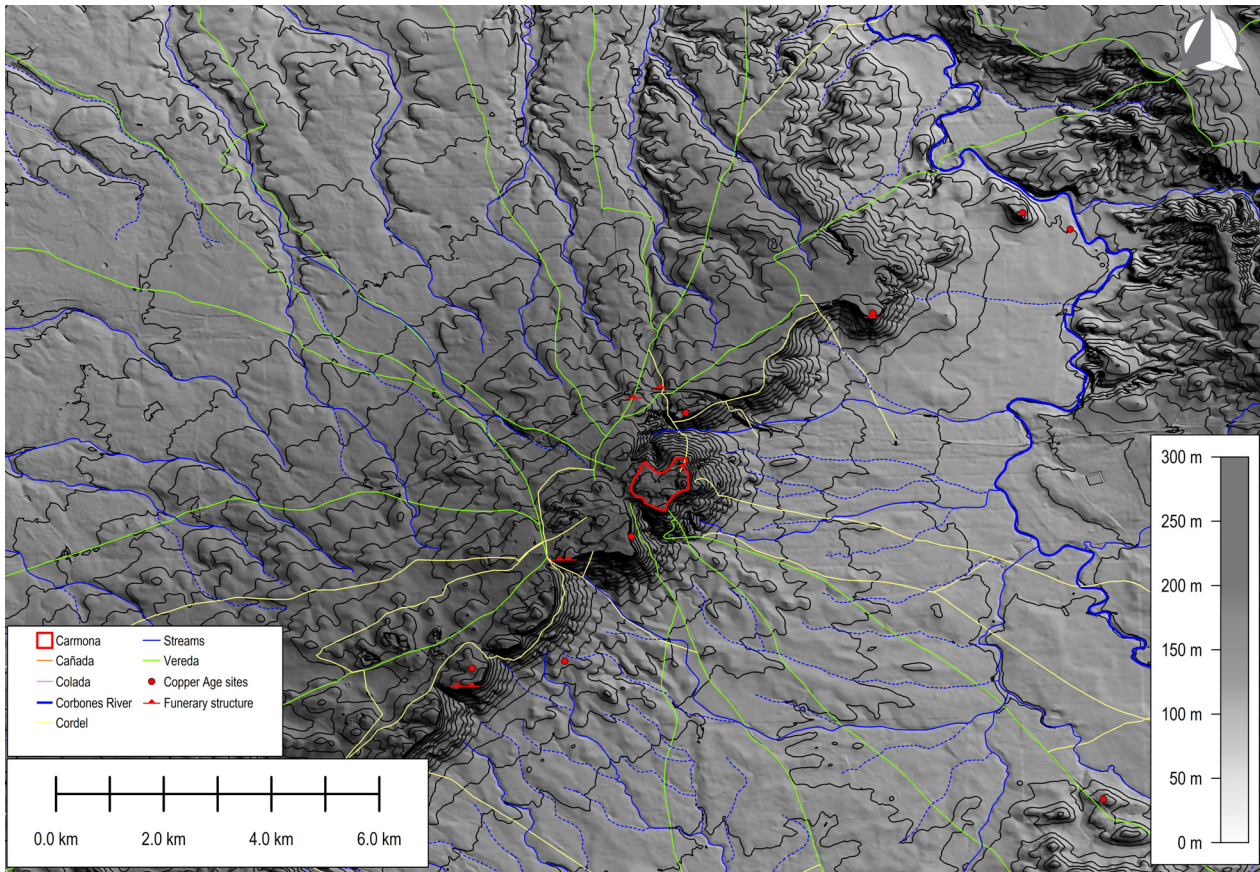


Fig. 37. Location of Carmona.

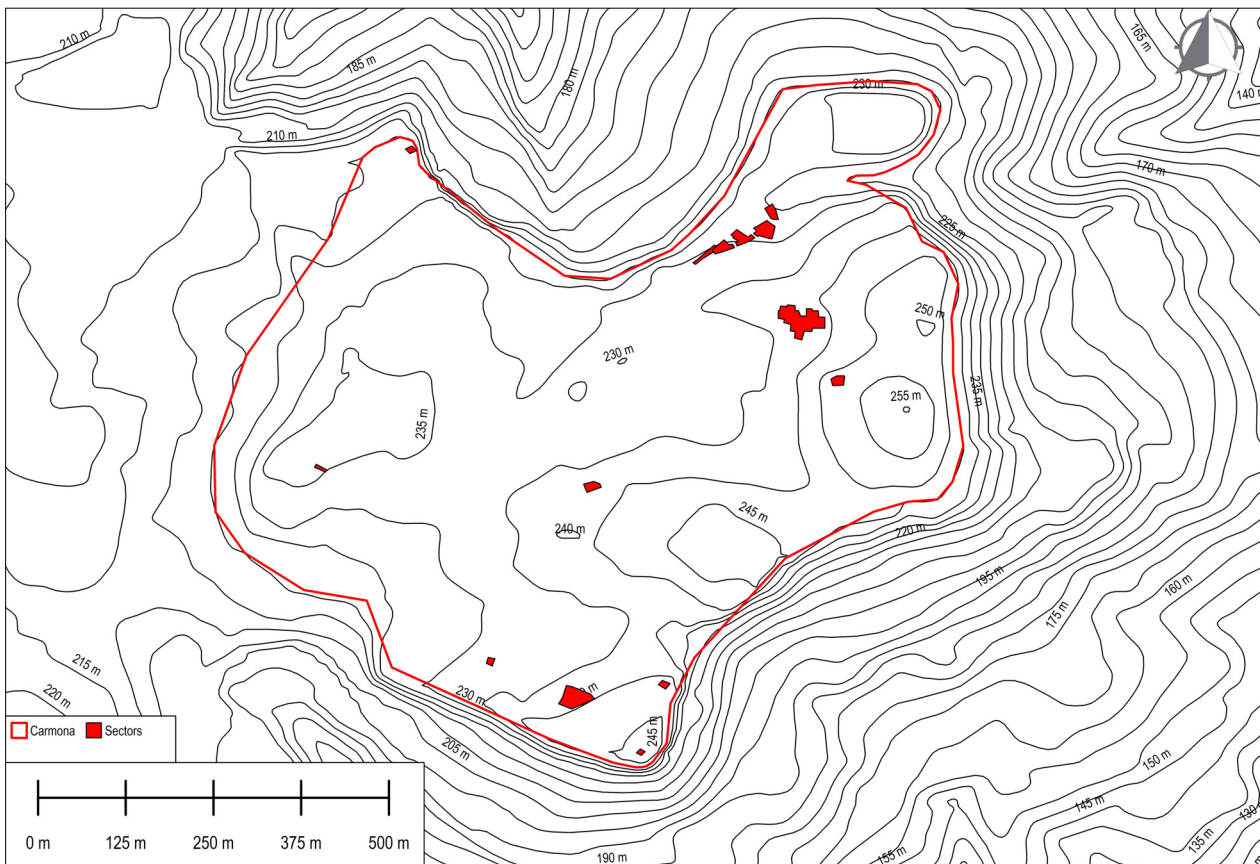


Fig. 38. Location of sectors with Copper Age evidence in Carmona.

### 5.3.2 History of Research

The first documentation of Copper Age structures on the Carmona site is from the surveys carried out by Pellicer Catalán and Amores Carredano in 1980. The CA-80/A test pit documented a structure which the excavators identified as a well, the lower fill of which contained Copper Age material. The second test pit was dug in the area of El Picacho (CA-80/B) and Chalcolithic material was documented at the base of the test pit (Pellicer Catalán/Amores Carredano 1985).

In 1987, during rescue excavations carried out in Calle General Freire 12, a level of reddish soil was documented on the bedrock of the site, on which an oval-shaped basin-like structure was recorded with dimensions of 1.60 by 1.30m and a depth of 0.33m. The material collected was dated to the Chalcolithic (Cardenete López et al. 1990). Likewise in Calle Costanilla Torre del Oro s/n, levels were documented that contained Chalcolithic pottery shapes (Cardenete López et al. 1991).

In the Plaza de Santiago 1 excavations, a truncated cone-shaped structure was identified. This structure was filled with stones as well as potsherds typical for the Copper Age (Cardenete López et al. 1992a).

In 1990, the excavations in Plazuela de Laso documented a U-section ditch with a width of 3.15m and a depth of 1.15m. This ditch contained a 0.95m deep structure made of stones and clay. The researchers dated the ditch and the structures to the Final Chalcolithic, based on structural similarities with other sites in the area (Cardenete López et al. 1992b, 508).

During emergency excavations carried out between 1996 and 1997 by Román Rodríguez and Conlin Hayes at Calle Dolores Quintanilla 6, ten Chalcolithic structures were documented. All the structures were dug into the bedrock and had circular plans and bell shape profiles with a flat or concave base. The authors identified what they considered to be huts, with measurements between 2.50 and 2.90m width, and storage pits, with measurements between 1.50 and 2m width. Both types of structures have been affected by modern removals and the authors estimated that they could have had a maximum depth between 1 and

1.50m (Román Rodríguez/Conlin Hayes 2001, 530; Conlin Hayes 2004). New excavations carried out in 1999 in Calle Dolores Quintanilla 12 identified 18 structures of the same type as those identified in Calle Dolores Quintanilla 6. Following this, excavations at Calle Calatrava 2 identified a storage pit, while in Calle Calatrava 4 a total of 13 structures were identified (Conlin Hayes 2003, 94; Román Rodríguez/Conlin Hayes 2005). In 2008, excavations at Alcazar del Rey Don Pedro confirmed the concentration of 3<sup>rd</sup> mill. BC structures in the area (Conlin Hayes/Gómez Saucedo 2003; Conlin Hayes 2004; Román Rodríguez/Vázquez Paz 2005; Román Rodríguez/Conlin Hayes 2005; Guerrero Chamero 2017).

In 2000, the excavations by Anglada Curado and Rodríguez Rodríguez in Galindo Street revealed a structure excavated into the bedrock. The filling of this structure was dated to the Chalcolithic, despite it being quite far from the area with the greatest concentration of findings from the Copper Age (Anglada Curado/Rodríguez Rodríguez 2003).

During the excavations carried out in the Plazuela de Santiago 6–7, 4.70m of a V-section trench were documented. This trench, which was excavated into the bedrock, was interpreted by the excavators as a structure with a draining function. The maximum documented width was 2.10m and the maximum depth was 2.35m. This structure is likely related to one documented by Cardenete et al. in Plaza de Santiago 1 (Gómez Saucedo 2003; Cardenete et al. 1992a).

### 5.3.3 Chronology

Radiocarbon dates for the site of Carmona are scarce (*table 14*) but provide a chronology covering the entire 3<sup>rd</sup> mill. BC.

Researchers have also developed a relative chronology based on the pottery documented at Calle Dolores Quintanilla 12. The first phase of this chronology is the ‘formative phase of the South-western Chalcolithic’ which reaches the first half of the 3<sup>rd</sup> mill. BC, and the second phase reaches the second half of the 3<sup>rd</sup> mill. BC (Conlin Hayes/Gómez Saucedo 2003, Román Rodríguez/Conlin Hayes 2001).

Sector	Structure	Sample	BP	Date $2\sigma$	Reference
Calle Dolores Quintanilla, 6	E1	Charcoal	-	2630–2470 BC	Conlin Hayes 2006
Calle Dolores Quintanilla, 6	E3	Charcoal	-	3340–3210 BC	Conlin Hayes 2006
Calle Dolores Quintanilla, 6	-	Charcoal	4055±50	2705–2470 BC	Nocete Calvo et al. 2011
Calle Calatrava, 4	E3	Bone	4247±33	2810–2749 (CNA 2895)	Conlin Hayes 2017
Ronda del Cenicero	Burial	Bone	3699±35	2154–2012 BC (CNA 2891)	Conlin Hayes 2017

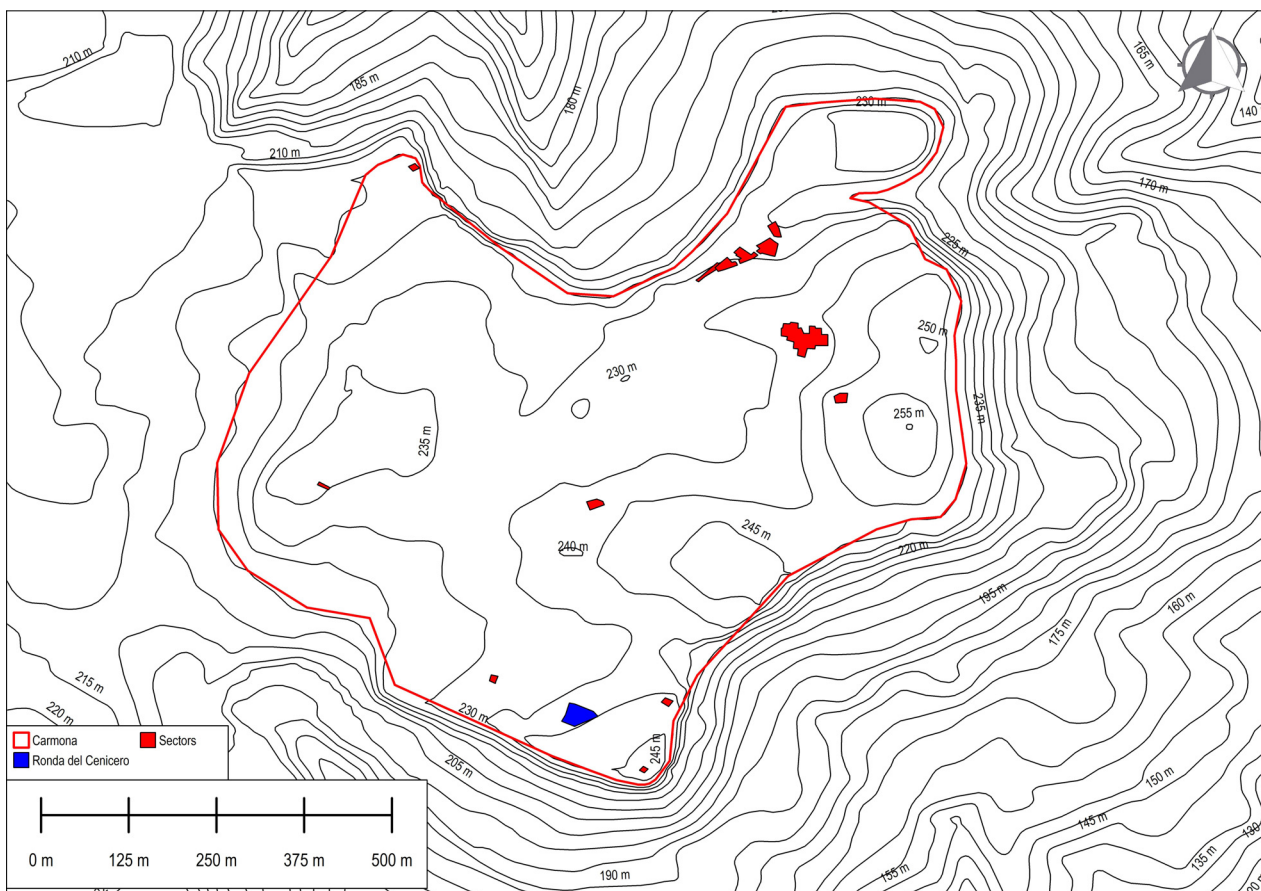
**Table 10.** List of radiocarbon dates for Carmona.

### 5.3.4 Previous Zooarchaeological Analyses

Two unpublished zooarchaeological analyses have been done in Carmona. Both were conducted by Moreno García in 1999 and were based on the animal remains recovered from structure 3 in Dolores Quintanilla 6 and structure 13 in Dolores Quintanilla 12 (Moreno García 1999a; 1999b).

### 5.3.5 The Excavation at Ronda del Cenicero

The selection of the sector Ronda del Cenicero excavation (henceforth RDC) was based on several factors. The first one was the location of the excavation, in the southern area of the Carmona plateau. There are records from the northern area, but not from the south. The second is because it was a recent archaeological excavation and there



**Fig. 39.** Location of the Ronda del Cenicero sector.

Test pit	Size (m)
A	6.5 x 5
A2	1 x 4
D	7 x 5
E	3.80 x 2.30
F	5 x 3
H	3 x 2

**Table 11.** Test pits from El Picacho (Carmona) with Copper Age levels.



**Fig. 40.** Location of test trenches in Ronda del Cenicero (figure courtesy of Román Rodríguez, in press).

was access to all the information and the excavation process. The last factor was the chronology of the site. The pottery recovered from the excavation in RDC showed a relative chronology from the Bell Beaker phenomenon, filling the completed sequence for the 3<sup>rd</sup> mill. BC of the other sectors analysed in the site of Carmona.

The excavation area is located in a plot of land near the southern escarpment of the plateau on which Carmona sits (*fig. 39*). It is on a natural slope that falls from the area known as El Picacho (Román Rodríguez 2011, Román Rodríguez in press). The area has been known since the 1980s for the presence of Bell Beaker pottery on its surface (Pellicer Catalán/Amores Carredano 1985).

A total of nine test trenches of varying sizes were opened, of which only five had Copper Age levels (*fig. 40*). The total excavation area was 163.49m<sup>2</sup> (*table 11*).

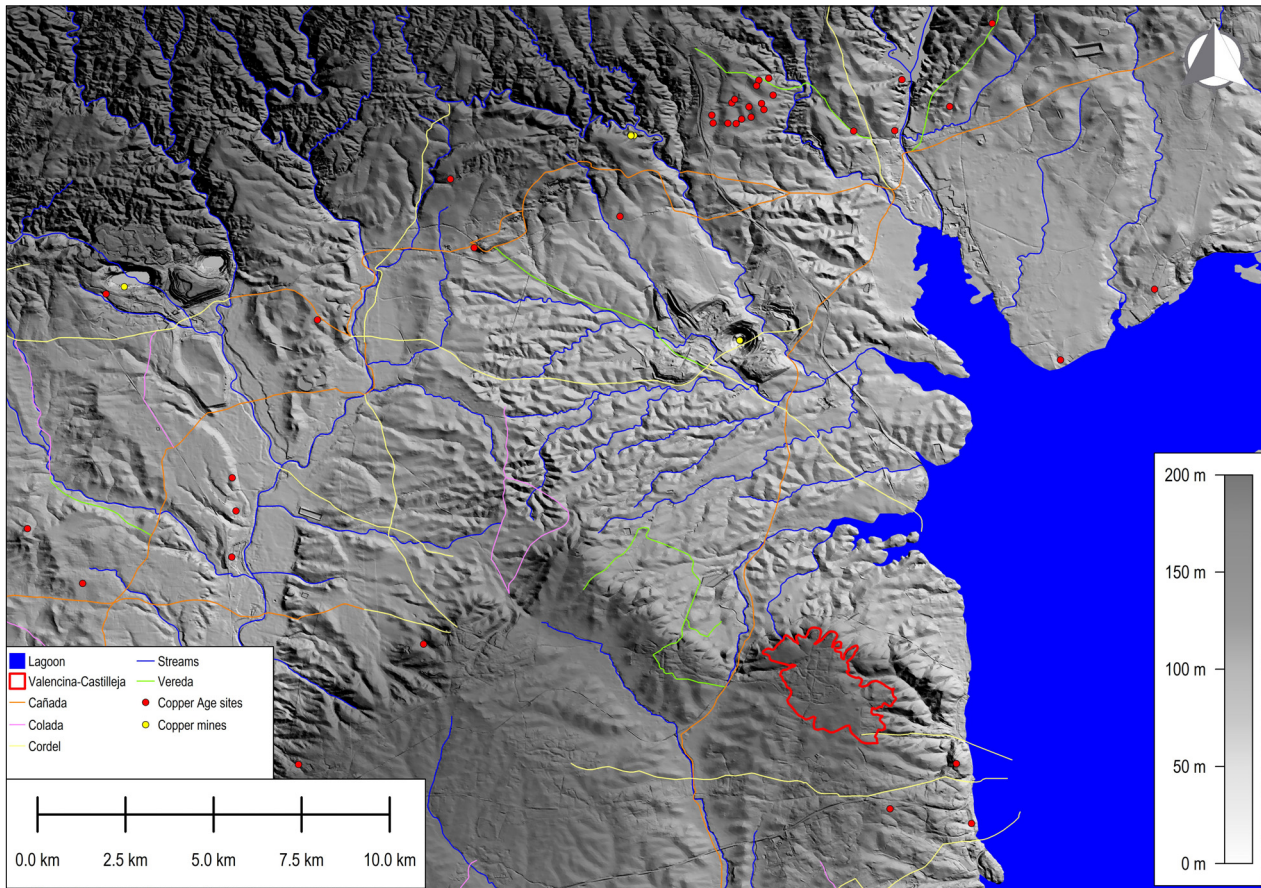
The results of the zooarchaeological analyses of two of the structures documented in test trench A are presented in chapter 6.

## 5.4 Valencina-Castilleja

### 5.4.1 Location

Valencina-Castilleja is located in a strategic position occupying the highest point of the Aljarafe plateau, 156m a.s.l. It is separated from the lowlands which have poor habitation conditions due to floods and diseases associated with malarial environments (Llergo López et al. 2013, 410) (*fig. 41*). The settlement is located on a quadrangular central upper plateau around which small hills are arranged. To the north are the Cerro de las Coronas, Cerro de la Cruz, Cerro de la Cabeza, and Cerro Mármol hills. Rolling hills where the Sitio de Valencina, El Algarrobillo, La Horca, and El Cuervo sectors are located to the south, as well as endorheic areas and runoffs through which water occasionally ran (Vargas Jiménez 2003, 130; Márquez Romero/Jiménez Jáimez 2010, 118).

According to Vargas Jiménez (2004, 42), Valencina-Castilleja has a lot of water in the subsoil;



**Fig. 41.** Location of Valencina-Castilleja.

this is confirmed by the presence of wells and water springs that emerge on the cornice itself.

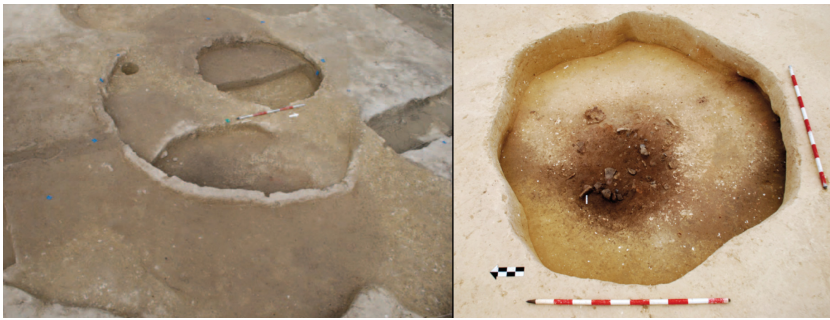
Based on the distribution of surface materials for Valencina-Castilleja, the total area of the site has been estimated at 480ha (Vargas 2003; 2004).

According to some authors (Arteaga Matute/ Roos 1995; Arteaga Matute/Nocete Calvo 1995; Arteaga Matute/Cruz-Auñón Briones 1999b, 591–597; Nocete 2001; López Aldana/Pajuelo Pando 2001; Nocete et al. 2005), Valencina-Castilleja would have been conceived as a permanent agricultural settlement made up of huts and storage pits, protected and drained by ditches and trenches. The site would have acted as a centre of power that would have had socio-economic and political control through a coercive system based on a hierarchical social and territorial system. For these authors, Valencina-Castilleja would have been a single settlement with a functional arrangement that would have been maintained throughout the 3<sup>rd</sup> mill. BC.

According to some researchers, the site of Valencina-Castilleja has a tripartite division (Arteaga

Matute/Cruz-Auñón Briones 1999b, 590). The first area is identified as a domestic area and is located in the northwestern zone. The second is identified as an intermediate area and is located in the eastern zone where production and storage activities would have been concentrated. The third is identified as an exclusive necropolis area which is located in the southeastern area where most of the megalithic monuments are concentrated.

Vargas Jiménez's research (2004) modifies the tripartite partition of the settlement and identifies only two sectors based on the differences in the archaeological record and the concentration of structures. The first defined sector is a residential and productive area, the second one is a funerary area. The residential and productive area is estimated to reach 235.6ha; it includes the central plateau and the peripheral hills. Vargas Jiménez establishes that there is no differentiation in the distribution of the huts, silos, and pits in this area and that it would be best understood as an articulated model based on nuclei made up of units



**Fig. 42.** Documented structure in Calle Trabajadores (López Aldana/Pajuelo Pando 2013, 162) (left). Hut from Calle Italia 6 (Paredes Courtot et al. 2014, 338) (right).

that would include both domestic and productive structures.

For Vargas Jiménez (2004, 38) and Santana Falcón (2011, 5), the structures traditionally identified as huts or hut floors exhibit variable morphologies and dimensions, through which they are classified into three groups:

- One group of semi-subterranean structures with a rectangular body and an oval apse with a small quadrangular access. These feature a post for fixing a pitched roof like those documented at Cerro de la Cabeza and La Emisora (Fernández Gómez/Oliva Alonso 1986; Murillo Díaz 1991, 559).
- Semi-subterranean structures with a circular layout, without a central post and adobe roof, such as those documented in El Mirador, Calle Alamillo, Calle Itálica 6, La Gallega, El Algarrobillo, Calle Trabajadores, or Calle Duero 39 (Murillo Díaz et al. 1985, 313; Martín Espinosa/Ruiz Moreno 1992, 455; Paredes Courtot et al. 2014, 338; Santana Falcón 1993, 551; López Aldana et al. 2001; López Aldana/Pajuelo Pando 2013, 163; Blanco Ruiz 1991, 431), and, more recently, in Calle Huelva (Delgado Canela et al. in press) (fig. 42).
- Semi-subterranean structures of complex plans based on overlapping circular structures at different levels articulated around a central area. These feature staggered accesses, hearths, and post holes such as the huts documented in La Emisora Norte or Avda de Andalucía 9, structure 77 in PP-Matarrubilla, or La Alcazaba (Murillo Díaz 1991a; García Morales et al. 2010; Queipo de Llano Martínez et al. 2010, 3209; Vargas Jiménez et al. 2010, 3341) (fig. 43).

During the excavations carried out in the Polideportivo sector, an occupation level was documented with two in-situ vessels and a silo associated



**Fig. 43.** Hut at Avda de Andalucía 9 (García Morales et al. 2010, 4265).

with an adobe wall, as well as a concentration of adobe with plant imprints. These plant-imprinted adobes also occur in the La Gallega sector and researchers have identified them as construction material under which Bell Beaker material was recovered (Murillo Díaz et al. 1987, 313; Martín Espinosa/Ruiz Moreno 1992, 455).

In 2017, during a rescue excavation prompted by the construction of a house and a swimming pool in the Calle Huelva sector, a slope in the terrain set in an E-W direction was revealed. This slope would be smoothed out by anthropogenic inputs over time that allowed the conservation of the Copper Age level (Delgado Canela et al. in press). In these works, it was possible to document what the excavators identified as a hut with a complete roof. This structure, dating from the first half of the 3<sup>rd</sup> mill. BC (ETH-86515: 4156±41, BP: 2882–2620 calBC), had a diameter of 3.80m and an average depth of about 0.20m (fig. 44). The cover was made of branches covered on the external and internal face with adobe acting as insulator. The structure did not have a central post-hole



**Fig. 44.** Hut from Calle Huelva (Delgado Canela et al. 2020).



**Fig. 45.** Hut in Cerro de la Cabeza (Fernández Gómez 2011, 23).

like those documented in the site of Marroquíes. Once the roof was removed, an occupation level of about 2cm depth was documented. In this level, fauna, pottery (plates and globular vessels), and abundant charcoal was retrieved (Delgado Canela et al. 2020). Below the occupation level, a preparation of the terrain was done where the structure would be located.

The works carried out at Cerro de la Cabeza by the Provincial Archaeological Museum of Seville identified what the archaeologists describe as a hut dating to the Bell Beaker period (Fernández Gómez/Ruiz Mata 1978, 209; Fernández Gómez/Oliva Alonso 1986, 24). This structure consisted of a central, rectangular main area with an oval apse at the back area. The authors identify this apse as a storage area, an interpretation justified by the presence of a large vessel. Access to the structure was granted by a small, square-shaped area with two post holes in front. Two more post holes were documented in the corners near the rectangular area. A central post and two smaller ones, located at the back part, were also documented. For the excavators, the structure appeared to have had a pitched roof (*fig. 45*) (Fernández Gómez/Oliva Alonso 1980, 23; 1986, 24).

Compared to the hut in Calle Huelva, this structure was quite reduced in depth. This implies that most structures of this type might have disappeared, especially in those sectors with longer occupation periods. In these areas, the levels corresponding to the Copper Age would have been more affected by later occupation periods.

The area described as a funerary sector which covers 233.20ha is located to the southeast of the



**Fig. 46.** Map of Valencina-Castilleja with the delimitations according to Vargas Jiménez 2004 (Vargas Jimenez 2003, 142).

populated area (Vargas Jiménez 2003; 2004; Vargas Jiménez et al. 2010, 3341) (fig. 46).

Contrary to the interpretations described above, other authors deny the existence of different areas in the site and defend the idea that Valencina-Castilleja was a not permanently inhabited site for temporary human aggregation by communal groups where ritual and funerary practices would have taken place (García Sanjuán 1999, 64–67; Costa Caramé et al. 2010, 107; García Sanjuán 2013, 31; García Sanjuán/Murillo Barroso 2013, 11; García Sanjuán 2017, 254). These authors argue based on the presence of funerary and ritual contexts throughout the site. They further suggest that the absence of mill stones, elements related to agricultural activities, and structures clearly identified as cabins supports their interpretation (García Sanjuán/Murillo Barroso 2013, 11).

For Fernández Gómez/Oliva Alonso (1985, 115), Valencina-Castilleja is a permanent site with an economy based on agricultural exploitation complemented by cattle exploitation and little evidence of metallurgical activity. Fernández Gómez (2011, 30 f.) defends the *ex-novo* creation of Valencina-Castilleja as a result of contact between Eastern Mediterranean populations and indigenous populations that had a basic agriculture-based economy. The technological improvements resulting from this contact, such as metallurgical exploitation or the introduction of irrigation, led to an increase in production which was reflected in the creation of storage structures and drainage ditches.

#### 5.4.2 History of Research

Research into the prehistoric site of Valencina-Castilleja began in the mid-19<sup>th</sup> cent. with the discovery of the megalithic tomb of La Pastora on February 5<sup>th</sup>, 1860. The site was subsequently published by Francisco Maria Tubino y Oliva in 1868.

According to different researchers, three chronological stages in the investigation of the Valencina-Castilleja site can be recognised (Rodríguez Bayona 2008, 130; Vargas Jiménez 2003, 134; Costa Caramé et al. 2010, 88).

From 1868 to 1974, the discovery of the large megalithic complexes of La Pastora, Matarrubilla,

and Ontiveros took place in Valencina-Castilleja. In these early years, research was mainly focused on recording large funerary structures (Tubino 1876; Obermaier 1919; Carriazo y Arroquia 1962; Collantes de Terán 1969).

From the mid-1970s to the 1980s, most of the excavations were carried out in the so-called settlement area by the provincial archaeological museum of Seville and the University of Seville. It is at this time when the excavations of La Candelera, Cerro de la Cabeza, or La Perrera took place (Fernández Gómez/Ruiz Mata 1978).

The latest stage, from 1985 to the present day, has been marked by the change of competences in matters of heritage of the local government from the Junta de Andalucía. During this period a large scale real estate development took place and with it an increase in archaeological excavations, most of which were rescue excavations carried out by commercial archaeology firms.<sup>6</sup>

#### 5.4.3 Chronology

The chronology of Valencina-Castilleja has been recently reassessed due to a major programme of radiocarbon dating. In this work a total of 178 dates from 17 different excavated sectors are presented. The radiocarbon and Bayesian modelling analyses establish a chronology for the Valencina-Castilleja site between 3000–2100 calBC (García Sanjuán et al. 2018).

Since the structures presented in this work (structures 115 and 116 from Pabellón Cubierto) were not analysed for this paper (García Sanjuán et al. 2018), the <sup>14</sup>C results can be checked in chapter 6.

<sup>6</sup> Cabrero García 1985; Fernández Gómez/Oliva Alonso 1985; Murillo Díaz et al. 1987; Fernández Gómez/Oliva Alonso 1986; Martín Espinosa/Ruiz Moreno 1992; Murillo Díaz et al. 1990; Blanco Ruiz 1991; Murillo Díaz 1991a; 1991b; Santana Falcón 1991; 1993; Ruiz Moreno 1999; Ruiz Moreno/Martín Espinosa 1993; Ruiz Moreno 1999; Vera Fernández et al. 2002; Arteaga Matute/Cruz-Auñón Briones 1999a; 1999b; 2001a; 2001b; López Aldana et al. 2001; Torres Muñoz 2006; Rodríguez González 2009; García Morales et al. 2010; Queipo de Llano Martínez 2010; Vargas Jiménez et al. 2010; Ortega Gordillo 2011a; 2011b; 2013; Paredes Courtot et al. 2014; Wheatley et al. 2012; Mederos et al. 2016; Castro Fernández et al. 2018; Delgado Canela et al. 2020.

#### 5.4.4 Previous Zooarchaeological Analysis

There is a regrettable lack of faunal studies in Valencina-Castilleja. To date, the only analyses have been those carried out on the material from the excavations of Fernando Fernández Gómez in Cerro de la Cabeza (Hain 1982), Ortega Gordillo in the Secondary Education Institute (IES) (Ortega Gordillo 2011b; Vargas Jiménez et al. 2010), and Partial Plan 9-Matarrubilla (Abril López et al. 2010; Abril López 2012); in the La Gallega sector, excavated by Martín Espinosa and Ruiz Moreno (Martín Espinosa/Ruiz Moreno 1992; Bernáldez Sánchez et al. 2013); the Mariana Pineda s/n sector (Pajuelo Pando/López Aldana 2013); the La Huera sector (Méndez Izquierdo 2013); the Avda de Andalucía sector, 9 (Sardá Piñero 2013); and more recently, the PP4-Montelirio sector (Liesau von Lettow-Vorbeck et al. 2014) and the Montelirio Dolmen (Pajuelo Pando 2016).

In spite of the scarce studies carried out on the fauna of Valencina-Castilleja, many publications refer to the zooarchaeological findings. For example at Cerro de la Cabeza, Besabe and Bennassar (1982, 89) comment on the remains of marine malacofauna, the bones and teeth of caprines, and a possible suid tusk. In Calle Duero 39, Blanco Ruiz (1991) documents a negative structure which he identifies as a 'germinated silo with a very wide mouth' in which a large quantity of 'wild boar' remains were found (Blanco Ruiz 1991, 430).

During the excavations at La Emisora Norte, Murillo Díaz (1991a) mentions the retrieval of human bone remains, as well as an equid skull and two bovid skulls, in a siliform-type structure that the author identifies as a hut (Murillo Díaz 1991a, 558 f.). At the Algarrobillo, the skeletal remains of an adult individual next to a bovid mandible has been documented in a negative structure originally identified as a hut (Santana Falcón 1993, 548).

In the excavations carried out in the Mirador de Itálica, Ruiz Moreno indicates the presence of fauna. Of particular interest at this sector are the remains of a macromammal lacking its head that had been deposited in a negative structure, as well as human remains comingled with animal mandibles in another structure. Also in structure E4, located in the same sector, human remains and a dog skeleton in anatomical position with adobes

on both sides of its skull have been recorded (Ruiz Moreno 1999, 512).

Suid mandibles, deer antlers, and dog bones, along with human remains from seven individuals, were documented by Arteaga Matute and Cruz-Auñón Briones during the works carried out in La Alcazaba (Arteaga Matute/Cruz-Auñón Briones 2001b, 707).

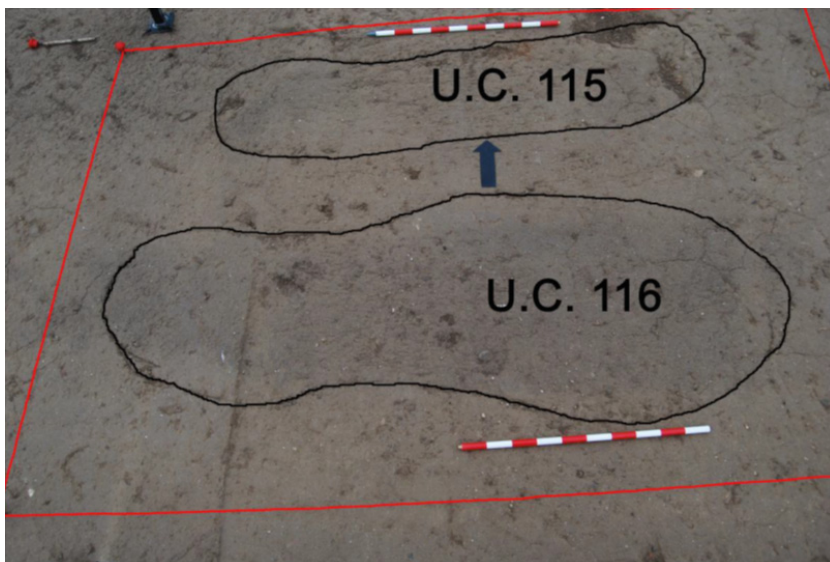
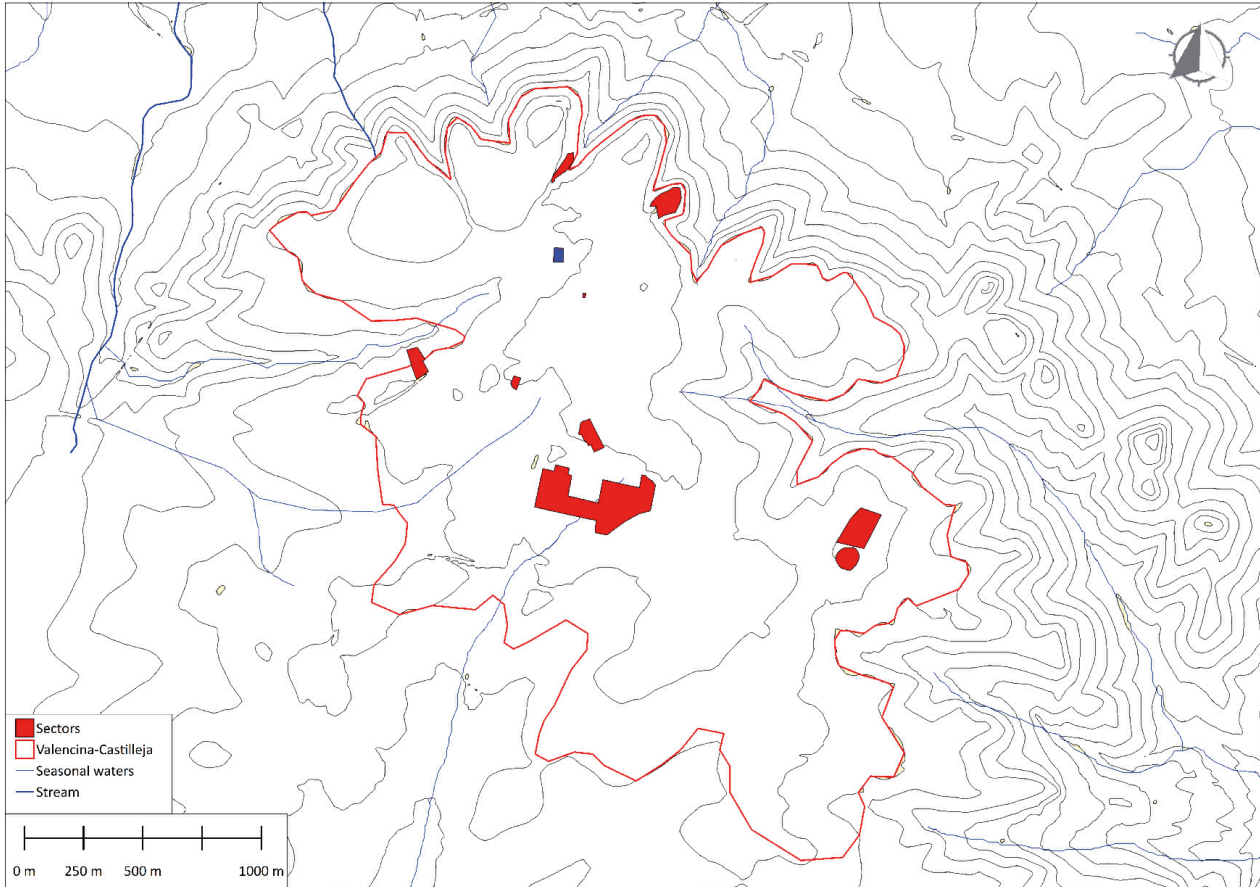
The publication on the archaeological excavations carried out by López Aldana in Calle Alamillo refers to the fauna registered during the excavation but limits itself to a brief taxonomic list (López Aldana et al. 2001, 631).

Fernández Gómez refers to the documentation of bovid remains in structure F62. He also references the presence of bovid, cervid, and caprine horns, as well as the skull of a dog next to a human mandible in one of the wells. Cervid remains, bovid horns, and a bovid metapodium in another well in the Cerro de la Cabeza were also identified. Furthermore, he references fauna percentages from cut D of the excavations of La Perrera (Fernández Gómez 2011, 28; 2013, 134–139). At Matacabras Street, Castro Fernández (2018) documents a well with human and faunal remains, including a bovid skull.

#### 5.4.5 The Excavation at the Pabellón Cubierto Sector

The sector known as Pabellón Cubierto is located in the southern sloped area between the south of Cerro de la Cabeza and Cerro de la Cruz (*fig. 47*). In the northern zone of the area, traditionally denominated as residential, the excavation area reached an extension of 2560m<sup>2</sup>. The archaeological excavation took place in 2009 under the direction of Mercedes Ortega Gordillo (2011a).

The method of excavation and recording was based on Harris (1991). At first, the upper level of the excavation area was mechanically cleared and then the identified structures were manually delimited and cleaned. According to the excavators, a total of 99 archaeological and modern structures were documented. Of these, 18 have been identified as storage pits, 16 as post holes, 34 as traces of fence trenches, 22 as structures with irregular plans and undetermined function,



**Fig. 47.** Location of the Pabellón Cubierto sector (in blue) and sectors with archaeozoological analyses (in red).

**Fig. 48.** Structures 115 and 116 at the Pabellón Cubierto sector (Ortega Gordillo 2010, 44).

three as habitation or production structures, two as domestic structures, and one as a funerary structure.

Once the excavation area was prepared, the selected structures were excavated on the basis of constructive and/or interfacial units. In order to excavate them, they were divided into intervention sectors, excavation levels, and stratigraphic

units. All stratigraphic units were screened during the excavation process.

A multitude of structures of types common in the Copper Age were documented. Two of these have been analysed: structure 115 and structure 116. Two soil layers related with structure 115 and 116 were also analysed (levels 143 and 144) (*fig. 48*).

## 5.5 Sites for Comparative Isotopic Analysis

### 5.5.1 El Amarguillo II

#### 5.5.1.1 Location

The site of El Amarguillo II is located on a plain in the countryside of Seville. It is in the municipal boundary of Los Molares (Seville) in a fertile flat area with abundant freshwater, 2km northeast of the village of Los Molares. The shoreline lies 15km to the west (fig. 49).

The site is located 90m.a.s.l. and according to the geomorphology lies over Tertiary sedimentary deposits of sand.

From an edaphological point of view, the site is located over a vertisol. According to IUSS Working Group WRB (2007, 97), and in spite of its richness, this is a labour-intensive soil to plant, and has thus been used mainly for husbandry practices and small crops of cereals and legume. This has been supported by palynological analyses which indicate the presence of cereal pollens (López García/

López Sáez 1997, 21). Analyses have also shown that greater deforestation occurred during the Copper Age when this area was characterised by open conifer forests and oak groves with a high density of bushes. The degradation of the forest due to anthropogenic reasons gave rise to the proliferation of meadows that the authors attributed to a possible intensification of livestock practices and a lower water availability. Likewise, the maintenance of the arboreal stratum would explain the exploitation of resources such as wood or fruits (López García/López Sáez 1997, 21). The main water supply is the Sarro stream, located 1km from the southern part of the site.

According to Cabrero García et al. (2003, 147), the extension of the site is approximately 20ha based on the dispersion of material on the surface. Oral testimonies collected by Ruiz Delgado attest to a funerary area located next to the north part of the site, which incorporated at least six collective burials. Some 2km east of this area is the site of Los Molares, where the Dolmen de Cañada Real was excavated in 1967 by Carriazo y

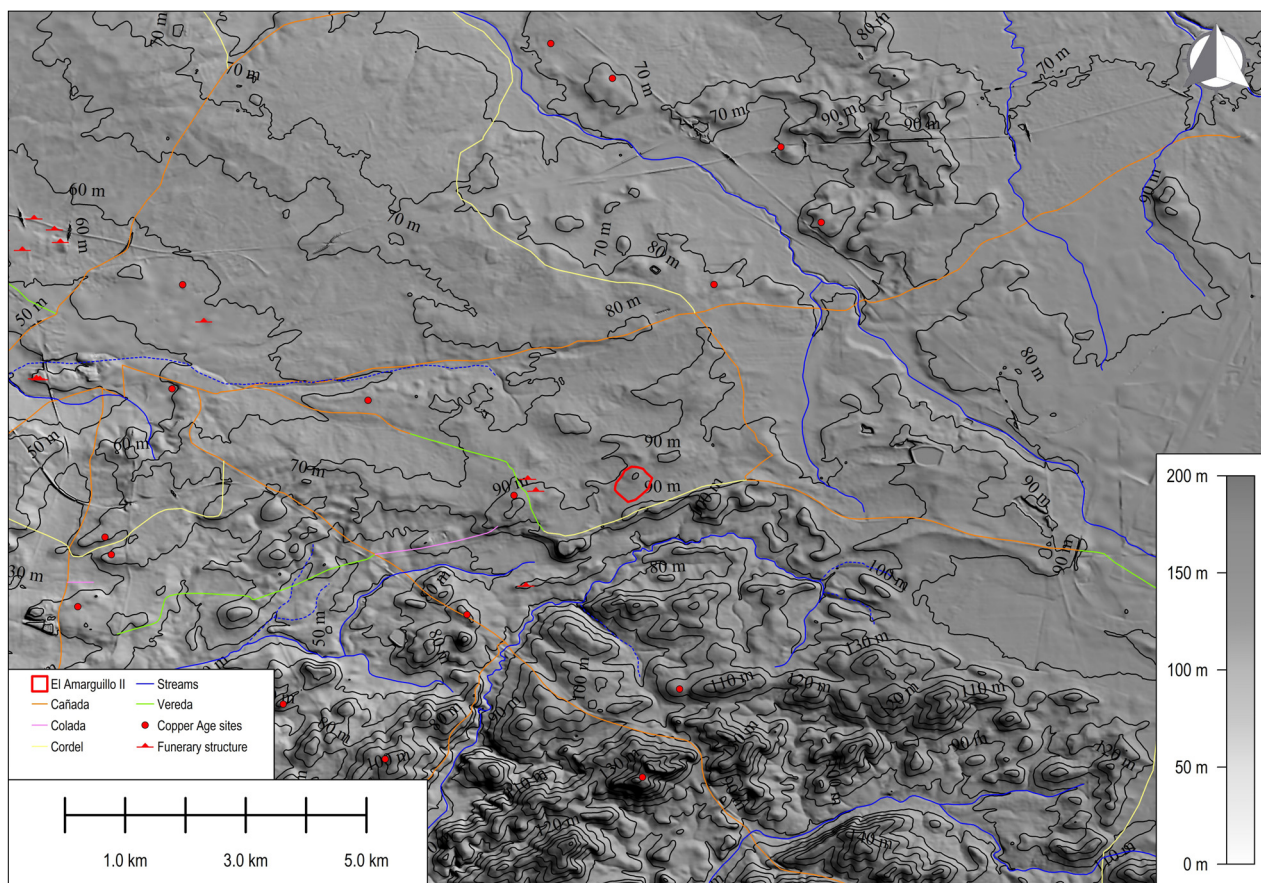


Fig. 49. Location of El Amarguillo II.

Arroquia and the Dolmen del Palomar was excavated in 1981.

In the case of the settlement of El Amarguillo II, the data obtained from the different archaeological activities, as well as the analyses carried out, point to a permanent settlement and an agricultural economy in a highly anthropised environment with cereal cultivation. The settlement's location, close to places of transit, would also foster the exchange of goods as some authors point out (Cabrero García et al. 2006, 83; López García/López Sáez 1997, 21).

### 5.5.1.2 History of Research

The site was discovered by Ruiz Delgado in 1980 and afterwards some archaeological work was done by Cabrero García (Cabrero García 1987; 1990; 1997; 2003).

The first archaeological diagnostic test trench was opened in 1986 by Cabrero García to identify the typology of structures and the chronostratigraphic sequence (Cabrero García 1987, 181). Cabrero identified a circular negative structure 1.5m in diameter and 90cm in depth with a stone plinth and walls made with adobe and vegetal materials. 2kg of copper ore were documented in the interior area of this structure (Cabrero García 1990) (*fig. 50*).

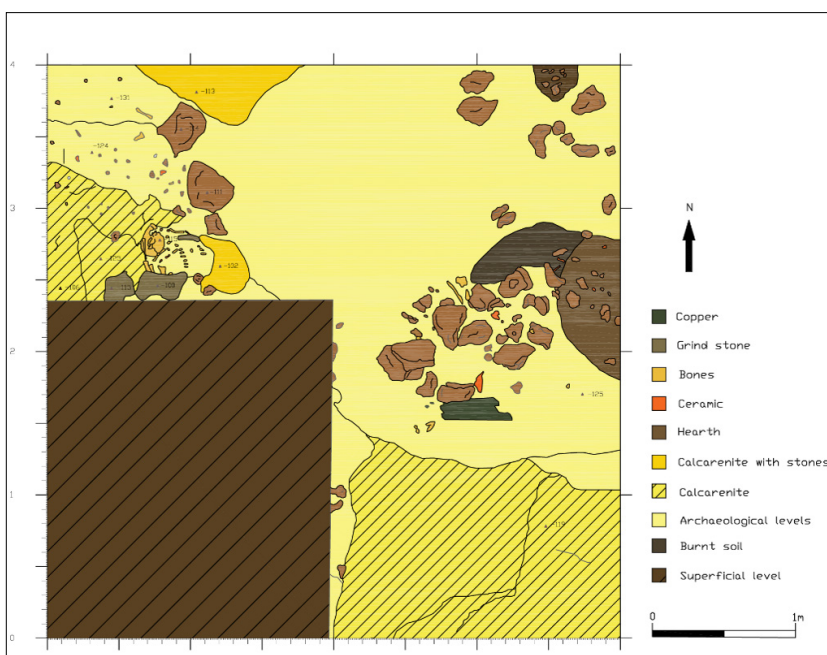
In 1987, a second field season was conducted. During this season, Cabrero García finalised work in the test trench started in 1986 and opened two others. A total area of 52.25m<sup>2</sup> was excavated (Cabrero García 1990, 276).

Seven more simple and poly-lobed circular negative structures were identified. The roof of five of them were done by the corbel vault technique whereas the remaining ones probably incorporated a stone plinth and adobe walls with vegetal material (Cabrero García 1990, 276).

According to some researchers, Amarguillo II was a permanent settlement with an economy based on agriculture (Cabrero García 1990, 276; Cabrero García et al. 2003, 147). This interpretation is based on the quality of the soil and the high amount of mill stones documented. In spite of this, other researchers also argue that the site could have been associated with the control of the closed driveway known as Cañada Real, which connected the Lower Guadalquivir Basin with the Sub-Baetic mountain chain, where pastures are abundant.

### 5.5.1.3 Chronology

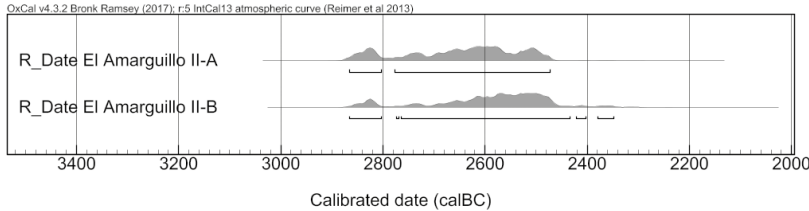
According to the two published radiocarbon dates, the site has been chronologically placed in the first half of the 3<sup>rd</sup> mill. BC (Cabrero García et al. 1997; 2006) (*table 12, fig. 51*).



**Fig. 50.** Structure 3 identified by Cabrero in 1986 (modified from Cabrero García 1987, 182).

Sample	Type	Lab	Date BP	CalBC. 68%	CalBC. 95%	Reference
Amarguillo II-A	Bone	Amarguillo-Beta	4070 ±60 BP	2850–2490	2870–2470	Cabrero et al. 1993
Amarguillo II-B	Charcoal	Amarguillo- OxA	4030±65 BP	2840–2470	2870–2340	Cabrero et al. 1993; 2006

**Table 12.** Radiocarbon dates of El Amarguillo II.



**Fig. 51.** Radiocarbon dates from El Amarguillo II.

**5.5.1.4 Previous Zooarchaeological Analysis**

The only zooarchaeological analysis done on this site is by Bernáldez Sánchez, and is unpublished. This analysis focuses on zooarchaeological material recovered from the test pit excavations in 1986 and the archaeological excavation done in 1987 (Bernáldez Sánchez 2009).

**5.5.2 Poblado Calcolítico**

**5.5.2.1 Location**

The site of Poblado Calcolítico is located in the southeastern limit of the Subportuguese area in the Iberian Phyrritic Belt 25km northwest of Seville and 1km south of the village of Aznalcóllar (Seville). The total extension of the site is unknown because the northern part was destroyed by copper mining, but, according to Hunt Ortiz (2003b, 1202), was above 4ha.

The site is located next to a copper mine and close to the Cordel de Escacena a Niebla and Cordel del Carne de Camino del Negro driveways. The soil of this area is composed of Devonian and Carboniferous materials (Vidal 2012, 70). From an edaphological point of view, the site is located in cambisols and eutritic regosols as well as chromic luvisols and leptosols. According to IUSS Working Group WRB (2007), cambisols and chromic luvisols are considered good soils for agricultural exploitation as well as for grazing and forest lands. Due to the low quality of the regosols and leptosols for

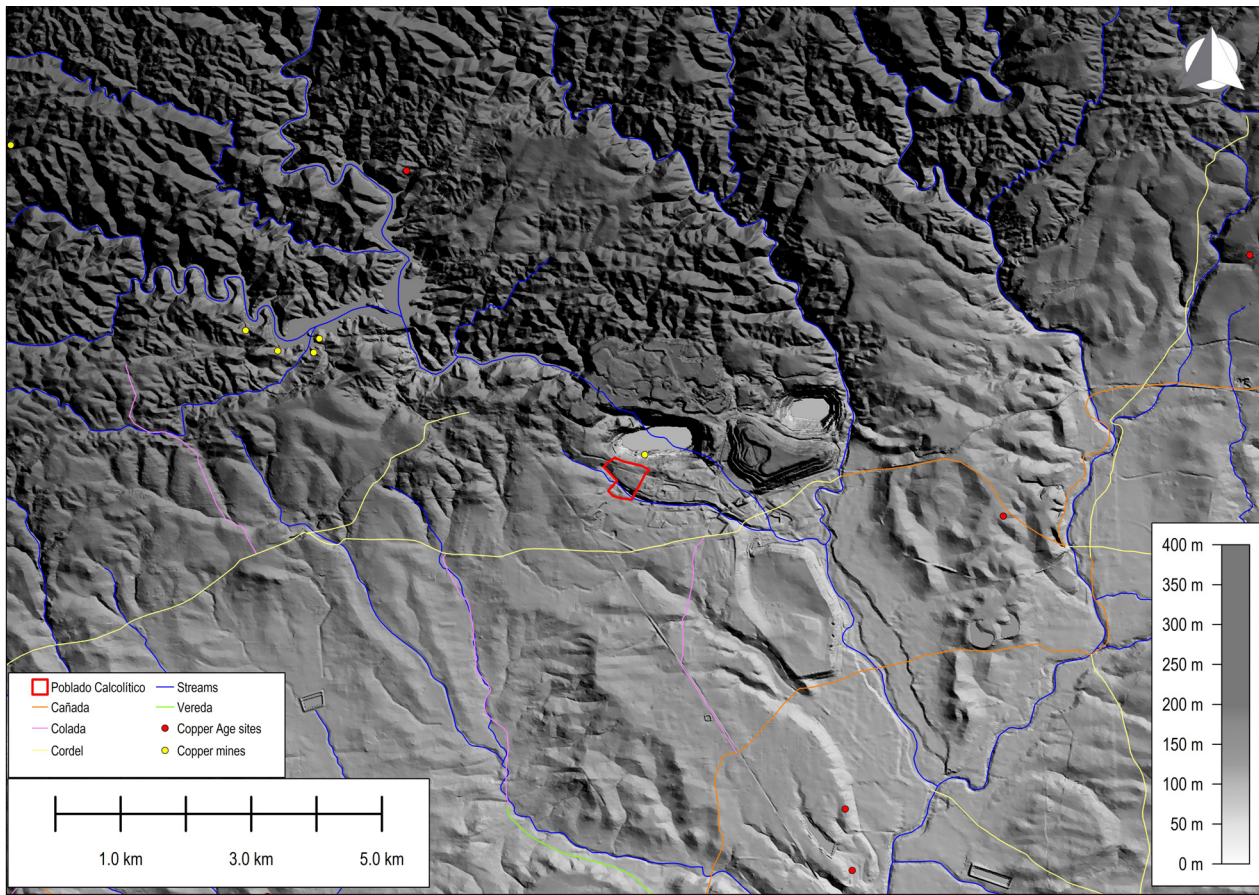
agricultural exploitation, its use has been mainly devoted to extensive grazing. The main water supply is the Agrío river, located 1km to the southern part of the site.

**5.5.2.2 History of Research**

The site of Poblado Calcolítico was detected in 1988 during surveys in which a total of eleven structures were identified along 60m in the profile north of the road A-477 Aznalcóllar-Gerena. According to the material dispersion, the site was settled on the north, south, and east parts of a small hill of 168m.a.s.l. located between the Los Arquillos stream to the south and the Agrío river to the north (Hunt Ortiz 1990, 289; 1995, 652) (fig. 52). Geophysical analyses covered over 140m<sup>2</sup> of the southern part of the site. They revealed trenches characteristic of non-fortified Copper Age sites in the southwest of Iberia (Hunt Ortiz 2003b, 1196).

According to Hunt (2003b, 1197), the site was affected in the 1970s by the construction of a channel by-passing the river Agrío. This splits the site into areas A and B on either side of the river.

In 1999, the construction of a quarry in area A and some drainage channels in area B left prehistoric remains exposed and prompted the first archaeological excavation that ran from 2000 to 2001. A total of ten structures were excavated during this campaign. Six of them were located in the quarry (U.I. 1–6) in area A and two in the profile north of the road A-477 Aznalcóllar-Gerena (U.I. 9–10) in area B (Hunt Ortiz 2003b, 1201).



**Fig. 52.** Location of Poblado Calcolítico.

In 2004, a surface cleaning of the southeast part of the site was done as part of a rescue excavation. During this excavation, 16 archaeological structures were identified. Of these structures, 15 are circular negative structures and one is an east-west oriented trench in the northern part of the site. Researchers divided the 15 structures into three categories based on form, size, and the presence of slate fragments: funerary structures, storage pits, and indeterminate. Nine funerary negative structures have been identified. They are circular negative structures 2m in diameter with evidence of slate fragments. The identified storage pits are less than 1m in diameter and have no evidence of slate fragments; three structures of this type have been documented. The three remaining irregular structures were classified as indeterminate (Sardá Piñero 2009, 3082).

According to Sardá Piñero (2009, 3082), the site of Poblado Calcolítico is not an agricultural settlement but a copper mining site with two

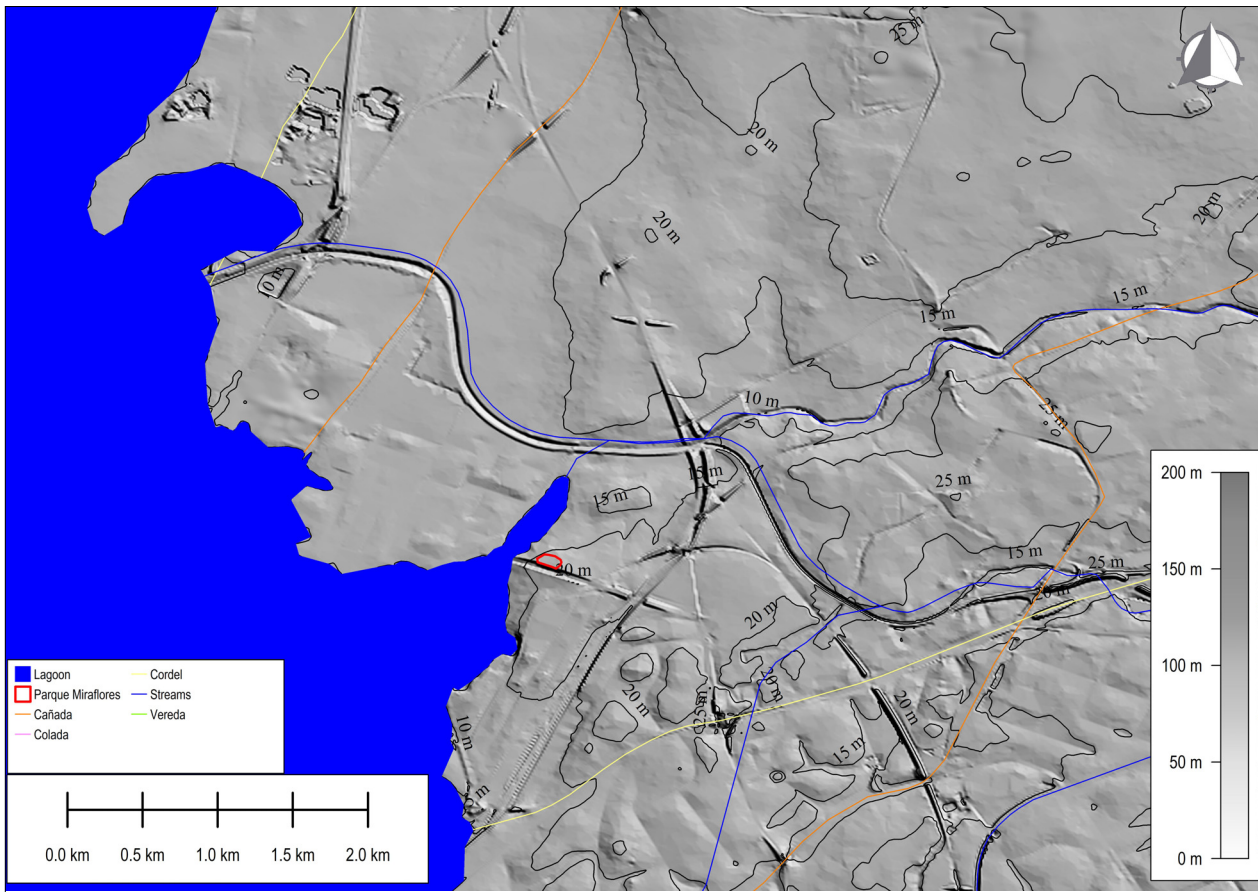
well-defined areas. The first area is a necropolis and is located in the southern part of the site. The second is a residential area; this area was excavated by Hunt Ortiz in 2000.

### 5.5.2.3 Chronology

The site dates from the second half of the 3<sup>rd</sup> mill. BC to the first half of the 2<sup>nd</sup> mill. BC, based on pottery fragments recovered in the archaeological excavation run by Hunt Ortiz in 2000 (Hunt Ortiz 2003b, 1196–1202).

### 5.5.2.4 Previous Zooarchaeological Analysis

To date, only one zooarchaeological analysis has been done in Poblado Calcolítico. The study was done by Bernáldez Sánchez (Bernáldez Sánchez/García Viñas 2010) and focused on the zooarchaeological materials recovered from structure 9



**Fig. 53.** Location of Parque Miraflores.

during the archaeological excavation of 2000 (Hunt Ortiz 2003b).

### 5.5.3 Parque Miraflores

#### 5.5.3.1 Location

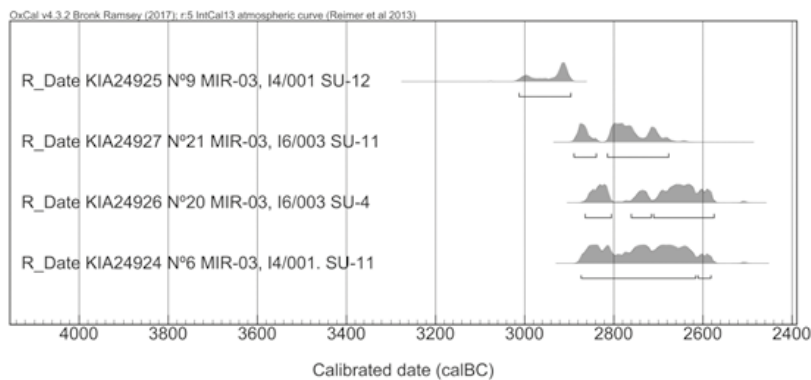
This site is located on the left bank of the lower terrace of the Guadalquivir River, on a small elevation (10–15 m a.s.l.) close to the confluence of the Tagarete stream and the paleo-estuary of the Guadalquivir (fig. 53). The soil is composed of red and brown clay, sand, and gravel (Lara Montero et al. 2004; IGME 984). From an edaphological point of view, the site is located over vertisols. This type of soil contains high proportions of expansive clay, and it is characteristic in areas with a clear alternation of dry and humid seasons promoting natural meadows or forests (IUSS Working Group WRB 2007, 109). According to Lara Montero et al. (2004, 246), the clay soil could be an important factor for

the location of the site due to its high productive capacity for agricultural practices (Lara Montero et al. 2004, 246). In spite of the suitability of this type of soil for grazing, herbaceous, and cereals crops, it is very labour-intensive to plant because it is exceedingly hard during the dry season and excessively wet in the humid season. These factors limit the possibility of exploitation to specific times of the year right after the wet season (IUSS Working Group WRB 2007; Perea Torres/González Fernández 2005, 980). A small exploitation after the humid season and extensive grazing for husbandry practices are common in this type of soils (IUSS Working Group WRB 2007, 97).

According to a palynological analysis done on one of the structures excavated in 2003, large amounts of anthropogenic deforestation occurred in the area, as land was cleared for barley crops and livestock pastures (Lara Montero et al. 2004, 247). An open riverside forest of alder, birch, and hazelnut trees would have been originally located next to the Tagarete river.

Site	Sample	Lab	Date BP	Cal. 68%	Cal. 95%	Reference
Parque Miraflores	Charcoal	KIA-24927	4190±28	2890–2700 calBC	2890–2670 calBC	Lara et al. 2004
Parque Miraflores	Charcoal	KIA-24926	4109±28	2850–2580 calBC	2870–2570 calBC	Lara et al. 2004
Parque Miraflores	Charcoal	KIA-24925	4327±24	3010–2895 calBC	3015–2895 calBC	Lara et al. 2004
Parque Miraflores	Charcoal	KIA-24924	4133±39	2870–2620 calBC	2880–2580 calBC	Lara et al. 2004

**Table 13.** Radiocarbon dates from Parque Miraflores.



**Fig. 54.** Radiocarbon dates from Parque Miraflores.

Lara Montero et al. (2004, 250) interpret this settlement as one of the small, permanent farming economy-based settlements located on the terraces of the paleo-estuary of the Guadalquivir River. The functioning of these settlements was dependent on medium-sized sites, which in turn were dependent on the larger settlement of Valencina-Castilleja.

### 5.5.3.2 History of Research

The prehistoric site of Parque Miraflores was identified in 1998 during the construction of a road. Between 2002 and 2003, a delimitation of the settlement was done based on surface material dispersion and an archaeological excavation was carried out.

Two different types of negative structures, located on two different points of the settlement, were excavated. The first structure, I4/001, located at the northern limit of the settlement, is a circular, basin-shaped negative structure 7.3m in

diameter and 1.73m in depth. The second structure, I6/003, located on top of the hill, is a conical pit 4.7m in diameter and 1.42m in depth.

### 5.5.3.3 Chronology

To date, only four radiocarbon dates have been done with material recovered from the two excavated structures (*table 13*). According to the results, the chronology spans from 3015 to 2570 calBC (*fig. 54*). Late Neolithic material was identified on the surface (Lara Montero et al. 2004, 246).

### 5.5.3.4 Previous Zooarchaeological Analysis

A zooarchaeological analysis has been done by Cáceres Sánchez but remains unpublished. A brief description of the fauna has been published by Lara Montero et al. (2004, 249).

## 6 Results

### 6.1 Archaeological Excavation at Loma del Real Tesoro II

The excavation was carried out during December 2015 and January 2016. Excavations were planned on the basis of the geophysical survey results. Initially, a 50m long by 3m wide trench was opened. This trench started in the central area of the site and had a northeast-southwest orientation. Afterwards, topsoil was removed to the north of the central structure as well as to the north and south of enclosure 2 and to the north of enclosure 3 to test the layout of the ditches. This resulted in an excavation area of 517m<sup>2</sup> in which 32 structures were documented and georeferenced. All features were delimited, cleaned, and identified by hand, but only eight of them were fully excavated (S-2, S-3, S-4, S-7, S-8, S-11, and S-18) (fig. 55).

Four test pits were opened at four different points of the excavation area. The test pits in structures S-1 and S-9, called test pit A and test pit B respectively, have the following characteristics:

- Test pit A was opened on the easternmost limit of the central structure (structure 1) and had an east-west orientation. It was 3.75m x 1m in size.
- Test pit B was opened on the southern limit of enclosure 2 (structure 9). It was 2.85m x 2.2m in size.

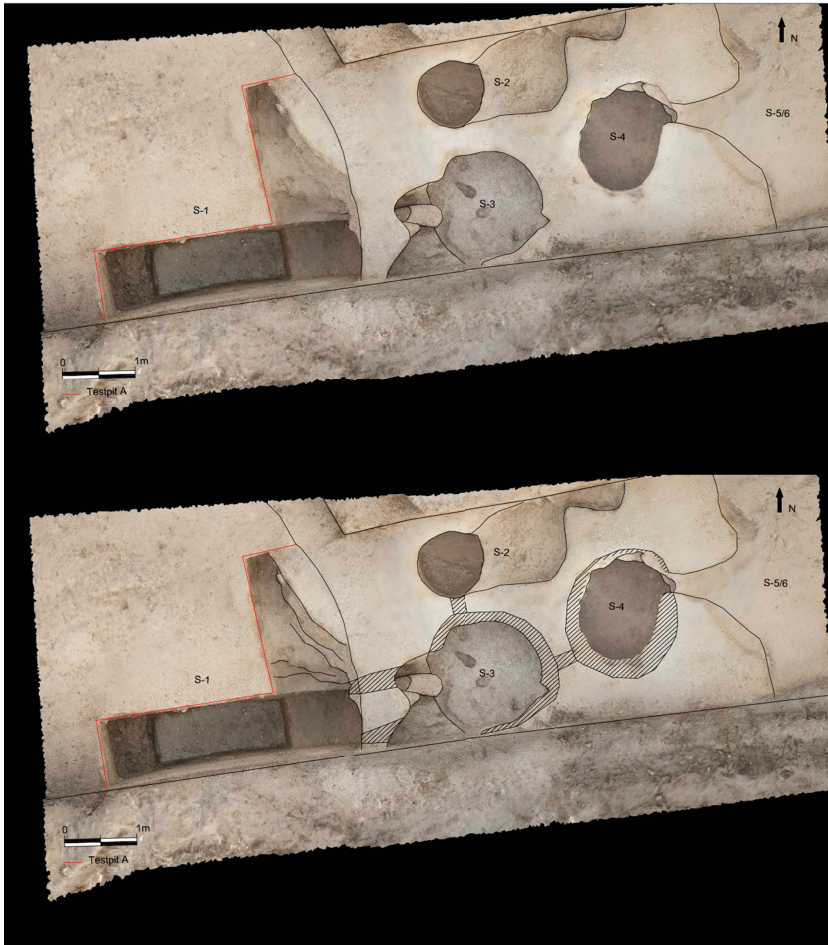
The objective of these two test pits was to obtain the complete stratigraphic sequence of the two structures.

The other two test pits, in structures 12 and 17, were only partially excavated.

- Test pit C was opened on the southern limit of enclosure 3 (structure 12). It was 1.70m x 1m. The objective was to analyse the relationship



Fig. 55. General overview of the excavated area at LRT-II.



**Fig. 56.** Relationship between the different interconnected structures at LRT-II.

between structure 12 and structure 11, which had been excavated into the upper level of enclosure 3.

- Test pit D was opened on the eastern limit of enclosure 4 (structure 17). It measured 1.80m x 1.30m. The objective was to obtain archaeological material that would allow the dating of the upper level of this enclosure.

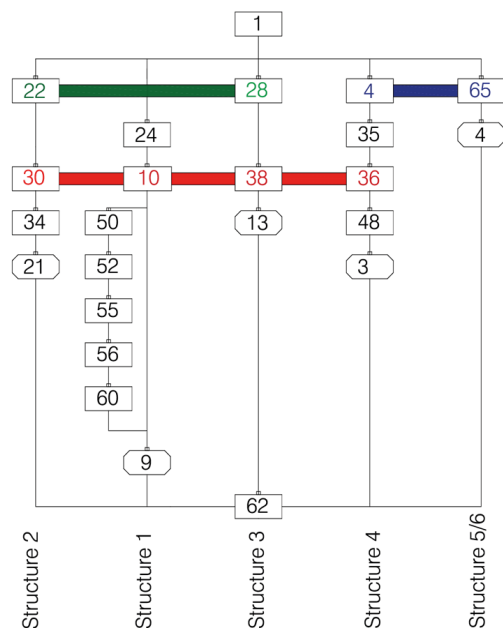
### 6.1.1 Archaeological Structures

#### 6.1.1.1 Structures 1, 2, 3, 4, and 5/6

During the excavation process, the existence of a communication system that passed between the first enclosure (structure 5/6) and the central enclosure (structure 1) via structures 3 and 4 was revealed. In addition, a connection between structure 3 and structure 2 was discovered (*fig. 56*).

In order to avoid over-representation, it was decided to analyse structures 1, 2, 3, and 4 together

(hereafter named CUE-1 for cluster of stratigraphic units) when the same stratigraphic unit was present in several of the structures (*fig. 57*).



**Fig. 57.** Harris matrix of structures 1 to 5/6 at LRT-II.

### 6.1.1.2 Structure 1

Structure 1 is located in the centre of the site. This is a macro-structure with an estimated diameter of 20m and a maximum depth of 1.81m. A 3m x 1m test pit with an E-W orientation was dug on the southern profile of the excavation area in order to obtain the section and the depth as well as to complete the stratigraphic sequence (fig. 58).

The geological test pit on the southern profile of structure 1 (LRT-005-Z) and the interior area (LRT-005) had a maximum depth of 1.60m, but as with the rest of the analysed structures, due to the loss of the upper levels of the fluvial terrace, the depth reached was around 2m if there had been no erosion.

During the excavation process, four clear phases of use were documented:

- Phase I: construction of the macro-structure and earliest documented use. This structure

contained an ash level (56b) covered by a layer of burnt adobes (56a) (fig. 59).

- Phase II: abandonment (level 55) and development of the small combustion structure (substructure 1A/level 53).
- Phase III: filling of the structure by level 50 and development of the canalisation (levels 51 and 10).
- Phase IV: abandonment of the structure and definitive clogging (level 24).

From levels 10 and 30 of structure 1 and level 38 from structure 2, ten bone samples were tested for radiocarbon dating, but all samples were negative due to poor collagen preservation (appendix 2). Only one bone sample (CAN-4295.1.1) from level 36 of structure 4 provided good <sup>14</sup>C results.

The absolute chronology was 4284 ± 34 BP (3011–2873 calBC 2σ), dating the level to the first half of the 3<sup>rd</sup> mill. BC (table 14; fig. 60).

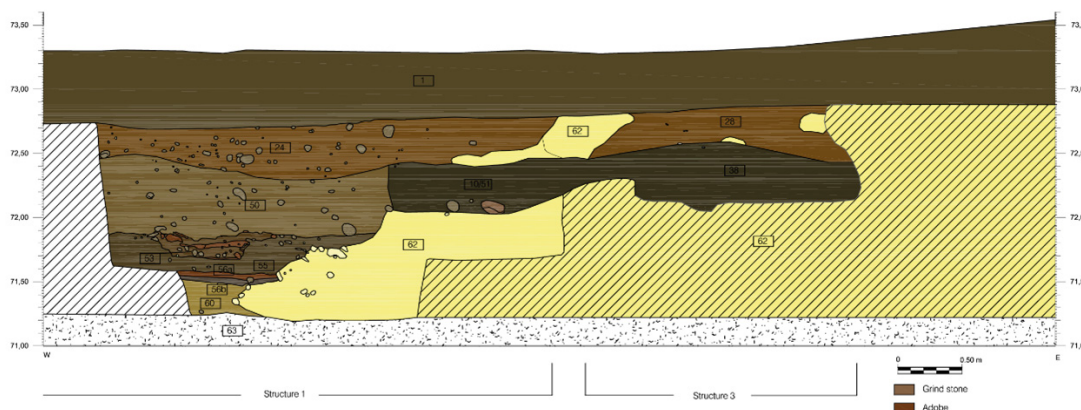


Fig. 58. Profile north of structure 1 and structure 3 at LRT-II.



Fig. 59. Arrangement of adobes in level 56/61 at LRT-II.

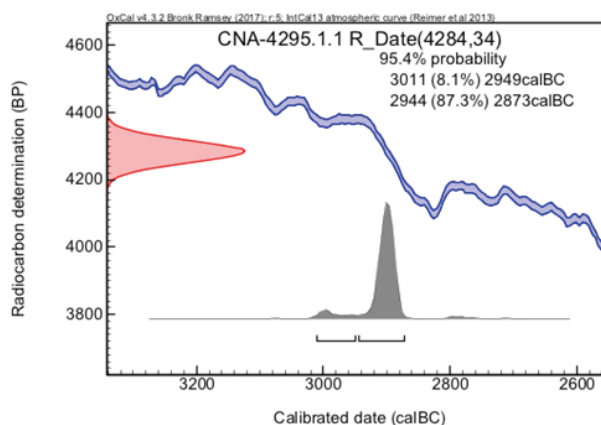


Fig. 60. Radiocarbon results of unit 36 at LRT-II.

Sample	Lab	Taxon	Element	BP	Cal 2σ BC
LRT-9	CNA	Dog	Long bone	4284 ± 34	3011–2873

**Table 14.** Results for radiocarbon analysis of level 36 at LRT-II.

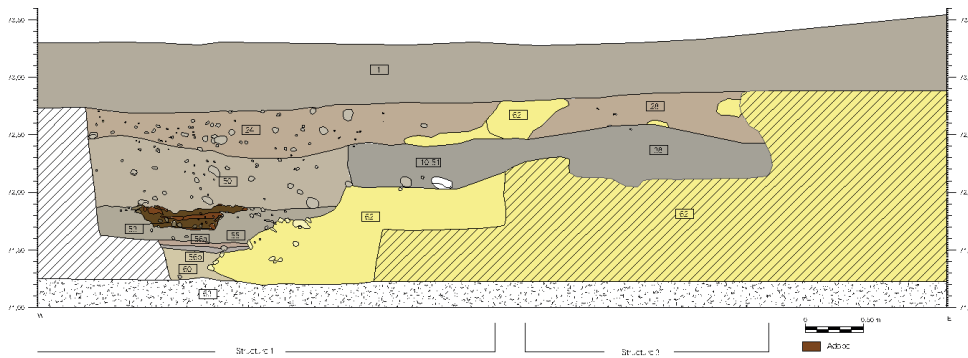
**Substructure 1A**

Sandwiched between level 55 (above) and level 52 (below), substructure 1A is a negative structure embedded into the northern profile of structure 1 (fig. 61). It has a circular shape, with an average width of 0.20m, a length of 1.30m, and a maximum depth of 0.20m. The large number of adobes and burnt material, as well as the ashes and carbons identified in the deposits that fill the structure and the evidence of rubefaction at the level where the structure is excavated, all confirm combustion inside the structure. The cultural features include pottery as well as lithic and faunal remains, all featuring thermo-alterations.

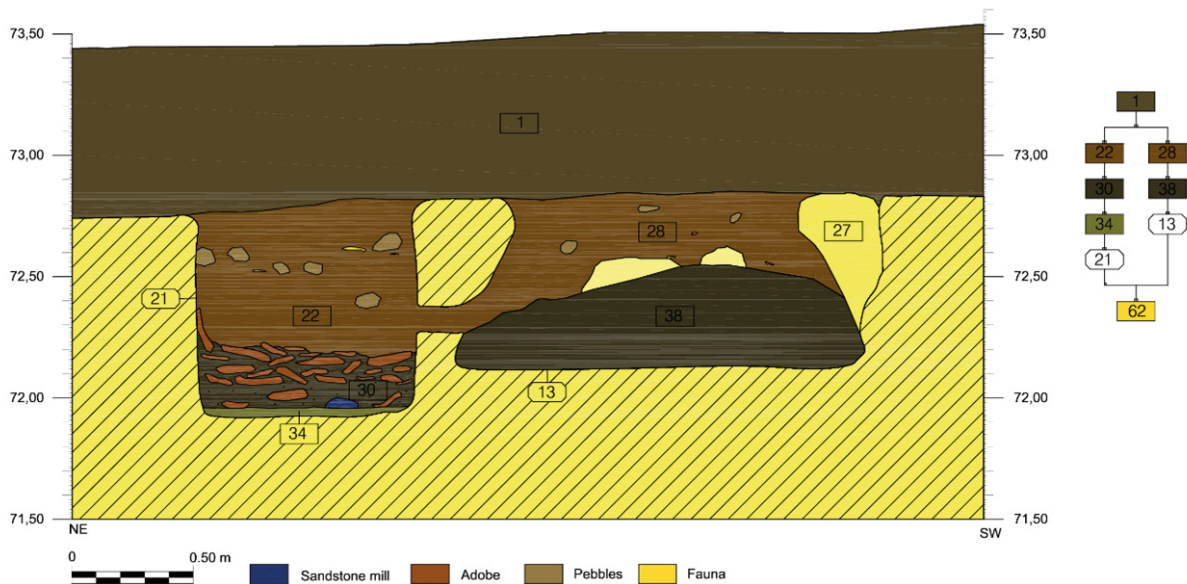
One bone was sampled for radiocarbon dating (LRT-31), but showed negative results due to poor collagen preservation (appendix 2, table A.2.5). As before, from the associated pottery, the relative date is placed to the end of the second half of the 3<sup>rd</sup> mill. BC.

**6.1.1.3 Structure 2**

This is an irregularly shaped structure located in the area between the central structure of the site (structure 1) and the first enclosure (structure 5/6). It was partially documented when it appeared in



**Fig. 61.** Profile north of structure 1 with substructure 53 at LRT-II.



**Fig. 62.** Profile of structure 2 (left) and structure 3 (right) at LRT-II.

the north profile of the excavation area. It had an average width of 0.90m and a length of 2.25m. The structure displayed a U-shaped section with a maximum depth of 0.15m on its eastern edge. In the western area of this section, a cylindrical pit was located with an average diameter of 1.09m and a depth of 0.87m. Three levels labelled 22, 30, and 31 were identified in structure 2. Level 22 is also present in structure 3 (level 28) and level 30 is present in structure 1 (level 10), structure 3 (level 38) and structure 4 (level 36) are connected by a channel between the two structures. The cylindrical pit is also connected to structure 3 by a hole of 0.22m diameter located 0.40m down the southern wall of the structure (*fig. 62*).

#### 6.1.1.4 Structure 3

This is a circular structure located in the area between the central structure of the site (structure 1) and the first enclosure (structure 5/6). It was partially documented because it was in the southern profile of the excavation area. It had an average width of 1.50m at its upper margin and 2.02m at its base. The structure showed a conical cross-section with a maximum depth of 0.78m. The structure is connected to structure 2 by a hole of 0.22m diameter located at 0.40m down the northern wall of the structure (*fig. 62*). It is also connected to structure 4 by another circular hole located 0.56m down the eastern wall. Two canals with an average diameter of 0.20m and an average length of 0.94m connect the structure to structure 1 on its western wall (*fig. 56*). At the base of the structure two small, irregular pits were identified. The first one was 0.38m long, 0.16m wide, and 0.12m deep. The second one had a circular tendency, with a diameter of 0.16m and a depth of 0.08m. Eight stratigraphic units were identified in this structure (*fig. 56* and *fig. 58*).

According to the radiocarbon dates for the base of the structure (level 36) it dates to the first half of the 3<sup>rd</sup> mill. BC.

#### 6.1.1.5 Structure 4

Structure 4 is a pit structure with an essentially oval plan, located between structure 3 and enclosure 1 (structure 5/6) (*fig. 56*). The maximum width at the upper part is 1.06m and 1.72m at the base. The structure showed a 'truncated cone' cross-section, with a maximum depth of 1.14m. A channel, 0.18m wide and 0.20m deep, located on the upper part of the eastern wall, connects this structure with enclosure 1 (structure 5/6). It is connected with structure 3 by a circular hole, 0.22m wide, located 0.48m down the western wall. From this channel to the bottom, the structure was probably insulated by a layer of clay fired *in situ* as in structure 2. Four levels were identified based on the adobe fragments documented (for descriptions, please check appendix 3).

#### 6.1.1.6 Structure 5/6

This structure belongs to enclosure 1, and has only been documented on the surface. It has a length of 3m and a maximum width of 6.21m. According to geological drilling done in this structure (LRT II-4), the maximum depth has been estimated to 2.5m (*fig. 63*).

The structure had a channel on the upper part of the west side that communicated with the upper part of structure 4 on its east side.



**Fig. 63.** View from the east of structure 5/6 at LRT-II.

### 6.1.1.7 Structure 7

Structure 7 is a negative structure with an oval tendency and an irregular base which has been dug into the marl. It is located in the area between enclosure 1 (structure 5/6) and enclosure 2 (structure 9 and 20). The maximum length north to south is 1.92m. The maximum width is 1.38m at the northern end and 0.90m at the southern end. The structure presents an irregular depth, it reaches 0.12 to 0.34m deep in the northern part and has an oval depression with a depth of 0.50m in the southern part. In this structure one level was identified. Although the filling of the structure showed evidence of combustion, the marl where the structure had been made did not show marks of rubefaction.

Three bone samples from level 29 were sent for radiocarbon analysis, but results were negative due to poor collagen preservation (appendix 2). According to associated pottery material, a relative date near the end of the second half of the 3<sup>rd</sup> mill. BC can be estimated.

### 6.1.1.8 Structure 8

Structure 8 is a circular negative structure with an irregular base dug into the marl. It is located in the area between enclosure 1 (structure 5/6) and

enclosure 2 (structure 9 and 20), south of structure 7. The maximum diameter is 0.85m and it has a variable depth, reaching 0.18m in the south and 0.28m in the north. One level was identified. As in structure 7, the filling of the structure (level 8) showed evidence of combustion, while the loams where the structure had been made did not show marks of rubefaction.

Two bone samples from level 8 were sent for radiocarbon analysis (samples LRT-11 and LRT-25, both from a second phalanx of an aurochs). They both yielded negative results due to poor collagen preservation (appendix 2). According to associated pottery material, a relative date in the 3<sup>rd</sup> mill. BC can be estimated.

### 6.1.1.9 Test Pit B, Structure 9

Structure 9 is a ditch which, together with structure 20, forms one of the access gates of enclosure 2 in its southern limit. The removal of the surface level from the excavation area over structure 9 revealed it to be about 16m long and up to 3m wide. A 2.20m x 3m test pit was done at the southern end of the structure in order to obtain the section as well as the complete stratigraphic sequence and total depth. This revealed a depth of 1.88m and a U-shape cross-section. Six levels have been identified, including the substructure 18a (fig. 64).

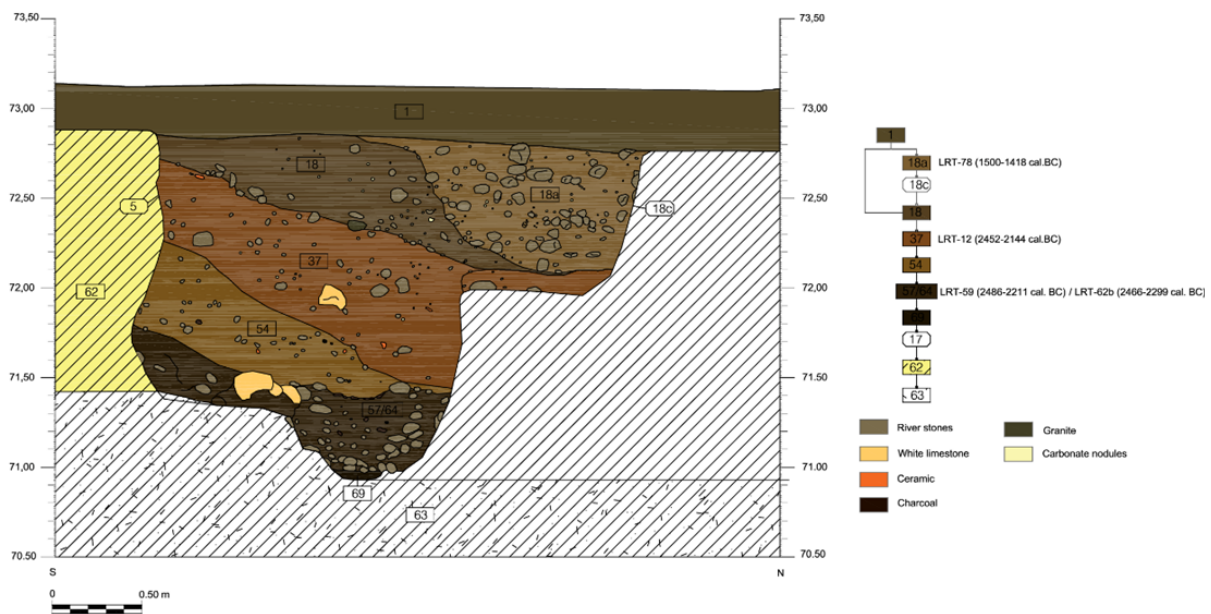


Fig. 64. West profile of structure 9 at LRT-II including the Harris matrix.

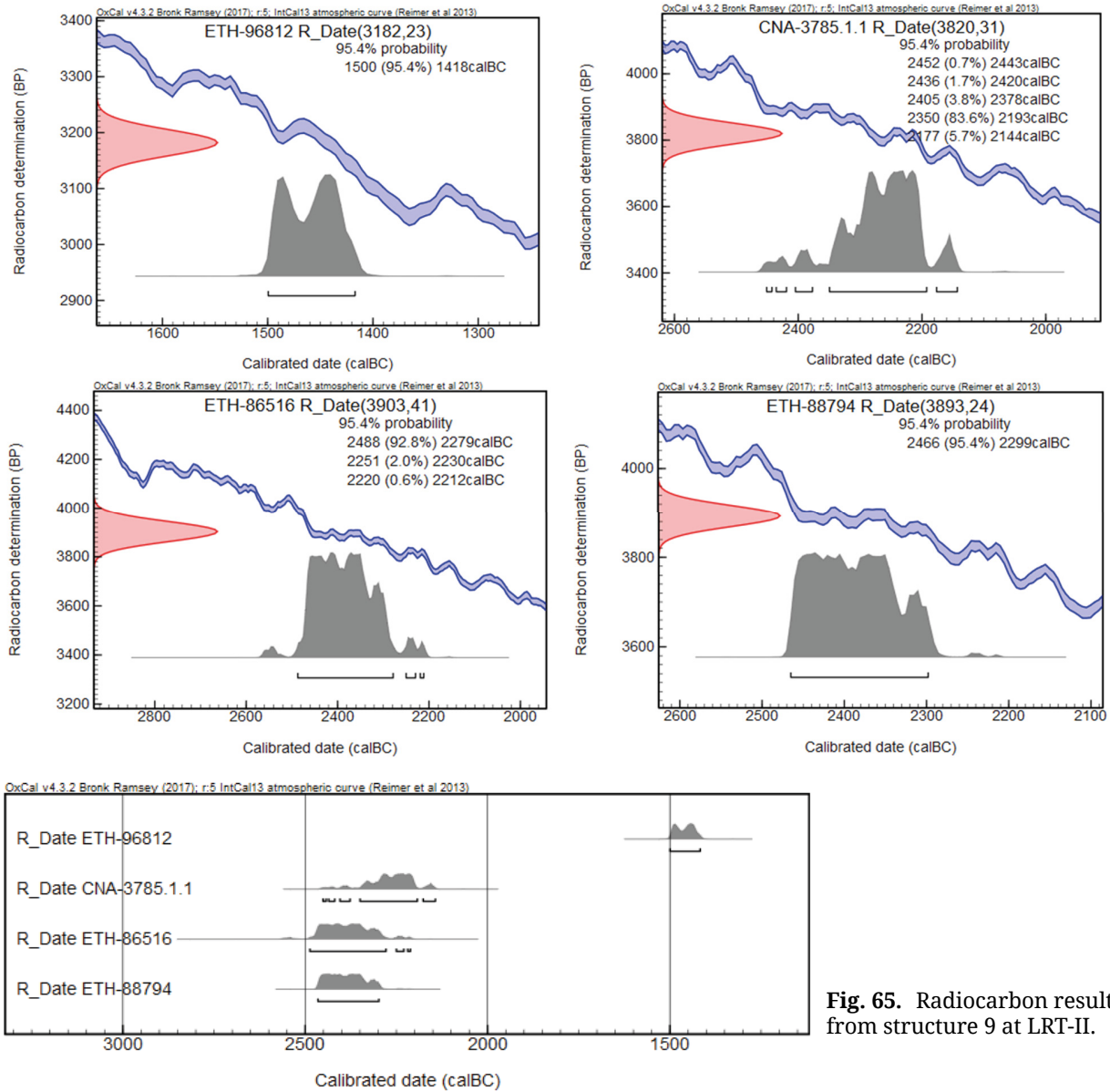


Fig. 65. Radiocarbon results from structure 9 at LRT-II.

Sample	Lab-ID	SU	Sample	BP	Cal 2σ BC
LRT-78	ETH-96812	18a	Charcoal	3182±23	1500–1418
LRT-12	CNA-3785.1.1	37	Bone	3820±31	2452–2144
LRT-59	ETH-86516	57/64	Bone	3903±41	2486–2211
LRT-62b	ETH-88794	57/64	Bone	3893±24	2466–2299

Table 15. Radiocarbon results from structure 9 at LRT-II.

According to the radiocarbon analysis of structure 9, corresponding to enclosure 2, the period of use spans from the second half of the 3<sup>rd</sup> mill. BC to the first half of the 2<sup>nd</sup> mill. BC. Once structure 9 is clogged, substructure 18a is excavated, which has provided a chronology of the mid-2<sup>nd</sup> mill. BC (fig. 65; table 15).

**Substructure 18a**

This substructure is located on the northwestern edge of level 18. The overall dimensions are unknown, as it is inserted into the north and west profile. It has a maximum known length and width of 1.70m and 0.86m, respectively, and the maximum depth is approximately 0.70m. The structure is filled with medium and large stones (fig. 66).



Fig. 66. Excavation process of sub-structure 18a at LRT-II.

6.1.1.10 Test Pit C, Structure 11

Structure 11 is a circular negative structure with cylindrical shape dug into the fill of the upper level of enclosure 3 (structure 12) (fig. 67). The diameter is 0.90m and it is 0.62m deep. Two stratigraphic units were identified (appendix 3).

Two bone samples from level 40 were sent for radiocarbon analyses (samples LRT-40 and LRT-56; a long bone from a size 3 animal and a *B. taurus* rib, respectively). Both yielded negative results due to poor collagen preservation (appendix 2). Based on the Bell Beaker material found in the level 47 of structure 11, a date at the end of the second half of the 3<sup>rd</sup> mill. BC after structure 12 had been filled is proposed.

6.1.1.11 Test Pit C, Structure 12

Structure 12 is a ditch that belongs to enclosure 3. It is 17.39m long and has a maximum width of 5.47m. A small test pit of 1m by 1.70m was excavated from structure 11 to the eastern limit of structure 12. Only a part of the superficial level of level 42 was excavated. According to the geological drill performed (LRTII-1) on this structure, the depth for this structure has been estimated to be 2m. Based on the Bell Beaker pottery material documented in level 42, a chronology of the end of the Copper Age is proposed for the final moments of this structure.

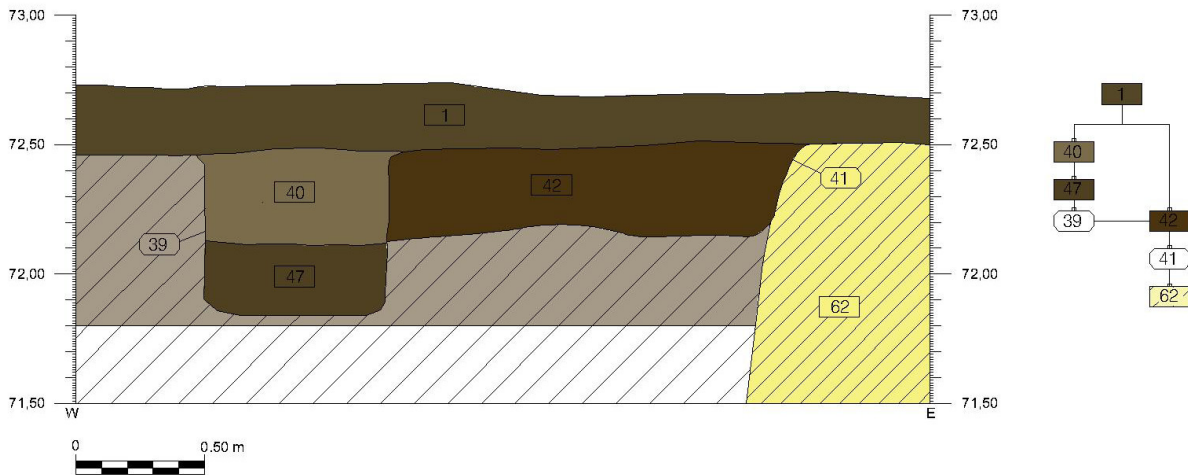
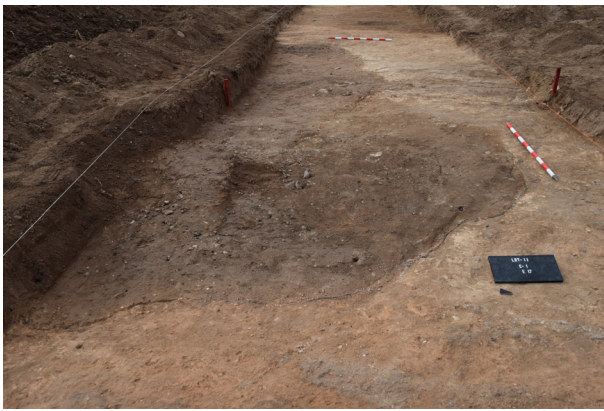


Fig. 67. Profile north of test pit C showing structure 11 and structure 12 at LRT-II.

### 6.1.1.12 Test Pit D, Structure 17

Structure 17 belongs to the northern part of one of the segmented ditches from enclosure 4 (*fig. 68*). The removal of the surface level from the excavation area revealed that the enclosure ran in a north-south direction and was 2.5m long and 6.70m wide. A 1.80m by 1.30m test pit was excavated on the eastern profile of the structure where the first two levels could be identified. Bell Beaker pottery was identified in both levels indicating a date in the second half of the 3<sup>rd</sup> mill. BC. Unfortunately, the total depth of the structure could not be documented.



**Fig. 68.** Structure 17 at LRT-II.

### 6.1.1.13 Structure 18

Structure 18 is a negative structure with round shape that is dug into the marl. It is located in the area between enclosure 2 (structure 9) and enclosure 3 (structure 12) (*fig. 69*). The diameter is between 0.70m and 0.85m and the preserved depth is 0.18m. One stratigraphic unit was identified.



**Fig. 69.** Structure 18 at LRT-II.

### 6.1.1.14 Structure 20

This structure belongs to enclosure 2, which, together with structure 9, forms one of the entrance gates. It was only documented on the surface, and extends approximately 6.84m in length and 4.27m in width (*fig. 70*). According to geological drill done on this structure (drill LRT-II-3, section 6.1.4.1 in this chapter), the depth has been estimated to be 2m. The surface material documented at this structure consists of pottery sherds, including Bell Beaker pottery.



**Fig. 70.** Structure 20 outlined in red at LRT-II.

## 6.1.2 Zooarchaeological Analysis from La Loma del Real Tesoro II

1059 faunal bones have been documented in eleven structures excavated at La Loma del Real Tesoro II. Levels 30 and 28 (corresponding to structures 2 and 3), as well as levels 10/51, 38, and 36 (corresponding to structures 1, 3, and 4), have been considered as a single unit when estimating the MNI due to the interconnectedness of these structures. This has been done to avoid overrepresentation of individuals. The conservation of the assemblage was quite poor so most of the fragments could not be identified (*table 16*).

	NISP	%	Weight (g)	%
Identified	293	27.66	5448.59	82.23
Unidentified	766	72.33	1177.28	17.76
Total	1059	100	6625.87	100

**Table 16.** NISP of Loma del Real Tesoro II.

Taxon	NISP	%	MNI	%	Weight (g)	%
Cattle	68	23.20	13	20.63	2334.54	42.84
Caprine	60	20.47	12	19.04	294.03	5.39
Pig	81	27.64	12	19.04	889.11	16.31
Dog	18	6.14	6	9.52	94.31	1.73
Cat	1	0.34	1	1.58	2.48	0.04
Total domestic	228	77.81	44	69.84	3614.47	66.33
Aurochs	8	2.73	4	6.34	1117.21*	20.50
Horse	5	1.70	2	3.17	397.73	7.29
Red deer	17	5.80	5	7.93	299.59	5.49
Hare	21	7.16	5	7.93	15.66	0.28
Lagomorpha	14	4.77	3	4.76	3.93	0.07
Total wild	65	22.18	19	30.15	1834.12	33.66
Total	293	100	63	100	5448.59	100
Human	2		2		9.53	

**Table 17.** Results of the zooarchaeological analysis from LRT-II including NISP, MNI, and weight (\*866 g belong to a horn).

As a result, domestic fauna dominates the assemblage (*table 17*). Cattle is the most represented species of livestock in La Loma del Real Tesoro II (although not when counting the number of bone fragments), followed by pigs and caprines. In the case of wild animals, red deer is the most represented species followed by aurochs and horse. Lagomorphs may be later intrusions.

The high degree of fragmentation in the assemblage made it difficult to determine age patterns and sexual differentiation, and to make size estimations. In the case of cattle, only one individual older than 24 months (from level 22-28 in structure 2-3) and one subadult younger than 42 months (from structure 17) could be identified. In the case of the caprine livestock, there is a predominance of infantile individuals. Three individuals under nine months were identified in level 22-28, in level 10-36-38, and in level 4.

An infantile under five months was identified in structure 7 and a sub-adult under 18 months was identified in structure 17. Only in structure 11 was it possible to identify an adult individual older than 40 months.

In the case of pigs, the age of slaughter is concentrated in most structures on juvenile individuals under 24 months. Three males were identified in level 22-28 of structure 2 and structure 3, as well as three each in structure 9 and structure 12. Only one female was identified in structure 7.

According to the unidentified fragments, there is a clear predominance of fragments corresponding to size 2 individuals, followed by size 3 and size 1. Fragments of the diaphyses of the elements of the appendicular skeleton are the most abundant in sizes 1, 2, and 3 followed by the axial and cranial elements. Based on the NMI four individuals could be identified, three of which correspond

Size	NISP	%	MNI	%	Weight (g)	%
Size 3	56	7.31	-	-	465.12	39.50
Size 2	637	83.15	3	75	646.2	54.88
Size 1	10	1.30	1	25	1.15	0.09
Unidentified	58	7.57	-	-	56.15	4.76
Bone tool	5	0.65	-	-	8.66	0.73
Total unidentified	766	100	4	100	1177.28	100

**Table 18.** Results of the zooarchaeological analysis from LRT-II according to size.

to size 2 and one to size 1. Likewise, five worked bones could be identified (*table 18*).

The detailed description of the three main herds (bovids, caprines, and suids) in each stratigraphic unit can be found in appendix 4.

### 6.1.2.1 Structure 1

The assemblage recovered in structure 1 consists of 243 bones. Most of the specimens remain unidentified (*table 19*), as preservation is poor and most specimens exhibit a high level of fragmentation.

Cattle is the most represented species in structure 1, followed by caprines and pigs (*table 20*). One dog and one cat were also identified. In the

	NISP	%	Weight (g)	%
Identified	73	30.04	961.09	75.94
Unidentified	170	69.95	304.43	24.05
Total	243	100	1265.52	100

**Table 19.** Results of the zooarchaeological analysis from structure 1 at LRTII.

Taxon	NISP	%	MNI	%	Weight (g)	%
Cattle	13	17.80	5	27.77	369.31	38.42
Caprine	13	17.80	3	16.66	33.93	3.53
Pig	27	36.98	3	16.66	229.79	23.90
Dog	3	4.10	1	5.55	17.08	1.77
Cat	1	1.36	1	5.55	2.48	0.25
Total domestic	57	78.08	13	72.22	652.59	67.90
Horse	4	5.47	1	5.55	301.76	31.39
Hare	11	15.06	3	16.66	6.48	0.67
Lagomorpha	1	1.36	1	5.55	0.26	0.02
Total wild	16	21.91	5	27.77	308.5	32.09
Total	73	100	18	100	961.09	100

**Table 20.** Results of the zooarchaeological analysis from structure 1 at LRT-II including NISP, MNI, and weight.

Size	NISP	%	MNI	%	Weight (g)	%
Size 3	12	7.05	-	-	133.8	43.95
Size 2	138	81.17	1	100	165.62	54.40
Size 1	1	0.58	-	-	0	0
Unidentified	19	11.17	-	-	5.01	1.64
Total unidentified	170	100	1	100	304.43	100

**Table 21.** Results of the zooarchaeological analysis from structure 1 at LRT-II according to size.

case of wild fauna, lagomorphs may represent later intrusions and there is debate about whether the equids represent domestic or wild individuals given the date. In all units there is a dominance of hind limb skeletal elements with less meat. Traces of fire are documented on all bones identified from level 53, suggesting possible use as fuel.

Values take into account the interconnection of level 10/51, level 30 (structure 2), level 38 (structure 3), and level 36 (structure 4).

In the case of bovids, the state of conservation has not allowed for the establishment of sex, age, or height at the withers. An infantile pig below twelve months as well as a caprine below nine months were identified. A subadult horse was also documented in level 10/51-38-36.

Elements from the fore and hind limbs predominate, being mostly elements with high meat content. The poor preservation could have distorted the samples due to taphonomic factors differentially preserving elements of high bone density such as metapodia and phalanges. Still, the reduced number of dental pieces could indicate a selective transport of these anatomical parts.

Based on the unidentified fragments, the fragments of size 2 individuals are the most abundant. The most common of these are small fragments of long bone diaphysis, followed by axial elements. In the case of fragments corresponding to size 3 individuals, the axial elements dominate. According to the MNI, one size 2 individual could be identified (*table 21*).

### 6.1.2.2 Structure 2 and 3

Due to the connections between the stratigraphic units of structure 2 and 3, these two structures were analysed together.

The collection recovered in structures 2 and 3 totals 271 faunal remains (*table 22*). Most specimens remain unidentified. Preservation is poor as most specimens exhibit a high level of fragmentation.

As in structure 1, domestic fauna dominates the assemblage. Pigs constitute the main taxon, followed by cattle and caprines. Values from level 10-30-36 and 38 are included (*table 23*).

	NISP	%	Weight (g)	%
Identified	82	30.25	763.02	70.19
Unidentified	189	69.74	323.98	29.80
Total	271	100	1087	100

**Table 22.** Results of the zooarchaeological analysis from structure 2 and 3 at LRT-II.

Taxon	NISP	%	MNI	%	Weight (g)	%
Cattle	11	13.41	2	12.5	177.13	23.21
Pig	29	35.36	3	18.75	173.22	22.70
Caprine	14	17.07	2	12.5	25.3	3.31
Dog	4	4.87	2	12.5	17.08	2.23
Cat	1	1.21	1	6.25	2.48	0.32
Total domestic	59	71.95	10	62.5	395.21	51.79
Horse	4	4.87	1	6.25	301.76	39.54
Red deer	1	1.21	1	6.25	59.57	7.80
Hare	18	21.95	4	25	6.48	0.84
Total wild	23	28.04	6	37.5	367.81	48.20
Total	82	100	16	100	763.02	100

**Table 23.** Results of the zooarchaeological analysis from structure 1 at LRT-II including NISP, MNI, and weight.

In the case of cattle, the state of conservation has not allowed us to determine the sex or size. In all units there is a predominance of skeletal elements with a reduced meat contribution. Cutmarks were identified on the sacrum of a subadult-adult individual above 24 months, which was identified in level 22-28.

Caprine and pig remains also exhibit a very poor state of preservation, and sex and wither height could not be estimated in most levels. For the caprine group, the skeletal elements from the fore limbs, which are often associated with high meat content, predominate. Two infants below six months were identified in level 22-28 and level 10/51-30-36-38. Two pigs were identified in level 22-28. One of these was slaughtered when over twelve months (i.e. subadult-adult) and the other was a subadult under twelve months. A male was identified based on the morphology of the canine. As with caprines, forequarter elements predominate.

Fragments from size 2 individuals predominate over fragments of size 3 and size 1 individuals (*table 24*). Elements of the appendicular skeleton are the most abundant in both size 2 and 3 individuals. Two bone tools were documented on level 28 of structure 3. One was identified as a possible small spatula and the other as a bone tip.

	NISP	%	Weight (g)	%
Size 3	12	6.34	125.73	38.80
Size 2	150	79.36	187.34	57.82
Size 1	4	2.11	0.61	0.18
Unidentified	21	11.11	8.45	2.60
Bone tool	2	1.05	1.85	0.57
Total unidentified	189	100	323.98	100

**Table 24.** Results of the zooarchaeological analysis from structure 2 and 3 from LRT-II according to size.

### 6.1.2.3 Structure 4

The faunal collection from structure 4 totals 319 remains (*table 25*). Most specimens remain unidentified. Preservation is poor, as most specimens exhibit a high level of fragmentation. Values from level 10-30-36 and 38 are included.

	NISP	%	Weight (g)	%
Identified	73	22.88	801.69	68.89
Unidentified	246	77.11	362	31.10
Total	319	100	1163.69	100

**Table 25.** Results of the zooarchaeological analysis from structure 4 at LRT-II.

Two stratigraphic units in structure 4 yielded animal remains. The values have been calculated taking into account the interconnection of level 10/51 (structure 1), level 30 (structure 2), level 38 (structure 3), and level 36 (structure 4).

Taxon	NISP	%	MNI	%	Weight (g)	%
Cattle	10	13.69	2	15.38	251.01	31.31
Pig	21	28.76	1	7.69	173.22	21.60
Caprine	14	19.17	2	15.38	39.28	4.89
Dog	4	5.47	2	15.38	24.65	3.07
Cat	1	1.36	1	7.69	2.48	0.30
Total domestic	50	68.49	8	61.53	490.64	61.20
Horse	4	5.47	1	7.69	301.76	37.64
Hare	11	15.06	3	23.07	6.48	0.80
Lagomorpha	8	10.95	1	7.69	2.81	0.35
Total wild	23	31.50	5	38.46	311.05	38.79
Total	73	100	13	100	801.69	100

**Table 26.** Results of the zooarchaeological analysis from structure 4 at LRT-II including NISP, MNI, and weight.

Domestic fauna dominates the assemblage with cattle constituting the main taxon in terms of MNI, and weight, followed by pig and caprines. Two dogs were identified in levels 4 and 36. The wild fauna concentrated in level 36, consisting of the remains of a horse and three lagomorphs (*table 26*).

One bovid has been identified in each of the stratigraphic units. In level 4 the elements of the fore and hind limbs predominate over the bovids identified in level 10/51-30-38-36, in which elements of low meat yield predominate.

With caprines fore limbs predominate in both units. Epiphyseal fusion data from an individual identified in unit 4 reveals a subadult/adult over nine months. In level 36, epiphyseal fusion data reveals an infant below six months which exhibits burning as well as marks derived from low-PH soil.

A single pig was identified in level 36, the elements from the fore limbs predominating. According to epiphyseal fusion data, this is an infantile/juvenile individual below twelve months. A male was spotted on account of the morphology of the canine. The phalanx I was split transversally.

The unidentified fragments from size 3 individuals indicate a predominance of axial elements as opposed to appendicular and cranial elements. In the case of size 2 individuals, fragments from the appendicular skeleton stand out (*table 27*). In addition, four bone tools, one of them a point, were recovered from unit 4.

	NISP	%	Weight (g)	%
Size 3	12	4.87	135.93	37.54
Size 2	207	84.14	204.42	56.46
Size 1	4	1.62	0.26	0.07
Unidentified	19	7.72	13.67	3.77
Bone tool	4	1.62	7.72	2.13
Total unidentified	246	100	362	100

**Table 27.** Results of the zooarchaeological analysis from structure 4 at LRT-II according to size.

#### 6.1.2.4 Structure 7

The collection recovered in level 26 totals 49 remains. Most specimens remain unidentified (*table 28*). Preservation is poor, as most specimens exhibit a high level of fragmentation along with traces of fire. Other marks include a rib from a size 3 mammal featuring a transversal cut along its main axis and a phalanx I from a red deer with a longitudinal cut-mark on its medial side.

	NISP	%	Weight (g)	%
Identified	7	14.28	31.85	48.47
Unidentified	42	85.71	33.86	51.52
Total	49	100	65.71	100

**Table 28.** Results of the zooarchaeological analysis from structure 7 at LRTII.

Concerning the identified fragment, domestic fauna dominates the assemblage with pigs constituting the main taxon, while caprines and red deer take second place (*table 29*).

In this structure, a single caprine hemimandible has been identified. Tooth eruption and wear data reveal an infant below five months. With regard to the pigs, it was possible to identify one specimen as female. The skeletal profile reveals an overrepresentation of forequarter elements.

Taxon	NISP	%	MNI	%	Weight (g)	%	NISP/MNI
Caprine	1	14.28	1	33.33	9.32	29.26	1
Pig	4	57.14	1	33.33	13.01	40.84	4
Total domestic	5	71.42	2	66.66	22.33	70.1	2.5
Red deer	2	28.57	1	33.33	9.52	29.89	2
Total	7	100	3	100	31.85	100	2.3

**Table 29.** Results of the zooarchaeological analysis from structure 7 at LRT-II including NISP, MNI, and weight.

Regarding the unidentified fragments, size 3 fragments are elements from the axial skeleton. Since only deer fragments have been documented in this category, one can assume that those elements might belong to this taxon. In the case of size 2 fragments, there is a predominance of appendicular elements followed by axial elements (*table 30*).

	NISP	%	Weight (g)	%
Size 3	3	7.14	10.99	32.45
Size 2	27	64.28	14.36	42.40
Unidentified	12	28.57	8.51	25.13
Total	42	100	33.86	100

**Table 30.** Results of the zooarchaeological analysis from structure 7 at LRT-II according to size.

#### 6.1.2.5 Structure 8

Only a phalanx II from structure 8 is identified as an aurochs above 18 months. Combustion marks suggest its possible use as fuel (*table 31*).

#### 6.1.2.6 Structure 9

The collection recovered in structure 9 totals 159 remains (*table 32*). Most specimens remain unidentified. Preservation is poor, as most specimens exhibit a high level of fragmentation. A human fragment was identified in level 37.

Domestic fauna dominates the assemblage with pigs constituting the main taxon and cattle taking second place, followed by dogs and caprines (*table 33*).

One bovid was identified in each stratigraphic unit. In the case of levels 37 and 54, two sub-adults below 30 months were identified. The skeletal profile reveals the hind and fore limbs to be

Taxon	NISP	%	MNI	%	Weight (g)	%	NISP/MNI
Aurochs	1	100	1	100	36.29	100	1
Total identified	1	100	1	100	36.29	100	1

**Table 31.** Results of the zooarchaeological analysis from structure 8 at LRT-II.

	NISP	%	Weight (g)	%
Identified	49	28.32	579.71	75.12
Unidentified	124	71.67	191.94	24.87
Total	173	100	771.65	100

**Table 32.** Results of the zooarchaeological analysis from structure 9 at LRT-II.

Taxon	NISP	%	MNI	%	Weight (g)	%	NISP/MNI
Cattle	9	18.36	3	23.07	199.97	34.49	3
Caprine	6	12.24	2	15.38	27.02	4.66	3
Pig	15	30.61	3	23.07	183.28	31.61	5
Dog	11	22.44	2	15.38	67	11.55	5.5
Total domestic	41	83.67	10	76.92	477.27	82.32	4.1
Aurochs	3	6.12	1	7.69	73.5	12.67	3
Red deer	2	4.08	1	7.69	25.4	4.38	2
Hare	3	6.12	1	7.69	3.54	0.61	3
Total wild	8	16.32	3	23.07	102.44	17.67	2.66
Total	49	100	13	100	579.71	100	3.76

**Table 33.** Results of the zooarchaeological analysis from structure 9 at LRT-II including NISP, MNI, and weight.

overrepresented in both units, with middle and high meat yielding elements predominating.

In the case of caprines, it has not been possible to estimate the sex and age. The skeletal representation revealed an over-representation of the hind limb and forefoot.

Three pigs were identified, with fore limbs and hind limbs being the dominant parts. All identified individuals had a range between infantile and juvenile. An individual from level 37 was identified as a juvenile/subadult under twelve months, and one from level 54 was identified as a male under 24 months.

The remains of two dogs were identified in level 37 and level 57/61 as well.

The wild fauna in this unit is scarce, consisting of only an aurochs in level 37, a red deer in level 54, and a lagomorph in level 57/61. Among the

wild fauna, the presence of a subadult aurochs under 30 months stands out.

According to the unidentified remains, fragments of size 2 individuals, among which fragments of the appendicular skeleton stand out and are the most abundant (*table 34*). In the case of size 3 individuals, the appendicular elements are also the most numerous, followed by fragments of the axial skeleton.

	NISP	%	Weight (g)	%
Size 3	14	11.29	88.16	45.93
Size 2	91	73.38	79.03	41.17
Unidentified	19	15.32	24.75	12.89
Total	124	100	191.94	100

**Table 34.** Results of the zooarchaeological analysis from structure 8 at LRT-II according to size.

### 6.1.2.7 Structure 11

The collection recovered from level 40 totals ten faunal remains. Most specimens remain unidentified (*table 35*). Preservation is poor, as most specimens exhibit a high level of fragmentation and crust adheres to the surfaces of many bones.

Concerning the identified fragments, it was only possible to identify three caprine hind limb bones. Epiphyseal fusion data confirms this to be an adult over 40 months (*table 36*).

	NISP	%	Weight (g)	%
Identified	3	30	51.14	58.01
Unidentified	7	70	37.01	41.98
Total	10	100	88.15	100

**Table 35.** Results of the zooarchaeological analysis from structure 11 at LRT-II.

Taxon	NISP	%	MNI	%	Weight (g)	%	NISP/MNI
Caprine	3	100	1	100	51.14	100	3
Total	3	100	1	100	51.14	100	3

**Table 36.** Results of the zooarchaeological analysis from structure 11 at LRT-II including NISP, MNI, and weight.

	NISP	%	Weight (g)	%
Size 2	7	75	37.01	100
Total	7	100	37.01	100

**Table 37.** Results of the zooarchaeological analysis from structure 11 at LRT-II according to size.

From the unidentified fragments, those identified as size 2 consist mostly of fragments from the appendicular skeleton. Since only caprines have been identified, it can be assumed that the fragments largely correspond to this taxon (*table 37*).

### 6.1.2.8 Structure 12

The assemblage recovered in structure 12 totals 30 remains (*table 38*). Preservation is poor, as most specimens exhibit a high level of fragmentation. This stratigraphic unit was not fully excavated.

Domestic fauna dominates the assemblage, with caprines constituting the main taxon according to NISP, followed by cattle and pigs. A red deer was also identified (*table 39*).

	NISP	%	Weight (g)	%
Identified	11	36.6	216.39	81.58
Unidentified	19	63.33	46.8	17.64
Total	30	100	265.24	100

**Table 38.** Results of the zooarchaeological analysis from structure 12 at LRT-II.

Taxon	NISP	%	MNI	%	Weight (g)	%
Cattle	2	18.18	1	25	145.94	67.44
Caprine	5	45.45	1	25	20.1	9.28
Pig	2	18.18	1	25	43.69	20.19
Total domestic	9	81.81	3	75	209.73	96.92
Red deer	2	18.18	1	25	6.66	3.07
Total identified	11	100	4	100	216.39	100

**Table 39.** Results of the zooarchaeological analysis from structure 12 at LRT-II including NISP, MNI, and weight.

Taxon	NISP	%	MNI	%	Weight (g)	%
Size 3	5	26.31	-	-	26.7	57.05
Size 2	13	68.42	-	-	19.92	42.56
Size 1	1	5.26	1	100	0.18	0.38
Total	19	100	1	100	46.8	100

**Table 40.** Results of the zooarchaeological analysis from structure 12 at LRT-II according to size.

In the case of bovids, the state of preservation has not allowed for the establishment of the sex and age, or the estimation of height at the withers. One male subadult/adult pig over 16 months as well as one juvenile/adult caprine over nine months were identified according to epiphyseal fusion.

Fragments of size 2 individuals dominate (table 40). In all sizes fragments from elements of the appendicular skeleton predominate.

**6.1.2.9 Structure 17**

The collection recovered in structure 17 presents 364 bones. Most of the specimens remain unidentified (table 41).

	NISP	%	Weight (g)	%
Identified	104	28.57	2148.44	84.63
Unidentified	260	71.42	390.16	15.36
Total	364	100	2538.6	100

**Table 41.** Results of the zooarchaeological analysis from structure 17 at LRT-II.

There is a clear predominance of domestic versus wild fauna, among which the presence of an aurochs stands out. Cattle constitute the main taxon, followed by pigs and caprines. The presence of a dog and a human fragment has also been documented (table 42).

In the case of cattle, the epiphyseal fusion data indicate a subadult individual between 24 and 42 months. It has not been possible to infer the sex due to the lack of the pertinent anatomical elements. Likewise, it has not been possible to calculate the mean height at the withers due to the lack of complete bones. A pig over 24 months and an infant below twelve months, as well as an infantile caprine under 18 months, were identified also.

Based on the unidentified fragments, the fragments of size 2 individuals are the most abundant (table 43). Most correspond to small fragments of elements from the axial skeleton, followed by appendicular skeletal elements. In the case of fragments corresponding to size 3 individuals, appendicular elements dominate.

Taxon	NISP	%	MNI	%	Weight (g)	%
Cattle	35	33.65	2	20	1348.2	62.75
Caprine	24	23.07	2	20	107.63	5.00
Pig	25	24.03	2	20	356.16	16.57
Dog	2	1.92	1	10	2.39	0.11
Total domestic	86	82.69	7	70	1814.38	84.45
Aurochs	3	2.88	1	10	141.42	6.58
Red deer	10	9.61	1	10	191.78	8.92
Lagomorpha	5	4.80	1	10	0.86	0.04
Total wild	18	17.30	3	30	334.06	15.54
Total identified	104	100	10	100	2148.44	100
Human	1		1		7.01	

**Table 42.** Results of the zooarchaeological analysis from structure 17 at LRT-II including NISP, MNI, and weight.

	NISP	%	Weight (g)	%
Size 3	15	5.76	162.44	45.09
Size 2	243	93.46	227.62	63.19
Size 1	2	0.76	0.1	0.02
Total	260	100	360.19	100

**Table 43.** Results of the zooarchaeological analysis from structure 17 at LRT-II according to size.

	NISP	%	Weight (g)	%
Identified	2	28.57	961.97	98.70
Unidentified	5	71.42	12.66	1.29
Total	7	100	974.63	100

**Table 44.** Results of the zooarchaeological analysis from structure 18 at LRT-II.

Taxon	NISP	%	MNI	%	Weight (g)	%	NISP/MNI
Aurochs	1	50	1	33.33	866	88.85	1
Horse	1	50	1	33.33	95.97	9.84	1
Total identified	70	100	2	66.66	974.63	100	35

**Table 45.** Results of the zooarchaeological analysis from structure 18 at LRT-II including NISP, MNI, and weight.

Taxon	NISP	%	MNI	%	Weight (g)	%
Size 3	1	20	-	-	6.93	54.73
Size 2	1	20	1	33.33	1.6	12.63
Unidentified	3	60	-	-	4.13	32.62
Total	5	100	1	33.33	12.66	100

**Table 46.** Results of the zooarchaeological analysis from structure 18 at LRT-II according to size.

### 6.1.2.10 Structure 18

The assemblage from this structure consists of seven bones. Most specimens remain unidentified (table 44). Preservation is poor, as most are highly fragmented.

From the identified fragments, the wild fauna is represented by an aurochs (*Bos primigenius*) and an equid (*Equus sp.*). If the equid is wild, then structure 18, which is composed of level 59, is singular in that no domesticated animals have been found in it (table 45).

The size 3 fragment is probably a cranial bone from an aurochs. One size 2 individual was documented from a fragment from the axial skeleton (table 46).

## 6.1.3 Results of the Isotopic Analyses

### 6.1.3.1 Mobility: Strontium ( $^{87}\text{Sr}/^{86}\text{Sr}$ )

A Total of 13 samples, seven of suids, three of caprines, two of bovids, one of a dog, and one of a horse, were isotopically analysed through  $^{87}\text{Sr}/^{86}\text{Sr}$ . Strontium values range from 0.70879 to 0.71366 (table A.5.1.1 in appendix 5; fig. 71).

Local pigs (n=6) range from 0.70879 to 0.71093 (average= 0.70965  $\pm$  0.0016 (2 $\sigma$ )). Local caprines (n=2) range from 0.70892 to 0.70986 (average= 0.70939  $\pm$  0.0012 (2 $\sigma$ )). Cattle yield a value of 0.70970, whereas those of horse and dog are 0.71024 and 0.70975, respectively. Outlier values appear in one caprine (0.71324) and one suid (0.71366).

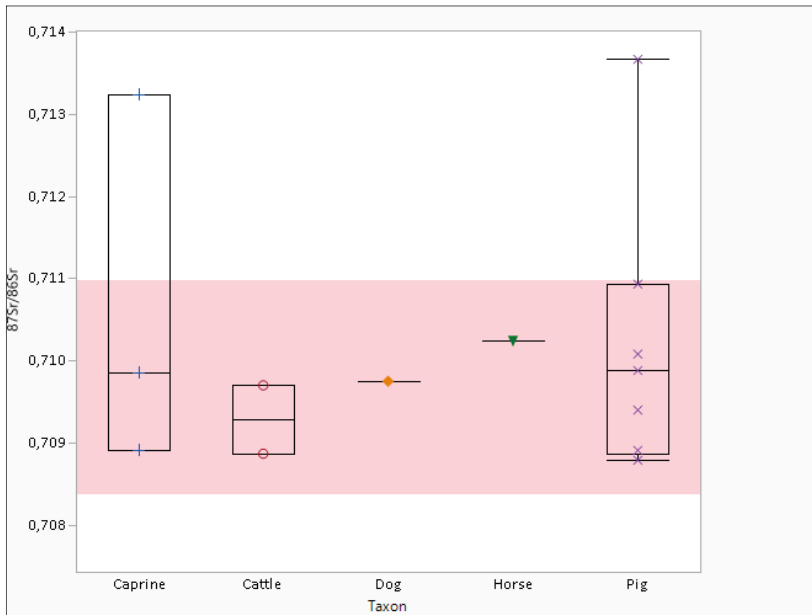
Disregarding outliers, the local range of the eleven  $^{87}\text{Sr}/^{86}\text{Sr}$  values from Loma del Real Tesoro II goes from 0.70837 to 0.71097  $\pm$  0.0012 (2 $\sigma$ ) (fig. 71).

### 6.1.3.2 Oxygen ( $\delta^{18}\text{O}_{\text{ap}}$ ) and Carbon ( $\delta^{13}\text{C}_{\text{ap}}$ )

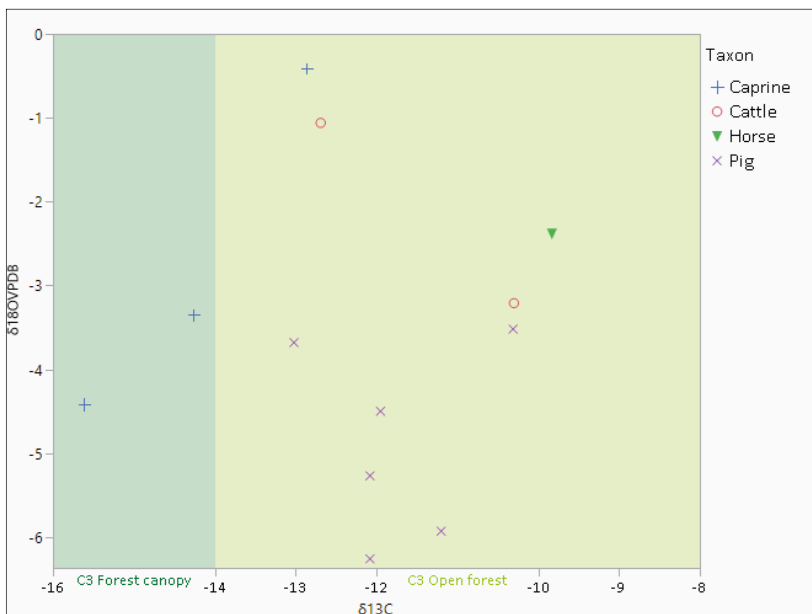
13 tooth enamel samples were analysed for  $\delta^{18}\text{O}_{\text{ap}}$  and  $\delta^{13}\text{C}_{\text{ap}}$ , but sample LRT-03 was discarded due to its low proportion of  $\text{CO}_3$  (table A.5.1.1 in appendix 5).

In terms of species,  $\delta^{18}\text{O}_{\text{VPDB}}$  tooth enamel values in caprines (n=3) range from -4.42‰ to -0.41‰. LRT-05 was excluded because it presents outlier values for  $^{87}\text{Sr}/^{86}\text{Sr}$ . The local range, based on the mean values for caprines (n=2)  $\delta^{18}\text{O}_{\text{VPDB}}$  tooth enamel, presents a range from -5.24‰ to 0.42‰ (average= -2.41‰  $\pm$  2.83‰ (1 $\sigma$ )). Cattle (n=2) has an  $\delta^{18}\text{O}_{\text{VPDB}}$  range between -3.21‰ and -1.06‰ (local range between -3.65‰ and -0.61‰; mean= -2.13‰  $\pm$  1.52‰ (1 $\sigma$ )). In the case of pigs, the  $\delta^{18}\text{O}_{\text{VPDB}}$  range (n=6) goes from -6.26‰ to -3.52‰. LRT-12 was excluded because it presents outlier values for  $^{87}\text{Sr}/^{86}\text{Sr}$ . The local mean value for pig (n=5)  $\delta^{18}\text{O}_{\text{VPDB}}$  ranges from -6.19‰ to -3.67‰ (mean= -4.93‰  $\pm$  1.26‰ (1 $\sigma$ )). The horse (sample LRT-09) has an  $\delta^{18}\text{O}_{\text{VPDB}}$  value of -2.38‰. The combined  $\delta^{18}\text{O}_{\text{VPDB}}$  tooth enamel (n=12) for all species ranges from -6.26‰ to -0.41‰. Excluding outlier values (n=10), the local range can be established between -5.56‰ and -1.66‰ (average= -3.61‰  $\pm$  1.95‰ (1 $\sigma$ )).

According to  $\delta^{13}\text{O}_{\text{ap}}$  values, cattle (n=2) range from -12.69‰ to -10.3‰. The local range



**Fig. 71.** Results of  $^{87}\text{Sr}/^{86}\text{Sr}$  from LRT-II by species.



**Fig. 72.** Results of  $\delta^{18}\text{O}_{\text{ap}}$  and  $\delta^{13}\text{C}_{\text{ap}}$  from LRT-II.

for cattle oscillates from  $-13.17\text{‰}$  to  $-9.81\text{‰}$  (average =  $-11.49\text{‰} \pm 1.68\text{‰}$  ( $1\sigma$ )). The carbon values ( $\delta^{13}\text{O}_{\text{ap}}$ ) for all caprines ( $n=3$ ) range from  $-15.62\text{‰}$  to  $-12.86\text{‰}$ . Disregarding outlier value from LRT-05, local range for  $\delta^{13}\text{O}_{\text{ap}}$  in caprines is established between  $-16.19\text{‰}$  and  $-12.29\text{‰}$  (average =  $-14.24\text{‰} \pm 1.95\text{‰}$  ( $1\sigma$ )). Pig ( $n=6$ ) ranges between  $-13.02\text{‰}$  and  $-10.31\text{‰}$ . The local range of mean values ( $n=5$ ), excluding outliers (i.e. LRT-12), for  $\delta^{13}\text{O}_{\text{ap}}$  oscillates from  $-12.75\text{‰}$  to  $-10.71\text{‰}$  (mean =  $-11.73\text{‰} \pm 1.02\text{‰}$  ( $1\sigma$ )). Horse has a value of  $-9.83\text{‰}$ .

The combined carbon values ( $\delta^{13}\text{O}_{\text{ap}}$ ) for all species ( $n=12$ ) ranges from  $-15.62\text{‰}$  to  $-9.83\text{‰}$ . The local range can be established between

$-13.86\text{‰}$  and  $-10.5$  (average =  $-12.18\text{‰} \pm 1.68\text{‰}$  ( $1\sigma$ )) (fig. 72).

### 6.1.3.3 Analysis of Diet: $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$

75 samples were analysed, of which one sample provided enough collagen to reconstruct diet (table A.5.1.2 in appendix 5). The sample is from a caprine identified in structure 12 that showed a predominant consumption of  $\text{C}_3$  plants from open forest. Despite this, due to the scarcity of samples with good-quality collagen, it is not possible to reach reliable conclusions on the consumption patterns at La Loma del Real Tesoro II.

## 6.1.4 Complementary Analyses at LRT-II

### 6.1.4.1 Geological Drills

The LRT-II settlement is located on a detritic platform from the late Middle Pleistocene and early Upper Pleistocene. This fluvial terrace is set on blue loams from the Upper Miocene.

The geomorphological profile of the upper 3m of the terrace consists, at its base, of a bank of gravel and pebbles with a sandy matrix, which is crowned by a deposit with a sandy-clay matrix. Above this level, a brown calcic luvisol heavily affected by anthropogenic activity.

The results of the geoarchaeological analyses on the structures indicate a substantial loss of the original upper surface. Taking this into account, all the enclosures and the central structure would have had a depth of around 2m, except for the first enclosure, which would have reached 2.50m. The deepest levels of the structures reached the detritic material and due to their drainage capacity at this level, it was difficult to excavate further. Due to their hydraulic conductivity, this material must have functioned as a small aquifer locked by the blue loams. For this reason, the ditches could have functioned as drains, mitigating the seasonal flooding of the site. The analyses revealed two

filling facies in most structures. The lower level, characterised by a clay matrix, showed features of intensive anthropogenic action. This anthropogenic activity decreased gradually from enclosure 3 to the central structure. The upper level presents a lower degree of anthropogenic alteration and a greater presence of sands, which could be indicative of a phase of abandonment or a rapid and intentional clogging process (fig. 73, 74).

The phosphate analyses carried out on the sediments from the geological columns point to a higher concentration in the lower levels of the analysed structures. At the same time, a higher concentration of phosphates towards the outermost enclosures could indicate a strategy of ‘cleaning and maintenance’ of the innermost enclosures, to the detriment of the outermost enclosures.

### 6.1.4.2 Phytolith Analyses

Phytolith concentrations and percentages of different morphotypes are presented in table A.5.2.1 in appendix 5. Samples LRTII-2, 3, 5, 7, 9, and 12 feature a phytolith concentration similar to the control samples, indicating an absence of plant material of human input. Samples LRTII-1, 4, 6, 8, and 10 showed positive results, yielding phytolith



Fig. 73. Enclosures 1–4 with geological test pits in red.

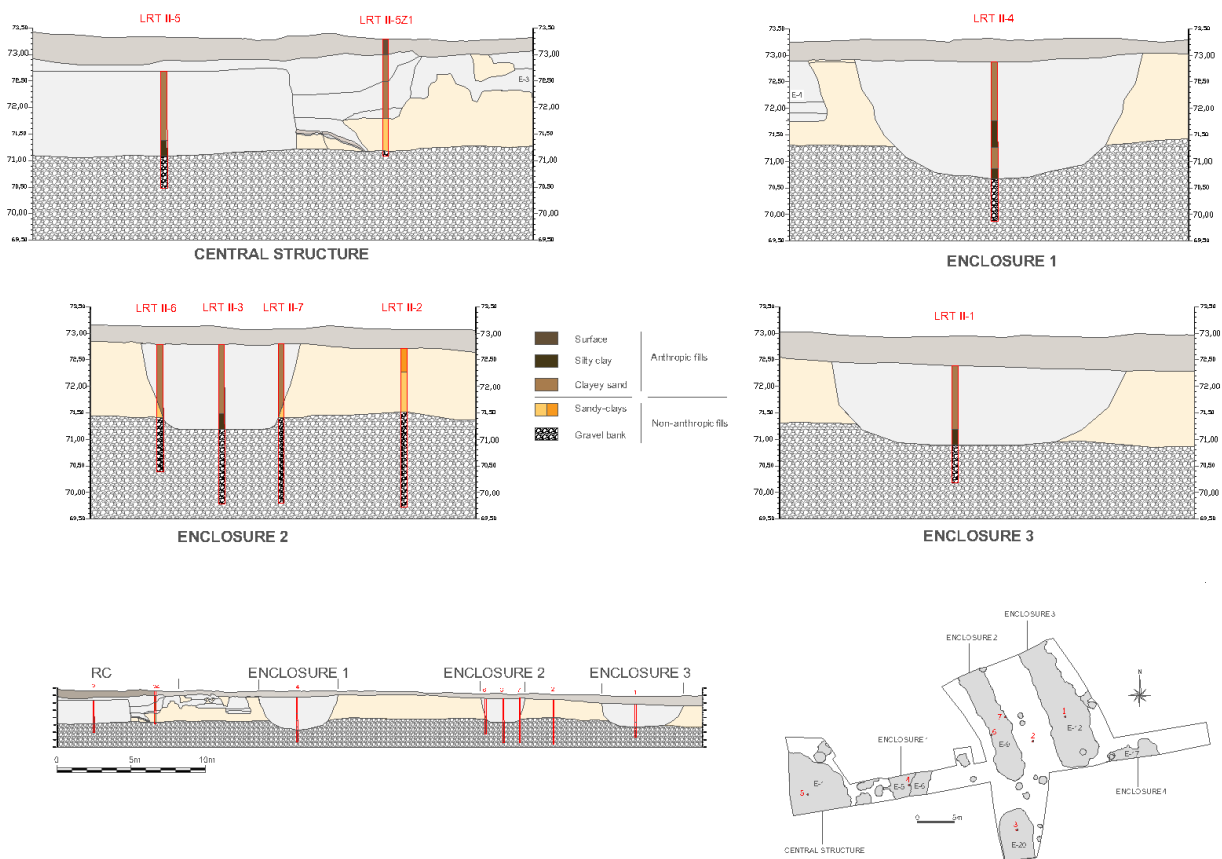


Fig. 74. Geological test pits at LRT-II (modified from Borja Barrera/Borja Barrera 2018).

concentrations close to or above one million items per gram of sediment.

Samples 1, 4, and 6 from structures 1, 2, and 3, respectively, exhibited large amounts of rugulate and weathered morphotypes, along with a low percentage of multicells, indicative of poor preservation conditions (Cabanes et al. 2011). Samples 8 and 10 from structures 7 and 11 are better preserved.

Grasses dominated all assemblages, although dicots, in the form of herbaceous and woody plants, were present in relatively substantial amounts. Most of the grasses in samples 1, 4, and 6 are  $C_3$  plants, as indicated by the high percentage of short cells from the *Pooideae* subfamily. Still, these grasses do not derive from domesticated cereals, considering that the percentage of dendritic morphotypes is well below 7 (Albert et al. 2008). On samples 8 and 10, short cells typical of the *Chloridoideae* and *Panicoideae* are more abundant. These assemblages are thus dominated by  $C_4$  plants.

The plant part most represented in samples 4, 6, and 10 is the inflorescence, whereas in

samples 1 and 8 leaves and stems dominate. The ratio between inflorescence and leaf/stem indicates that the assemblages contain a mixture of both (Regev et al. 2015). Only sample 4 is clearly dominated by inflorescences.

The FTIR spectra of samples 1, 6, 8, and 10 are characterised by the presence of quartz, calcite, and clay minerals (a mixture of kaolinite and smectite groups). Given the low intensity of the clay minerals absorption in samples 8 and 10, it can be inferred that the sediments were exposed to high temperatures (Berna et al. 2007). The inference of high temperature is supported by the presence of large amounts of charred remains.

Considering the overall high amounts of dicots and  $C_4$  plants in these assemblages, it appears that  $C_4$  grasses were used along with cereals. Due to their poor preservation it is difficult to state whether these cereals were domesticated or not. In other words, the low occurrence of dendritic morphotypes could be due either to an absence of domesticated cereals or to diagenesis. This is especially the case in sample 4, which is dominated by



Fig. 75. Phytolith identifying in structure 4.

	NF	%	Weight (g)	%
Shapeless	160	88.39	2462.56	88.81
Form	21	11.60	310.09	11.18
Total	181	100	2772.65	100
Loom weight	1		8	

Table 47. Analysis of pottery from structure 1 at LRT-II.

grass inflorescences, is poor in dendritic morphotypes, and exhibits a large amount of short cells from C<sub>4</sub> plants and dicot morphotypes (fig. 75).

For all these reasons, none of the studied assemblages can be taken to represent grain storage units. Rather, the mixture of monocots (both C<sub>3</sub> and C<sub>4</sub>) and dicots points to waste disposal. In the case of samples 6 and 10, which show signs of alteration due to temperature, it is even plausible to link their mixed assemblages to the use of plant fuel.

### 6.1.4.3 Pottery Analyses

A total of 1384 pottery fragments were recovered during the archaeological excavation in LRT-II. The state of preservation was quite poor and only one complete vessel could be documented in structure 18. Descriptions and figures are presented in appendix 6.

#### Structure 1

181 pottery fragments, weighing 2780.65g, and a loom weight have been documented in structure 1 (table 47).

There is a predominance of open shapes in most identified units. The fragments with Bell Beaker decoration of the maritime type and geometric dot type dominate samples in most of the stratigraphic units (fig. 76) except for unit 53,

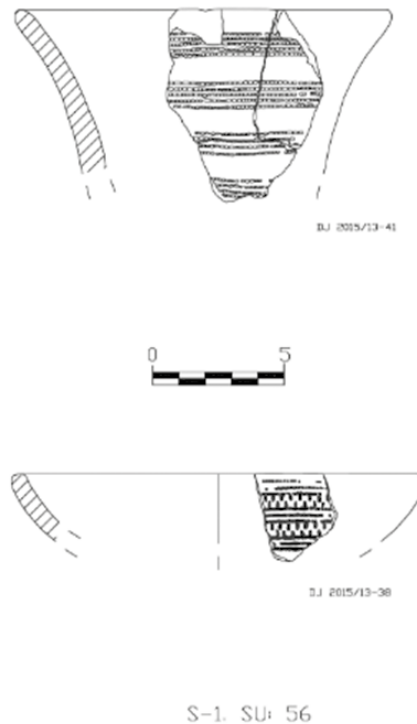


Fig. 76. Bell Beaker pottery from structure 1 at LRT-II.

	NF	%
Bell Beaker	7	63.63
Almagre	4	36.36
Total	11	100

Table 48. Fragments with decoration from structure 1 at LRT-II.

where fragments treated with red ochre (Almagre) predominate (table 48).

Among other pottery documented in level 10, a fragment of a loom weight (ID 18) with circular section that presents signs of reduced firing and fine temper, and a fragment (ID 19) with a vegetable imprint on one of its surfaces, should be noted.

**Structure 2**

62 pottery sherds, weighing 1519.05g, and a loom weight have been documented in structure 2 (table 49). The red ochre (Almagre) treated fragments predominate in level 22. One fragment of rim with a rounded protuberance or mamelon and vegetable imprints were documented in level 22 and 31. A loom weight was identified in stratigraphic unit 31 as well (fig. 77).

	NF	%	Weight (g)	%
Shapeless	54	87.09	995.69	65.54
Form	8	12.90	523.36	34.45
Total	62	100	1519.05	100
Loom weight	1		64.41	

**Table 49.** Pottery fragments from structure 2 at LRT-II.



**Fig. 77.** Loom weight (DJ2015-13-85) from structure 2, level 31.

**Structure 3**

202 pottery sherds were recovered from structure 3 (table 50). The majority are shapeless fragments from different vessels. Most of them have grey and brown pastes with medium and small temper and were fired in reducing and irregular conditions.

One must highlight the presence of a loom weight (ID 266) in level 28 as well as four

	NF	%	Weight (g)	%
Shapeless	174	86.13	1609	81.03
Form	28	13.86	376.51	18.96
Total	202	100	1985.51	100

**Table 50.** Pottery fragments from structure 3 at LRT-II.

fragments with decorations in level 38. One vegetable imprint was documented in level 28 as well.

**Structure 4**

184 pottery sherds, weighing 2148g, and two loom weight fragments have been documented in structure 4 (table 51). The presence of a sherd with stamped decoration in level 4, as well as a small cup with red ochre (Almagre) treatment, stands out. A fragment of adobe with incised decorations and a loom weight have also been documented in this unit. In level 36, a sherd with stamped decorations has been documented as well. In both units, small, mainly open shapes dominate.

	NF	%	Weight (g)	%
Shapeless	166	90.21	1839.73	85.64
Form	18	9.78	308.27	14.35
Total	184	100	2148	100
Loom Weight	2			

**Table 51.** Pottery fragments from structure 4 at LRT-II.

**Structure 7**

77 pottery sherds were recovered (table 52). The majority are shapeless fragments from different kinds of vessels. Most feature grey and brown pastes with medium and small temper fired in reducing and irregular conditions. Thirteen fragments can be attributed to shapes. Among other clay products documented in this level, one 22.13g adobe fragment was identified.

	NF	%	Weight (g)	%
Shapeless	64	83.11	1069.17	89.29
Form	13	16.88	128.17	10.70
Total	77	100	1197.34	100

**Table 52.** Pottery fragments from structure 7 at LRT-II.

### Structure 8

There are two handmade sherds. One shapeless fragment has oxidized paste and presents evidence of having been exposed to secondary firing. Among other clay products documented in this unit, fragments of adobe were identified.

### Structure 9

A total of 281 pottery sherds, weighing 5857.98g, were found (table 53). In addition, two crucible fragments were also documented.

There is a predominance of open shapes, small bowls, and vessels in most of the identified units. The presence of Bell Beaker pottery with linear maritime typology is evident in level 57/64 and geometric dots in the rest of the identified units (fig. 78), with the exception of level 37, where decorated pottery were not documented and the small-sized shapes stand out.

	NF	%	Weight (g)	%
Shapeless	240	85.40	4527.7	77.29
Form	41	14.59	1330.28	22.70
Total	281	100	5857.98	100

**Table 53.** Pottery fragments from structure 9 at LRT-II.



**Fig. 78.** Bell Beaker fragment from level 54.

### Structure 11

34 sherds were recovered (table 54). The majority are shapeless fragments from different kinds of vessels. Most of them have grey and brown pastes,

	NF	%	Weight (g)	%
Shapeless	31	91.17	654.1	95.97
Form	3	8.82	27.45	4.02
Total	34	100	681.55	100

**Table 54.** Pottery fragments from structure 11 at LRT-II.

tempered with medium and small grits and firing in reducing conditions.

### Structure 12: Level 42

105 pottery sherds, weighing 2082.97g, have been documented in the test pit carried out on level 42 (table 55).

Reduced fired pastes predominate and small bowls as well as carinated pots stand out. Four fragments have been identified that show Bell Beaker decoration of a geometric dotted style.

	NF	%	Weight (g)	%
Shapeless	89	84.76	1800.97	86.46
Form	16	15.23	282	13.53
Total	105	100	2082.97	100

**Table 55.** Pottery fragments from structure 12, level 24 at LRT-II.

### Structure 17

286 sherds, weighing 4585.46g, and a loom weight have been documented in the survey carried out in structure 17 (table 56).

	NF	%	Weight (g)	%
Shapeless	181	75.73	3432	74.94
Form	58	24.26	1147.46	25.05
Total	239	100	4579.46	100

**Table 56.** Pottery fragments from structure 17 at LRT-II.

As was the case with structure 9, there is a predominance of open shapes, small hemi-spherical bowls, and globular vessels in most of the identified units of this structure.

Most items feature grey and brown pastes with medium temper firing in reducing conditions.

Bell Beaker pottery with linear maritime typology is present, including a fragment with a herring bone variety of decoration in level 26. Geometric dots are also present in both levels (fig. 79).

### Structure 18

Two sherds were recovered from level 59. Both are from vessels with open shape.

### Structure 20

Two fragments with geometric dotted Bell Beaker decorations from a globular vessel and a bowl, as



**Fig. 79.** Maritime Bell Beaker Herring bone variety (left) and geometric dots decoration documented in level 26 (right).



**Fig. 80.** Bell Beaker pottery from the upper level of structure 20 at LRT-II.

well as a rim from a globular pot, were documented on the surface level of structure 20 (*fig. 80*).

#### 6.1.4.4 Lithic Analyses

Lithic industry analyses at Loma del Real Tesoro II show a clear predominance of siliceous rocks (71%) over other raw materials. Most are brownish and brown flints. These are followed by quartzite (15%).

A significant number of scarcer materials, such as rock crystal, quartz, and limestone, were also found, as well as some indeterminate ones (note: This is a preliminary *de visu* approach that needs to be confirmed and extended with petrological studies).

In terms of core exploitation, a total of 42 nuclei and 25 parts which could be core waste or fragments thereof have been retrieved. There is a predominance of non-cortical over cortical pieces (NCDC) and no cortex residues (NC).

The size of the small nuclei, as well as the rest of the set, indicates that medium and small nodules could have derived from the collection of raw material readily accessible in the vicinity.

As for the types of nuclei, most of them have been classified as ‘diverse’ because adaptation to the raw shape of the nodules at the time of knapping seems evident. In order to extract the positive bases (BP), the multi-facial size is used, clearly adapting the method of extraction to the raw material used, mostly pebbles, in such a way that the most common ones do not follow a well-defined typology.

In relation to the size and configuration strategies, there is total control of the Indirect Technical Operative Topics. This is the reason for the absence of large pieces, compared to the generalisation and standardisation of small and very small size tools.

The existence of the less elaborate and simple percussion platforms of positive bases (BP) and negative bases of 2<sup>nd</sup> generation (BN2G), such as smooth and cortical platforms, must be highlighted. Far less abundant are points, faceted pieces, and dihedrals, although, as in the case of the typology of the nuclei, these types are not very clear for classification.

Regarding the typometry of BP and BN2G (those that can be measured), a predominance of microlithic parts over the rest is evident. As far as widths of the pieces are concerned, it cannot be said that there is a clear trend because there are as many laminar pieces as there are wide sheets.

As for the types of supports, the internal ones openly dominate over all the others. They are followed quantitatively by semi-cortical types. From our point of view, this characteristic responds to

the use of cut edges of siliceous rocks located in the vicinity of the deposit, which determines the typometry of the extracted pieces. It is clear that cortical pieces are practically discarded in the process of producing the stone tools, as shown by the scarce presence of cortical pieces in the ensemble. If the data above is linked with the presence of cortical surface in the BP and BN2G, again there is a preference for pieces without cortex. The cortices were possibly rejected in a place far away from the deposit, perhaps in the place of the raw material supply within the lithic workshop.

In general, it can be said that there are no very complex stonework techniques, neither with the nuclei nor with the BP and BN2G. In fact, there are barely any internal flakes that indicate the existence of pressure flaking technique. There are only a few small cores for small flakes, with an area in which the extractions of small flakes are located, which would not necessarily indicate an indirect retouch or flaking by pressure.

BN2G types have similar characteristics as BP. As far as the predominant type of retouching is concerned, a dominion of the order of the simple ones (racloirs, drills, scrapers, retouched notches, denticulates, and other pieces with simple retouches) is evident, as these reach to a total of 78 pieces. In this context, there is a very significant number of pieces with abrupt retouches such as truncations, back sheets, and other pieces with this type of retouching.

A variety of types of split stone stand out, both with simple and abrupt retouches. Still, the absence of pieces with flat retouching is particularly noteworthy.

The most significant feature of this site is the higher number of retouched and denticulate notched lithics in comparison to other types. In general, the following tendencies can be observed:

- Although not very numerous, a significant presence of tools of paleo-epipaleolithic tradition such as scrapers, racloirs, drills, and truncated pieces.
- A high proportion of notches and denticulates.
- A large number of pieces with retouches, all simple and/or abrupt. Some of the retouches have been classified as ‘use marks’.
- As for typical Copper or Bronze Age elements, there are three sickle elements only, which

represent a type of new working tool linked to new production models. This piece had its peak in the Copper Age, although it appeared during the Neolithic.

- In this section, the absence of foliaceous pieces, or those with flat retouching, is quite remarkable.

The polished stone tools have a high fragmentation index with 20 fractured pieces compared to 13 complete ones, those found in the surface have been included.

Of the 33 polished stones, the mill stones, which add up to more than half of the total, stand out. Together with the grinders, they constitute the most represented tools of grinded stone in the site. This is followed by five axes (three complete, one fractured, and one a fragment) and an adze. The rest has been classified as two straighteners (one of them doubtful), a ball, and three indeterminate pieces.

In addition to studying the working process of tool production, the question how these tools were used in other work processes was asked. Although there are no functional or traceological studies, these were assigned to some ‘types’ and ‘works’. This should, of course, be taken as a preliminar classification:

- Tools related to agricultural activities: mill stones, grinders, sickle elements, and denticulates.
- Tools related to wood or tree carving: axes and adzes.
- Tools related to craft activities (wood, skins, bone, etc.): scrapers, racloirs, and notches.
- Tools related to the production of stone tools.

There are only very few pieces of the last group, namely debarkers, cores, waste pieces, splinters, and debris. For this reason, it is assumed that tool production would have been carried out elsewhere.

With all this information, it can be concluded that the site had a clear habitat context. This is shown by the types of tools discovered, such as mill stones and knurls, tools of a handcrafted nature, such as retouched notches, denticulates, racloirs, as well as un-retouched, and retouched flakes.

There are also elements that indicate the development of an economy where crop farming must have been very important. These elements

include: sickle elements, denticulates, axes, adzes, mill stones, and grinders. Furthermore, unlike what usually happens in other places and contexts, especially funerary, the total absence of arrowheads is significant. Perhaps this activity was relegated to a secondary role to rising livestock, which left hunting as a residual activity useful in times of crisis or as a prestige activity.

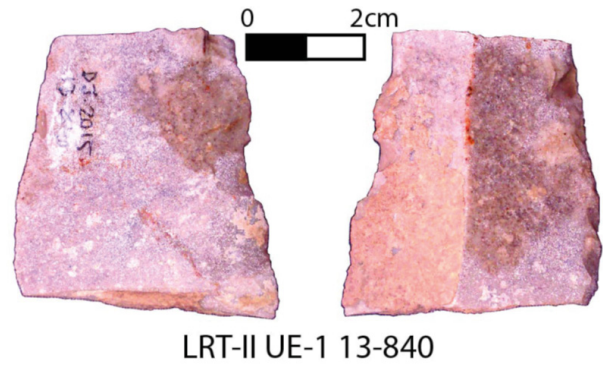
Analyses of lithic origin and surveys from existing quarries in the Province of Granada, the closest being those of Cerro del Reloj (Montefrío, Granada) and Gallumbares (Loja, Granada), evidenced a large number of Milano flint slabs. These quarries are located 165km and 150km respectively away from the site. The location of this material in this deposit falls within the scope of distribution of these quarries, which until this stage of the investigation, is being observed throughout the south of the peninsula. This distribution ranges from Millares in the southeast to the Necropolis of Aljezur in the southwest. These slabs are the result of work carried out when making flint sheets or other similar products.

There are also two fractured flint sheets and one flake, all of which are of the Malaver Formation type (Montecorto, Ronda, Malaga) (*fig. 81*). Similarly, six Turón flint types (Valle del Turón, Malaga) have been identified between fractured sheets, lifts, and slabs.

Finally, three rhyolites from Huelva appear as fractured sheets and slabs. This material comes from El Cerro de Cañalás (Huelva) or the Andévalo (Huelva) (*fig. 82*).

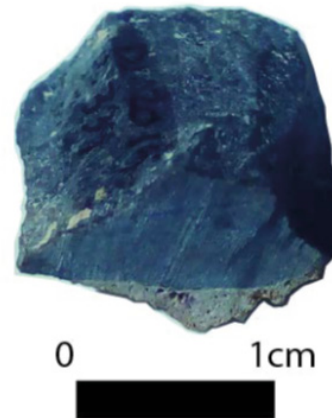
The percentage of polished stones compared to the flakes is small. There are some stone tools of possible dolerites that could come from the local geological deposits of Ossa-Morena, as well as the basalts and the amphibolites, gabbros, and andesites. Until more precise geochemical studies are carried out, it is not possible to determine whether these dolerites come from the Baetic Mountains or not.

Among the grinding tools are sandstones (mainly quartzarenites and grauvaques) (*fig. 83*) that look like highly used mill stones. These materials can be found about 15km to the north in a straight line from the archaeological site of Loma del Real Tesoro. Granodiorites can be found about 12km northeast in a straight line from the site,

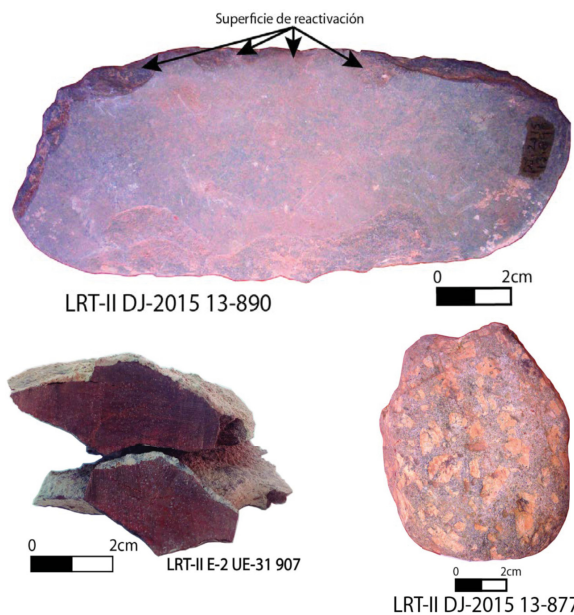


**Fig. 81.** Malaver formation type documented at LRT-II (Photo: J.A.Lozano Rodríguez).

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**Fig. 82.** Riolite from Huelva documented in LRT-II (Photo: J.A.Lozano Rodríguez).



**Fig. 83.** Mill made on Slate (top), mill in grauvaque (bottom left) and hammer in granodiorite from a river pebble (bottom right) (Photo: J.A.Lozano Rodríguez).

although some of the materials used are river pebbles (fig. 85) and therefore could be retrieved much closer. There are also mill stones of granite highly used, the closest granites lying about 7km north-northeast of the site. Grinding tools made of slate are of very different types within the milling material, although some are difficult to assign; the sources of this material are somewhat closer, just 4.5km north-northeast in a straight line from the site.

As expected, any stones with enough abrasion capacity and hardness are suitable as grinding material. To produce some tools such as mill stones sufficiently large sized raw material is needed, which is not likely to be found in Plio-Quaternary terraces and paleo-terraces. Therefore, it is needed to look for it at the geological areas where it emerges, which are at the distances indicated above. This may be the reason why most mill stones show traces of heavy use.

What is clear is that all the materials indicate a domestic context identical to the one that has been studied in pits on other settlements from the 4<sup>th</sup> mill. BC. Here, the remains of flint chipping, hammerheads, and, in general, material discarded from domestic activities are abundant.

#### 6.1.4.5 Pollen Analyses

Eleven samples of 10g of sediment were studied following standardised protocols (Burjachs et al. 2003). The three samples from structure 1 were sterile in terms of pollen. In level 10, this is because of its strong clay nature, which tends to destroy pollen through oxidative processes. In levels 53 and 55, the sterility is likely partially due to the same circumstances, but may also be related to the abundance of microcharcoal remains and ashes in the sediments, which indicate that the pollen may have been destroyed due to elevated temperatures.

Palynological data point to the existence of a scarce forest cover with open oak groves (*Quercus ilex/coccifera* <15%) in a parkland landscape. The accompanying shrub elements (*Smilax*, *Asparagus*, *Chamaerops*, *Rhamnus*, and *Olea europaea*) would probably indicate a relatively warm climate, but aridity is also indicated by the preponderance of *Artemisia* (7–10.6%). Probably, the cause of this

degraded forest was intensive human impact on the ecosystems, since in the pollen spectra there are abundant anthropic-nitrophilous grasses (*Cardueae*, *Aster*, *Cichorioideae*, and *Rumex sp.*) as well as anthropozoogenic plants (*Plantago lanceolata*, *P. major/media*, *Urtica dioica*, and *Chenopodiaceae*). This is further supported by the two samples from structure 2 and the one from structure 11, in which cereal pollen appeared in percentages > 3%, and indicate the existence of crops at a local level in the proximity of the structures. The preponderance of coprophilous fungi (*Sordaria*, *Podospora*, and *Sporormiella*) in all samples hints at the presence of economic activities based on crop farming and livestock practices. At a regional level, it is likely that certain groves of African gall oaks (*Quercus faginea*) thrived, sheltered in cooler depressions and shades, while carob trees (*Ceratonia siliqua*) would thrive in particularly rocky soils. The landscape would appear dominated by large areas of grassland (*Poaceae* ~22–30%), accompanied by *Scrophulariaceae*, *Fabaceae*, and *Brassicaceae* (fig. 84).

The pollen analyses from LRT-II have indicated a highly anthropised environment in which riverbank vegetation is absent, despite the site being located in the vicinity of the Guadalquivir and the Adelfas stream. Cereals such as *Triticum*, *Hordeum*, and oats produce a large quantity of pollen, but their dispersion is quite restricted, so their low presence in the pollen spectra is common in prehistoric pollen profiles (Behren 1981, 227).

In spite of having documented nitrophilic species such as *Chenopodiaceae*, *Artemisia*, and *Urtica*, which are generally related to anthropised environments, *Chenopodiaceae* and *Artemisia* also associate with marshy areas, and *Urtica dioica* with riverine forests. Given the proximity of La Loma del Real Tesoro to the paleo-mouth of the Guadalquivir River, caution must be exercised when using these values as proxies of anthropisation (Behren 1981, 237).

According to the results of our pollen analyses, the presence of cereals argues in favour of permanent settlements. Although the detection of husbandry practices through pollen analysis is highly debated, there are some taxons that were detected at La Loma, Valencina-Castilleja, and Parque Miraflores, such as *Plantago*, that could indicate a husbandry economy.

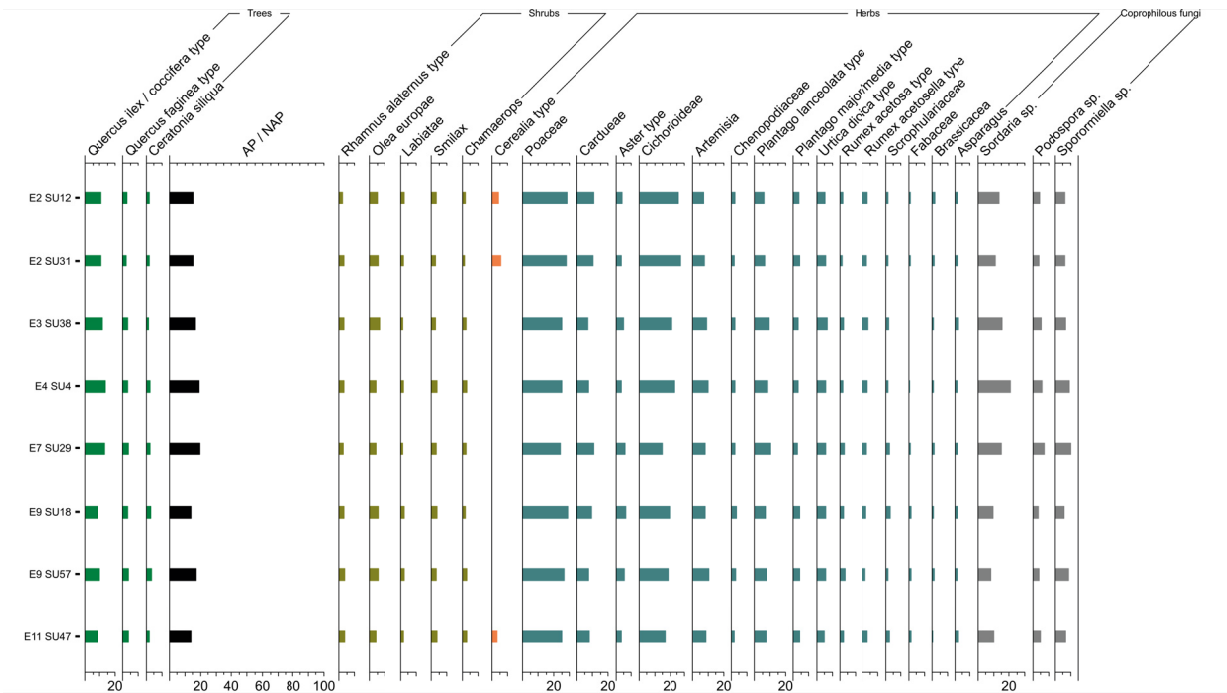


Fig. 84. Palynological data from LRT-II.

Bheren (1981, 228) suggests that the division of areas between crops and pastures is a recent phenomenon in contrast to the mixed economies of prehistoric periods, where the system of crop rotation in a fallow system should be the usual practice.

Another indicator could be *Artemisia* sp., which some authors (Behren, 1981) identify with pathways and ruderal areas in nitrogen-rich locations such as habitation areas or cultivated sectors. According to other authors (Li et al. 2008), the pollen of *Artemisia*, together with that of *Chenopodiaceae*, would be an indicator of intensive grazing. Finally, mention should be made of *Chenopodiaceae* and *Polygonaceae*. The latter includes several genera associated with open grassland areas such as *Rumex* that some authors identify with winter grains (Behren 1981, 236).

**6.1.4.6 Interpretation of Loma del Real Tesoro**

The analyses carried out in the settlement of La Loma del Real Tesoro evidence a site divided into two sectors (LRT-I and LRT-II). Based on the results of the radiocarbon dating carried out on the material from the excavation of LRT-II and the study of the surface materials documented in LRT-I, these two sectors were, at least at some point, occupied

at the same time. The structural difference, as well as the difference in the documented archaeological materials, in particular the presence of pottery of domestic character (a predominance of plates with almond rims in the case of LRT-I and the presence of Bell Beaker pottery in the case of LRT-II), suggests that both sectors could have had different functions.

In the case of LRT-I, the morphological patterns of the ditch enclosures match those documented at other locations on the southwestern Iberian Peninsula. The presence of plates of a markedly domestic character hint that this was the residential sector of the settlement as opposed to LRT-II, with a focus on agricultural activities.

In LRT-II both the geophysical analyses and the archaeological excavation indicated that the sector was displayed around a central macro-structure of approximately 20m in diameter and a total of four enclosures arranged in a concentric manner (structures 5/6, 9, 12, and 17). The sectioning of the ditches also shows different accesses that lead to the conclusion that the configuration of the site was planned at the beginning of the construction of the concentric enclosures and the central structure. The whole complex is framed by a larger enclosure (enclosure 5).

The location of the settlement above a level of impermeable marlstones points to a strategy for

the management of water resources that would periodically accumulate and would need to be channelled for a correct management.

The analysis of the geological columns, carried out in the central structure as well as in enclosures 1, 2, and 3, points to a depth of the pits of around 2m, where a level of gravel and sand is reached; this would allow the structures to become temporarily flooded.

The phosphate analyses carried out on the sediments from the geological columns point to a higher concentration in the lower levels of the analysed structures. At the same time, a higher concentration of phosphates away from the central structure and towards the outermost enclosures could indicate a strategy of 'cleaning and maintenance' of the innermost enclosures, to the detriment of the outermost enclosures.

Stratigraphic analysis of the central structure (structure 1) has shown three clear phases of use and abandonment. In the first phase, the presence of ash levels covered by adobes is documented, which leads to the possibility of it being used as a *fumier*.

*Fumier* deposits are made up of manure, as well as plant debris from fodder and bedding (Brochier 2005). Periodically, these deposits are burned, leaving a sequence of ash layers.

*Fumier* structures have been widely documented throughout the Mediterranean area from the Neolithic to the Iron Age (Martín Rodríguez 2015). On the Iberian Peninsula, this type of structure is more common in the 5<sup>th</sup> and 4<sup>th</sup> mill. BC, extending until the Bronze Age (Martín Rodríguez 2015, Fernández Eraso/Polo Díaz 2008; Polo Díaz/Fernández Eraso 2008). According to Martín Rodríguez (2015, 14), they are usually associated with other economic practices, mainly agricultural.

After a phase of abandonment, marked by level 51, a third phase is observed where a small combustion structure is documented (substructure 53). Subsequently, the adjacent structures (structures 2, 3, and 4) are reused to connect the first enclosure (structure 5/6) with the central structure by means of a system of channels in which water seems to play an important role, as demonstrated by the episodes of hydromorphism in structure 5/6.

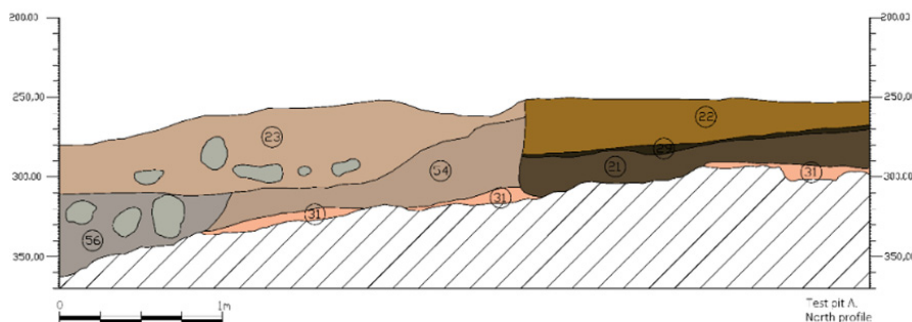
## 6.2 Carmona

### 6.2.1 Zooarchaeological Analyses from Ronda del Cenicero

The zooarchaeological analysis was conducted in two structures from test pit A, structure 24 and structure 54. Both were inserted in the profiles of the test pit, thus, the recording of the levels is incomplete. Nonetheless, the results allow to infer the use of these levels. Both structures provided pottery from the Bell Beaker horizon.

#### 6.2.1.1 Structure 24

Structure 24 is a negative basin type structure that was partially documented because it was affected by modern structures and inserted into the S-E profile of test pit A. It had an essentially oval perimeter, with an average width of 2.40m and a length of more than 4m. The structure featured a U-shaped cross section, with a maximum depth of 0.60m and three stratigraphic units labelled level 21, 29 and 22. A posthole filled with a greenish clay appeared on its perimeter (*fig. 85*).



**Fig. 85.** North profile of structure 24 (adapted from Román Rodríguez, 2011).

**Level 21**

A total of 140 faunal bones were analysed. The proportion of unidentified remains is high, taking into account that most of the remains were assigned to unidentified categories (table 57). Preservation is poor as most specimens exhibit a high level of fragmentation.

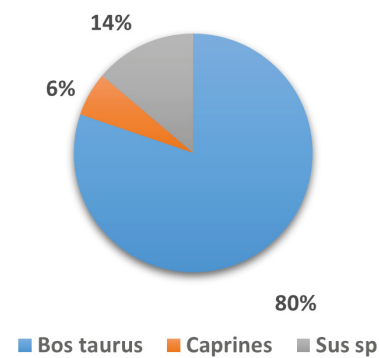
The domestic fauna dominates the assemblage, with cattle constituting the main taxon and pigs taking second place, followed by caprines and dogs (table 59).

Among the unidentified fragments, size 3 tends to correspond to fragments of the appendicular skeleton followed by cranial and axial fragments. Since only cattle fragments have been documented, one can safely assume that those elements would correspond to this taxon. In the case of size 2 fragments, as with size 3 fragments, there is a predominance of fragments from the appendicular skeleton and a low proportion of elements from the axial and cranial skeleton (table 58).

Level 21 yielded seven individuals. Cattle could have been used for traction and for secondary products of delayed consumption. The two

caprines hint at both secondary products (adult) and an optimisation of meat output (subadult). Pigs were obviously kept for meat production. The predominance of fore and hind limb elements in the three stocks reinforces the hypothesis of meat consumption, though the restricted sample size does not allow to draw definitive conclusions. Based on the study of meat contributions in level 21, cattle played a major role as meat provider (fig. 86).

**Edible meat**



**Fig. 86.** Edible meat from level 21, structure 24 at Ronda del Cenicero in Carmona.

	NF	%	Weight (g)	%
Identified	41	29.28	343,35	63.15
Unidentified	99	70.71	200,34	36.84
Total	140	100	543.69	100

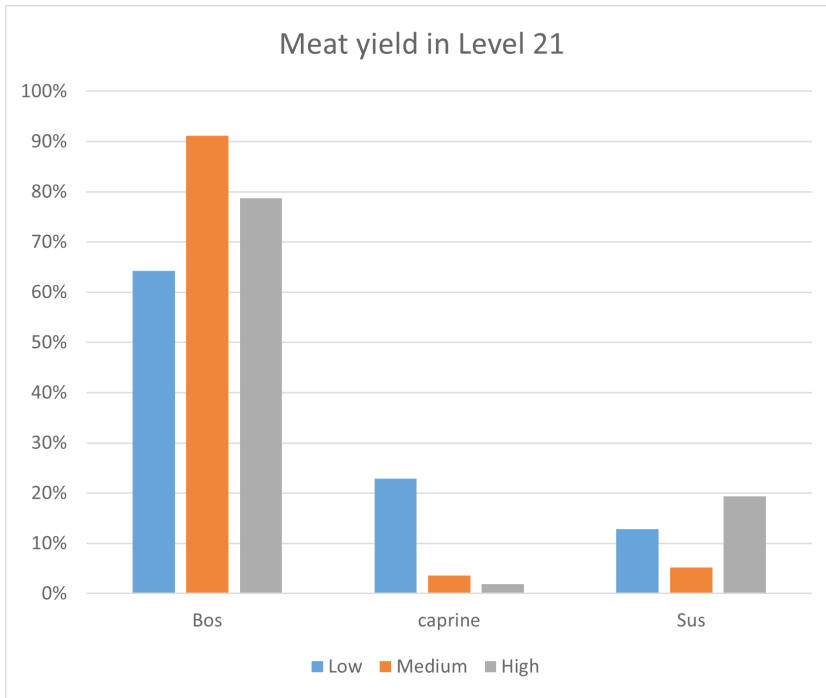
**Table 57.** Results of the zooarchaeological analysis from level 21, structure 24 at Ronda del Cenicero in Carmona.

	NF	%	Weight (g)	%
Size 3	20	20.20	100.09	49.96
Size 2	79	79.79	100.25	50.03
Total unidentified	99	100	200.34	100

**Table 58.** Results of the zooarchaeological analysis from level 21, structure 24 at Ronda del Cenicero in Carmona including NISP, and weight.

Taxon	NISP	%	MNI	%	Weight (g)	%	MNI/NISP
Cattle	21	51.21	1	14.28	271.78	79.15	21
Caprine	7	17.07	2	28.57	18.25	5.31	3.5
Pig	9	21.95	2	28.57	42.11	12.26	4.5
Dog	3	7.31	1	14.28	9.75	2.83	3
Total domestic	40	97.56	6	85.71	341.89	99.57	6.66
Lagomorpha	1	2.44	1	14.28	1.46	0.43	1
Total wild	1	2.44	1	14.28	1.46	0.43	1
Total identified	41	100	7	100	343.35	100	5.85

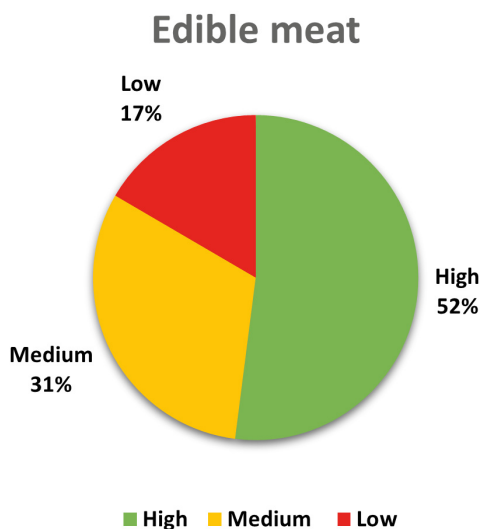
**Table 59.** Results of the zooarchaeological analysis from level 21, structure 24 at Ronda del Cenicero in Carmona including NISP, MNI, and weight.



**Fig. 87.** Meat yield from level 21, structure 24 at Ronda del Cenicero in Carmona.

Cattle also contributed the highest proportion of meat from anatomical elements of high meat yield, followed by pigs and caprines. In contrast with cattle and pigs, for caprines, anatomical elements of low meat yield predominate (fig. 87).

Based on total meat yield, there is a predominance of anatomical portions of high yield, mainly from the fore and hind limbs, as opposed to medium and low yield meat portions (fig. 88).



**Fig. 88.** Proportion of meat yield from level 21, structure 24 at Ronda del Cenicero in Carmona.

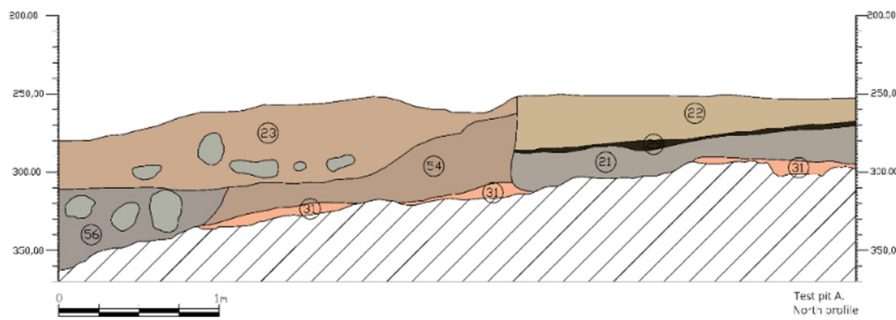
**Level 29**

Level 29 is a soil layer located in structure 24 (fig. 89). It is a soil level of black colour and sandy texture. The upper part of the level is a thin, yellow clay layer with intrusions of charcoal fragments. Level 29 has a maximum thickness of 0.08m and a minimum thickness of 0.10m. Bell Beaker decorated pottery stand out (Román Rodríguez in press, 152).

Eleven remains comprise the faunal assemblage (table 60). The proportion of unidentified remains is high; most were assigned to indeterminate categories. The level of preservation of the faunal assemblage is poor. Domestic fauna dominates the assemblage, with cattle constituting the main taxon (table 61).

The unidentified fragments show that size 3 fragments are elements from the appendicular skeleton. Since only cattle fragments have been documented, it can be assumed that those elements would correspond to this taxon. In the case of size 2 fragments, there is a predominance of fragments from the appendicular and axial skeleton (table 62).

The portions identified in this unit are waste elements of the quartering process whose meat yield is essentially nil. At best, this would reveal the unit which might have been used as a dump for waste.



**Fig. 89.** Profile of structure 24, level 29 at Ronda del Cenicero in Carmona. Adapted from Román Rodríguez (2011).

	NISP	%	MNI	%	Weight (g)	%
Identified	2	18.18	2	66.66	11.3	30.77
Unidentified	9	81.81	1	33.33	25.42	69.22
Total	11	100	3	100	36.72	100

**Table 60.** Results of the zooarchaeological analysis from level 29, structure 24 at Ronda del Cenicero in Carmona including NISP, MNI, and weight.

	NISP	%	MNI	%	Weight (g)	%	NISP Total/NISP taxon	NISP/MNI
Cattle	1	50	1	33.33	10.41	92.12	2	1
Lagomorpha	1	50	1	33.33	0.89	7.87	2	1
Total identified	2	100	2	66.66	11.3	100	0	1

**Table 61.** Results of the zooarchaeological analysis from the identified fragments from level 29, structure 24 at Ronda del Cenicero in Carmona including NISP, MNI, and weight.

	NISP	%	MNI	%	Weight (g)	%
Size 3	6	66.66			19.27	75.80
Size 2	3	33.33	1	33.33	6.15	24.19
Total unidentified	9	100	1	33.33	25.42	100

**Table 62.** Results of the zooarchaeological analysis from the unidentified fragments from level 29, structure 24 at Ronda del Cenicero in Carmona including NISP, MNI, and weight.

### Level 22

Level 22 is a soil layer of yellow colour and sandy texture located in the upper part and outer area of structure 24 (fig. 90). The upper part of the level is a thin, yellow clay layer with intrusions of middle and small-sized stones in the lower part. It had a maximum thickness of 0.15m. Sherds with Bell Beaker decoration, as well as lithic remains, adobe and burned seeds were recorded (Román Rodríguez 2011, 150).

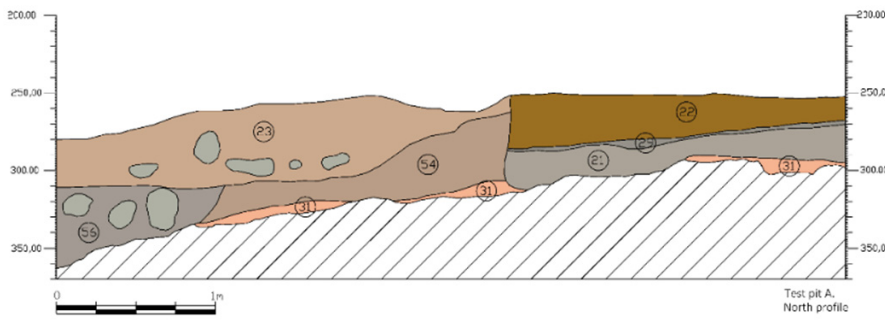
A total of 24 animal bones were documented (table 63). The proportion of unidentified remains

is quite high, the level of preservation in the assemblage is poor and fragmentation extensive.

Regarding unidentified fragments, the domestic fauna dominates the assemblage, with cattle

	NISP	%	Weight (g)	%
Identified	7	29.16	167.3	81.14
Unidentified	17	70.83	38.88	18.85
Total	24	100	206.18	100

**Table 63.** Results of the zooarchaeological analysis from level 22, structure 24 at Ronda del Cenicero in Carmona.



**Fig. 90.** Profile of structure 24, level 22 at Ronda del Cenicero in Carmona adapted from Román Rodríguez (2011).

	NISP	%NISP	MNI	%MNI	Weight (g)	%Weight
Cattle	3	42.85	1	33.33	145.68	87.07
Caprine	3	42.85	1	33.33	18.28	10.92
Dog	1	14.28	1	33.33	3.34	1.99
Total identified	7	100	3	100	167.3	100

**Table 64.** Results of the zooarchaeological analysis from the identified fragments from level 22, structure 24 at Ronda del Cenicero in Carmona including NISP, MNI, and weight.

constituting the main taxon and caprines taking second place, followed by a dog (table 64).

The unidentified fragments showed size 3 fragments to correspond with skull elements. Since only cattle have been documented, it is safe to assume that these correspond to this taxon. In the case of size 2 fragments, there is a predominance of fragments from the appendicular skeleton and a low proportion of elements from the axial skeleton (table 65).

Level 22 contributed two individuals. The adult bovid could have been used for traction and the production of secondary products of delayed consumption. In the case of the subadult goat its function would have been meat production but perhaps also hide or leather production. In terms of anatomical parts, there is a clear predominance of fore- and hindquarters in the case of bovids,

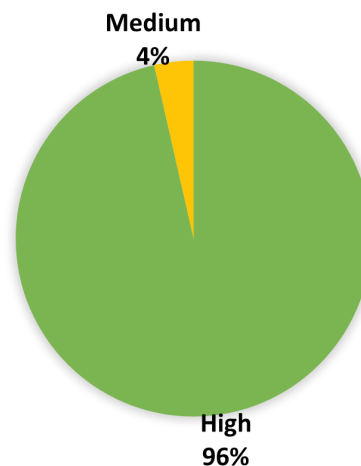
and a predominance of forequarters and axial skeleton in the case of caprines.

Based on the study of meat contributions in level 22, cattle contributed 89% of the edible meat and caprines only 11%. Cattle is represented by high meat yielding elements (92%) whereas in caprines 100% of the meat would derive from elements of medium yield (fig. 91).

In terms of meat supply, there is an almost monopolistic predominance of anatomical parts with elevated meat yield, mainly fore and hind limbs, as opposed to medium-yield ones.

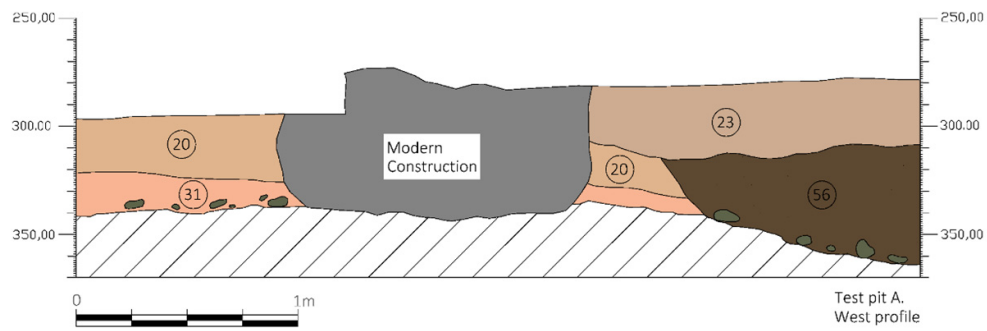
	NISP	%	Weight (g)	%
Size 3	8	47.06	22.11	56.86
Size 2	4	23.52	13.15	33.82
Unidentified	5	29.41	3.62	9.31
Total unidentified	17	100	38.88	100

**Table 65.** Results of the zooarchaeological analysis from unidentified fragments from level 22, structure 24 at Ronda del Cenicero in Carmona including NISP, MNI, and weight.



**Fig. 91.** Meat yield from level 22, structure 24 at Ronda del Cenicero, Carmona.

**Fig. 92.** Profile of structure 55, level 56 at Ronda del Cenicero in Carmona adapted from Román Rodríguez (2011).



**6.2.1.2 Structure 55**

Structure 55 is a negative basin type structure. This structure had a quadrangular perimeter that was partially documented because of its location on the N-E corner of test pit A. It had an oval-shaped plan, with a documented width of 0.90m and a maximum documented length of 1.10m. The structure had a U-shaped cross section, with a maximum depth of 0.50m (fig. 92). A single level, level 56, was documented in this structure. It is a level of brown, sandy soil of low consistency. Finds of material culture from this structure were scarce but faunal remains were recovered (Román Rodríguez in press, 157).

**Level 56**

Level 56 consists of compacted brown soil with a sandy texture and medium grain size. It has a maximum thickness of 50cm. The level features large intrusions of typical stones from the Alcor

unit, as well as fragments of adobes. Sherds, animal remains and two metal slags were found.

Fifteen bones were found, a high proportion of which is unidentified (table 66). The level of preservation is poor, exhibiting an intense fragmentation as well as evidence of weathering that could indicate a different origin for a part of the sample in this deposit.

Only domesticated animals were identified, with pigs being apparently more frequent than cattle (table 67).

Within the unidentified fragments only one bovid and one pig are documented, therefore, it is safe to assume that elements recorded as size 3 and size 2 are from these species (table 68). Size 3 fragments correspond to elements from the appendicular skeleton. In the case of size 2 fragments, there is a predominance of fragments from the appendicular skeleton.

Level 56 features two individuals. In the case of cattle, lack of data relative to sex and age does

	NISP	%	Weight (g)	%
Identified	4	26.66	21.57	30.40
Unidentified	11	73.33	49.38	69.59
Total	15	100	70.95	100

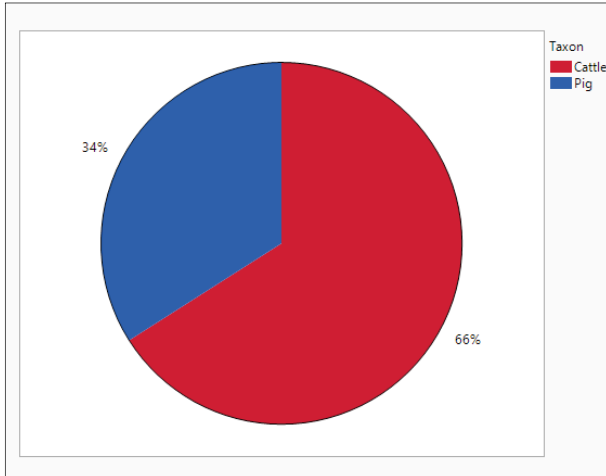
**Table 66.** Results of the zooarchaeological analysis from level 56, structure 24 at Ronda del Cenicero in Carmona.

	NISP	%	Weight (g)	%
Size 3	3	27.27	32.91	66.64
Size 2	8	72.72	16.47	33.35
Total unidentified	11	100	49.38	100

**Table 68.** Results of the zooarchaeological analysis from the unidentified fragments from level 56, structure 24 at Ronda del Cenicero in Carmona including NISP, MNI, and weight.

	NISP	%	MNI	%	Weight (g)	%
Cattle	1	25	1	50	14.32	66.38
Pig	3	75	1	50	7.25	33.62
Total identified	4	100	2	100	21.57	100

**Table 67.** Results of the zooarchaeological analysis from the identified fragments from level 56, structure 24 at Ronda del Cenicero in Carmona including NISP, MNI, and weight.



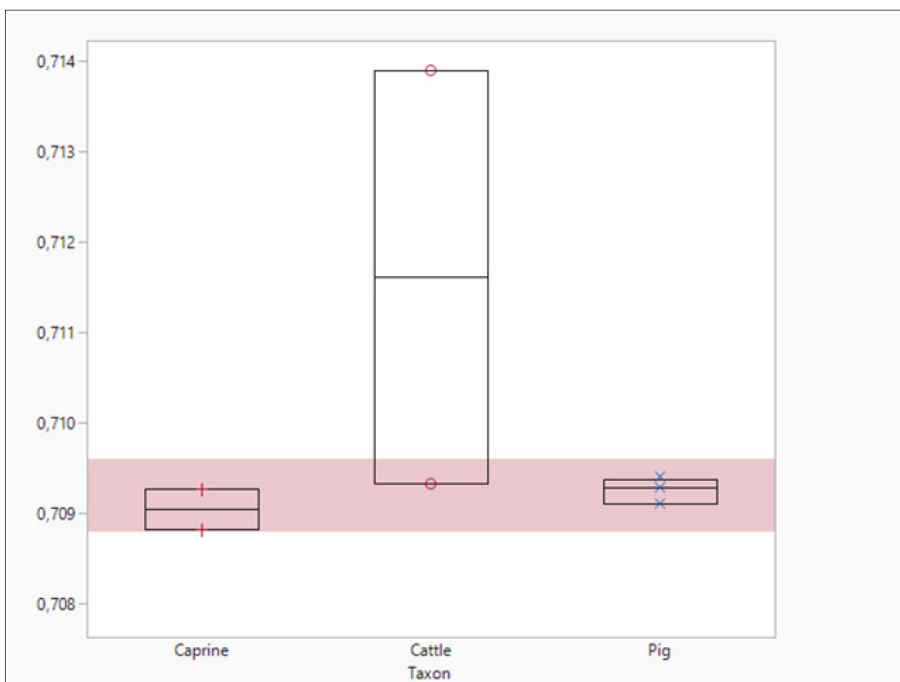
**Fig. 93.** Edible meat from level 56, structure 24 at Ronda del Cenicero in Carmona.

not allow any conclusions to be drawn regarding functions prior to slaughtering although meat supply appears to be the most sensible (*fig. 93*).

Anatomical parts correspond to waste products of the quartering process of practically nil meat yield. This suggests the deposit to have functioned as a rubbish disposal area.

## 6.2.2 Isotope Analyses from Carmona

A total of 59 samples of tooth enamel from six different individuals (MNI) were analysed for  $\delta^{18}\text{O}_c$  and  $^{87}\text{Sr}/^{86}\text{Sr}$  (three pigs and three cattle).



**Fig. 94.** Results of  $^{87}\text{Sr}/^{86}\text{Sr}$  from Ronda del Cenicero, Carmona.

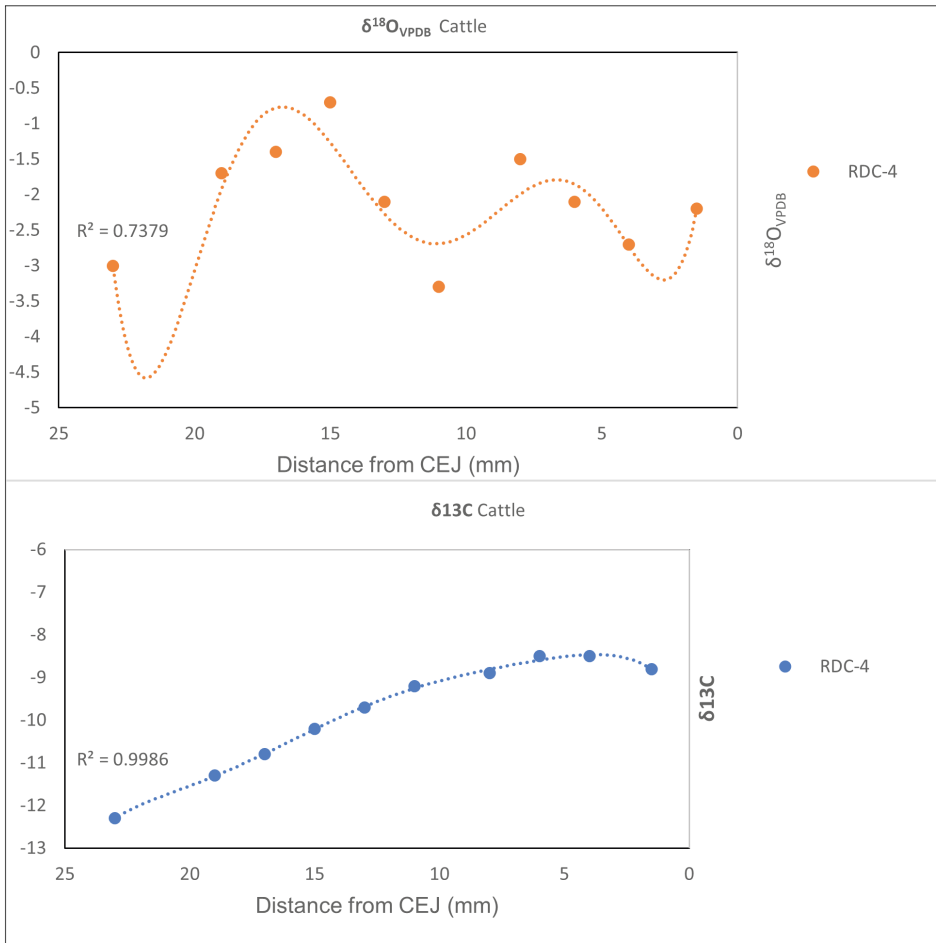
### 6.2.2.1 Mobility: Strontium ( $^{87}\text{Sr}/^{86}\text{Sr}$ )

The results from strontium isotope analyses for all the faunal remains ranged from 0.70881 to 0.71441 (*table A.5.1.2.1* in Appendix 5). According to the different analysis by species, caprines (n=4) provided a range from 0.70881 to 0.70941 (average =  $0.70911 \pm 0.0004$  ( $2\sigma$ )). Cattle (n=8) ranged from 0.70924 to 0.71441 (average =  $0.712945 \pm 0.004$  ( $2\sigma$ )). Six values, two for each tooth (RDC-7, RDC-8 and RDC-9) from the same individual, have shown an outlier signature (*fig. 94*). Disregarding these outliers, the local range for cattle from Carmona (n=2) oscillated from 0.70924 to 0.70932 (average =  $0.70928 \pm 11.3$  ( $2\sigma$ )). Pigs (n=3) ranged from 0.70910 to 0.7093 (average =  $0.70925 \pm 0.0002$  ( $2\sigma$ )).

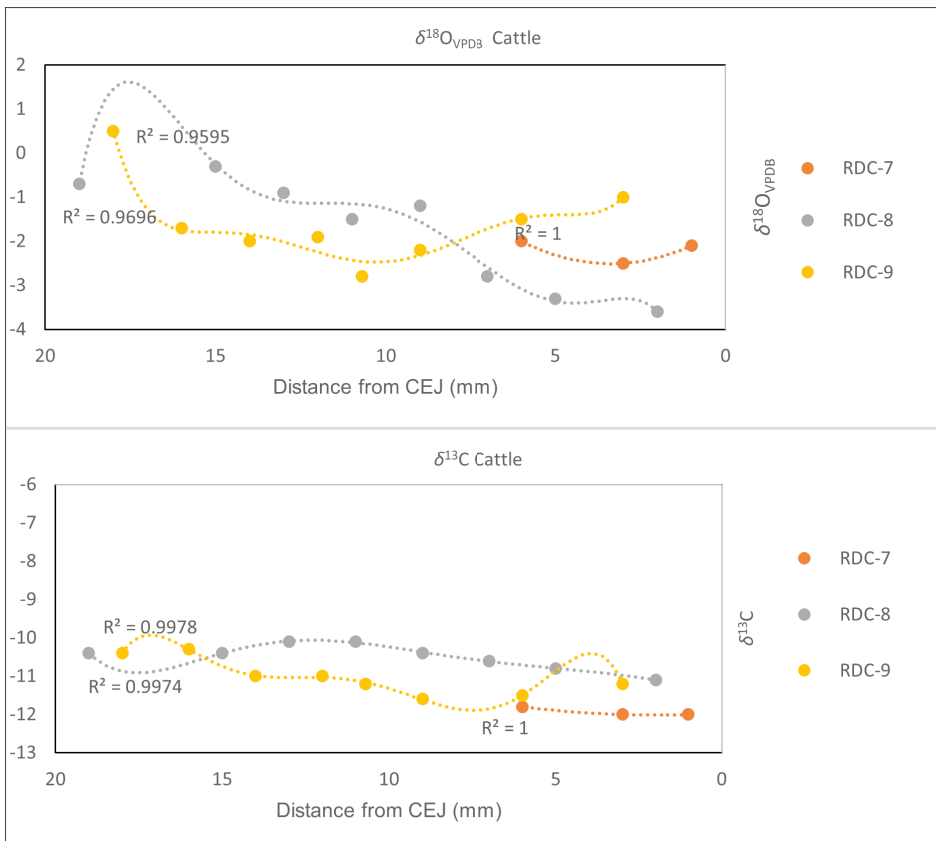
Disregarding outlier values, the local range from Carmona ranges from 0.70879 to 0.70959  $\pm 0.0003$  ( $2\sigma$ ) (*fig. 94*).

### 6.2.2.2 Oxygen ( $\delta^{18}\text{O}_{ap}$ ) and Carbon ( $\delta^{13}\text{C}_{ap}$ )

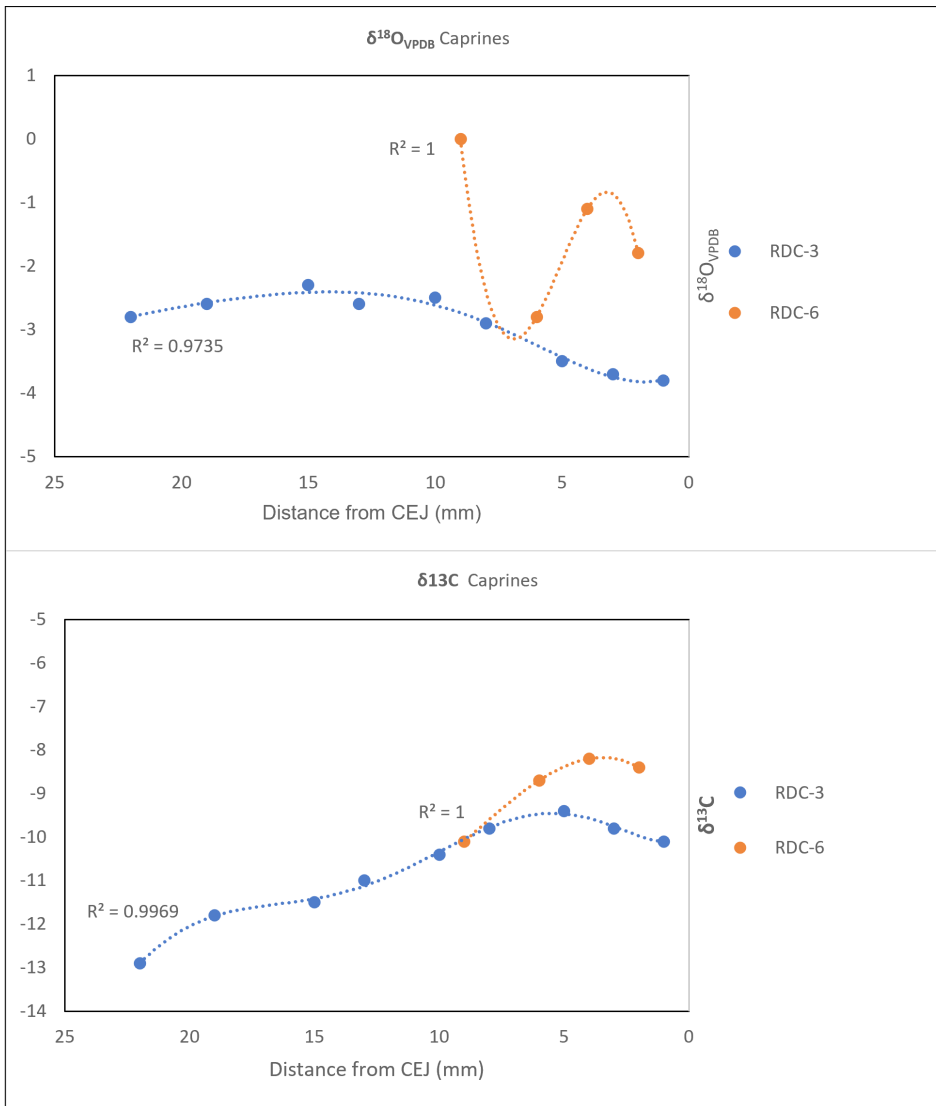
A total of 44 enamel samples were analysed. In the case of cattle, an intra-tooth sampling was performed. Results are plotted from the occlusal part of the tooth crown to the cement-enamel junction (CEJ) following a time series. Samples 4 and 6 belong to individual 3 (*fig. 95*), while samples RDC-7, 8 and 9 belong to individual 4 (*fig. 96*) (*table A.5.1.2.1* in appendix 5).



**Fig. 95.**  $\delta^{18}O$  (up) and  $\delta^{13}C$  (below) values for local bovid from Carmona.



**Fig. 96.**  $\delta^{18}O$  (up) and  $\delta^{13}C$  (below) values for outlier bovid from Carmona.



**Fig. 97.** δ<sup>18</sup>O (up) and δ<sup>13</sup>C (below) values for caprines from Carmona.

In terms of groups, caprines δ<sup>18</sup>O<sub>VPDB</sub> (n=13) ranged from -3.8‰ to 0‰. Local range for caprines was established between -3.53‰ and -1.45‰ (average: -2.49‰ ± 1.04‰ (1σ)). Pig values (n=2) range from -4.2‰ to -3‰ (local range: -4.44‰ to -2.76‰; average: -3.6‰ ± 0.84‰ (1σ)). For cattle δ<sup>18</sup>O<sub>VPDB</sub> values (n=29) range from -3.6‰ to 0.5‰. Excluding samples RDC-7, RDC-8 and RDC-9, which have non-local values according to <sup>87</sup>Sr/<sup>86</sup>Sr values, the local range for cattle (n=10) was established between -2.85‰ and -1.29‰ (average: -2.07‰ ± 0.78 (1σ)) (fig. 95, 96).

Based on the mean of all the local animals (n=25) the range of δ<sup>18</sup>O<sub>ap</sub> values at Carmona are between -3.4‰ to -1.42‰ (average: -2.41‰ ± 0.99 (1σ)).

For cattle, sample RDC-4, RDC 7, 8, and 9 (n=29) range from -12.3‰ to -8.5‰ (mean= -10.55‰

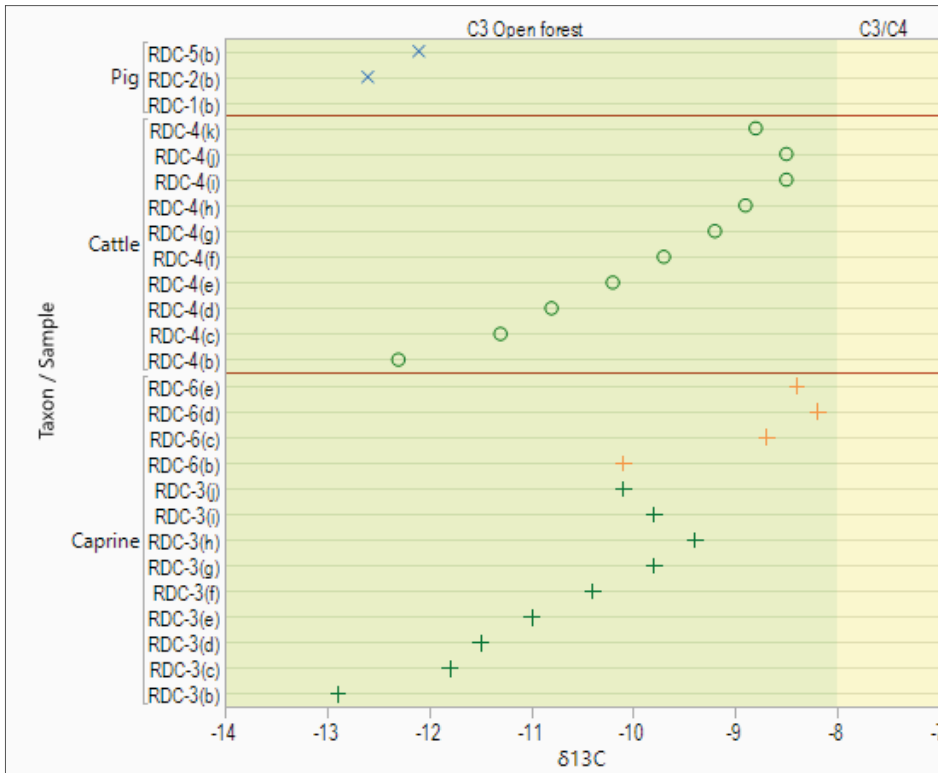
± 1.04‰ (1σ)). In the case of RDC-7, RDC-8 and RDC-9, samples belong to the same individual that had outlying <sup>87</sup>Sr/<sup>86</sup>Sr values. Its δ<sup>13</sup>C<sub>ap</sub> (n=19) ranged from -12‰ to -10.1‰ (mean= -10.94‰ ± 0.62‰ (1σ)). The δ<sup>13</sup>C<sub>ap</sub> tooth enamel range of mean values for local cattle (n=10) is established from -11.12‰ to -8.52‰ (mean= -9.82‰ ± 1.30‰ (1σ)). For caprines, sample RDC-3 and RDC-6 (n=13) ranged from -12.9‰ to -8.2‰. Local range for caprines was established between -11.53‰ and -8.79‰ (average= -10.16‰ ± 1.37‰ (1σ)). In the case of the pigs, the local range of δ<sup>13</sup>C<sub>ap</sub> tooth enamel mean values (n=2) ranges from -12.7‰ to -12‰ (mean= -12.35‰ ± 0.35‰ (1σ)).

Based on the mean of all the local animals (n=25) the range for δ<sup>13</sup>C<sub>ap</sub> at Carmona is between -11.62‰ to -8.78‰ (average= -10.2‰ ± 1.42 (1σ)) (fig. 97).

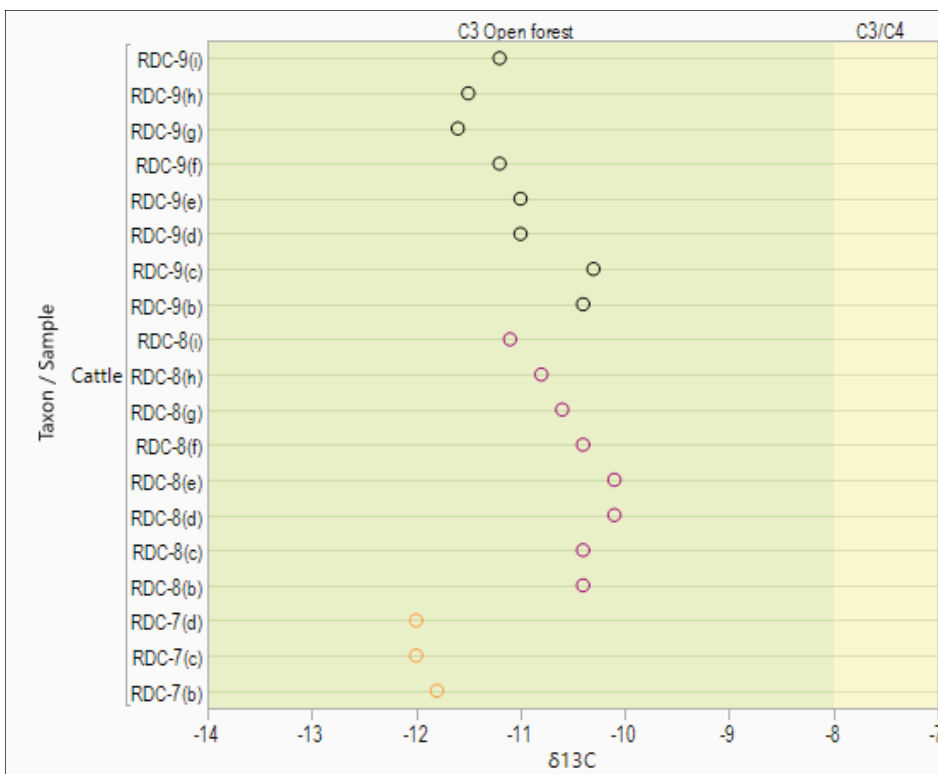
In the case of RDC-3 and RDC-6 (caprines) and RDC-4 (bovid), a change in diet with a predominant consumption of C<sub>3</sub> plants during the initial stages of dental mineralisation and a trend towards consumption of C<sub>3</sub>/C<sub>4</sub> plants in the final moments of mineralisation, possibly due to seasonality, was observed.

For pigs there is a clear predominance of consumption of C<sub>3</sub> plants from open areas (*fig. 98*).

Samples with non-local strontium isotope signatures (i.e. RDC-7, RDC-8 and RDC-9) probably derive from the same individual who had a mixed consumption of C<sub>3</sub> plants from open areas (*fig. 99*).



**Fig. 98.** δ<sup>13</sup>C values from pig, caprines and cattle at Ronda del Cenicero in Carmona.



**Fig. 99.** δ<sup>13</sup>C values from outlier cattle at Ronda del Cenicero in Carmona.

### 6.3 Valencina-Castilleja

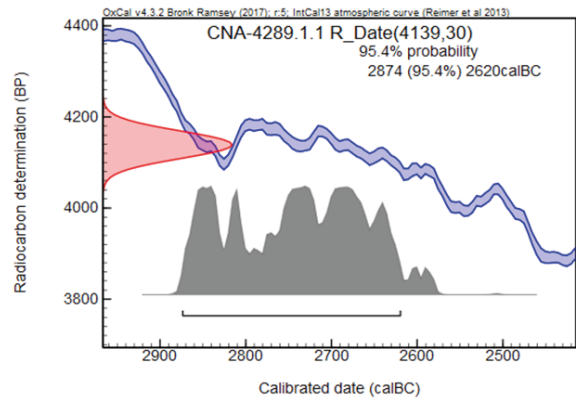
#### 6.3.1 Zooarchaeological Analyses at Valencina-Castilleja

A multitude of structures of different types from the Copper Age were documented at Pabellón Cubierto, of which structures 115 and 116 have been completely analysed. Two layers related to structures 115 and 116 were analysed also (level 143, 144).

Radiocarbon dating has provided a time frame that spans the entire 3<sup>rd</sup> mill. BC (*fig. 100*).

##### 6.3.1.1 Level 144

Level 144 is in the northern half of test pit 1 and is associated with the outer levels of structure 115. With a maximum thickness of 48cm, level 144 corresponds to a compacted medium-dark brown soil level of clayey texture and medium to fine grain size that incorporates calcium detritus as well as small fragments of charcoal intrusions. The cultural features include Bell Beaker sherds, a perforated slate plate, a knife fragment and flint flakes, metallic slag fragments, and a ceramic textile weight. According to the excavators, it was a formation created over a long period of time with rather eroded materials due to dragging from more elevated zones of the Cerro de la Cruz (Ortega Gordillo 2011a).



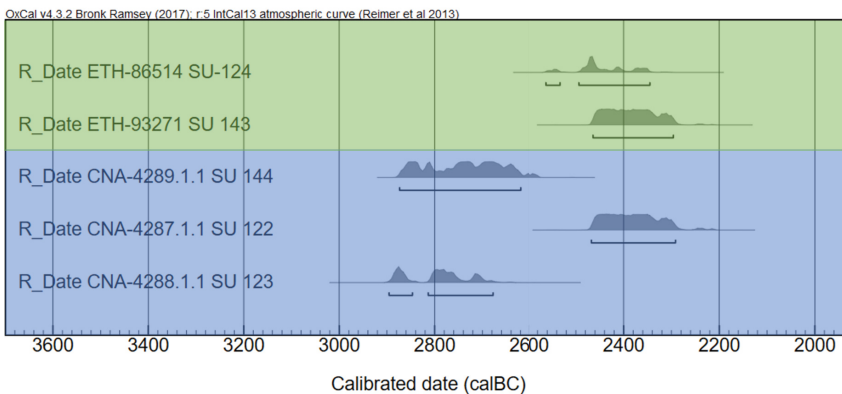
**Fig. 101.** Radiocarbon dating from level 144, structure 115 at Pabellón Cubierto in Valencina-Castilleja.

One bone sample was analysed for radiocarbon dating (*table 69; fig. 101*), which provided an absolute chronology of 4139±30 BP (2874–2620 calBC), dating the level to the first half of the 3<sup>rd</sup> mill. BC.

The faunal assemblage totals 524 bones (*table 70*). Most specimens remain unidentified. Preservation is poor as they exhibit a high level of fragmentation.

Domestic fauna dominates with pigs constituting the main taxon, and cattle taking second place, followed by caprines (*table 71*).

The analysis suggests that the faunal remains represent consumption. In the case of caprines, there is an absolute predominance of the forequarters compared to the small proportion of other anatomical parts, suggesting that only selected parts



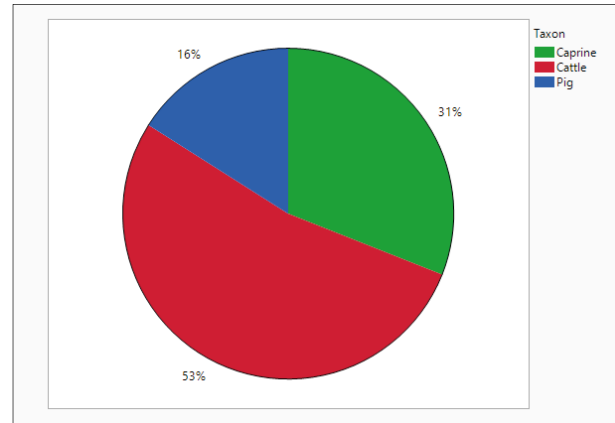
**Fig. 100.** Radiocarbon dates from Pabellón Cubierto at Valencina-Castilleja.

Sample	Lab-Id	Taxon	Element	BP	Cal 2σ BC
VA-3	CNA-4289.1.1	Size 2	Long bone	4139±30	2874–2620

**Table 69.** Radiocarbon dating from level 144, structure 115 at Pabellón Cubierto in Valencina-Castilleja.

	NISP	%	Weight (g)	%
Identified	45	8.58	162.1	28.64
Unidentified	479	91.41	403.88	71.35
Total	524	100	565.98	100

**Table 70.** Results of the zooarchaeological analysis from level 144, structure 115 at Pabellón Cubierto in Valencina-Castilleja.



**Fig. 102.** Edible meat from level 144, structure 115 at Pabellón Cubierto in Valencina-Castilleja.

Taxon	NISP	%	MNI	%	Weight (g)	%	NISP/MNI
Cattle	15	33.33	1	20	79.8	49.22	15
Pig	17	37.77	1	20	38.4	23.68	23.68
Caprine	7	15.55	2	40	42.2	26.03	8
Sheep	1	2.22					
Total domestic	40	88.88	4	80	160.04	98.72	13.33
Hare	5	11.11	1	20	1.7	1.04	5
Total wild	5	11.11	1	20	1.7	1.04	5
Total identified	45	100	5	100	162.1	100	11.25

**Table 71.** Results of the zooarchaeological analysis from level 144, structure 115 at Pabellón Cubierto in Valencina-Castilleja.

Taxon	Cranial	Axial	Forelimb	Hindlimb	Foot	Total	%
Cattle	0.07	0.019	-	0.177	0.18	0.447	53.34%
Caprine	-	-	0.094	0.16	-	0.255	30.42%
Pig	0.013	-	0.114	-	0.008	0.136	16.22%
Total	0.083	0.019	0.208	0.337	0.188	0.838	100

**Table 72.** Meat contribution of the three main livestock level 144.

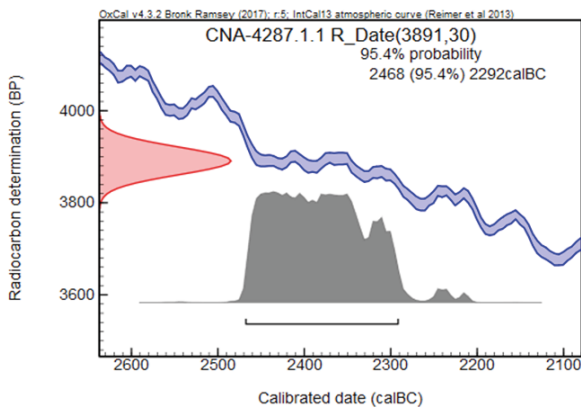
arrived at the place of consumption from the place where quartering took place. As with goats and sheep, in the case of pigs the proportions of the skeletal parts seem to indicate a selection of the parts with the highest meat yields, such as the fore

limbs, hind limbs and the skull. The remaining elements would have been abandoned at the quartering site (*table 72*).

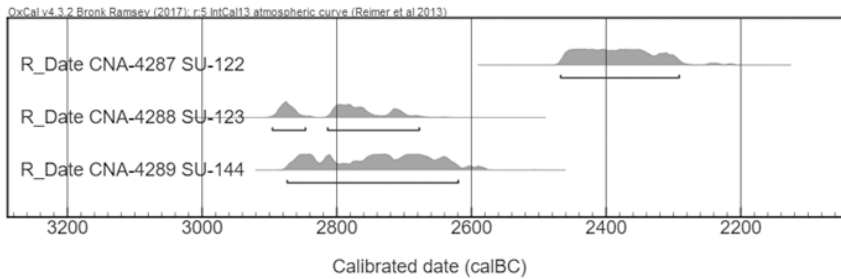
Cattle provided the highest proportion of edible meat followed by caprines and pigs (*fig. 102*).

**6.3.1.2 Structure 115**

Radiocarbon dating indicates structure 115 came into use by the beginning of the 3<sup>rd</sup> mill. BC. Level 144, associated with this structure, also presents a date in the first half of the 3<sup>rd</sup> mill. BC. The infilling of the structure by level 122 would have occurred in the second half the 3<sup>rd</sup> mill. BC. (*fig. 103*).



**Fig. 104.** Radiocarbon date from level 122, structure 115 at Pabellón Cubierto in Valencina-Castilleja.



**Fig. 103.** Radiocarbon dates from structure 115.

Sample	Lab-Id	Taxon	Element	BP	Cal 2σ BC
VA-1	CNA-4287.1.1	Size 2	Long bone	3891±30	2468–2292

**Table 73.** Radiocarbon date from level 122, structure 115 at Pabellón Cubierto in Valencina-Castilleja.

Taxon	NISP	%	MNI	%	Weight (g)	%
Cattle	3	42.85	1	33.33	7.06	32
Caprine	3	42.85	1	33.33	10.3	46.6
Pig	1	14.28	1	33.33	4.7	21.30
Total identified	7	100	3	100	22.06	100

**Table 74.** Results of the zooarchaeological analysis from level 122, structure 115 at Pabellón Cubierto in Valencina-Castilleja.

**Level 122**

Level 122 is a soil layer filling the upper part of structure 115 with a maximum thickness of 20cm. This level corresponds to a vegetal brown soil level of lime-sandy texture, medium compaction and medium-fine grain size. It incorporates small calcium detritus intrusions. Cultural features include sherds, of which four show Bell Beaker elements bearing marks that suggests they rolled down from higher areas. Lithics, animal remains, shells, and adobes are documented as well (Ortega Gorrillo 2011a).

One bone sample was used for radiocarbon dating (*table 73; fig. 104*). This provided an absolute date of 3891±30 BP (2468–2292 calBC), dating the level to the second half of the 3<sup>rd</sup> mill. BC.

The faunal assemblage of this level totals 71 bones. The proportion of unidentified remains is quite high. Preservation is poor as most specimens exhibit a high level of fragmentation. Regarding the identified fragments, domestic fauna dominates, with caprines constituting the main taxon and cattle taking second place, followed by pigs (*table 74*).

Size	NISP	%	Weight (g)	%
Size 2	16	25	33.9	43.51
Unidentified	48	75	44	56.48
Total unidentified	64	100	77.9	100

**Table 75.** Results of the zooarchaeological analysis from level 122, structure 115 at Pabellón Cubierto in Valencina-Castilleja including NISP, and weight.

Unidentifiable fragments to which not even size could be assigned constitute the most frequent category. Fragments identified as size 2 are from an appendicular skeleton (*table 75*).

**Level 123**

Level 123 is located at the base of structure 115, below level 122. With a maximum thickness of 62cm, level 123 corresponds to a dark brown soil level of lime-sandy texture, medium-fine grain size and low compaction. It incorporates a high quantity of calcium detritus. The cultural features include Bell Beaker pottery whose surface marks suggest they would have rolled downhill. Lithics, bones and shell remains, in addition to adobes, were also documented (Ortega Gordillo 2011a). One bone was radiocarbon dated, providing an absolute date of 4204±30 ANE (2896–2679 calBC) that coincides with the first half of the 3<sup>rd</sup> mill. BC. (*table 76; fig. 105*).

The zooarchaeological analyses showed a total of 2967 bones. The proportion of unidentified remains is quite high (*table 77*). Preservation is poor.

Domestic fauna dominates the assemblage in which pig constitutes the main taxon and caprines take second place, followed by cattle (*table 78*).

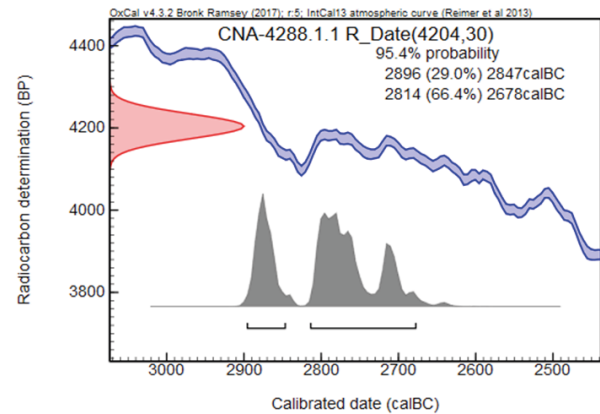
Size 3 remains mostly correspond to the appendicular skeleton with a low proportion of cranial and axial fragments. In the case of size 2 fragments there is also a predominance of fragments from the appendicular skeleton followed by those from the axial and cranial skeleton (*table 79*).

Sample	Lab-Id	Taxon	Element	BP	Cal 2σ BC
VA-2	CNA-4288.1.1	Pig	Rib	4204±30	2896–2679

**Table 76.** Radiocarbon date from level 123, structure 115 at Pabellón Cubierto in Valencina-Castilleja.

	NISP	%	Weight (g)	%
Identified	430	14.49	2680.18	43.53
Unidentified	2537	85.50	3475.54	56.46
Total	2967	100	6155.72	100

**Table 77.** Results of the zooarchaeological analysis from level 123, structure 115 at Pabellón Cubierto in Valencina-Castilleja.



**Fig. 105.** Radiocarbon date from level 123, structure 115 at Pabellón Cubierto in Valencina-Castilleja.

**6.3.1.3 Level 143**

Level 143 is located in the southern half of test pit 1 and is linked to structure 116. With a maximum thickness of 25cm level 143 consists of dark brown soil of silty-sandy texture and medium compaction, which incorporates small coal intrusions (Ortega Gordillo 2011a).

Two bone samples were radiocarbon dated (*table 80; fig. 106*). Sample VA-8 provided no results due to poor collagen preservation while sample VAL-402, provided an absolute date of 3889 ± 25 BP (2463–2295 calBC) placing the level in the second half of the 3<sup>rd</sup> mill. BC.

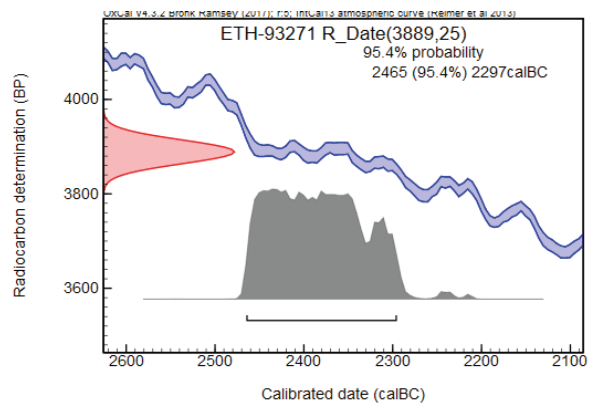
There were 210 bones. The proportion of unidentified remains is high (*table 81*). The level of preservation is poor.

Species	NISP	%	MNI	%	Weight (g)	%
Cattle	49	11.42	2	11.76	636.17	23.74
Caprine	120	27.97	5	29.41	558.24	20.83
Pig	225	52.44	5	29.41	1426.54	53.24
Dog	6	1.39	1	5.88	14.9	0.55
Total domestic	400	93.24	13	76.47	2635.85	98.38
Red deer	2	0.46	1	5.88	29.7	1.10
Hare	14	3.26	1	5.88	7.83	0.29
Rabbit	8	1.86	2	11.76	4.8	0.17
Lagomorpha	5	1.16	-		1	0.03
Total wild	29	6.75	4	23.52	43.33	1.61
Total identified	429	100	17	100	2679.18	100
Bird	1		1		1	

**Table 78.** Results of the zooarchaeological analysis from level 123, structure 115 at Pabellón Cubierto in Valencina-Castilleja including NISP, MNI, and weight.

	NISP	%	Weight (g)	%
Size 3	70	2.75	670.23	19.28
Size 2	548	21.60	954.58	27.46
Unidentified	1919	75.64	1850.73	53.25
Total unidentified	2537	100	3475.54	100

**Table 79.** Results of the zooarchaeological analysis from level 123, structure 115 at Pabellón Cubierto in Valencina-Castilleja including NISP, and weight.



**Fig. 106.** Radiocarbon date from level 143, structure 116 at Pabellón Cubierto in Valencina-Castilleja.

Sample	Lab-Id	Taxon	Element	BP	Cal 2σ BC
VA-8	CNA	Pig	Tibia	Negative	-
VAL-402	ETH-93271	Cattle	Mandible	3889 ± 25	2463–2295

**Table 80.** Radiocarbon dates from level 143, structure 115 at Pabellón Cubierto in Valencina-Castilleja.

	NISP	%	Weight (g)	%
Identified	40	19.05	465.84	55.63
Unidentified	170	80.95	371.52	44.37
Total	210	100	837.36	100

**Table 81.** Results of the zooarchaeological analysis from level 123, structure 115 at Pabellón Cubierto in Valencina-Castilleja including NISP, and weight.

Domestic fauna dominates, with pigs constituting the main taxon and caprines taking second place, followed by cattle (*table 82*).

The analysis of the unidentified fragments showed that size 3 fragments correspond to the axial skeleton. Since only cattle and deer have been documented, one can assume, given the very different proportions of cattle and deer, that most

Taxon	NISP	%	MNI	%	Weight (g)	%
Cattle	6	15	1	12.5	233.8	50.18
Pig	19	47.5	2	25	179.04	38.43
Caprine	11	27.5	2	25	32.9	7.06
Total domestic	36	90	5	62.5	445.74	95.68
Red deer	2	5	1	12.5	18.3	3.92
Lagomorpha	2	5	2	25	1.8	0.38
Total wild	4	10	3	37.5	20.1	4.31
Total	40	100	8	100	465.84	100

**Table 82.** Results of the zooarchaeological analysis from level 143, structure 115 at Pabellón Cubierto in Valencina-Castilleja including NISP, MNI, and weight.

	NISP	%	Weight (g)	%
Size 3	10	5.89	19.22	5.17
Size 2	160	94.11	352.3	94.83
Total unidentified	170	100	371.52	100

**Table 83.** Results of the zooarchaeological analysis from level 143, structure 115 at Pabellón Cubierto in Valencina-Castilleja including NISP, and weight.

	NISP	%	Weight (g)	%
Identified	27	8.70	301.17	46.27
Unidentified	283	91.29	349.61	53.72
Total	310	100	650.78	100

**Table 84.** Results of the zooarchaeological analysis from level 121, structure 116 at Pabellón Cubierto in Valencina-Castilleja including NISP, and weight.

elements represent cattle. In the case of size 2 fragments there is a predominance of fragments from the appendicular skeleton and a low proportion of elements from the axial and cranial skeleton (*table 83*).

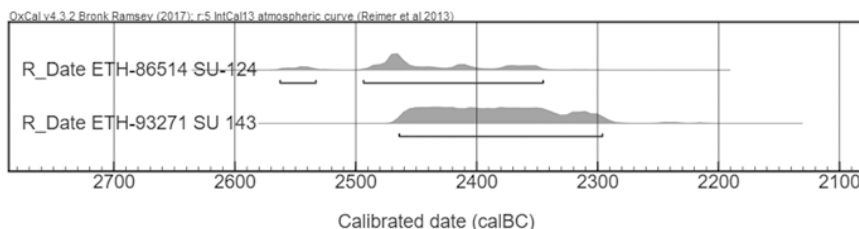
#### 6.3.1.4 Structure 116

As with structure 115, the radiocarbon data of structure 116 indicate a date in the second half of the 3<sup>rd</sup> mill. BC. for the construction of this structure as well as level 143 (*fig. 107*).

#### Level 121

Level 121 is a soil layer filling the upper part of structure 115. It has a maximum thickness of 27cm and is a greyish-brown soil level of silty-sandy texture, medium compaction and medium-fine grain size. It incorporates calcium detritus as well as small fragments of coal intrusions. The cultural features include potsherds, of which 19 Bell Beaker fragments bearing marks suggesting downslope rolling. Lithics, animal remains, shells and adobes are also documented (Ortega Gordillo 2011a).

One bone sample was analysed for radiocarbon dating (sample VA-4: a long bone from a size 2



**Fig. 107.** Radiocarbon dates from structure 116.

Species	NISP	%	MNI	%	Weight (g)	%
Cattle	5	18.51	1	20	156.6	51.99
Caprine	9	33.33	1	20	72.57	24.09
Pig	10	37.03	1	20	66.8	22.18
Total domestic	24	88.88	3	60	295.97	98.27
Red deer	2	7.4	1	20	3.9	1.29
Hare	1	3.7	1	20	1.3	0.43
Total wild	3	11.11	2	40	5.2	1.72
Total	27	100	5	100	301.17	100

**Table 85.** Results of the zooarchaeological analysis from level 121, structure 116 at Pabellón Cubierto in Valencina-Castilleja including NISP, MNI, and weight.

animal). Due to poor collagen preservation it was not possible to date this element.

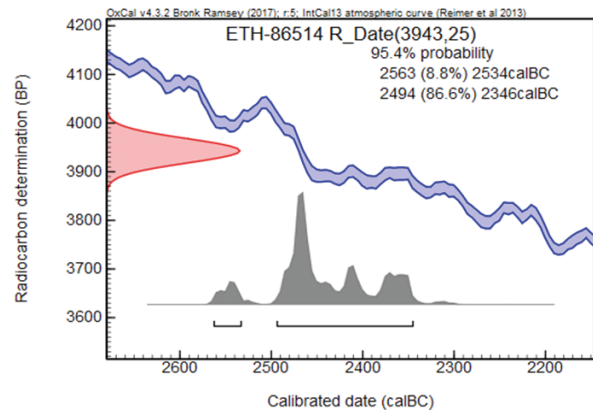
The zooarchaeological analysis yielded a total of 310 bones. The proportion of unidentified remains is high, taking into account that most were assigned to unidentified categories (*table 84*). The level of preservation is poor.

Identified fragments are dominated by domestic faunas, with pigs constituting the main taxon and caprines taking second place, followed by cattle (*table 85*).

#### Level 124

With an average depth of 34cm, level 124 is located at the base of structure 116 and under level 121. With a maximum thickness of 34cm, it corresponds to a dark brown soil level of silty-sandy texture, medium-fine grain size and low compaction. It incorporates calcium detritus in a lower proportion than in level 121. Cultural features include sherds, of which 69 are Bell Beaker fragments bearing rolling marks. Lithics, animal remains, shells, metal slag and adobes are also documented (Ortega Gordillo 2011a).

Two bone samples were radiocarbon dated (*table 86*; *fig. 108*). Sample VA-5 provided a negative result due to poor collagen preservation, but



**Fig. 108.** Radiocarbon date from level 124, structure 116 at Pabellón Cubierto in Valencina-Castilleja.

Sample VAL-408 provided a date of 3943±25 BP (2563–2346 calBC), dating the level to the second half of the 3<sup>rd</sup> mill. BC.

There were 735 bones. The proportion of unidentified remains is high (*table 87*). The level of preservation is poor.

Domestic fauna dominates the assemblage, with pigs constituting the main taxon and caprines taking second place, followed by cattle (*table 89*).

With the unidentified fragments, size 3 fragments are mostly those from the axial skeleton,

Sample	Lab-Id	Taxon	Element	BP	Cal 2σ BC
VA-5	CNA	Size 2	Rib	Negative	
VAL-408	ETH-86514	Pig	Metatarsal III	3943 ± 25	2563–2346

**Table 86.** Radiocarbon dating from level 124, structure 116 at Pabellón Cubierto in Valencina-Castilleja.

	NISP	%	Weight (g)	%
Identified	141	19.19	1614.63	58.99
Unidentified	594	80.81	1122.71	41.01
Total	735	100	2737.34	100

**Table 87.** Results of the zooarchaeological analysis from level 124, structure 116 at Pabellón Cubierto in Valencina-Castilleja.

	NISP	%	Weight (g)	%
Size 3	27	4.55	221.03	19.68
Size 2	567	95.45	901.68	80.32
Total unidentified	594	100	1122.71	100

**Table 88.** Results of the zooarchaeological analysis from level 124, structure 116 at Pabellón Cubierto in Valencina-Castilleja including NISP, and weight.

Taxon	NISP	%	MNI	%	Weight (g)	%
Cattle	25	17.48	2	11.76	742.22	45.96
Caprine	50	35.66	7	41.17	373.45	23.12
Sheep	1					
Pig	58	40.55	4	23.52	451.88	27.98
Dog	1	0.69	1	5.88	3.98	0.24
Total domestic	135	94.40	14	82.35	1571.53	97.33
Wild boar	1	0.69	1	5.88	14.5	0.89
Red deer	2	1.39	1	5.88	25.1	1.55
Hare	5	3.49	1	5.88	3.5	0.21
Total wild	8	5.59	3	17.64	43.1	2.66
Total identified	143	100	17	100	1614.63	100

**Table 89.** Results of the zooarchaeological analysis from level 124, structure 116 at Pabellón Cubierto in Valencina-Castilleja including NISP, MNI, and weight.

followed by the appendicular and cranial skeleton. Since only cattle and deer have been documented, it can be assumed that size 3 elements correspond to cattle given its far higher frequency when compared to deer. In the case of size 2 fragments, there is a predominance of those from the appendicular skeleton and a low proportion of elements from the axial and cranial skeleton (*table 88*).

### 6.3.2 Isotope Analyses from Valencina-Castilleja

#### 6.3.2.1 Mobility: Strontium ( $^{87}\text{Sr}/^{86}\text{Sr}$ )

A total of 84 samples were analysed for  $^{87}\text{Sr}/^{86}\text{Sr}$  (*table A.5.1.3.a* in appendix 5). This was made up of 32 cattle (MNI= 18), 24 caprines (MNI= 16), 23 pigs (MNI= 23), and two dogs (MNI= 2).

From caprines and cattle a maximum of three samples from each tooth (occlusal, central part

and cement-enamel junction) were taken whenever possible (*table A.5.1.3* in appendix 5).

Strontium values of the analysed samples range from 0.70823 to 0.71687. In terms of groups, cattle values range from 0.70871 to 0.71687 (n=32). Three values, two of them from the same teeth (PA-41 and sample VAL-506), have shown an outlier signature: PA-41b (0.71687  $\pm$  0,00003 (1 $\sigma$ )); PA-41k (0.71607  $\pm$  0,00001 (1 $\sigma$ )); and VAL-506 (0,71226  $\pm$  0,00001 (1 $\sigma$ )). Disregarding these outliers, the local cattle from Valencina-Castilleja (n=29) ranges from 0.70849 to 0.71009 (average= 0.70929  $\pm$  0.0008; (2 $\sigma$ )).

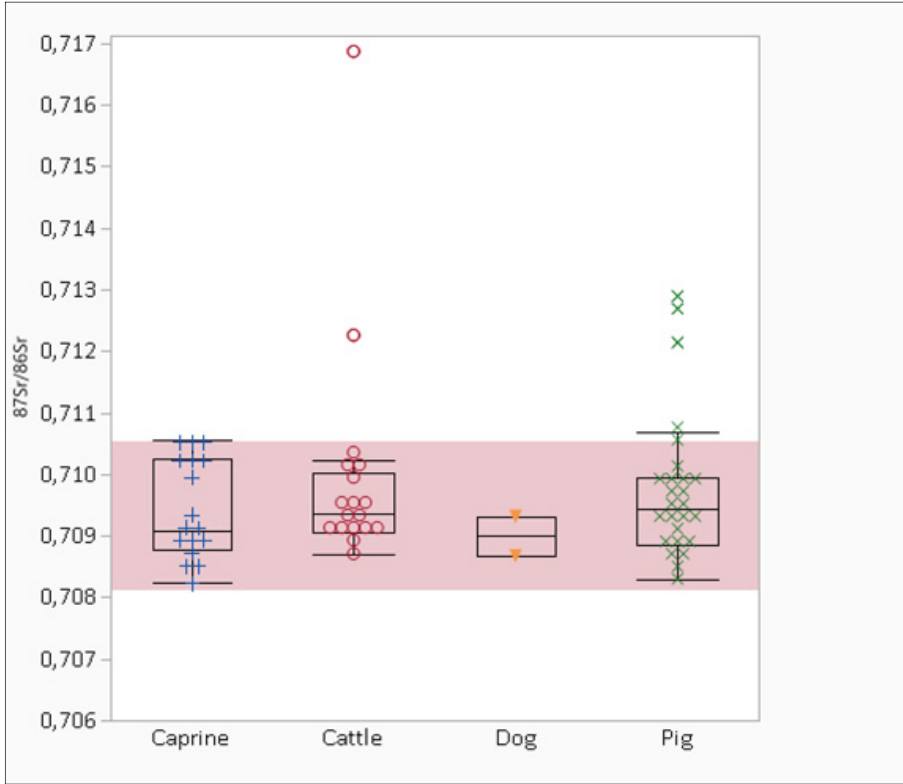
Caprines showed a range from 0.70823 to 0.71056 (n=24). The local range for them is established between 0.70967 and 0.71076 (average= 0.70936  $\pm$  0.0014 (2 $\sigma$ )).

Pigs ranged from 0.7083 to 0.71289 (n=26). Three samples exhibit outlier values: VAL 102 (0.71289  $\pm$  0.00002 (1 $\sigma$ )); VAL-450 (0.71269  $\pm$  0.00001 (1 $\sigma$ )) and VAL-453 (0.71214  $\pm$  0.00002 (1 $\sigma$ )). Disregarding outliers, the local range for pigs

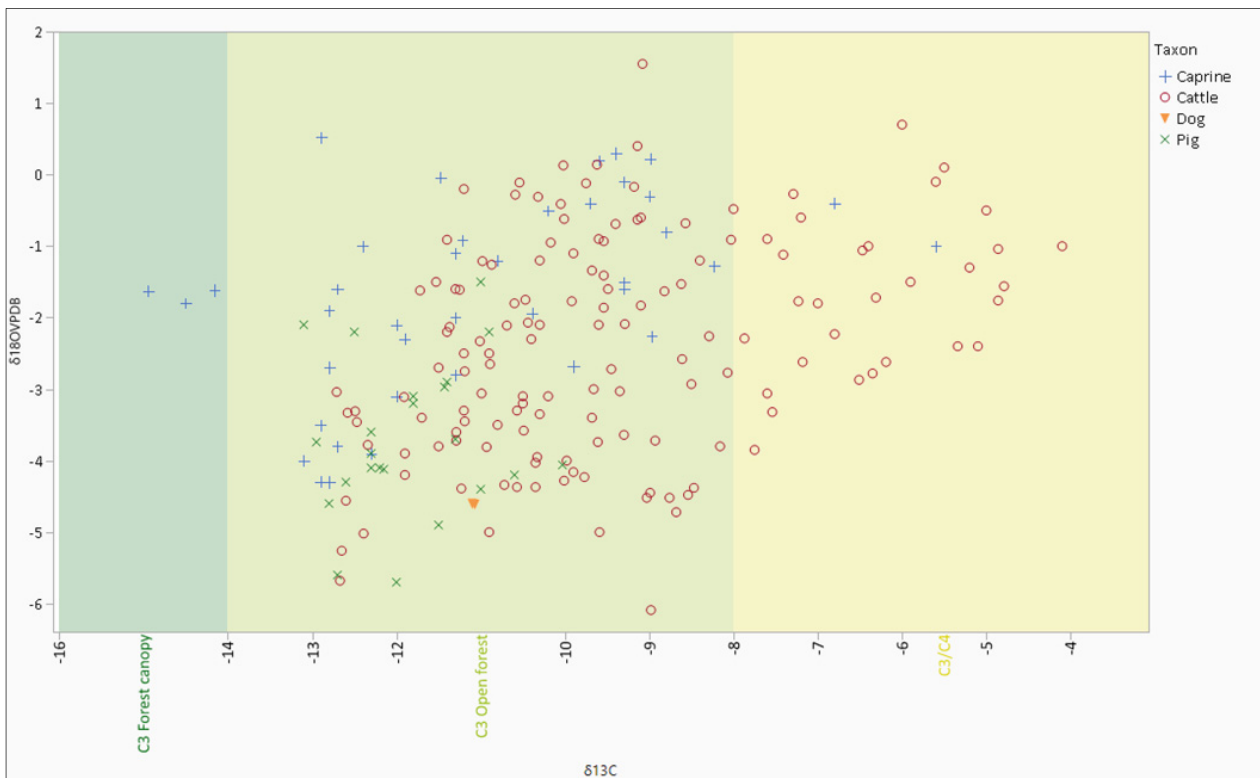
(n=23) is from 0.70814 to 0.71054 (average= 0.70934 ± 0.0012 (2σ)).

The two dogs analysed ranged from 0.70868 to 0.70932. Local range (n=2) is between 0.7082 and 0.7098 (average= 0.7090 ± 0.0008 (2σ)).

If the outlying values (n=78) are excluded, the combination of all isotopic values in Valencia-Castilleja is established between 0.70812 and 0.71052 (average= 0.70932 ± 0.0012 (2σ)) (fig. 109).



**Fig. 109.**  $^{87}\text{Sr}/^{86}\text{Sr}$  values from all species, in red rectangle the estimated local baseline in Valencia-Castilleja.



**Fig. 110.**  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}_{\text{Cap}}$  results by species in Valencia-Castilleja.

### 6.3.2.2 Oxygen ( $\delta^{18}\text{O}_{\text{ap}}$ ) and Carbon ( $\delta^{13}\text{C}_{\text{ap}}$ )

212 tooth samples were analysed for  $\delta^{18}\text{O}_{\text{ap}}$  and  $\delta^{13}\text{C}_{\text{ap}}$ , of which 194 were enamel, nine were cementum and nine were dentine samples. In the case of six caprines and twelve cattle an intra-tooth sampling was performed. Results are plotted from the occlusal part of the tooth crown to the cement-enamel junction (CEJ) following a time series (*table A.5.1.3.a* in appendix 5).

The total  $\delta^{18}\text{O}_{\text{VPDB}}$  tooth enamel range for caprines (n=43) goes from -4.3‰ to 0.52‰. The total local range based on the mean values for caprines is from -3‰ to -0.24‰ (mean = -1.62‰  $\pm$  1.38‰ (1 $\sigma$ )).

According to  $\delta^{18}\text{O}_{\text{VPDB}}$  values, the total range of values for cattle (n=125) of  $\delta^{18}\text{O}_{\text{VPDB}}$  tooth enamel is from -5.68‰ to 1.55‰ (mean = -2.10‰  $\pm$  1.38‰ (1 $\sigma$ )). Sample 41 has non-local values according to  $^{87}\text{Sr}/^{86}\text{Sr}$  values and, for that reason, has been excluded from the calculation of the local range. Local cattle ranges (n=115) from -4.34‰ to 1.55‰. Established on the mean values,  $\delta^{18}\text{O}_{\text{VPDB}}$  tooth enamel has a range from -3.18‰ to -0.66‰ (mean = -1.92‰  $\pm$  1.26‰ (1 $\sigma$ )).

For pigs, the total range of  $\delta^{18}\text{O}_{\text{VPDB}}$  tooth enamel values (n=26) went from -5.7‰ to -1.5‰ (mean = -3.73‰  $\pm$  1.02‰ (1 $\sigma$ )). Samples 102, 450 and 453 exhibit non local  $^{87}\text{Sr}/^{86}\text{Sr}$  and have been excluded from the calculation of the local range. This local range for pigs (n=23) went from -5.7‰ to -1.5‰. The local range for  $\delta^{18}\text{O}_{\text{VPDB}}$  tooth enamel in pigs is established between -4.77‰ and -2.63‰ (mean = -3.70‰  $\pm$  1.07‰ (1 $\sigma$ )).

Combined (n=194)  $\delta^{18}\text{O}_{\text{VPDB}}$  tooth enamel values for all species ranged from -5.7‰ to 1.55‰. Excluding outliers, the local range for Valencina-Castilleja (n=181) is established between -3.48‰ to -0.66‰ (mean = -2.07‰  $\pm$  1.41‰ (1 $\sigma$ )) (*fig. 110, 111*).

Carbon values ( $\delta^{13}\text{C}_{\text{ap}}$ ) for all samples (n=194) ranged from -14.95‰ to -4.1‰. Excluding outlier values, the local range for Valencina-Castilleja (n=181) is established between -12.2‰ and -7.78‰ (mean = -9.99‰  $\pm$  2.21‰ (1 $\sigma$ )).

In terms of species, combined (n=43) carbon values ( $\delta^{13}\text{C}_{\text{ap}}$ ) for all caprines ranged from -14.95‰ to -5.6‰. Total local range, based on the mean values for caprines,  $\delta^{13}\text{C}_{\text{ap}}$  tooth enamel

is from -13.38‰ to -9.16‰ (mean = -11.27‰  $\pm$  2.11‰ (1 $\sigma$ )).

Carbon values ( $\delta^{13}\text{C}_{\text{ap}}$ ) for all cattle (n=125) range from -12.71‰ to -4.1‰. Excluding sample 41, the values for local cattle (n=115) range from -11.91‰ to -4.1‰. The local range on the mean values for  $\delta^{13}\text{C}_{\text{ap}}$  in enamel is between -11.11‰ and -7.17‰ (mean = -9.14‰  $\pm$  1.97‰ (1 $\sigma$ )).

In the case of pigs (n=26),  $\delta^{13}\text{C}_{\text{ap}}$  values ranged from -13.12‰ to -10.03‰. Excluding outliers, the range for local pigs (n=23) went from -13.1‰ to -10.03‰. The local range on the mean  $\delta^{13}\text{O}_{\text{ap}}$  values lies between -12.65‰ and -11.05‰ (mean = -11.85‰  $\pm$  0.80‰ (1 $\sigma$ )).

### 6.3.2.3 Analysis of Diet: $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$

Cattle (n=8)  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values, respectively, ranged from -21‰ to -14‰ and 5‰ to 8‰, with averages of -18‰  $\pm$  2.7‰ (1 $\sigma$ ) and of 6  $\pm$  0.8‰ (1 $\sigma$ ) for  $\delta^{15}\text{N}$ . Pig (n=10)  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values ranged from -21‰ to -14‰ and 5.5‰ to 9‰, respectively, with averages of -19‰  $\pm$  2.0‰ (1 $\sigma$ ) for  $\delta^{13}\text{C}$  and of 6‰  $\pm$  1.0‰ (1 $\sigma$ ) for  $\delta^{15}\text{N}$ . Caprines (n=11)  $\delta^{13}\text{C}_c$  and  $\delta^{15}\text{N}$  values ranged from -21‰ to -17‰ and 4‰ to 8‰, respectively, ( $\delta^{13}\text{C}_c$   $\bar{Y}$ : -20‰  $\pm$  1.2‰ (1 $\sigma$ ) and  $\delta^{15}\text{N}$   $\mu$ : 6‰  $\pm$  1.2‰ (1 $\sigma$ )). Dog (n=4)  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values ranged from -21‰ to -18‰ and from 5‰ to 9‰, respectively, with averages of -19‰  $\pm$  1.3‰ (1 $\sigma$ ) for  $\delta^{13}\text{C}$  and of 7‰  $\pm$  1.5‰ (1 $\sigma$ ) for  $\delta^{15}\text{N}$ . Dogs and suids reflect a  $\text{C}_3$  terrestrial environment, but cattle and caprines feature quite diverse values including some  $\text{C}_4$  resource consumption (*fig. 112*).

Values can be checked in *table A.5.1.3.b* in appendix 5.

## 6.4 Comparative Isotope Analyses

### 6.4.1 El Amarguillo II

Amarguillo II is located on a level of Pliocene sands from the Upper Messinian. To the north there are quaternary eluvial levels and on the southern part sandy loams and tertiary biocalcarenes as well as small clay nuclei and quaternary pebbles. Toward the east tertiary levels of conglomerates, gravels, sand and lutites are present.



Fig. 111.  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}_{\text{Cap}}$  results by individual in Valencina-Castilleja.

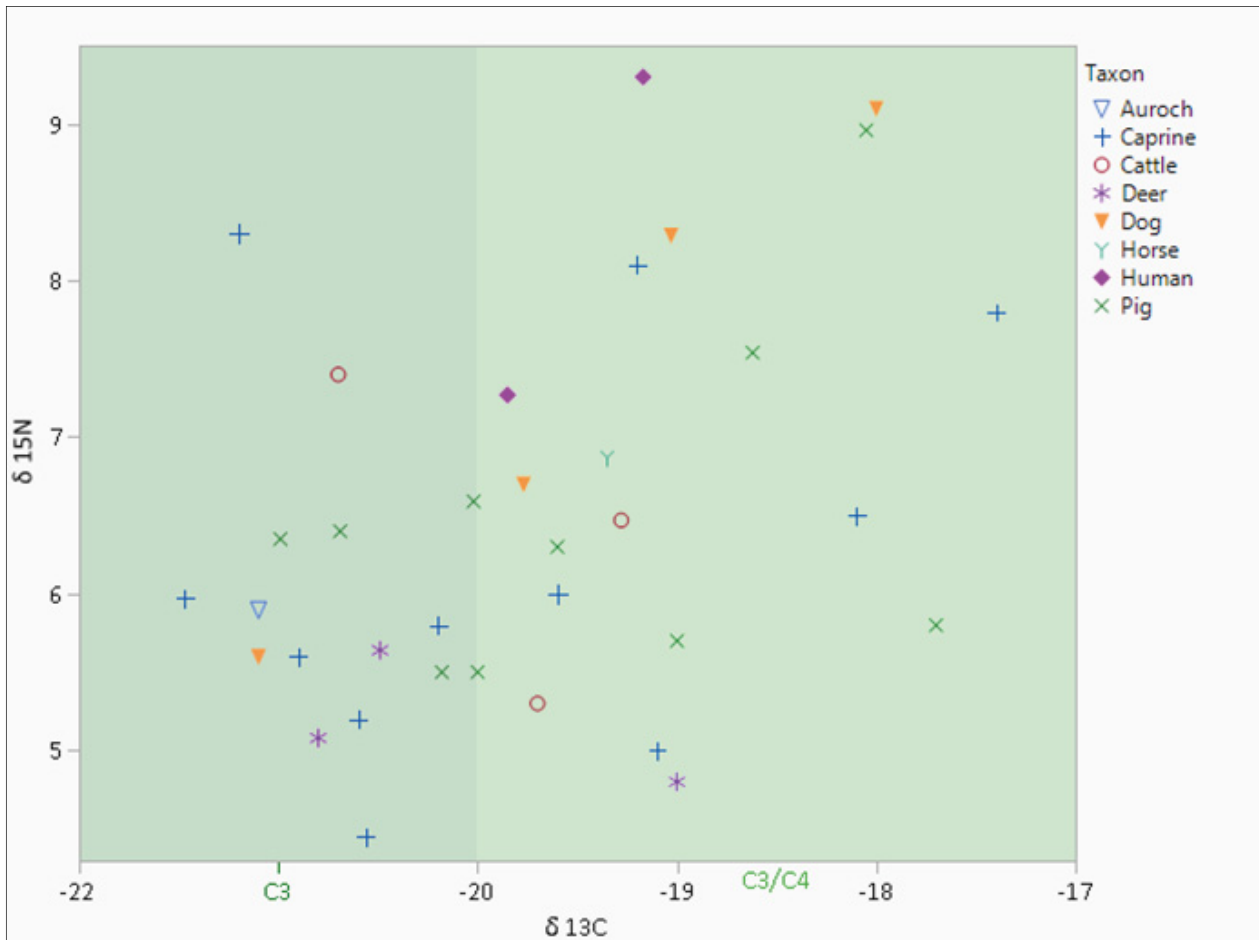


Fig. 112.  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  results by species in Valencina-Castilleja.

A total of 24 samples of tooth enamel from four different individuals (MNI: two caprines, two cattle, one pig and one aurochs) were analysed for  $\delta^{18}\text{O}_{\text{ap}}$ ,  $\delta^{13}\text{C}_{\text{ap}}$  and  $^{87}\text{Sr}/^{86}\text{Sr}$ .

#### 6.4.1.1 Mobility: Strontium ( $^{87}\text{Sr}/^{86}\text{Sr}$ )

Seven samples were used for  $^{87}\text{Sr}/^{86}\text{Sr}$  analysis (table A.2.6b in appendix 2). In the case of caprines and cattle, two samples from each tooth, each from the occlusal and cement-enamel junction, were analysed (table A.5.1.4 in appendix 5).

Strontium values for all the analysed samples ranged from 0.70876 to 0.70953. In terms of groups, cattle values ranged from 0.70902 to 0.70953 ( $n=2$ , average =  $0.709275 \pm 0.0006$  ( $2\sigma$ )), while caprines ( $n=4$ ) showed values ranging from 0.70876 to 0.70919 ( $n=4$ , average =  $0.70898 \pm 0.0004$  ( $2\sigma$ )).

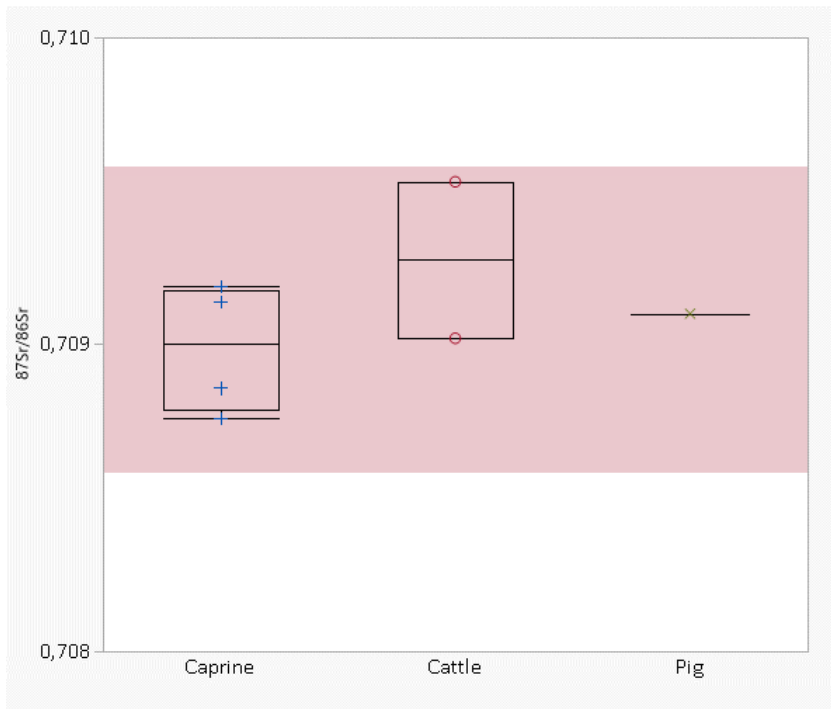
For pigs ( $n=1$ ), a value of  $0.7091 \pm 0.00003$  ( $1\sigma$ ) was obtained.

The local values from El Amarguillo II ranged from 0.70858 to  $0.70958 \pm 0.0004$  ( $2\sigma$ ) (fig. 113).

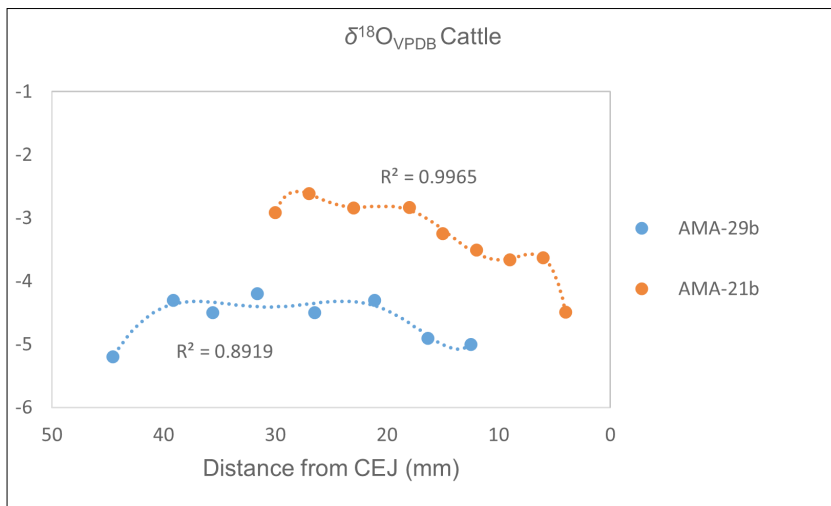
#### 6.4.1.2 Oxygen ( $\delta^{18}\text{O}_{\text{ap}}$ ) and Carbon ( $\delta^{13}\text{C}_{\text{ap}}$ )

A total of 17 samples were analysed for  $\delta^{18}\text{O}_{\text{ap}}$  and  $\delta^{13}\text{C}_{\text{ap}}$ . In the case of two caprines, two cattle and the aurochs, an intra-tooth sampling was performed (table A.2.6b in appendix 2). Results are plotted from the occlusal part of the tooth crown to the cement-enamel junction (CEJ) following a time series (fig. 114, 115). Values are shown in table A.5.1.4 in appendix 5.

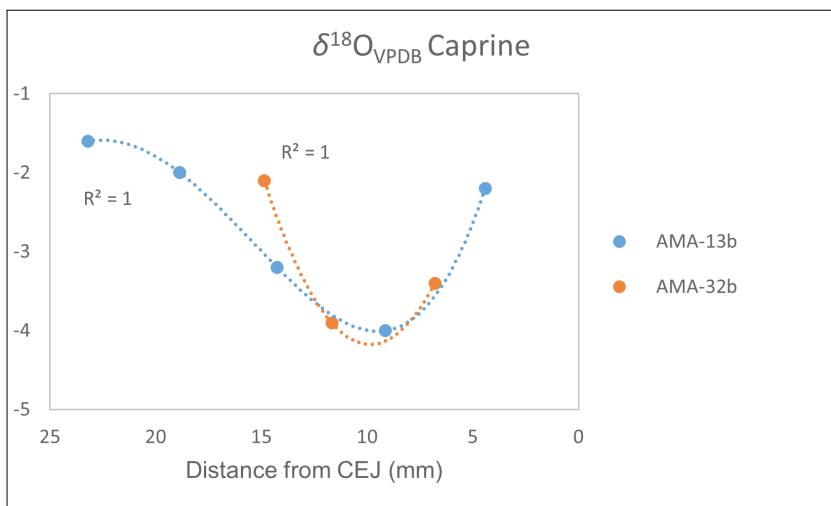
In terms of groups, the total  $\delta^{18}\text{O}_{\text{VPDB}}$  tooth enamel local range for the mean values for caprines ranges from  $-4\text{‰}$  to  $-1.6\text{‰}$  (average =



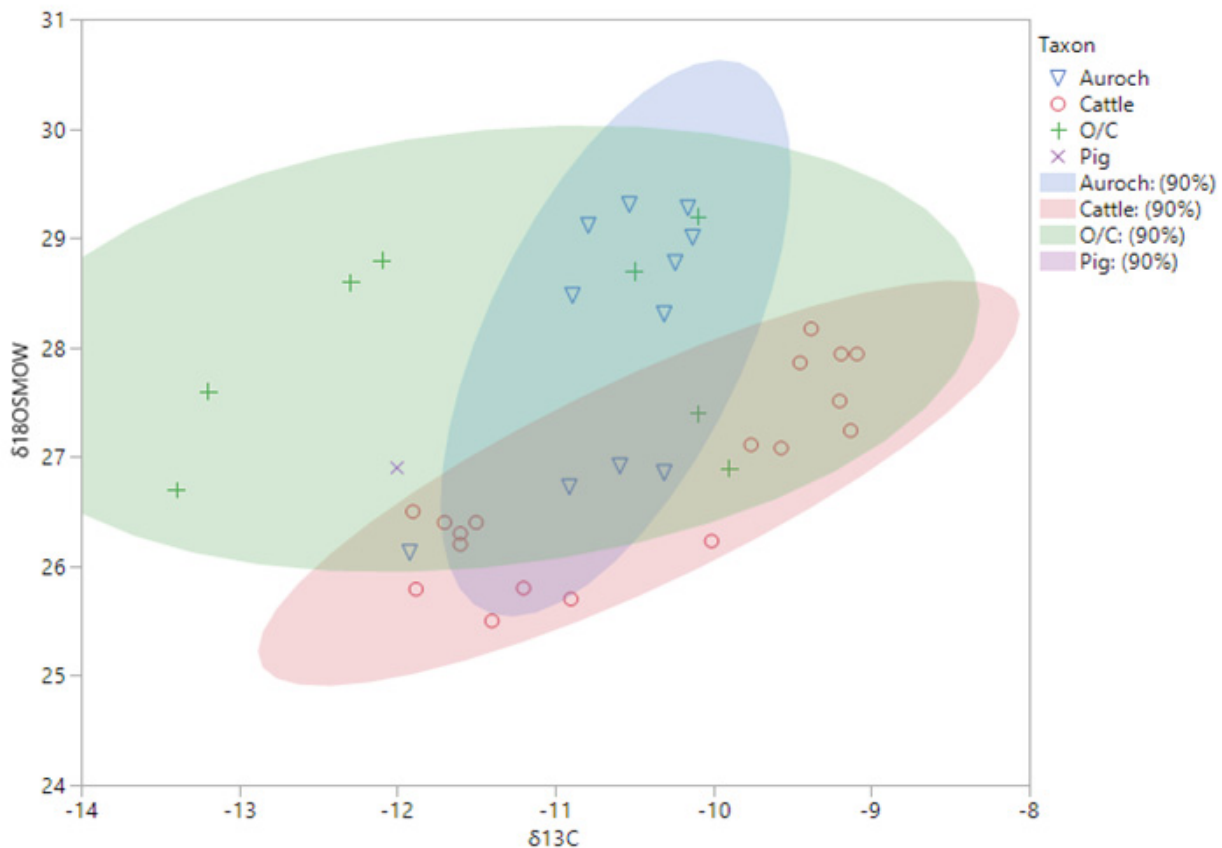
**Fig. 113.** Results of  $^{87}\text{Sr}/^{86}\text{Sr}$  from Amarguillo II, Los Molares.



**Fig. 114.** Results of  $\delta^{18}\text{O}_{\text{ap}}$  from caprines from El Amarguillo II, Los Molares.



**Fig. 115.** Results of  $\delta^{18}\text{O}_{\text{ap}}$  from cattle from El Amarguillo II, Los Molares.



**Fig. 116.** Results of  $\delta^{13}\text{C}_{\text{ap}}$  and  $\delta^{18}\text{O}_{\text{ap}}$  from Amarguillo II, Los Molaes.

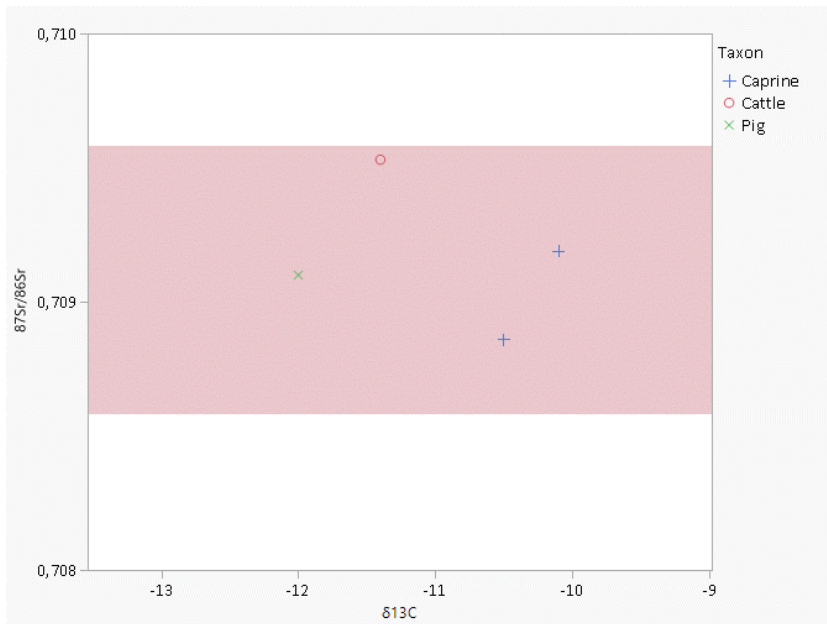
$-2.8\text{‰} \pm 0.93\text{‰}$  ( $1\sigma$ ).  $\delta^{18}\text{O}_{\text{VPDB}}$  (‰) on sample AMA-13 ranged from  $-4.0\text{‰}$  to  $-1.6\text{‰}$  (average =  $-2.6\text{‰} \pm 0.97\text{‰}$  ( $1\sigma$ )) and in AMA-32 from  $-3.9\text{‰}$  to  $-2.1\text{‰}$  (average =  $-3.13\text{‰} \pm 0.92\text{‰}$  ( $1\sigma$ )) (fig. 115).

For cattle,  $\delta^{18}\text{O}_{\text{VPDB}}$  tooth enamel values on AMA-29 range from  $-5.2\text{‰}$  to  $-4.2\text{‰}$  (average =  $-4.61\text{‰} \pm 0.37\text{‰}$  ( $1\sigma$ )) and on AMA-21 ( $n=10$ ) from  $-4.92\text{‰}$  to  $-2.61\text{‰}$  (average =  $-3.46\text{‰} \pm 0.75\text{‰}$  ( $1\sigma$ )) (fig. 114). The local range on the mean values for cattle ( $n=18$ ) went from  $-5.2\text{‰}$  to  $-2.61\text{‰}$  (average =  $-3.97\text{‰} \pm 0.83\text{‰}$  ( $1\sigma$ )). For pigs, sample AMA-7 provided a value of  $-3.8\text{‰}$ , aurochs values ( $n=11$ ) oscillated between  $-4.00\text{‰}$  and  $-1.51\text{‰}$  (average =  $-2.52\text{‰} \pm 0.96\text{‰}$  ( $1\sigma$ )).

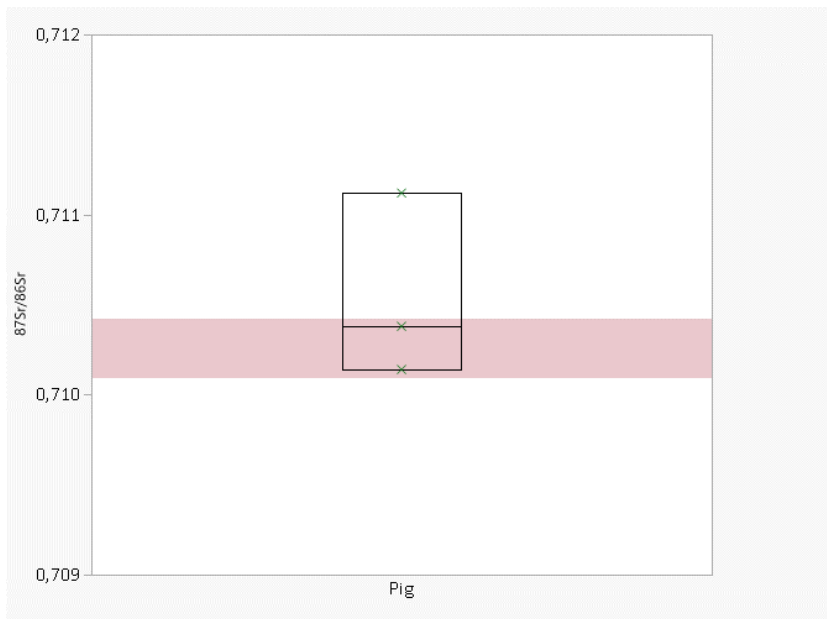
If one establishes the local range for the mean values of all groups ( $n=38$ ), this would go from  $-5.2\text{‰}$  to  $-1.51\text{‰}$  (average =  $-3.30\text{‰} \pm 1.09\text{‰}$  ( $1\sigma$ )). The results are rather homogeneous and no evidence of non-local individuals has been recorded in terms of  $\delta^{18}\text{O}_{\text{VPDB}}$  results.

According to  $\delta^{13}\text{C}_{\text{ap}}$  (‰), caprine sample AMA-13 ranged from  $-13.4\text{‰}$  to  $-10.1\text{‰}$  (average =  $-12.22\text{‰} \pm 1.31\text{‰}$  ( $1\sigma$ )). In AMA-32,  $\delta^{13}\text{C}$  (‰) ranged from  $-10.5\text{‰}$  to  $-9.9\text{‰}$  (average =  $-10.16\text{‰} \pm 0.30\text{‰}$  ( $1\sigma$ )). The local range of the mean values for caprines  $\delta^{13}\text{C}_{\text{ap}}$  tooth enamel has a range from  $-13.4\text{‰}$  to  $-9.9\text{‰}$  (average =  $-11.45\text{‰} \pm 1.46\text{‰}$  ( $1\sigma$ )). For cattle, sample AMA-29 values vary from  $-11.9\text{‰}$  to  $-10.9\text{‰}$  (average =  $-11.47\text{‰} \pm 0.31\text{‰}$  ( $1\sigma$ )) and in AMA-21 ( $n=10$ ) from  $-11.88\text{‰}$  to  $-9.09\text{‰}$  (average =  $-9.66\text{‰} \pm 0.83\text{‰}$  ( $1\sigma$ )). The total local range of mean values for cattle ( $n=18$ ) ranged from  $-11.9\text{‰}$  to  $-9.09\text{‰}$  (average =  $-10.47\text{‰} \pm 1.12\text{‰}$  ( $1\sigma$ )). For pigs, AMA-7 provided a value of  $-12\text{‰}$  and aurochs ( $n=11$ ) from  $-10.91\text{‰}$  to  $-10.13\text{‰}$  (average =  $-10.48\text{‰} \pm 0.29\text{‰}$  ( $1\sigma$ )) (fig. 116).

The local range for the mean values for all groups ( $n=38$ ) ranged from  $-13.4\text{‰}$  to  $-9.09\text{‰}$  (average =  $-10.75\text{‰} \pm 1.11\text{‰}$  ( $1\sigma$ )). This range indicates an open environment characterised by  $\text{C}_3$  plants (fig. 117).



**Fig. 117.** Results of  $\delta^{13}\text{C}_{\text{ap}}$  by species from Amarguillo II, Los Molares.



**Fig. 118.** Results of  $^{87}\text{Sr}/^{86}\text{Sr}$  from Poblado Calcolítico, Aznalcóllar.

#### 6.4.2 Poblado Calcolítico

Six samples from three different pigs (MNI) were analysed for  $\delta^{18}\text{O}_{\text{ap}}$  and  $\delta^{13}\text{C}_{\text{ap}}$  plus  $^{87}\text{Sr}/^{86}\text{Sr}$  (table A.5.5.1 in appendix 5).

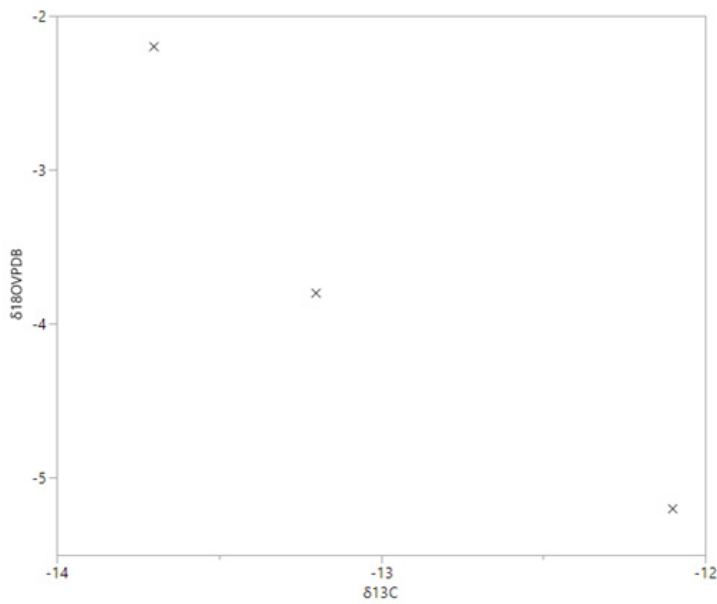
( $2\sigma$ ), establishing the isotope range for Poblado Calcolítico between  $0.71009$  and  $0.71042 \pm 0.0001$  ( $2\sigma$ ). The outlier has a value of  $0.71112 \pm 0.0002$  ( $2\sigma$ ) (fig. 118).

##### 6.4.2.1 Mobility: Strontium ( $^{87}\text{Sr}/^{86}\text{Sr}$ )

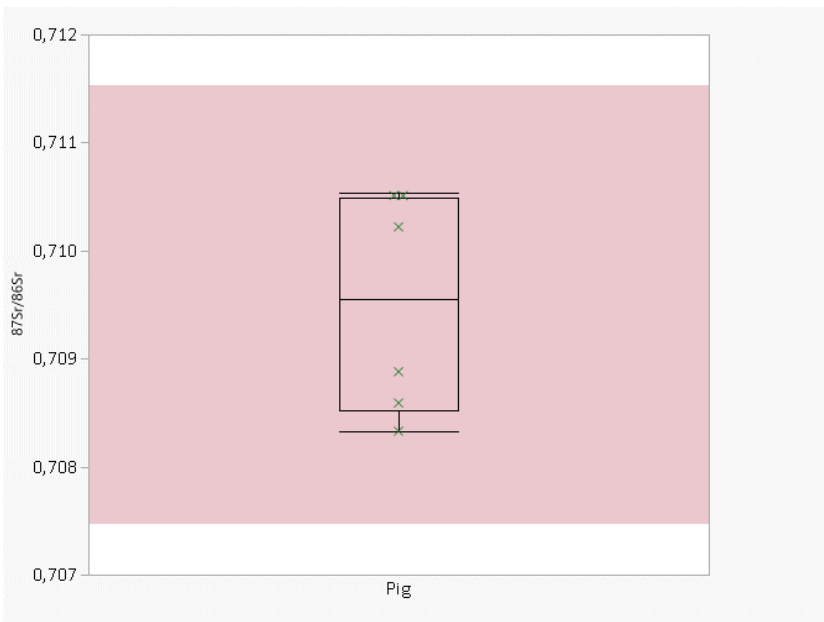
Three pig samples were analysed for  $^{87}\text{Sr}/^{86}\text{Sr}$ . Two analysed individuals present local values and the third one is possibly an outlier. Local pigs ranged from  $0.71014$  to  $0.71038$  (average =  $0.71026 \pm 0.0001$

##### 6.4.2.2 Oxygen ( $\delta^{18}\text{O}_{\text{ap}}$ ) and Carbon ( $\delta^{13}\text{C}_{\text{ap}}$ )

Oxygen values ( $\delta^{18}\text{O}_{\text{VPDB}}$ ) for all samples ( $n=3$ ) ranged from  $-5.2\text{‰}$  to  $-2.2\text{‰}$ . Excluding sample PAR-23, which has non-local values in  $^{87}\text{Sr}/^{86}\text{Sr}$ , the



**Fig. 119.** Results of  $\delta^{13}\text{C}_{\text{ap}}$  from Poblado Calcolítico, Aznalcóllar.



**Fig. 120.** Results of  $^{87}\text{Sr}/^{86}\text{Sr}$  from Parque Miraflores, Seville.

local range for pigs from Poblado Calcolítico was established between  $-5.48\text{‰}$  and  $-3.52\text{‰}$  (average =  $-4.5\text{‰} \pm 0.98$  ( $1\sigma$ )).

The  $\delta^{13}\text{C}_{\text{ap}}$  values ranged from  $-13.7\text{‰}$  to  $-12.1\text{‰}$ . Excluding outliers, local values ranged between  $-13.42\text{‰}$  and  $-11.88\text{‰}$  (average =  $-12.65 \pm 0.77\text{‰}$  ( $1\sigma$ )) (fig. 119).

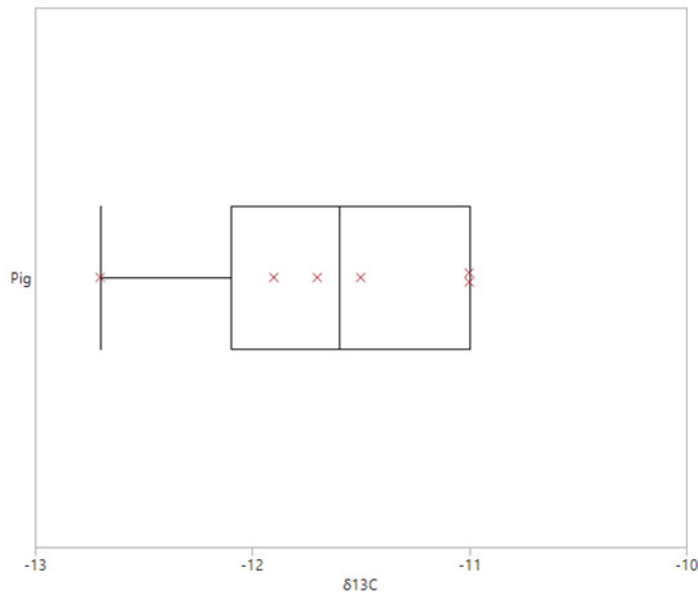
### 6.4.3 Isotopic Analyses in Parque Miraflores

Parque Miraflores stands on an eluvial level composed of quaternary pebbles, sand and clays.

Twelve tooth enamel samples, from six different pigs (MNI), were analysed for  $\delta^{18}\text{O}_{\text{ap}}$ ,  $\delta^{13}\text{C}_{\text{ap}}$  and  $^{87}\text{Sr}/^{86}\text{Sr}$  values (table A.5.1.6 in appendix 5).

#### 6.4.3.1 Mobility: Strontium ( $^{87}\text{Sr}/^{86}\text{Sr}$ )

The results of the isotopic analyses performed with the six pig samples provided a range of values from 0.70833 to 0.71054. The isotopic range is established between  $0.70747$  and  $0.71153 \pm 0.002$  ( $2\sigma$ ). Results are presented in fig. 120.



**Fig. 121.**  $\delta^{13}C_{ap}$  values from Parque Miraflores, Seville.

#### 6.4.3.2 Oxygen ( $\delta^{18}O_{ap}$ ) and Carbon ( $\delta^{13}C_{ap}$ )

Oxygen values ( $\delta^{18}O_{VPDB}$ ) for all samples (n=6) ranged from -3.9‰ to 0.1‰. Local range has been established between -3.88‰ and -0.52‰ (average =  $-2.2 \pm 1.68$ ‰ ( $1\sigma$ )).

$\delta^{13}C_{ap}$  values for all samples (n=6) ranged from -12.7‰ to -11.0‰. Local range was established between -12.26‰ and -11.0‰ (average =  $-11.63 \pm 0.63$ ‰ ( $1\sigma$ )).

The analysis shows a predominant consumption of  $C_3$  plants in an open forest environment (fig. 121).

## 7 Discussion

### 7.1 Ditched Enclosures in the Lower Guadalquivir Basin: Permanent vs. Non-Permanent Sites

Diversification is often taken as an indicator of intensification of agricultural and stockbreeding practices (Greenfield 2010, 30). In southern Iberia, and more specifically the Lower Guadalquivir Basin, the first evidence of diversification of agricultural activities have been traditionally traced back to the Late Neolithic and Chalcolithic periods (Llergo López et al. 2013; Pérez Ripoll 1999). The presumable increase in the standing numbers of livestock at that time would have required exclusive attention on the part of people for their management. In the case of caprines, the incompatibility of large herds of these ruminants with agricultural crop exploitation in a restricted area would have fostered, in turn, the development of transhumant movements on a regional scale. According to Pérez Ripoll (1999) in such a scenario, settlements would have developed as organisational centres for the movements of flocks. These transformations, a direct result of increasing social complexity within societies, can be detected from the Mediterranean to the Atlantic area of the Iberian Peninsula.

But diversification and intensification are both elusive phenomena to detect in the archaeological record and the area covered by this study seems to be no exception to the rule. To prove the aforementioned trends a lot of good data rather than a lot of good ideas are required.

According to Uerpmann (1973), two issues for any study of skeletal remains to be representative of livestock practices must be taken into account:

- (1) The assessment of whether a given site represents a permanent or a temporary settlement, and to determine whether, throughout the year, periods of intermittent occupation existed or not.
- (2) An understanding of the socioeconomic status of a given community and its relationships of inter-dependence with other settlements in the region where an exchange of products, in this case animals, could have taken place.

In the case of Valencina-Castilleja, the occupation lasted from 3200 to 2300 calBC (García Sanjuán et al. 2018). From this latter date, the settlement is not abandoned as García Sanjuán (2017) argues, but rather the intensity of its occupation is reduced. This is demonstrated by later findings in different sectors of the settlement which correspond to the Early Bronze, Late Bronze, and Iron Ages. Specific examples of this are seen in the Tartessian tombs of the Señorío de Guzmán or in the Final Bronze and protohistoric materials identified in the Cerro de la Cabeza, IES (Fernández Gómez/Oliva Alonso 1986, 31; Fernández Gómez 2011; Ortega Gordillo 2011b). Although the site covers a large area, estimated at 468ha, all areas may not have been occupied at the same time (Vargas Jiménez 2003; Abril López 2012, 255; García Sanjuán 2018). According to Abril López (2012, 255), the total area occupied moved through time. Some researchers (Abril López 2012, 255; Vargas Jiménez 2003, 85) defend a model of dispersed occupation according to basic units that encompass domestic (huts) and productive (storage pits, workshops, fences) functions. This model would explain the large extension of the settlement. According to Vargas Jiménez et al. (2012, 133), the ditches identified in the Municipal Parcel sector would link with the ditch documented in PP-Matarrubilla and would separate an interior area of productive activities from an area mainly of a funerary nature during the first half of the 3<sup>rd</sup> mill. BC. Once the ditches were filled, the funerary elements are documented inland, as has been demonstrated in the Secondary Education Institute sector (IES), where domestic and funerary evidences replace those of productive nature (Vargas Jiménez et al. 2010; 2012, 131).

For some other researchers (Wheatley et al. 2012, 75), the presence of domestic structures in the area between the Tholos de La Pastora and Montelirio, or in sector PP4, would call into question the division of the settlement. Despite this, the sectors could have had different phases with different uses.

To date, the interpretation of Valencina-Castilleja has focused on two divergent opinions. The first considers Valencina-Castilleja to represent a centre of power with an (*sic.*) ‘incipient class society’ sustained by a ‘state’ in which elites settled on the mainly fortified centres exploited the smaller peripheral communities through physical and ideological coercion, the former exemplified by the payment of taxes (Cruz Auñón Briones/Arteaga Matute 1999; Nocete Calvo 2001, 95; Nocete Calvo et al. 2005; López Aldana/Pajuelo Pando 2001, 217). The data that lend support to such scenario, as will be argued below, are far from straightforward or simply rest upon shaky ground.

The main argument put forward by these authors to justify Valencina-Castilleja as a centre of power is the sheer abundance of structures called ‘silos’, presumably used to harbour surplus agricultural productions, but such abundances are far from real. In this way, Cruz-Auñón Briones/Arteaga Matute (1999) mention a total of 110 ‘silos’ in the La Estacada Larga sector, yet that number is based on an estimation rather than on a record of actual structures. In fact, the ‘silos’ thus far recorded at La Estacada Larga, although undoubtedly an infra-estimation of the original number due to extensive erosion and destruction, amount to a mere 25, with nowhere specified how many of them were excavated. If extrapolated from the data offered by Mejías García, that number must be low (Cruz-Auñón Briones/Arteaga Matute 1999, 604; Mejías García 2017, 88). Indeed, this latter author mentions a total of 1841 structures at Valencina-Castilleja, of which only 28% (515) were excavated and in only 42% of the latter (216) the excavation was complete (Mejías García 2017, 88). The abundance of ‘silos’ thus needs further qualification.

Another problem regarding this presumable abundance of ‘silos’ that García Sanjuán and Murillo Barroso (2013, 9) mention is a lack of absolute dates that does not allow to decide how many of them were in use at a given moment. Also, despite their being labelled as ‘silos’, the functionality of these structures should not be understood exclusively in terms of cereal storage (Díaz del Río Español 2001; 2003; López Sáez et al. 2006). Attributing an exclusive agricultural surplus storage function to these structures is a questionable

inertia since most of them have never been subjected to analyses to substantiate that claim (López Sáez et al. 2006, 26; García Sanjuán/Murillo Barroso 2013, 8). Many of the structures identified as storage units or irregularly shaped hut floors could well have had another function. This would be the case of the so-called clay pits, documented on so many European sites, intended for obtaining clay for construction (Miret i Mestre 2015, 197).

The second traditional interpretation of Valencina-Castilleja postulates it to be a site that emerged as a burial ground, rather than as the settlement of a sedentary community. In this interpretation, the site fostered recurrent population aggregations of local groups inhabiting the Lower Guadalquivir Valley with the purpose of creating social relations (García Sanjuán 2017; García Sanjuán et al. 2017; 2018).

This second scenario of a non-permanent settlement is grounded on equally questionable data, the main ‘premise’ being that its oldest dates correspond to the funerary deposits from the artificial caves of La Huera and Calle Dinamarca (Méndez Izquierdo 2013; García Sanjuán et al. 2018). As the authors themselves concede, such ‘premise’ is far from warranted due to the scarcity of absolute dates from clearly domestic contexts, the only dated domestic structures as of this writing being those from Calle Ruiseñor, La Parcela Municipal, and one of the structures documented at the IES sector (García Sanjuán et al. 2018). Still, this model does not necessarily exclude the prolonged residence of certain individuals or groups in particular areas of the site (García Sanjuán et al. 2018).

Funerary or not, the main argument that García Sanjuán puts forward to characterise Valencina-Castilleja as a temporary aggregation site is based on the absence of the stone plinth huts and adobe walls that are documented in other contemporaneous sedentary sites such as Los Millares, San Blas, Marroquies Bajos, or Zambujal, as well as in the lack of hearths (García Sanjuán 2013; 2017; García Sanjuán/Murillo Barroso 2013; García Sanjuán et al. 2017).

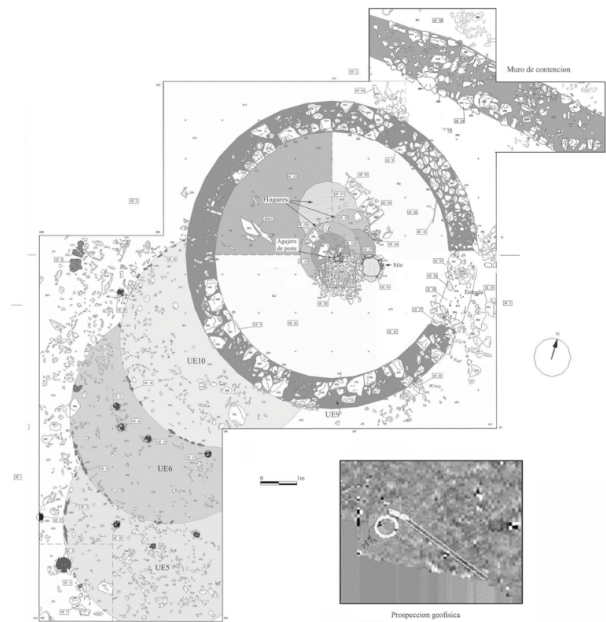
Despite the scarcity and/or dubious interpretation of domestic structures at Valencina-Castilleja, the fact that the original topography of the settlement has changed dramatically through time and

the Copper Age levels in most sectors have disappeared must be carefully considered when evaluating this hypothesis. Vargas Jiménez was the first to report erosion, agricultural activities and urban development as responsible for stratigraphic losses of up to a meter in certain places (Vargas Jiménez 2003, 130). In the case of the La Estacada Larga sector for example the upper third of the documented structures were devastated by erosion, as was also the case at La Alcazaba, where the prehistoric soil horizon was completely eliminated by ancient and modern disturbances (Cruz Auñón Briones/Arteaga Matute 1999, 604; Arteaga Matute/Cruz-Auñón Briones 2001b, 705). In the PP-Matarrubilla, Pabellón Cubierto and Calle Trabajadores sectors erosive processes and recent urban development have done away with the upper levels of all structures (Queipo de Llano Martínez et al. 2010, 3209; Ortega Gordillo 2011a; 2013, 129; López Aldana/Pajuelo Pando 2013, 158). In the Mariana Pineda sector a geomorphological study reported the loss of no less than 80cm of archaeological deposits, and in the V-IES sector the archaeological excavation confirmed that the land was levelled, by moving soil from the highest parts of the terrain to lower ones in the southwest (Moro Berraquero et al. 2009, 374; Vargas Jiménez et al. 2010, 3349).

Because of this, only structures dug deep into the ground survived.. In most cases, the Copper Age occupation levels have been long lost. Interpretations in these circumstances need to be taken with caution.

In spite of these drawbacks, evidence for the presence of huts and other domestic structures such as those described in chapter 5 exist at Valencina-Castilleja that refute the arguments put forward by García Sanjuán (2013; 2017), García Sanjuán/Murillo Barroso (2013), and García Sanjuán et al. (2017; 2018).

An interesting parallel of the Valencina-Castilleja huts appears at the San Blas site (Cheles, Badajoz) on the Gadiana Valley. Here, the <sup>14</sup>C dates of two stone base huts indicate that these date to the middle of the 3<sup>rd</sup> mill. BC (Hurtado Pérez 2004b, 151).<sup>7</sup>



**Fig. 122.** Planimetry from test pit K7 made in San Blas showing the evolution of the construction of the huts (after Hurtado Pérez 2004b, 148).

Material typical of the Bell Beaker horizon, such as copper palmela points, daggers, and Bell Beaker pottery with incised motifs, also indicate that these huts were occupied during the mid to the end of the 3<sup>rd</sup> mill. BC. From the initial moments of the settlement, structures are documented that the excavators describe as (lit. translated): ‘circular structures with a diameter of 5.60 m, built with branches and covered with mud, with small slate slabs surrounding their base to contain the walls’ (Hurtado Pérez 2004b, 148). The construction consisted of a circular trench in which a framework of branches would be fitted and shimmed with small slate slabs placed on the edge. The whole framework was covered by adobe. On the outside post holes were documented that would support the roof beams, as well as a post hole in the central area of the interior of the hut (Hurtado Pérez 2004b, 148) (*fig. 122*).

As in the San Blas site, the early huts from the site of Marroquíes (Jaén province) are built using a perimeter trench. It is not until after 2200 BC that this construction model is replaced by the 8m diameter stone base huts of the so-called ZAMB 3 and 4 of Marroquíes (Hurtado Pérez 2004b; Serrano Peña et al. 2011, 143; Díaz del Río Español 2013, 73). Structures documented as domestic in

<sup>7</sup> H22: (SB/H22/29) 3950±40 BP/2550–2540 calBC 2σ; K7: (SB/K7/37) 3990±40 BP/ 2580–2430 calBC 2σ.

the early stages of the Copper Age in Marroquíes are characterised by an underground area some 0.3 to 0.5m deep, with some reaching depths of 1.5m and diameters between 1 and 3m. The roofs were made of clay and organic material and in most cases seemed to be conical shape without a central post hole. The fireplaces are seldom clearly delimited, often taking the form of a level formed by abundant coal (Serrano Peña et al. 2011, 99). At later stages, underground and semi-subterranean structures were replaced by structures with a perimetral groove surrounding the structure with clay and organic matter cover supported by perimetrical posts. The presence of hearths inside huts is not common at this time, most being recorded outside the living space. As in the previous phase, the soil of ancient surface levels has disappeared (Serrano Peña et al. 2011, 145). At these later stages in Marroquíes, the absence of hearths inside huts indicate that food processing and consumption would have taken place in external (communal?) spaces (Serrano Peña et al. 2011, 156).

This data refutes the second argument of García Sanjuán (2013; 2017) that favours a non-permanent nature for Valencina-Castilleja based on its lack of hearths. Indeed, Martín Espinosa and Ruiz Moreno (1990, 458) already argued that the absence of documented hearths within the living structures, either because of taphonomic loss or because the hearths were located on the outside of the structures, did not rule out the presence of habitation areas.

As happened with huts, habitational areas must have been heavily affected by the loss of ancient floors and topsoil. Likewise, as explained above, when taking into consideration settlements such as Marroquíes, the documented habitational structures in most cases lacked a defined shape thus the only evidence of habitation was the level with a presence of coals. In Valencina-Castilleja, many structures identified as huts exhibit these same levels with coals that are difficult to characterise as hearths.

Still, unequivocal clear hearths have been documented in some sectors of Valencina-Castilleja. Such would be the case of the structure identified by Santana Falcón in the El Algarrobillo sector, a level of compacted soil associated with a hearth

formed by pebbles and burnt adobes (Santana Falcón 1993, 551). Likewise, area 2 of the La Alcazaba sector features an unquestionable hearth (Vargas Jiménez 2010, 3341). More recently, a small circular structure with combustion residues, interpreted as a hearth, was documented in Calle Huelva 16 (Delgado Canela et al. 2021).

According to García Sanjuán (2013; 2017) and García Sanjuán et al. (2017), the predominance of manufactured goods on exotic materials as opposed to the low number of agricultural production artefacts such as mill stones (often fragmented), would be another argument to interpret Valencina-Castilleja as a non-permanent settlement. In this case, a biased research design should not be excluded.

Ever since the 1960s, most of the research at Valencina-Castilleja focused on material documented in the funerary structures. Because of this, one may expect an over-representation of elements on exotic raw materials since these are prestige items that often appear among grave goods. On the other hand, in non-funerary contexts at Cerro de la Cabeza, Fernández Gómez and Oliva Alonso (1980, 26) were the first to report large, polished axes that they interpreted as ploughshares. These authors also mention adzes, barquiform mill stones and large cores with traces of flaking as indicators of a local production of lithics. Many other mill stone fragments were documented at Cerro de la Cabeza (Fernández Gómez/Oliva Alonso 1986, 22). Fragments of mill stones and grinders have been now also reported at the La Gallega, El Algarrobillo, area 1 of La Alcazaba, and, more recently, the Biblioteca Municipal sectors (Martín Espinosa/Ruiz Moreno 1990, 457; Santana Falcón 1993, 551; Vargas Jiménez 2010, 3341; Vargas Jiménez, personal communication). Since these lithic materials were transported from the Sierra, mill stones were frequently reused, leading to extensive fragmentation, a feature also recorded at Loma del Real Tesoro (chapter 5).

Cereal pollen percentages are a fourth hotly debated issue. In general, most authors agree that cereal pollen tends to be under-represented in archaeological deposits, due to its low production and dispersion capabilities (Heim 1970). When it comes to establishing the precise percentage of

cereal pollen that allows one to discern the presence of a crop field, authors establish different criteria. In this way, Heim (1963) concluded that cereal pollen reaches percentages of 3 to 4% when crop farming occurs within 2km of the sampling point yet Richard (1985) established that 2% was sufficient to certify the presence of crops around an archaeological site.

The results from the pollen analyses done on two sectors of Valencina-Castilleja showed a highly anthropised and deforested environment. This argues in favour of a permanent settlement thus, indirectly, the presence of cereal cultivation (Llargo López/Ubera Jiménez 2006, 29; Llargo López et al. 2013). This data seems coincident with those obtained from Loma del Real Tesoro II, Carmona, El Amarguillo II and Parque Miraflores, where an open and deforested environment resulting from anthropisation where cereals and herbaceous plants increase over time as tree and shrubs diminish seems compelling (Cabrero García et al. 2006, 83; López García/López Sáez 1997 21; Llargo López et al. 2008; Lara Montero et al. 2004, 247). Aquatic plants, as well as ferns, mosses, and lichens at Parque Miraflores reveal more humid conditions than in the remaining sites. This agrees with the location of the site barely 10m above sea level, next to the paleo-coast and mouth of the Tagarete stream (Lara Montero et al. 2004, 247).

Cereal pollen from structures 2 and 11 at LRT-II hint at crops close to the settlement. In turn, *Rumex acetosella*, an indicator of open environments, points to the presence of crops that some have postulated to represent mainly winter cereals (Behren 1981, 236). Crops are indirectly corroborated by the numerous mill stones, grinding stones, axes, and adzes documented on the surface. Likewise, the lithic industry documented during the 2015 excavation points to instruments such as axes, adzes, mill stones, sickle elements and denticulated tools, related to the treatment of wood and practices typical of agricultural economies. In the case of structures 2, 3, 4, and 11, more relevant is the fact that coprophilic fungi and phytoliths unrelated to cereal storage, indicate the presence of manure, possibly aimed for fertilising the fields.

The presence of cereal indicating cereal exploitation (barley in the case of Parque Miraflores; Lara Montero et al. 2004) and the increase in vegetation typical of grazing lands reveal the existence of livestock and pasturelands around settlements, and this also points to the presence of permanent populations.

For all these reasons, the ‘central state model’ advocated for the Lower Guadalquivir Valley where Valencina-Castilleja would have played a role as a centre of power is not supported by the non-zooarchaeological data available. At Valencina-Castilleja there is no evidence for the existence of surplus cereal accumulations nor of constructions associated with administrative tasks, elements that are necessary for the management of a state-level economy. Likewise, the funerary record does not reveal the high-status burials’ one would expect in a coercive system of taxation over neighbouring communities.

The model defended by García Sanjuán (2013; 2017; García Sanjuán et al. 2017), is not supported by the available non-zooarchaeological data either. Notwithstanding the extensive loss of archaeological deposits at Valencina-Castilleja, huts and hearths are still occasionally documented in several sectors. As was already mentioned, the presence of stone plinth huts at San Blas and Marroquíes date to the second half of the 3<sup>rd</sup> mill. BC, yet the domestic structures from the first half of this millennium are similar to those documented at Valencina-Castilleja. In contrast, it must be noted that the mountainous location of San Blas and Marroquíes must have dictated an easier access to stone resources for construction than was the case at Valencina-Castilleja.

To summarise, from the Late Neolithic onward and during the 3<sup>rd</sup> mill. BC, there seems to exist a settlement ‘inertia’ where sites became permanent. Along the Middle Guadalquivir Valley this pattern is seen in many sites including our case studies from Valencina-Castilleja and La Loma del Real Tesoro but also at Parque Miraflores, El Amarguillo, Poblado Calcolítico and Carmona. This trend conforms with that recorded at a broader geographical scale on more distant 3<sup>rd</sup> mill. BC sites as would be Marroquíes (SE Spain) and San Blas, on the Middle Guadiana River Valley.

## 7.2 Husbandry Strategies in Southern Iberia: General Considerations

It is difficult to evaluate which productive activity, crop farming or the raising of livestock, had more economic weight during the Copper Age. Some authors (Fernández Gómez/Oliva Alonso 1985, 107) argue that food at Valencina-Castilleja would have been based on crushed and cooked cereals as documented for other areas of the peninsula (e.g., at Los Picos-Fontarrón evidence was found of a porridge made of acorn flour and barley) (Bueno Ramírez et al. 2010, 56). It has to be kept in mind that, under most scenarios, crop farming offers far higher yields than livestock. For that reason, animal husbandry has been considered an investment of time and work, acting as a fallback resource (i.e. an insurance of sorts) in case of crops collapse or scarcity of vegetal resources (Bogucki 1993, 497).

The potential livestock of any territory depends, among others, on the existing vegetation and the raising conditions that often require different strategies depending on the species (*table 90*). Goats, for example can easily graze in the mountains and in relatively dense forests whereas sheep require herbaceous pastures that are usually connected to stubble or crop fields where agricultural work, in particular ploughing, facilitates the growth of that vegetation (Badal 1999). Likewise, sheep cannot stay long in the same place, unless they exist in very low numbers, because of their destructive grazing of the vegetation. When water insures good fodder sheep need to rotate around fields; in drier conditions larger scale movements (transhumance, *sensu lato*) appear.

Bovines require less attention than sheep in terms of mobility yet need abundant herbaceous pasture and water to drink on an almost daily basis. The flat biotopes of the marshlands and riverside areas of the Lower Guadalquivir are ideal for bovines due to their abundance of water and natural pastures (Badal 1999; Pérez Ripoll 1999, 95). In fact, the fertile plain of the Lower Guadalquivir would be suitable for the maintenance of good sheep and cattle herds (Pérez Ripoll 1999, 95; Abril López 2012, 325).

According to Pérez Ripoll (1999, 95), the pattern of slaughter in traditional husbandry-focused

Iberian societies reveals maximum combined yield for draught animals, which are slaughtered when no longer useful as labour force. The breeding of cattle with the exclusive aim of providing meat does not make economic purpose for prehistoric/traditional societies due to the time delay that a bovine requires to reach its optimum weight for slaughter (Bogucki 1993, 497). For traditional (late-maturing) breeds, the optimum slaughter age for cattle when meat yield is sought revolves around 2.5 to 3.5 years, whereas cows and oxen can have an 'occupational life-span' of up to a decade (Uerpmann 1972, 18; Bogucki 1993, 497). Also, given their slower turn-over rate, bovines are less productive than caprines in terms of meat yield but although their meat is consumed less frequently, when this occurs it yields larger quantities. The slaughter of a bovine not only requires greater effort but also, unless all is consumed at a given moment, will also require additional labour to preserve as beef jerky or equivalent products (Badal 1999). For these reasons, in traditional societies, bovine slaughter very often correlates with communal feasting and other aggregational events.

In the case of caprines, Payne (1973, 282) was the first to argue that in traditional societies herds are not maintained for a single product, although one specific product may always play a more determinant role, depending on the needs of the human group. Caprine livestock provides meat, milk, wool, skin, and manure. The mobility of the herds makes them ideal 'tools' for clearing the stubble on the fields after harvest; pigs can be used for this same purpose but are introduced before caprines to feed on the leftover grain. An important task goats (browsers) take is the control of thickets, since these are seldom taken by sheep (grazers). Goats can also take a role as deforestation agents since they not only can feed on bark but also on the leaves and the branches of fallen trees.

Caprine husbandry, in particular that of sheep, was an important activity in Iberia since post-Neolithic times and up until the 20<sup>th</sup> cent., despite the fact that their use as meat providers was often secondary (Hadjikoumis 2010, 9).

The model proposed by Payne (1973), establishes three strategies for managing a herd of sheep depending on whether the aim is milk, wool

Herd	Primary products	Secondary products	Activities	Diet	Requisites	Crop compatibility
Cattle	Meat, leather	Milk, manure	Plough, draught	Herbaceous	Flat biotopes, water supply	Compatible with crops
Sheep	Meat, leather	Milk, wool, manure	Maintenance of farmland, deforestation of forest bushes	Herbaceous	Grazing	Not compatible with crops
Goat	Meat, leather	Milk, manure		Scrubland	Grazing	Not compatible with crops
Pig	Meat, leather	Manure	Maintenance of farmland, offal removers	Omnivorous	Water supply	Not compatible with crops

**Table 90.** Referential features of the main domesticates.

or meat production. In the case of meat production, the model proposes that there should be a predominance of individuals slaughtered at an early age, between 2 and 3 years, when animals reach their maximum size. Injured or sick individuals could be slaughtered at any time depending on conditions. Dairy herds are characterised by a higher proportion of females and a higher number of male lambs being slaughtered. Indeed, this higher proportion of females is achieved through the systematic slaughtering of young males, leaving some for replacement of the herd. In the case of lambs, a common practice is to slaughter one out of every two animals, the survivor being reared by two females. In this way, the female whose lamb has been slaughtered continues to produce milk (Vigne/Helmer 2007, 32; Morales Muñiz, personal communication). In the case of wool production, there would exist a predominance of adult individuals, both male and female. Lamb slaughter is not intensive, as is also the case with the slaughtering of adult individuals that they provide wool of lesser quality. These are progressively replaced by younger individuals. Non-breeding males are castrated (Payne 1973, 281).

In Iberia, herds of sheep traditionally feature a proportion of around 20 to 25 females per male (Acosta Naranjo 2002). In the case of goats, the ratio is slightly higher, with around 25 to 30 females per male.

According to Payne (1973, 299), milk from sheep is of better quality than that from goats. Despite this, goat milk is much appreciated in certain communities, both Iberian and worldwide.

In addition, goats have higher milk yields and a slightly higher reproductive rate than sheep (Davis 2017, 51).

Pérez Ripoll (1999) describes two overlapping slaughter patterns in goats. In dairy farming the slaughtering focuses on adult and senile animals and young males. The second pattern focuses on meat production, best represented by sheep, and is characterised by the slaughtering of young individuals. Meat production does not rule out the use of milk, although milk production is restricted in time (from lactation to oestrus), and, in terms of overall yield. It is meant mostly for consumption at the level of the family (i.e. 'self-consumption') (Pérez Ripoll 1999, 98). If the goal is milk production, young males and senile females would be in the minority, discarded in favour of producers. When wool is sought, there would be a predominance of senile individuals of both sexes discarded because of their low yield or poor wool quality (Li 2012, 196).

Some authors disagree on the use of mortality profiles to establish functionality because these indicate the final function of the animals while ignoring, in most cases, alternative uses (Greenfield 1988; 2014; Halstead 1998). Likewise, Lyman (1994) and Halstead (1998), argue that factors such as the differential preservation of juvenile bones versus adult bones, or the use of adult bone for making tools, may distort mortality profiles and need to be taken into account.

According to Li, an important indication of the local character of the animal population is the presence of lambs and foetuses. If animals derive

from external sources, the age ranges will be more restricted, with a predominance of market-age animals and few young individuals. Indeed, seasonal sites have age ranges concentrated in one or two specific cohorts whereas permanent sites incorporate individuals of all ages (Li 2012). In case caprines were raised locally, but were consumed both inside and outside of the site, two situations could occur:

- (1) When the goal is meat production, there would be comparatively fewer animals in the optimal age range for meat production in the deposit because of them being exported elsewhere. In addition, one would find lambs that died of natural causes as well as a high number of adults no longer playing reproductive roles.
- (2) When the goal are secondary products, there would be an increase in individuals slaughtered at an early age as well as senile female individuals whose milk production and wool quality is low. In the case of wool production, castrated males would also be frequent (Li 2012, 195 f.).

According to Pérez Ripoll (1999, 99), mortality profiles would indicate that young animals not needed for reproduction would be slaughtered before getting 18 months old, leaving females and a few males to replace the less productive senile individuals. In the case of piglets, this slaughter would occur in late spring/early summer while with lambs it would occur throughout the summer, autumn and winter (Pérez Ripoll 1999, 99).

Davis (2017, 51) indicates that the sheep:goat ratio may vary according to the nature of the landscape and vegetation. For Pérez Ripoll (1999, 96) areas located in river valleys with flat hills are most appropriate for sheep farming as opposed to goat farming. The settlements located in the Lower Guadalquivir Basin without steep or rocky terrains are suitable for breeding sheep but not goats. As seen in the previous chapter, this is supported by the faunal data evidencing the proportion of sheep to be considerably higher than that of goats. One paradigmatic case in our samples is the La Perra Sector from Valencina-Castilleja where the sheep:goat ratio is 4:1 (Hain 1982, 39).

Pigs played an important role in the Iberian Copper Age communities (Hadjikoumis 2010, 8). This is especially true in the south of the peninsula

where the increase of the human population would have demanded fast growing and easy to fatten species to meet the demand in certain times and places. Pigs are capable of quickly and efficiently transforming waste into high quality meat, are very adaptative and also prolific (Bogucki 1993, 497).

The development of the *dehesa* parkland, dated from the 4<sup>th</sup> mill. BC onwards, marked the emergence of an ideal environment for raising pigs (López Sáez et al. 2007; Hadjikoumis 2010, 9). Pigs cannot be set apart from the overall agricultural production system and have traditionally been part of the subsistence economy (Pérez Ripoll 1999, 99). Despite this, pigs must be kept on non-farmed land because of the damage they inflict on crops when digging (Hadjikoumis 2010).

One of the main problems for estimating the importance of pigs in the overall agricultural system of production is the difficulty to morphologically and metrically set apart domestic pig and wild boar (Hadjikoumis 2010, 4; Albarella et al. 2005). In Chalcolithic Iberia the remarkable feature is a decrease in pig size (von den Driesch 1972; Morales Muñiz 1976; Hadjikoumis 2010, 6). This does not conform well with optimal raising conditions under semi-free regimes but rather with sedentary, less than optimum, management strategies (Hadjikoumis 2010, 6).

Environmental degradation, resulting from more intensive deforestation in the immediate surroundings of the settlements, led to a reduction in vegetation suitable for maintaining free-roaming pig herds (Hadjikoumis 2010, 348). This environmental degradation not only affected domestic pigs, but probably also the size of the wild boar populations.

### 7.2.1 Husbandry Strategies in the Lower Guadalquivir Valley: Case Studies

At Valencina-Castilleja the traditional view is that domestic livestock not only played a major role but also that in most sectors pigs were the most frequent species (Hain 1982; Pajuelo Pando/López Aldana 2013; Abril López 2012, 277; Bernáldez Sánchez 2013). Along with bovines, pigs appear to represent the main stock and for some authors

this alone would suggest a process of intensification and specialisation in husbandry management practices (Hadjikoumis 2010, 348). Despite this, the results from previous zooarchaeological studies in different sectors of this site reveal sheep to be the dominant species in terms of MNI, and that the animal economy was likely diversified and based on the production of secondary products in addition to meat (appendix 7). Cattle, although taking third place both in terms of NISP and MNI, still played an important role as a meat producer and for secondary products such as milk, manure or labour. Pigs, despite featuring the highest NISP, served as a second-order meat resource perhaps also taking roles as natural waste disposers and manure producers (Nelson 1998, 2). Could this high pig NISP indicate a more intimate association with households only as would be the case for the ruminants? Stabling in pigs is suggested by their small size and incidence of dental pathologies, but this is an issue requiring further research.

The sex and age profiles for cattle point instead to a non-specialised livestock strategy on family-level, in which animals were multifunctional. The proportion of females exceeds that of males in most sectors, including those of La Gallega, La Perrera, and La Candelera. This is taken to reflect an exploitation aimed at obtaining both secondary products (mostly females, but also oxen) and meat in the case of males (Hain 1982, 150; Bernáldez Sánchez 2013) (*fig. 123*).

The tendency for individuals to be slaughtered at a young age for meat supply and as adults, when labour and milk were targeted seems compelling (*fig. 123*).

The use of bovines for draught is evidenced by the presence of bone pathologies associated with this kind of activity in several sectors of Valencina-Castilleja including Cerro de la Cabeza, La Perrera, PP Matarrubilla, and La Gallega (Hain 1982; Fernández Gómez 2013, 139; Abril López 2012; Bernáldez Sánchez 2013; Pérez Ripoll 1999, 98).

At the Pabellón Cubierto sector, a peculiar wear of the cervical area of incisors reveals prolonged access of the Valencina-Castilleja bovines to natural pastures, as this kind of wear is caused by abrasion of grasses being pulled in-between incisors by the tongue.

Based on the analyses conducted in the sectors of La Perrera, Cerro de la Cabeza, and PP Matarrubilla, the data reveal average heights at the withers for females of 1.15m and of 1.27m for males and castrates (Hain 1982, 25; Abril López 2012). According to Hain, the difference in size between males and females is not only marked but also the Valencina-Castilleja bovines exhibit higher sizes than those recorded at this time outside the region as would be Zambujal and Cerro de la Virgen (Hain 1982, 25). Log-ratio analyses evidence the Valencina-Castilleja bovines to be larger than the reference standard for this period (*fig. 124*). This high size reflects favourable conditions, in which the herd would possibly exist in a semi-free-roaming regime, also pointed out by the isotopic analyses (see chapter 7.3).

The plotting of the width of the diaphysis (SD) and the maximum length (GL) of the metacarpus and metatarsus evidences a clear difference between bulls and cows (*fig. 125*).

In the case of caprines, there is a clear predominance of sheep over goats, the latter being all female (Hain 1982, 39). In sheep, females outnumber males two to one and this could be taken to indicate a production focusing on meat and dairy products alike (Hain 1982; Fernández Gómez/Oliva Alonso 1985, 122).

Despite all age cohorts in sheep being represented, the mortality profile (*fig. 126*) reveals that in most sectors there is a predominant slaughtering of animals below two years, this being the optimum age when meat output is sought (Hain 1982, 41; Fernández Gómez 2013, 139; Bernáldez Sánchez 2013; Pajuelo Pando/López Aldana 2013). In the study carried out at Cerro de la Cabeza and La Perrera, one out of five individuals were slaughtered within their first nine months of age, and just under half of the remaining individuals were slaughtered after reaching two years (Hain 1982, 40). One third of the latter reach above 3.5 years suggesting use for dairy farming and perhaps wool as well. Since castrated individuals provide larger quantity and better-quality wool, the finding of castrates and large sheep in sectors such as PP-Matarrubilla and La Perrera reinforces this use of sheep for wool production (Abril López 2012, 278; Fernández Gómez/Oliva Alonso 1985, 121). Also, given that the highest quality wool

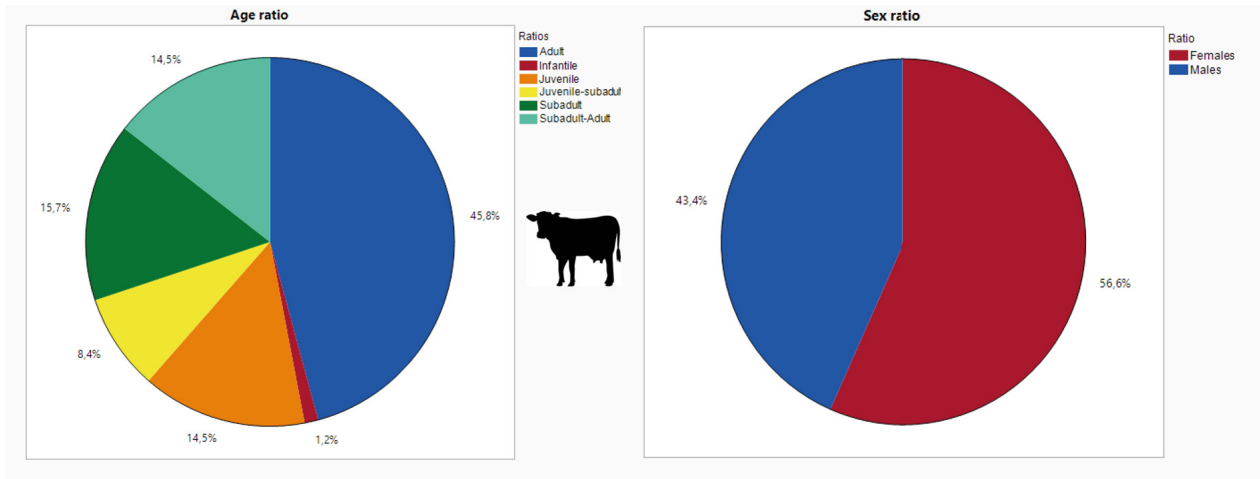


Fig. 123. Cattle sex and age ratio from Valencina-Castilleja.

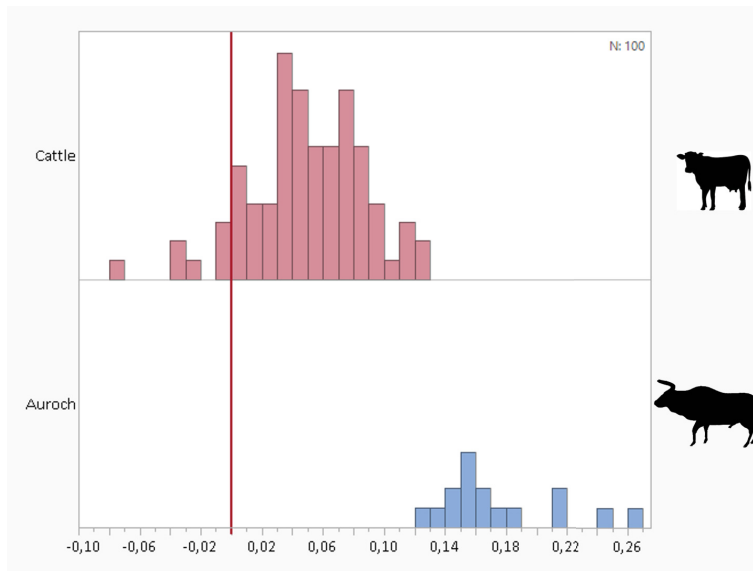


Fig. 124. Variation in cattle and aurochs postcranial measurements using a log-ratio technique. The standard ('0.00') is expressed by a red vertical line and is calculated from Elms Farm Period I, Heybridge, Essex (Johnstone/Albarella 2015; including data from Hain 1982 and Liesau von Lettow-Vorbeck et al. 2014).

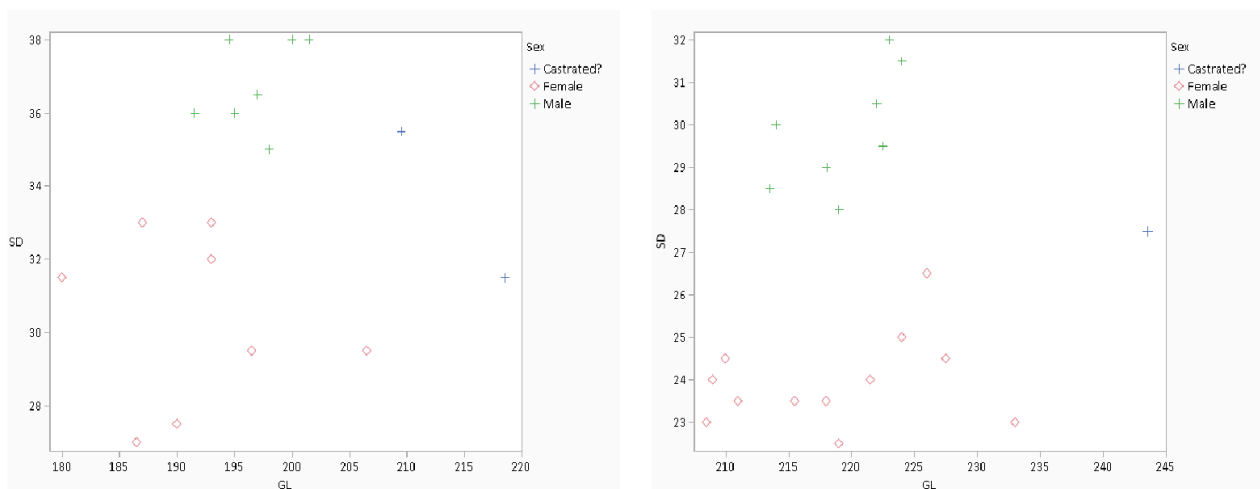


Fig. 125. Scatter diagrams showing the size of the metacarpal (left) and metatarsal (right). GL (greatest length) vs. SD (smallest breadth of the diaphysis). Including data from Hain (1982) and Liesau von Lettow-Vorbeck et al. (2014).

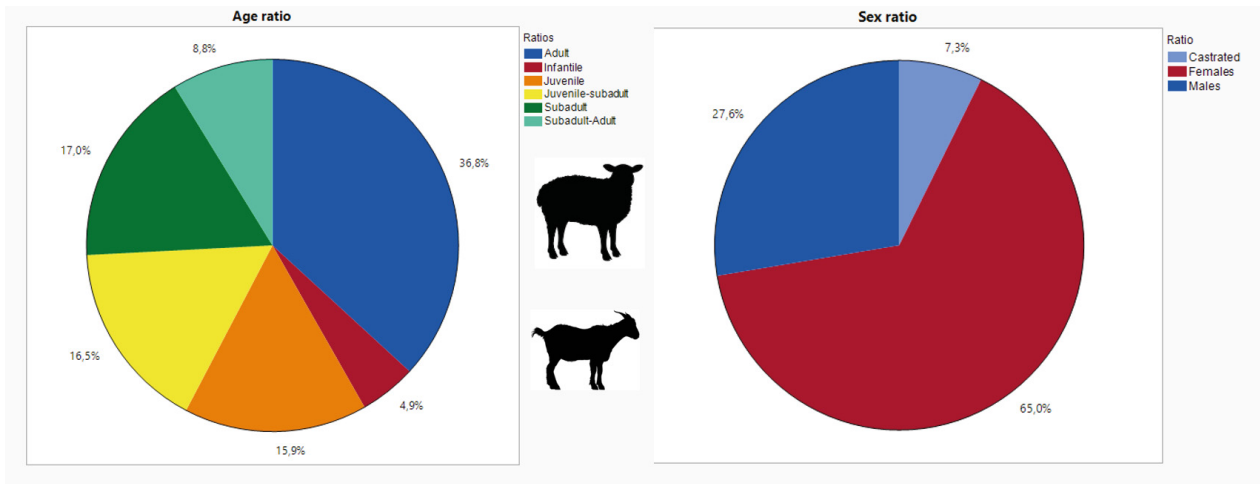


Fig. 126. Caprine age ratio and sex ratio in sheep at Valencina-Castilleja.

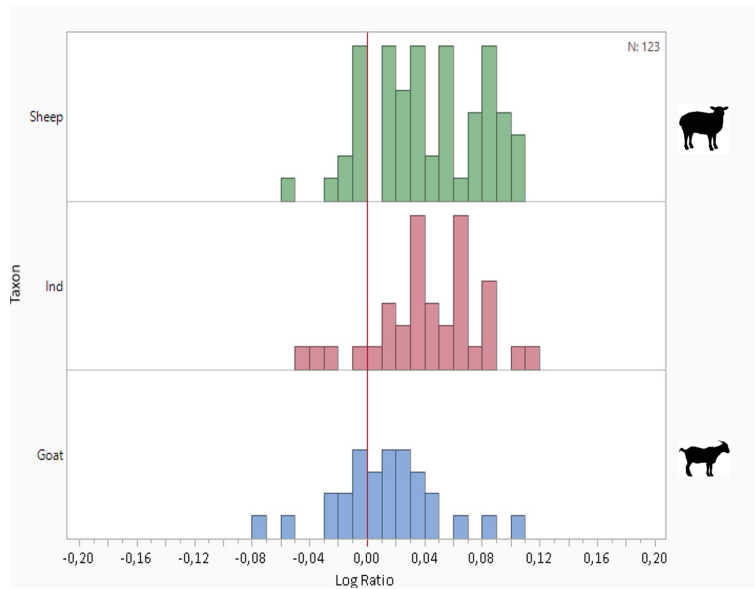


Fig. 127. Variation in sheep and goat post-cranial measurements compared with a standard using a log-ratio technique. The standard ('0,00') is expressed by a red vertical line and is calculated from a group of 26 adult female unimproved Shetland sheep from a single flock (Davis 1996; including data from Hain 1982 and Liesau von Lettow-Vorbeck et al. 2014).

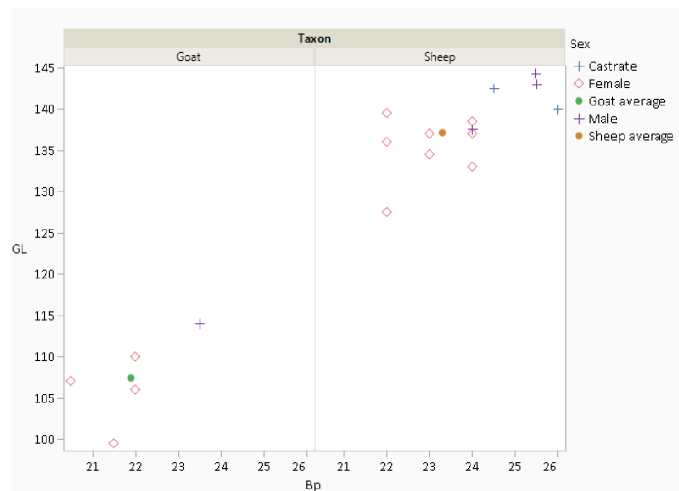
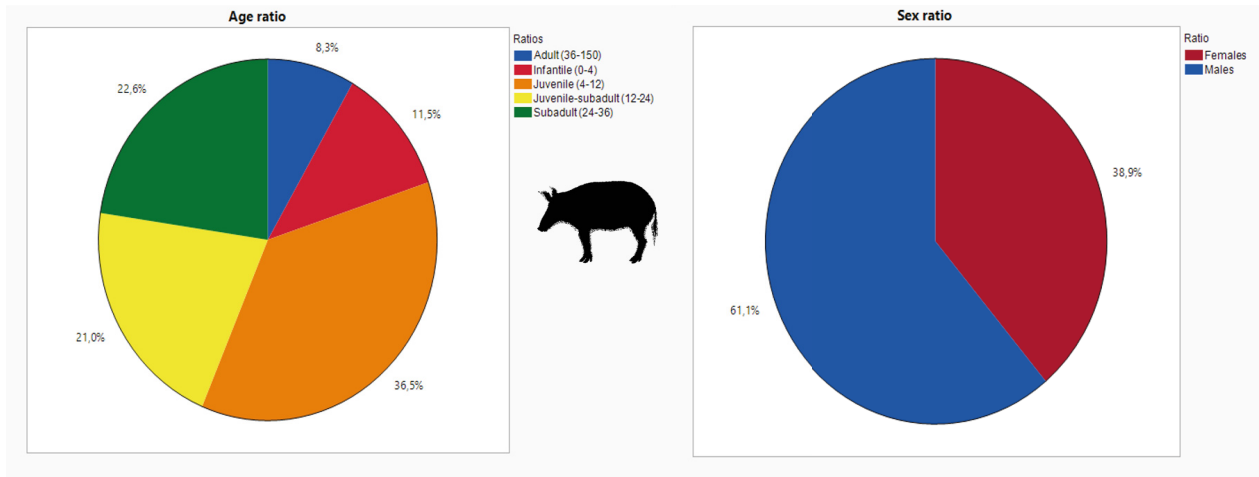


Fig. 128. Scatter diagrams showing the size of metacarpals at Valencina-Castilleja. Bp (breadth of the proximal end); GL (greatest length) from sheep and goat (including data from Hain 1982 and Liesau von Lettow-Vorbeck et al. 2014).



**Fig. 129.** Age and sex ratio for pigs from Valencina-Castilleja.

comes from individuals between three and six years of age, the predominance of females among animals above 3.5 years, again suggests that females would be preferentially slaughtered when wool production diminished, a fact first put forward by Hain (1982, 41). The sex and age profiles of sheep point to a non-specialised, probably local, and household-level farming where most animals, as was also the case for cattle, played several roles.

In the study conducted by Hain, goats show a later age of slaughter, a fact that would again support their use in milk production (Hain 1982, 41).

The size estimation analyses of sheep from Valencina-Castilleja also stress the large size of these individuals. Hain (1982, 43) estimated that sheep ranged from 60 to 74cm in height at the withers with scarce differences between males and females. Goats would have been smaller, with an estimated height at the withers for females at Cerro de la Cabeza ranging between 56 and 65cm (Hain 1982, 47).

Log-ratio analyses reinforce this large size of the Valencina-Castilleja caprines, in particular sheep from Cerro de la Cabeza, PP4-Montelirio and Pabellón Cubierto (Hain 1982; Liesau von Lettow-Vorbeck et al. 2014) (*fig. 127*). This reinforces the notion of favourable living conditions also suggested for cattle due to favourable grazing lands (Llargo López/Ubera Jiménez 2013). The location of the site, near important aquifers, such as those found on the foothills of Gerena, and sandwiched between the Guadiamar River and a

bank associated with the former Guadalquivir's paleo-mouth, would guarantee sufficient pasture throughout the year for a small livestock population of caprines.

Plotting the maximum length (GL) and maximum proximal breadth (Bp) of the metacarpus, reveals the difference existing between the larger sheep and the smaller goats documented in Valencina-Castilleja (*fig. 128*). This size difference between sheep and goats may reflect differences in the management of the two stocks. In the case of sheep, large size would indicate good conditions, mainly in the maintenance and access to good pasture, and a non- or semi-stabled regime. The goats, that appear in far lower frequency, were likely maintained in a stabled regime aiming at a dairy production for self-consumption purposes where meat, mainly provided by young animals, would be for the most part a side product of the milk economy.

The sex distribution analysis in pigs of the different sectors in Valencina indicates a 2:1 sex ratio in favour of males (Hain 1982; Abril López 2012; Bernaldez 2013; Pajuelo Pando/López Aldana 2013; Liesau von Lettow-Vorbeck et al. 2014; this work) (*fig. 129*). Such predominance of males conforms with a strategy aimed at meat production. Although all cohorts are represented, studies conducted at El Cerro de la Cabeza and La Perrera, coincide with ours in signalling substantial numbers of individuals slaughtered during their first year of life (Hain 1982; Fernández Gómez/Oliva Alonso

1985, 120). In Hain's samples, there was a predominance of individuals slaughtered between 13 and 26 months that he considers males for the most part, with a smaller fraction slaughtered after 26 months. It makes sense that males would be kept until they reached their maximum size around two years to optimise meat yield. One way or the other, the higher proportion of males, together with a predominance of individuals slaughtered during their second year of life, clearly points to a managed population (i.e. domestic pigs), rather than a wild or a mixed population of pigs and wild boar (fig. 129). This would reinforce the idea of a consolidated productive economy dependent on domestic resources as opposed to a casual/opportunistic relationship with wild boar (Hadjikoumis 2010, 346). This gender and age profiles also suggest a system of non-specialised exploitation, typical for household-level economies focused on meat production where quantity predominates over meat quality.

García Sanjuán argued that rapid processes of social and economic differentiation would explain a pig breeding strategy based on a regime of semi-free herds as the *montanera* system. García Sanjuán's reasoning rests on Hain's estimations on the size of pigs from Cerro de la Cabeza and La Perreña, which, according to the latter author, featured a height at the withers of ca. 65cm and a slender constitution, reflecting the semi-free regime of those pigs (Hain 1982; García Sanjuán 2013; 2017).

According to García Sanjuán, the zoomorphic representations of suids (fig. 130), which he attributes to domestic pigs, in the tholos of Montelirio stresses the importance that pigs had in these societies, where they became an important social and economic resource. One major drawback of the argument put forward by García Sanjuán is that throughout history all representations of domestic pigs in Iberia and Europe depict animals that resemble their agrotypes so that, based on physical appearance alone, one cannot say whether an animal is wild or domestic. Physical differences between domestic pigs and their wild ancestors would thus be restricted to size so that, in the absence of such parameter, discrimination between domestic and wild on the basis of figurative representations is impossible.

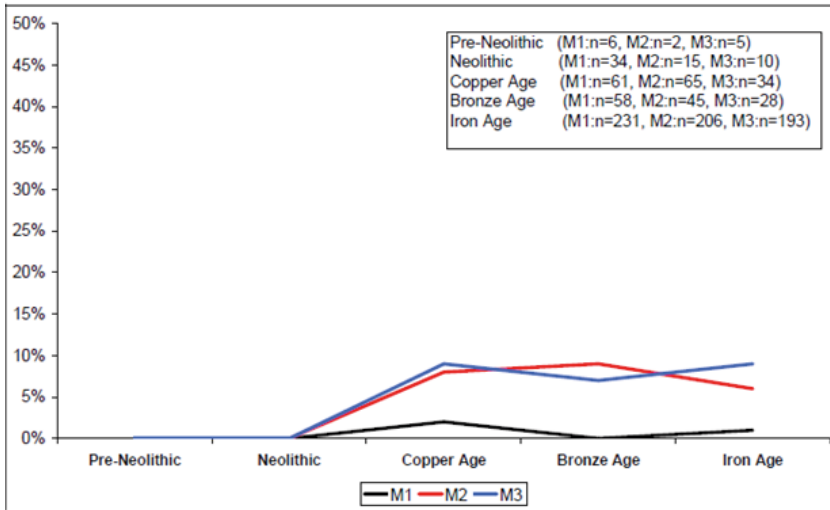


Fig. 130. Combs with zoomorphic representation from Valencina-Castilleja (after Bueno Ramirez et al. 2016, 385; photo: Rodrigo de Balbín Behrmann).

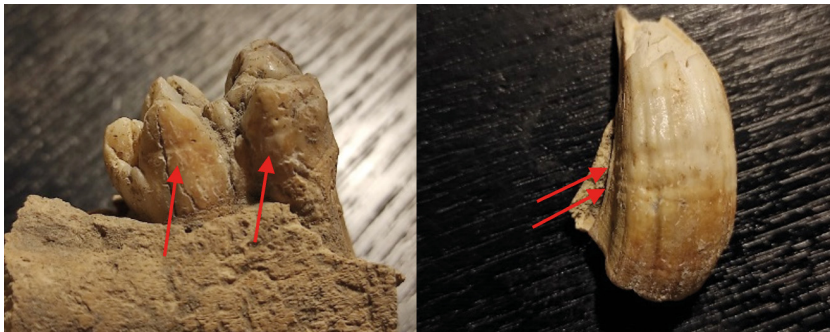
In addition, at Valencina-Castilleja zoomorphic figures include representations of a bovid in a pit from Calle Trabajadores, where a human skull was found also and an equine-pot from a funerary pit documented at PP4-Montelirio (García Sanjuán 2013; López Aldana/Pajuelo Pando 2013). Could those depictions reveal significant roles for cattle or, far more plausible in the Copper Age, for domestic horses?

The study carried out by Hain established the height at the withers for the Valencina-Castilleja pigs (lit. translated) 'between 60 and 70cm'. It is important to stress that Hain's estimations were based on a previous study carried out at Cerro de la Virgen by von den Driesch (1972). In fact, Hain could not estimate the height at the withers of the intensively fractured Valencina-Castilleja pigs as specified in his work:

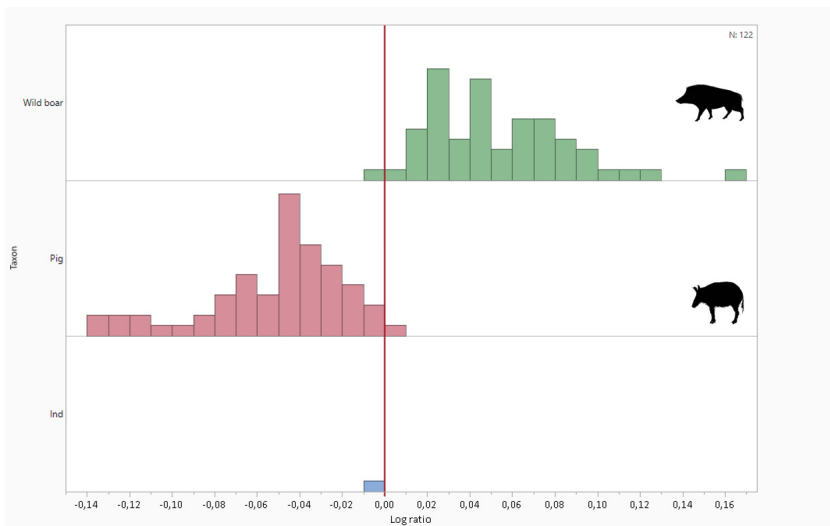
'Da selten in ganzer Länge erhaltene Röhrenknochen vorliegen, können meist nur Breitenmaße verglichen werden. Aus dem eben genannten Grund werden auch keine Widerristhöhenberechnungen durchgeführt. Was die Problematik angeht, aus kurzen Knochen (Talus und



**Fig. 131.** Double (or more) LEH line presence on each mandibular molar during Spanish Prehistory (after Hadjikoumis 2010, 238).



**Fig. 132.** LEH in M2 (left) and upper canine from structure 116 and 115 from Pabellón Cubierto.



**Fig. 133.** Variation in pigs and wild boar post-cranial measurements compared with a standard using a log-ratio technique. The standard ('0,00') is expressed by a red vertical line and is calculated from the Late Neolithic assemblage of Durrington Walls (Albarella and Payne 2005; including data from Hain 1982 and Liesau von Lettow-Vorbeck et al. 2014).

Calcaneus) und Metapodien allein die Schulterhöhe zu rekonstruieren, verweise ich auf die diesbezüglichen Ausführungen bei von den Driesch und Boesneck (1974: 342)' (Hain 1982, 75).<sup>8</sup>

'Um sich ein ungefähres Bild von der absoluten Größe der Schweine von Valencina machen zu können, sei vermerkt, daß von den Driesch (1972)

<sup>8</sup> 'Since tubular bones are rarely preserved in their entire length, only width can be compared in most cases. For the reason just mentioned, no calculations of the height at the

withers are done. Regarding the problem of reconstructing the shoulder height from short bones (talus and calcaneus) and metapodia only, I refer to the relevant explanations in von den Driesch and Boesneck (1974: 342).'

für die Schweine vom Cerro de la Virgen eine Widderristhöhe von knapp 60 cm bis knapp 75 cm, durchschnittlich gut 65 cm, angenommen hat, und daß in Valencina etwa gleichgroße bis etwas größere Tiere erwartet werden können<sup>9</sup> (Hain 1982, 76).

What Hain did instead was a comparison of the SLC measurement of the scapula and the maximum distal breadth (Bd) of the tibia of pigs from settlements on the Iberian Peninsula ranging from the Neolithic to Medieval times, deciding that the size of the Valencina-Castilleja pigs was below those from Zambujal and similar to those from El Cerro de la Virgen (Hain 1982, 76).

The increase in the number of dental pathologies, such as Linear Enamel Hypoplasia (LEH), identified with Neolithic pigs from southern Iberia (*fig. 131*), suggests deficient breeding conditions that would also be reflected in the size of individuals. This is apparently indicative of an intensification in the management of pigs (Hadjikoumis 2010, 238).

The presence of LEH (Linear Enamel Hypoplasia) in pigs kept in a *montanera* regime has never been recorded, because this practice allows varied access to food resources (roots, bark, seeds, pastures etc). Pigs kept in a stabled regime have restricted access to food so pathologies related to nutritional deficiencies are often common. The presence of pigs with LEH at Cerro de la Cabeza (Hadjikoumis 2010) and those identified in structures 115 and 116 from Pabellón Cubierto (*fig. 132*) call into question the proposal of García Sanjuan (2013; 2017) that pigs were kept in a semi-free-roaming regime.

The study conducted by Hadjikoumis suggests a differentiation in size between domestic pigs and wild boars. According to him this suggests that pigs from La Perrera and El Cerro de la Cabeza were genetically isolated from wild boars, hybridisation events between both populations being scarce or nil (Hadjikoumis 2010, 241).

Log-ratio analyses on the suids from Pabellón Cubierto, Cerro de la Cabeza, and PP4-Montelirio sectors of Valencina-Castilleja reveal the reduced size of pigs when compared to the Durrington Walls standard (Albarella/Payne 2005; Hain 1982; Liesau von Lettow-Vorbeck et al. 2014) (*fig. 133*). This marked size reduction probably reflects several factors, including an impoverishment in the diet and a restriction of backcrossing events between domestic pigs and wild boar.

Along this line of reasoning, the increased frequencies of dental pathologies recorded on our samples conforms with a reduction in size, since both hint at poor breeding conditions. This in turn, suggests greater control of individual pigs and thus an absence of a pig herd, but instead a pig exploitation strategy carried out at the level of each domestic unit.

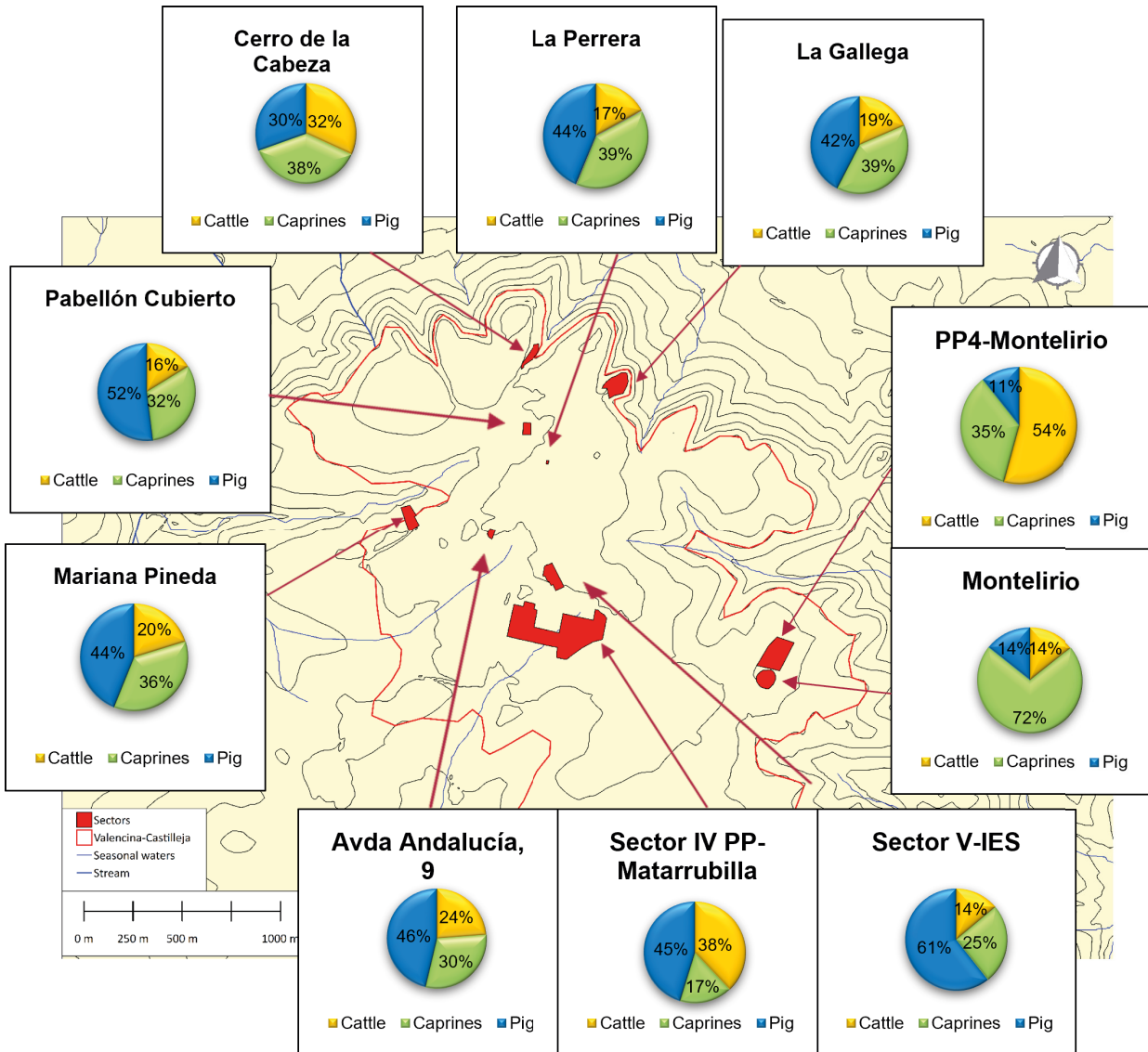
The mobility analyses presented in chapter 6 and below indicate a local range for almost all individuals that were analysed. Only three outliers with isotopic values from more radiogenic areas were found. In this case, it is possible that these represent wild boars. The isotopic ranges of the Valencina-Castilleja pigs indicates a more restricted range when compared with the domestic ruminants, reinforcing the idea of a stabling or semi-stabling regime with restricted access to resources, as some authors have already mentioned (Hain 1982; Cruz-Auñón Briones/Arteaga Matute 1999; Hadjikoumis 2010).

Except in the V-IES sector, where the data points to an increase in pigs, the spatial distribution of stocks in Valencina-Castilleja evidence no significant variations from sector to sector (*fig. 134*). In the PP4-Montelirio sector there is a higher frequency of cattle also and a predominance of caprines is seen at the tholos of Montelirio, but both are essentially funerary areas.

At Carmona, despite the scarcity of data, based on the NISP, caprines, dominated by sheep, play the main role followed by cattle and pig (appendix 7). According to Martínez Sánchez, this predominance of caprines was developing in the area since the Middle Neolithic (Martínez Sánchez 2013a, 37).

The mixed use of sheep and cattle hints at the existence of a self-sufficient subsistence economy where animals would be valued for all their

9 'In order to get an approximate idea of the absolute size of the pigs of Valencina, it should be noted that von den Driesch (1972) assumed a wither height of just under 60 cm to just under 75 cm, on average a good 65 cm, for the pigs of the Cerro de la Virgen, and that in Valencina, animals of similar or slightly larger size can be expected.'



**Fig. 134.** Spatial distribution of the NISP from the main domestic stocks on the different sectors of Valencia-Castilleja.

products and not just for their meat, the sole exception to that ‘rule’ being pigs.

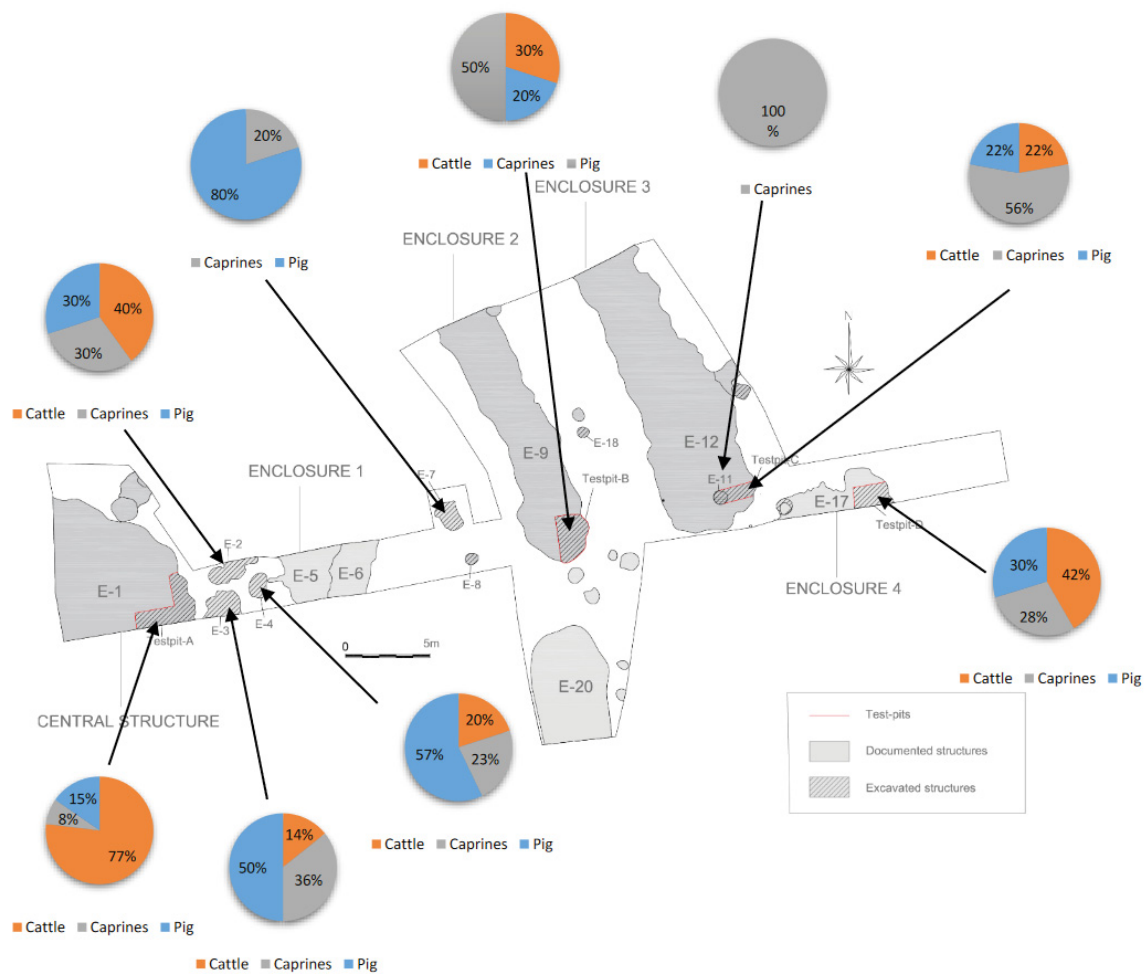
For the cattle of Carmona Moreno García (1999a; 1999b) suggests a mixed use of stocks for a small, self-sufficient community, as at Valencia-Castilleja. The slaughter pattern indicates a predominance of adult and infantile, which according to Moreno, point to their use for milk production. This strategy combines the exploitation of the youngest individuals for high-quality meat and that of adults for milk/dairy products and labour. In the case of caprines, the mortality profile suggests a preferential slaughter of infantile, juvenile, and sub-adults with a secondary peak of senile individuals, again suggesting a

multifunctional strategy for obtaining meat and secondary products.

Log-ratio analyses from Carmona also reveal the large size of cattle and caprines, reinforcing the hypothesis of a livestock management practice based on a semi-free regime in which access to resources is guaranteed by the productive environment around the settlement.

As at Valencia-Castilleja, the mortality profiles of pigs reflect a preferential consumption of non-adult animals.

The wild fauna from the LRT-II sector of the La Loma del Real Tesoro settlement features higher frequencies than anywhere else (appendix 7). This increase in wild species, also documented at



**Fig. 135.** Spatial distribution of the NISP from the main domestic stocks on the different sectors of La Loma Real del Tesoro.

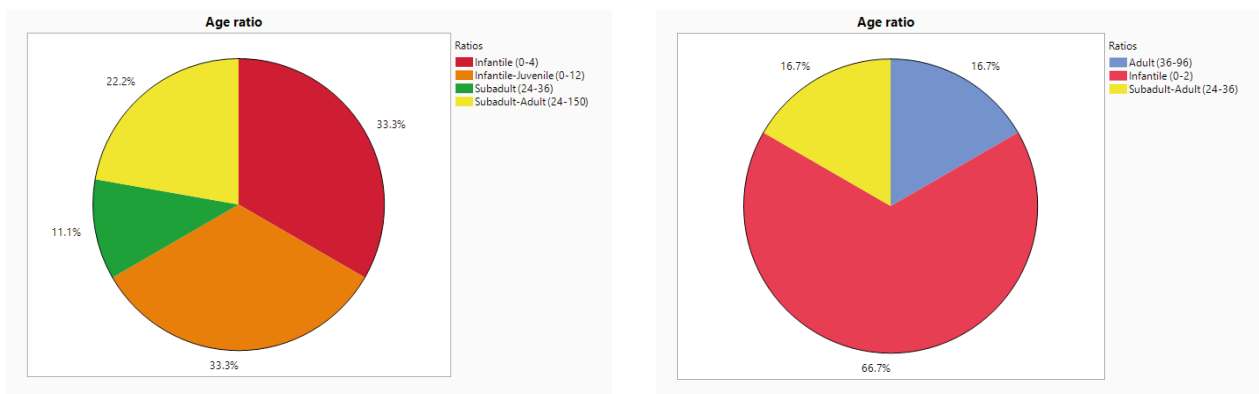
Poblado Calcolítico, may reflect the proximity of both settlements to the Sierra Norte of Seville and a more intimate interaction of the human populations with wild environments than is the norm for sites on the lower lying Guadalquivir Valley plain.

Taking the weight of the remains as a reference, cattle constitute the number one taxon in terms of biomass, followed by pigs. In terms of the spatial distribution, the greatest concentration of cattle appears in the central structure, whereas in structures 9, 11, and 12 caprines are most frequent. Pigs, in turn, concentrate on structures 3, 4, and 7 (fig. 135).

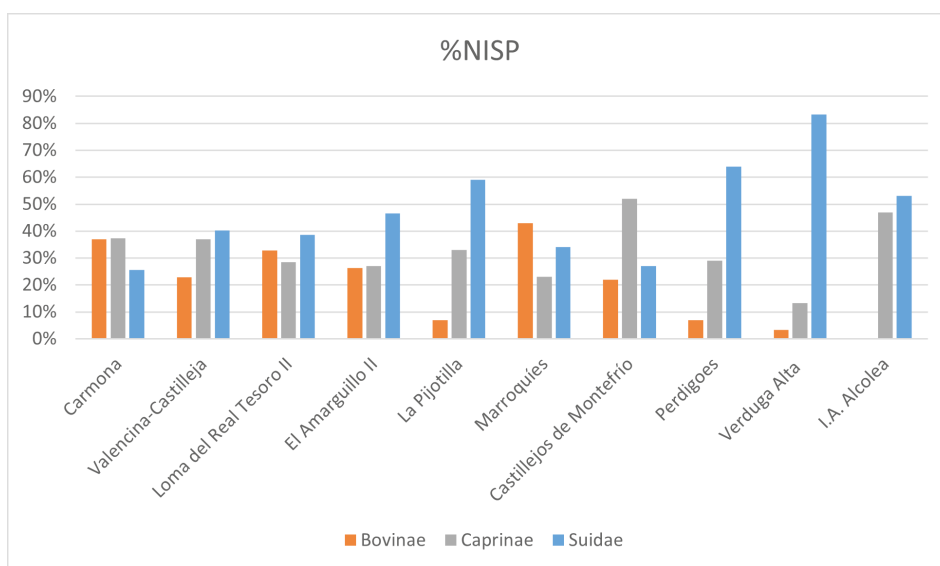
In the case of caprines, despite the small sample, the predominance of individuals slaughtered at a young age seems clear. This contrasts with the situation documented for pigs, which show a similar age of slaughter in all age ranges. This would

indicate a use for pigs in strict terms of meat exploitation that is further supported by the 3:1 predominance of males over females (fig. 136). For bovines, less clear inferences can be drawn, although the abundance of sub-adults and adults hint at multifunctional roles.

At El Amarguillo II and Parque Miraflores, studies reported a predominance of domestic animals over wild ones and also showed a diversified economy in which the main role was played by cattle at El Amarguillo II and pig at Parque Miraflores (Bernáldez Sánchez 2009b, 122; Lara Montero et al. 2004, 250) (appendix 7). In the case of Poblado Calcolítico, only one structure has been analysed where wild species predominate over domestic ones (Bernáldez Sánchez/García-Viñas 2010). This finding reflects a closer interaction with wild habitats due to its location near the Sierra Norte of Seville.



**Fig. 136.** Age distribution in pigs and caprines from Loma del Real Tesoro II.



**Fig. 137.** Species proportion (%NISP) by sites (including data from Moreno García 1999a; 1999b; Hain 1982; Abril López 2012; Liesau von Lettow-Vorbeck et al. 2014; Sardá Piñero 2013; Bernáldez Sánchez 2002; 2009a; Bernáldez Sánchez et al. 2013; Riquelme Cantal 1996; Cabaço 2010; 2011; Martínez Sánchez 2013b).

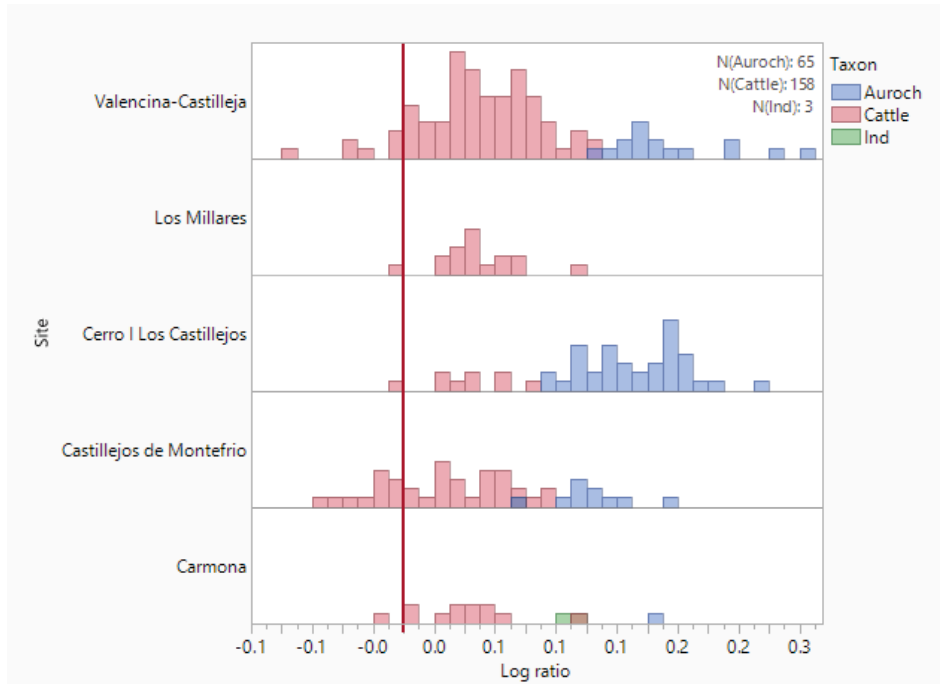
Our study systematically reveals livestock management practices pointing to a diversified exploitation system that is characteristic for domestic farming economies where hunting plays a secondary role. Considering species abundances in terms of NISP reveals a stockbreeding practice in which pigs played a major role as meat provider whereas caprines and cattle, despite lower frequencies, played the main role as secondary products providers (fig. 137).

Log-ratio analyses in cattle evidence the large size of individuals from all sites analysed when compared to the standard. Measurements from Los Castillejos de Montefrío (Granada), Los Millares

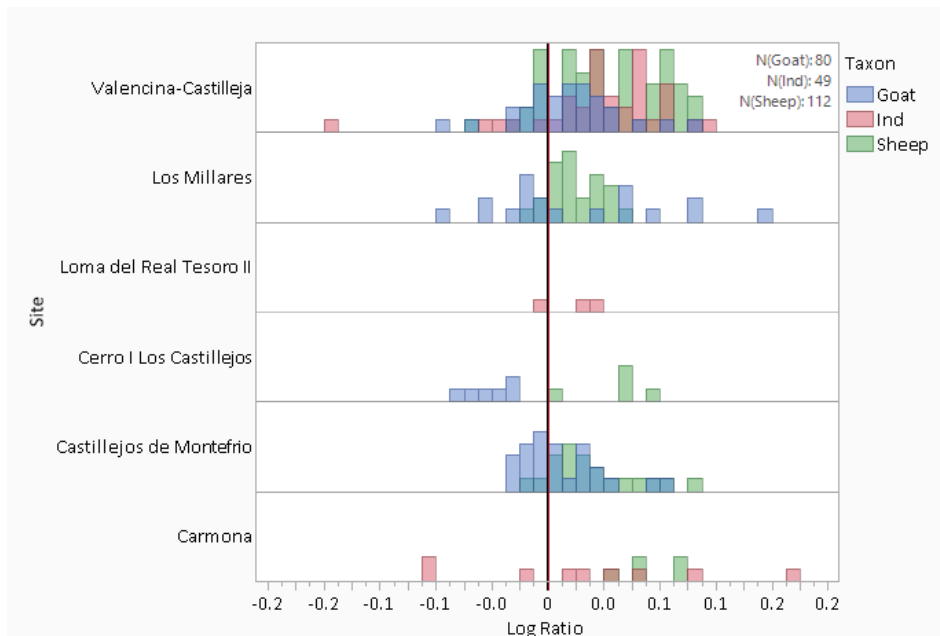
(Almería), and Cerro I Los Castillejos (Fuente de Cantos-Badajoz) have been included here for comparative purposes (Castaños Ugarte 1997) (fig. 138).

Log-ratio analyses of caprines have shown the large size of all individuals, in particular sheep, as was also the case with cattle. Such values would indicate good access to resources, thus probably a semi-free stockbreeding regime (fig. 139).

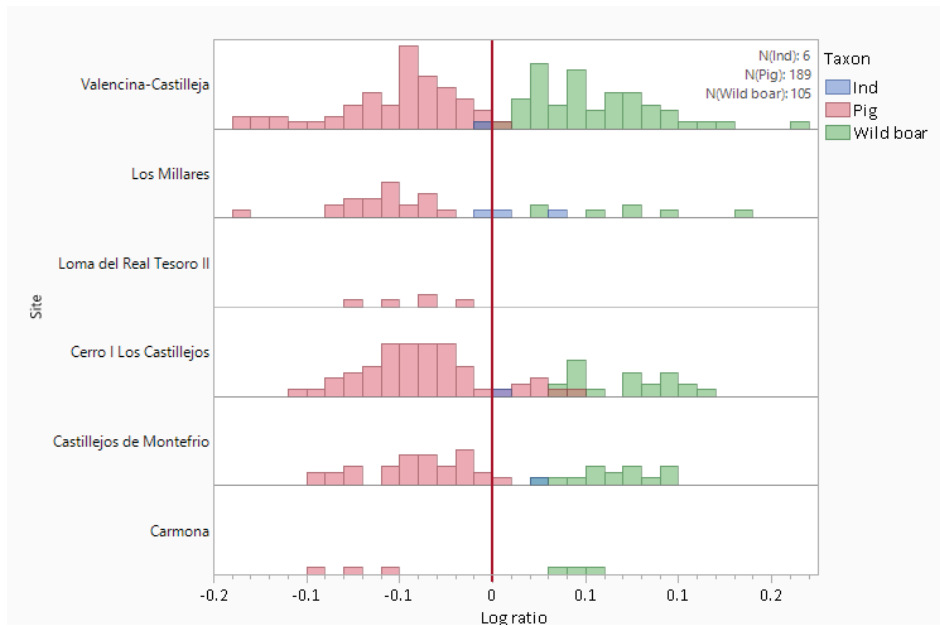
In contrast with the ruminant stocks, pigs exhibit a systematically lower size when compared to the standard (fig. 140). Only at Cerro I Los Castillejos (Fuente de Cantos) pigs are larger although here the possibility exists that a significant number of suids represent wild boar.



**Fig. 138.** Variation in cattle and aurochs postcranial measurements from different Copper Age sites in the Iberian Peninsula using a log-ratio technique. The standard ('0,00') is expressed by a red vertical line and is calculated from Elms Farm Period I, Heybridge, Essex (Johnstone/Albarella 2015; including data from Hain 1982; Liesau von Lettow-Vorbeck et al. 2014; Peter/Driesch 1990; Castaños Ugarte 1997; Ziegler 1990; Riquelme Cantal 1996; Moreno García 1999a).



**Fig. 139.** Variation in sheep and goat post-cranial measurements from different Copper Age sites of the Iberian Peninsula compared with a standard using a log-ratio technique. The standard ('0,00') is expressed by a red vertical line and is calculated from a group of 26 adult female unimproved Shetland sheep from a single flock (Davis 1996; including data from Hain 1982; Liesau von Lettow-Vorbeck et al. 2014; Peter/Driesch 1990; Castaños Ugarte 1997; Ziegler 1990; Riquelme Cantal 1996; Moreno García 1999a).



**Fig. 140.** Variation in pigs and wild boar post-cranial measurements from different Copper Age sites in the Iberian Peninsula compared with a standard using a log-ratio technique. The standard ('0.00') is expressed by a red vertical line and is calculated from the Late Neolithic assemblage of Durrington Walls (Albarella/Payne 2005; including data from Hain 1982; Liesau von Lettow-Vorbeck et al. 2014; Peter/Driesch 1990; Castaños Ugarte 1997; Ziegler 1990; Riquelme Cantal 1996; Moreno García 1999a).

### 7.3 Subsistence Patterns and Economic Systems in the Lower Guadalquivir Valley during the Copper Age: An Isotopic Approach

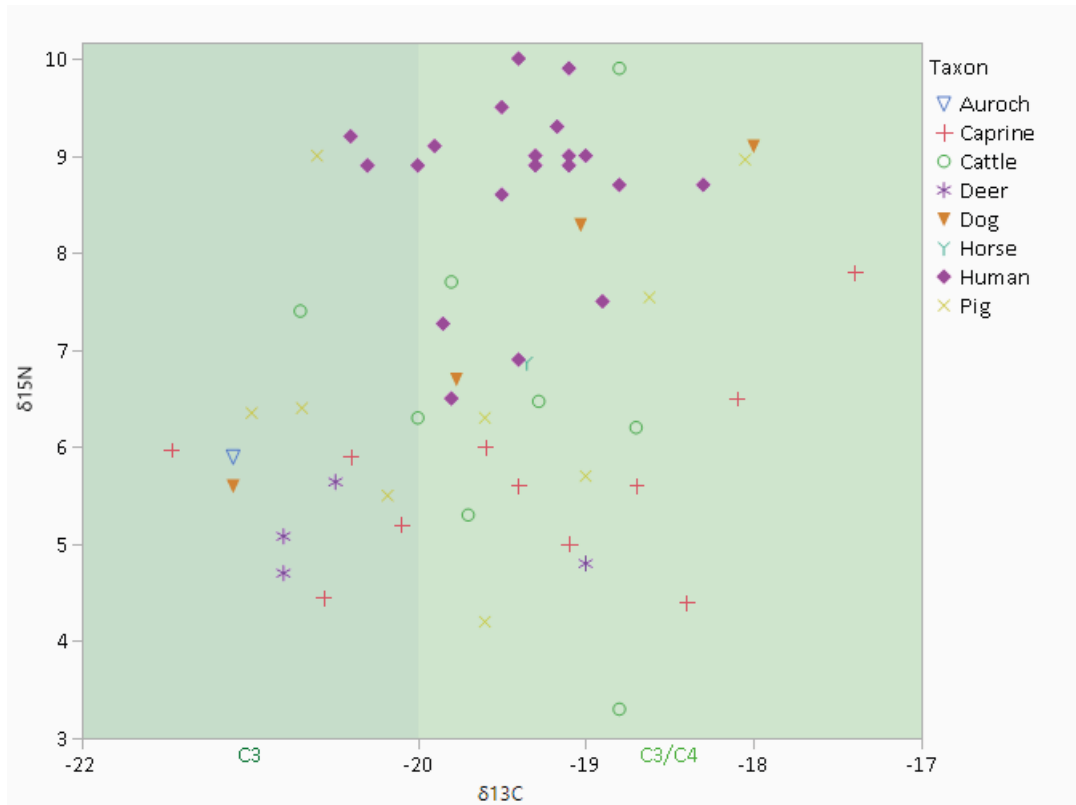
According to Perez Ripoll (1999, 99), the transformations that arose in the Late Neolithic implying a greater specialisation in the management of agricultural and domestic animal resources would have reached their zenith during the Chalcolithic period when a dissociation on the part of the livestock breeders from the crop farming took place. According to this model, large herds would have required greater autonomy, fostering the emergence of transhumance either at a local or regional scale.

According to Fernández Gómez (2013, 139), the low representation of wild species documented in test trenches C and D of La Perrera demonstrate that hunting played a secondary role similar to what is seen in the remaining sectors of Valencina-Castilleja where fauna has been analysed. As evidenced by the faunal record of Valencina-Castilleja, Carmona, and El Amarguillo II, hunting played a

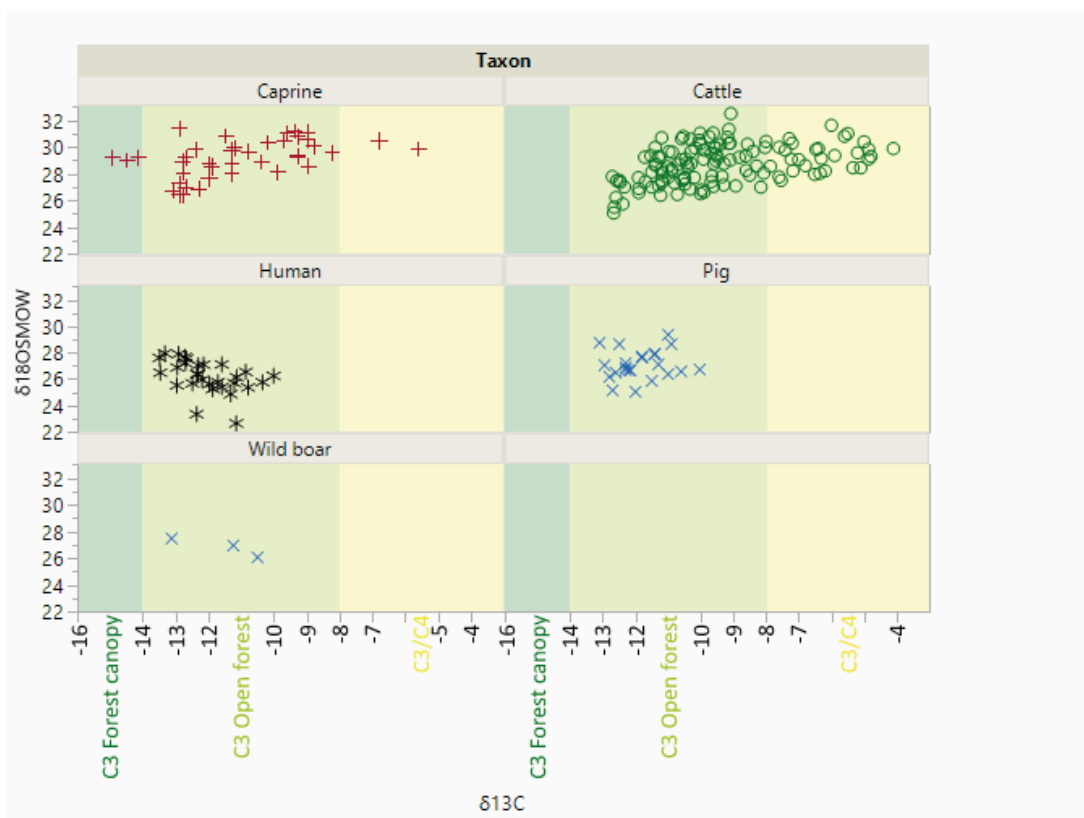
minor role in the economic life of the communities of the Guadalquivir Valley that focused instead ruminant herds. Is it possible to gather further insights into the features of these herds and their management through alternative means?

Previous studies on human bone remains from Valencina-Castilleja indicate a diet based on type  $C_3$  plants with low protein intake, mainly deriving from herbivores (Díaz-Zorita Bonilla 2017, 124). This data reinforces the idea of a subsistence economy based on crop farming resources and those of the livestock whose isotopic signatures can be seen in fig. 141 (Fontanal-Coll et al. 2017, 446).

The  $\delta^{13}C_{co}$  values of the fauna from Valencina-Castilleja are compatible with a diet composed of  $C_3$  plants, typical of open landscapes, as well as with a mixed diet of  $C_3$  and  $C_4$  plants. The evidence for consumption of  $C_4$  plants is understandable in environmental terms, due to the closeness of the site to the Guadalquivir paleo-estuary where  $C_4$  plants abound. The wide dispersion of values for the different species based on  $\delta^{13}C_{co}$  and  $\delta^{15}N$  values is another key feature to keep in mind for the remainder of this discussion (fig. 141).



**Fig. 141.** Results of  $\delta^{13}C_{co}$  and  $\delta^{15}N$  from Valencina-Castilleja showing, in different colours, the type of plants consumed C3/C4 (human values taken from Díaz-Zorita 2017 and Fontanal-Coll et al. 2015).



**Fig. 142.**  $\delta^{13}C_{cap}$  and  $\delta^{18}O$  from Valencina-Castilleja (human values taken from Díaz-Zorita 2017).

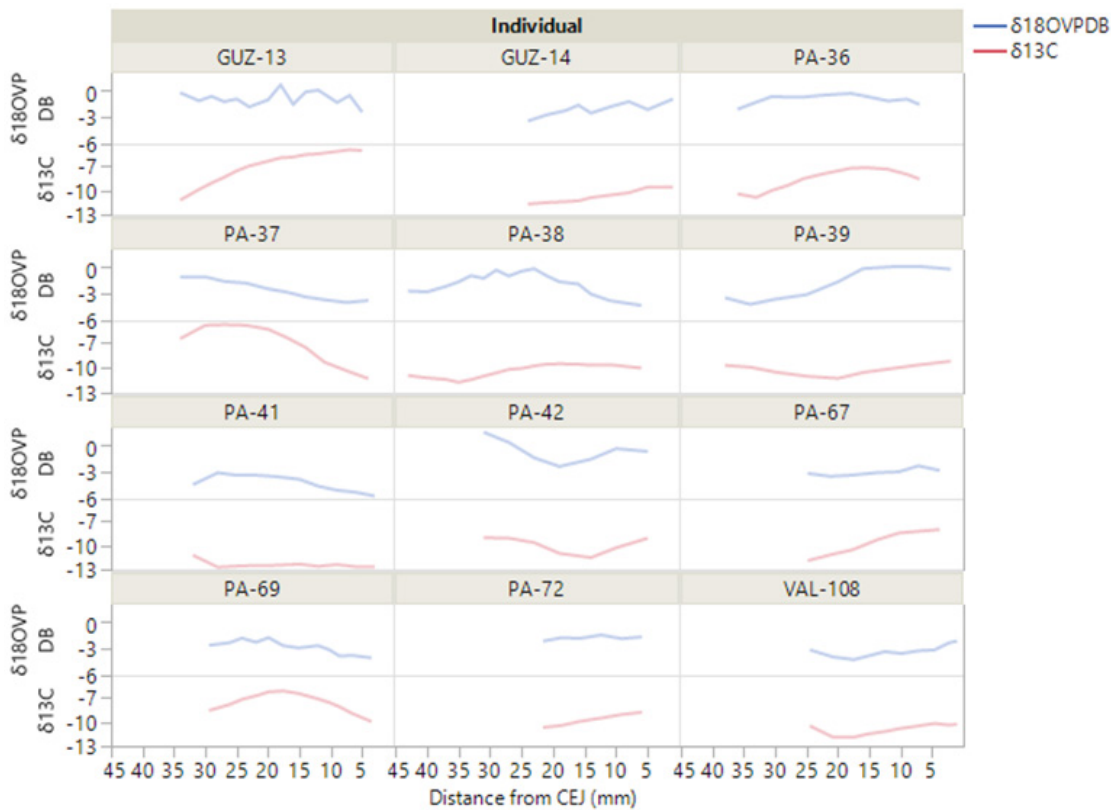


Fig. 143. Intra-individual sampling analysis of  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}_{\text{ap}}$ .

In the case of cattle, the predominance of  $\text{C}_3/\text{C}_4$  plants in the diet could be due to their preferential consumption of grass in contrast with sheep, who have a preference for forbs which are mostly  $\text{C}_3$  plants. Likewise, the variability in the values of  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}_{\text{ap}}$  reflect both a differential access to water as well and changes in the availability of seasonal vegetation (fig. 142).

Due to the multi-proxy approach implemented in this study, it is possible to look at intra-individual sampling to reconstruct the life histories of particular individuals (fig. 143). This would be the case of the PA-37, 38, and 39 samples that indicate a mixed consumption during the early stages of growth and a diet of  $\text{C}_3$  plants in the later life of this individual, a pattern typical of open forest landscapes. Samples GUZ-13 and GUZ-14 point instead in an opposite direction, for here the consumption of  $\text{C}_3$  plants from open forest predominates during the first stages of tooth formation and later stages shows a mixed consumption of type  $\text{C}_3/\text{C}_4$  plants. This variability in consumption patterns rests upon seasonal changes.

The  $\delta^{18}\text{O}$  vs.  $\delta^{13}\text{C}_{\text{ap}}$  data point to a greater use made of the territory by caprines as opposed to cattle.

Intra-tooth analyses indicate certain variations in the consumption of  $\text{C}_3$  and  $\text{C}_4$  plants, as well as variations in the values of  $\delta^{18}\text{O}$  that would be accounted for by the variability of water access points, as well as by seasonality (fig. 144). The increase in the  $\delta^{18}\text{O}$  values along with the increase in the values of  $\delta^{13}\text{C}_{\text{ap}}$ , indicate a lower humidity, which, in the case of  $\delta^{18}\text{O}$  would be reflected in the vegetation, as well as by an increase in the consumption of  $\text{C}_4$  plants.

The consumption of  $\text{C}_4$  plants has been now documented for humans in the area of the Portuguese Extremadura (Waterman et al. 2016). For some authors, the increase in consumption of  $\text{C}_4$  plants began in the middle of the 3<sup>rd</sup> mill. BC in the area of the central plateau of the Iberian Peninsula (Díaz del Río Español et al. 2017).

For pigs, values show a more restricted use of the territory than that seen for caprines, and, as with the latter, the increase of  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}_{\text{ap}}$  values should be closely related to seasonal changes

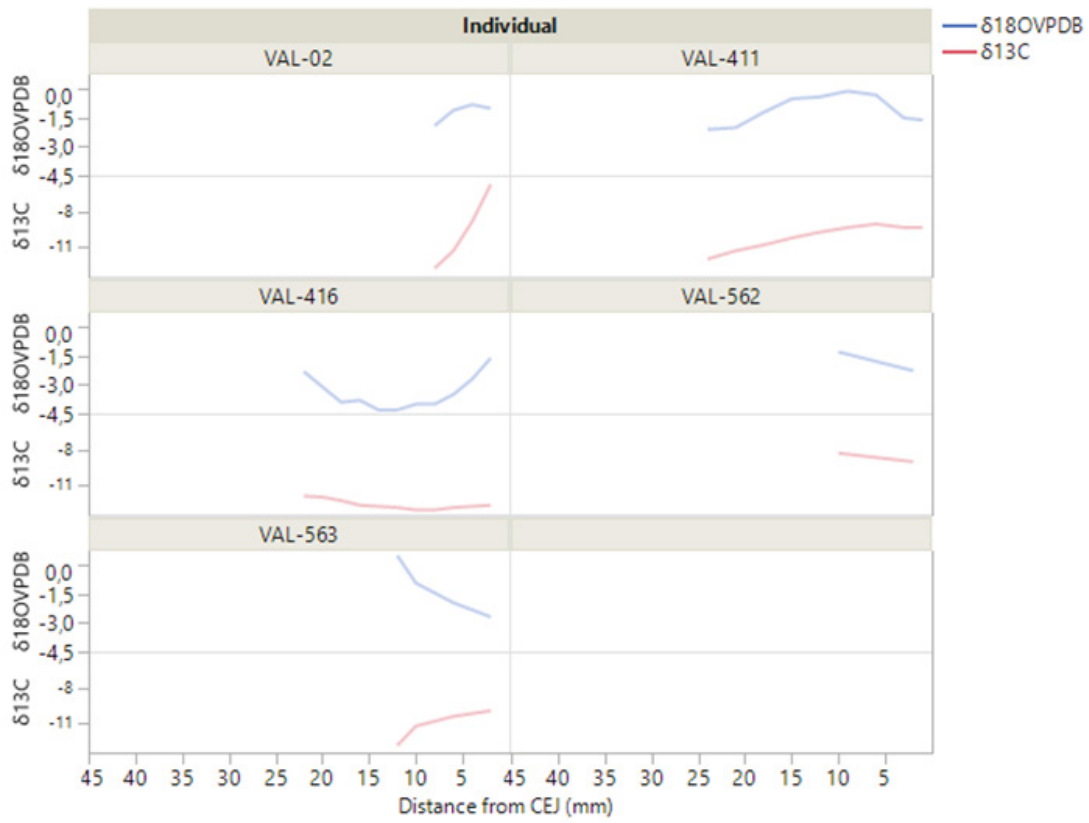


Fig. 144. Intra-individual sampling analysis of  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}_{\text{ap}}$ .

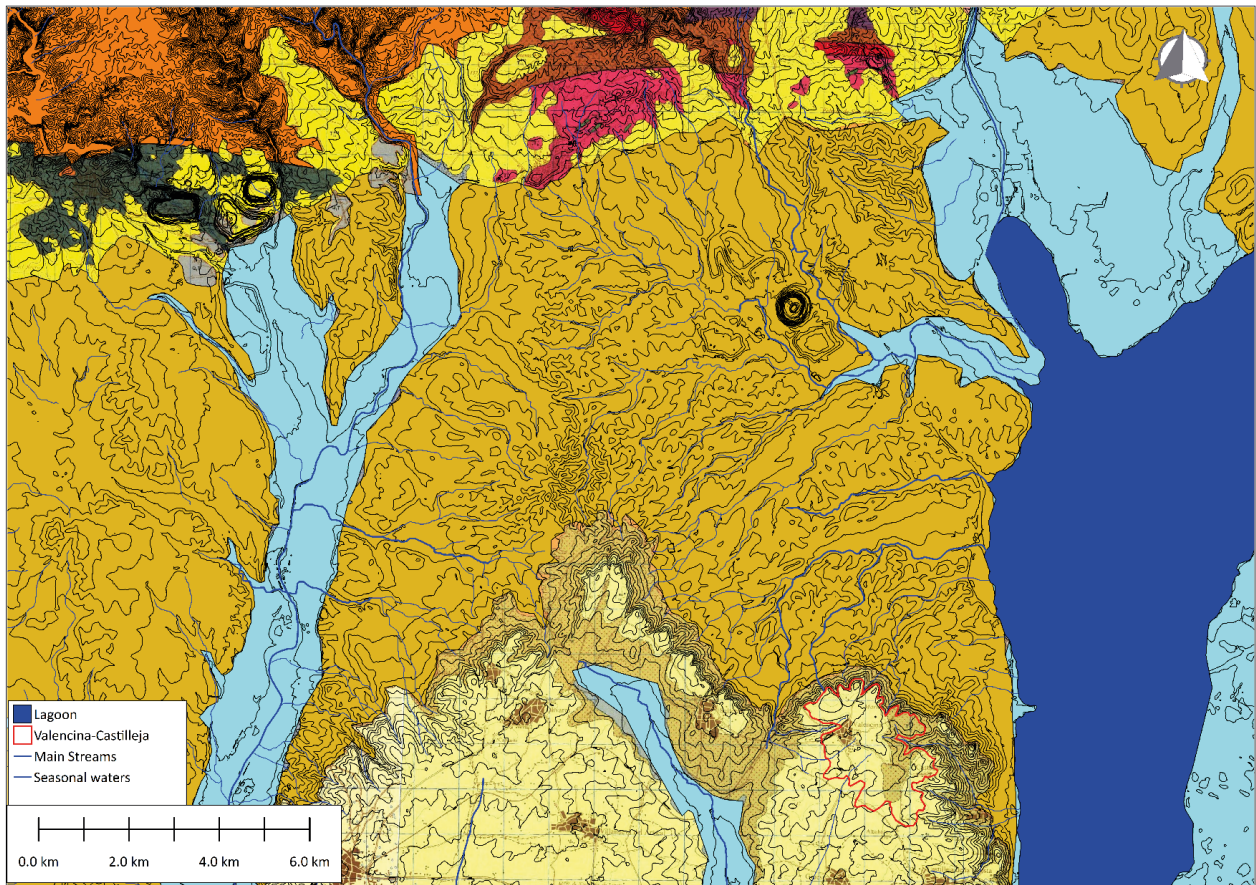


Fig. 145. Main streams and seasonal water in the foothills of Gerena.

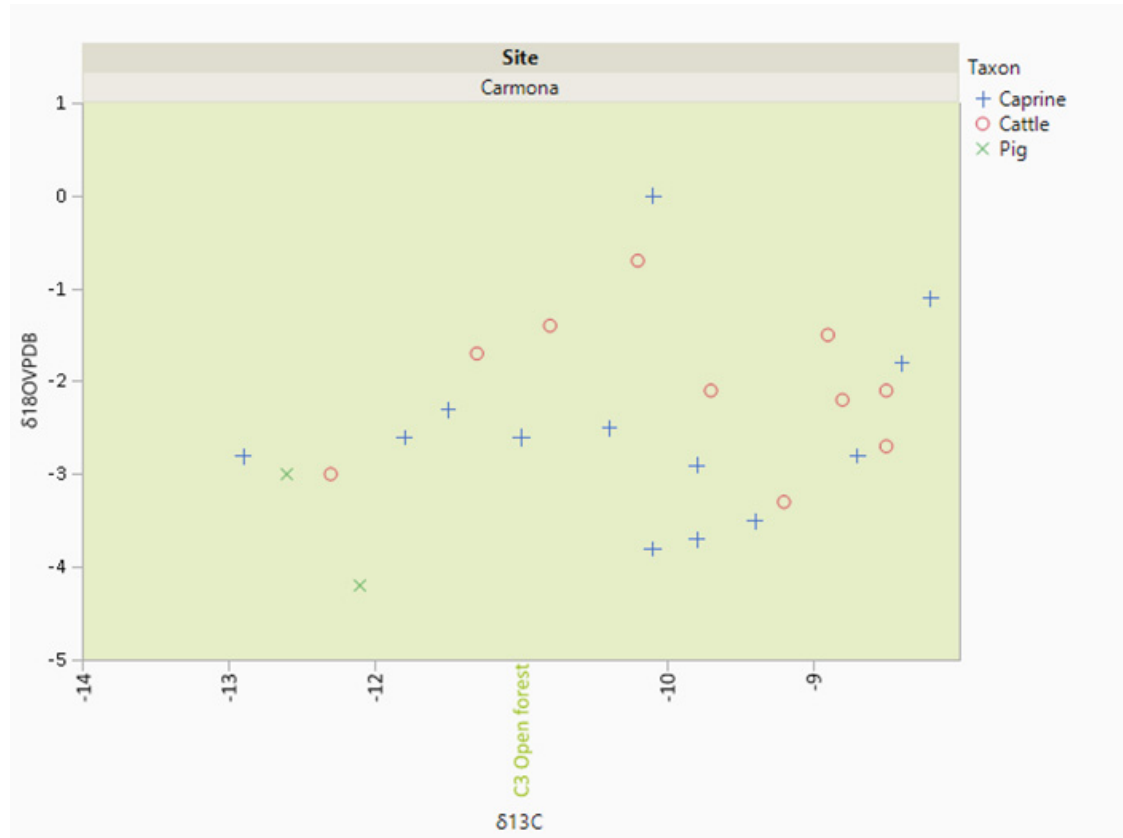


Fig. 146. Analysis of  $\delta^{18}O$  vs.  $\delta^{13}C_{ap}$  based on local cattle, caprines, and pigs in Carmona.

in the vegetation, typical for the Guadalquivir Valley (i.e. dry summers and wet winters).

The variability of  $\delta^{18}O$  is also explained by the diversity of available river resources at Valencina-Castilleja. Paleoenvironmental reconstructions as well as archaeological excavations indicate the presence of a temporary runoff near the site as well as the presence of wells on the site itself (Vargas Jiménez 2003). These different water sources would translate into different  $\delta^{18}O$  signatures within a restricted space. Likewise, the presence of the paleo-estuary and the different streams on the foothills of Gerena, each with independent origins, should also foster this variability (fig. 145).

The data from Carmona suggests a landscape with more vegetation in which the local bovines evidence a preferential consumption of  $C_3$  plants typical of dense and open forests, as well as access to different water sources (fig. 146). This hints at a management strategy in which bovines were kept in the semi-free-roaming regime one would expect in case Valencina-Castilleja spread over a wide territory. The fact that  $C_3$  plants from dense forest environments were consumed suggests

that, despite the landscape being already anthropised, woodland pockets persisted around this site at the time.

The data from El Amarguillo II indicates consumption of  $C_3$  plants typical of open forests and a recurrent access to water sources suggestive of a low mobility of the individuals (fig. 147).

The  $\delta^{13}C_{ap}$  and  $\delta^{18}O_{VPDB}$  data suggest a livestock management strategy where cattle and swine were kept in a semi-stabling regime, with restricted access to water sources. This scenario contrasts with that of caprine husbandry, evidencing higher variability in consumption of  $C_3$  plants and a diversified access to water sources. That the water sources for caprines do not coincide with those of cattle, suggesting a non-overlapping of herds at the spatial level is noteworthy.

Paleodietary analyses from El Amarguillo II indicate the consumption of fruits, shrub, branches, and small trees by caprines. The analyses on pigs point to a rather varied diet where the consumption of grasses was lower and fruits and seeds were also taken (Cabrero García et al. 1997, 136).

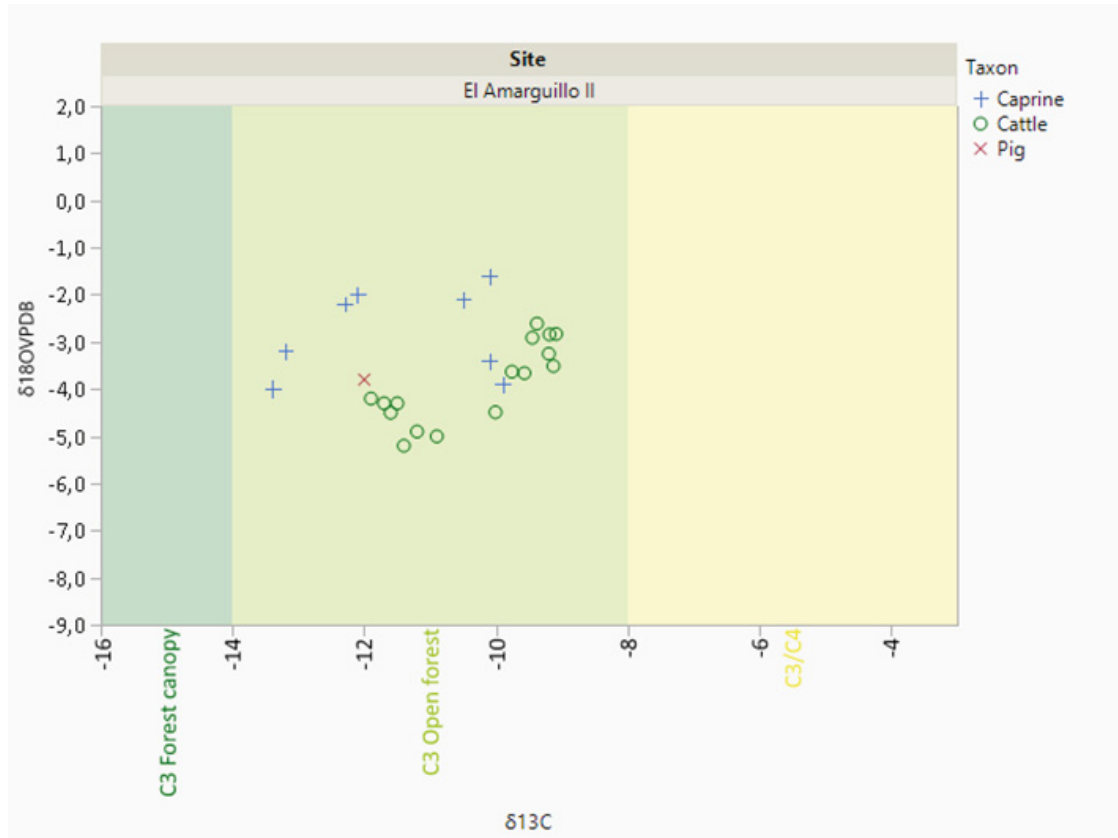


Fig. 147. Analysis of  $\delta^{18}\text{O}$  vs.  $\delta^{13}\text{C}_{\text{ap}}$  at Amarguillo II.

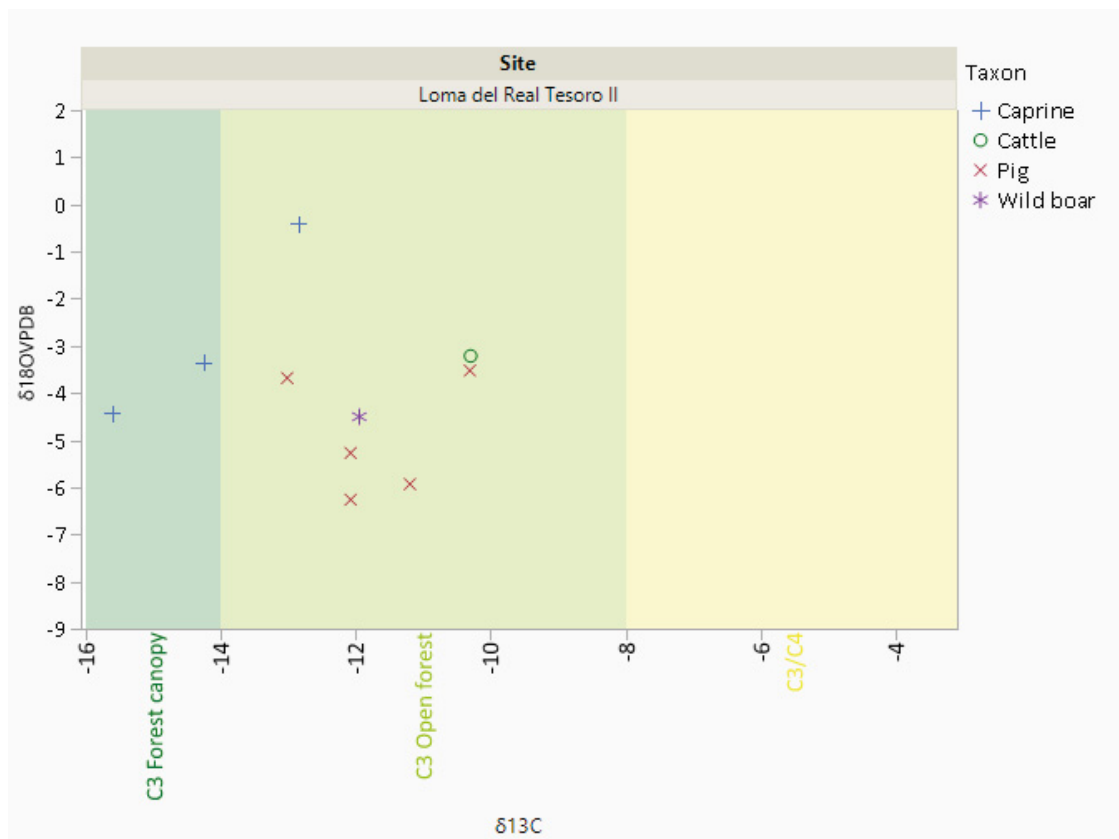


Fig. 148. Analysis of  $\delta^{18}\text{O}$  vs.  $\delta^{13}\text{C}_{\text{ap}}$  at LRT-II.

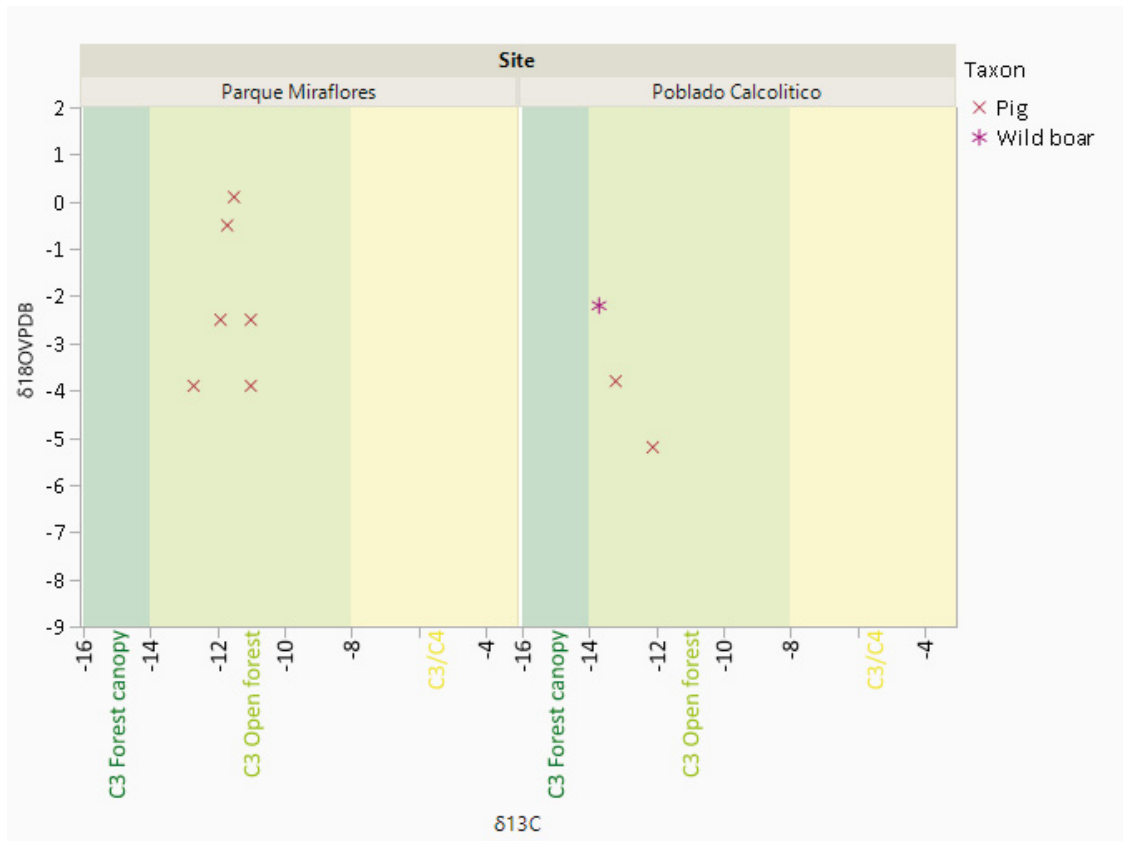


Fig. 149. Comparative analysis of  $\delta^{18}O$  vs.  $\delta^{13}C_{ap}$  at Parque Miraflores and Poblado Calcolítico.



Fig. 150. Comparative analysis of  $\delta^{13}C_{co}$  and  $\delta^{15}N$  for all sites in Southern Iberia (including data from Díaz-Zorita Bonilla 2017; Fontanal-Coll et al. 2015; Beck et al. 2018; Žalaitė et al. 2018; Waterman et al. 2015; 2016).



**Fig. 151.** Comparative analysis of  $\delta^{18}\text{O}$  vs.  $\delta^{13}\text{C}_{\text{ap}}$  for all sites in south-west Iberia (including data from Díaz-Zorita Bonilla 2017; Díaz-Zorita Bonilla et al. 2017; 2018; 2020; Waterman et al. 2016; 2015; 2014).



**Fig. 152.** Comparative analysis of  $\delta^{18}\text{O}$  vs.  $\delta^{13}\text{C}_{\text{ap}}$  for all sites in southern Iberia including humans (including data from Díaz-Zorita Bonilla 2017; 2020; Díaz-Zorita Bonilla et al. 2017; 2018; Waterman et al. 2016; 2015; 2014).

The data from Loma del Real Tesoro II does not allow definitive conclusions regarding mobility patterns, but they do indicate the consumption of  $\text{C}_3$  plants typical of open environments. This reinforces the results of the pollen analyses, which revealed an open environment around this settlement.

At La Loma del Real Tesoro II, phytolith analyses evidenced the presence of  $\text{C}_3$  and  $\text{C}_4$  plants in most of the analysed structures with those from structures E7 and E11 dominated by type  $\text{C}_4$  plants (fig. 148).

The pigs from Parque Miraflores and Poblado Calcolítico reveal the consumption of  $\text{C}_3$  plants

typical of an open environment. In the case of Poblado Calcolítico values conform best with those from a closed forest environment and this seems in agreement with the location of the settlement on the foothills of the Sierra (*fig. 149*).

These results can be evaluated on a broader scale. When the whole southern Iberian Peninsula is considered, paleodietary analyses of  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  (collagen) hint at two alternative models of livestock management (*fig. 150*). In fortified settlements such as Zambujal, where a higher level of conflict has been postulated, analyses indicate stockbreeding practices with a higher degree of control over individuals, possibly through a stabling regime. In contrast, in the presumably less conflictive environment of the Lower Guadalquivir Valley, as would be the case for Valencina-Castilleja, it can be seen that the data points to a far more extensive use of the territory, typical of settlements with dispersed populations (*fig. 151* and *152*).

#### 7.4 Mobility Patterns and Herd Management Strategies

The results of the study suggest that the mobility of the herds in the six sites that were analysed on the Lower Guadalquivir Basin was quite restricted during this period.

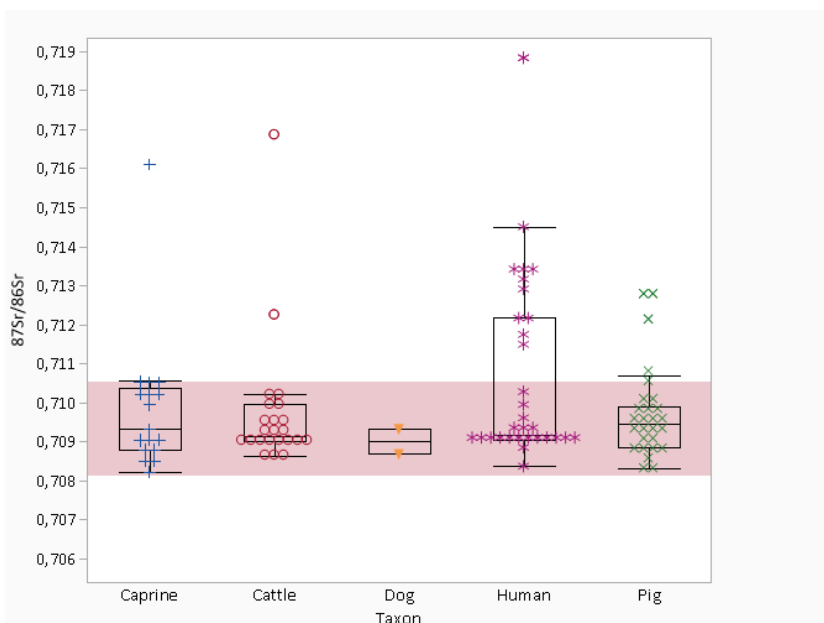
The  $^{87}\text{Sr}/^{86}\text{Sr}$  analyses of Díaz-Zorita Bonilla on 25 samples (19 humans, two bovines, one pig, and

one goat) from Valencina-Castilleja showed that all individuals except for the goat exhibited local ranges. The goat could have been brought from a different region or could have been a transhumant individual (Díaz-Zorita Bonilla 2017, 91). Of those, eleven humans from different sectors showed non-local values. The results showed a settled human community where the wider isotopic range of caprines ( $^{87}\text{Sr}/^{86}\text{Sr}$  values from 0.70967 to 0.71076) revealed a wider exploitation of the territory that contrasts with that seen in suids ( $^{87}\text{Sr}/^{86}\text{Sr}$  values from 0.70814 to 0.71054) and bovines ( $^{87}\text{Sr}/^{86}\text{Sr}$  values from 0.70849 to 0.71009). The reduced ranges of the latter two stocks hint at more restricted areas of exploitation within the territory, possibly next to the settlement (*fig. 153*).

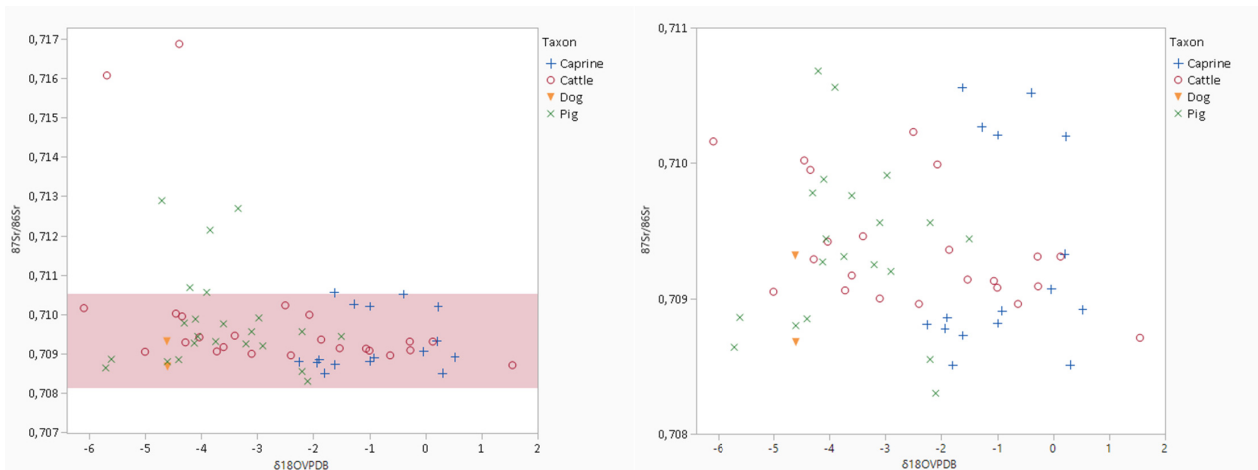
In the group of bovines, only two individuals (PA-41 and PA-506) exhibited non-local values (samples PA-41b and PA-41k come from the same tooth), the remaining individuals exhibiting values that coincided with the local ranges established for the Valencina-Castilleja site.

The comparison of  $\delta^{18}\text{O}_{\text{ap}}$  vs.  $^{87}\text{Sr}/^{86}\text{Sr}$  values show reduced mobility, understood as mobility restricted to the area around each site, probably reflecting specific needs of each species as well (*fig. 154*).

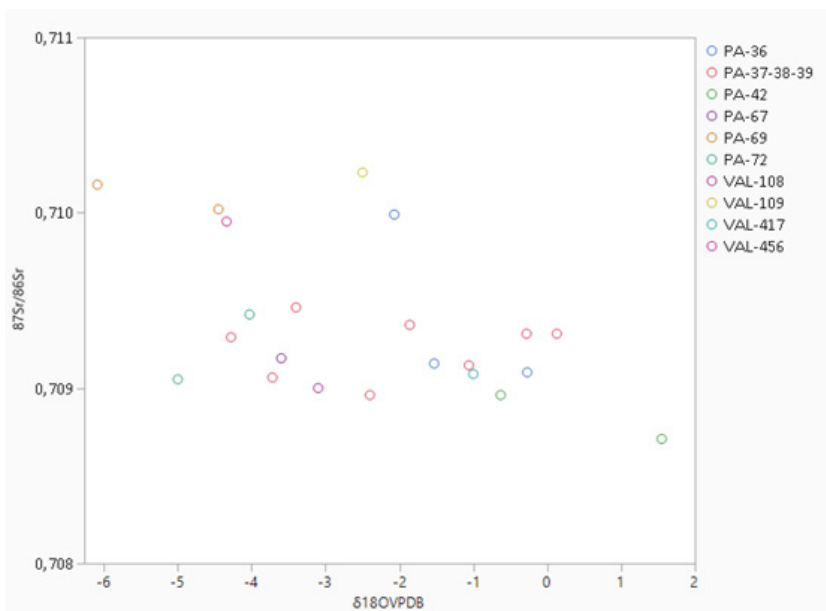
The results of the  $\delta^{18}\text{O}_{\text{ap}}$  vs.  $^{87}\text{Sr}/^{86}\text{Sr}$  for the local cattle confirms the reduced mobility of all individuals that were analysed. In the case of individual PA-36, the intra-tooth analysis demonstrated



**Fig. 153.** Results from  $^{87}\text{Sr}/^{86}\text{Sr}$  in Valencina-Castilleja including the results of Díaz-Zorita Bonilla (2017).



**Fig. 154.** Results of  $\delta^{18}\text{O}$  data vs. the  $^{87}\text{Sr}/^{86}\text{Sr}$  in Valencina-Castilleja. Left: Valencina local range in red and non-local individuals. Right: Distribution of individuals within the local range.



**Fig. 155.** Results of  $\delta^{18}\text{O}$  data vs. the  $^{87}\text{Sr}/^{86}\text{Sr}$  for intra-tooth analyses in cattle from Valencina-Castilleja.

a certain degree of mobility at the local level, also recorded on individual PA-37-38-39, whose variability of  $\delta^{18}\text{O}_{\text{VPDB}}$  values not only reflect access to different water sources, but also changes associated with seasonality (fig. 155, 156).

Individual PA-37-38-39, previously published (Díaz-Zorita Bonilla et al. 2017), revealed changes *in-utero* and during the first months of life in its M1 (PA-37), where the consumption of  $\text{C}_4$  plants was reflected. The results from its M2 and M3 reflected consumption of  $\text{C}_3$  plants. In the case of M1, some of this variability is possibly caused by lactation (fig. 157).

Geomorphological studies in the Valencina-Castilleja area report several headlands, endorheic

zones, and runoffs, which Vargas Jiménez says constituted occasional water sources until the mid-20<sup>th</sup> cent. (Vargas Jiménez 2003, 130) (fig. 125). Also, wells reported within the settlement perimeter provide water of different origins. Both elements explain the variations of  $\delta^{18}\text{O}_{\text{VPDB}}$  values seen in the analyses (Fernández Gómez/Oliva Alonso 1985; Castro Fernández et al. 2008).

Although the paper by Díaz-Zorita Bonilla (2017) reports an allochthonous caprine, all the caprines studied for this publication feature values that are coincident with the geology of the Valencina-Castilleja site.

The results of  $\delta^{18}\text{O}_{\text{ap}}$  vs.  $^{87}\text{Sr}/^{86}\text{Sr}$  analysis reveals two different groups of caprines, opening

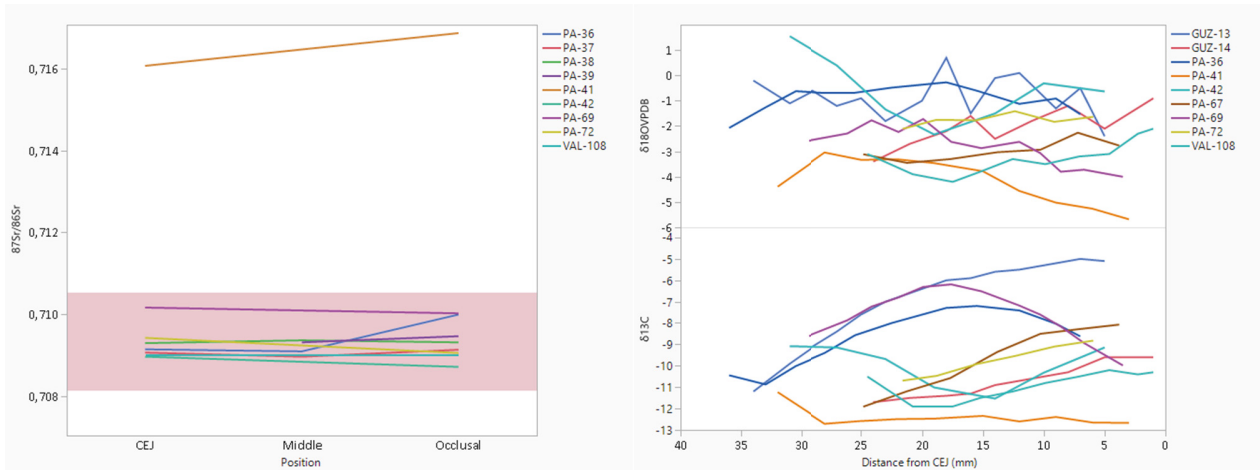


Fig. 156. Intra-individual cattle tooth  $^{87}\text{Sr}/^{86}\text{Sr}$  (left),  $\delta^{18}\text{O}$  (upper right), and  $\delta^{13}\text{C}$  (bottom right) results.

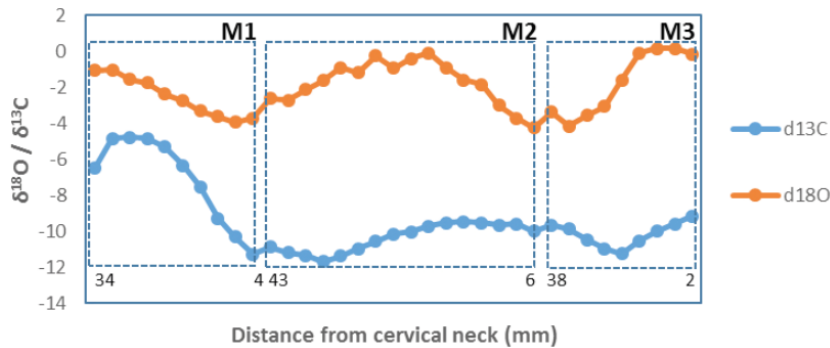


Fig. 157. Intra-individual cattle tooth  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  values in Díaz-Zorita Bonilla et al. (2017).

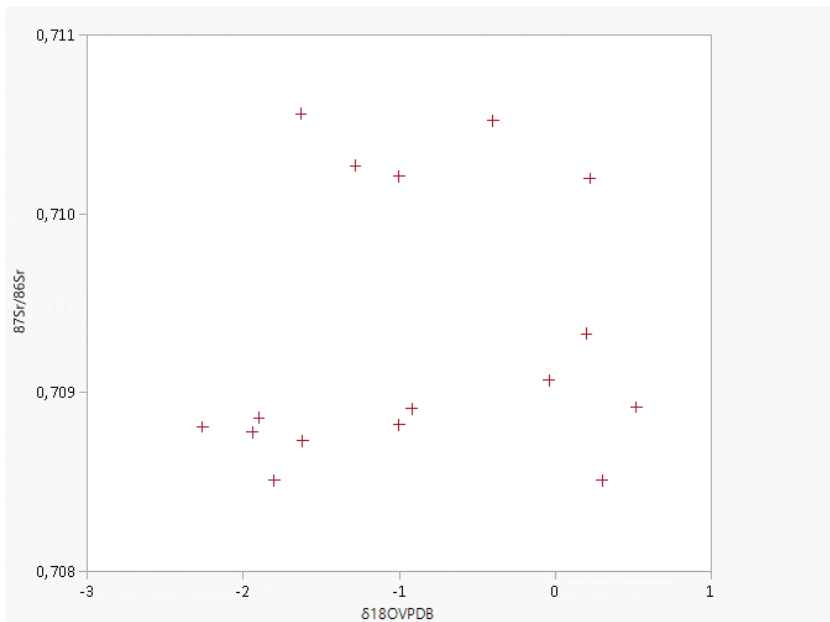
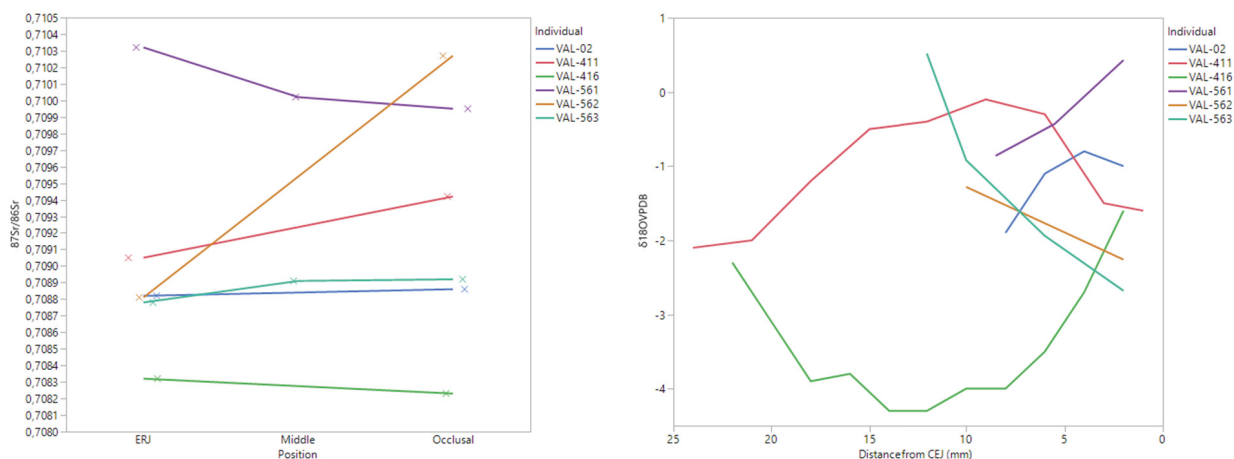


Fig. 158. Results of  $\delta^{18}\text{O}$  data vs. the  $^{87}\text{Sr}/^{86}\text{Sr}$  for intra-tooth analyses in caprines from Valencina-Castilleja.

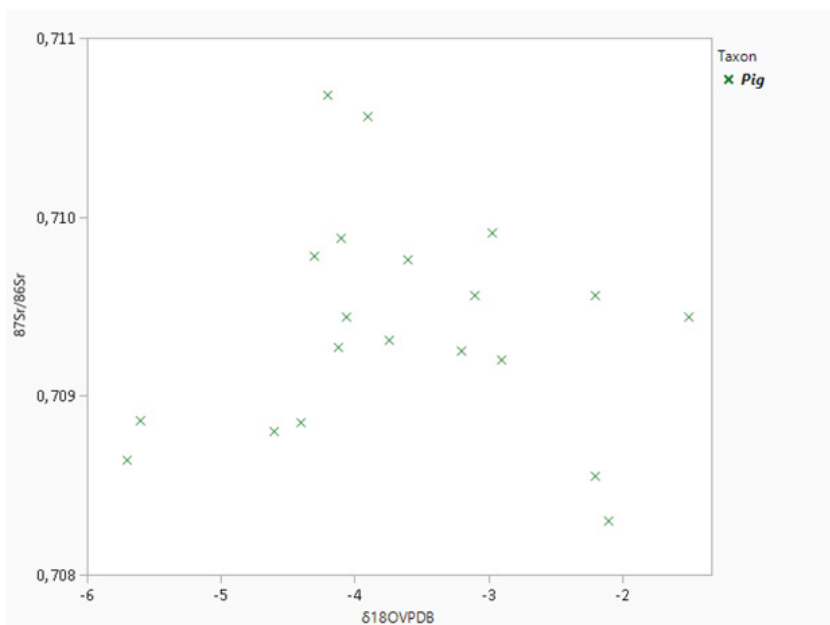
two alternative interpretations (*fig. 158*). The first possibility is that there existed two groups of caprines at Valencina-Castilleja, with each one making use of two different areas of pasture around the settlement. If taken into account that all analysed individuals originated in the same

sector, structure, and level, the hypothesis that these derive from different groups seems feeble and questionable.

The second possibility is that there was a rotation of caprines in the pasture grounds, so that individuals rotated seasonally around the



**Fig. 159.** Intra-individual cattle tooth  $^{87}\text{Sr}/^{86}\text{Sr}$  (left),  $\delta^{18}\text{O}$  (upper right) results.



**Fig. 160.** Results of  $\delta^{18}\text{O}$  data vs. the  $^{87}\text{Sr}/^{86}\text{Sr}$  for intra-tooth analyses in pigs from Valencina-Castilleja.

settlement, perhaps benefiting from the leftovers of crops in a fallow-operation system, as some authors have suggested for prehistoric societies with domestic economies (Behren 1981). Food from agricultural fallow land and residues generated by cereal agriculture are good fodder resources for domestic ruminants (Martínez Sánchez 2013a, 42).

Except for individual VAL-562, which shows a certain degree of mobility within the local range, intra-tooth analyses reinforce the presence of caprine herds with a reduced mobility (*fig. 159*). As was also the case for cattle,  $\delta^{18}\text{O}_{\text{VPDB}}$  values indicate mobility at a local level, with varied access to water sources.

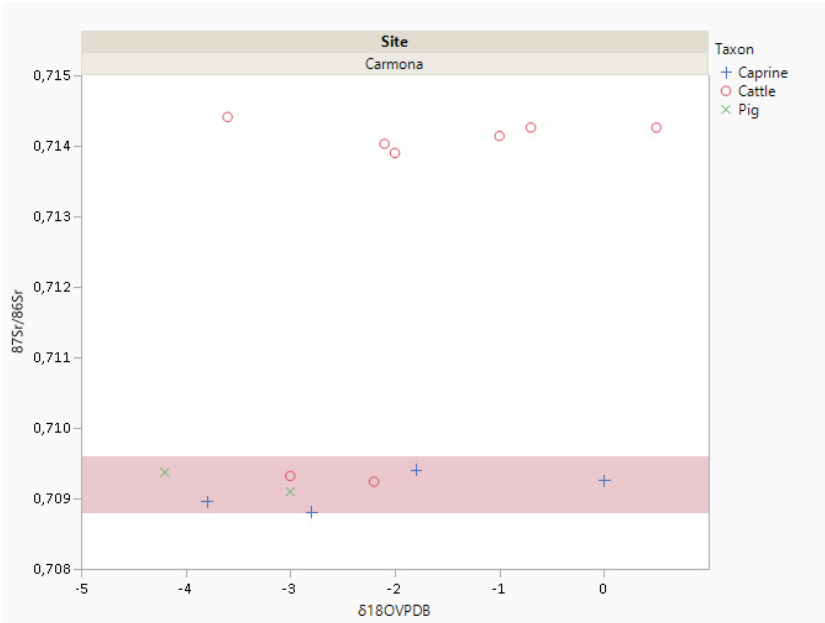
As said before, the three suids that presented non-local radiogenic values at Valencina-Castilleja

could be specimens of the far more mobile wild boar instead of domestic pigs.

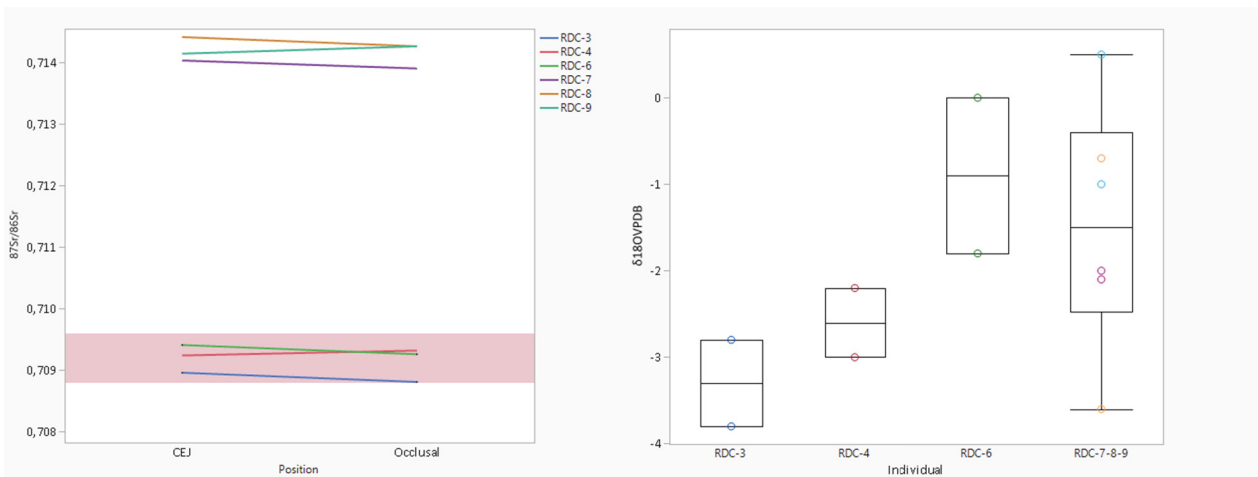
The  $\delta^{18}\text{O}_{\text{VPDB}}$  analyses on pigs from different sectors of this site show a differential access to water sources despite featuring lower ranges than caprines and bovines; this possibly reflects a regime of stabling or semi-stabling (*fig. 160*).

Analyses of  $^{87}\text{Sr}/^{86}\text{Sr}$  from Carmona showed that all animals had local ranges except for a bovine (samples RDC-7, RDC-8, and RDC-9) that could have been imported from an area with higher radiogenic values (*fig. 161*). Intra-tooth values show reduced mobility at the local level (*fig. 162*).

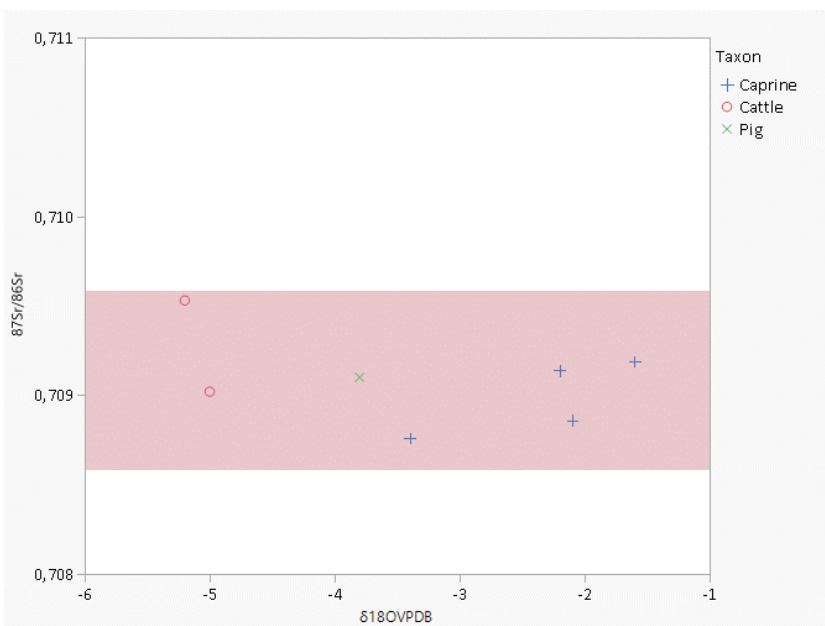
The  $\delta^{18}\text{O}_{\text{VPDB}}$  value reveals variability in the access to water sources throughout the life of this allochthonous bovine.



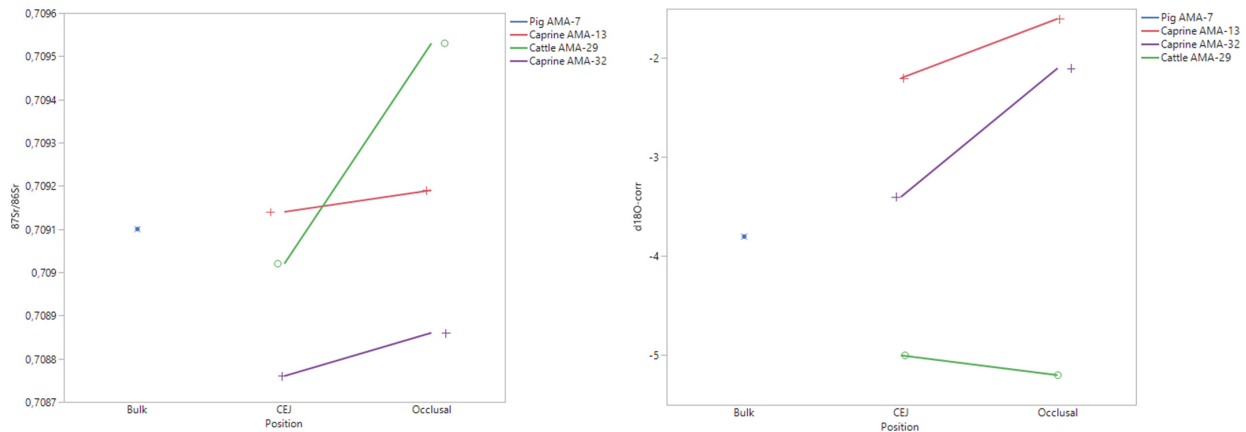
**Fig. 161.**  $^{87}Sr/^{86}Sr$  and  $\delta^{18}O_{VPDB}$  isotopic analysis by species from Carmona.



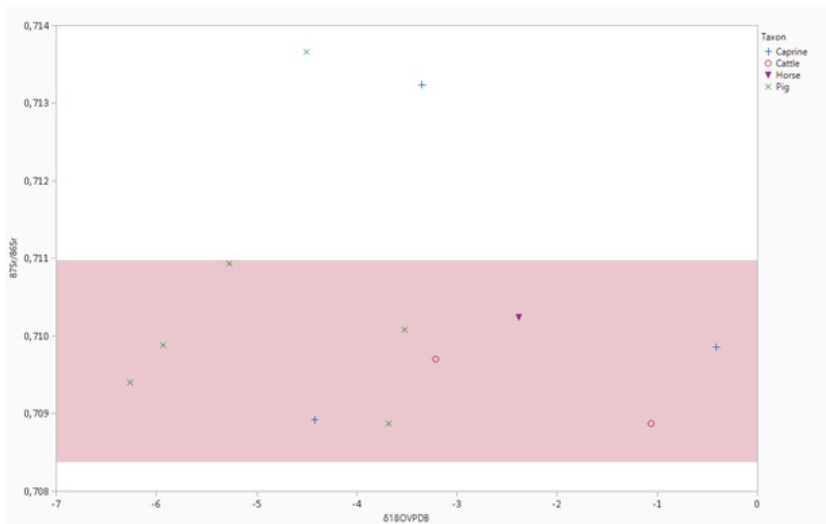
**Fig. 162.** Intra-tooth  $^{87}Sr/^{86}Sr$  and  $\delta^{18}O_{VPDB}$  isotope analysis from Carmona.



**Fig. 163.** Results of  $\delta^{18}O$  data vs. the  $^{87}Sr/^{86}Sr$  for intra-tooth analyses from Carmona.



**Fig. 164.**  $^{87}\text{Sr}/^{86}\text{Sr}$  vs. dental tooth formation (left) and  $\delta^{18}\text{O}_{\text{VPDB}}$  vs dental tooth formation in El Amarguillo II (right).



**Fig. 165.** Results of  $\delta^{18}\text{O}$  data vs. the  $^{87}\text{Sr}/^{86}\text{Sr}$  for intra-tooth analyses from Loma del Real Tesoro II.

The  $^{87}\text{Sr}/^{86}\text{Sr}$  values from El Amarguillo II showed that all individuals from all stocks exhibited local values (fig. 163).

The intra-tooth  $^{87}\text{Sr}/^{86}\text{Sr}$  values of bovines evidence some degree of local mobility. Indeed, according to  $\delta^{18}\text{O}_{\text{VPDB}}$  intra-tooth values, and despite the overall low mobility of the herds, there is a differentiation between the water sources of caprines and pigs, and those of bovines (fig. 164).

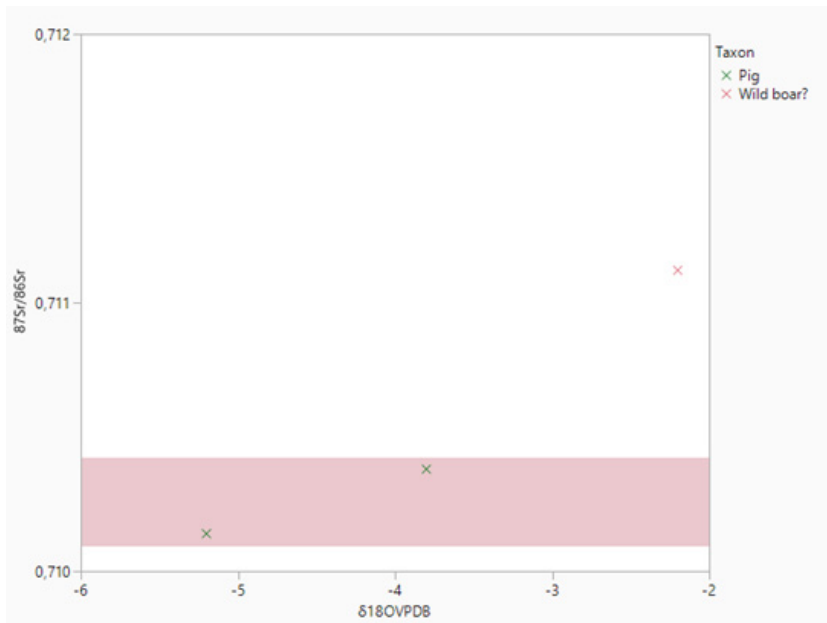
In the case of Loma del Real Tesoro II,  $^{87}\text{Sr}/^{86}\text{Sr}$  values show a predominance of individuals with local ranges that contrast with those of a suid and a caprine deriving from a more radiogenic zone (i.e. the mountains a few kilometres northwards of the site?) (fig. 165).

According to the  $\delta^{18}\text{O}_{\text{VPDB}}$  values, a variability to the water access sources exist, revealing a

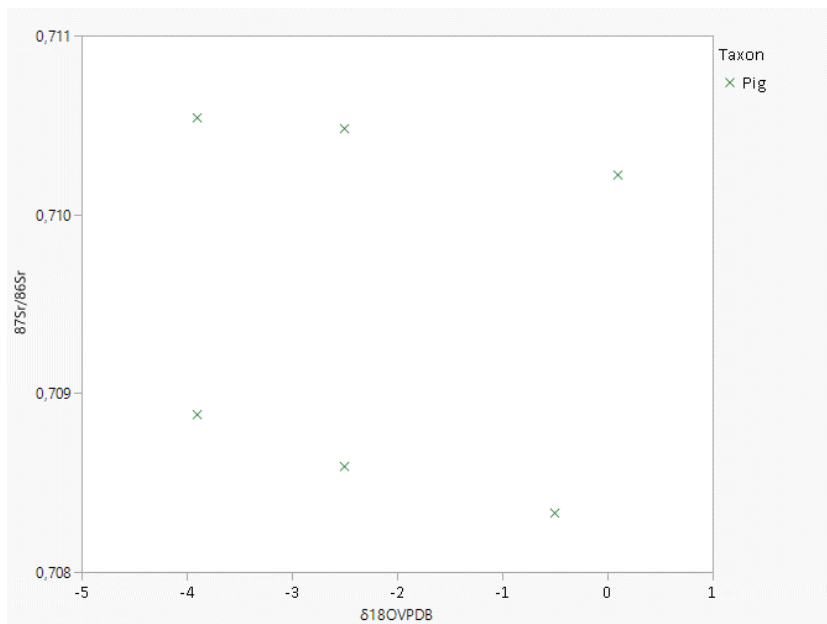
difference between the catchment area of pigs and the remaining livestock; such difference may reflect a semi-stabling regime for pigs with a more restricted access to water sources.

The small sample from Poblado Calcolítico does not allow for any conclusive results to be made, yet the data suggests that pigs were managed on a low mobility basis within the territory (fig. 166). The variability of the  $\delta^{18}\text{O}_{\text{VPDB}}$  values can be explained in terms of seasonal shifts.

The results from Parque Miraflores also do not allow any definitive conclusions on the issue of mobility.  $^{87}\text{Sr}/^{86}\text{Sr}$  and  $\delta^{18}\text{O}_{\text{VPDB}}$  values point to two different groups of suids in terms of access to water sources (fig. 167). In this case, one of the groups could be wild boar and the other domestic pigs, although the small sample size does not allow such a hypothesis to be confirmed.



**Fig. 166.** Results of  $\delta^{18}\text{O}$  data vs. the  $^{87}\text{Sr}/^{86}\text{Sr}$  for intra-tooth analyses from Poblado Calcolítico.



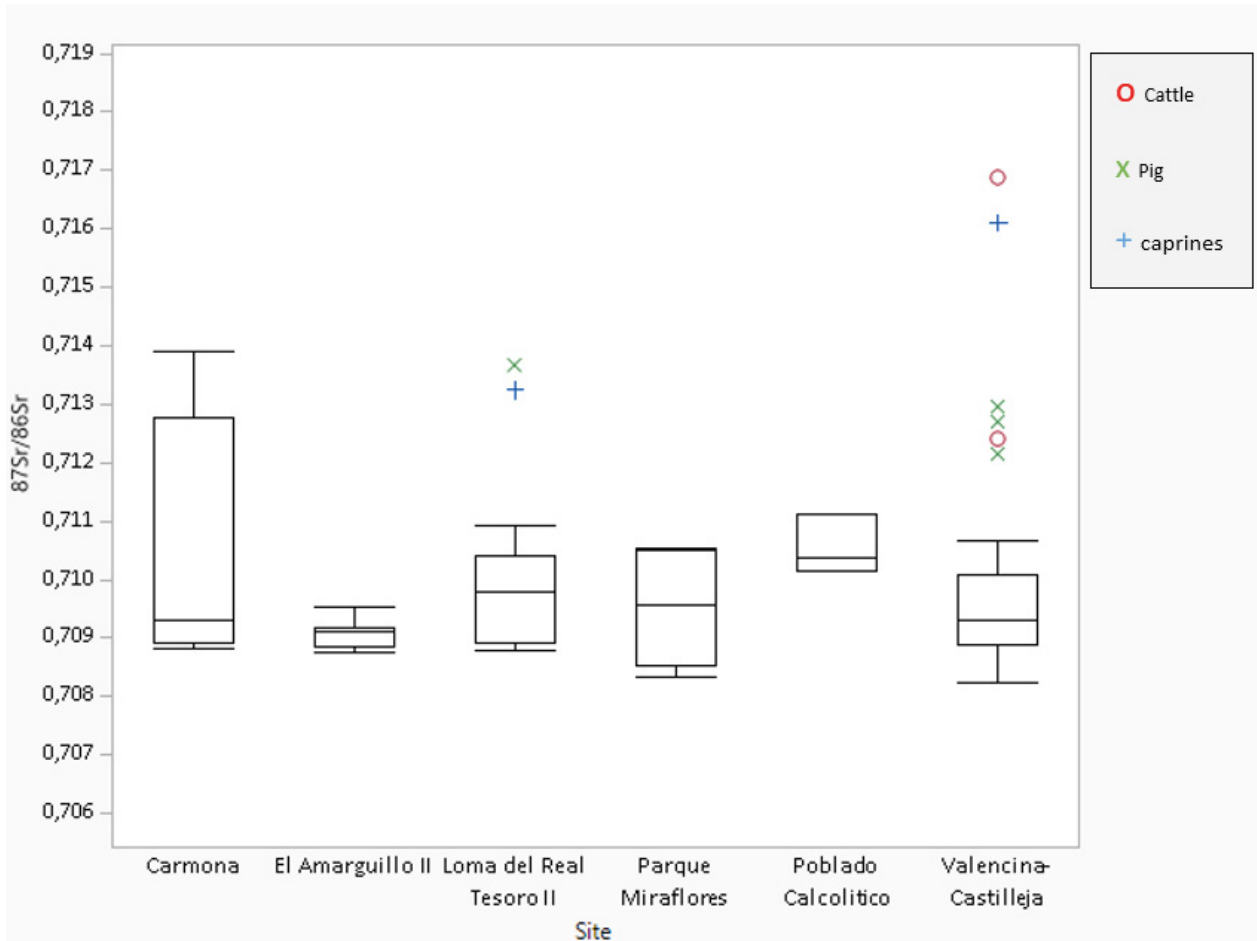
**Fig. 167.** Results of  $\delta^{18}\text{O}$  data vs. the  $^{87}\text{Sr}/^{86}\text{Sr}$  for intra-tooth analyses from Parque Miraflores.

Results from  $^{87}\text{Sr}/^{86}\text{Sr}$  show that the mobility of livestock in all sites was very low, suggesting that the populations were settled (stable) (fig. 168). In the case of Carmona and Valencina-Castilleja, the mobile individuals that were identified are mainly cattle, as already documented in other settlements from the southwestern Iberian Peninsula, such as Leceia and Zambujal (Wright et al. 2019).

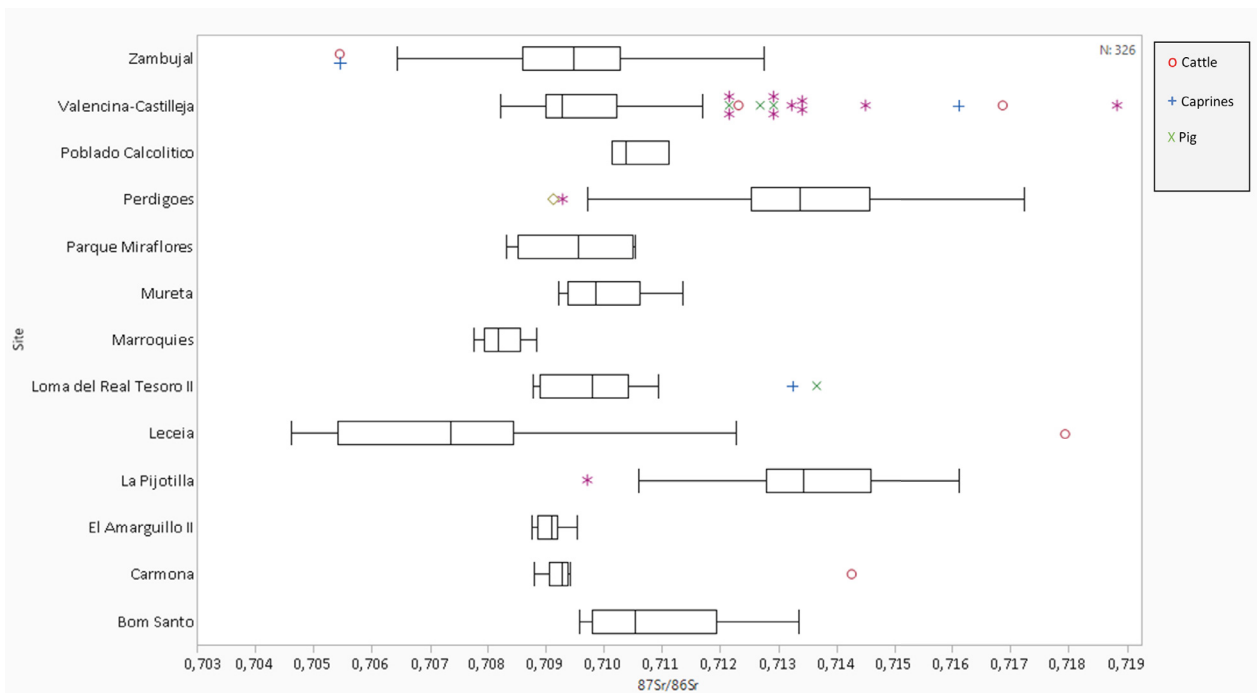
Since the mobility of Copper Age people has been established at Valencina-Castilleja (Díaz-Zorita Bonilla 2017), the presence of cattle with origins in distant settlements could likely be due to their inherent physical characteristics: they

can move easily through different landscapes and could have been used for long-distance transport. In this case the functionality of bovines as a means of traction and their possible use for exchanges among settlements are possibilities to be reckoned with (fig. 169). Alternately, these alloctonous animals could reflect punctual exchanges of animals among settlements in order to avoid inbreeding of the local herds.

Except for a minority of cases (i.e. 13 out of 208 = 6.25%), most of the 3<sup>rd</sup> mill. BC faunal remains studied thus far in southern Iberia in terms of mobility appear to be of local origin.



**Fig. 168.** Comparative analysis of  $^{87}\text{Sr}/^{86}\text{Sr}$  of all sites presented in this study (including data from Díaz-Zorita Bonilla 2017).



**Fig. 169.** Results of  $^{87}\text{Sr}/^{86}\text{Sr}$  data from different Copper Age sites from the southern Iberian Peninsula (including data from Díaz-Zorita Bonilla 2017; Díaz-Zorita et al. 2018; 2020; Carvalho et al. 2019; Wright et al. 2019; Žalaitė et al. 2018; Valera et al. 2020; Waterman et al. 2014).

In Valencina-Castilleja, out of a total of 68 samples, only one caprine, two cattle, and three suids of non-local origin have been documented; in the case of suids even the possibility that these outliers were wild boar cannot be ruled out.

If these non-local suids from Valencina-Castilleja are indeed wild boar, cattle would be the species featuring the highest degree of mobility not only in this site but also at Carmona, Zambujal, and Leceia.

### 7.5 ResourceComplex Management Strategies in the Guadalquivir Valley

World-systems theory is based on the dependence of an area (core) on another area (periphery) with goods and resources circulating in-between both areas. According to this theory, exchanges among settlements can take place at a macro-regional level or at a micro-local level within settlements. The latter would foster social differentiation within a settlement through the possession of certain goods to which only a part of the group has access (Harding 2013, 379).

Likewise, both zooarchaeological data and livestock mobility analyses point to stable communities with reduced mobility whenever the exchange of livestock with nearby populations is practically non-existent. For these reasons, the so-called Centre-Periphery model (Harding 2013), based on an interdependence of settlements located in the vicinity of a given site, in this case Valencina-Castilleja, cannot be applied in the area based on the results from this study.

This alone would not eliminate the possibility that Valencina-Castilleja played a relevant role in terms of exchanges, as inferred from the presence of exotic resources such as amber, variscite, ostrich eggs, or ivory that were brought over long distances (García Sanjuán 2013; Schuhmacher et al. 2013; Odriozola Lloret/García Sanjuán 2013; Murillo Barroso/García Sanjuán 2013; Nocete Calvo et al. 2005). Likewise, the geostrategic location of the settlement – close to the Guadalquivir paleo-estuary, the pyritic belt, and fertile land – all fostered the aggregation of populations that gave rise to this so-called mega-site.

Bogucki (1993, 493 f.) argues that, traditionally, the domestic economies of groups that share cultural values have been the most important unit for economic decision-making on the acquisition, allocation, and consumption of resources, with the decisions of a village or lineage subordinated to the decisions of the smaller groups that control productive resources. Each domestic unit would have as its main objective the accumulation of resources in order to obtain stability and social prestige. Within this system, bovids would have played a key role, as repeatedly evidenced by ethnographical data from widely different traditional cultures. This accumulation would not necessarily imply social inequality but could have laid the foundations for it. According to Jones, in less complex societies domestic production or work would be carried out by the family or residential group (Jones et al. 2011). In the case of societies with greater social complexity, the members would be mobilised for achieving common objectives such as the construction of monuments or ceremonial places, using surpluses generated by the domestic economy.

Authors such as Polanyi believe that domestic economies are only feasible in settled agricultural societies (Polanyi 1957, 254). In the case of the settlements analysed in this work, cattle plays a major role in the socioeconomic development of the groups that settled in the Guadalquivir Valley mainly because of their use for traction. In his now seminal ethnological studies, Singh was the first to demonstrate the importance of bovine traction for land cultivation in Burkina Faso, observing how households using bovine traction were able to duplicate the ploughed space when compared to households without bovines (Singh 1988).

Cattle farming also constituted a major resource in the development of domestic societies because it was a self-regenerating resource that replaced human labour more efficiently (Bogucki 1993, 501).

The zooarchaeological and isotopic results presented here hint at a system with a diversified, agriculture-based household economy where domestic livestock acted as a secondary resource complementary to other agricultural practices such as crop farming in the case of cattle and caprines as well as a food supplement in the case

of pigs. Apparently, the size of the herds was not large enough to require movement over medium or long distances as the mobility analyses reveal. At those human densities, the environmental conditions of the Lower Guadalquivir Valley made it possible to provide enough resources to sustain a small-sized herd without the need of recurring to long distance movements.

Halstead argues that a faunal spectrum in which one domestic stock prevails over the others is indicative of large-scale, specialised pastoralism, as opposed to small-scale farming with a mixed economy that maintains a wider range of livestock in order to have the variety of products that insured self-sufficiency and reduced the risk of losses due to disease or crisis (Halstead 1996, 26).

Despite the fact that cattle are not the best represented taxon in the faunal record of the sites analysed in this work, the number of heads in any domestic economy tends to be reduced in order to maximise productivity (Bogucki 1993, 497).

As mentioned in chapter 1, Khazanov (1984, 17–25) described four kinds of Pastoralism:

- (1) Nomadic pastoralism: in which there is no crop farming and which involves the movement of people and animals over a very wide and geographically well-defined territory (Arnold/Greenfield 2006, 7). These settlements would be characterised by their small size (Connor 1984; Haaland 1981).
- (2) Semi-nomadic pastoralism: characterised by extensive pastoralism with periodical changes in cultivation and where agriculture plays a secondary role. This stage could be an intermediate step between nomadic pastoralism and mixed economies (Khazanov 1984, 20).
- (3) Semi-sedentary pastoralism: Farming here plays the main role in the economic sector, although this may also imply short seasonal migrations both in time and space. This would essentially correspond with the notion of transhumance. Large sectors of the population would almost exclusively engage with herding activities whereas others would be exclusively devoted to crop farming. Agropastoral societies of this kind should ideally exist at a medium level of social organisation (i.e. one wherein production and exchange are

coordinated at an intra-regional scale, something similar to a chiefdom level of organisation) (Sadr 1991, 9).

- (4) Sedentary animal husbandry: typified by animal husbandry constituting a supplement to crop farming practices.

Crop farming populations inhabit nucleated, long-lived villages or else live in more dispersed and short-lived hamlets and homesteads. They are characterised by the concentration of all sites in fertile areas and by an absence of seasonal herder campsites (Sadr 1991, 14). In the case of mixed economies, just as farmers, these may inhabit nuclear villages or dispersed households for a long or a short time. The main population centres are located on fertile land but generally have an associated series of satellite herding camps dispersed at distances beyond 15 to 20km from the main settlements generally located on poor agricultural soils. Those 15 to 20km roughly represent the distance that can be covered by half a day's trekking with the herds.

A society with a mixed economy could conceivably exist at any level of social complexity, from the tribal and band organisation to the state level. It is the only level of symbiotic relationship possible in societies with low complexity and if it is occurring in a setting of higher complexity, it represents a less than optimal use of the available resources (Sadr 1991, 9).

Returning to the categorisation made by Cribb described in chapter 1 (Cribb 1982), the settlements analysed in the present work would all comply best with model 2 (*table 91*). This model is based on sedentary populations with a farming economic base at subsistence level, in which livestock would be based on small number of heads per flock, sufficient to cover domestic needs, and whose movements would concentrate around each settlement.

Some authors have argued that the presence of movements of a transhumant nature is associated with megalithic monuments (Higgs 1976; Murrieta Flores et al. 2011; 2014) but this must be discarded for the groups that inhabited the Lower Guadalquivir Valley during Copper Age times, as these fit far better into the sedentary animal husbandry economy model.

Type	Productive regime	Number of stock	Marketing strategy	Mobility
1	Fully specialized agriculture, minimal pastoralism	A few animals for traction and transport	Agricultural products marketed and subsistence	Fully sedentary
2	Predominantly farming, limited pastoralism	Small number of stock for household needs	Agricultural, subsistence pastoralism	Sedentary, limited movement of flock around village
3	Pastoralism combined with cultivation	Numbers beyond perennial carrying capacity of locality	Agricultural and pastoral product marketed	Village-based transhumance
4	Predominantly or exclusively pastoral	Large numbers of stock beyond carrying capacity of locality	Pastoral products marketed, subsistence cultivation optional	Fully nomadic

**Table 91.** Taxonomy of herding economical systems (after Cribb 1982).

The now seminal study of Halstead on recent pastoralism in Greece reveals two types of household economies:

- (1) Owners with abundant land and crops whose livestock is characterised by a pair of oxen for draught, several cows for milk, and pigs for meat. In the case of caprines, they follow the same guidelines as for the agropastoral groups, where herds have reduced mobility, restricted to the limits of the community, with limited access to good pastures so that the herds tend to be small and less productive due to poorer nutrition.
- (2) Landless owners whose livestock is characterised by one draught animal, one cow and several caprines for milk and meat production. Valencina-Castilleja fits well with Halstead's Model 1 (Halstead 1996, 23).

The data from our study suggests that agricultural practices were the main resource for the economies of the Lower Guadalquivir Valley during the 3<sup>rd</sup> mill. BC. Livestock practices played a complementary role, typical of mixed economies where animals play multifunctional roles.

In the case of resources such as copper ore, prospecting carried out in the Sierra Norte of Seville revealed two main nuclei of mining exploitation. These are possibly related to the catchment areas of settlements located both in the vicinity of Valencina-Castilleja and the Vega de Carmona reflecting exploitation at a local level in both instances. Resources such as traded metals, lithics, and exotics simply played a multiplier role on the effects generated by agricultural accumulation strategies for which draught animals must have been capital (Bogucki 1993, 501).

## 8 Conclusions

### 8.1 General Considerations

Since its discovery, the site of Valencina-Castilleja has baffled archaeologists. One major reason for this is its unexpectedly large size. Indeed, with a maximum area now estimated to reach close to 500ha, it took time for excavators to realise that the different ‘sites’ (nowadays called sectors) they were digging did not constitute isolated units but instead were all part of a larger whole. Because of this the site has now been granted the status of a mega-site in the new archaeological taxonomy.

But the ‘bigger is better’ inertia to grant importance to items exclusively on quantitative terms, itself a result of a somewhat narrow processualist approach to archaeology, took a different twist with Valencina-Castilleja when it came to interpretation. Even when the unitary nature of this mega-site was definitively acknowledged, many archaeologists could not easily digest the idea that the large size of this settlement did not equate with ‘complexity’ of one kind or another. The problem here is that whereas a processualist approach applies best to the economic (i.e. productive) realm, for the social and ideological domains, quantitative parameters, be they size, numbers, frequencies etc., need not equate with ‘importance’. In fact, very often, just the opposite is true. For that reason, when framing interpretations solely in terms of social and ideological meaning, domains where quantification is far less important than contextualisation, what truly matters is an appropriate context. The successive attempts to explain Valencina-Castilleja must be understood within a deficient or incomplete context. These attempts often carry the unstated assumption that size equals complexity. This assumption leads to interpretations that describe Valencina-Castilleja as a centre of power, a gathering place for people, a site where incipient elites and a stratified society progressively emerged, or as a singular funerary ground. All of these proposals, as well as attempts to fit Valencina-Castilleja into models such as ‘Centre-Periphery’ have been deficient, to a larger or smaller extent, in terms of context.

This research was designed to evaluate how adequate and realistic previous interpretative proposals are. With a focus on faunal data, the main aims and objectives are:

- To determine the temporality and period of use of Valencina-Castilleja.
- To assess the importance of livestock as part of the primary ResourceComplex for the social-economical development of the human group settled in the Lower Guadalquivir Valley during the 3<sup>rd</sup> mill. BC.
- To understand herd management strategies, including mobility patterns of each domestic stock at an intra- and inter-site level, with the help of conventional zooarchaeological protocols and novel techniques.

To achieve these objectives, it was clear from the start that it was not enough to analyse one single site, no matter how relevant, but that this site needed to be placed within an appropriate context. It was for this reason that similar analyses to those implemented for Valencina-Castilleja were carried out at La Loma del Real Tesoro II and Carmona. The need to apply a broader perspective led to the incorporation of samples from El Amarguillo II, Poblado Calcolítico and Parque Miraflores. The multi-isotopic analyses of livestock diet ( $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ ) and mobility ( $^{87}\text{Sr}/^{86}\text{Sr}$  and  $\delta^{18}\text{O}$ ) was carried out on a regional, not just local, level.

Several overriding methodological issues hampered the research. The first limitation was the way the faunal collections were retrieved, mostly by hand. The problems of biased representations associated with this method of retrieving faunal remains have been discussed at length for decades. Given that all domestic stocks in our case belong to the group of so-called macro-mammals, the problems of a non-exhaustive retrieval of remains will especially affect the frequencies of the younger cohorts, in particular those of pigs and small ruminants (caprines). This is certainly a factor to be reckoned with. Likewise the high fragmentation of bones because of taphonomical processes was another negative factor. In particular, the non-preservation of bone collagen at the site of

La Loma del Real Tesoro II did not allow us to obtain enough  $^{14}\text{C}$  dates to unequivocally determine the temporality of the site.

The third limitation has been the lack of comparative data for most of these sites, turning this work into the main reference for the fauna from each of the analysed sites, the exception here being Valencina-Castilleja. Much the same can be said for the biochemical analyses that constitute the first studies for this region and time in most cases.

In addition to a deficient contextualisation of the evidence, another major drawback in the traditional interpretations of the societies from Valencina-Castilleja in particular and the Lower Guadalquivir River during the 3<sup>rd</sup> mill. BC in general has been the tendency to interpret data at face value, a third problem being the sheer lack of data to back up proposals.

Take the model proposed by authors such as Arteaga Matute/Cruz-Auñón Briones (1999) and Nocete Calvo (2008). It postulates that Valencina-Castilleja acted as a centre of power with incipient elites exerting taxation on secondary centres. But any straightforward data such as weapons for soldiers or differences in burials to be expected in a stratified society is lacking. This proposal postulates negative structures ('silos') to represent places to store cereal surpluses, but does not even provide pollen analyses, studies of phytoliths or radiocarbon dates as a support. Alternative uses, as the manure accumulation areas evidenced in this research (chapter 6) on the basis of coprophilous fungi and phytoliths at Loma Real del Tesoro II, are not even considered except by some authors such as Bernaldez Sánchez (2013). Given such a state of affairs, it would not even be necessary to ever carry out a zooarchaeological research to refute that proposal.

The model proposed by García Sanjuán (2017), in which the Valencina-Castilleja site functioned as a place of temporal aggregations for people to carry out rituals and interchange goods, is based on the equally questionable and unstated assumption that pigs kept in a *montanera*-style management system would be able to generate enough meat surpluses to foster social inequality. Here, pigs, not cereal, are the icons elevated to a symbolic status, but the bulk of the evidence to back up the

proposal rests upon isolated pictorial depictions of suids (pig/wild boar?) on a few tools.

Neither one of these two proposals, nor others put forward over the years, reflect upon the fact of a patchy and defective record, interpreting data at face value. In particular, no proposal seems to take into account the fact that, at places like Valencina-Castilleja, one is forced to work with a minor, yet never quantified, fraction of the original archaeological evidence. In this study it was quantified how much of the archaeological levels at some of the Valencina-Castilleja sectors has been lost because of agricultural practices, erosion and urban development. No data exists at present to either prove or disprove that this has not also been the case on other sites from this region.

## 8.2 Summary of Results

The results of the present study allow to state that the main aims and objectives of the research proposal have all been achieved. The radiocarbon dates evidence that Valencina-Castilleja was occupied throughout the 3<sup>rd</sup> mill. BC thus the idea of intermittent occupations, whether on a seasonal basis within the year or with multi-year periods of abandonment, must definitively be ruled out. The data allows also to assess the importance that livestock resources played in the societies that occupied the lower valley of the Guadalquivir River during the 3<sup>rd</sup> mill. BC and how these stocks were managed.

The two major features diagnostic for this husbandry strategy are homogeneity and self-sufficiency. Results showed a similar species spectrum for all sites with a clear dominance of the domestic stocks. Wild animals' higher frequencies at Loma del Real Tesoro II, as its higher frequency of aurochs, may simply reflect the proximity of this site to the forests on the foothills of Sierra Morena. The spectrum of wild mammals is similar and basically restricted to five species (red deer, rabbit, wild boar, horse, and aurochs). Wild boar is underrepresented at all sites, possibly because many bones were incorporated into the unidentified suid category.

The domestic stocks reflect the range that is typical for Iberian Neolithic economies, with little

presence of dog and none apparently of domestic horse although genetic analyses will be required to ascertain that the horse remains that were retrieved all represent wild animals. The three main ‘economic’ stocks, cattle, caprines – sheep and goat – and pigs seem to be homogeneously represented, their ‘importance’ depending on the abundance estimator chosen for analysis. In this way, pig is the main stock in terms of NISP, whereas in terms of MNI caprines – mostly sheep – dominate and cattle is always first when weight is considered. Despite minor differences, the proportion among these three stocks is similar in all three settlements. This distribution conforms best with that of a farming economy, showing nowhere evidence of specialisation. The hypothesis of pig being the number one stock at Valencina-Castilleja finds no support in our study.

All cohorts, from newborn/infantile to senile, are present in the domestic stocks from these sites and this makes for a more compelling case suggestive of a non-specialised domestic economy.

The abundance of specific cohorts in turn reflects uses given to each stock. In the case of pigs there is a higher proportion of juvenile-subadults in all sites, as can be expected when the meat yield is the goal. For the ruminants these profiles are not as straightforward to interpret and depend on the various products aimed at and these differ among stocks. Still, in all cases multiple uses are the norm. Cattle seems more homogeneous from site to site than caprines. With cattle adults predominate and there is a second peak for subadults. Also, adults are mostly females and a few castrates. This hints at a diversified herd management strategy aiming at a secondary production of meat (sub-adults and senile) with a focus on secondary products with labour/draught ranking as important on account of the foot pathologies recorded. Manure, as inferred from the coprophilous fungi found in some of the so-called ‘silo’ structures, and draught both signal crop farming as the most important part of the economy. This in no way rules out that dairy products were also targeted.

The caprine herds – mostly sheep – were slightly different between Valencina-Castilleja and La Loma del Real Tesoro II. At La Loma del Real Tesoro II, juvenile sheep predominate and adult sheep, including castrates, at Valencina-Castilleja.

The presence of castrates points to wool production among other secondary products but even when juveniles dominate the aim for secondary products is clear. In the case of goats, only adult females are documented, thus the focus on milk seems obvious.

Abundant osteological clues reveal that cattle and sheep were kept outdoors. Osteometrical observations evidence large size of specimens of these two species in all studied cases that seem incompatible with stabling. The erosion on the neck of the incisors of cattle reveals protracted grazing on the fields as well. By these same tokens, the small size of pigs and their recurrent dental pathologies indicate sub-optimal raising conditions that are associated with stabling or restricted movements, probably around the households. This data, reinforced by that from isotopic analyses, refutes the hypothesis of pigs being raised under a free-roaming, *montanera*-style, regime. The data on goat is too restricted to decide on how animals were raised.

This zooarchaeological data gained confirmation and further detail from the stable isotope analyses. In terms of diet, the  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  data from Valencina-Castilleja and Carmona showed cattle, caprines, pigs, and dogs all exhibiting different  $\delta^{15}\text{N}$  values, thus different diets. The  $\delta^{13}\text{C}$  results further showed that although all the sites are located in a  $\text{C}_3$  plant-rich environment, cattle and caprines evidence consumption of  $\text{C}_4$  plants. Given that the Guadalquivir Valley is rich in  $\text{C}_4$  plants in their wild form, it is evident that these stocks were kept in a free-roaming or a semi-stabled regime at the very least and this would explain their size. This free/semi-stabled regime of the domestic ruminants gets further confirmation in that the  $\text{C}_3$  plants consumed did not all derive from similar environments. In this way,  $\text{C}_3$  plants from open areas are documented in cattle and caprines from El Amarguillo II and La Loma del Real Tesoro II, whereas at Poblado Calcolítico the  $\text{C}_3$  plants derive from a dense forest environment.

In contrast,  $\delta^{13}\text{C}$  data from pig apatite revealed consumption restricted to  $\text{C}_3$  plants. Although in most cases these  $\text{C}_3$  plants derive from open land (Parque Miraflores, El Amarguillo II, La Loma del Real Tesoro II) and others from dense forest (Poblado Calcolítico), both types are not present in the

same site as was occasionally the case with ruminants, which shows that the area of provisioning for vegetal matter was more restricted in pigs.

The  $^{87}\text{Sr}/^{86}\text{Sr}$  and  $\delta^{18}\text{O}$  analyses, aiming at a better assessment of the mobility of these domestic stocks, reinforced and enlarged the scope of the dietary data. These studies showed that all of the analysed herds had quite restricted mobility patterns that conform best with domestic (farming) economies. Local  $^{87}\text{Sr}/^{86}\text{Sr}$  signatures are seen in all cases and only two cattle and three suids from Valencina-Castilleja, one cattle from Carmona, and one suid from Poblado Calcolítico exhibited non-local values, with the proviso that the suids could all be wild boar. One of the bovids from El Amarguillo II presented a non-local value in the upper band of the tooth but a local value in the lower band, suggesting that it had been brought into the settlement in its youth. This majority of local values points in all cases to herds with mobility restricted to a local level (i.e. around settlements). The catchment area would thus be quite reduced and therefore it seems that the acquisition of resources was carried out in the vicinity of the sites. The pollen analyses from Valencina-Castilleja (Llergo López/Ubera 2013) evidence the presence of ruderal plants, most of which are of a  $C_4$  type. This in turn, would indicate that bovids were specifically grazing on the foothills of the Gerena area, but also feeding on fodder and post-harvest plant leftovers where  $C_3$  plants abound. Although no such specific proposals can be made for the remaining stocks, what seems clear is that herds could be sustained throughout the year in the area. The lack of need of transhumance helps to explain the scarcity of non-local isotopic signatures in these samples.

The  $\delta^{18}\text{O}$  data indicated a diversified access of animals to different water sources. Again, the ruminants, cattle in particular, show the most diversified spectrum and pig the most restricted but the presence of different water sources even within the perimeter of Valencina-Castilleja explains why pig data also exhibits variation. One way or the other, the evidence of animals roaming around sites, especially the Gerena foothills, where a wealth of water courses with different isotopic signatures still exist, seems beyond question.

As a result of these analyses, here a model for the Lower Guadalquivir during the 3<sup>rd</sup> mill. BC is

proposed, based on stable communities of mainly crop farming economies, in which the domestic stocks would play secondary though occasionally crucial roles as a fallback resource, and where contacts among neighbouring settlements could be permanent or sporadic but mainly devoted to the exchange of objects, without the need to recur to a periodic, let alone large-scale, mobility of the herds. This model would call into question the feasibility of applying the Centre-Periphery model to the societies of the Lower Guadalquivir Valley during the 3<sup>rd</sup> mill. BC.

### 8.3 Final Remarks and Proposals for Future Work

As stated at the beginning of this chapter, most of the interpretations that have been made about Valencina-Castilleja were, in fact, extrapolations from data and models from somewhere else. The fact remains that the more we learn about it and about the Lower Guadalquivir Valley in the corresponding period, the more we see it emerging as a setting with few parallels, even within the Iberian Peninsula.

According to established wisdom, human life after the so-called Neolithic revolution became fraught with all sorts of problems, from disease and conflict, to famine and wealth. While this must be true on a large scale, one may still conceive that exceptions existed to the general trend under particular circumstances. One of these circumstances has to do with the density of human populations. Population densities throughout history often appear to be correlated with conflict, and this correlation seems to be stronger when resources become scarce. The lack of reliable data on population densities in this corner of the Iberian Peninsula during this period makes it difficult to determine the extent which this area was dictated by conflict. Another factor is resource availability. The area in question features rather mild weather throughout the year. Although summers tend to be harsh, vegetation grows permanently along the banks of the Guadalquivir River. It may not be a place of abundance but neither is it a place of scarcity. Seasonal variations change little from year to year, and even within the year.

In other words, this could have been a rather stable and predictable environment.

Under such circumstances, and more so with low population densities, this part of Iberia could have been a rather nice place to live 5000 years ago. Without the need to recur to change, no wonder that the Copper Age faunal assemblages resemble so much those established in the area 2000 years before.

A *cul-de-sac* of sorts before navigation became widespread in the Mediterranean...in short, a haven of sorts.

Given this scenario, it seems clear why there are no fortified villages typical for the Portuguese Extremadura at this period or why settlements were never placed on the top of hills or on more strategic and easily ground, as is the case a few centuries later in the same area. Perhaps there was no need for this. The settlements could simply choose those places people deemed most appropriate to mend their herds and crops.

We believe that it is within this mostly non-conflictive (or low conflict) scenario where neighbours could get along with each other, where there was wealth (perhaps not in excess but still wealth for everybody) that the huge size of the Valencina-Castilleja site and its relations with neighbouring sites should be interpreted and we sincerely hope that this work will serve as a pioneer of things that need to be understood and put into context than has been hitherto the case.

The approach to understanding and framing the relevant issues within the proper context is broad. Firstly, in order to ensure sample comparability, systematic programs of fine-sieving and flotation of archaeological deposits are needed to make sure that nothing, not even the smallest remains, are lost. This will not only yield many young specimens from the domestic stocks that have been lost up to now, but also provide information on the

microfaunas of vertebrates and invertebrates that to complete the environmental data crucial for a comprehensive and non-biased interpretation.

Secondly, thorough taphonomical analyses on all fauna collections prior to study are required. This will insure comparability of samples but also reveal to what extent data is reliable.

Thirdly, there are issues that need to be addressed that can only be accomplished with specific methodologies. Among these, soil analysis (perhaps also as part of the taphonomy) and aDNA to insure the correct identification of pigs and wild boar etc. have to be mentioned.

For the future it is planned to continue the archaeological excavations at La Loma del Real Tesoro II. With a better understanding of the archaeological record and the results of the surveys and the geophysics, there is a better idea of the function of the site and this has helped to re-define the future excavation strategy.

The analysis of zooarchaeological collections with similar methods to those applied in this work will create a corpus of comparative data to yield a better understanding of the zooarchaeological and demographic profiles of animal stocks in the Guadalquivir Valley. The same applies to the biochemical analyses. The incorporation of more samples with a better definition of the sampling strategy will help to better characterise the mobility and dietary patterns of animals as well as to better reconstruct the ancient environment.

This list is far from complete yet it allows to understand that, no matter how intensive, diversified, and long the efforts have been, it constitutes but a small pebble in a huge road that needs to be built. We thus want to finish our work hoping that, both because of its achievements as well as its drawbacks, it will stimulate others to follow. If this should be the case, its main and major goal will be definitively fulfilled.



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## RESSOURCENKULTUREN 29

### A GOOD PLACE TO LIVE?

This book focuses on the management of livestock resources to assess the significance of livestock as a primary resource within the socio-economic complex of human groups settled in the Lower Guadalquivir Basin during the 3<sup>rd</sup> mill. BC. The study examines two main areas: the estuary of the Guadalquivir River, where Valencina-Castilleja is the primary site of investigation, and the Corbones River Valley, with the sites of Carmona and La Loma del Real Tesoro serving as secondary points of interest. Additionally, other nearby sites, such as Parque Miraflores, Poblado Calcolítico, and El Amarguillo II, located in different geological environments of southwestern Iberia, were incorporated into the comparative analysis to explore similarities and differences in the exploitation of biotic resources. Using conventional zooarchaeological protocols and isotopic analyses of paleodiet ( $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ ) and mobility ( $^{87}\text{Sr}/^{86}\text{Sr}$ ,  $\delta^{18}\text{O}$ ), the aim is to enhance the understanding of herd management strategies for each type of domestic livestock at both intra- and inter-site levels.



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