Social archaeology of food in early medieval rural Iberia
(5th-9th c. AD)

Thesis submitted for the degree of
Doctor of Philosophy by

Maite Iris García Collado

SUPERVISOR
Juan Antonio Quirós Castillo

eman ta zabal zazu

Universidad del País Vasco
Euskal Herriko Unibertsitatea

October 2020

ABSTRACT

This thesis draws a social history of food in early medieval rural Iberia based on the comparison of dietary patterns between three regions as revealed by carbon and nitrogen stable isotope ratios on bone collagen. Ten rural settlements dated to between 5th and 9th centuries and distributed between Madrid-Toledo, the Basque Country and Catalonia were subjected to osteoarchaeological analysis for age and sex estimation and palaeodietary reconstruction. They included fifteen human assemblages and eight fauna datasets for a total of 280 human and 115 fauna samples successfully measured for δ^{13}C and δ^{15}N. The isotopic characterisation of domestic herbivores was not only useful for the definition of local isotopic baselines of each ecosystem, but also for investigating agrarian practices. It was revealed that livestock management strategies shared many common features within the same region. All herbivores were mainly fed on C_3 resources, but a few specimens from Madrid-Toledo and Catalonia also had small proportions of C_4 plants. One of the most interesting findings was the consumption of intensively manured crops by herbivores from Madrid-Toledo, pointing at collective agrarian practices such as the lifting of the fences. Pigs were mostly free-ranged, but in Catalonia their diet was supplemented with domestic waste too. Fowl were also fed with human refuse from households and they showed the most diverse dietary patterns. These data are evidence of the existence of complex agrarian systems in Iberian early medieval rural settlements. Humans also presented some regional affinity in their dietary patterns, but there were greater differences between populations from the same region and within them. In general, all individuals had terrestrial diets largely based on C_3 resources with variable contributions of C_4 plants and animal proteins. Human populations from Madrid-Toledo had predominantly C_3 diets combined with small but regular intake of millets for most individuals and in this region animal protein consumption varied from limited in villages to abundant in farms. Dietary patterns in the Basque Country were characterised by the great importance of C_4 plants, although C_3 resources were still majority. Animal protein intake was moderate, without relevant differences between assemblages except for Finaga, where marine resources could have been consumed sporadically. In Catalonia diets were also based on C_3 resources and only a few individuals had small proportions of C_4 plants. Conversely, animal protein intake was abundant, although it may be overestimated by the preferential consumption of omnivores, young specimens and occasionally marine resources. Age and sex did not stand out as decisive factors in the configuration of diets and only the youngest individuals showed distinct dietary patterns due to breastfeeding and weaning. Social status as expressed through grave goods was associated with δ^{13}C values and crop consumption patterns, as individuals buried with artefacts both in Madrid-Toledo and the Basque Country tended towards more enriched carbon isotope ratios, pointing at greater consumption of C_4 plants. Instead, there was no association between δ^{15}N values and the presence of grave goods, which indicates animal protein intake was not directly related with the placing of artefacts during the funerary ritual. Likewise, the location of burials, in terms of exclusion from the community cemetery or proximity to churches, was not linked to diet. Individuals found in different funerary contexts within the same settlement or to various distances from religious buildings were not significantly different in their dietary patterns, meaning that the factors which determined the location of graves were not the same that regulated the access to food resources.

RESUMEN

Esta tesis traza una historia social de la alimentación en la Iberia rural altomedieval basada en la comparación de los patrones alimenticios de tres regiones a partir de análisis de isótopos estables de carbono y nitrógeno sobre colágeno óseo. Diez asentamientos rurales datados entre los siglos V y IX y distribuidos entre Madrid-Toledo, el País Vasco y Cataluña fueron sometidos a análisis osteoarqueológicos para la estimación de la edad y el sexo y la reconstrucción de la alimentación. Se incluyen quince conjuntos de humanos y ocho de fauna, que suman un total de 280 muestras de humanos y 115 de fauna en los que se pudieron medir los valores de $\delta^{13}C$ y $\delta^{15}N$ con éxito. La caracterización isotópica de los herbívoros domésticos no fue útil solo para la definición de los valores isotópicos en la base de cada ecosistema, sino también para el conocimiento de las prácticas agrarias. Se descubrió que las estrategias de gestión de la ganadería eran similares dentro de la misma región. Todos los herbívoros eran alimentados principalmente con recursos C_3, aunque algunos especímenes de Madrid-Toledo y Cataluña también comían pequeñas proporciones de plantas C_4. Uno de los hallazgos más interesantes fue el del consumo de cultivos abonados intensivamente por parte de los herbívoros de Madrid-Toledo, lo cual apunta a prácticas agrarias colectivas como la derrota de las mieses. Los cerdos eran generalmente pastoreados en espacios abiertos, pero en Cataluña su dieta también se suplementaba con desechos domésticos. Las aves también se alimentaban con desperdicios procedentes de las casas y mostraban patrones alimenticios muy diversos. Estos datos ponen en evidencia la existencia de sistemas agrarios complejos en los asentamientos rurales altomedievales ibéricos. Los humanos también presentaban ciertas afinidades en sus patrones alimenticios entre regiones, pero había mayores diferencias entre las poblaciones de la misma región y dentro de ellas mismas. En general, todos los individuos tenían dietas terrestres ampliamente basadas en recursos C_3 con contribuciones variables de plantas C_4 y proteínas de origen animal. Las poblaciones humanas de Madrid-Toledo tenían dietas predominantemente C_3 combinadas con la ingesta minoritaria pero regular de mijos para la mayor parte de los individuos. En esta región el consumo de proteínas de origen animal variaba de limitado en las aldeas a abundante en las granjas. Los patrones alimenticios en el País Vasco se caracterizaban por la gran importancia de las plantas C_4, a pesar de que los recursos C_3 eran mayoritarios. La ingesta de proteínas de origen animal era moderada, sin diferencias relevantes entre los conjuntos excepto por Finaga, donde los recursos marinos podrían haber sido consumidos esporádicamente. En Cataluña las dietas también estaban basadas en recursos C_3 y sólo algunos individuos tenían acceso a pequeñas proporciones de plantas C_4. En cambio, la ingesta de proteínas de origen animal era abundante, a pesar de que podría haber sido sobrevalorada a causa del consumo preferencial de omnívoros, especímenes jóvenes y ocasionalmente recursos marinos. La edad y el sexo no destacaban como factores decisivos en la configuración de las dietas y sólo los individuos más jóvenes mostraban patrones alimenticios diferenciados debidos a la lactancia y el destete. El estatus social expresado a través de los depósitos funerarios se asociaba a los valores de $\delta^{13}C$ y las pautas de consumo de cereales, ya que los individuos enterrados con artefactos tanto en Madrid-Toledo como en el País Vasco tendían a proporciones de isótopos estables de carbono más enriquecidas. Por el contrario, no había ninguna asociación entre los valores de $\delta^{15}N$ y la presencia de depósitos funerarios, lo cual indica que la ingesta de proteínas de origen animal no estaba directamente relacionada con la colocación de artefactos durante el ritual funerario. Asimismo, la localización de los enterramientos, en términos de exclusión del cementerio comunitario o de

proximidad a las iglesias, tampoco estaba relacionado con la dieta. Individuos hallados en distintos contextos funerarios dentro del mismo asentamiento y a distancias variables de los edificios religiosos no eran significativamente diferentes en sus patrones alimenticios, indicando que los factores que determinaban la localización de las tumbas no eran los mismos que regulaban el acceso a los recursos alimenticios.

CONTENTS

1 INTRODUCTION

1.1 DIET AS A WINDOW TO PAST SOCIETIES

Beyond biological needs, diet plays an essential role in the construction of personal and collective identities, social dynamics and strategies of distinction (Douglas 2001, Hastorf 2017, Moffat & Prowse 2010, Mennell *et al.* 1992). At the same time, diet can be considered an artefact where food production, distribution and consumption converge (Parker Pearson 2003). In this way, the study of food in the past can provide information about a wide range of topics, such as agrarian production, the exploitation of wild products, storage systems, culinary traditions, allocation of food resources to specific social groups and commensality. The first step in the study of diet in any context, past or present, is not only the characterisation of the foodstuffs available, but also what was considered edible by each society (Parker Pearson 2003). Although this may seem obvious, the existence of food taboos and collective preferences concerning specific products, preparations or seasons is a great source of information about social and cultural aspects of past societies.

In this thesis food will be used as a tool to deepen into social organisation and the role of overlapping identities in the articulation of early medieval rural communities in Iberia. On one hand, access to food is conditioned by economic position and social status. In the Early Middle Ages these two factors determined access to the means of production of food, such as land and tools, and the degree of freedom each individual or community had to make decisions about their own production. Therefore, diet would potentially not be the same in autonomous communities, where peasants would be able to diversify harvesting and husbandry in order to reduce risks (Montanari 1979), as in dependent communities, where the productive strategies would be imposed by supralocal powers. In the same way, there would be differences between the diets of the communities whose production was aimed at self-sufficiency and those who were well integrated into commercial networks (Wickham 2005).

On the other hand, diet is helpful to identify social inequalities because food has commonly been used as an element of power display (Quirós 2013, Wickham 2011). The restriction of certain foods to a specific social group is a well-known phenomenon. It could be caused by the natural unavailability of particular foodstuffs in any given context, which would have raised it cost, or it could be explicitly regulated by laws, as it happened with game in the Late Middle Ages (Birrell 2006). Then, the consumption of these products would be a recognisable sign of social distinction. It is important to note these highly-estimated products changed over time and space. Then, their interpretation will always be contextual, since each of them obeyed a language of signs only understandable in a specific context. In addition, hosting feasts was a well-known form of power display among early medieval elites (Althoff 1996). These were characterised by abundance of food and consumption of exotic products (van der Veen 2003). Actually, being invited to and taking part in feasts was a sign of being part of the ruling group.

Thanks to the cross-cutting nature of diet, it is possible to use food consumption patterns as a non-specific indicator of many facets of social relationships, such as age, gender, social status, legal condition, religion or ancestry. However, the kaleidoscopic nature of diet is counterbalanced by its ambiguity in many regards, which make it of little use without contextual information. In this setting, carbon and nitrogen stable isotope analyses on bone collagen are an excellent method to tackle the topic. One of the most interesting features of this technique is the opportunity to elaborate dense interpretations based on individualised data about every individual in a population. It is equally engrossing the impossibility to manipulate isotopic signatures in life or during the funerary ritual. This does not mean that carbon and nitrogen stable isotope ratios return a detailed account of the products consumed. It is just to say that, unlike public feasting or the placement of grave goods during the funeral, the information obtained from these analyses is mediated by the same biases for all social groups in a specific context. Thus, results are truly comparable between individuals with different personal and collective social identities. Based on these premises, the aim of this thesis is to use the unique perspective offered by diet, as understood from the new data provided by osteoarchaeological and isotopic records, in order to characterise the social structure of early medieval Iberian rural societies, which otherwise have often been regarded as plain and uniform.

1.2 RESEARCH AIMS AND OBJECTIVES

The main aim of this thesis is to characterise the agrarian practices and the diet of early medieval rural societies in Iberia based on carbon and nitrogen stable isotope ratios on bone collagen as a means to understand their internal social, economic and political organisation as well as their relationships with the other elements of the landscapes where they lived. In other words, the purpose is to make the most of the palaeodietary data provided by biomolecular analytical techniques in order to bring forth and disentangle the complexity of these local scale communities that otherwise look plain and homogeneous on other archaeological records. Thus, this thesis intends to elucidate the main factors in the configuration of human diets in early medieval rural contexts, whether they were the availability of local resources, political constrains from supralocal powers or local strategies of distinction set up for showing social status within the community. Agrarian practices, which can also be investigated through carbon and nitrogen stable isotope analyses of local fauna, are also a target of this research, as they can provide information about the productive structure and the internal cohesion of past societies. Altogether, beyond gaining new knowledge about dietary patterns in early medieval Iberian farms and villages, the ultimate aim of this work is to use these new data to bring up novel questions and debates about the social and political agency of rural societies, the relationships between the domestic units that formed them and the identities of all the individuals that made them up, productive adult men and women, but also children, the elder, the sick, the disabled, the unfree, the migrants and the marginalised.

Then, the specific objectives of this research can be classified in two group. The first one focuses on the concrete outcomes that can be obtained from the osteoarchaeological study and carbon and nitrogen stable isotope analysis of early medieval Iberian rural populations. They can be summed up in five points. This thesis pursues to create a systematic record of early medieval funerary practices across Iberia, paying special attention to types of burials and grave goods, in order to make distant contexts comparable. Second, a complete osteoarchaeological study of the human populations selected will be done. It will concentrate on calculating the minimum number of individuals in each funerary structure and on age estimation and sex determination to draw the demographic profile of each settlement. Based on this information it will be possible to characterise the population dynamics of these human assemblages and to identify biases in their composition. Third, this research is aimed at characterising the feeding patterns of the domestic animals raised in the villages and farms under study through carbon and nitrogen stable isotope analyses of bone collagen. They can provide information about livestock management strategies and agrarian practices put in action by early medieval rural communities, such as the use of fodder from different cereals to supplement pasturing or intensive manuring. Besides, $\delta^{13}C$ and $\delta^{15}N$ values of local fauna are essential to interpret the results of humans, as they settle the isotopic baseline of the surrounding ecosystems. Fourth, the same analytical technique will be applied to a selection of humans from each population. It will be especially interesting to know the proportions of different crops in the diet in each assemblage and the relative importance of terrestrial animal protein and aquatic resources. Moreover, these data will be compared between regions to verify if common features could be recognised between the populations from nearby settlements. Fifth, the data obtained about human diet will be crossed with age and sex of the individuals in order to understand how food resources were internally distributed. Besides, social status will also be analysed in relation to food consumption patterns based on the presence of grave goods and the location of burials. Overall, the objective is to determine which were the most important factors in the configuration of early medieval diets in rural Iberia and how they changed depending on geographic location or chronology.

The second group of objectives of this thesis has more to do with the situation of archaeological research of early medieval rural contexts in Iberia and, although it may look like a minor issue, it is essential for the development of the whole discipline. It is a specific objective of this research to recover some of the most relevant archaeological contexts discovered by commercial archaeology during the last three decades, to make the them available for the academic community and to integrate them into the most updated narratives and debates. The issue is that, except for a few happy exceptions, most rescue archaeological interventions have never been published thoroughly because of the extremely tight time and budget conditions under which they are usually carried out and in many cases the access to records depends on having the right contacts and the kindness of people in charge. Likewise, some older archaeological projects developed from the academic sphere suffer similar problems. As a result, there are literally thousands of early medieval burials in Spanish and Portuguese museums waiting to be studied. Hence, this thesis seeks to create a standardised and methodologically up to date body of data about early medieval funerary archaeology, human osteoarchaeology and palaeodiet in Iberia which enables turning profits in historical terms from the great public investments made on these sites and can be used by fellow scholars on the revision and construction of new questions and narratives. Besides, only a broad systematic database will allow to make well-grounded comparisons within Iberia and with other European territories and to bring research on early medieval Iberian bioarchaeological records in line with international standards.

1.3 THESIS FORMAT AND STRUCTURE

This thesis is made up of seven chapters. The first one is the present introduction, where the main elements of the research, namely the topic and object of study, the geographic and chronological coordinates, the theoretical framework and the aims and objectives, have been exposed. The second chapter covers all the methods applied in this research, including the systematisation of archaeological records, human osteoarchaeology for age estimation and sex determination, zooarchaeology for the identification of fauna samples, a detailed explanation about the fundamentals of carbon and nitrogen stable isotope ratios on bone collagen as well as the specific protocols applied, and statistics and cartographic representation. The third chapter constitutes the main body of data of this thesis. It contains the presentation of all the materials analysed and the raw results. It is divided into three main sections, one for each the three regions tackled, and within them there is a subsection for every site. Under the heading of each case study there are four parts. The first one introduces the location and the history of research of the site and the description of the settlement and the funerary contexts. The second part addresses human populations, that is, the macroscopic preservation of human osteoarchaeological remains and their demography. The third and fourth parts display the results of carbon and nitrogen stable isotope ratios of fauna and human samples respectively. In each case they consist of a presentation of the samples analysed, an assessment of the preservation of bone collagen and the exposition and explanation of the results of each dataset. The fourth chapter is a comprehensive interpretation of all the data obtained from different perspectives. Attention is paid to animal feeding strategies and agrarian practices, the characteristics of human diet in each region, the variability of food consumption patterns due to age and sex, the role of diet in the definition of social status and the comparison of regions analysed for this research with other contemporary Iberian, European and Mediterranean contexts. The fifth chapter accommodates the conclusions, which focus on the main results and limitations of this research and the works for the future that it inspires. The sixth chapter collects all the bibliographic references cited. The seventh chapter contains the appendices, which are entirely formed by tables with all the raw data on which this thesis is based. In the previous chapters they are cited when appropriate.

2 METHODOLOGY

2.1 FUNERARY ARCHAEOLOGY

2.1.1 THE SYSTEMATISATION OF CONTEXTUAL INFORMATION

One of the challenges of this thesis was to combine and compare information from very different archaeological records. Most of the populations considered in this work were excavated within the framework of commercial archaeology, which has its own idiosyncrasies (Vigil-Escalera 2011). Since the author of this thesis did not participate in the excavation of any of the sites, all the contextual data, such as types of graves or position of the skeletons, relies on the criteria of the people in charge of the interventions. In addition, most of this information comes from grey literature, either unpublished technical reports or original field recording sheets, and there are only a few monographs and peer-reviewed papers about the sites tackled, so a large part of the data included in this research comes from personal communications or museum archives. Then, it was essential to normalise the data available from all the sites in order to make them comparable. The following sections are dedicated to make clear the criteria used in this process. They will focus on four aspects: the types of grave, the kind of deposits and the position of skeletons, grave goods and the other objects found in the graves, and chronology.

2.1.2 TYPES OF GRAVES

The type of funerary structure can potentially provide hints about the social or legal status of the individuals buried in it (Roig & Coll 2011), about their religion (Vigil-Escalera 2015) and it may also be useful as chronological indicator (Ibáñez & Moraza 2005). Considering that in many of the sites analysed in this thesis several different types of burials coexisted in the same funerary area, it was deemed interesting to check for any relation between grave types and demography or diet. For this purpose, it was necessary to homogenise the typologies defined for each site, despite being aware this may obscure some of their specific features. Eventually, twelve types were established, which are described below. The type of grave each individual was buried in is specified in table 7.1.

Simple pit grave (SP): Cut in the local geological substratum, either sedimentary deposits or bedrock.

Piled simple pit grave (SPp): Cut in the local geological substratum, either sedimentary deposits or bedrock, designed to hold several individuals in overlapping layers.

Lateral niche grave (N): Funerary structure consisting of a pit cut in the local geological substratum with one or two lateral chambers or niches at the bottom. The bodies are placed in the lateral niches and these are usually sealed with standing slabs.

Slabs grave (SL): Cut in the geological substratum whose perimeter is reinforced with standing stone slabs.

Walls grave (WL): Cut in the local geological substratum whose perimeter is reinforced with stacked stones. The regularity and quality of these perimetral walls can be very variable.

Stuccoed walls grave (WLs): Walls grave whose interior is lined with stuccos.

Tegulae grave (TE): Funerary container created with Roman flat *tegulae* lining the floor and the perimeter of the pit and usually creating a gabled cover.

Grave made of building material fragments (BMf): Cut in the local geological substratum whose perimeter is reinforced with fragments of building materials, such as *tegulae*, *imbrices* and bricks, irregularly arranged. Within this category there is a special type of grave, which are those created by two superimposed *imbrices* or fragments of *dolia* for the burial of fetuses or neonates.

Grave made of mixed materials (MX): Cut in the local geological substratum whose perimeter is reinforced by different types of materials, such as stone slabs, stacked stones forming walls, *tegulae* and bricks.

Sarcophagus (SC): Monolithic container for human remains.

Non-funerary structure (NFS): Structures originally created for domestic or productive purposes, reused for the disposal of human bodies, sometimes along with animal carcasses and other types of waste. Among the sites included in this work, silos and a well were used in this way.

Undetermined grave (U): The features of the funerary structure cannot be defined.

2.1.3 POSITION OF THE INDIVIDUALS

An accurate record of the position of the skeletons during fieldwork is essential to understand the formation of the assemblages of anthropological material recovered in each grave (Duday 2006). This is particularly important for the burials where several individuals are found, which account for a great proportion of those included in this study. On one hand, it is necessary to distinguish between primary and secondary deposits. Primary deposits are those preserved as they were originally laid. In the case of skeletal remains, their main feature is that they maintain most of the anatomical connections. Secondary deposits are the result of the alteration of primary deposits and, therefore, usually do not keep anatomical connections. On the other hand, the position of the individuals in primary position can also provide information on faith, social or legal status. Likewise, the distribution of skeletal remains in secondary deposits, that is, their arrangement and location in the grave, can inform about the types of reuse practiced. Next, the positions of skeletal remains identified in the sites under study are described as normalised by the author. The specific position of each individual can be checked on table 7.1.

Primary deposit, supine position (1S): Individual in its original position lying straight on the back.

Primary deposit, prone position (1P): Individual in its original position lying straight on the abdomen.

Primary deposit, lateral position (1L): Individual in its original position lying straight on one side.

Primary deposit, fetal position (1F): Individual in its original position lying flexed on one side.

Primary deposit, thrown body (1T): Individual in its original position in an abnormal posture, indicating little care in its deposition.

Secondary deposit, reduction (2R): Individual moved from its original location placed at the feet, the lateral or the head of the grave where it was originally buried.

Secondary deposit, ossuary (2O): Individual moved from its original location placed in a funerary structure specifically designed for hosting human remains removed from other graves.

Secondary deposit in filling (2Fi): Individual moved from its original location found scattered in the filling of a grave.

Secondary deposit in tumulus (2Tu): Individual moved from its original location found scattered in the tumulus of a grave, an accumulation of soil on the cover for marking it.

Secondary deposit, undetermined (2U): Individual moved from its original location found in an undetermined setting.

Undetermined deposit (U): The type of deposit where the individual was recovered cannot be defined because information is lacking.

Besides, information about the orientation of burials was also collected. Orientation was recorded only in the cases where there were primary deposits and it was expressed mentioning first the cardinal direction where the head of the individual was placed.

2.1.4 GRAVE GOODS AND OTHER OBJECTS

The presence of grave goods and other objects accompanying the individuals is a characteristic feature of the funerary rituals between 5th and 7th centuries (Brownlee 2020), even though it was not generalised among all individuals or sites (Vigil-Escalera 2013). Nowadays funerary deposits are usually interpreted as an indicator of the social status of the individual, either real or constructed during the funerary ritual (Pohl & Reimitz 1998), and ethnic paradigms are less popular (Halsall 2011). The two main challenges for the analysis of grave goods are, first, that the range of objects found in these graves is very wide and, second, that it is not always easy to determine which item was deposited with which individual, especially in the graves with more than one individual. For these reasons, a few decisions had to be made in order to make comparisons between sites possible. On one side, only the objects which can certainly be related to a single individual according to the records available are included. On the other, grave goods were considered only in terms of presence or absence based on a number of predefined types sorted in three categories:

Clothing items & jewellery: Includes fibulae, belt plates, earrings, necklace items, bracelets and rings.

Containers: Includes containers made of pottery, glass, metal and wood.

Tools & weapons: Includes long swords, short swords, spears, axes, knives, farm tools, personal hygiene items and flint tools.

In addition, in the first and the last categories there is an extra field for the less common objects which did not fit into any of the predefined types. For the category “Clothing items & jewellery” this included mainly buckles, rivets or hobnails and for the category “Tools & weapons” helmet items, arrowheads, hooks, needles, horseshoes, handles or different types of undetermined metal objects. Moreover, there is an extra fourth category named “Others” to record all the findings which did not fit in the previous ones. Fauna remains, religious items, coins and unidentified objects are the kind of grave goods included under this heading. Finally, the presence of coffin items, such as nails and rivets, was indicated in a separated category, since these elements are not grave goods but part of the funerary container. In all cases the identification of the objects followed those proposed by the people in charge of each archaeological project. Table 7.2 shows the presence or absence of coffin items and each type of grave goods individual by individual.

2.1.5 CHRONOLOGY

In general terms, the chronologies for sites and individuals proposed by the archaeologists responsible of each archaeological project were accepted and these are the ones presented in the “Materials & results” section and reported in table 7.1 for each individual. There are only two remarks to be made. Some of the chronologies originally set may currently be outdated. When newer bibliography including updated chronological criteria are available, these are incorporated into the body of evidence. Also, all the radiocarbon dates were recalibrated with the most updated resources: the software OxCal 4.2 (Bronk Ramsey & Lee 2013) and the calibration curve IntCal13 (Reimer *et al.* 2013). For this reason, the calibrated dates reported in the original publications and in this work may differ and only the most recent are used. The complete list of radiocarbon dates available for the human populations studied in this thesis can be found in table 7.3.

2.2 HUMAN OSTEOARCHAEOLOGY

2.2.1 NAMING INDIVIDUALS

Each individual included in this thesis was given a unique code to identify it unambiguously. Because it was desirable to have a homogeneous naming system across all the sites, original denominations were adapted. Then, the codes used in this work may not be the same as those given in technical reports or publications. However, it is easy to match the codes used here with the original ones following the instructions below.

Generally, the code of each individual was elaborated according to this formula: [Acronym of the site] [Grave number or SU of the cut of the grave] - [Consecutive number of individual within the grave] - [SU of the individual] ([Code originally given to the individual]) It has to be taken into account there was not information on all the fields for the individuals from every site. For example, in most sites individuals were not given a distinctive code and in some cases not even a stratigraphic unit (SU). In table 2.1 an example of the code of an individual from each site is fully developed in order to make the understanding of the naming system easier.

Table 2.1. Examples of the codes of individuals from each site.

Individual	*Name of the site*		*Grave no SU cut*	*No indiv in grave*	*SU individual*	*Code individual*
BOA 068-1	BOA	Boadilla	68	1	-	-
GOZ 131-3-4546	GOZ	Gózquez	131	3	4546	-
LH 6-1-7192	LH	La Huelga	6	1	7192	-
SNC 30150-2-30152	SNC	El Soto/El Encadenado	30150	2	30152	-
ALD B088/B098-02(B089)	ALD	Aldaieta	B088/B098	2	-	B089
FIN 02-1-44	FIN	Finaga	2	1	44	-
SMD 3081-1-3080(208)	SMD	Dulantzi	3081	1	3080	208
CG 393-2-0874	CG	Can Gambús	393	2	874	-
PMCV 50-2-474	PMCV	Castellar del Vallès	50	2	474	-
RVSM 042-1-158(050)	RVSM	Sant Menna	42	1	158	50

2.2.2 IDENTIFICATION, INVENTORY AND MINIMUM NUMBER OF INDIVIDUALS

All the individuals which preserved any anatomical elements were subjected to a summarised inventory. First, all the skeletal remains preserved for each individual were laid out and identified. The main references used for identification were White & Folkens (2005) for adults, and Scheuer & Black (2000) and Schaefer *et al.* (2009) for subadults. Then, the anatomical areas preserved and to what extent were recorded. For this aim the human skeleton was divided into twelve anatomical areas and the proportion present of each of them was recorded for every individual. The twelve anatomical areas defined were the following: cranium, including teeth; vertebrae, including hyoid; ribs, including sternum; right shoulder girdle; left shoulder girdle; right arm; left arm; hands; pelvis; right leg; left leg and feet. The preservation of each one of them was assessed according to five brackets: 0% preserved, 1-25% preserved, 25-50% preserved, 50-75% preserved, 75-100% preserved. Despite this quick inventory method may leave out the details, it was enough for the purposes of this research and it was chosen because it allowed recording a great number of individuals in a short time.

When more than one individual was detected in a given context, the minimum number of individuals (MNI) was calculated based on the most frequent anatomical element (White & Folkens 2005: 339) after having separated subadult and adult skeletal remains. In most of the cases, the MNI was calculated grave per grave, that is, considering all the human remains recovered from each funerary structure as a single context. Only in a few sites, where the stratigraphic record was very detailed, was the MNI calculated based on individual stratigraphic units.

2.2.3 MACROSCOPIC PRESERVATION

The preservation of each individual was assessed macroscopically based on three criteria (García-Collado *et al.* 2019): completeness, fragmentation and surface preservation. Completeness refers to the proportion of the skeleton preserved for each individual. It was recorded based on four brackets:

1-25% of the skeleton is preserved
25-50% of the skeleton is preserved
50-75% of the skeleton is preserved
75-100% of the skeleton is preserved

Fragmentation indicates the percentage of fragmented anatomical elements among those preserved for an individual. It was also recorded according to the following intervals:

0% of the anatomical elements preserved are fragmented
1-25% of the anatomical elements preserved are fragmented
25-50% of the anatomical elements preserved are fragmented
50-75% of the anatomical elements preserved are fragmented
75-100% of the anatomical elements preserved are fragmented

For the assessment of surface preservation, which is essential to evaluate the possibilities of any osteoarchaeological assemblage, the proposal made by Brickley & McKinley (2004: 15–16) was used. These authors present a progressive scale covering the main changes caused by abrasion and erosion on skeletal remains based on clear definitions and supporting images. Even though an individual can present various degrees of surface preservation on different anatomical elements, only the prevalent one for each individual was recorded. Below there are the definitions used. Images can be looked up in the original publication.

Grade 0: Fresh appearance
Grade 1: Slight surface erosion
Grade 2: More extensive surface erosion with deeper penetration
Grade 3: Most surface eroded, some details of the surface masked
Grade 4: All surface eroded, uneven distribution of depth or degree of alterations
Grade 5: Heavy erosion on all surface with some modifications of profile
Grade 6: Heavy erosion on all surface with substantial modification of profile

This recording system is simple and quick to apply and it allows comparing easily different populations and identifying biases in the results of osteoarchaeological analyses due to macroscopic preservation.

2.2.4 AGE ESTIMATION

The first division based on age is between subadults and adults. In general terms, subadults are the individuals who did not fulfil skeletal development before death. Adults are the individuals who did complete it. The threshold between these two categories is established by convention at 20 years of age. This study used the age categories recommended by Scheuer & Black (2000: 469) for subadults and Falys & Lewis (2011) for adults. Both proposals agree on defining each age category based on well-defined and easily recognisable milestones of skeletal development. The age categories are the following:

Fetus	< 40 weeks in utero
Infans 1	Birth – 7 years
Infans 2	8 – 14 years
Juvenile	15 – 19 years
Young adult	20 – 34 years
Middle adult	35 – 45 years
Old adult	> 45 years

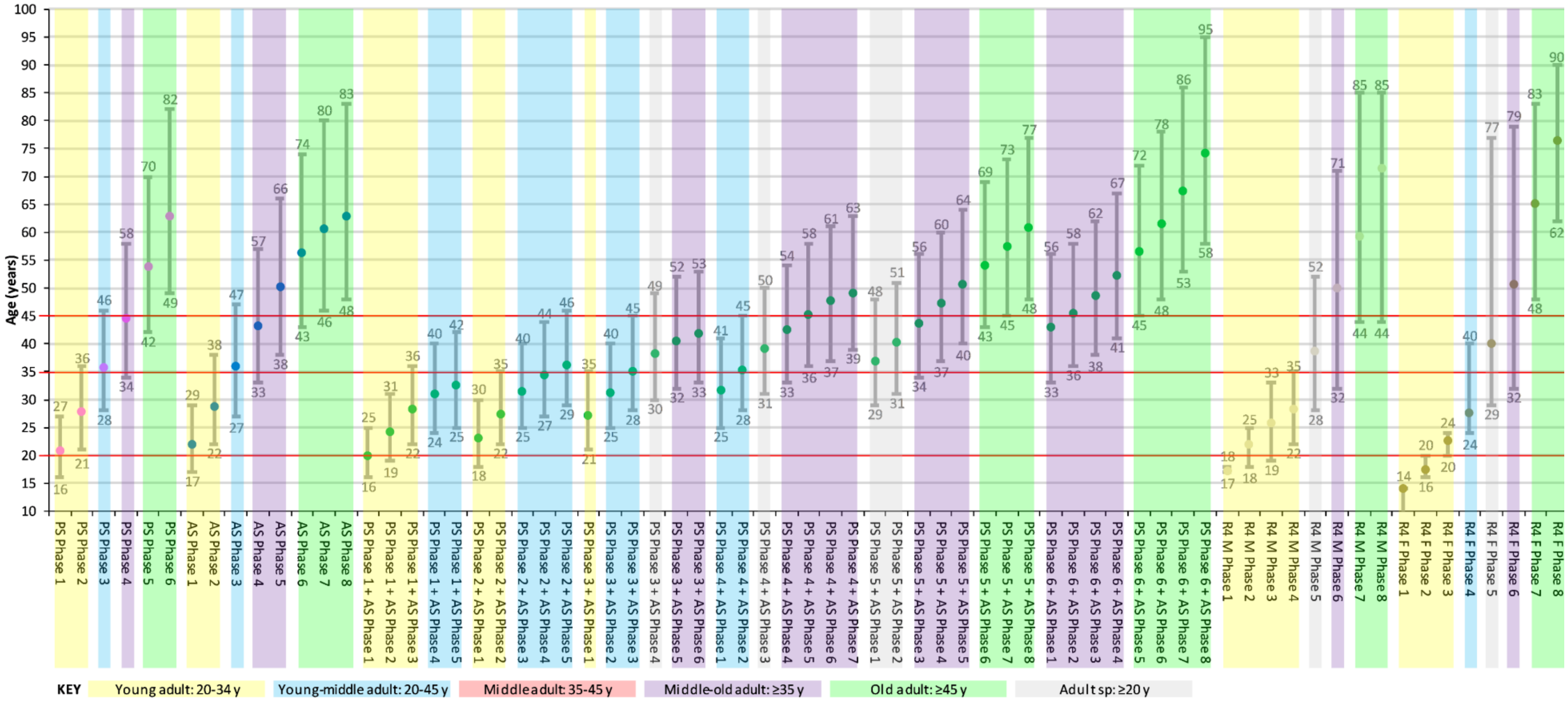


Figure 2.1. Phases for the degeneration of pubic symphysis, auricular surface and sternal rib end allocated to adult age categories. Key: PS = pubic symphysis, AS = auricular surface, R4 M = fourth rib sternal end male, R4 F = fourth rib sternal end female.

In addition, whenever possible infans 1 were divided into infans 1A (birth – 2 years) and infans 1B (3 – 7 years). This subdivision is useful for discussing specific issues concerning the first years of life, such as infant mortality or breastfeeding and weaning. In the case of adults, intermediate categories (young-middle adult, middle-old adult) were used when necessary. The generic categories subadult sp (< 20 years) and adult sp (> 20 years) were applied when it was not possible to make more precise estimations.

The methods used for the estimation of age at the time of death of subadults were grounded on three pillars: dental development and eruption, epiphyseal fusion and lineal growth. Dental development was recorded according to Smith (1991) and age estimation based on tooth development and eruption followed generally Gustafson & Koch (1974) and Ubelaker (1989: 64), along with the data from Caldas *et al.* (2012) and Haavikko (1970) for third molars. Sixty-three epiphyses, including all major bones of axial and appendicular skeletons, were systematically observed and recorded. They were classified into three stages:

Open fusion: Epiphysis and diaphysis are completely separated
Partial fusion: Epiphysis and diaphysis are united, but the fusion line between them is still observable
Complete fusion: Epiphysis and diaphysis are united and the fusion line between them is unobservable

The age of fusion of each epiphysis was checked on the reference manual by Schaefer *et al.* (2009: 337–349). Combined age ranges for males and females together were used. As for linear growth, twenty-nine measurements were systematically used for subadult age estimation according to the works by Black & Scheuer (1996), Cardoso *et al.* (2017), Maresh (1970), Molleson *et al.* (1993), Rissech & Black (2007), Saunders *et al.* (1993), Scheuer & MacLaughlin-Black (1994) and Young (1957). In the case of fetuses, specific tables and equations based on forty-six measurements elaborated by Fazekas & Kósa (1978), Scheuer & MacLaughlin-Black (1994) and Scheuer *et al.* (1980) were employed. When more than one method could be applied to a subadult, dental development and eruption were given preference for final age estimation. The results of subadult age estimation broken down by methods can be found in table 7.5.

Regarding adults, the first thing to say is that fragments with completely fused epiphyses, typical adult size bones and loose teeth with closed roots were considered adults by default. Still, it is possible that some of them belonged to juvenile individuals. The methods used for the estimation of adult age at death were based on the degeneration of immobile joints, whose progress is not determined by the activities carried out by the individual. Different methods grounded on this principle were combined to obtain the most accurate estimations possible. The pubic symphysis and the auricular surface of the ilium are the anatomical areas useful for this purpose most commonly observable. In this research the descriptions for the degeneration of the pubic symphysis proposed by Brooks & Suchey (1990) and the auricular surface by Lovejoy *et al.* (1985) were followed. Even knowing there are more recent updates (Buckberry & Chamberlain 2002, Hartnett 2010), it was decided to stick to the originals because they are still the most popular and, therefore, the results will be more easily comparable. However, a modification was introduced in the allocation of chronological ages. Instead of using the ages given by the original authors, the work by Samworth & Gowland (2007) was applied. This is a statistical reprocessing of the chronological ages assigned to the phases defined by Brooks & Suchey (1990) and Lovejoy *et al.* (1985) based on populations from modern Britain and contemporary Portugal. The advantages of this new proposal are that it is built on populations closer to the ones analysed in this thesis than those used for the original elaboration of the methods, which came exclusively from the USA. In addition, it is independent of sex, it provides statistically founded chronological ages for every combination of pubic symphysis and auricular surface, and it has been proven to be robust and reliable on other populations (Passalacqua 2010). For this work 68% prediction intervals were always used. In addition, whenever possible the method based on the degeneration of the sternal end of the fourth rib (Iscan *et al.* 1984, Iscan *et al.* 1985) was also applied. In order to allocate adult age estimations to the categories proposed by Falys & Lewis (2011) systematically, every phase or combination of phases was initially assigned to a category (figure 2.1). The phases for pubic symphysis, auricular surface and sternal rib end degeneration of each individual are itemised in table 7.6.

2.2.5 SEX DETERMINATION

Working exclusively with anthropological remains, it is very difficult to address all the dimensions of sexual identity (Higuero 2015). The only aspect which can be tackled with some confidence is biological sex, even if there are many caveats and limitations. Biological sex is not a dichotomy (i.e. male-female), but a continuous variable with a wide range of forms. With the aim of simplifying this reality, five categories covering the complete spectrum were used (Buikstra & Ubelaker 1994: 21):

Female individual
Probably female individual
Ambiguous individual
Probably male individual
Male individual

The individuals who did not preserve any sexual indicator were classified as undetermined. This was the case of all the subadults, whose skeletons do not present any macroscopically observable sexual indicator because they did not complete its development before death (Lewis 2007: 47–48). For this reason, macroscopic sex determination was not even attempted for any subadult.

The indicators used for sex determination of adults were based on pelvic and cranial morphology. In the pelvis, the ventral arc, subpubic concavity, ischiopubic ramus (Phenice 1969), subpubic angle, greater sciatic notch and preauricular sulcus (Buikstra & Ubelaker 1994: 18–19) were assessed. In the skull, the nuchal crest, mastoid process, supraorbital margin, glabella and mental eminence (Buikstra & Ubelaker 1994: 19–20) were recorded. The indicators of the pelvis are deemed more reliable than those of the skull, so the former were given priority for final sex determination. Table 7.6 includes the description of each sexual indicator observable for every adult individual.

2.2.6 RECORDING AND DATABASE

A database was designed *ad hoc* by the author for archiving, processing and enquiring all the information from the osteoarchaeological analysis. The software used was FileMaker Pro 18 Advanced. The database is formed by 608 fields, indexed based on the unique code of each individual (see section 2.2.1) and organised in six modules: general data (figure 2.2), preservation (figure 2.3), summarised bone inventory (figure 2.4), adult age (figure 2.5), sex (figure 2.6) and subadult age (figure 2.7). Four additional modules for the recording of the metric features of subadults and adults, as well as oral and metabolic pathologies made up of 1610 fields were also created and compiled, but the data on these topics are not included in this thesis.

2.2.7 PALAEODEMOGRAPHY

Several palaeodemographic tools were used to characterise the demographic structure of the human populations analysed, also with the aim of identifying the biases that affected assemblages in terms of under- or overrepresentation of specific age or sex groups. Even if some of the indicators employed are very simple, it was deemed important to explicitly state them here. First, the distribution by age and sex categories is presented in a table for each population. The detailed list of age estimation and sex determination for each individual can be found on table 7.4. Next, a set of purely descriptive indicators was used to summarise the main features of every assemblage. These were the following:

MNI, minimum number of individuals, obtained as explained in section 2.2.2

GENERAL DATA

INDIVIDUAL ID

PhD ○ Yes ○ No

SITE

STORAGE REF

STUDY

☐ Preservation ☐ Stature
☐ Inventory complete ☐ Metrics
☐ Inventory summary ☐ Oral
☐ Age ☐ Metabolic
☐ Sex ☐ Other obvious paths

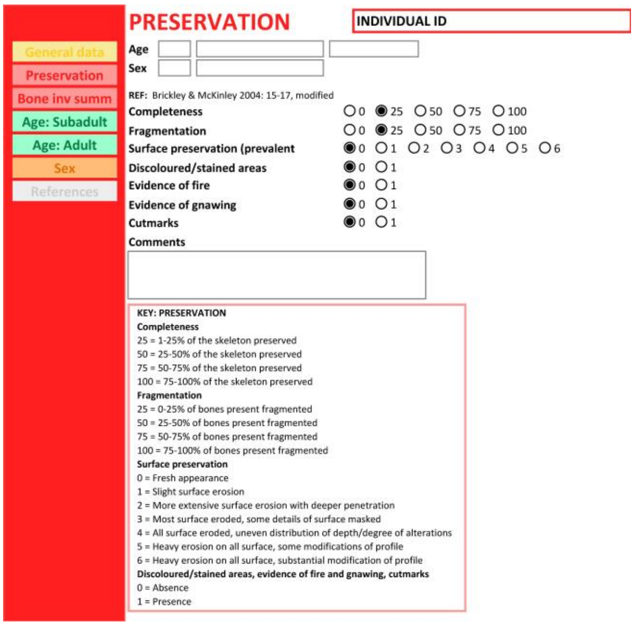
AGE

SEX

COMMENTS

DATE CREATION

Figure 2.2. Database for osteoarchaeological data. Module for general data



PRESERVATION

INDIVIDUAL ID

Age

Sex

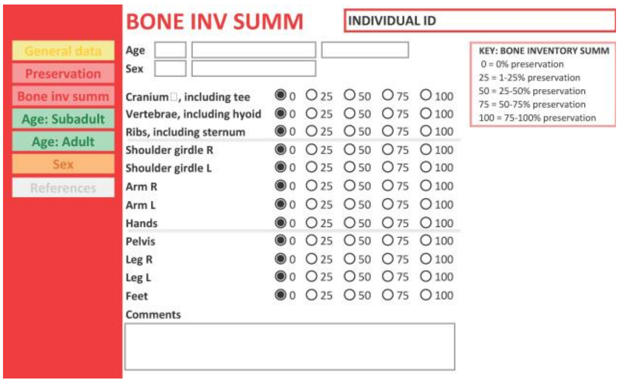
REF: Brickley & McKinley 2004: 15-17, modified

Completeness	○ 0	● 25	○ 50	○ 75	○ 100		
Fragmentation	○ 0	● 25	○ 50	○ 75	○ 100		
Surface preservation (prevalent	● 0	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
Discoloured/stained areas	● 0	○ 1					
Evidence of fire	● 0	○ 1					
Evidence of gnawing	● 0	○ 1					
Cutmarks	● 0	○ 1					

Comments

KEY: PRESERVATION
Completeness
25 = 1-25% of the skeleton preserved
50 = 25-50% of the skeleton preserved
75 = 50-75% of the skeleton preserved
100 = 75-100% of the skeleton preserved
Fragmentation
25 = 0-25% of bones present fragmented
50 = 25-50% of bones present fragmented
75 = 50-75% of bones present fragmented
100 = 75-100% of bones present fragmented
Surface preservation
0 = Fresh appearance
1 = Slight surface erosion
2 = More extensive surface erosion with deeper penetration
3 = Most surface eroded, some details of surface masked
4 = All surface eroded, uneven distribution of depth/degree of alterations
5 = Heavy erosion on all surface, some modifications of profile
6 = Heavy erosion on all surface, substantial modification of profile
Discoloured/stained areas, evidence of fire and gnawing, cutmarks
0 = Absence
1 = Presence

Figure 2.3. Database for osteoarchaeological data. Module for the assessment of preservation



BONE INV SUMM

INDIVIDUAL ID

Age

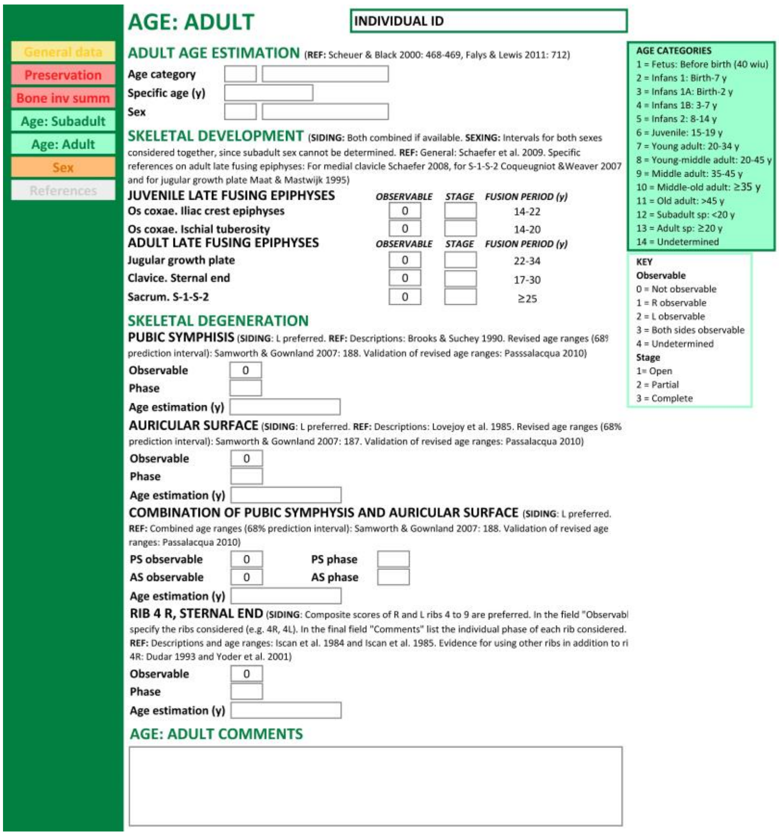
Sex

Cranium□, including tee	● 0	○ 25	○ 50	○ 75	○ 100
Vertebrae, including hyoid	● 0	○ 25	○ 50	○ 75	○ 100
Ribs, including sternum	● 0	○ 25	○ 50	○ 75	○ 100
Shoulder girdle R	● 0	○ 25	○ 50	○ 75	○ 100
Shoulder girdle L	● 0	○ 25	○ 50	○ 75	○ 100
Arm R	● 0	○ 25	○ 50	○ 75	○ 100
Arm L	● 0	○ 25	○ 50	○ 75	○ 100
Hands	● 0	○ 25	○ 50	○ 75	○ 100
Pelvis	● 0	○ 25	○ 50	○ 75	○ 100
Leg R	● 0	○ 25	○ 50	○ 75	○ 100
Leg L	● 0	○ 25	○ 50	○ 75	○ 100
Feet	● 0	○ 25	○ 50	○ 75	○ 100

Comments

KEY: BONE INVENTORY SUMM
0 = 0% preservation
25 = 1-25% preservation
50 = 25-50% preservation
75 = 50-75% preservation
100 = 75-100% preservation

Figure 2.4. Database for osteoarchaeological data. Module for summarised inventory



AGE: ADULT

INDIVIDUAL ID

ADULT AGE ESTIMATION (**REF:** Scheuer & Black 2000: 468-469, Falys & Lewis 2011: 712)

Age category

Specific age (y)

Sex

SKELETAL DEVELOPMENT (**SIDING:** Both combined if available. **SEXING:** Intervals for both sexes considered together, since subadult sex cannot be determined. **REF:** General: Schaefer et al. 2009. Specific references on adult late fusing epiphyses: For medial clavicle Schaefer 2008, for S-1-S-2 Coqueugniot &Weaver 2007 and for jugular growth plate Maat & Mastwijk 1995)

JUVENILE LATE FUSING EPIPHYSES	***OBSERVABLE***	***STAGE***	***FUSION PERIOD (y)***
Os coxae. Iliac crest epiphyses	0		14-22
Os coxae. Ischial tuberosity	0		14-20
ADULT LATE FUSING EPIPHYSES	***OBSERVABLE***	***STAGE***	***FUSION PERIOD (y)***
Jugular growth plate	0		22-34
Clavice. Sternal end	0		17-30
Sacrum. S-1-S-2	0		≥25

AGE CATEGORIES
1 = Fetus: Before birth (40 wiu)
2 = Infans 1: Birth-7 y
3 = Infans 1A: Birth-2 y
4 = Infans 1B: 3-7 y
5 = Infans 2: 8-14 y
6 = Juvenile: 15-19 y
7 = Young adult: 20-34 y
8 = Young-middle adult: 20-45 y
9 = Middle adult: 35-45 y
10 = Middle-old adult: ≥35 y
11 = Old adult: >45 y
12 = Subadult sp: <20 y
13 = Adult sp: ≥20 y
14 = Undetermined

KEY
Observable
0 = Not observable
1 = R observable
2 = L observable
3 = Both sides observable
4 = Undetermined
Stage
1= Open
2 = Partial
3 = Complete

SKELETAL DEGENERATION

PUBIC SYMPHISIS (**SIDING**: L preferred. **REF:** Descriptions: Brooks & Suchey 1990. Revised age ranges (68⁹ prediction interval): Samworth & Gownland 2007: 188. Validation of revised age ranges: Passsalacqua 2010)

Observable 0
Phase
Age estimation (y)

AURICULAR SURFACE (**SIDING**: L preferred. **REF:** Descriptions: Lovejoy et al. 1985. Revised age ranges (68% prediction interval): Samworth & Gownland 2007: 187. Validation of revised age ranges: Passalacqua 2010)

Observable 0
Phase
Age estimation (y)

COMBINATION OF PUBIC SYMPHYSIS AND AURICULAR SURFACE (**SIDING**: L preferred. **REF:** Combined age ranges (68% prediction interval): Samworth & Gownland 2007: 188. Validation of revised age ranges: Passalacqua 2010)

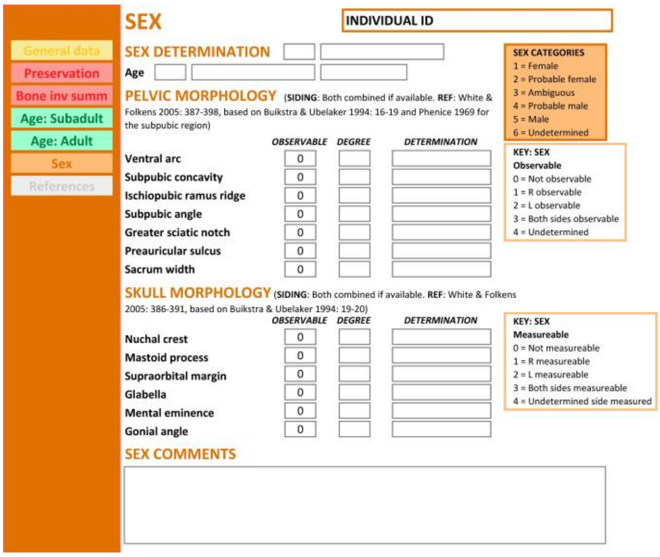
PS observable 0 **PS phase**
AS observable 0 **AS phase**
Age estimation (y)

RIB 4 R, STERNAL END (**SIDING**: Composite scores of R and L ribs 4 to 9 are preferred. In the field "Observabl specify the ribs considered (e.g. 4R, 4L). In the final field "Comments" list the individual phase of each rib considered. **REF:** Descriptions and age ranges: Iscan et al. 1984 and Iscan et al. 1985. Evidence for using other ribs in addition to ri 4R: Dudar 1993 and Yoder et al. 2001)

Observable 0
Phase
Age estimation (y)

AGE: ADULT COMMENTS

Figure 2.5. Database for osteoarchaeological data. Module for adult age estimation



SEX

INDIVIDUAL ID

SEX DETERMINATION

Age

PELVIC MORPHOLOGY (**SIDING**: Both combined if available. **REF**: White & Folkens 2005: 387-398, based on Buikstra & Ubelaker 1994: 16-19 and Phenice 1969 for the subpubic region)

	OBSERVABLE	***DEGREE***	***DETERMINATION***
Ventral arc	0		
Subpubic concavity	0		
Ischiopubic ramus ridge	0		
Subpubic angle	0		
Greater sciatic notch	0		
Preauricular sulcus	0		
Sacrum width	0		

SEX CATEGORIES
1 = Female
2 = Probable female
3 = Ambiguous
4 = Probable male
5 = Male
6 = Undetermined

KEY: SEX
Observable
0 = Not observable
1 = R observable
2 = L observable
3 = Both sides observable
4 = Undetermined

SKULL MORPHOLOGY (**SIDING**: Both combined if available. **REF**: White & Folkens 2005: 386-391, based on Buikstra & Ubelaker 1994: 19-20)

	OBSERVABLE	***DEGREE***	***DETERMINATION***
Nuchal crest	0		
Mastoid process	0		
Supraorbital margin	0		
Glabella	0		
Mental eminence	0		
Gonial angle	0		

KEY: SEX
Measureable
0 = Not measureable
1 = R measureable
2 = L measureable
3 = Both sides measureable
4 = Undetermined side measured

SEX COMMENTS

Figure 2.6. Database for osteoarchaeological data. Module for sex determination

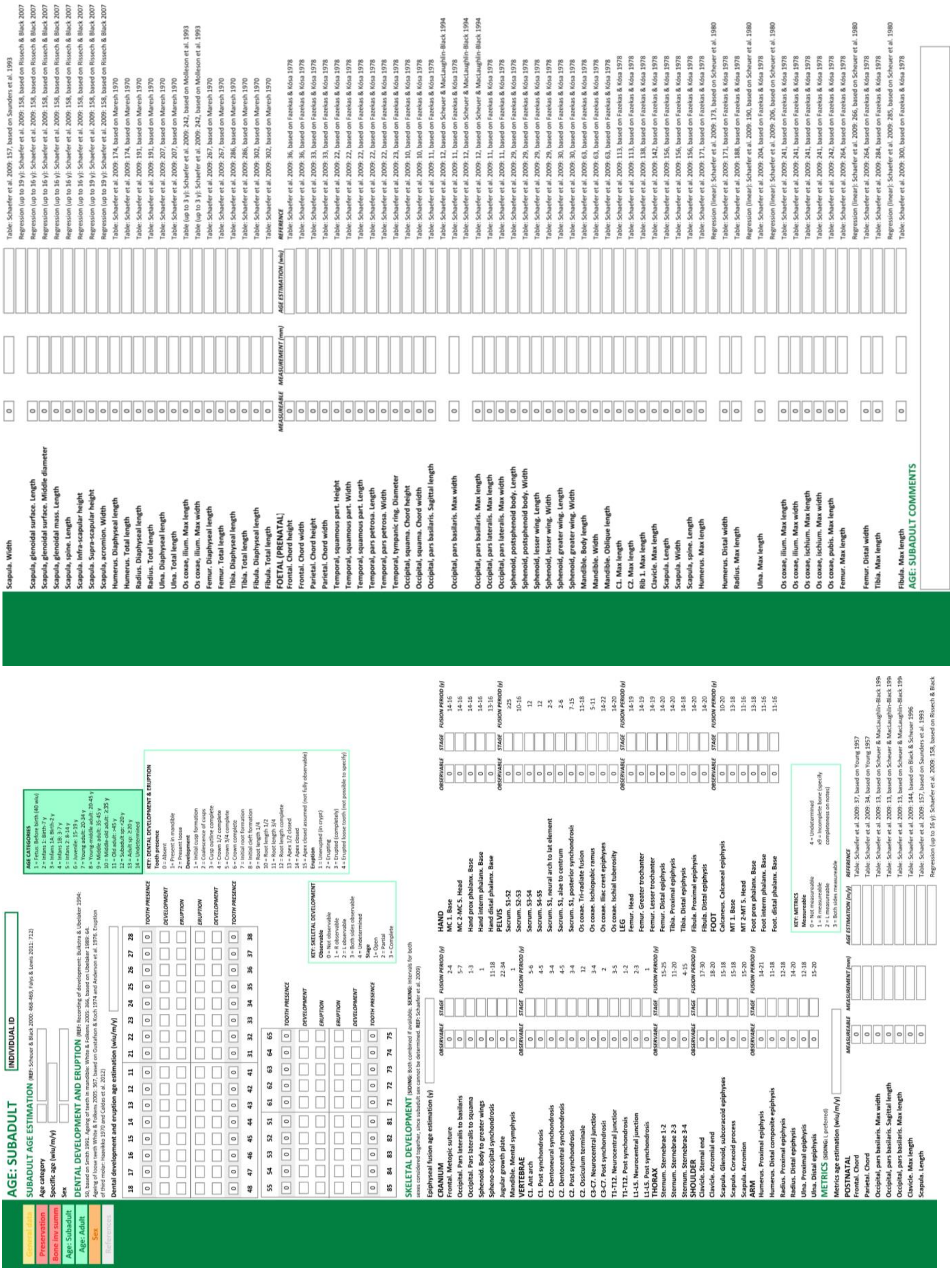


Figure 2.7. Database for osteoarchaeological data. Module for subadult age estimation

%subad, percentage of subadult individuals over the MNI

%ad, percentage of adult individuals over the MNI

S/A, subadult/adult ratio: Proportion of subadults per each adult, calculated according to the formula

S/A = frequency of subadults / frequency of adults

M/F, sex ratio: Proportion of males for each woman (Chamberlain 2006: 18), calculated following the formula

M/F = number of male individuals / number of female individuals

To calculate this parameter female individuals and probably female individuals were grouped and the same was done with male individuals and probably male individuals. Ambiguous and undetermined individuals are not considered

Furthermore, age and sex distribution of each population was represented in custom-made demography charts (figure 2.8). These were specifically designed graphs with two types of information. On one side, bars represent the absolute frequency of each age category (F = fetus, I1 = infans 1, I2 = infans 2, J = juvenile, A = adults), divided by sex (blue = male individuals, red = female individuals, grey = undetermined sex) in the case of adults and in the cases where the sex of subadults was determined through DNA analyses. For most populations, adults were represented altogether. Only when it was possible to estimate age precisely for more than a third of the adults in assemblages of more than ten individuals, they were displayed itemised (YA = young adult, MA = middle adult, OA = old adult). In these cases, adults with loose age estimations (i.e. young-middle adults, middle-old adults, adults sp) were proportionally distributed among the categories they could potentially fit in (e.g. if there are six middle-old female adults, three are assigned to the middle adult female category and three to the old adult female category). Individuals with unspecific age estimations (i.e. subadults sp, undetermined age) were not included in these charts. For this reason, the number of individuals represented in the chart (n) does not always match the total size of the population (MNI), both figures being displayed in the upper left corner. On the other side, in the populations with a MNI greater than five, a line overlapping bars depicts the progression of the probability of death or mortality rate (q_x) along age categories, computed following G. Acsádi and J. Nemeskéri (1970: 65). Fetuses are not included in this calculation.

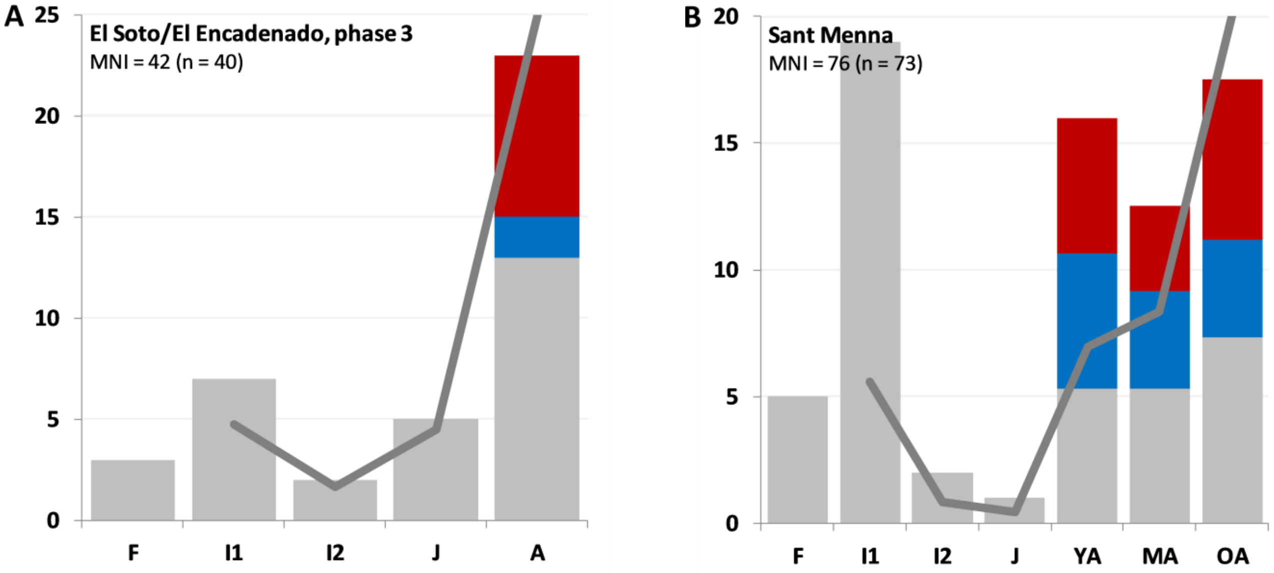


Figure 2.8. Examples of demography charts. (A) Demography chart with adults aggregated. (B) Demography chart with adult categories itemised

After descriptive indicators, palaeodemographic estimators were employed to approximate to the original demographic structure of these populations. This is something difficult to do starting only from archaeological skeletal assemblages. The main problems arise from the representativeness of osteoarchaeological assemblages, the limits of methods for age estimation and sex determination, and preservation. On one hand, it is often challenging to determine the representativeness of a skeletal sample (Séguy & Buchet 2013: 14–18). Human osteoarchaeological assemblages are inevitably the result of a long selection process. Frequently not everyone in the community was buried in the same cemetery, sometimes not all the funerary areas in a settlement are found and even more often the burial grounds identified are not excavated entirely. Moreover, not all the individuals buried may be preserved, recovered, studied and published. All in all, the data obtained may refer to a very small portion of the original population. On the other hand, age estimation and sex determination techniques impose important constrains to palaeodemographic reconstruction. These are largely linked to biological factors, such as the impossibility to determine the sex of subadults based only on macroscopic examination (Lewis 2007: 47–55) or the subtlety of skeletal changes caused by ageing in adults (Nawrocki 2010), which sometimes make the results of adult age estimation of little utility for historical purposes. However, the most important problem affecting palaeodemography is the so-called mimicry effect (Bocquet-Appel & Masset 1982). This is the replication of the demographic structure of the population ageing methods are based on, in the populations under study. Even if palaeodemographers have been working hard during the last two decades to solve this issue (Hoppa & Vaupel 2002), for the moment the solutions available are technically complex and difficult to apply to small sample sizes and fragmentary skeletal assemblages. Besides, there is the preservation bias, which makes any of the former issues more difficult to overcome in poorly preserved archaeological populations. These biases are important to keep in mind when interpreting the results of palaeodemographic studies such as the ones in this thesis. Actually, it is our opinion that palaeodemographic estimators and other statistical elaborations are more useful in comparative terms than as absolute data. That is, they may be helpful to know which population had a longer life expectancy at birth or to determine if a population had a greater or smaller mortality rate during the first year of life than another population, but it is unlikely that the absolute values obtained correlate accurately with the real ones.

The palaeodemographic estimators used in this work are based on the juvenility index (JI) proposed by J. P. Bocquet-Appel and C. Masset (1977). Being aware of the limitations of skeletal material as a source for palaeodemographic reconstruction, these researchers developed a set of estimators to be calculated easily with the data supplied by osteoarchaeological analyses. The juvenility index is calculated as follows:

$$JI = D_{5\text{-}14} / D_{>20} ,$$

where $D_{5\text{-}14}$ is the proportion of individuals between 5 and 14 years of age at death in the population under study and $D_{>20}$ is the proportion of individuals older than 20 years of age at death, that is, adults, in the same population. Some of the strong points of this approach are that it does not take into account the youngest individuals, which are often underrepresented in archaeological assemblages, it does not require specific age estimations for adults, and it was grounded exclusively on historical preindustrial populations, which should be close to the ones targeted in this research. Therefore, based on the juvenility index, it is possible to calculate life expectancy at birth (e_0), and mortality rates during the first year of life ($_1q_0$) and during the first five years of life ($_5q_0$) with the formulae below:

$$e_0 = 78.721 \times \log_{10}\sqrt{1/JI} - 3.384 \pm 1.503$$

$$_1q_0 = 0.568 \times \sqrt{\log_{10} 200 \times JI} - 0.438 \pm 0.016$$

$$_5q_0 = 1.154 \times \sqrt{\log_{10} 200 \times JI} - 1.014 \pm 0.041$$

Nevertheless, there are some caveats to be considered. Juvenility index and the estimators derived from it should only be used when $JI \geq 0.100$. In addition, in this research it was decided to exclude from this statistical elaboration the assemblages with a minimum number of individuals smaller than ten, because it was regarded unfeasible that such a small sample size reflected accurately the demographic structure of their original populations. Likewise, it should be noted these are the equations for stationary populations, that is, for populations with zero growth. It is unlikely that the human groups analysed here did not experience any increase or decrease over time. However, since the data available do not allow to measure these trends, this was considered the most appropriate strategy. It is also interesting to remark these formulae incorporate an error, which means a range of up to 3 years in the case of life expectancy at birth. In the results section only the central value for each population will be reported, but this variability is to be kept in mind when interpreting outcomes.

Finally, there is a case where this method could not be applied and needs to be commented separately. The population corresponding to phase 4 of Dulantzi (see section 3.2.3.2.2) had a minimum number of more than ten individuals, but its juvenility index was smaller than 0.100 due to the unusual distribution of subadults in it. However, thanks to the good preservation of skeletal material in the site, it was possible to estimate the age at death of a great number of adults. For this reason, it was considered interesting to get at least the life expectancy at birth for this population using an alternative method, even if it is less robust. Then, only for the population of phase 4 of Dulantzi, life expectancy at birth was calculated applying the life table as explained by G. Acsadi and J. Nemeskéri (1970: 60–65). The age ranges used were the same as the age categories defined for age estimation. Individuals with intermediate age estimations (i.e. young-middle adults, middle-old adults, adults sp) were allotted proportionally among the potential categories they could be placed in, as it was done for demographic charts with adult ages itemised. Maximum longevity was set at 60 years arbitrarily. In order to make sure this estimation of life expectancy at birth was comparable with the ones obtained following the method by J. P. Bocquet-Appel and C. Masset (1977), life expectancy at birth was calculated with life tables for all the other populations considered in this thesis. The mean difference between both estimations was 3.2 years, which is only slightly bigger than the error of the estimation for stationary populations by J. P. Bocquet-Appel and C. Masset (1977). Therefore, in this exceptional case this alternative procedure to get life expectancy at birth using the life table was considered acceptable. For the human population of phase 4 of Dulantzi mortality rates between birth and ages 1 (${}_1q_0$) and 5 (${}_5q_0$) were not calculated.

2.3 ZOOARCHAEOLOGY

2.3.1 THE ROLE OF FAUNA IN PALAEODIETARY RECONSTRUCTION

For a well-grounded palaeodietary reconstruction, first it is necessary to characterise the isotopic baseline of the ecosystems under study. This is so because carbon and nitrogen stable isotope values vary geographically and temporally due to natural and human-mediated factors (Katzenberg 2008: 425) such as local geology, altitude, distance to the coast, precipitations, aridity and agrarian practices (e.g. manuring, Bogaard *et al.* 2007). Plants or animals as close in chronology and geographic origin as possible to the human populations tackled can be used for this purpose. The latter are more commonly chosen (López-Costas & Alexander 2019), because fauna remains are usually easier to recover from archaeological contexts. Instead, the isotopic analysis of plants has only recently been incorporated to the reconstruction of medieval diets (Hamerow *et al.* 2019) and hitherto has not been applied to any Iberian context.

Then, fauna remains are usually sampled and subjected to the same isotope analyses as humans with the aim of using them as a proxy of the isotopic baseline of the targeted ecosystems. One of the main biases of this approach is that it assumes the animals found in archaeological sites were locally raised, omitting phenomena like trade and transhumance. There are several indicators that suggest long distance trade networks in Iberia disappeared after the disarticulation of the Roman empire and that early medieval rural communities as the ones investigated in this work acted mainly at the local scale (Wickham 2005: 741–759). Therefore, the assumption that most of the livestock found in early medieval Iberian farms and villages came from the surroundings of the settlements is probably true in these contexts, but it is not something that should be taken for granted for any archaeological setting (Valenzuela-Lamas *et al.* 2016).

Herbivores are especially suitable for outlining the isotopic baseline of ecosystems, because they have monotonous diets exclusively based on plants. Then, it is possible to control the offset between the isotopic values of their food sources and those of their own body tissues, and between these and their consumers'. This is further facilitated by the fact that the tissue analysed both in the case of animals and humans, namely bone collagen, is the same, so the comparisons between them are straightforward. The herbivores of economic interest in early medieval contexts are mostly domesticates, including sheep (Ovis aries), goats (Capra hircus), cattle (Bos taurus) and equids (Equus sp). Then, these were the taxa preferentially sampled. The first two are difficult to distinguish from each other just based on skeletal remains. For this reason, they will be often considered together. Equids are also difficult to identify at the species level, so it must be kept in mind that in this work the name Equus sp designates indistinctly horses (Equus caballus) or donkeys (Equus asinus).

Omnivorous species like swine (Sus scrofa domesticus) and birds (Avis) and, to a lesser extent, domestic carnivores such as dogs (Canis familiaris) and cats (Felis catus), were also included in the datasets where possible, since they can contribute to refine the isotopic baseline of their ecosystems. In addition, both herbivores and omnivores can provide new insights into productive strategies and agrarian practices in order to understand, for example, if certain types of fodder were restricted to specific taxa (Balasse & Ambrose 2005), if swine were free-ranged or yard-kept (Hammond & O'Connor 2013), manuring practices or communal management of agrarian spaces (e.g. lifting of the fences, García-Collado 2016).

2.3.2 NAMING FAUNA SAMPLES

As in the case of humans, fauna samples were also given a unique code. These were created in the following way: [Acronym of the site] F[SU the sample comes from] - [Taxon code]([Consecutive number of sample from the same SU and taxon]). For example, sample SNC F31373-O comes from stratigraphic unit (SU) 31373 of the site El Soto/El Encadenado and belongs to a sheep, while sample PMCV F12-164-S(2) was gotten from SU 12-164 of the site Castellar del Vallès and is the second pig sampled from that SU. Table 2.2 and table 2.3 present the acronyms of all the sites fauna was sampled from and the codes for taxa respectively.

Table 2.2. Acronyms of the sites fauna was sampled from.

Acronym site	*Name site*
ASI	Alameda del Señorío de Illescas (Boadilla)
BOA	Boadilla
GOZ	Gózquez
SNC	El Soto/El Encadenado
ALD	Aldaieta
SMD	Dulantzi
CG	Can Gambús
HCT	Horts de Can Torras (Castellar del Vallès)
PMCV	Castellar del Vallès
RVSM	Sant Menna

Table 2.3. Taxa codes.

Code taxon	*Taxon*
B	Bos taurus
OC	Ovis/Capra
O	Ovis aries
C	Capra hircus
E	Equus sp
S	Sus scrofa domesticus
A	Avis
AG	Gallus gallus domesticus
CN	Canis familiaris
F	Felis catus

2.3.3 IDENTIFICATION

The fauna samples were taxonomically identified with the reference manuals by Barone (1976) and Schmid (1972) for mammals, and Cohen & Serjeatson (1996) for birds. Sheep and goat were distinguished only when the differences were very clear following Boessneck (1969), Halstead *et al*. (2002) Kratochvil (1969) and Payne (1969, 1985). In this task the contribution of zooarchaeologist I. Grau-Sologestoa was essential and much appreciated. In addition, most of the sites investigated had previous zooarchaeological studies (Gózquez: Morales & Pino 2000, Morales & Ortiz 2000; Boadilla: Rodríguez Monterrubio 2015; El Soto/El Encadenado: Morales & Llorente 2004; Aldaieta: data provided by P. Castaños in Azkarate 1999; Dulantzi: Grau-Sologestoa 2015; Can Gambús: Molina 2008a; Castellar del Vallès: Molina 2008b, Molina 2008c), which facilitated the job notably, since in many cases fauna remains were stored separated by taxa.

2.3.4 RECORDING

Before submitting them for analysis, every fauna sample was recorded in order to minimise the effect of destruction on future research. For this purpose, the protocol proposed by S. J. M. Davis (1992) was applied as implemented by the Zooarchaeology laboratory of the University of Sheffield. This includes taxonomic and anatomical element identification (see section 2.3.2), assessment of preservation state (fragmentation, surface preservation, butchery, burning and gnawing marks), age estimation (epiphyseal fusion: Silver 1969, tooth wear of sheep and goats: Payne 1973, tooth wear of cattle and pigs: Grant 1982) and metric record (Albarella & Davis 1994, Albarella *et al.* 2005, Davis 1992, Payne & Bull 1988, von den Driesch 1976) of each fragment, either bone or tooth. These data are important not only for the preservation of the zooarchaeological collections, but also for the interpretation of the results of isotopic analyses. Specially age can be useful for interpreting nitrogen isotope values, since these can be affected by suckling (Balasse & Tresset 2002).

2.4 CARBON AND NITROGEN STABLE ISOTOPE ANALYSES

2.4.1 FUNDAMENTALS OF CARBON AND NITROGEN STABLE ISOTOPE ANALYSES FOR PALAEODIETARY RECONSTRUCTION

2.4.1.1 Basic concepts

Atoms of any chemical element are made up of protons, positively charged particles; electrons, negatively charged particles, and neutrons, particles without electric charge. Neutrons and protons form the nucleus of the atom and determine its mass. Electrons orbit around the nucleus, they have negligible mass and their number matches that of protons. Each chemical element is characterised by a specific number of protons. However, the number of neutrons and, therefore, mass can be variable. Isotopes are the different versions of a single chemical element which differ in the number of neutrons and, as a result, in mass (Hoefs 2018: 1). Most chemical elements can be found with several different amounts of neutrons, that is, they have more than one isotope.

Focusing on the elements of interest for palaeodietary reconstruction, carbon (C) is defined by having six protons and six electrons. Usually it presents six neutrons, making a mass of twelve (^{12}C); but it can also have seven or eight neutrons, creating atoms of thirteen (^{13}C) and fourteen (^{14}C) units of atomic mass respectively. Nitrogen (N) is characterised by having seven protons and seven electrons and typically it appears with seven neutrons, for an atomic mass of fourteen units (^{14}N). Still, nitrogen has another isotope with eight neutrons and fifteen units of atomic mass (^{15}N). Isotopes can be stable or unstable, the latter of which are also called radioactive (Meier-Augenstein 2018: 2). Stable isotopes do not suffer changes over time. Conversely, unstable or radioactive isotopes decay at regular intervals and get transformed into other elements. ^{12}C, ^{13}C, ^{14}N and ^{15}N are stable isotopes. On the contrary, ^{14}C is a radioactive isotope, a feature which is exploited to use it as a chronological indicator (Renfrew & Bahn 2016: 146–155). All the isotopes of the same chemical element are not equally abundant. The natural abundances of the stable isotopes of carbon and nitrogen are displayed in table 2.4 and table 2.5.

Table 2.4. Natural abundance of carbon stable isotopes (Meier-Augenstein 2018: 5)

Isotope	*Abundance (%)*
^{12}C	98.89%
^{13}C	1.11%

Table 2.5. Natural abundance of nitrogen stable isotopes (Meier-Augenstein 2018: 5)

Isotope	*Abundance (%)*
^{14}N	99.63%
^{15}N	0.37%

All the isotopes of a chemical element have almost identical physical and chemical properties. However, since they have distinct atomic masses, they show slightly different behaviours in mass-dependant processes (Meier-Augenstein 2018: 3). This means that the relative abundance of light and heavy isotopes, also known as isotopic signature, at the beginning of the reaction is not the same as the resultant at the end. This phenomenon is called fractionation (Schoeller 1999) and is due to the differences in the energy of the bonds of heavy isotopes in comparison with those of lighter isotopes (Meier-Augenstein 2018: 15), which makes it easier for lighter isotopes to be incorporated into the compound resultant of the reaction than it is for heavier isotopes. These differences in mass are more pronounced among the lighter elements of the periodic table (Hoefs 2018: 53), such as carbon and nitrogen, than among heavy elements, because in light elements an extra neutron accounts for a greater proportion of the total mass. For example, ^{13}C is 8.3% heavier than ^{12}C, and ^{15}N is 7.1% heavier than ^{14}N, while in the case of a heavy element like strontium (Sr) ^{87}Sr is only 1.2% heavier than ^{86}Sr. Therefore, the effects of fractionation are more noticeable on light elements than on heavy ones.

Isotopes are useful for palaeodietary reconstruction because they allow to trace the origin of the nutrient sources of organisms analysing their tissues (Ambrose 1993, Katzenberg 2008, Lee-Thorp 2008, Schoeninger 2010). In other words, the isotopic composition of the tissues of any organism reflects the isotopic signature of the food that organism fed on. Thus, obtaining the isotopic composition of the tissues of a human or animal, it is possible to determine its main food sources. Concentrating on the matters of interest for this research, carbon and nitrogen are present in most foodstuff, but not all of them have the same isotopic composition. When different resources are consumed, their carbon and nitrogen atoms, with their particular isotopic signature, are used by the organism to synthetize bone collagen and other tissues. Comparing the isotopic composition of the bone collagen of an individual with the known isotopic signature of the potential dietary resources available in that context, while taking fractionation into account, it is possible to identify the main food groups used by a human or animal.

Carbon and nitrogen stable isotope compositions are not reported in absolute terms, because the differences in the isotopic signature of materials typically at natural abundance levels, as bone collagen, are too small. Instead, δ notation is used. δ values express the relative difference in isotopic composition between a sample and an internationally established standard (Szpak *et al.* 2017: 610) according to the following equation (Coplen 2011):

$$\delta = (R_{sample} - R_{standard}) / R_{standard} = (R_{sample} / R_{standard}) - 1 ,$$

where

$$R = \text{abundance of rare isotope} / \text{abundance of frequent isotope}$$

Since the resulting values are normally very small, they are reported in per mil units (‰). The international standard for carbon is VPDB (Viena Pee Dee Belemnite), a virtual material based on a marine fossil currently exhausted (Meier-Augenstein 2018: 8). The international standard for nitrogen is AIR (Ambient Inhalable

Reservoir), that is, atmospheric air (Meier-Augenstein 2018: 9). Then, positive δ values mean the analysed material is enriched or is more abundant in the rare isotope than the international standard. Conversely, negative δ values imply that the compound analysed is depleted or is scarcer in the rare isotope than the international standard. Due to the specificities of the international standards chosen, most food sources have negative $\delta^{13}C$ values and positive $\delta^{15}N$ values.

2.4.1.2 Carbon stable isotopes ratios

2.4.1.2.1 From inorganic carbon to plants in terrestrial environments

In terrestrial environments the main carbon reservoir is the atmosphere, where carbon is present mostly as CO_2. At present the mean $\delta^{13}C$ of atmospheric carbon is around -8‰ (Schoeninger 2010: 447). However, it is important to be aware that during the last century and half $\delta^{13}C$ has decreased about 1.5‰ due to the release of great amounts of carbon depleted in ^{13}C as a consequence of the massive combustion of fossil fuels linked to Industrialisation, a process known as the Suess effect (Schwarcz & Schoeninger 2011: 730). Then, before the 19th century $\delta^{13}C$ of atmospheric carbon was around -6.5‰. Therefore, this was the $\delta^{13}C$ value at the base of terrestrial ecosystems during Early Middle Ages.

Carbon is passed from the atmosphere to the biosphere, that is, the ensemble of living organisms, thanks to plants and some bacteria which convert inorganic carbon into organic molecules through photosynthesis. In this process atmospheric carbon isotope ratios suffer significant fractionation. The scale of fractionation depends on the photosynthetic pathway of each plant (Hedges 2009: 496). Two major groups of plants with distinct $\delta^{13}C$ values can be distinguished based on this criterion (O'Leary 1981, B.N. Smith & Epstein 1971).

The first one is formed by C_3 plants. They carry out photosynthesis following the Calvin-Benson cycle (Benson & Calvin 1950) and their name derives from the fact that the first stable molecule they produce during photosynthesis is formed by three carbon atoms (Schwarcz & Schoeninger 2011: 729). This is the most widespread photosynthetic pathway, including between 80% and 90% of plants (Hoefs 2018: 334). It is characteristic of plants from temperate climates and it includes all trees and shrubs and most grasses on Earth (Ambrose 1993: 86). Thus, among the foods available in early medieval Iberia, all fruits, vegetables, legumes and the majority of crops, comprising wheat, barley, rye and oats, belonged to the group of C_3 plants. The $\delta^{13}C$ values of modern C_3 plants range globally between -32‰ and -22‰, with a mean of -26‰ (Deines 1980). The few measurements of medieval C_3 seeds from Iberia available reported $\delta^{13}C$ values for wheat and barley between -24.3‰ and -20.9‰ (Araus & Buxó 1993, Ferrio *et al.* 2006), which are consistent with the aforementioned reference values accounting for the Suess effect.

The other major group is that of C_4 plants. They make photosynthesis according to the Hatch-Slack cycle (Slack & Hatch 1967), whose first stable product are four carbon atom molecules (Schwarcz & Schoeninger 2011: 729). This photosynthetic pathway is an adaptation to hot and dry environmental conditions, which contributes to avoid the loss of water during the process. Then, it makes sense that most C_4 plants are original from tropical areas (Pyankov *et al.* 2010). This group is made up of grasses and sedges (Ambrose 1993: 86) and all that were consumed during the Early Middle Ages in Iberia were imported (Alexander 2016: 247). Initially, these were restricted to millets, i.e. broomcorn millet or *Panicum miliaceum* and foxtail millet or *Setaria italica*, which arrived from Asia into western Europe during the Bronze Age (Moreno-Larrazabal *et al.* 2015, Lightfoot *et al.* 2013). Sugarcane, also a C_4 plant, was introduced after the 8th century by Muslims (Galloway 2005). However, it is unlikely it had a significant weight on the diet of the rural communities analysed in this thesis, because it only arrived at the end of the period studied. C_4 plants are isotopically distinguishable thanks to their enriched $\delta^{13}C$ values in comparison with C_3 plants. Modern specimens vary between -15‰ and -9‰ and they average globally -13‰ (Bender 1968, Deines 1980, Fraser *et al.* 2013). At the moment there are no $\delta^{13}C$

measurements of C_4 medieval plants from Iberia in the literature. The closest parallels are from medieval northern Italy, where broomcorn and foxtail millets averaged -10.4‰ (Iacumin *et al.* 2014: 568).

There is a third photosynthetic pathway named CAM (crassulacean acid metabolism, Schwarcz & Schoeninger 2011: 729–730), which produces $\delta^{13}C$ values intermediate between C_3 and C_4 plants. Still, only cacti and some specific types of plants (e.g. pineapple) use it, so it would not have been relevant for the diet of early medieval peasants in Iberia.

Besides, there are several external and internal factors which affect $\delta^{13}C$ values on plants. They are important because the variability they generate is passed on the animals and humans eating them, so it is reflected on the $\delta^{13}C$ of consumers too. On one side, there are environmental factors, such as altitude, temperature, water supply, light exposure and nutrient content in soil, which modify CO_2 availability and intake in different ways producing a range of $\delta^{13}C$ values (Heaton 1999, Marshall *et al.* 2007, Schwarcz & Schoeninger 2011: 730). Three of these environmental factors are especially relevant for this research. First, a geographic pattern in the distribution of $\delta^{13}C$ linked to climate is observed in Europe between the north and the south of the continent and between Atlantic and continental areas (Van Klinken *et al.* 1994, Van Klinken *et al.* 2001). This can mean between 2‰ and 4‰ enrichment in $\delta^{13}C$ of analogous plants from warmer and drier areas in comparison with colder and wetter regions and these differences are also passed on consumers. Therefore, this is important be kept in mind when comparing results from distant areas and even within Iberia itself, which has a notable diversity of climates and participates of both Atlantic and Mediterranean watersheds. Second, there is so-called canopy effect (Bonafini *et al.* 2013, Drucker *et al.* 2008, van der Merwe & Medina 1991), which consists in an isotopic depletion of CO_2 under densely forested areas. It is caused predominantly by the decomposition of organic matter from plants, which release CO_2 depleted in ^{13}C in comparison with atmospheric CO_2. Therefore, the plants making photosynthesis in the understory and the animals or humans feeding on them will also present depleted $\delta^{13}C$ values, which can be up to 5‰ lower than those of equivalent organisms living in open environments (Doppler *et al.* 2017, Goude & Fontugne 2016). In early medieval Iberia, livestock grazing in wooded pastures could potentially have been affected by this process. However, most palynological analyses available point at the predominance of intensively deforested landscapes during the period of study (Hernández-Beloqui *et al.* 2013, Hernández-Beloqui *et al.* 2015, López-Sáez *et al.* 2010, Riera-Mora & Esteban-Amat 1994), so the canopy effect should not have been significant. Third, aridity (i.e. high temperatures and low rainfall) and also salinity are environmental factors which directly affect the incorporation of carbon into plants and the $\delta^{13}C$ values resulting from photosynthesis (Farquhar *et al.* 1989: 520, Heaton 1999: 638, Hedges *et al.* 2006: 124–125). Under these conditions, plants restrict the opening of stomata, that is, the pores on leaves which allow gas exchange, in order to prevent water loss. This causes the constraint of CO_2 intake and, as a result, enriched $\delta^{13}C$ values in comparison with normal settings. For this reason, the current characterization of the area of Madrid-Toledo as semiarid (Paniagua *et al.* 2019), as well as the proximity of at least one of the sites analysed in this thesis (i.e. Gózquez, see section 3.1.1.1.1) to several salty springs, could be important factors to consider when interpreting animal carbon stable isotope ratios. In general C_4 plants are less sensitive than C_3 ones to environmental factors because they are more resilient to any stressor (O'Leary 1988).

On the other side, genetic factors, which determine individuals' response to changing environmental conditions, generate differences in photosynthesis both between species working on the same photosynthetic pathway and between plants of the same species grown under identical conditions (Malainey 2011: 181). In addition, not all the tissues of the same plant have the same isotopic signature. There may be offsets in $\delta^{13}C$ of up to 2‰ between seeds, stems and leaves (Lightfoot *et al.* 2016). It is important to bear this in mind, especially when only one portion of a plant is typically consumed or when different parts are eaten by animals and humans. Also, the various biochemical fractions of plants have different carbon isotope ratios (Ambrose & Norr 1993: 3–4). Carbohydrates tend to be close to $\delta^{13}C$ values of the whole plant, while lipids are usually depleted up to 5‰. Protein is the most variable fraction, with offsets from -1‰ to 3‰. This is relevant, especially considering the process of dietary routing that takes place during the incorporation of macronutrients to bone collagen (see section 2.4.1.4.4).

2.4.1.2.2 From inorganic carbon to plants in aquatic environments

The carbon cycle in aquatic environments works in a slightly different manner and there are differences between marine and freshwater ecosystems too. Oceans are the biggest carbon reservoir near the Earth's surface, where it is present as dissolved inorganic carbon. The great majority of dissolved inorganic carbon is bicarbonate (HCO_3), which is enriched in ^{13}C (Boutton 1991: 179). Then, currently the $\delta^{13}C$ of surface water in oceans averages globally 1‰ (Meier-Augenstein 2018: 29). That is, marine carbon isotope ratios are significantly enriched in comparison to atmospheric CO_2. For this reason, the plants, algae and bacteria (i.e. phytoplankton) doing photosynthesis in oceans also have enriched $\delta^{13}C$ values regarding terrestrial plants (Chisholm *et al.* 1982). Most marine plants, algae and bacteria follow the C_3 photosynthetic pathway and at present they have $\delta^{13}C$ values between -24‰ and -19‰ (Fry 2006: 45–46), so there is some overlap with terrestrial plants.

Freshwater ecosystems are more complex because they mix various carbon sources in different proportions from case to case (Katzenberg 2008: 426–427). Dissolved inorganic carbon in rivers and lakes is also predominantly formed by bicarbonate (HCO_3), but the contributions of atmospheric CO_2 and specially CO_2 from the decomposition of organic matter are greater (Boutton 1991: 181). The latter two are notably depleted in ^{13}C, so freshwater environments tend to present $\delta^{13}C$ values lower than those of oceans and closer to terrestrial ones, usually between -15‰ and 0‰. As a result, freshwater plants, algae and bacteria, which follow predominantly the C_3 photosynthetic pathway, range between -50‰ and -10‰.

Aquatic plants, algae and bacteria show the same variability due to environmental and genetic factors as their terrestrial counterparts (see section 2.4.1.2.1, B.N. Smith & Epstein 1971). Carbon sources and, consequently, $\delta^{13}C$ of aquatic plants can vary within the same body of water due to latitude, depth, water temperature, pH, light intensity and nutrient availability (France & Peters 1997, Fry & Sherr 1988). There is also a difference in carbon isotope ratios depending on the proximity to the coast, both in marine and freshwater environments (France 1995a, Post 2002). Coastal and benthic waters are enriched in ^{13}C in comparison with offshore and pelagic ones. This is especially relevant for palaeodietary reconstruction because it is possible that in specific contexts only certain marine or lacustrine niches were exploited. For example, species living close to the coast could be preferred over those found in open water. Nevertheless, at the moment the information available about fishing practices during Early Middle Ages in Iberia is extremely scarce. Besides, migratory and anadromous species show $\delta^{13}C$ values intermediate between those of the various environments where they live (Hobson 1999). For all these reasons, $\delta^{13}C$ values of aquatic plants and the animals or humans feeding on them are very difficult to predict, particularly in freshwater environments (Dufour *et al.* 1999). Then, it would have been advisable to include fish among the fauna remains used to establish the isotopic baseline of each context. Unfortunately, in most sites they were not available or taxonomically identified, so no aquatic animals were analysed in this thesis.

2.4.1.2.3 Carbon stable isotope ratios from plants to animals and humans

Consumers, either animal or human, incorporate into their body tissues carbon isotope ratios from their food sources. During this process they experience fractionation. On one hand, it is typically accepted that there is a 5‰ enrichment of $\delta^{13}C$ between diet and bone collagen (Ambrose & Norr 1993, Jim *et al.* 2004, van der

Merwe & Vogel 1978). Still, feeding experiments have recorded δ^{13}C diet to bone collagen offsets ranging between 1‰ and 6‰ (DeNiro & Epstein 1978, Howland *et al.* 2003, Tieszen *et al.* 1983, Tieszen & Fagre 1993), most likely due to differences in the taxa analysed and their physiological and dietary behaviour (Caut *et al.* 2009). Also, even if the 5‰ diet to bone collagen δ^{13}C offset is widely accepted, it may only work in individuals feeding on monoisotopic diets (Ambrose & Norr 1993: 9–11, Katzenberg 2008: 424), that is, when both energy (i.e. the ensemble of carbohydrates and lipids) and protein derive from the same photosynthetic pathway. In feeding experiments it was verified that when energy came from C_3 sources and protein from C_4 ones, or *vice versa*, diet to bone collagen offset was smaller than 5‰. Heteroisotopic diets may have been common in the contexts analysed in this thesis, so this possible source of variation is to be considered.

On the other hand, carbon stable isotope ratios are enriched between 1‰ and 2‰ in each step of the food chain (Bocherens & Drucker 2003), so plants, herbivores, omnivores and carnivores from the same ecosystem have increasing δ^{13}C values in this order. Since marine food chains tend to be longer, this effect is more noticeable in marine and freshwater environments than in terrestrial ecosystems (Schoeninger & DeNiro 1984). Moreover, the trophic level effect is also observable in breastfed babies and suckling animals (Fuller *et al.* 2006, Tsutaya & Yoneda 2015), because carbon isotope ratios in breastmilk too suffer fractionation when they pass from the mother to the child or cub.

Otherwise, δ^{13}C values in fauna and humans are quite stable. There is no significant physiological variation in δ^{13}C based on sex or age (Schwarcz & Schoeninger 1991). In other words, differences in δ^{13}C between individuals of different ages and sexes are due to social or cultural reasons. Similarly, unlike nitrogen isotope ratios (see section 2.4.1.3.3), δ^{13}C is not affected by nutritional stress (Hobson *et al.* 1993).

Summing up, carbon stable isotopes have two main uses in palaeodietary reconstruction. The first one is to identify the photosynthetic pathway a given organism fed on. In mixed diets it may even be possible to estimate the proportions of C_3 and C_4 plants. The second purpose of carbon isotope ratios is to distinguish individuals eating terrestrial, marine and freshwater resources. When the δ^{13}C values of these two variables overlap (e.g. C_4 plants and marine resources), nitrogen stable isotopes can contribute to elucidate the predominant food source (see section 2.4.1.3).

2.4.1.3 Nitrogen isotopes ratios

2.4.1.3.1 From inorganic nitrogen to plants in terrestrial environments

The largest nitrogen reservoir near the Earth's surface is the atmosphere, where nitrogen means 78% of it. In the atmosphere nitrogen is present as N_2 (Meier-Augenstein 2018: 30). Unlike carbon, the isotopic signature of nitrogen is considered a constant, that is, it has stayed stable over time. Because the international standard for nitrogen isotope ratios is the atmosphere itself (more precisely AIR, Ambient Inhalable Reservoir; see section 2.4.1.1), its δ^{15}N value by definition is 0‰.

Atmospheric nitrogen is not available for living organisms, but there are different fixation processes that transform it into molecules assimilable by plants (Malainey 2011: 41), which are at the base of any food chain. There is a small portion of nitrogen which is fixed as a result of lighting. However, most nitrogen in terrestrial environments is fixed through bacteria. Some of these bacteria have a symbiotic relationship with specific plants, namely legumes, such as broad beans, peas, lentils, chickpeas, alfalfa or clovers. In fixer plants *Rhizobium* bacteria form nodules in the roots where nitrogen fixation takes place. Therefore, atmospheric nitrogen is incorporated into legumes almost directly. Still, it suffers some depletion during the process, so the δ^{15}N values of legumes are typically between -5‰ and 0‰ (Schwarcz & Schoeninger 2011: 730). Besides, fixer plants also provide bioavailable nitrogen to the surrounding soil, so they can be used to improve the quality of soils for agrarian activities (Peña-Chocarro *et al.* 2019: 60). Conversely, non-fixer plants rely on bacteria living in soil to get nitrogen in the forms they can assimilate, mainly nitrates (NO_3^-). These bacteria get nitrogen predominantly from the decomposition of organic matter, which tends to be enriched in ^{15}N. Then, terrestrial soils in temperate ecosystems usually have $\delta^{15}N$ values between 1‰ and 4‰ (Lee-Thorp 2008: 928), greater than those of atmospheric nitrogen. As a consequence, $\delta^{15}N$ values of non-fixer plants commonly range between 2‰ and 6‰ (Schwarcz & Schoeninger 2011: 730), that is, they are more enriched in ^{15}N than fixer plants (DeNiro & Epstein 1981). Nevertheless, the differences between fixers and non-fixers in the same environment are usually small.

Several environmental factors affect $\delta^{15}N$ in plants, so as differences can be notable even on a small scale. Altitude, temperature, precipitations, water and nutrient availability $\delta^{15}N$ between analogous plants, pH, soil type and age, depth and porosity can cause significant variations (Ambrose 1991, Amundson *et al.* 2003, Heaton *et al.* 1986). Two of these environmental factors deserve to be underlined because their impact may be especially relevant in the contexts studied here. In the first place, there is aridity (i.e. high temperatures and low rainfall), which can generate the enrichment of $\delta^{15}N$ values up to 20‰ (Heaton 1987, Schwarcz *et al.* 1999). This phenomenon is to a great extent the result of fractionation caused by evaporation of nitrogen in soils due to high temperatures. Salinity has a similar effect on $\delta^{15}N$, but the mechanism behind it is not fully understood. Nonetheless, it is likely that in coastal environments marine nitrates carried by sea spray, which tend to have more enriched nitrogen isotope ratios than terrestrial ones (see section 2.4.1.3.2), is what generates the greater $\delta^{15}N$ of plants. None of the sites analysed in this thesis is close enough from the coast to have been directly affected by marine salinity, but at least one (i.e. Gózquez, see section 3.1.1.1.1) was near an area of salty springs which could have enriched the nitrogen isotope ratios of the animals grazing in the vicinity. Moreover, the whole region of Madrid-Toledo is currently considered a semiarid zone (Paniagua *et al.* 2019). Although the palaeoenvironmental records available are not enough to confirm this was also the case during Early Middle Ages, it cannot be discarded that the livestock and human populations from this area were affected by the effect of aridity on $\delta^{15}N$. In the second place, human activities can also significantly modify the nitrogen isotope ratios of soils and, as a consequence, of the complete food chain (Hoefs 2018: 71–72, Meier-Augenstein 2018: 32). In the contexts tackled by this research the most influential anthropic activity of this type was agriculture and more specifically manuring (Bogaard *et al.* 2007, Fraser *et al.* 2011, Szpak *et al.* 2012). The contribution of animal waste can enrich $\delta^{15}N$ of soils up to 8‰ in comparison to analogous unmanured crops. Animal dung can come from either letting livestock graze on the leftovers of harvest or by accumulating it from stabled animals. The former is known as lifting of the fences or *derrota de las mieses* in Spanish and it implies a strong union within the peasant community in order to manage agriculture and animal husbandry coordinately. Hence, exceptionally high $\delta^{15}N$ values in herbivores from temperate environments could indicate they grazed on fields manured by themselves yearly and this could be interpreted as a sign of cohesion and internal articulation of the communities in charge.

Finally, plants also show some internal variability regarding nitrogen isotope ratios. On one side, there are meaningful differences in nitrogen isotope ratios of non-fixer plants between grasses, shrubs and trees growing in the same environment (Virginia & Delwiche 1982), possibly due to variation in root depth. On the other side, differences in $\delta^{15}N$ values between the various parts of plants are specially interesting for palaeodietary reconstruction (Ambrose 1991, Bogaard *et al.* 2007, Szpak *et al.* 2013), because in many instances only one portion of the plant is eaten, or one of them is saved for human consumption and another one for feeding animals. In this way, it has been verified that shoots are often enriched in ^{15}N in comparison to roots, and grains have greater $\delta^{15}N$ values than rachis.

In any case, at the moment there are no measurements of $\delta^{15}N$ on medieval seeds or charcoal from Iberia, so it is difficult to make any well-grounded hypothesis about the nitrogen isotope ratios of soils and early medieval agrarian practices in the areas of study. Therefore, the only proxy available to characterise the nitrogen isotopic baseline of the sites analysed is local fauna (see sections 2.3.1, 2.4.1.3.3).

2.4.1.3.2 From inorganic nitrogen to plants in aquatic environments

There are not many differences in the nitrogen cycle between terrestrial and aquatic environments, either marine or freshwater. Inorganic nitrogen in bodies of water consists of dissolved N_2 from the atmosphere or rocks and it has a mean $\delta^{15}N$ around 1‰ (Peterson & Fry 1987). However, inorganic nitrogen coexists with multiple sources of nitrogen from decaying organic matter from both aquatic and surrounding terrestrial environments, the latter of which are usually enriched in ^{15}N. Moreover, oceans, rivers and lakes suffer more intense denitrification than terrestrial ecosystems (Hoefs 2018: 68). This is the process that transforms organic nitrogen molecules back into gaseous forms to be released into the atmosphere. Since during denitrification the lighter isotope ^{14}N is preferred over the heavier ^{15}N, it results into an enrichment of $\delta^{15}N$ in the original environment where it takes places. On this basis, aquatic fixing bacteria and algae transform nitrogen into organic molecules assimilable by plants with little fractionation, as it happens in terrestrial environments. As a result, in oceans non-fixer plants and algae present $\delta^{15}N$ values between 4‰ and 6‰ (Coltrain *et al.* 2004, Wada *et al.* 1975) and this enrichment in comparison to terrestrial ecosystems is observable in all the steps up the food chain. Baseline $\delta^{15}N$ values in freshwater ecosystems are even more difficult to predict because of the greater variation in nitrogen sources (Fry 2006: 46). Furthermore, several environmental factors such as depth and nutrient flow and availability can also influence $\delta^{15}N$ of aquatic plants and all the subsequent trophic levels.

This thesis includes populations close to two different marine ecosystems (i.e. the Cantabrian Sea for the Basque Country and the Mediterranean Sea for Catalonia) and a number of rivers. Unluckily, it was not possible to analyse any aquatic fauna remains from the sites studied because in no case were they appropriately collected or identified. In addition, there are no published measurements of carbon and nitrogen stable isotope ratios of aquatic resources for these areas during Early Middle Ages. The closest data available, both geographically and chronologically, are from Galicia (López-Costas & Müldner 2016) and Asturias (MacKinnon *et al.* 2019) for the Cantabrian Sea and from Teruel (Alexander *et al.* 2019) for the Mediterranean Sea, all of them dated to the Late Middle Ages. Even so, although the dataset is small, it agrees with the observations previously made by other researchers, who concluded that Mediterranean fish tend to more depleted $\delta^{15}N$ values than Atlantic fish (Barrett *et al.* 2011, O.E. Craig *et al.* 2013, García-Guixé *et al.* 2010, Vika & Theodoropoulou 2012), overlapping partially the range of terrestrial animals. This is something particularly important to remember when interpreting the results of the populations from Catalonia (see section 3.3), due to their proximity to the Mediterranean Sea.

2.4.1.3.3 Nitrogen stable isotope ratios from plants to animals and humans

Proteins are the only macronutrient with a significant amount of nitrogen in their composition, so the greatest part of nitrogen both in animals and humans comes from this dietary fraction (see section 2.4.1.4.4). Still, when it is incorporated into the consumer's body tissues, nitrogen isotope ratios experience significant fractionation (DeNiro & Epstein 1981, Minagawa & Wada 1984). The scale of this fractionation depends on the tissue under study. For bone collagen it has been established to be between 3‰ and 6‰ (Hedges & Reynard 2007, O'Connell *et al.* 2012), even if there is still nowadays a debate due to the wide breadth of this range (Makarewicz & Sealy 2015). Because this fractionation happens each time nitrogen goes from an organism to the next one (e.g. from plants to herbivores, from herbivores to omnivores or carnivores), it is useful to identify the position of an individual in the food chain. In other words, plants should always have lower $\delta^{15}N$ values than herbivores or vegans, and omnivores and carnivores should present greater $\delta^{15}N$ values in comparison to both plants and herbivores. Besides, in the case of omnivores, such as humans, it is possible to get an approximation to the proportion of vegetal and animal protein in diet looking at the difference in $\delta^{15}N$ between the consumer and herbivores from the same context and trying to elucidate how much of the trophic level change was completed in each case.

In addition, nitrogen isotope ratios can contribute to distinguish individuals feeding on terrestrial and aquatic environments. This is possible thanks to the fact that aquatic food chains are notably longer than terrestrial ones (Schoeninger *et al.* 1983, Schoeninger & DeNiro 1984). Therefore, having more trophic steps, nitrogen isotope ratios are fractionated more times, so fish, marine mammals and humans eating them tend to present higher $\delta^{15}N$ values than their terrestrial peers. All types of aquatic ecosystems are made up of longer food chains than terrestrial environments, but among them marine food chains are usually longer than those from freshwater ecosystems (Dufour *et al.* 1999). Likewise, migratory and anadromous fish have intermediate nitrogen isotope ratios, which represent proportionately the amount of time spent by each species or specimen feeding in marine and freshwater environments (France 1995b).

No consistent correlation due to physiological factors has been detected between age or sex and $\delta^{15}N$ (Ambrose 2001, Schwarcz & Schoeninger 1991), so in principle it is reasonable to assume that differences between individuals and between demographic groups were based on dietary variation. However, there are other physiological variables, often poorly understood, which frequently hinder the interpretation of results.

First, there is some variability in nitrogen isotope ratios between species feeding in the same environment and on the same diet, due to differences in the predominant mechanism for the excretion of nitrogenous waste (Vanderklift & Ponsard 2003), which differs between mammals, birds and fish. Nevertheless, more recent research questioned this finding (Caut *et al.* 2009). It has also been proposed that, among herbivores, digestive anatomy could influence $\delta^{15}N$, since foregut fermenters (i.e. cattle, sheep, goats) would have an extra fractionation step in comparison to hindgut fermenters (i.e. equids; Sponheimer *et al.* 2003, Van Klinken *et al.* 2001: 48).

Second, nitrogen isotope ratios are related with the processes which may somehow cause physiological stress (D'Ortenzio *et al.* 2015), but in some cases the evidence available is contradictory. For example, it has been typically accepted that rapid growth, as it happens during the first years of life or during adolescence, causes the enrichment of $\delta^{15}N$ in body tissues due to the recycling of proteins needed to meet the requirements of such a fast modelling and remodelling (Lidén & Angerbjörn 1999). Still, later studies demonstrated those differences may be negligible in bone collagen because of the slow turnover rate of bone protein (Waters-Rist & Katzenberg 2010). Something similar happens with pregnancy and pathology. Pregnancy is also a moment of rapid growth, but when nitrogen isotope ratios of contemporary pregnant women were monitored, actually a small depletion in ^{15}N was detected (Fuller *et al.* 2004). This is possibly due to a change in the metabolism of nitrogen, causing the more isotopically depleted products to be preferentially used for tissue synthesis. Since this effect would only last during pregnancy, it is unlikely it would be reflected in bone collagen, even if it is known that bone collagen turnover rate is accelerated during pregnancy. The effect of pathology on nitrogen isotope ratios has not been clearly defined (Richards & Montgomery 2012). Several researches have proven that $\delta^{15}N$ is enriched around the specific skeletal portions where there are lesions such as fractures, periostitis or osteomyelitis, probably due to the recycling of body proteins in order to meet the requirements of the rapid remodelling needed to repair them (Katzenberg & Lovell 1999, Olsen *et al.* 2014). Conversely, no obvious association between chronic disease and nitrogen isotope ratios has been detected up to the moment (Brozou *et al.* 2019, Salesse *et al.* 2019, Quintelier *et al.* 2014).

Third, nutritional stress and protein imbalance also affect $\delta^{15}N$. Famine or low protein diets cause the same reaction as rapid growth or acute pathology: the body recycles protein with the aim of trying to maintain normal metabolism in the absence of a dietary flow of nitrogen, which results in an enrichment of δ^{15}N as a consequence of the additional trophic level fractionation it implies (Fuller *et al.* 2005, Hobson *et al.* 1993). Paradoxically, excess of protein in diet has the same final result (Sponheimer *et al.* 2003), which means an important interpretative problem for palaeodietary reconstruction. Nevertheless, not all the data available supports the hypothesis that a surplus of protein generates the increase of nitrogen isotope ratios (Ambrose 2001: 252–253).

Fourth, it is worth noting that, as it happened with carbon isotope ratios (see section 2.4.1.2.3), breastfed human babies and suckling cubs are isotopically a trophic level above their mothers or the females breastfeeding them (de Luca *et al.* 2012, Dupras 2010, Fogel *et al.* 1989, Fuller *et al.* 2006, Jay 2009, Reynard & Tuross 2015, Tsutaya & Yoneda 2013). This fact has been used to study infant feeding practices over time, trying to identify the age subadults were weaned in each context (Bourbou *et al.* 2013, Dittmann & Grupe 2000, Reitsema *et al.* 2016). However, recently this approach has been criticised (Beaumont *et al.* 2014, Beaumont *et al.* 2018, Beaumont 2020) and analysis of incremental dentine rather than bulk bone collagen is preferred due to its greater resolution (Fuller *et al.* 2003, Kwok *et al.* 2018). Because it was not planned ahead, this newer technique was not applied in the present research.

All in all, the main utility of nitrogen isotope ratios in palaeodietary reconstruction is to determine the trophic level or the position in the food chain of animals or humans and, indirectly, to estimate the proportion of animal protein in diet. Besides, this proxy can aid distinguishing individuals feeding on terrestrial and aquatic environments based on the greater number of trophic steps usually existing in the latter. This, combined with carbon stable isotope ratios, can separate the consumption of marine and freshwater resources (see section 2.4.1.2).

2.4.1.4 Bone collagen

2.4.1.4.1 Bone and collagen composition and structure

Bones and teeth are the human and animal tissues most commonly recovered from archaeological contexts because they are mineralised, which protects them to a great extent from decomposition and diagenesis (Collins *et al.* 2002). For this reason, collagen, the most abundant protein in skeletal remains, soon became a popular material for radiocarbon dating, and extraction techniques and criteria for assessing diagenesis were developed (Katzenberg 2008: 416). Therefore, when carbon and nitrogen stable isotope analyses emerged, the bases for applying them to skeletal remains were well settled. In addition, collagen is one of the few and the main source of nitrogen in the skeleton, so it can be used to obtain two types of information (δ^{13}C and δ^{15}C) contemporaneously from a single analysis. Since this research focuses on bones, and teeth were only exceptionally sampled (see section 2.4.2.1), the remaining explanation will focus on the former. However, bone and dentine collagen share many compositional and structural features. A deeper description on the specific characteristics of teeth and dentine collagen is provided by Hillson (2005: 146–150).

Bone is a composite material formed by a matrix of protein bound to mineral crystals, which provide elasticity and strength respectively (White & Folkens 2005: 42). In dry bone, the organic fraction represents approximately 30% of its weight and the inorganic fraction 70% (Katzenberg 2008: 416). The latter is mainly formed of hydroxyapatite, a calcium phosphate of the hydroxyl group, but there is also a significant proportion of apatite based on carbonates (~2%, Hedges 2009: 495). The organic fraction of bone is mostly (85-90%) made up of collagen. This is a structural protein characterised by a rope-like structure composed of three polypeptide chains twisted in a right-hand helix (Pollard & Heron 2008: 274). Bone collagen is made up of nineteen amino acids: eight essential and eleven non-essential. The difference between them is that the former cannot be synthesized by the human body, so they necessarily have to be acquired through diet.

Instead, the latter can be formed by humans based on specific nutrients (Schwarcz 2001: 192–193). In addition, the organic fraction of bone comprises other non-collagenous proteins, mainly osteocalcin, and lipids (Katzenberg 2008: 416).

2.4.1.4.2 Turnover

It is important to consider bone turnover in order to be aware of the space of lifetime represented by the results of isotope analyses. During life, bone and its constituents are constantly remodelling (Brickley & Ives 2008: 28–30). In subadults this process is driven by growth and it is quite fast. Instead, after skeletal development is completed, turnover rates decrease significantly, because remodelling only has to meet the demands of bone repair. Every time bone is remodelled, it assimilates molecules from the food and drink the individual consumes at that moment. Those new molecules bring with themselves the isotopic signature of the foodstuffs they come from, which is incorporated into the different components of bone, for example collagen. Therefore, the isotopic signature of collagen from any bone is an average of the diet consumed by the individual during the period complete turnover takes place.

Bone collagen turnover rates vary depending on a number of factors. As explained above, age is one of the main factors, but sex, nutrition, health and activity are important variables too (Hedges *et al.* 2007). In addition, the structural arrangement of bone is essential. There are two types of bones according to this criterion (White & Folkens 2005: 40). Cortical or compact bone is dense and tightly-packed and it forms the external layer of bones. Instead, trabecular or spongy bone, which occupies most of the inner cavities of bones, presents a honeycomb structure. Trabecular bone remodels faster than cortical bone. It is estimated adult cortical bone remodels 3% per year, while trabecular bone remodels 18% annually (Valentin 2002: 188). Then, the overall turnover rate of each skeletal element is determined by its proportion of cortical and trabecular bone. For example, ribs, which have a substantial proportion of trabecular bone, are considered to preserve the isotopic signature of approximately the last five to ten years of life of the individual. Meanwhile, femora, with a greater proportion of cortical bone, represent up to the last three decades of life (Jørkov *et al.* 2009). Considering the short life expectancy of most historical populations, this means most of the adult bones analysed in this research would still carry a significant proportion of collagen synthetized during adolescence (Hedges *et al.* 2007). Besides, this makes it difficult to detect short term events such as rapid growth, pregnancy, acute illness or occasional nutritional stress through stable isotope analyses of bone collagen.

2.4.1.4.3 Diagenesis

In biomolecular archaeology, it is essential to ensure the materials analysed preserve the *in vivo* signature, that is, the values they had when the organism was alive. Bone collagen is a suitable material for this purpose, because it is a stable molecule thanks to the protection provided by the mineral fraction of bone (Collins *et al.* 2002, Dobberstein *et al.* 2009, Hedges 2002). However, bone collagen can be affected by a number of physical, chemical and biological processes which can modify its composition and structure. This phenomenon is known as diagenesis. The two main diagenetic mechanisms which affect bone collagen are degradation and contamination (Van Klinken 1999: 688). Degradation is any process which leads to the breakdown of bone collagen, facilitating its loss. It is due to the break of the bonds between the individual amino acids forming collagen, resulting into shorter polypeptide chains which can be more easily leached or metabolised by bacteria. Three intimately linked processes can conduct to collagen degradation (Collins *et al.* 2002). On one hand, there is collagen hydrolysis, caused by the combination of high temperatures, acid environment and active water movements. On the other, there is mineral loss, also related to extreme pH and groundwater activity. The third collagen degradation factor is microbial activity, caused by bacteria and fungi from soil and gut which live on collagen (Jans *et al.* 2004). These three processes interact closely with each other in a circle where the disintegration of the inorganic fraction leaves collagen unprotected from microbial attacks and, at the same time, collagen loss accelerates mineral decomposition. In any case, bone collagen degradation itself does not alter *in vivo* isotopic signatures. The main issue is that it decreases bone collagen content. Then, bigger samples are required to extract collagen enough to perform analyses, so background contaminants may have a greater effect on the results (Van Klinken 1999: 688–689). Contamination is the result of the binding of exogenous substances to bone collagen, which may modify original isotope ratios. These may be artificial products bone come in contact with during recovery or laboratory procedures, such as preservatives or reagents, or more commonly natural substances deriving from the decomposition of organic matter, either soil or collagen itself. The impact of diagenetic processes can be reduced with appropriate pretreatment (see section 2.4.2.2) and the resulting collagen extracts should always be assessed with the quality criteria presented in section 2.4.2.5.

2.4.1.4.4 Routing

All dietary fractions (carbohydrates, proteins, lipids) do not contribute equally to the isotopic composition of bone collagen. That is, the isotopic signature measured on bone collagen is not the perfect average of the whole diet consumed by the individual, but certain products are overrepresented and others are overlooked.

In mammals, proteins are almost the only source and reservoir of nitrogen. That is to say, collagen is the sole skeletal tissue which contains nitrogen, and all of it comes from the protein fraction of diet (Hedges *et al.* 2006: 121). Then, nitrogen isotope ratios measured on bone collagen only provide information about protein intake, so low protein products are not represented in this proxy (Müldner 2009: 329–330). Considering that generally animal derived products are considerably richer in protein than plants, this implies meat and other secondary products are significantly more visible in the isotopic record than grains, vegetables and fruits.

Conversely, carbon is present in all three dietary fractions, but they do not contribute proportionately to bone collagen. Several feeding experiments proved that, in a normal nutritional status, carbon in bone collagen comes mainly from dietary protein (Ambrose & Norr 1993, Froehle *et al.* 2010), meaning carbohydrates and lipids are also underrepresented by this proxy. This may not be relevant if protein and energy (the ensemble of carbohydrates and lipids) derive from the same photosynthetic pathway; in other words, if the animals consumed are feeding on the same type of plants as humans, either C_3 or C_4. But it is a problem when most of the proteins come from a photosynthetic pathway different from that of energy, that is, when animals are feeding predominantly on C_3 ecosystems and humans are introducing in their diets significant amounts of C_4 plants, or *vice versa*, because the photosynthetic pathway of energy will be obscured. Besides, in diets where the minimum protein intake requirements are not met quantitatively (low amounts of proteins) or qualitatively (poor quality proteins), other dietary fractions may be used for the synthesis bone collagen (Ambrose & Norr 1993), with the exception of the approximately 20% of essential amino acids which necessarily need to come from ingested proteins (Jim *et al.* 2004: 62, Jim *et al.* 2006). This introduces a further uncertainty factor in the interpretation of the results of carbon isotope analyses on bone collagen. Still, the deprivation of protein in diet has to be extreme to trigger this alternative metabolism, so it is probably incompatible with the vast time scale represented by bone collagen. In another vein, more recent research confirmed the predominance of protein on bone collagen, but it also demonstrated that at least around 25% of the carbon in bone collagen derives from the energy fraction of diet (Fernandes *et al.* 2012), so results may not be that biased.

2.4.2 PROCEDURES OF CARBON AND NITROGEN STABLE ISOTOPE ANALYSES ON BONE COLLAGEN

2.4.2.1 Sampling

The sampling strategy of human populations aimed at obtaining the most representative picture possible, but due to budget and time restrictions the proportion of individuals sampled varied from site to site mostly based on the size of the populations. Small and medium size assemblages (La Huelga, Finaga, Can Gambús, Castellar del Vallès, Sant Menna) were almost completely sampled and only a few individuals from each one were left aside because they did not preserve any appropriate anatomical element to be sampled. The medium size sites of El Soto/El Encadenado and Dulantzi are exceptions to this rule because they were sampled by other colleagues before the author was involved in this research, so sampling criteria were not unified. In addition, the archaeological site of Dulantzi was re-excavated in 2014, after the analyses of the individuals from the first phase of the project had been completed. The new intervention turned out almost doubling the size of the population, but unfortunately these individuals could not be sampled. Still, they are included in the palaeodemographic study. Something similar happened with Finaga. A new intervention in 2014 added two burials to the fifteen known since 1994. These two new individuals could not be studied or sampled because they were still not deposited in the corresponding institution at the time this research was carried out. The bigger populations included in this thesis (Boadilla, Gózquez, Aldaieta) could not be entirely sampled because they would have required too many resources. Then, they were randomly sampled in order to avoid an aforethought selection to introduce any bias. Whenever possible two samples from each human individual were taken: one from a rib and another one from a long bone. When both were available, ribs were preferentially analysed. Long bones were only submitted when ribs gave poor quality collagen. Flat bones, such as skull or os coxae, were only sampled when no other anatomical elements were preserved. Short and irregular bones were avoided.

Fauna samples were taken from the contexts closer to the human populations analysed (see section 2.3.1). Most of the cemeteries studied (Boadilla, Gózquez, El Soto/El Encadenado, Dulantzi, Can Gambús, Castellar del Vallès) had adjacent and contemporary settlements at least partially excavated, so fauna samples could be obtained from them. In the cases of Boadilla and Castellar del Vallès, parts of the settlements were designated independent archaeological sites for administrative purposes. For this reason, some of the fauna samples associated to these human populations have different acronyms (see section 2.3.2): Alameda del Señorío de Illescas (ASI) is the settlement linked to Boadilla (BOA) and Horts de Can Torras (HCT) is related to Castellar del Vallès (PMCV). No fauna samples were taken from the settlement of La Huelga because it is so close to El Soto/El Encadenado that is was considered that the samples from the latter would be enough. The remaining human populations included in this thesis (Aldaieta, Finaga, Sant Menna) came from archaeological sites which consisted only in the cemetery. Then, the number of animal remains which could be sampled was very restricted. Actually, at Finaga no faunal remains at all were found. This is also the reason why Sant Menna is the only context where fauna samples from later chronologies were included (table 7.8). The sampling strategy followed was aimed at getting a good representation of all the main domestic taxa of economic interest (cattle, ovine, caprine, equids, swine, fowl) and pets (dogs, cats), as well as diverse dietary regimes (herbivores, omnivores, carnivores). Bones were preferred over teeth. In fact, the latter were only sampled at three sites. In the case of El Soto/El Encadenado teeth were the only anatomical element of equids preserved. At Aldaieta teeth were chosen because they were almost the only faunal remain available. Instead, at Dulantzi the decision of picking teeth was due to the fact that the sampling strategy was not clear when the analyses were performed. In all the assemblages, mandibles with deciduous dentition and bones with unfused epiphyses were mostly excluded in order to avoid subadult specimens, since they may retain the isotopic signal of lactation and bias the results (Balasse 2014: 4125–4127). No wild taxa or fish were included in the analyses, because they were very scarce. However, in the case of fish, this may be an artefact of the absence sieving during fieldwork.

Both in the case of humans and fauna, approximately 1 to 5 g of bone per sample were taken, trying the entire sample to come from a single anatomical element (e.g. sampling a single rib, instead of several fragments from different ribs). Bones already fragmented were preferred in order to minimise the impact on the preservation of collections. If solely complete anatomical elements were available, samples were cut with a hand saw. Incisions were performed in the least visible and diagnostic portion of the bones, making an effort not to pierce them completely to keep them available for measurement (Mays *et al.* 2013). Anatomical areas useful for age and sex estimation or species identification, and those exhibiting pathological signs were excluded from sampling. The animal teeth selected were all loose.

2.4.2.2 Collagen extraction

After sampling and before measurement, bone and dentine samples went through a chemical treatment with the objective of removing contaminants and isolating collagen. All the samples included in this thesis were prepared at the facilities of the Centre for Isotopic Research on Cultural and Environmental Heritage (CIRCE) and the Department of Environmental, Biological and Pharmaceutical Science and Technology (DISTABIF) of the University of Campania Luigi Vanvitelli in Caserta (Italy), thanks to the collaboration with the research group coordinated by C. Lubritto. The protocol consisted of a sequence of acid and alkali attacks (DeNiro & Epstein 1981) followed by gelatinisation (Longin 1971) and lyophilisation (Bocherens *et al.* 1991), as explained by Passariello *et al.* (2012), without the ultrafiltration step. Below there is a detailed exposition of the process:

1 Mechanical cleaning and pulverisation: Many of the samples had been previously washed with tap water at room temperature by the osteoarchaeologists working on the collections. The first step in the collagen extraction lab was to scratch the outer surface of bones and teeth with a scalpel in order to remove soil, rootlets and any other visible contaminants. Bones were cut and trabecular tissue was dismissed because it is often a trap for exogenous material. Then, cortical bone was pulverised, since this presentation increases the surface of the sample for chemical treatment. Teeth were first dissected with a small electric rotary saw to expose dentine. Afterwards, dentine was abraded with a rotary burr and the resulting powder was collected. Dentine comprising the complete height of the teeth was sampled. Approximately 1 g per sample of bone or dentine powder was weighed into polypropylene tubes.

2 Demineralisation and removal of base-soluble contaminants: Pulverised samples went through four acid and one alkali attacks. Acid was aimed to remove the inorganic fraction of bone (i.e. hydroxyapatite), dissolved atmospheric CO_2 and acid-soluble contaminants. The objective of alkali was to get rid of humic acids. To begin with, samples were treated with 0.6 M HCl for 2 hours with lids resting on the tubes so as to let gaseous by-products escape. After that time, lids were tightened and tubes were centrifuged at 7000 rpm for 5 minutes. The liquid phase was discarded and 0.6 M HCl was applied again and left overnight. In the morning, samples were centrifuged (7000 rpm, 5 minutes), liquid was removed and fresh 0.6 M HCl was poured. After 1 hour, tubes were centrifuged (7000 rpm, 5 minutes) and acid was discarded. Next, samples were neutralised rinsing them in deionized water at least three times or until they reached neutral pH (pH = 7). Between rinses they were centrifuged at 6000 rpm for 10 minutes, pH was checked with litmus paper and water was discarded. When neutral, samples were treated with 0.1 M NaOH while being centrifuged at 3000 rpm during 30 minutes. Afterwards, the liquid phase was thrown away and samples were neutralised following the same procedure explained above. A last acid attack with 0.6 M HCl was applied for 30 minutes. Then, samples were centrifuged

at 7000 rpm for 5 minutes in order to separate liquid and solid phases and the former was discarded. Finally, samples were neutralised as already explained. All the procedure was performed at room temperature.

3 Gelatinisation: Proteins are soluble in weak acid solutions at the right temperature in a process known as denaturation. This attribute is used to isolate collagen from acid-insoluble contaminants still in the sample. For this purpose, samples were acidified adding 10 m of a pH 3 HCl solution, obtained diluting 0.6 M HCl in deionized water while controlling pH. Then, the mouth of the tubes was wrapped in teflon and lids were tightened in order to prevent evaporation. Samples were placed in an oven at 70ºC for 20 hours. Afterwards, the resulting solution was poured in 16 ml glass tubes and passed through 9 ml Ezee filters (60-90 µm pore size). Previously, glass tubes and Ezee filters were rinsed with deionized water and subjected to ultrasonic bath for 30 minutes. This filtering separates solubilized proteins from insoluble residue. Next, the filtered solution is transferred into new preweighed polypropylene tubes.

4 Lyophilisation: The objective of this step is to remove water from the sample through sublimation so as to keep only solid collagen fibres. First, samples were covered with pierced parafilm, keeping the lids for later. Then, samples were frozen overnight. Next, they were put in the freeze-drier for 24 hours or until the samples were completely dry. After taking them out from the freeze-drier, parafilm was removed, lids were put on and tubes were weighed again in order to calculate the amount of collagen obtained for each sample.

The material resulting from this process is not only collagen. Collagen is undoubtedly the main component, but it also contains traces of other non-collagenous proteins and lipids, as well as exogenous organic and inorganic matter (Ambrose 1990: 432). For this reason, this material is sometimes referred to as “collagen”, to make clear it is the product of the gelatinisation of demineralised bone and not pure collagen protein (DeNiro 1985: 808, Van Klinken 1999: 687). Still, in this thesis the result of the chemical process described above will be called collagen for the sake of simplicity.

2.4.2.3 Isotope ratio mass spectrometry (IRMS)

Carbon and nitrogen stable isotope ratios are measured with Isotope Ratio Mass Spectrometers (IRMS), an instrument specifically designed for the measurement of isotopic compositions at natural abundance levels with great precision and accuracy (Meier-Augenstein 2018: 85). This technique is based on the simultaneous measurement of ionized carbon and nitrogen molecules previously separated by a magnet according to their mass. More specifically, this research used continuous flow IRMS (Preston & Owens 1983, Preston & Owens 1985), where samples are combusted, and molecules are separated by gas chromatography and carried to the IRMS online by an helium stream thanks to the coupling of an Elemental Analyser (EA) to the IRMS. EA-IRMS systems can be divided in four parts (Hoefs 2018: 27–29, Malainey 2011: 411–424):

1 Inlet system: The material resulting from the collagen extraction protocol (see section 2.4.2.2) is weighted into tin capsules (Säntis Analytical) in aliquots between 0.8 and 1.0 mg and placed into the autosampler carrousel. For each sample (Meier-Augenstein 2018: 94–95), the measurement procedure starts with the release of the capsule containing the sample into an oxidation furnace. This is a quartz glass tube kept at 1020ºC where the sample is introduced together with oxygen, which contributes to the combustion, and helium, which acts as a carrier throughout the entire procedure. There, the capsule is quickly combusted and the resulting gas goes through the chromium oxide and copper oxide filling the tube. Then, collagen is oxidised and is transformed into CO_2, N_2, NO_x, SO_2 and H_2O. Immediately afterwards, gas sample passes through a filter made of silver wool to remove sulphur compounds and is transported by the helium stream to a reduction furnace, another quartz glass tube containing copper wires at 600ºC which reduce nitrogen oxides (NO_x) into N_2 and eliminate excess oxygen. Finally, helium carries gas sample through a water trap to remove water molecules. At this point, only carbon (CO_2) and nitrogen (N_2) mixed together are kept. Thereafter, they enter

the gas chromatography column, which is packed with a polymer that does not let carbon and nitrogen go through it at the same speed, so nitrogen leaves the chromatography column and is introduced into the IRMS before carbon with an appreciable gap between them.

2 Ionization: Nitrogen and carbon enter separately the IRMS. Regardless the chemical species, first they are ionized. That is, they are transformed into electrically charged particles. For this purpose (Hoefs 2018: 28–29, Malainey 2011: 413–414), molecules go through a vacuum chamber with a heated tungsten filament which releases electrons placed perpendicularly to the sample inlet. Then, carbon and nitrogen molecules from the sample collide with the electrons from the ionization source and, as a consequence, they lose one of their own electrons, becoming positive ions.

3 Mass analyser: The beam of charged carbon or nitrogen molecules arrives to the mass analyser, where there is a magnet that separates them according to their mass (Hoefs 2018: 29). (Actually, they are separated according to their mass to charge ratio (m/z), but, since after ionization their charge is 1, their mass is equal to their mass to charge ratio.) The magnet is placed perpendicularly to the ion beam, so it obligates molecules to trace a curved trajectory. Then, ions made of lighter isotopes take paths with shorter radii than molecules formed by heavier isotopes. That is, lighter ions tend to deflect more from the magnet than heavier ions. In this way, the beam of carbon or nitrogen molecules is split into several smaller beams composed of molecules of equal mass.

4 Ion detection: The ion beams of uniform mass leaving the mass analyser are focalised to collide with Faraday cups, the devices acting as ion detectors in IRMS (Malainey 2011: 423–424). Three contiguous Faraday cups for each chemical species are placed at the end of the instrument, in the precise location where the ion beam for each mass is known to end. For carbon they measure the masses 44 ($^{12}C^{16}O^{16}O$), 45 ($^{13}C^{16}O^{16}O$) and 46 ($^{12}C^{16}O^{18}O$). There are other CO_2 molecules with mass 45 ($^{12}C^{16}O^{17}O$) and 46 ($^{13}C^{16}O^{17}O$) and with masses up to 49, which are accounted for thanks to the fact that the relationship between O^{17} and O^{18} is known and stable (H. Craig 1957). In the case of nitrogen, Faraday cups are set at masses 28 ($^{14}N^{14}N$), 29 ($^{14}N^{15}N$) and 30 ($^{15}N^{15}N$), but the latter is not used for the calculation of $\delta^{15}N$. Every time ions of a given mass strike the assigned Faraday cup, there is a drop in voltage. The intensity of the voltage generated is proportional to the abundance of the mass recorded in that Faraday cup. From these data $\delta^{13}C$ and $\delta^{15}N$ are calculated.

Carbon and nitrogen stable isotope ratios at natural abundance levels cannot be measured in absolute terms (Meier-Augenstein 2018: 82). Therefore, in order to obtain the isotopic composition of samples, they are compared simultaneously with known reference gases. This means that during the measurement procedure the sample is alternated with reference gases. That is, a regular measuring cycle consists of first the measurement of nitrogen reference gas, then nitrogen from the sample, afterwards carbon from the sample and finally carbon reference gas. Later, thanks to standard reference materials measured interleaved between samples, the comparative values obtained are calibrated to be reported to the international standards VPDB for $\delta^{13}C$ and AIR for $\delta^{15}N$ (Szpak *et al.* 2017).

The complete sample set for this research was measured at the Centre for Isotopic Research on Cultural and Environmental Heritage (CIRCE) of the University of Campania Luigi Vanvitelli in Caserta (Italy), under the collaboration with the research group led by C. Lubritto. These facilities are equipped with a Delta Plus Isotope Ratio Mass Spectrometer coupled to a FlashEA 1112 Elemental Analyser via a ConFlo II interface (Thermo Fisher Scientific). Samples were measured on a single run. The reference gases used as comparison during measurement of raw isotope ratios were CO_2 for carbon and N_2 for nitrogen. Calibration of $\delta^{13}C$ and $\delta^{15}N$ relative to the international standards VPDB and AIR was based on the measurement of internationally certified standard reference materials alternated with samples. A series of calibration standards was measured every twelve samples. The internationally certified standard reference materials used for the calibration of carbon stable isotope ratios were IAEA-CH3 ($\delta^{13}C$ = -24.72‰ ± 0.04) and IAEA-CH6 ($\delta^{13}C$ = -10.45‰ ± 0.03) and for nitrogen isotope ratios IAEA-USGS34 ($\delta^{15}N$ = -1.8‰ ± 0.2) or IAEA-N-1 ($\delta^{15}N$ = 0.4‰ ± 0.2) and IAEA-N-2 ($\delta^{15}N$ = 20.3‰ ± 0.2). Accuracy (systematic errors) was monitored with the repeated measurement of two internal standard reference materials with well-characterised isotopic compositions (CIRCE yeast: $\delta^{13}C$ = -24.30‰ ± 0.3; $\delta^{15}N$ = 0.10‰ ± 0.3; SIRFER yeast: $\delta^{13}C$ = -20.02‰; $\delta^{15}N$ = -1.24‰) interspersed every twelve samples and it was determined to be ± 0.07‰ for $\delta^{13}C$ and ± 0.12‰ for $\delta^{15}N$. Precision (random errors) was assessed repeating the measurement of approximately 10% of the samples and it was calculated to be 0.10‰ for $\delta^{13}C$ and ± 0.14‰ $\delta^{15}N$ on the basis of the mean standard deviation of 49 samples replicated three times.

2.4.2.4 Reproducibility

Ten samples were replicated at the facilities of the Department of Archaeology of the University of Durham (UK), including collagen extraction and measurement. Chemical treatment (Longin 1971) and measurement procedures were very similar, but there were a few differences, so the protocol employed at the University of Durham will be briefly described hereunder. Collagen extraction started from bone chunks of around 200 mg. They were superficially mechanically cleaned, placed into 15 ml glass tubes, covered with 10 ml of 0.5 M HCl and put into a fridge for demineralisation. Tubes were shaken once a day and acid was changed every two days. Samples were considered to be fully demineralised when they floated or became soft, which took between two and four weeks. Acid was removed using Ezee filters and samples were rinsed in deionized water three times. Afterwards, tubes were filled with deionized water and HCl was added dropwise while monitoring pH until reaching pH 3. Next, they were placed in a hot block at 75ºC for 24 hours with the aim of gelatinizing collagen. The resulting solution was filtered first with Ezee filters to remove insoluble residues and then with ultrafilters (Brown *et al.* 1988), which allow to select molecules bigger than 30 kDa, ensuring only well-preserved collagen is obtained. Ultrafilters were previously cleaned rinsing them with deionized water in the centrifuge at 3000 rpm for 5 minutes. Then, samples were loaded in them and they were centrifuged at 3000 rpm for 15 minutes. The supernatant fraction (i.e. molecules greater than 30 kDa) was transferred into preweighed plastic tubes, covered with pierced parafilm and frozen overnight. After that, they were put into the freeze-dryer for lyophilisation during the night. The resulting material was mostly collagen. It was placed into tin capsules and measured at the Department of Earth Sciences of the University of Durham on a Delta V Advantage Isotope Ratio Mass Spectrometer coupled to a Costech Elemental Analyser (Thermo Scientific). Every sample was measured in duplicate. The precision of the measurements performed at the University of Durham was a little better than those made at CIRCE. The mean standard deviation of the two replicates for each of the ten samples analysed was ± 0.06‰ for $\delta^{13}C$ and ± 0.11‰ $\delta^{15}N$.

All the individual measurements of the ten samples measured both at CIRCE and the University of Durham were pooled together in order to evaluate reproducibility between different facilities. The mean standard deviation of all the measurements for each sample was ± 0.17‰ for $\delta^{13}C$ and ± 0.21‰ $\delta^{15}N$. This is just slightly bigger than the internal precision at CIRCE and it is clearly below the significance at the level of dietary interpretation. Therefore, it can be concluded that the carbon and nitrogen stable isotope ratios obtained at CIRCE are reproducible with great precision.

2.4.2.5 Collagen quality criteria

For a well-founded palaeodietary reconstruction, it is necessary to ensure that the samples analysed were not substantially affected by diagenesis (see section 2.4.1.4.3) and they preserve the *in vivo* isotopic signature. The most widely used indicators for assessing bone collagen integrity are collagen yield, carbon and nitrogen weight contents and carbon to nitrogen atomic ratio (Lee-Thorp 2008: 930, Roberts *et al.* 2017: 363), because they are easy to obtain during collagen extraction and measurement, and they are straightforward to apply.

Collagen yield (%coll) refers to the weight proportion of collagen preserved in any bone sample, so it is an indicator of collagen degradation. It is estimated according to the following formula:

Collagen yield: %coll = [Collagen final mass] / [Sample initial mass] x 100

Approximately 22% of the weight of fresh bone is collagen (Van Klinken 1999: 689). The lower the proportion preserved, the greater the risk of contamination. However, it needs to be considered that certain steps of the collagen extraction procedure, such as the treatment with NaOH or the use of ultrafilters, may decrease collagen yields notably (Jørkov *et al.* 2007). Several researchers have proposed different values under which collagen should be considered too degraded. For collagen yield, this thesis will follow the proposal by Van Klinken (1999: 689–690), who concluded that collagen from European samples is mostly intact up to 0.5% and showed that the amino acid profile of collagen does not vary significantly above that value. Then, in this research only samples with collagen yields below 0.5% are excluded from palaeodietary reconstruction.

Carbon (%C) and nitrogen (%N) weight contents in bone collagen are also useful to assess the preservation of unaltered isotope signatures, since they can provide hints on collagen degradation and the presence of contaminants. Intact bone collagen presents carbon weight contents around 35% and nitrogen weight contents of about 13% (Van Klinken 1999: 690–691). Still, the minimum carbon and nitrogen weight concentrations reported for well preserved bone collagen are 13.0% and 4.8% respectively (Ambrose 1990: 437–438). These are the thresholds for elemental content applied in this thesis in order to discriminate well and poorly preserved bone collagen.

In addition, carbon and nitrogen weight contents are used to calculate the carbon to nitrogen atomic ratio (C/N) of each sample. This is another indicator of collagen integrity which ensures the proportion between these two elements is consistent with bone collagen. Its calculation accounts for the differences in mass between carbon (atomic mass = 12) and nitrogen (atomic mass = 14) applying the equation below:

Carbon to nitrogen atomic ratio: C/N = [Carbon weight content] / [Nitrogen weight content] x 14 / 12

The most widely accepted range for this parameter is between 2.9 and 3.6 (DeNiro 1985), since the samples outside those values are likely to be affected by contamination. This is the range used in this work too.

Summing up, bone collagen preservation of all the samples was assessed before incorporating them into the dataset used for palaeodietary reconstruction applying the four criteria presented above. In order to accept a sample as preserving the *in vivo* isotopic signature, it had to show collagen yield above 0.5%, carbon weight content over 13.0%, nitrogen weight content greater than 4.8% and carbon to nitrogen atomic ratio between 2.9 and 3.6. All the samples meeting these parameters are included in table 7.9 for humans and table 7.11 for fauna. Samples outside those ranges were discarded and were not used for any historical interpretation. They are shown in tables 7.10 and 7.12 for humans and fauna respectively, with the indicators of poor collagen preservation highlighted.

2.5 STATISTICS

2.5.1 DESCRIPTIVE AND INFERENTIAL STATISTICS

Statistics was used to understand the characteristics of the data obtained and to make inferences about the relationships between different groups of individuals (Vanpool & Leonard 2011). Initially every variable was explored within each population or assemblage calculating sample size (n), mean, standard deviation (SD), minimum (min), maximum (max) and range.

In order to detect meaningful similarities and differences between groups, different tests were used according to the nature of data. Quantitative data grouped according qualitative criteria was analysed using the comparison of means or distributions, which differed depending on whether data were normally distributed or not. For this purpose, Shapiro-Wilk test was used (Shapiro & Wilk 1965).

Most datasets were not normally distributed, so nonparametric tests were applied more frequently. Mann-Whitney U test (Mann & Whitney 1947) was employed when there were only two groups to be compared. The assessment of the distributional assumption was accomplished through visual inspection of the population pyramids of each group. Since distributions were different in every case, results were always interpreted in terms of differences between distributions. When there were three or more groups to be compared, Kruskal-Wallis H test (Kruskal & Wallis 1952) was used. In this case the distributional assumption was evaluated examining visually boxplots. In all the cases in this thesis, this test was considered a comparison between distributions, because the distributions of the groups compared were always different. Besides, when there were statistically significant differences between distributions, pairwise *post hoc* comparisons between all the groups were run using Dunn's procedure with Bonferroni correction (Dunn 1964) in order to detect specifically the pairs of groups where the differences lay.

In the cases where distributions were normal, parametric tests for mean comparison were employed. The assumption of homogeneity of variances between groups was checked with Levene's test (Levene 1960). When this requirement was met and there were only two assemblages to confront, independent samples t-test was applied (Student 1908) and, if the result was statistically significant, effect size was expressed with Cohen's d (J. Cohen 1988). Instead, if homogeneity of variances was not found, Welch t-test was used (Welch 1947). When there were more than two groups to be compared and their variances were homogeneous, one-way ANOVA was employed (Vanpool & Leonard 2011: 153–177) and, if differences between means were statistically significant, effect size was reported as ω^2 (Field 2018: 738) and pairwise *post hoc* comparisons were carried out applying Tukey test (Braun 1994). Likewise, when two or more groups were confronted but they did not fulfil the assumption of homogeneity of variances, one-way Welch ANOVA was applied (Welch 1947).

In other instances, the aim was to verify the association between qualitative variables. If all cell counts were equal or greater than five, chi-squared test was used (Pearson 1900). In this case, when statistically significant associations were detected in 2 x 2 contingency tables, the strength of the association was measured with φ (phi coefficient) (Cramér 1946). Conversely, if any cell count was smaller than five, Fisher's exact test was applied (Fisher 1922).

All statistics, except effect sizes, were calculated with IBM SPSS Statistics 25. Effect sizes (d, ω^2) were computed with custom Excel tables. In all cases significance level was set at 0.05.

2.5.2 GRAPHS

Different types of graphs were used to represent data. The three main ones are briefly described below in order to facilitate their understanding throughout the text.

Scatterplots (figure 2.9A) were used to represent carbon and nitrogen stable isotope data. Carbon isotope ratios ($\delta^{13}C$) are displayed on the horizontal axis and nitrogen isotope ratios ($\delta^{15}N$) on the vertical axis. Both variables are expressed in units per mil (‰). Attention was paid to keep both axes proportional, so as an increase of a certain magnitude in one of them would also mean the same growth on the other one.

Carbon and nitrogen stable isotope ratios were also displayed in boxplots (figure 2.9B) when the distributions of two or more groups were compared. Each box represents one of the groups. The line inside the box marks the median (mdn) of the group, the lower limit of the box the first quartile (Q_1) and the upper limit of the box the third quartile (Q_3), so the height of the box equates the interquartile range (IQR) and it includes 50% of the distribution. The lower and upper lines represent 1.5 times the IQR, unless the end of the line is beyond the minimum or the maximum of the distribution. In those cases, the lines end at the minimum or the maximum values of the assemblage. Then, outliers are defined as the cases placed more than 1.5 times the IQR away from any of the edges of the corresponding box and they are symbolised with circles. Likewise, the data points more than three times the IQR away from the edges of their box are considered extreme outliers and they are shown as stars.

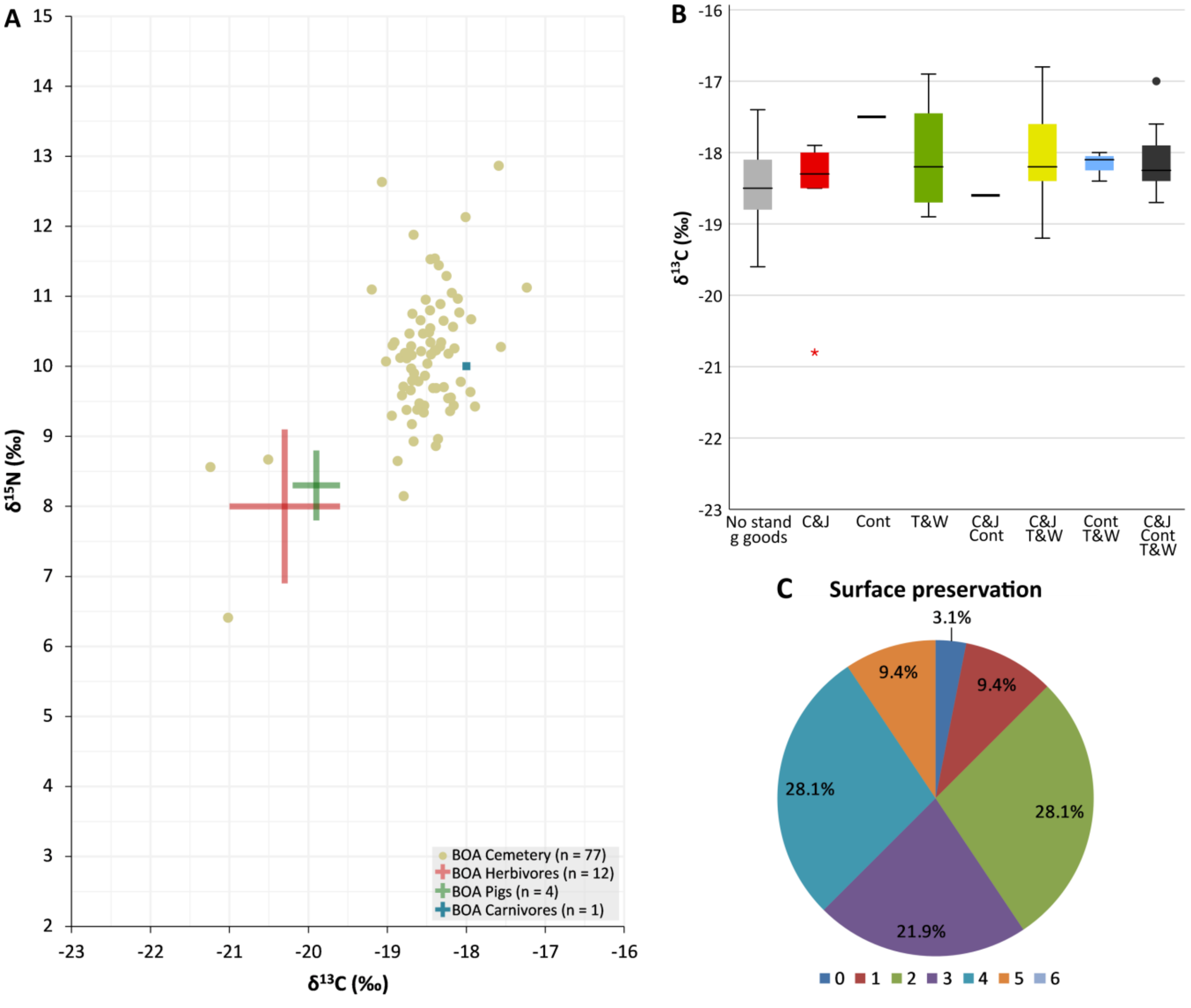


Figure 2.9. Examples of the types of graphs used in this thesis: (A) scatterplot, (B) boxplot, (C) pie chart

Pie charts are used to represent the distribution of qualitative variables (figure 2.9C). They consist of a circle divided in various sections whose size corresponds to the relative frequency of each option of the variable. Here they were employed, among others, to represent the variability of macroscopic preservation within each population analysed.

In addition to these graphs, demography charts were used to represent the demographic profiles of each population (see section 2.2.7). Demography charts, scatterplots and pie charts were created in Microsoft Excel 2019. Boxplots were made with IBM SPSS Statistics 25.

2.6 CARTOGRAPHY

Unless otherwise stated through references, all the cartography included in this thesis was elaborated by the author in ESRI ArcGIS Desktop 10.6. The sources of the cartographic resources used are listed in table 2.6 and they are explained in greater detail in the following paragraphs.

A large-scale map including Europe, Greenland, northern Africa and the Middle East was created based on GTOPO30 (Gesch *et al.* 1999), a Digital Elevation Model (DEM) developed by the Center for Earth Resources Observation and Science (EROS) of the United States of America Geological Survey (USGS). This is a worldwide DEM with a cell size of approximately 1 km. The base of this map was formed by a layer representing elevations and a hillshade. World state borders updated to 2016 were provided by Eurostat's Geographic Information System of the European Commission (GISCO). River courses at the global level were taken from the project WHYMAP (World-wide hydrogeological mapping and assessment programme) carried out by the German Federal Institute for Geosciences and Natural Resources (BGR, Bundesanstalt für Geowissenschaften und Rohstoffe) and UNESCO, and the outline of lakes and reservoirs from the online archive Natural Earth. The resulting cartography was also used for the representations of Iberia.

Regional scale maps were elaborated for the three areas of study covered in this research. Their base was made up of the topographic Spanish provincial map 1:200.000 (Provincial 200), a Digital Elevation Model also at 1:200.000 scale (MDT200) and the hillshade derived from the latter. All of them are offered by the Spanish National Institute of Geography (IGN, Instituto Geográfico Nacional) and they are hosted at the National Centre of Geographic Information (CNIG, Centro Nacional de Información Geográfica). Relevant rivers for the regions selected were obtained from the Water Basin Plan 2015-2021 led by the Spanish Ministry for the Ecological Transition and the Demographic Challenge (MITECO, Ministerio para la Transición Ecológica y el Reto Demográfico).

Table 2.6. Cartographic resources used

Resource	*Source*	
World DEM	USGS EROS	https://doi.org/10.5066/F7DF6PQS
World state borders	Eurostat GISCO	https://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/administrative-units-statistical-units/countries
World rivers	BGR & UNESCO	http://ihp-wins.unesco.org/layers/geonode:world_rivers
World lakes & reservoirs	Natural Earth	https://www.naturalearthdata.com/downloads/10m-physical-vectors/
Regional topographic map (Provincial 200)	IGN CNIG	http://centrodedescargas.cnig.es/CentroDescargas/index.jsp#
Regional DEM (MDT200)	IGN CNIG	http://centrodedescargas.cnig.es/CentroDescargas/index.jsp#
Local DEM[1]	IGN CNIG	http://centrodedescargas.cnig.es/CentroDescargas/index.jsp#
Local orthophotos[2]	IGN CNIG	http://centrodedescargas.cnig.es/CentroDescargas/index.jsp#
Iberian rivers	MITECO	https://www.miteco.gob.es/es/cartografia-y-sig/ide/descargas/agua/masas-de-agua-phc-2015-2021.aspx
Iberian reservoirs	MITECO	https://www.miteco.gob.es/es/cartografia-y-sig/ide/descargas/agua/masas-de-agua-phc-2015-2021.aspx
Iberian canals	MITECO	https://www.miteco.gob.es/es/cartografia-y-sig/ide/descargas/agua/red-hidrografica.aspx

[1] MDT02 for Gózquez, El Soto/El Encadenado, La Huelga, Can Gambús, Castellar del Vallès and Sant Menna; MDT05 for Boadilla, Aldaieta and Finaga; MDT200 for Dulantzi

[2] 2017 for Gózquez, El Soto/El Encadenado, La Huelga, Aldaieta, Finaga and Dulantzi; 2018 for Boadilla, Can Gambús, Castellar del Vallès and Sant Menna

A local scale map for each site was also created. They were formed by the superposition of a hillshade of the most detailed Digital Elevation Model and the most updated orthophoto available in each case. Both DEMs and orthophotos are part of the National Plan of Aerial Orthophotography (PNOA, Plan Nacional de Fotografía Aérea) and they were downloaded from the National Centre of Geographic Information (CNIG) of the Spanish National Institute of Geography (IGN). Rivers, reservoirs and canals important to understand local landscapes were acquired from the cartography provided by the Spanish Ministry for the Ecological Transition and the

Demographic Challenge (MITECO) under the framework of the Water Basin Plan 2015-2021. Any other features, such as the extent of sites or the location of neighbouring interest points, are represented according to the information available in the literature, referenced in the text.

Plans at the intrasite level were based on the information provided by publications and unpublished reports, cited adequately in every case.

3 MATERIALS & RESULTS

3.1 MADRID-TOLEDO

3.1.1 GÓZQUEZ

3.1.1.1 The site

3.1.1.1.1 Location and history of research

The site of Gózquez is located south of the region of Madrid (figure 3.1), in the municipality of San Martín de la Vega. Its UTM ETRS89 coordinates are 30T 448967 4454438 and it is 563 meters above sea level. It is 55 km northeast of Toledo, 22 km south of Madrid and 34 km southwest of Alcalá de Henares, the former Roman city of Complutum. Relative to the other sites from the same area analysed in this thesis, Gózquez is 22 km northeast of Boadilla and 28 km south of El Soto/El Encadenado and La Huelga. The site is situated in a small valley within the basin of the Jarama river, 5 km from the present riverbed. The proximity to the river would have facilitated the availability of fertile fields in the surroundings of the settlement. In addition, two small tributaries of the Jarama river, namely de la Vega and Gózquez streams, meet north of the site, creating a swamp area suitable for pasture, and there were also a number of salt water springs nearby.

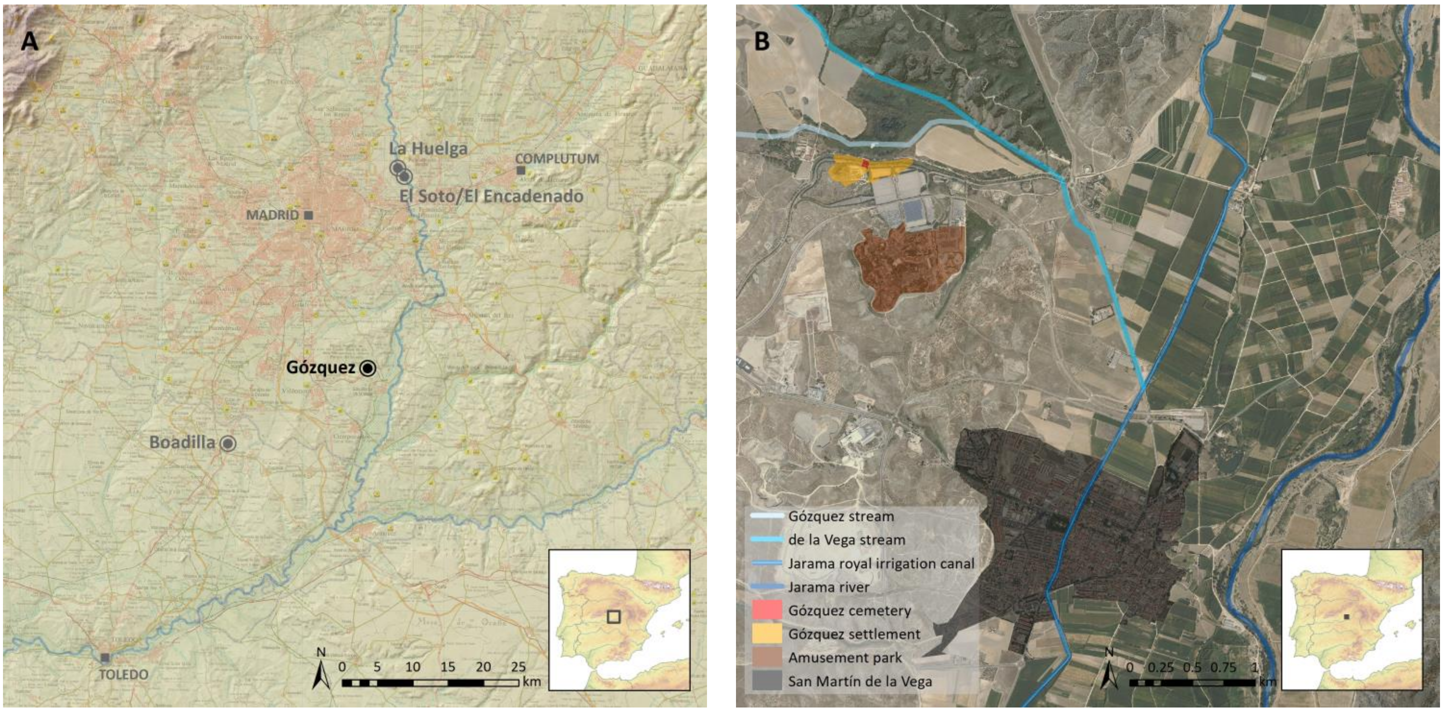


Figure 3.1. Geographical location of the site of Gózquez (San Martín de la Vega, Madrid) (A) at the regional and (B) local scale

Gózquez was excavated due to the construction of an amusement park in the area. The works started in 1997 with the assessment of the archaeological potential and the delimitation of the site through electromagnetic survey and test pits. Then, between 1998 and 1999 several open-air extensive excavation campaigns were carried out by the cooperative society Área. The excavation of the residential spaces was directed by A. Vigil-Escalera (nd). It covered 2.4 ha of intensive excavation in the eastern neighbourhood of the settlement and up to 9.5 ha of archaeological supervision and topographic recording including also the western sector. The excavation of the cemetery was under the responsibility of M. Contreras and A. Fernández Ugalde (Contreras 2011) and it comprised almost 0.5 ha. The complete assemblage of human remains from Gózquez is currently stored in the facilities of the Regional Museum of Archaeology of Madrid, in Alcalá de Henares.

The village of Gózquez is one of the best-known early medieval archaeological sites in Iberia because it was one of the first cases where both domestic, productive and funerary structures were extensively excavated. During the last two decades there has been a steady flow of publications tackling the site from a wide range of perspectives. There are a few descriptive papers on the settlement (Vigil-Escalera 2013a) and the cemetery (Contreras 2006, Contreras & Fernández Ugalde 2006), but most commonly Gózquez has been employed as an example for the understanding of landscape and settlement patterns in early medieval Iberia (Ariño 2013, Diarte-Blasco 2016, Quirós & Vigil-Escalera 2006, Vigil-Escalera 2006a, Vigil-Escalera 2006b, Vigil-Escalera 2009a, Vigil-Escalera 2019, Vigil-Escalera & Quirós 2012). Within this topic, A. Vigil-Escalera's (2007a) seminal paper on the definition of villages and farms is especially relevant. The site has also been used to analyse the internal organisation of early medieval settlements (Vigil-Escalera 2010, Vigil-Escalera 2015a) and for the typological classification of domestic and productive structures built in perishable materials (Tejerizo 2013, Tejerizo 2014, Vigil-Escalera 2000, Vigil-Escalera 2003a, Vigil-Escalera 2012). There are also a few works about the pottery (Serrano *et al.* 2016, Vigil-Escalera 2003b, Vigil-Escalera 2007b) and glass (de Juan *et al.* 2019, Gómez de la Torre-Verdejo 2017) recovered at Gózquez, as well as bioarchaeological evidence such as animal bones (Grau-Sologestoa 2013a), seeds (Vigil-Escalera *et al.* 2014), pollen (Hernández-Beloqui *et al.* 2013, López-Sáez *et al.* 2010) and starch (Aceituno 2015, Vigil-Escalera 2020). Regarding the funerary record, the cemetery of Gózquez has been part of the most recent interpretations on funerary practices in early medieval Iberia (Vigil-Escalera 2013b). Some monographic papers based on the analysis of burials and focusing on specific topics such as social organisation (Quirós & Vigil-Escalera 2011), religious identity (Vigil-Escalera 2015b) and legal status (Vigil-Escalera 2013c) have been published too. There is a previous unpublished osteoarchaeological analysis carried out by C. Sampedro (1999, 2011) on the human remains recovered both in the cemetery and the residential area of Gózquez, which includes data on demography and pathologies. However, there is a problem with the references given in this study to each individual, because they do not always match the labels of the anthropological material stored in the Regional Museum of Archaeology of Madrid, so in many cases the precise individual the text was referring to could not be identified. Anyway, the whole collection was re-examined by the author in order to have all the contexts analysed under the same methodological standards. Finally, it should be mentioned that the results on carbon and nitrogen stable isotope analyses on bone collagen of animals and humans from Gózquez have already been published by the author (García-Collado 2016), even if here a more in-depth analysis is presented.

3.1.1.1.2 The settlement

The site of Gózquez was occupied during three historical periods (Vigil-Escalera 2013a). First, there is evidence on a prehistorical settlement, including several burials, dated to between the Chalcolithic and the Bronze Age (Díaz-del-Río *et al.* 2017, Pérez Villa 2014). The early medieval village was founded during the second quarter of the 6th century and it was inhabited until the mid-8th century. Finally, a small late medieval occupation (13th-14th c.) probably linked to agrarian activities was identified on top of the early medieval cemetery. This sequence indicates that the early medieval village was a completely new settlement, which did not directly link with any previous Roman sites. However, a Roman villa named La Marañosa is known to have been 2 km north, so it is possible that the community settled in Gózquez still exploited its agrarian structures.

The early medieval settlement was organised in three main sectors (figure 3.2). There were two residential areas, one on the east and one on the west, both of them established on smooth hills. Between them there was the cemetery, located in a slight depression. The identification of several domestic units and the presence of a large cemetery define this settlement as a village (Vigil-Escalera 2007a: 243), that is, a community integrated by several extended families whose ties were based on the shared exploitation of a common territory and were archaeologically expressed through the burial of its members in the communitarian graveyard.

Figure 3.2. Gózquez, complete plan of the site (Vigil-Escalera nd: 372, modified)

At the intra-site level, Gózquez was organised in well-defined plots delimited by trenches (figure 3.3, Vigil-Escalera 2013a: 161–162), each one accommodating a domestic unit. Within the space for each family there was a main residential construction built in perishable materials on stone perimeter banks (Vigil-Escalera 2003a) and various productive structures around. These included several different types of sunken featured buildings (Tejerizo 2014, Vigil-Escalera 2000), many silos or underground storage pits, cooking ovens, a water well and a press probably for oil production. In addition, every domestic unit had a large rectangular plot free of structures, which are interpreted as spaces for agrarian activities such as gardens, threshing floors or enclosures for animals (Vigil-Escalera 2010). No meaningful differences were found in the size or the quality of structures between domestic units, neither in material culture or bioarchaeological evidence. Constructions were frequently rebuilt, but the new ones always respected the boundaries established for each domestic unit, which suggests the internal arrangement was defined at the foundation of the settlement and it was strictly preserved. Considering the size of the site, the number of domestic units forming it is estimated to have been between ten and twelve.

Regarding chronology, the site is dated to between the first quarter of the 6th century and the middle of the 8th century (Vigil-Escalera 2013a: 175). These dates are based on the combination of stratigraphy and pottery together with a few radiocarbon measurements. Moreover, thanks to the analysis of some closed contexts with abundant pottery it was possible to define four periods: period IA, 525-560; period IB, 560-620; period II, 620-660, and period III, 660-750. This meant a rare opportunity to understand the diachronic evolution of the site in detail.

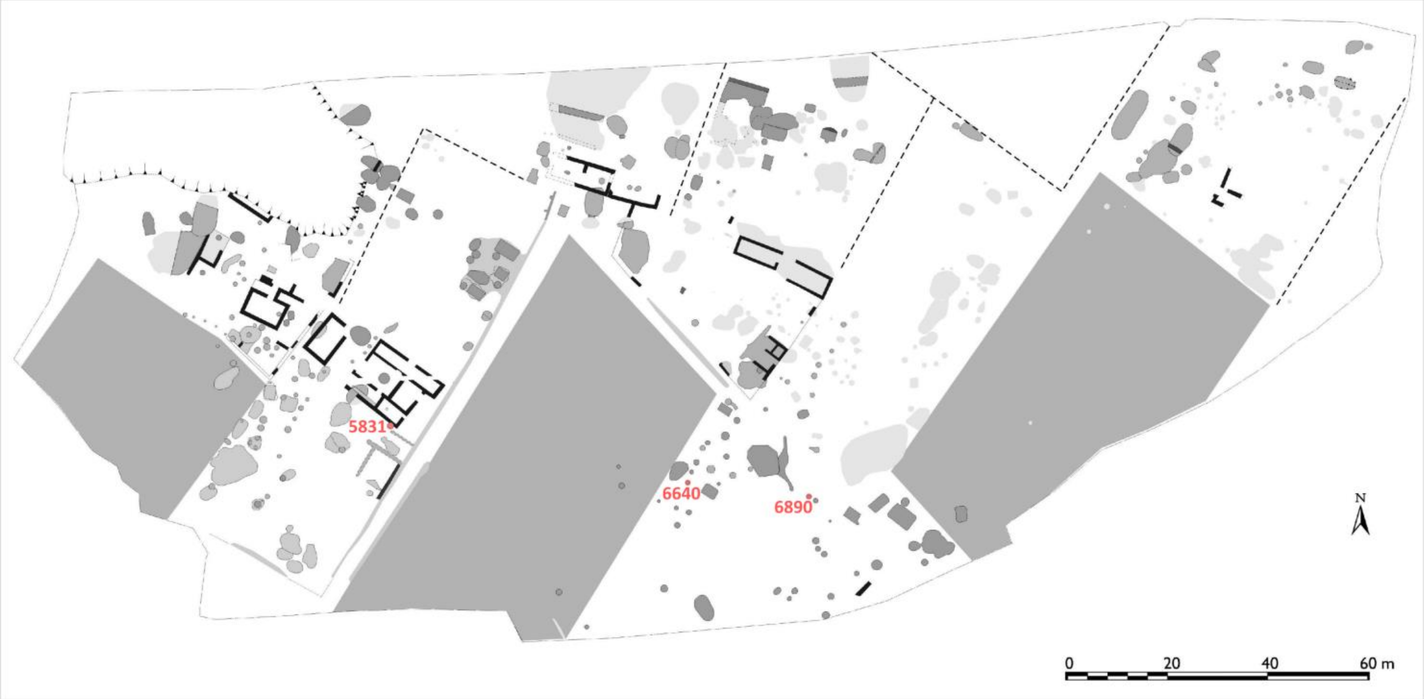


Figure 3.3. Gózquez, detailed plan of the eastern neighbourhood with an interpretation of the internal organisation. The grey spaces free of structures are interpreted as fields for agrarian activities. The dashed lines represent the hypothetical boundaries between domestic units. The silos highlighted in red are those where human deviant burials were found. (Vigil-Escalera 2010: 3, modified)

The material culture recovered at Gózquez has also been extensively studied (Vigil-Escalera 2013a: 171–174). The most frequent material was domestic pottery (Vigil-Escalera 2003b). Pots, bowls, jugs, bottles and dishes were the most common shapes. Their production suffered deep transformations along the occupation sequence of the site. During the first phase (period IA, 525-560) slow and fast wheel productions were balanced. However, during period IB (560-620) slow wheel productions began to predominate and the first handmade items appeared, setting the trend for the gradual homogenisation of slow wheel productions verified during periods II (620-660) and III (660-750). It is unclear whether pottery was produced on site or traded at the regional level, because no clear pottery kiln was identified during excavations. African pottery imports were the only evidence of long-distance exchange in this category and, even if they were very scarce, they were present in every period. Glass at Gózquez was rare too, but it was identified over the complete lifespan of the site. Bowls, dishes, drinking glasses and beakers in green, blue and amber colours were the most abundant findings (Gómez de la Torre-Verdejo 2017: 206–230). Up to the mid-6th century raw glass came mainly from Egypt, but since then glass from Syria-Palestine started to predominate. In addition, there was a rise in recycled glass during the 7th century (de Juan *et al.* 2019). The great majority of metal items recovered in Gózquez were discarded tools, most frequently knives. The only personal adornment metal objects found in the residential area were three belts, which contrasts with the relative abundance of clothing items and jewellery recovered in the cemetery. Interestingly, one of them was a liriform belt plate, a type dated to the 7th century and absent from the funerary contexts at Gózquez. Finally, hand mills are worth mentioning. They were very frequent. They were often found fragmented and reused as building material or lids for silos. They were made in two varieties of granite, both of them probably coming from Madrid north mountain ranges, at least 70 km from Gózquez, pointing at the existence of a fluent regional exchange network.

Gózquez is also one of the best-known early medieval sites at the bioarchaeological level. Abundant botanical and faunal remains were recovered (Vigil-Escalera *et al.* 2014). Botanical macroremains were clearly dominated by cereals, among which hulled barley and free-threshing wheats prevailed. Hulled wheat, rye and oats were also present in smaller amounts. No millet remain was identified in the carpological record. However, the unpublished analysis of starches on hand mills detected a prevalence of millet starch grains over wheat and barley (Aceituno 2015, Vigil-Escalera 2020). Legumes and fruits were very scarce. Olives were the only relevant taxa among the latter. Agricultural practices showed great stability, as no differences were recognised between the different chronological phases. Regarding husbandry, ovicaprids and cattle were the main taxa. According to kill-off patterns, the former were raised for both meat and wool and the latter predominantly for secondary products such as traction and dairy products. Ovicaprid husbandry intensified from the middle of the 7th century. Equids, for traction, and fowl were also well represented. Conversely, pigs were of minor importance. Wild species and pets were scarce too. Exceptionally a few shells of riverine and marine molluscs were recovered. All together the evidence is indicative of a diversified and non-specialized productive strategy where agriculture and animal husbandry were well integrated. Finally, pollen analyses provided information about landscape and land use (López-Sáez *et al.* 2010). High percentages of cereal pollen were detected in most of the samples, but they came from silos fillings, so probably they are more representative of the products stored in them than landscape. Olive tree pollen was also significant, which points at the presence of this type of culture in the surroundings of the village and is consistent with the identification of a possible oil press in the site. All in all, the territory around Gózquez would have been mostly deforested and dominated by pastures with scattered holm oaks, cereal fields and olive groves.

3.1.1.1.3 The funerary contexts

Two different types of funerary contexts were identified at Gózquez (table 7.1). On one hand, there was the cemetery and, on the other, the burials in silos. The cemetery (figure 3.4A) was placed in the central valley between the two domestic neighbourhoods (figure 3.2; Contreras 2006, Contreras 2011, Contreras & Fernández Ugalde 2006). At the moment of the archaeological intervention 383 graves were preserved but only 247 were excavated, so this is the total number of burials that will be used here. This means that the great majority of the funerary structures in Gózquez were located in the cemetery (n = 247/250 = 98.8%). The graveyard had a well-defined rectangular outline. For this reason, it has been proposed that it may have been fenced with some kind of enclosure (Vigil-Escalera 2013a: 161). When the orientation of tombs could be recorded, all of them were arranged in west-east direction with minor variations (n = 172/247 = 69.9%). However, it was not possible to check orientation in almost a third of the cases (n = 75/247 = 30.4%). Burials were vaguely organised in lines and they did not intersect each other. This, together with their frequent reuse, suggests they may have been somehow marked on the surface. In fact, some burials preserved a tumulus on top of them. Altogether the use of the cemetery is dated to between the 6th and the middle of the 8th century. An internal periodisation could be attempted based on grave goods, but it would affect less than a quarter of the individuals, so it was decided it was not worth it.

At the cemetery of Gózquez there were four types of graves. Most of them were simple pits excavated in the bedrock (n = 223/247 = 90.3%). Lateral niche graves was the next type in importance (n = 10/247 = 4.0%). They were similar to simple pits, but corpses were placed in a lateral chamber at the bottom of the pit. Only one of the lateral niche graves (GOZ 110) was made up of two chambers, one to the north and one to the south. It has been proposed that, in this chronological context, lateral niche graves could be linked to the Jewish funerary tradition (Vigil-Escalera 2015b), pointing to the existence of a multi-faith community at Gózquez. There was also a small proportion of slabs burials (n = 8/247 = 3.2%), consisting of pits reinforced with perimeter vertical slabs. Finally, there were the burials made with fragments of building materials (n = 6/247

= 2.4%). In the case of Gózquez, these were all neonate tombs protected by an *imbrex* on the bottom and another one on the top.

In total 361 individuals were identified in the cemetery, which translates as a mean occupation of 1.5 individuals per burial. The maximum number of individuals in a grave was ten. Most of them were primary deposits and individuals were placed in supine position (n = 196/361 = 54.3%). Conversely, a quarter of the population was recovered in different types of secondary deposits: in well-defined reductions next to an individual in primary position (n = 58/361 = 16.1%), mixed in the filling of the burial (n = 23/361 = 6.4%) or scrambled in the tumulus found on some of the funerary structures (n = 11/361 = 3.0%). It was not possible to determine the original position of the remaining individuals (n = 73/361 = 20.2%).

The presence of nails indicated that about one third of the individuals was buried in wooden coffins (n = 105/361 = 29.1%). Besides, approximately one quarter of the individuals was accompanied by grave goods (n = 87/361 = 24.1%, table 7.2). Clothing items and jewellery was by far the most frequent type of grave good (n = 81/361 = 22.4%). It included fibulae, belt plates, earrings, necklace items, bracelets, rings and other small buckles and rivets. Tools were considerably less common (n = 18/361 = 5.0%) and they were only represented by knives and a tweezer. Only two individuals were buried with containers (n = 2/361 = 0.6%), in both cases made of pottery. In addition, coins were recovered together with two individuals (GOZ 143-1-4604, GOZ 157-1-4674) and an unidentified object formed by an iron ring and a sheet of glass was found next to individual GOZ 112-2-4468.

The other type of funerary context identified at Gózquez were non-funerary structures reused for human burials (figure 3.4C, Vigil-Escalera nd, Vigil-Escalera 2013c). More specifically there were three silos scattered around the eastern residential quarter (figure 3.3), which was the only one excavated. Therefore, they made a really small proportion of the funerary structures of the site (n = 3/250 = 1.2%). Two of them (GOZ 6640, GOZ 6890) were quite close from each other, probably within the same domestic unit, and the other one (GOZ 5831) was further. All the three structures were similar in terms of shape and size, even if silo GOZ 6890 was slightly smaller than the other two. The combination of radiocarbon dates (table 7.3) and pottery dated the human assemblage in silo GOZ 6640 between the middle of the 6th century and the beginning of the 7th century and those from silos GOZ 5831 and GOZ 6890 between the 7th century and the middle of the 8th century. Only silo GOZ 6890 was occupied by a single individual. In each of the other two silos there were five individuals. This made a total of eleven individuals. All of them were primary deposits (n = 11/11 = 100.0%), but they were in abnormal positions which indicated they had been placed with little care or they had been thrown into them. No evidence of coffins (n = 0/11 = 0.0%) or grave goods (n = 0/11 = 0.0%) was recovered in these silos. Only in silo GOZ 6640 an earring was found, but it was not taken into consideration because it could not be assigned to a specific individual. There was also plenty of pottery, building material and fauna in the fillings of these silos, but they cannot be considered grave goods. They were just other items disposed of when these underground storage structures were abandoned. Still, it is interesting to mention that in silo GOZ 5831, together with the five human individuals, there were the complete carcasses of an ovicaprid, a dog and a bovine and the fragmentary remains of another six ovicaprids, two equids, a bovid, a fowl and a rabbit.

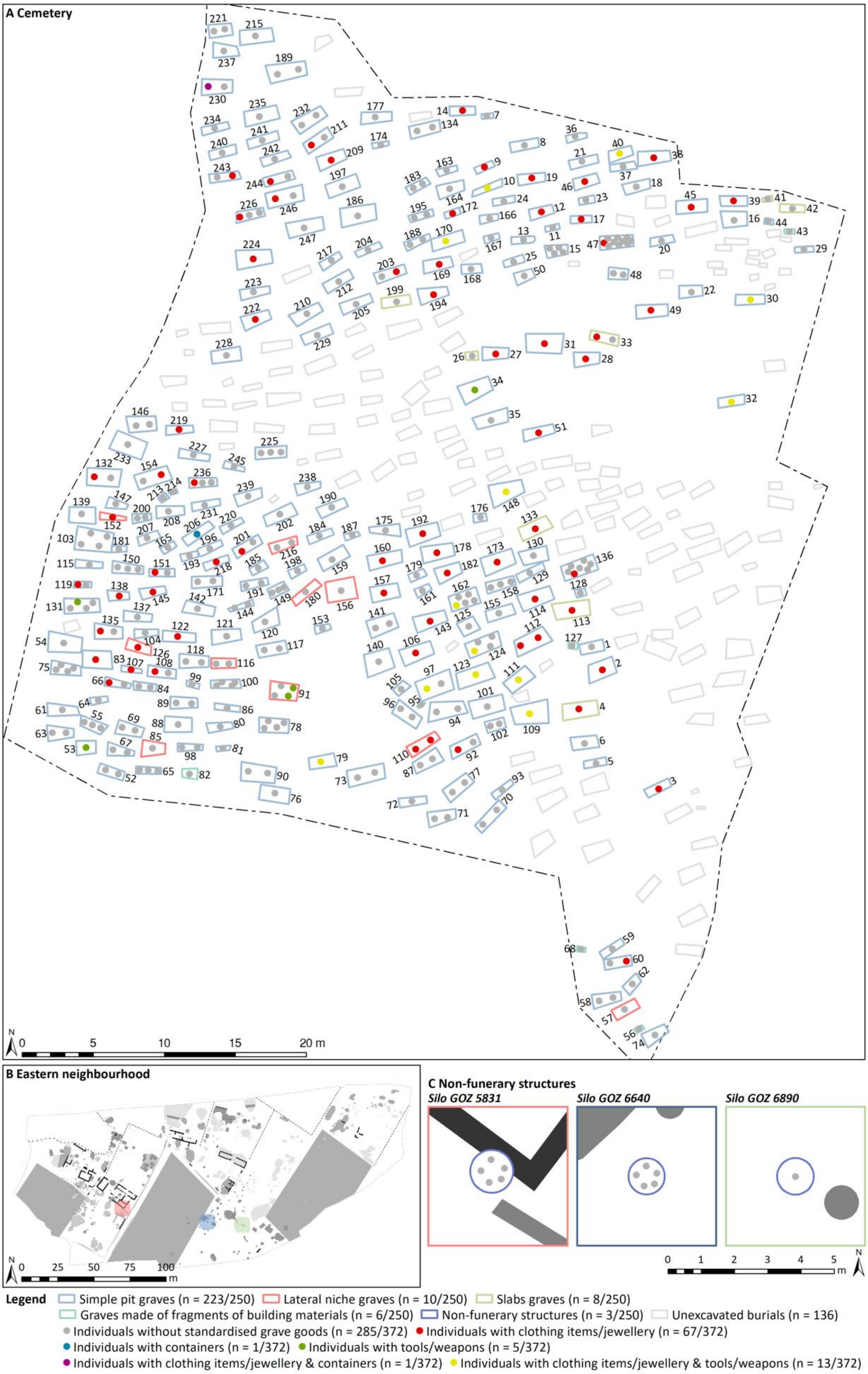


Figure 3.4. Gózquez, funerary contexts (Contreras 2006: 282, Contreras 2011: 13, García-Collado 2016: 65, Vigil-Escalera 2010: 3, Vigil-Escalera: 372, modified). (A) Cemetery. (B) General plan of the eastern neighbourhood highlighting the three areas with non-funerary structures. The colour of each area matches that of the frame of their corresponding detailed plan to the right. (C) Non-funerary structures. The dashed line depicts the excavation limits. The outline of burials is represented with a solid line whose colour shows the type of funerary structure according to the legend. The number next to each burial is its identifier. Points symbolise the individuals recovered in each burial. Their colour indicates the presence or absence of grave goods as stated in the legend

3.1.1.2 The human populations

3.1.1.2.1 Macroscopic preservation

The preservation of anthropological material at the cemetery of Gózquez (figure 3.4A) was not good. During fieldwork a total of 361 individuals were identified in 247 funerary structures. However, only slightly more than half of them preserved any skeletal element when they arrived to the laboratory (n = 202/361 = 56.0%, table 7.1). This meant that only 202 individuals could be analysed. In addition, the individuals who survived were mostly incomplete, fragmented and severely eroded (figure 3.5, table 7.7). The vast majority were represented by less than 25% of the skeleton and almost nine out of ten individuals had more than 75% of the skeletal remains preserved fragmented. The preservation of bone surface was more variable. Still, most individuals showed quite severe erosion. In fact, almost two thirds of the population presented heavy erosion with some modifications of profile (grade 5) or worse, and less than 5% of the individuals had more extensive surface erosion with deeper penetration (grade 2) or better. Summing up, macroscopic preservation is an important bias to consider when interpreting the results of the osteoarchaeological study of this population.

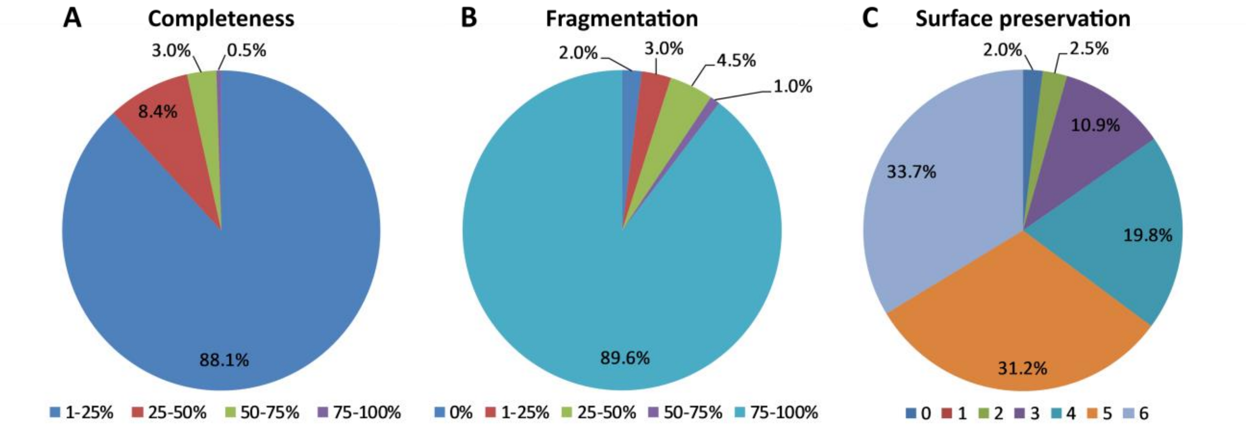


Figure 3.5. Pie charts representing the distribution of the three variables for the assessment of macroscopic preservation of the human population from the cemetery of Gózquez. (A) Completeness. (B) Fragmentation. (C) Surface preservation

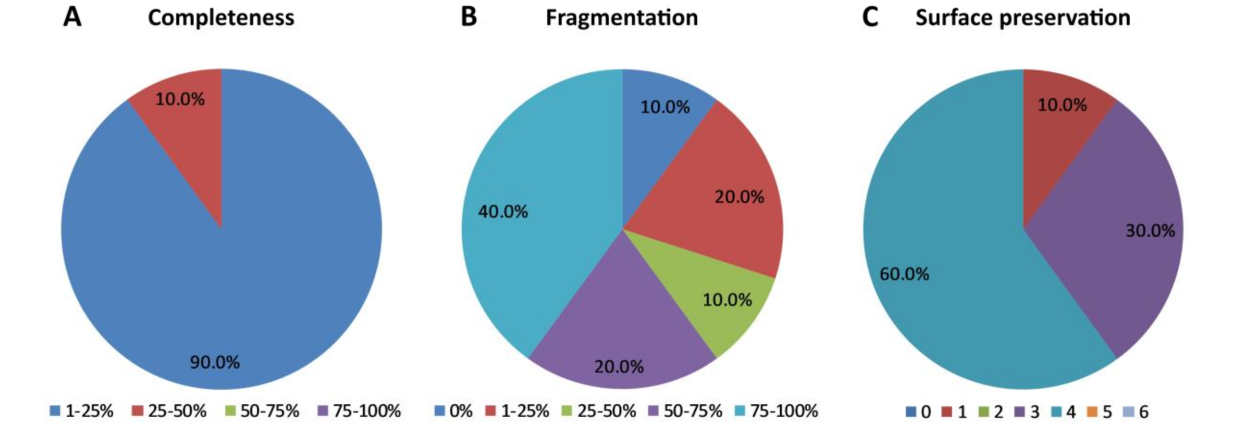


Figure 3.6. Pie charts representing the distribution of the three variables for the assessment of the macroscopic preservation of the human population from the settlement of Gózquez. (A) Completeness. (B) Fragmentation. (C) Surface preservation

There was a substantial contrast with the preservation of the individuals buried in the settlement (figure 3.4C). Eleven individuals in three structures were recovered in the eastern neighbourhood of the village. All of them except one preserved skeletal remains (n = 10/11 = 90.9%, table 7.1). The individual missing (GOZ 6640-1-6644) was lost during transport or storage for unknown reasons, so it could not be included in this osteoarchaeological study. Individuals were as incomplete as in the cemetery, but they were significantly less fragmented (figure 3.6, table 7.7). It is especially remarkable that more than a third of the individuals had less than 50% of the skeletal remains preserved fragmented. Moreover, surface preservation was reasonably good. The worse situation recorded were individuals with all the surface eroded and uneven distribution of depth or degree of alterations (grade 4) and four out of the ten individuals analysed were even better preserved. Thanks to this acceptable preservation it was possible to make detailed observations on this small assemblage.

3.1.1.2.2 Demography[1]

The human assemblage excavated at the cemetery of Gózquez was the largest analysed in this thesis. The archaeological intervention recovered skeletal remains of a minimum of 202 individuals (table 3.1, figure 3.7, table 3.2, table 7.4, table 7.5, table 7.6). Subadults made up 19.8% of the assemblage and adults 75.2%, which means in the cemetery there was approximately one subadult for every four adults. This is a slightly low subadult/adult ratio and suggests subadults, especially the youngest ones, may be underrepresented. In fact, many burials which must have contained subadults due to their small size, did not preserve any anthropological remain. Similarly, in many cases poor preservation (see section 3.1.1.2.2) prevented to make precise age estimations. Then, it is not possible to determine if the absence of any adults above 35 years of age at death is a real data or a consequence of poor preservation. Sex determination was also difficult because of the bad preservation of diagnostic anatomic areas, and the results produced quite an imbalanced sex ratio, with just 65 men for every 100 women. This is an unlikely scenario in any normal preindustrial population, as the one from the cemetery of Gózquez is supposed to have been, and it underlines the impact of preservation on the partiality of the demographic data available. Nevertheless, the demographic profile of the population buried in the graveyard of Gózquez looks like a typical stable premodern agricultural population (Chamberlain 2006: 64–68, Séguy & Buchet 2013: 114). These are characterised by high risk of death during the first years of life, which declines afterwards and increases gradually during adulthood. This trend can be observed in the evolution of the curve representing the probability of death in figure 3.7, albeit in a typical premodern population infans 1A would be expected to be more numerous. Although the juvenility index of this population was slightly below 0.100 (table 3.2), it was decided to use it because the distance to the accepted value was negligible. The palaeodemographic estimators derived from it indicate life expectancy at birth (36.2 years) was quite high, but this is probably also influenced by the underrepresentation of infans 1.

The distribution of grave goods by age and sex categories was also considered and it resulted in some interesting findings. Grave goods were more frequently placed next to adults than to subadults (individuals with grave goods: S = 6, A = 38, S/A = 0.16; individuals without grave goods: S = 34, A = 114, S/A = 0.30). Besides, among adults, female individuals were more commonly accompanied by artefacts than male individuals (individuals with grave goods: M = 1, F = 6, M/F = 0.17; individuals without grave goods: M = 12, F = 14, M/F = 0.85). As a consequence, the sex ratio of the adults with grave goods was extremely low. Meanwhile, the sex ratio of individuals without grave goods was quite balanced and closer to the general population. Still, the presence or absence of grave goods was not statistically significantly associated to neither age nor sex (grave goods vs age, chi-squared test: $n = 192$, $\chi^2 = 1.793$, d.f. = 1, $p = 0.181$; grave goods vs sex, Fisher's exact test: $n = 43$, $p = 0.202$). No meaningful differences were found either based on the type of grave goods associated to each demographic group. Likewise, the analysis of the spatial organisation of individuals

---

[1] Age and sex estimations reported by García-Collado 2016: 66 were reviewed afterwards and some of them had to be corrected, so what was published does not match exactly the results presented here. More precisely, age or sex estimations of individuals GOZ 021-1-4048, GOZ 054-1-4224, GOZ 058-1-4198, GOZ 066-1-4236, GOZ 097-1-4377, GOZ 100-2-4399, GOZ 101-1-4438, GOZ 102-1-4403, GOZ 162-4-4698, GOZ 200-1-4872, GOZ 230-1-5003 and GOZ 5831-1-6150 were modified.

in the cemetery (figure 3.9) did not reveal any pattern or cluster of individuals with specific demographic features, so in this case topographic organisation does not seem to have followed any age or sex criterion.

Table 3.1. Age and sex distribution by absolute frequencies of the human population from the cemetery of Gózquez. Key: F = fetus, < 40 weeks in utero; I1A = infans 1A, birth – 2 years; I1B = infans 1B, 3 – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; Ssp = subadult sp, < 20 years; YA = young adult, 20 – 34 years; YMA = young-middle adult, 20 – 45 years; MA = middle adult, 35 – 45 years; MOA = middle-old adult, > 35 years; OA = old adult, > 45 years; Asp = adult sp, > 20 years; UA = undetermined age; M = male individuals (including probably male individuals); F = female individuals (including probably female individuals); US = undetermined sex (including ambiguous individuals)

	F	*I1A*	*I1B*	*I2*	*J*	*Ssp*	*YA*	*YMA*	*MA*	*MOA*	*OA*	*Asp*	*UA*	*Total*
M	-	-	-	-	-	-	1	-	-	-	-	12	-	13
F	-	-	-	-	-	-	3	-	-	-	-	17	-	20
US	2	5	18	7	4	4	1	-	-	-	-	118	10	169
Total	2	5	18	7	4	4	5	0	0	0	0	147	10	202

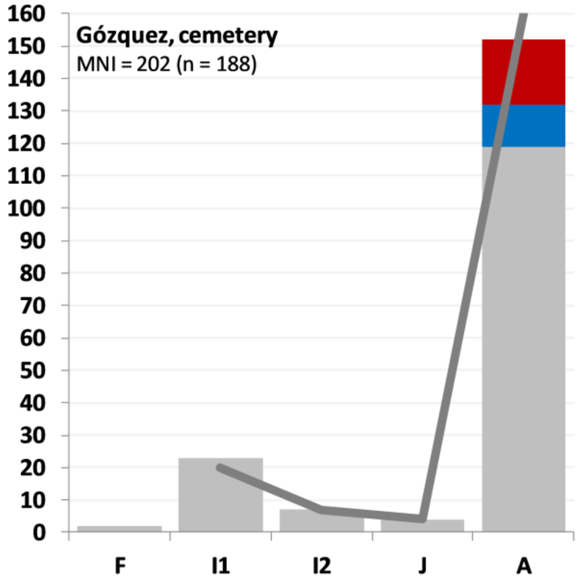


Figure 3.7. Demography chart of the human population from the cemetery of Gózquez. Bars represent the absolute frequencies of each age category (F = fetus, < 40 weeks in utero; I1 = infans 1, birth – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; A = adults, > 20 years), separated by sex whenever possible (blue = male individuals, red = female individuals, grey = undetermined sex). The line depicts the progression of the probability of death (q_x) along age categories, calculated according to G. Acsádi and J. Nemeskéri (1970: 65). The minimum number of individuals of the population (MNI) and the number of individuals represented in the chart (n) are shown on the upper left corner. These two numbers differ because subadults sp (< 20 years) and individuals of undetermined age are not displayed

Table 3.2. Demographic descriptive indicators and palaeodemographic estimators of the human population from the cemetery of Gózquez

Descriptive indicators	
MNI	202
%subad	19.8%
%ad	75.2%
S/A	0.26
M/F	0.65

Estimators	
JI	0.099
e_0	36.2
${}_1q_0$	0.208
${}_5q_0$	0.299

Conversely, the demography of the individuals in the settlement was very different (table 3.3, figure 3.8, table 3.4, table 7.4, table 7.5). The assemblage available for study was formed by a minimum number of ten individuals. The most striking feature was that all of them were subadults and half of those whose age could be determined were under 7 years. The youngest was between 2 year and 2 years and 8 months and the oldest between 18 and 20 years. For this reason, the outline of the curve of the probability of death in figure 3.8 is unusual, with the peak at juveniles, which is normally the age category with the lowest mortality rate. Because of the absence of adults, subadult/adult ratio, sex ratio and palaeodemographic estimators could not be calculated. The difference in the demographic structure of this assemblage is also obvious in figure 3.9. While in the cemetery adults were clearly prevalent, these non-funerary structures were taken up by subadults of different ages. It is noteworthy that the two oldest individuals, both juveniles, were together in the same silo. It is difficult to find an explanation to the abnormal age distribution of this assemblage. These individuals were segregated from the community cemetery; they were denied the common funerary ritual, since most of them were simply thrown into the silos, and age seems to have been a determining factor in their exclusion. These deviant burials could have been caused by some kind of disease, which would have affected more severely young individuals, but no pathological sign supporting this hypothesis was found, although most infectious processes do not leave any trace on the skeleton. The most widely accepted explanation for this phenomenon is that the excluded individuals were slaves or other forms of legally marginalised individuals (Roig & Coll 2011a), after all, people who were not considered members of the village community. Still, from a practical point of view, it does not make sense that all the slaves in a village were young children and teenagers. However, it must be acknowledged that in other contexts, both in the region of Madrid-Toledo (Vigil-Escalera 2013c) and in Catalonia (see sections 3.3.1, 3.3.3, Roig 2015: 369–389), burials in non-funerary structures are not predominantly occupied by subadults. Actually, in this sense Gózquez looks like an exception.

Table 3.3. Age and sex distribution by absolute frequencies of the human population from the settlement of Gózquez. Key: F = fetus, < 40 weeks in utero; I1A = infans 1A, birth – 2 years; I1B = infans 1B, 3 – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; Ssp = subadult sp, < 20 years; YA = young adult, 20 – 34 years; YMA = young-middle adult, 20 – 45 years; MA = middle adult, 35 – 45 years; MOA = middle-old adult, > 35 years; OA = old adult, > 45 years; Asp = adult sp, > 20 years; UA = undetermined age; M = male individuals (including probably male individuals); F = female individuals (including probably female individuals); US = undetermined sex (including ambiguous individuals)

	F	*I1A*	*I1B*	*I2*	*J*	*Ssp*	*YA*	*YMA*	*MA*	*MOA*	*OA*	*Asp*	*UA*	*Total*
M	-	-	-	-	-	-	-	-	-	-	-	-	-	0
F	-	-	-	-	-	-	-	-	-	-	-	-	-	0
US	-	1	3	2	2	2	-	-	-	-	-	-	-	10
Total	0	1	3	2	2	2	0	0	0	0	0	0	0	10

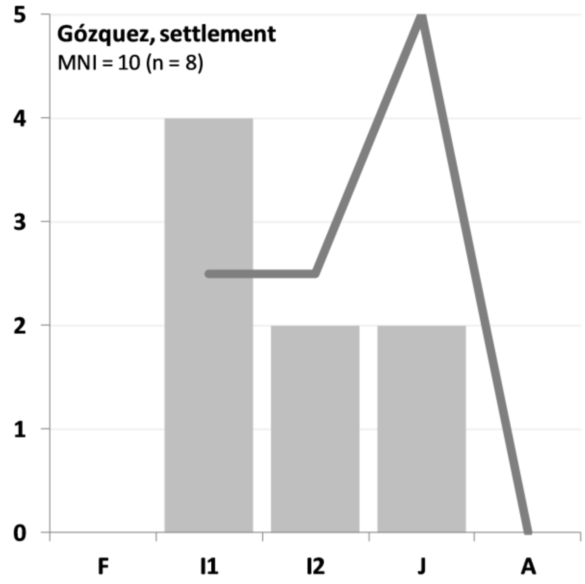


Figure 3.8. Demography chart of the human population from the settlement of Gózquez. Bars represent the absolute frequencies of each age category (F = fetus, < 40 weeks in utero; I1 = infans 1, birth – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; A = adults, > 20 years), separated by sex whenever possible (blue = male individuals, red = female individuals, grey = undetermined sex). The line depicts the progression of the probability of death (q_x) along age categories, calculated according to G. Acsádi and J. Nemeskéri (1970: 65). The minimum number of individuals of the population (MNI) and the number of individuals represented in the chart (n) are shown on the upper left corner. These two numbers differ because subadults sp (< 20 years) and individuals of undetermined age are not displayed

Table 3.4. Demographic descriptive indicators of the human population from the settlement of Gózquez. Palaeodemographic estimators are not reported because there were no adults in this assemblage, so it is not possible to calculate the juvenility index. For the same reason it is not possible to work out subadult/adult and sex ratios either

Descriptive indicators	
MNI	10
%subad	100.0%
%ad	0.0%
S/A	-
M/F	-

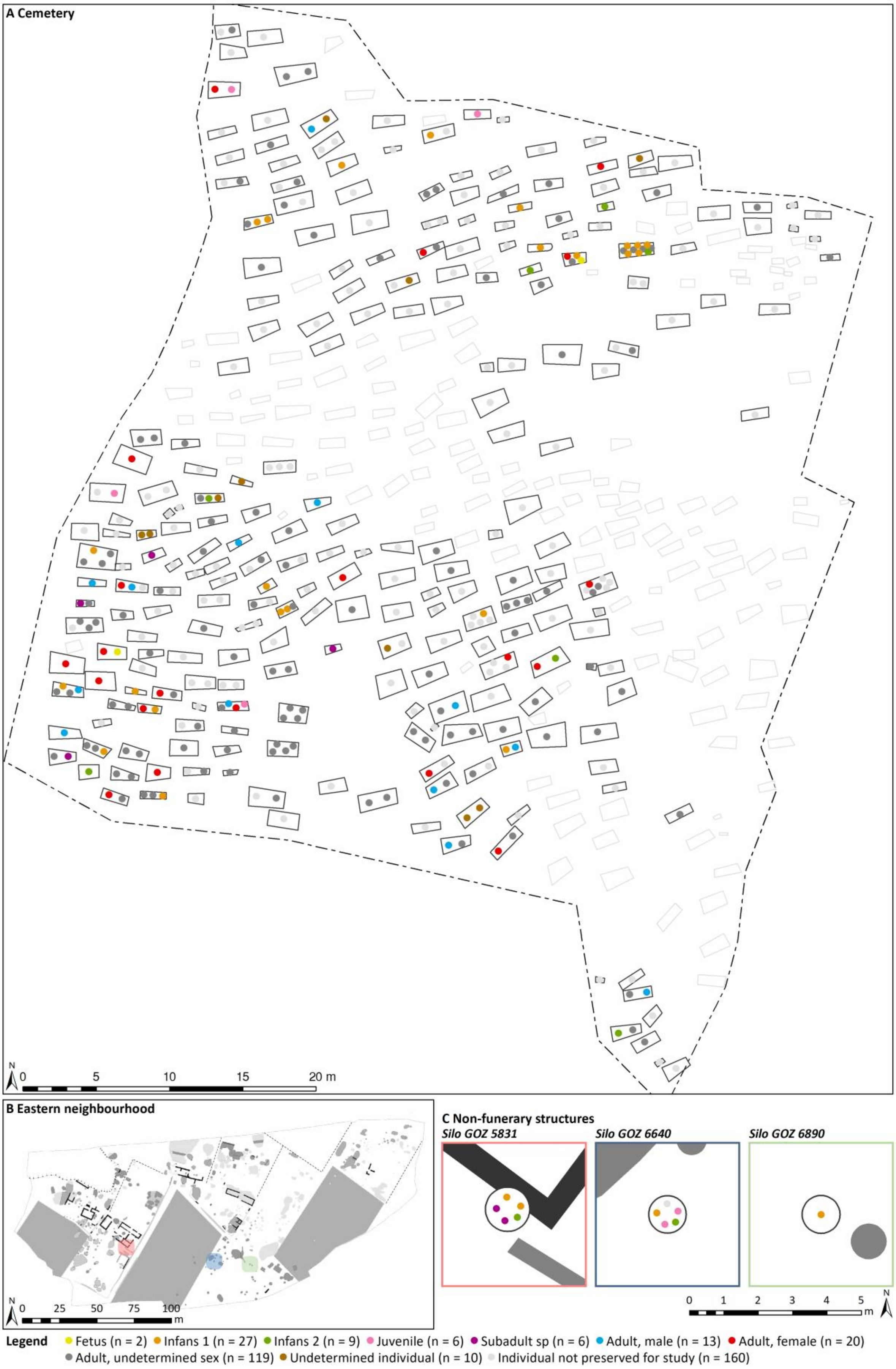


Figure 3.9. Gózquez, spatial distribution of individuals by age and sex (Contreras 2006: 282, Contreras 2011: 13, García-Collado 2016: 65, Vigil-Escalera 2010: 3, Vigil-Escalera: 372, modified). (A) Cemetery. (B) General plan of the eastern neighbourhood highlighting the three areas with non-funerary structures. The colour of each area matches that of the frame of their corresponding detailed plan to the right. (C) Non-funerary structures. The dashed line depicts the excavation limits. Points symbolise the individuals recovered in each burial. Their colour indicates their age and sex as stated in the legend

3.1.1.3 Faunal diet

3.1.1.3.1 Sampling

Twenty-six fauna samples from Gózquez were analysed to characterise the local isotopic baseline (table 7.8, figure 3.10). They came from the fillings of silos and sunken featured structures in the settlement. They were selected from well dated contexts in order to cover the three periods defined for the site. In this way, the samples represented all the taxa of economic interest in early medieval contexts, with a majority of herbivores (Bos taurus, Ovis aries/Capra hircus, Equus sp) over omnivores (Sus scrofa domesticus, Avis). No carnivores were included. In two cases subadult individuals were selected. One of them was bird, so its age should not have any influence on isotopic signatures. The other one was a cattle, which will be discussed appropriately. All the samples consisted of bone fragments.

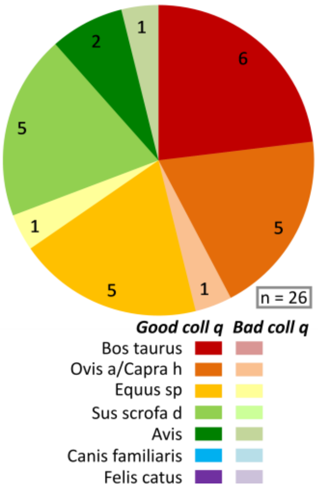


Figure 3.10. Pie chart representing the distribution of fauna samples from Gózquez by taxa and collagen quality. Numbers represent the absolute frequency of each group

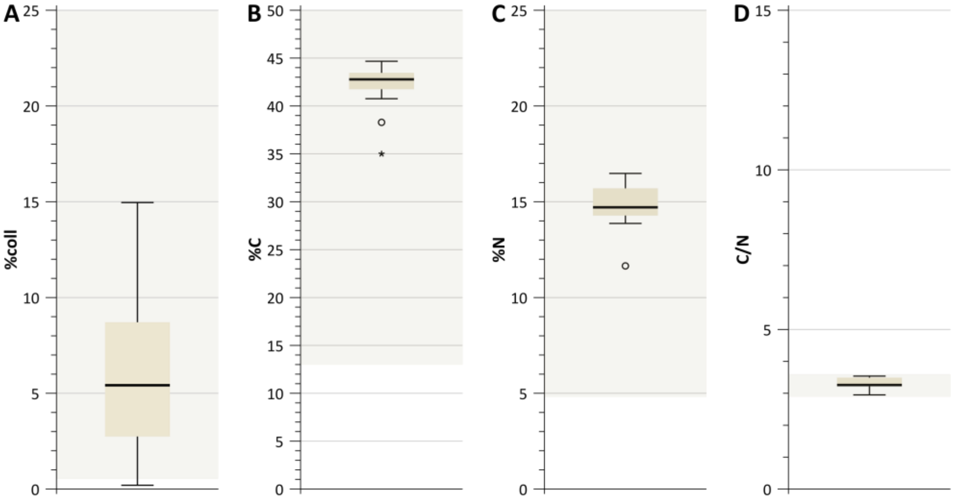


Figure 3.11. Boxplots representing the collagen quality indicators of fauna samples from Gózquez. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

3.1.1.3.2 Collagen quality

According to the criteria assessed, most of the fauna samples from Gózquez preserved good quality collagen (table 7.11, table 7.12, figure 3.10, figure 3.11). Because of a mistake in the recording protocol, collagen yields (%coll) are not available for fourteen of samples. However, among the remaining twelve samples, all except one had collagen yields greater than 1.0%. Carbon (%C) and nitrogen weight contents (%N), with values between 35.0% and 44.7% and between 11.6% and 16.5% respectively, were within the acceptable ranges in every case. Likewise, carbon to nitrogen atomic ratios (C/N) were always between 2.9 and 3.5. Then, only one sample with a collagen yield too small had to be rejected. Besides, it was not possible to measure δ^{13}C and δ^{15}N on two samples due to technical issues with the IRMS. Since the entire samples had been employed for those extractions, they could not be prepared again and they had to be dismissed. Summing up, three out of the 26 fauna samples from Gózquez had to be discarded and 23 had acceptable collagen quality indicators for being used on palaeodietary reconstruction.

3.1.1.3.3 Results

Formed by 23 specimens, the fauna assemblage from Gózquez is the largest of its kind analysed in this thesis (table 3.5, table 7.11, figure 3.12, García-Collado 2016: 68–70). Possibly linked to this big sample size, the assemblage was quite heterogenous, even though wide distributions are also verified in other fauna ensembles tackled in this research. Herbivores, including cattle, ovicaprids and equids, constituted more than two thirds of the sample. Their mean $\delta^{13}C$ (-19.6‰) indicates their diet was predominantly based on C_3 plants. However, their standard deviation (0.9‰) and range (3.2‰) were quite broad. In addition, some specimens had $\delta^{13}C$ values too enriched for monotonous C_3 diets. Although it is difficult to define a stark cut-off point because of the absence of plant reference values, it is likely that herbivores with $\delta^{13}C$ greater than -19‰ were incorporating small but consistent amounts of C_4 plants to their diets. Three out of the four specimens in this group were cattle, which means half of the samples of this taxon analysed, and the other one was a goat. That is, at Gózquez cattle had access to C_4 resources more frequently than any other herbivore or domestic animal. Also, consumption of C_4 plants by ovicaprids would have been incidental and none of the equids analysed had $\delta^{13}C$ values compatible with the presence of spring crops in their diets. Actually, it is unlikely that millets, which were potentially the only C_4 plant in this context, were available in nature, so their identification as part of the feeding regime of cattle could mean this taxon was kept closer to the settlement than ovicaprids or equids. Still, it has to be mentioned that the other three cattle samples analysed had some of the most depleted $\delta^{13}C$ values in the whole assemblage, which signifies they had exclusively C_3 diets. What is clear is that cattle at Gózquez had access to a more varied range of ecological niches or food resources than other herbivores, showing a difference in husbandry strategies between herbivore taxa. Alternatively, the heterogeneous $\delta^{13}C$ values of cattle from Gózquez could be due to diversity in origins. If cattle were raised in geographic areas with isotopic baselines different from the zones where other herbivores grazed, it would be logical that they showed a different range of isotope signatures. This could be due to the participation of cattle in transhumance routes, either long or short distance, or to the supply of cattle for Gózquez through market. In this context none of these two hypotheses has any archaeological evidence to support them, so the consumption of small amount of C_4 plants is still the most plausible explanation, but transhumance or cattle trade cannot be completely ruled out.

Table 3.5. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of fauna samples from Gózquez. Standard deviation is only reported if sample size is greater than two

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All fauna	23	-19.6	0.9	-21.3	-18.1	3.2	7.9	1.3	3.9	9.9	6.0
Herbivores	16	-19.6	0.9	-21.3	-18.1	3.2	8.0	1.2	5.7	9.9	4.2
Bos taurus	6	-19.5	1.1	-20.8	-18.2	2.6	7.7	1.6	5.7	9.4	3.7
Ovis/Capra	5	-19.4	0.8	-20.3	-18.1	2.2	8.0	0.7	6.8	8.7	1.9
Equus sp	5	-19.8	0.9	-21.3	-19.0	2.3	8.4	1.1	6.9	9.9	3.0
Omnivores	7	-19.7	0.8	-21.0	-18.4	2.6	7.7	1.7	3.9	9.4	5.5
Sus scrofa d	5	-19.7	0.5	-20.4	-19.2	1.2	8.1	0.2	7.9	8.3	0.4
Avis	2	-19.7	-	-21.0	-18.4	2.6	6.7	-	3.9	9.4	5.5

In the same way, the distribution of $\delta^{15}N$ among herbivores at Gózquez was not only remarkably wide, but it also spread around values exceptionally high for animals eating just plants. Their mean was 8.0‰, with a standard deviation of 1.2‰ and a range of 4.2‰. In fact, this was, together with Boadilla (see section 3.1.2.3.3), the herbivore assemblage with the most isotopically enriched $\delta^{15}N$ mean in this work. Once again, cattle showed the greatest variability, but there were no meaningful differences between them and ovicaprids or equids. These enriched $\delta^{15}N$ values in herbivores require an explanation. They could be a reflection of the isotopic baseline of the surroundings of the site. Aridity and salinity can generate enriched $\delta^{15}N$ values at the base of the food chain (see section 2.4.1.3.1). However, even if central Iberia is currently considered a semi-arid zone (Paniagua *et al.* 2019) and it is known around Gózquez there were several salty springs (see section 3.1.1.1.1), it is unlikely such an enrichment is due only to environmental factors. Conversely, it is feasible that manuring also contributed to this phenomenon (Bogaard *et al.* 2007, Fraser *et al.* 2011). Manuring could have been accomplished disseminating dung from stabled animals or bringing them into the fields to graze on the leftovers of crops after harvest. The latter is more likely because it is technically simpler and there is no archaeological evidence of intensive stabling of livestock during Early Middle Ages. This practice would have provided manure yearly brought by animals themselves. Then, soil and plants in these plots would have had enriched δ^{15}N values in comparison to those where animals did not enter. If this procedure were sustained, higher δ^{15}N values would also be reflected on the isotopic signatures of the cattle, ovicaprids or equids eating year after year those manured crops. This agrarian strategy, known as lifting of the fences or *derrota de las mieses* in Spanish, is an excellent example of the early integration between agriculture and animal husbandry. Moreover, since it would have involved several domestic units, it is a sign of the cohesion of the village community of Gózquez and their ability to manage landscape and environmental resources collectively.

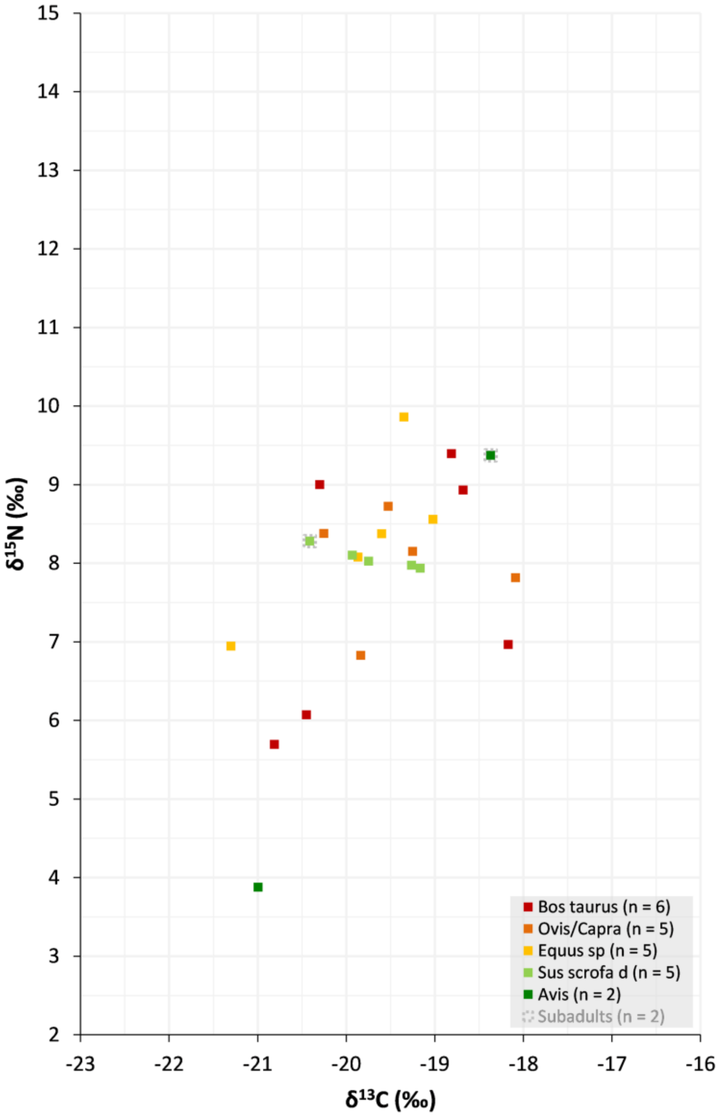


Figure 3.12. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of fauna from Gózquez grouped by taxa. Subadult specimens are highlighted with a dotted grey fringe around them

Besides, a small set of omnivores was also successfully analysed. It comprised four pigs and two fowl. Their mean δ^{13}C was -19.7‰ and they had a standard deviation of 0.8‰ and a range of 2.6‰. Similarly, their mean δ^{15}N was 7.7‰, with a standard deviation of 1.7‰ and a range of 5.5‰. However, the moderate standard deviations and ranges conceal the differences between the two taxa analysed. Pigs were characterised by the homogeneity of their isotopic signatures. According to δ^{13}C, which showed a range of just 0.5‰, all of them had diets based on C_3 resources. Nitrogen isotope ratios were even more remarkable, since their range was as small as 0.2‰. The absolute δ^{15}N values of pigs were very close to ovicaprids', which suggests their animal protein intake was restricted, so they behaved mostly like herbivores. For this reason, it is unlikely that pigs were kept in courtyards. Instead, they were probably free-ranged in open areas where C_4 plants were not available (Hammond & O'Connor 2013). On the contrary, the two fowls analysed were extremely different between them. One had an exclusively C_3 diet and it was probably completely herbivore, as indicated by its very depleted δ^{13}C and δ^{15}N values. Instead, the other fowl was within the range for mixed C_3-C_4 diets, even if the contribution of spring crops would have been small. Meanwhile its δ^{15}N was among the highest of the ensemble, so probably it had a considerable amount of animal protein in its diet. Actually, it is worth noting that the difference between both specimens was bigger than a trophic level shift (5.5‰). This dietary variability in fowl is a constant among the fauna assemblages included in this research.

Furthermore, the evolution of fauna dietary patterns over time was analysed (table 7.8). Fowl was excluded because it was only represented by two specimens and they were contemporary. Then, after examining figure 3.13, no clear diachronic patterns were recognised for any of the taxa either for δ^{13}C or δ^{15}N. Still, it is important to consider that none of the groups resulting of crossing the variables taxon and chronology were made up of more than two specimens. In any case, the data available suggest livestock management strategies did not vary substantially along the life of the village of Gózquez.

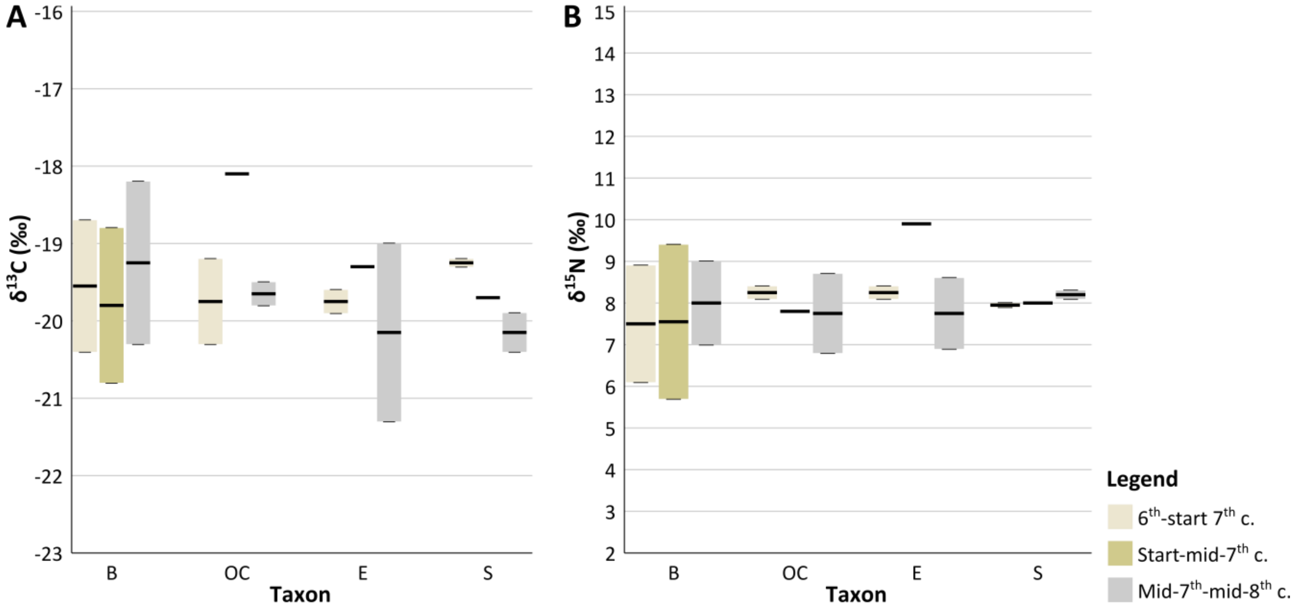


Figure 3.13. Boxplots representing (A) carbon stable isotope ratios (δ^{13}C) and (B) nitrogen isotope ratios (δ^{15}N) of fauna from Gózquez grouped by taxa and chronology. Key: B = Bos taurus, OC = Ovis/Capra, E = Equus, S = Sus scrofa domesticus

3.1.1.4 Human diet

3.1.1.4.1 Sampling

The human population excavated at Gózquez was too big to be analysed entirely. Then, a random sampling guided by macroscopic preservation was carried out. On one hand, 36 individuals from the community cemetery were selected (figure 3.14). A quarter of the assemblage was formed by subadults. All age categories were represented, except fetuses. The remaining three quarters were adults, among which there was a well-balanced proportion of males and females. On the other hand, five individuals from the silos burials in the settlement were also sampled (figure 3.16). They were all subadults because this was the only age group represented in these deviant funerary contexts. The anatomical elements most frequently chosen either in the cemetery or in the settlement were ribs and long bones.

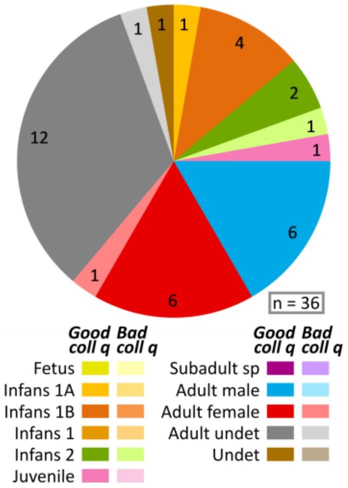


Figure 3.14. Pie chart representing the distribution of human samples from the cemetery of Gózquez by age, sex and collagen quality. Numbers represent the absolute frequency of each group

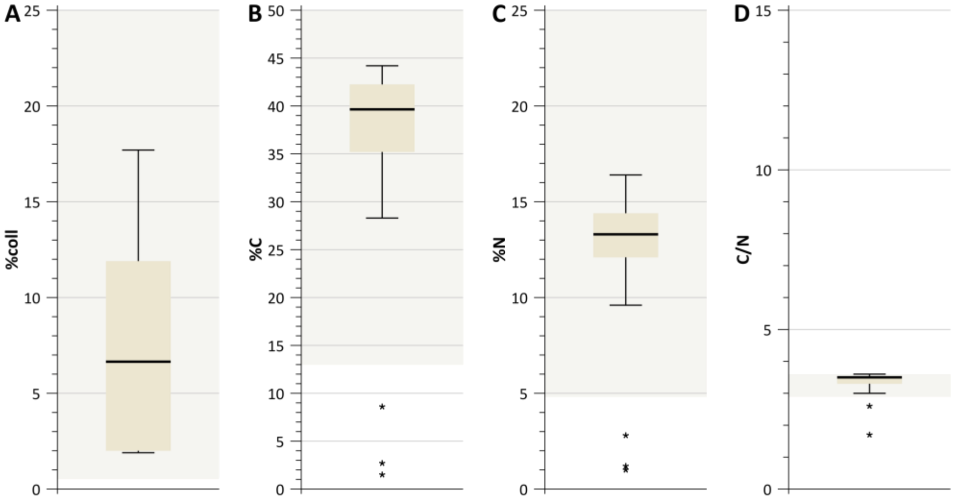


Figure 3.15. Boxplots representing the collagen quality indicators of human samples from the cemetery of Gózquez. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

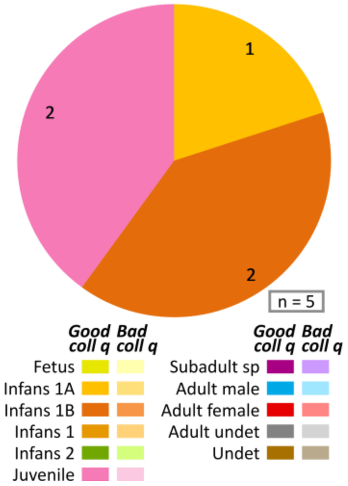


Figure 3.16. Pie chart representing the distribution of human samples from the settlement of Gózquez by age, sex and collagen quality. Numbers represent the absolute frequency of each group

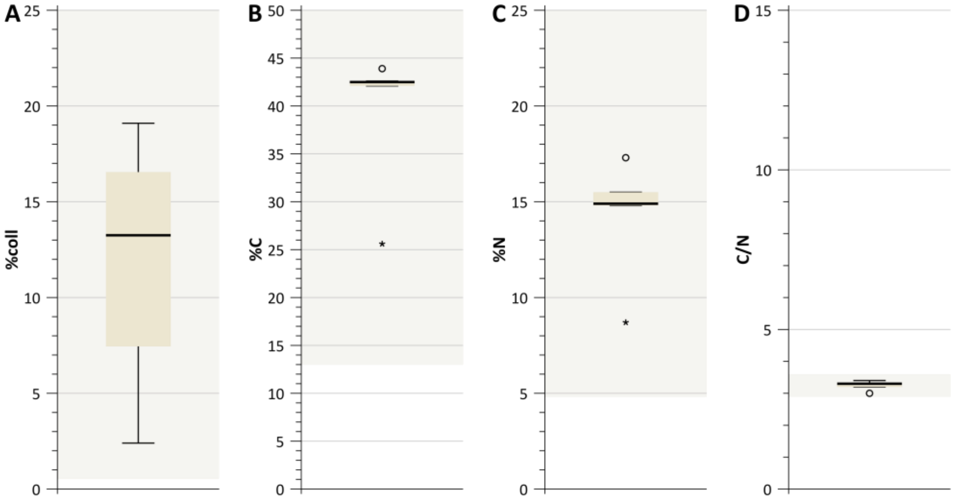


Figure 3.17. Boxplots representing the collagen quality indicators of human samples from the settlement of Gózquez. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

3.1.1.4.2 Collagen quality

Most of the human samples from Gózquez had well preserved collagen (table 7.9, table 7.10). Among the individuals from the cemetery (figure 3.14, figure 3.15), collagen yield (%coll) is only available for six of them because of a recording mistake. Nevertheless, collagen yield was greater than 1.0% in all the cases correctly registered. Carbon (%C) weight contents of the individuals buried in the community graveyard moved between 1.5% and 44.2%, and between 1.0% and 16.4% for nitrogen weight content (%N). Only three samples were responsible for the lowest values for both variables, so most of the assemblage clustered within acceptable ranges. Likewise, carbon to nitrogen collagen ratios (C/N), with a minimum of 1.7 and a maximum of 3.6, were also mostly within the values for well preserved collagen. All in all, only three samples of the human assemblage from the cemetery of Gózquez had to be rejected and 33 were valid for palaeodietary reconstruction. The individuals from the settlement followed similar trends (figure 3.16, figure 3.17). Collagen yield was always greater than 2.4%, except in one case where it was not written down due to the same recording mistake as for the individuals in the cemetery. The other collagen quality indicators were also within acceptable values for all the samples. Carbon weight content (%C) ranged between 25.6% and 43.9%, nitrogen weight content (%N) between 8.7% and 17.3% and carbon to nitrogen atomic ratio (C/N) between 3.0 and 3.4. Therefore, all the five samples from the settlement had good quality collagen.

3.1.1.4.3 Results

In the village of Gózquez two human assemblages were distinguished (García-Collado 2016[2]). On one hand, the human population buried in the community cemetery provided 33 valid samples. On the other, among the individuals thrown into silos in the settlement, five were successfully measured for carbon and nitrogen stable isotope ratios.

Table 3.6. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of human samples from the cemetery of Gózquez. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one. Key: C&J = clothing items & jewellery, Cont = containers, T&W = tools & weapons

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All humans	33	-18.7	0.7	-20.0	-16.2	3.8	9.9	1.1	8.4	13.9	5.5
Subadults	8	-18.6	0.6	-19.5	-17.7	1.8	10.2	1.7	8.4	13.9	5.5
Infans 1A	1	-17.7	-	-	-	-	13.9	-	-	-	-
Infans 1B	4	-18.7	0.6	-19.5	-18.1	1.4	9.9	0.9	8.6	10.8	2.2
Infans 2	2	-18.7	-	-18.9	-18.4	0.5	8.9	-	8.4	9.4	1.0
Juveniles	1	-19.0	-	-	-	-	10.3	-	-	-	-
Adults	24	-18.7	0.7	-20.0	-16.2	3.8	9.8	0.8	8.6	11.2	2.6
Male adults	6	-18.7	0.5	-19.6	-18.2	1.4	9.8	1.0	8.7	11.1	2.4
Female adults	6	-18.5	0.5	-19.4	-18.2	1.2	10.3	0.9	8.6	11.2	2.6
Grave g absence	23	-18.8	0.8	-20.0	-16.2	3.8	9.9	1.2	8.6	13.9	5.3
Grave g presence	10	-18.6	0.3	-19.0	-18.2	0.8	9.7	0.9	8.4	10.8	2.4
C&J presence	9	-18.5	0.3	-19.0	-18.2	0.8	9.7	1.0	8.4	10.8	2.4
Cont presence	1	-18.7	-	-	-	-	10.2	-	-	-	-
T&W presence	2	-19.0	-	-19.0	-18.9	0.1	10.3	-	9.9	10.6	0.7

The assemblage from the graveyard made up the bulk of the dataset (table 3.6, table 7.9, figure 3.18, figure 3.19). The 33 individuals analysed had a mean $\delta^{13}C$ of -18.7‰ with a standard deviation of 0.7‰ and a range of 3.8‰. Then, there was an offset of 0.9‰ between the mean $\delta^{13}C$ of this population and the mean of the herbivores from the same site (see section 3.1.1.3.3). The first thing to underline about this distribution is the homogeneity of $\delta^{13}C$ in the assemblage. Even if the range is one of the widest among the populations considered in this thesis, it was largely due to the presence of an extreme outlier, but almost two thirds of the sample concentrated in a range of just 1‰. This points at a quite homogenous diet. Going into the specific, the $\delta^{13}C$ values of the population from the cemetery of Gózquez indicate their diet was predominantly based

---

[2] After the publication of García-Collado 2016 age and sex estimations of some individuals (i.e. GOZ 021-1-4048, GOZ 054-1-4224, GOZ 058-1-4198, GOZ 066-1-4236, GOZ 097-1-4377, GOZ 100-2-4399, GOZ 101-1-4438, GOZ 102-1-4403, GOZ 162-4-4698, GOZ 200-1-4872, GOZ 230-1-5003, GOZ 5831-1-6150) were reviewed and had to be corrected. For this reason, the statistics presented in that work and here do not always match and some conclusions were updated.

on C_3 resources. Therefore, most of their plant intake must have been formed by winter crops, mainly barley and wheat, as revealed by the carpological record (Vigil-Escalera *et al.* 2014: 15–17), as well as legumes, vegetables and fruits.

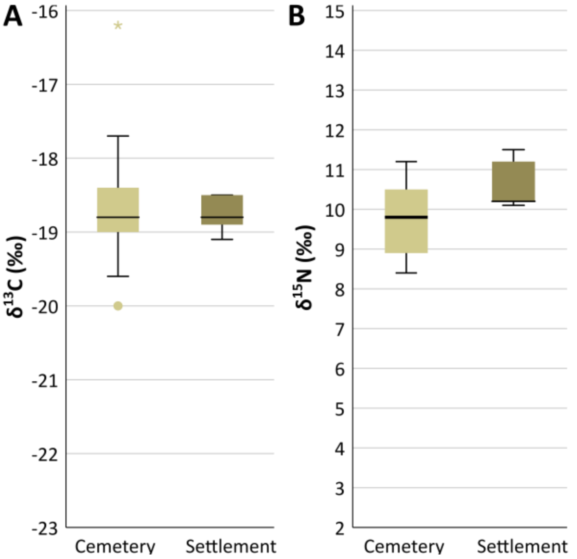


Figure 3.18. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from Gózquez divided by location of burials

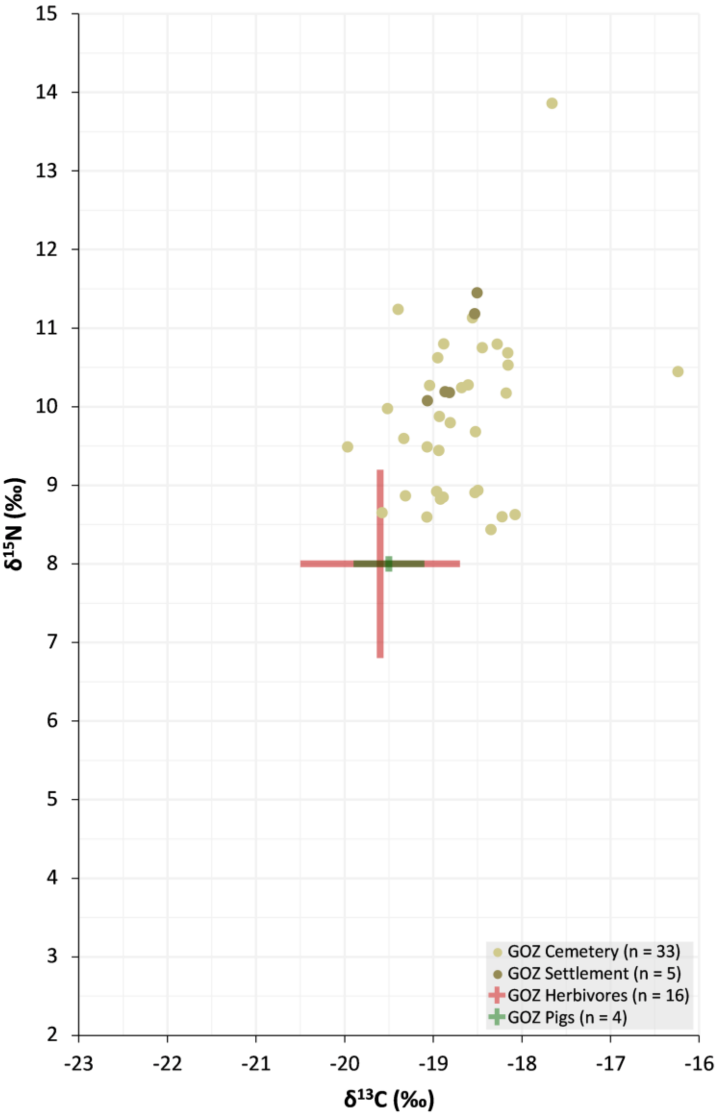


Figure 3.19. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from Gózquez divided by assemblage. Crosses represent mean and one standard deviation of the fauna from Gózquez grouped by feeding regime. Fowl are not displayed because they are very variable. Subadult specimens were excluded from the calculation of these parameters

Still, many individuals exhibit carbon stable isotope ratios too positive to be the result of exclusive C_3 diets. In the absence of contemporary plant reference values, it is difficult to establish a cut-off point, but it is reasonable to propose that individuals with $\delta^{13}C$ values above -18.0‰ were getting more enriched carbon sources. Consumption of marine resources can be ruled out because of the large distance from the site to the coast and the lack of the corresponding increase of $\delta^{15}N$ usually associated to fish intake. Hence, the most likely reason for this enrichment are C_4 plants, which in early medieval Iberia were restricted to broomcorn and foxtail millets. The fact that some of the specimens from the associated fauna assemblage also presented enriched $\delta^{13}C$ values, suggesting the feeding of livestock with millets at least occasionally, is a further argument supporting this hypothesis. Actually, in this context it is challenging to determine if C_4 plants were directly eaten by humans or if their isotopic signal was incorporated to their body tissues indirectly through animals, because the enrichment shown by Gózquez villagers was not outstanding and the offset between human and herbivore $\delta^{13}C$ means did not exceed the fractionation normally accepted for one trophic level (~1‰). Nevertheless, there are two types of evidence which in this case point at the direct consumption of millets by humans. First, according to zooarchaeological analyses (Vigil-Escalera *et al.* 2014: 12–13), the taxa preferentially aimed at human consumption were ovicaprids and pigs, which had predominantly exclusive C_3 diets. Therefore, they could not have been responsible of the enrichment of human carbon stable isotope ratios. Second, the analysis of starch grains on hand mills from Gózquez revealed a clear prevalence of millets over other crops (Aceituno 2015, Vigil-Escalera 2020), proving *Panicum miliaceum* and *Setaria italica* were transformed on site. In any case, considering the magnitude of $\delta^{13}C$ values, probably the consumption of millets would have been quite restricted, even if regular enough to be reflected on bone collagen. Nonetheless, it should not be forgotten that, due to the so-called routing effect (Ambrose & Norr 1993, see section 2.4.1.4.4), bone collagen tends to underrepresent the isotopic signature of carbohydrates, which are the main component of cereals, so the real importance of millets in diet could be obscured.

Regarding $\delta^{15}N$, the population buried in the cemetery had a mean of 9.9‰, a standard deviation of 1.1‰ and a range of 5.5‰, so the offset between humans and herbivores from Gózquez was 1.9‰ (see section 3.1.1.3.3). This value is way below the fractionation for one trophic level normally associated to nitrogen isotope ratios (~5‰). Therefore, it can be concluded that the intake of animal protein by the individuals buried in the cemetery of Gózquez was quite restricted. Actually, in a few cases $\delta^{15}N$ values of humans and fauna overlapped. In fact, herbivores was the group of animals closer to humans, reinforcing the idea that human diet at Gózquez was largely based on plants. However, the variability of nitrogen isotope ratios should not be overlooked. Excluding the only outlier on this variable, the range of $\delta^{15}N$ in this assemblage was 2.8‰. This span is enough to have meant significant differences in the consumption of animal proteins within the community, although it may be very difficult to identify the factors determining the access to these resources.

Three individuals were identified as outliers for different reasons. First, there was individual GOZ 086-1-4324 who presented the most depleted $\delta^{13}C$ of the assemblage. This value indicates its diet was exclusively made up of C_3 resources, a pattern shared with approximately one third of the individuals analysed, but which was not the standard in this context. This individual was an adult of undetermined sex buried alone in a simple pit tomb without any grave goods. Apparently, there was no particular feature which made it noteworthy in any other way.

Second, individual GOZ 060-1-4205[3] had the most enriched $\delta^{13}C$ values not only in Gózquez, but within the whole human assemblage analysed in this thesis. Meanwhile, its $\delta^{15}N$ was close to the mean of the population. For this reason, it seems unlikely the enrichment of $\delta^{13}C$ was caused by marine fish consumption. Conversely, this particular isotopic signature was probably due to significant intake of C_4 plants. That is, this individual would have eaten larger proportions of millets than any other of the individuals successfully analysed, although probably C_3 resources still constituted a good portion of its carbon sources. It is unclear why this individual had such a different diet in comparison to the majority of the population. This was an adult individual whose age at death and sex could not be estimated more precisely. No relevant pathological signs which could justify its special diet were observed in the skeleton. It was buried in a simple pit grave together with another individual (GOZ 60-2-4205), an adult probably male carrying a buckle; but individual GOZ 060-1-4205 did not have any grave goods of its own. Mobility may explain this divergence. Strontium isotope analyses suggest this individual spent childhood in a region with a geology different to the surroundings of Gózquez (unpublished data). While the site is located in a Cenozoic area, its strontium isotopic signature indicates it was raised in a region formed by Mesozoic sediments. This type of geology can be found in the mountain ranges surrounding the Jarama-Guadarrama basin to the north, east and south, as well as in many other

---

[3] In García-Collado 2016: 71 there were some mistakes about the identification of individuals GOZ 060-1-4205 and GOZ 60-2-4205. Age and sex estimations reported here are the correct ones. In the former publication it was also said that strontium isotope analysis was performed on individual GOZ 60-2-4205, but indeed both carbon and nitrogen stable isotope analyses and strontium isotope analysis were carried out on individual GOZ 060-1-4205.

regions of Iberia, Europe and northern Africa. Anyway, what is relevant here is that the place of origin of this individual may also have a different carbon and nitrogen stable isotope baseline, which could explain its high $\delta^{13}C$. Still, it is likely it was eating significant amounts of C_4 plants (or marine fish, in case it came from a place further away), since such an enrichment cannot be attributed to a monotonous C_3 diet under any circumstances. In this sense, it is worth mentioning that in the cemetery of Gózquez there was only another individual with a similar strontium isotope signature (GOZ 101-1-4438) whose carbon and nitrogen stable isotope ratios were close to the mean of the population.

The third outlier was individual GOZ 226-2-4985. This individual had the second highest $\delta^{13}C$ value of the assemblage. However, what made it really extraordinary was its nitrogen isotope ratio, which was the greatest in Gózquez and the second most enriched of all the samples analysed for this thesis. Still, this is easy to explain, because this individual was an infans 1A, who died when it was between 1 year and 1 year and 6 months old. Then, this enrichment of both $\delta^{13}C$ and $\delta^{15}N$ in comparison to the whole population means it was still being breastfed when it died or it was weaned shortly before its death. Feeding on breast milk implies a fractionation between mother and baby equal to any other trophic level change, so breastfeeding babies are around 1‰ higher in $\delta^{13}C$ and 5‰ higher in $\delta^{15}N$ than their mothers (Beaumont *et al.* 2018, Dupras 2010, Reynard & Tuross 2015). In this case, the offset between this individual and the mean of adult females from the cemetery of Gózquez was 0.9‰ for $\delta^{13}C$ and 3.7‰ for $\delta^{15}N$. This was the only infans 1A from the cemetery with well-preserved collagen, so any conclusions must be taken with caution, but data point at a quite prolonged breastfeeding. It would be expected that by this age individual GOZ 226-2-4985 would have been at least partially weaned, so carbon and nitrogen stable isotope ratios should have started to decrease progressively. However, it is known this process takes some time to get reflected on bone collagen. Then, it would be imperceptible if it happened only a few weeks or months before the death of the individual.

Table 3.7. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of human samples from the settlement of Gózquez. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one

	n	*δ¹³C (‰)*					*δ¹⁵N (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All humans	5	-18.8	0.3	-19.1	-18.5	0.6	10.6	0.7	10.1	11.5	1.4
Subadults	5	-18.8	0.3	-19.1	-18.5	0.6	10.6	0.7	10.1	11.5	1.4
Infans 1A	1	-18.5	-	-	-	-	11.5	-	-	-	-
Infans 1B	2	-18.8	-	-19.1	-18.5	0.6	10.7	-	10.1	11.2	1.1
Juveniles	2	-18.9	-	-18.9	-18.8	0.1	10.2	-	10.2	10.2	0.0
Grave g absence	5	-18.8	0.3	-19.1	-18.5	0.6	10.6	0.7	10.1	11.5	1.4

The assemblage formed by the individuals found in the settlement, all of them thrown into silos (table 3.7, table 7.9, figure 3.18, figure 3.19), was not much different from those in the cemetery. Five out of the eleven individuals recovered were successfully analysed. Their mean $\delta^{13}C$ was -18.8‰, standard deviation 0.3‰ and range 0.6‰. These values make them virtually indistinguishable from the population buried in the graveyard. There was an offset of 0.8‰ between their mean $\delta^{13}C$ and local herbivores' (see section 3.1.1.3.3) and they were even more homogeneous than the population from the cemetery. Actually, all five were clustered in the 1‰ range which concentrated most of the individuals from the burial ground. According to these carbon stable isotope ratios, individuals thrown into silos had diets predominantly based on C_3 resources but probably with small contributions of C_4 plants. The arguments to support this interpretation are the same used for the population in the cemetery.

The mean $\delta^{15}N$ of the individuals from the settlement was 10.6‰, and they had a standard deviation of 0.7‰ and a range of 1.4‰. Then, the offset between the mean $\delta^{15}N$ of this human assemblage and local herbivores' was 2.6‰ (see section 3.1.1.3.3), notably higher than for the population from the graveyard. That is, all the individuals in silos were within the range of the nitrogen isotope ratios obtained in the cemetery, but they concentrated on its upper half. This means that, as it happened with the assemblage from the burial ground, the animal protein intake of these individuals was limited. However, when compared with the complete dataset from Gózquez, these individuals were among those with greater access to meat or other animal byproducts.

Summing up, there were no statistically significant differences in either carbon or nitrogen stable isotope ratios between the population buried in the cemetery and the individuals in silos ($\delta^{13}C$ GOZ cemetery (n = 33) vs settlement (n = 5), Mann-Whitney U test: U = 81.000, z = -0.065, p = 0.967; $\delta^{15}N$ GOZ cemetery (n = 33) vs settlement (n = 5), Mann-Whitney U test: U = 122.500, z = 1.730, p = 0.084). Still, the assemblage from the settlement had the particularity that it was entirely made up of subadults (see section 3.1.1.2.2 and below), so subadults from both datasets were directly compared in order to verify if age may be biasing interpretations. Unsurprisingly no statistically significant differences were identified either between the subadults from the cemetery and the settlement neither for $\delta^{13}C$ or $\delta^{15}N$ ($\delta^{13}C$ GOZ cemetery subadults (n = 8) vs settlement subadults (n = 5), Mann-Whitney U test: U = 15.500, z = -0.663, p = 0.524; $\delta^{15}N$ GOZ cemetery (n = 8) vs settlement (n = 5), Mann-Whitney U test: U = 26.000, z = 0.881, p = 0.435). This is relevant in historical terms because it means there were allegedly no differences in diet between the individuals buried in the cemetery according to the conventional funerary ritual and those thrown into silos without any ritual gesture. Anyhow, if differences did exist, they were undetectable isotopically, which signifies they must have been based on qualities or preparations, but not on the type of products consumed. Thus, whatever determined them to be excluded from the common funerary ritual, it did not affect their access to food resources in similar conditions as their peers. Osteoarchaeology and carbon and nitrogen stable isotope analyses cannot elucidate whether it was disease, legal status or allochthonous origin that led to their segregation. Yet strontium isotope analyses suggested individuals in silos were non-local more frequently than those buried in the cemetery (unpublished data), so mobility may be one of the keys to understand this phenomenon.

It is also interesting to explore the relationship between diet and personal identities, such as age and sex, or social status as understood from grave goods. Figure 3.20 and figure 3.21 show the distribution of carbon and nitrogen stable isotope ratios of the individuals from the cemetery divided by age and sex. No statistically significant differences were found within the assemblage from the cemetery between subadults and adults in any of the two variables analysed ($\delta^{13}C$ GOZ cemetery subadults (n = 8) vs adults (n = 24), Mann-Whitney U test: U = 78.000, z = -0.787, p = 0.454; $\delta^{15}N$ GOZ cemetery subadults (n = 8) vs adults (n = 24), Mann-Whitney U test: U = 92.500, z = -0.153, p = 0.881). Not even when specific age categories were compared independently was any statistically significant difference detected ($\delta^{13}C$ GOZ cemetery specific age categories, Kruskal-Wallis H test: n = 32, H = 3.441, d.f. = 4, p = 0.487; $\delta^{15}N$ GOZ cemetery specific age categories, Kruskal-Wallis H test: n = 32, H = 5.591, d.f. = 4, p = 0.232). Nevertheless, this does not mean there were no changes in diet through life. Actually, a weak pattern can be observed in the evolution of $\delta^{13}C$ (figure 3.21A), according to which median carbon stable isotope ratios were depleted progressively as age increased. This can be interpreted as a consequence of the disappearance of the breastfeeding effect. Infans 1B already do not show clears sign of this phenomenon. However, most subadults of any age have $\delta^{13}C$ values more positive than -19‰, which indicates the diets of children and adolescences probably included certain amount of millets more frequently than in the case of adults. Conversely, $\delta^{15}N$ does not show any pattern in relation to age (figure 3.21B). The number of adults analysed whose sex could be determined was very small and maybe because of this no statistically significant differences in the distribution of either $\delta^{13}C$ or $\delta^{15}N$ were identified ($\delta^{13}C$ GOZ cemetery adult males (n = 6) vs adult females (n = 6), Mann-Whitney U test: U = 24.500, z = 1.061, p = 0.310; $\delta^{15}N$ GOZ cemetery adult males (n = 6) vs adult females (n = 6), Mann-Whitney U test: U = 23.000, z = 0.802, p = 0.485). Therefore, following these data, at the village of Gózquez there would have been no meaningful differences between sexes in the access to food resources. Still, it must be underlined again these conclusions are not strongly grounded due to the small sample size.

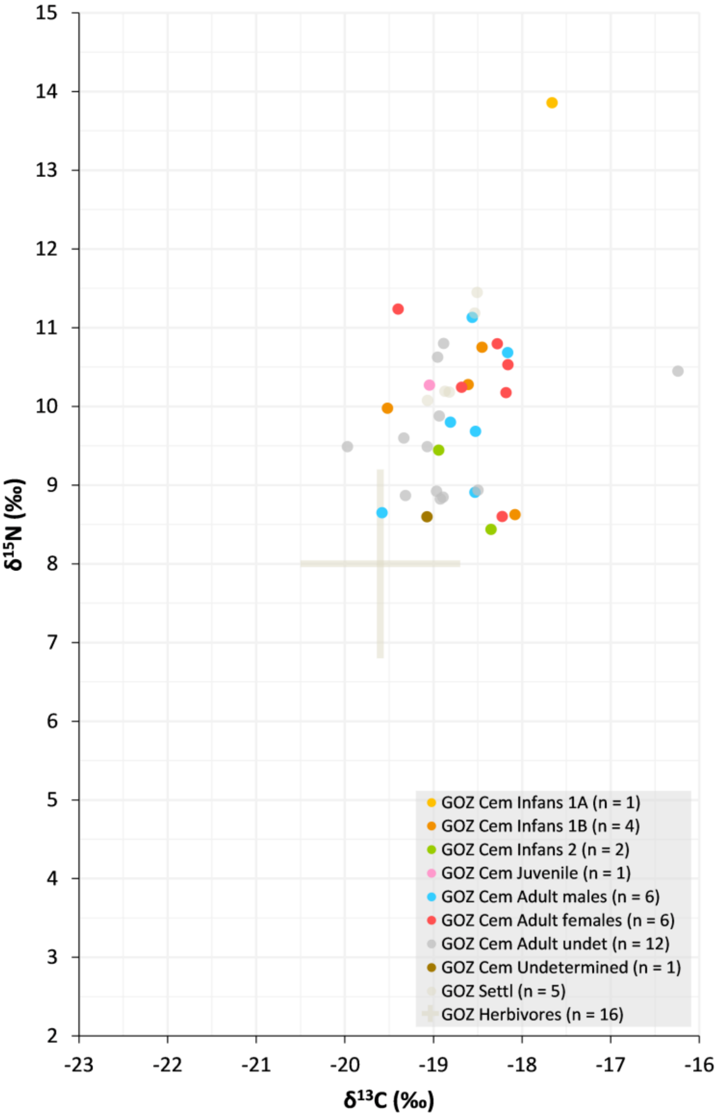


Figure 3.20. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of humans from the cemetery of Gózquez divided by demographic categories. Cross represents mean and one standard deviation of herbivores from Gózquez

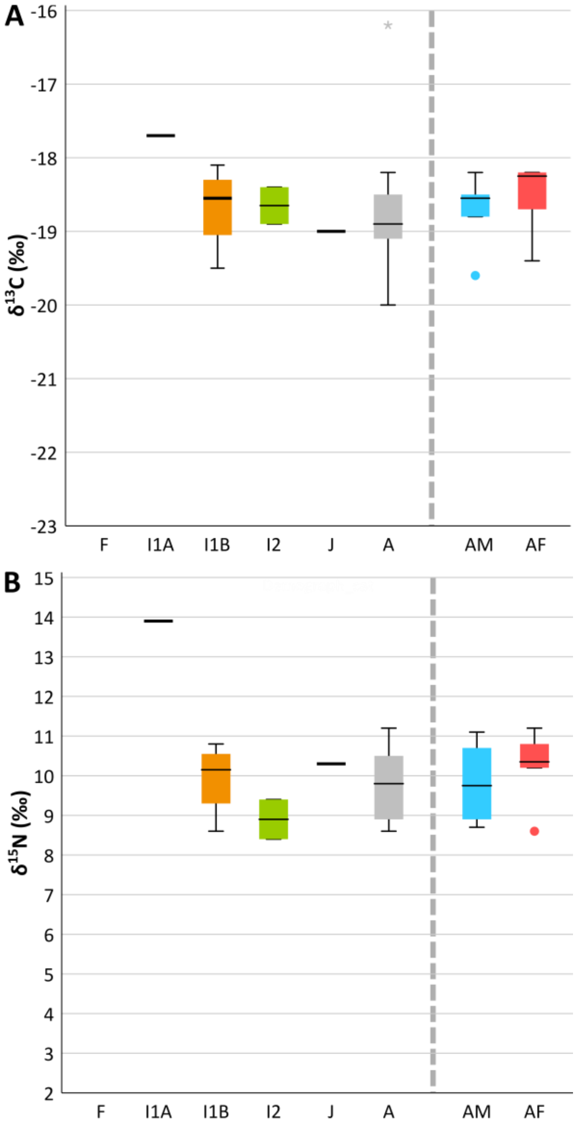


Figure 3.21. Boxplots representing (A) carbon stable isotope ratios (δ^{13}C) and (B) nitrogen isotope ratios (δ^{15}N) of humans from the cemetery of Gózquez divided by demographic categories. Key: F = fetus, I1A = infans 1A, I1B = infans 1B, I2 = infans 2, J = juvenile, A = adults, AM = adult males, AF = adult females

Among the individuals recovered in the settlement (figure 3.22, figure 3.23) no clear patterns were observable either, possibly also because sample size was quite small. Nevertheless, two facts are worth mentioning. First, it is interesting to observe the isotopic signature of the infans 1A in this assemblage. Only this individual and another one from the cemetery represented this age category in the whole dataset from Gózquez. The individual in the graveyard was already discussed in detail because it was an outlier showing the enrichment typically caused by breastfeeding. Conversely, individual GOZ 6890-1-6891, who died when it was between 2 years and 2 years and 8 months old, did not present such a clear enrichment. Its δ^{13}C and δ^{15}N were in both cases the highest in the settlement, but they were within the range of the majority of the population from the cemetery. This means this individual had already been weaned by the time it died, something logical considering its age. However, it is likely it retained partially the breastfeeding effect, since its carbon and nitrogen stable isotope ratios were still not completely comparable to older individuals. Second, juveniles are also noteworthy. The two individuals belonging to this category found in the settlement had almost identical isotopic signatures. Besides, the only juvenile analysed in the cemetery also exhibited very similar carbon and nitrogen stable isotope ratios. Actually, the range of δ^{13}C of these three individuals was just 0.2‰ and the range of δ^{15}N only 0.1‰. These figures suggest that, regardless the place where they were buried, the diet of juveniles at Gózquez was very uniform and more homogeneous than in any other age group, although small sample size makes it difficult to assess the real significance of this observation.

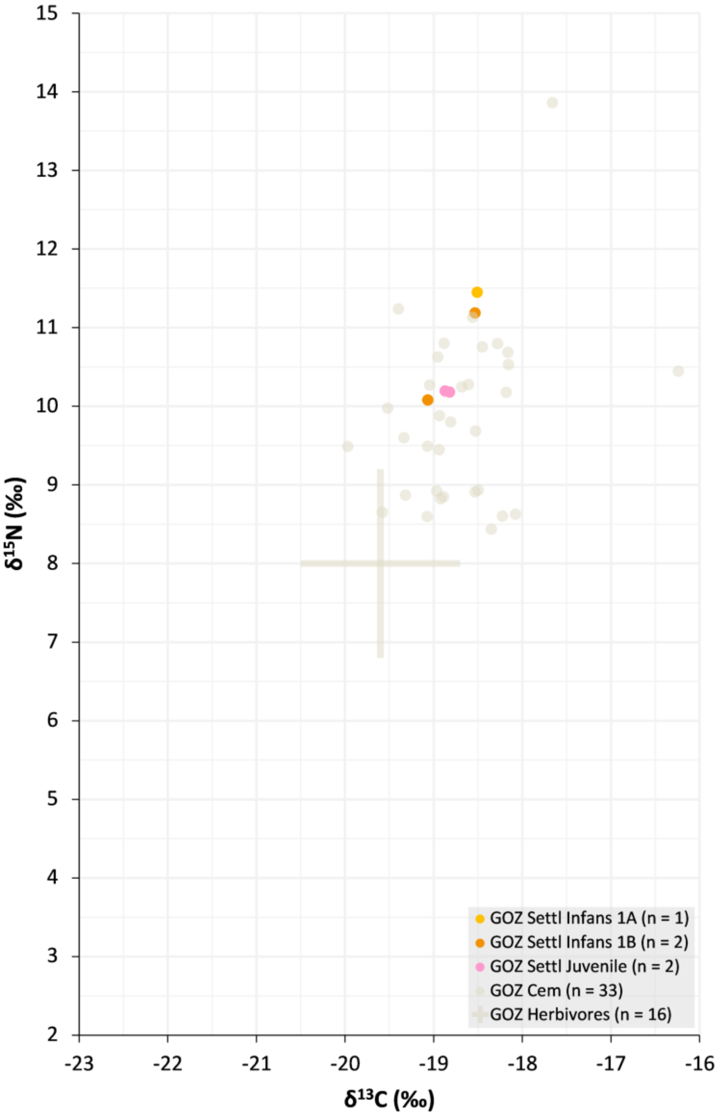


Figure 3.22. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of humans from the settlement of Gózquez divided by demographic categories. Cross represents mean and one standard deviation of herbivores from Gózquez

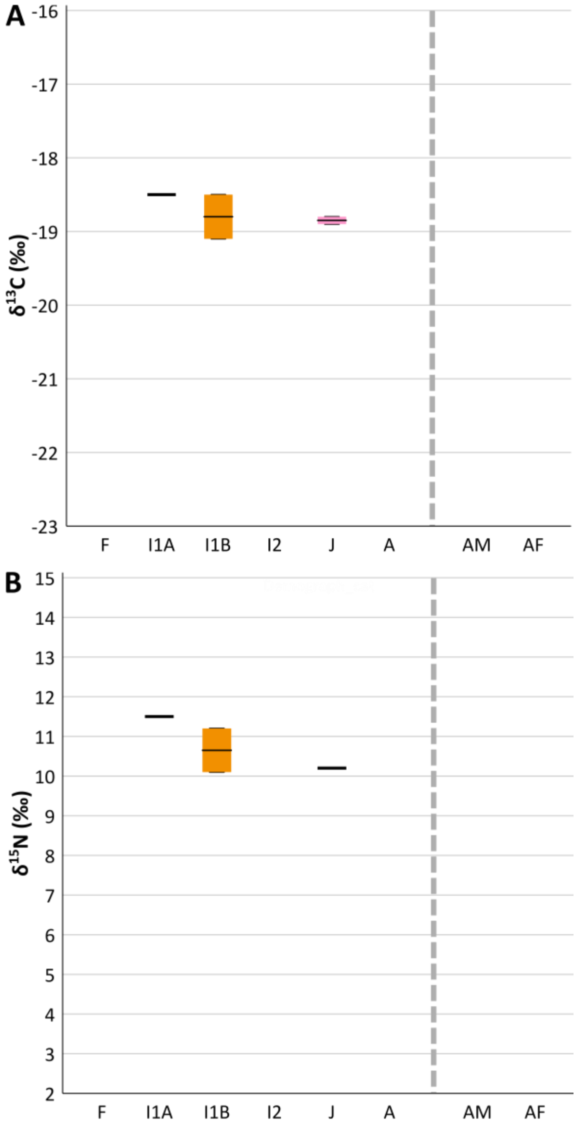


Figure 3.23. Boxplots representing (A) carbon stable isotope ratios (δ^{13}C) and (B) nitrogen isotope ratios (δ^{15}N) of humans from the settlement of Gózquez divided by demographic categories. Key: F = fetus, I1A = infans 1A, I1B = infans 1B, I2 = infans 2, J = juvenile, A = adults, AM = adult males, AF = adult females

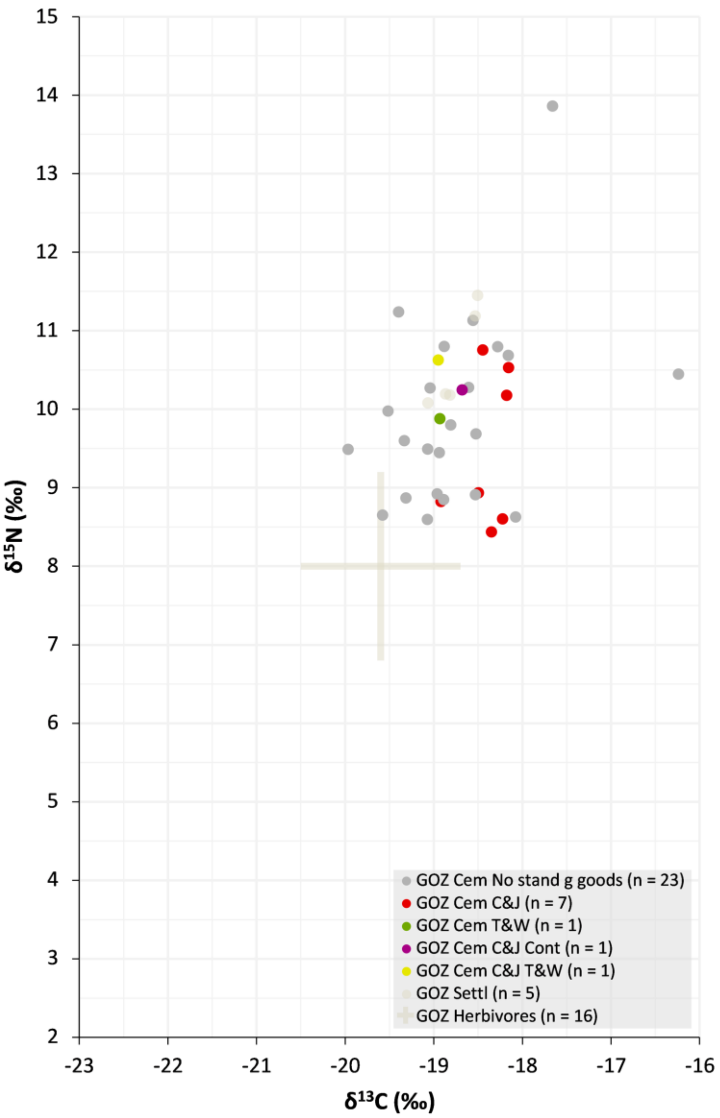


Figure 3.24. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from the settlement of Gózquez divided by type of grave goods. Cross represents mean and one standard deviation of herbivores from Gózquez. Key: No stand g goods = no standardised grave goods, C&J = clothing items & jewellery, Cont = containers, T&W = tools & weapons

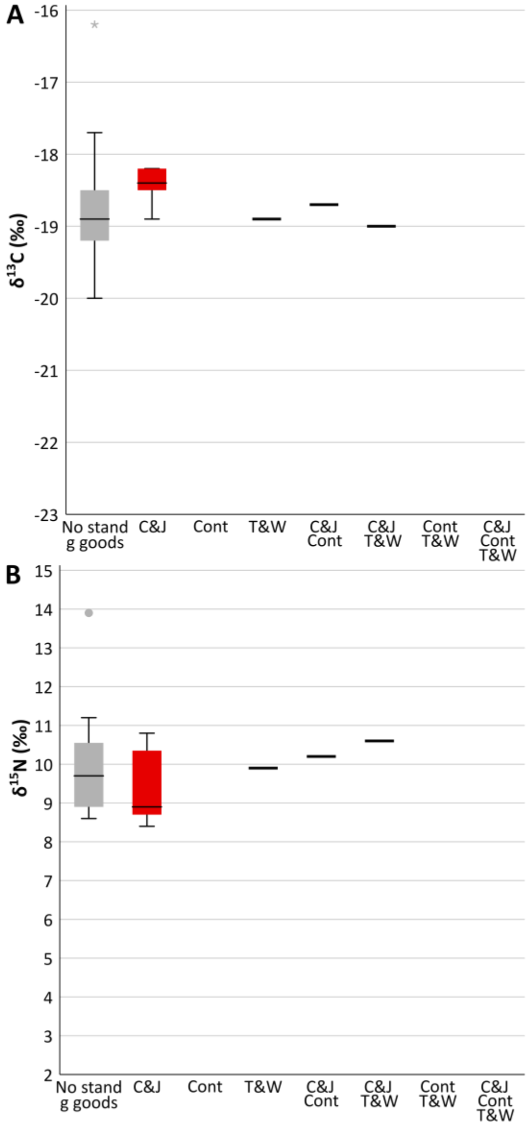


Figure 3.25. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from the settlement of Gózquez divided by type of grave goods. Key: No stand g goods = no standardised grave goods, C&J = clothing items & jewellery, Cont = containers, T&W = tools & weapons

Only ten of the individuals from the cemetery analysed were accompanied by some kind of grave goods.[4] This meant a percentage of individuals with grave goods similar to that of the whole population (see section 3.1.1.1.3). Their distribution according to the type of artefacts found with them is represented in figure 3.24 and figure 3.25. There were no statistically significant differences in the distribution of either $\delta^{13}C$ or $\delta^{15}N$ due to the presence or absence of grave goods ($\delta^{13}C$ GOZ cemetery individuals without grave goods (n = 23) vs

---

[4] Some of the grave good attributions reported in García-Collado 2016: 66 were wrong and do not match table 7.2. In particular, individual GOZ 060-1-4205 did not have any grave goods, but individual GOZ 135-1-4568 did. In addition, the identification and characterisation of the individuals in burial GOZ 047 was refined and it affects this issue. The individual referred to as GOZ 047-1/2-4155 in García-Collado 2016 is actually individual GOZ 047-01-4154 and, while it was reported not to have any grave goods, indeed it was accompanied by a buckle. Likewise, individual named GOZ 047-A?-4154 in the publication corresponds really to individual GOZ 047-02-4154. In García-Collado 2016 it was said to have some kind of grave goods, but it did not. Due to these changes, statistics, graphs and some of the interpretations set out here are slightly different from what presented in García-Collado 2016.

individuals with grave goods (n = 10), Mann-Whitney U test: U = 156.500, z = 1.632, p = 0.105; δ^{15}N GOZ cemetery individuals without grave goods (n = 23) vs individuals with grave goods (n = 10), Mann-Whitney U test: U = 104.000, z = -0.432, p = 0.686). Actually, their means were quite similar. The mean δ^{13}C of individuals without grave goods was -18.8‰ and that of the individuals with any kind of artefacts was -18.6‰. Likewise, individuals without any grave good had a mean δ^{15}N of 9.9‰, while the mean δ^{15}N of individuals with grave goods was 9.7‰. There were no statistically significant differences between the individuals with specific types or associations of grave goods either (δ^{13}C GOZ cemetery specific grave goods, Kruskal-Wallis H test: n = 33, H = 5.371, d.f. = 4, p = 0.251; δ^{15}N GOZ cemetery specific grave goods, Kruskal-Wallis H test: n = 33, H = 1.989, d.f. = 4, p = 0.738).

However, there was some divergence in the width of the distributions between individuals with and without grave goods which is worth noting. Individuals with grave goods had in general smaller standard deviations and narrower ranges than individuals without them. This was especially striking in the case of carbon stable isotope ratios. While individuals without grave goods had a standard deviation of 0.8‰ and a range of 3.8‰, the standard deviation of individuals with grave goods was just 0.3‰ and they were all in a span of 0.8‰. Several conclusions can be driven from these data. It looks like individuals buried with grave goods would have had quite uniform diets in terms of carbon sources. They were all between -19‰ and -18‰, so their diet would have been largely based on C_3 resources and it is likely they were also eating small proportions of C_4 plants. Instead, none of the individuals eating exclusive C_3 diets was buried with grave goods. It is also interesting that individuals with clothing items and jewellery were the group with the most enriched δ^{13}C. If the presence of these artefacts were read in chronological terms (Contreras 2006: 279, Vigil-Escalera 2013a: 177), it would mean millet consumption was especially prevalent during the first phases of the villages. However, the absence of any indicators to identify later individuals weakens this hypothesis. Regarding δ^{15}N, individuals with grave goods were distributed along the entire range of the assemblage, so they just showed the same variation in the consumption of animal protein as the whole population. In fact, two small clusters on the upper and lower ends of the range were observed, but they did not share any other feature in terms of age, sex or type of graves goods.

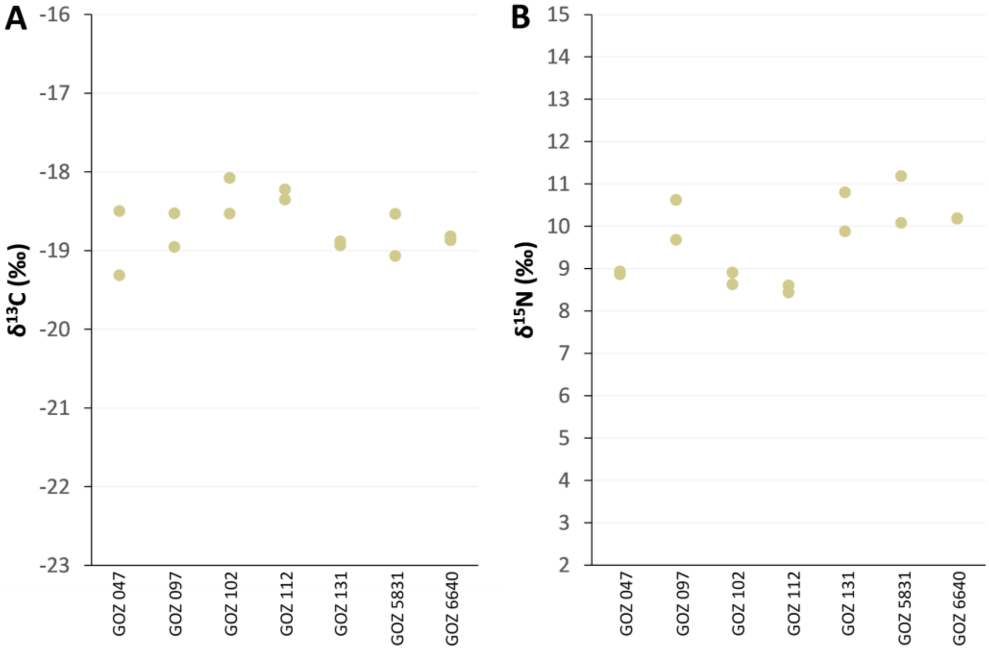


Figure 3.26. Scatterplots representing the spread of (A) carbon stable isotope ratios (δ^{13}C) and (B) nitrogen isotope ratios (δ^{15}N) of the individuals from Gózquez buried in the same funerary structure

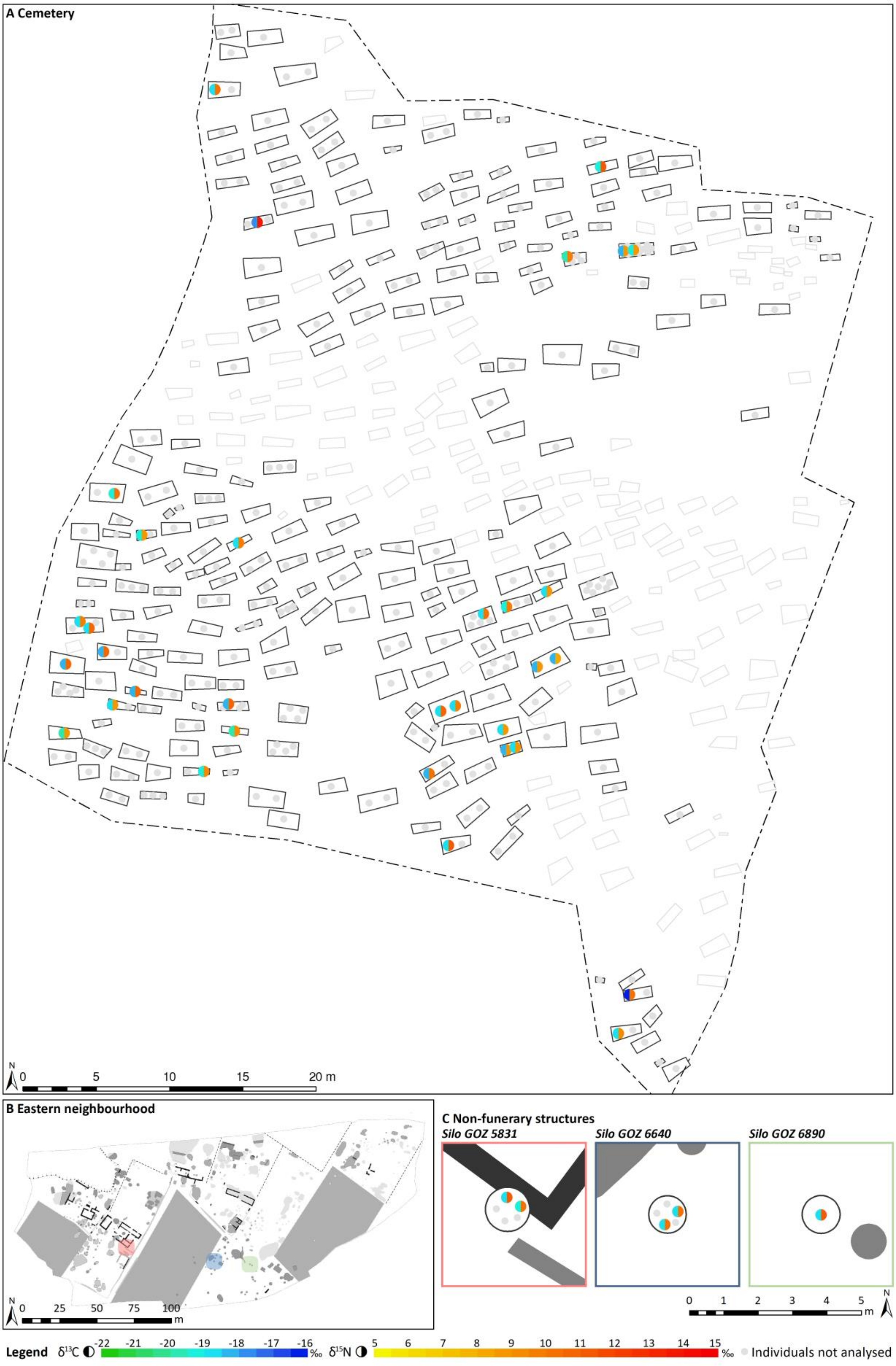


Figure 3.27. Gózquez, spatial distribution of individuals divided by carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) (Contreras 2006: 282, Contreras 2011: 13, García-Collado 2016: 65, Vigil-Escalera 2010: 3, Vigil-Escalera: 372, modified). (A) Cemetery. (B) General plan of the eastern neighbourhood highlighting the three areas with non-funerary structures. The colour of each area matches that of the frame of their corresponding detailed plan to the right. (C) Non-funerary structures. The dashed line depicts the excavation limits. Individuals successfully analysed are represented with a big circle divided in two. The left half symbolises $\delta^{13}C$ and the right half $\delta^{15}N$ according to the colour gradient shown in the legend. Individuals not analysed are depicted with a smaller grey point

Seven pairs of individuals buried in the same structure were analysed (figure 3.26). Five came from the cemetery (GOZ 047, GOZ 097, GOZ 102, GOZ 112, GOZ 131) and the other two were found in different silos in the settlement (GOZ 5831, GOZ 6640). It is interesting to analyse their variation in order to try to understand the links between the individuals buried together. The mean standard deviation of δ^{13}C of the individuals sharing the same structure was 0.2‰. Similarly, the mean standard deviation of δ^{15}N between these seven pairs was 0.4‰. These figures are smaller than the standard deviation of any of the variables considered both in the cemetery and the settlement. Therefore, they signify the variability within the same structure was smaller than among the whole population. That is, it was more likely that two individuals buried in the same grave or silo had similar diets than any other pair of individuals, although in some cases clear differences were observed. This supports the hypothesis that individuals buried together could have belonged to the same domestic unit or extended family, where they would have had access to similar foodstuffs. In line with this, it is worth highlighting that the two pairs from the settlement behaved in opposing ways. In one case both individuals had almost identical isotopic signatures, but the two individuals in the other one were quite different from each other, especially in δ^{15}N.

Finally, figure 3.27 represents the spatial distribution of the individuals analysed and their carbon and nitrogen stable isotope ratios. Under the premise that both δ^{13}C and δ^{15}N at Gózquez were quite homogeneous, no clear patterns or differences are observed within the cemetery or between the three areas of the settlement where human remains were found. Then, the general overview is that there is no relationship between isotopic signatures and topographic distribution, so individuals with very different dietary patterns were buried close to each other and *vice versa*. Besides, in this picture it is possible to observe the similarity between the individuals buried in the same structure discussed in the previous paragraph.

3.1.2 BOADILLA

3.1.2.1 The site

3.1.2.1.1 Location and history of research

Boadilla is the southernmost site included in this research. This name designates a cemetery located north of the town of Illescas, in the province of Toledo, just 4 km south of the border with the region of Madrid (figure 3.28). Its UTM ETRS89 coordinates are 30T 429705 4443432 and it is 585 meters above sea level. However, Boadilla belongs to a vaster settlement which extends up to 1 km around the cemetery and is known under different names because it has been investigated in separated archaeological interventions. However, in this thesis the whole settlement and funerary areas will be referred to as Boadilla. Altogether Boadilla is halfway between Toledo (35 km south) and Madrid (32 km north), 54 km southwest of the Roman city of Complutum (current Alcalá de Henares), 22 km southwest of Gózquez and 46 km southwest of El Soto/El Encadenado and La Huelga. The site is located in an area dominated by flatlands with a few small hills. The Boadilla stream flows in west-east direction and it would have divided the cemetery from the settlement. In the area there are many other seasonal water courses. This landscape would have been suitable for cereal fields. In the surroundings there are still some patches of holm oak meadows, which probably were greater in the past.

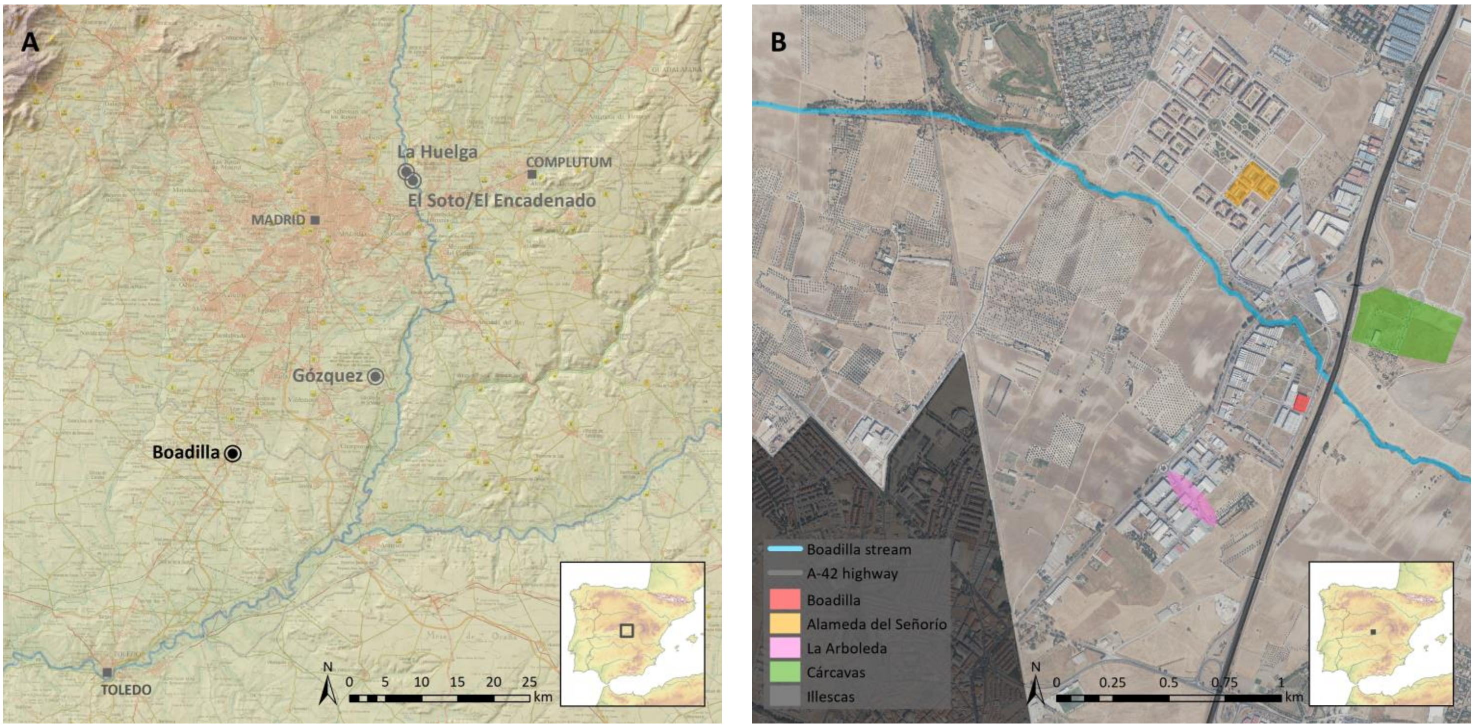


Figure 3.28. Geographical location of the site of Boadilla (Illescas, Toledo) (A) at the regional and (B) local scale

All the archaeological interventions on Boadilla and the surrounding sites were driven by urban or industrial development north of Illescas. The first early medieval evidence in this area was a burial found in 1994 by R. Hernando and P. Iguácel during the monitoring for the installation of a natural gas pipe for supplying the industrial park La Arboleda (Hernando & Iguácel 1994). Even though the discovery is published, it was not possible to determine its precise location, so in figure 3.28B it is depicted approximately. During the first decade of the 21st century, the area north of Illescas was revitalised. On one hand, a new industrial park was promoted northeast of La Arboleda. This led to the discovery of the cemetery of Boadilla, covering about 3000 m^2, which was excavated between 2005 and 2008 by the company J. M. Rojas Arqueología under the direction of G. Garrido and J. Perera (Catalán & Rojas 2009). On the other hand, two new residential areas were promoted north of Boadilla stream. The district west of road A-42 is named Alameda del Señorío. Many of these plots revealed archaeological remains of different chronologies. Excavations were carried out in several of them, but it has only been possible to access some information about the results from plots R-23, R-24 and R-30 (approximately 2.5 ha), excavated between 2007 and 2008 by M. J. Calvo and R. Catalán (2007). The situation east of road A-42 was similar. A vast area was surveyed for the development of a new residential zone in 2004. Immediately north of Boadilla stream the early medieval settlement of Cárcavas was discovered, including at least one burial (Domínguez Fernández & López Lancha 2010). The early medieval remains occupied at least 1.3 ha, but the information available on this site is so brief that it could not be precisely located in the map. This thesis focuses on the human population from the cemetery of Boadilla, which is currently curated at the Museum of the Holy Cross, in Toledo.

In addition to the papers mentioned in the paragraph above about the different archaeological interventions on Boadilla and the surrounding settlement, there are a few more publications on this site. R. Catalán (2013) wrote a monographic work on a specific type of fibula found in one of the graves of the cemetery of Boadilla and a thorough analysis on the pottery from Alameda del Señorío was released recently (Catalán *et al.* 2018). Besides, there is an unpublished zooarchaeological report about a few of the deposits from this sector of the settlement (Rodríguez Monterrubio 2015) and two palynological and anthracological samples from a burial and a domestic structure respectively were also analysed (Pérez-Díaz *et al.* 2019: 361–363). Finally, the palaeodietary reconstruction of the population buried in Boadilla, including fauna samples from Alameda del Señorío, was already published by the author of this thesis and her colleagues (García-Collado *et al.* 2019). Here these results are further discussed and they are contextualised at the regional and supra-regional levels.

3.1.2.1.2 The settlement

The area north of Illescas, where the cemetery of Boadilla and the surrounding settlement extend, presents a wide occupational sequence. The oldest evidence dates to the Bronze age. It consists mostly of silos, including one at Alameda del Señorío containing a human burial (Calvo & Catalán 2007: 12–13), which are scattered along all the areas investigated and extend further north of Cárcavas (Domínguez Fernández & López Lancha 2010). North of Boadilla stream and west of road A-42 an Iron Age necropolis was discovered by J. M. Magariños and L. A. Domingo (Domínguez Fernández & López Lancha 2010: 184), but there is no more information about it. Roman imperial pottery was found in the superficial layers of Alameda del Señorío and a kiln for pottery, glass or metal dated to the Late Empire was identified in this area too (Catalán *et al.* 2018: 492). The foundation of the early medieval settlement is dated to the last quarter of the 5th century and it was occupied probably until the middle of the 8th century, even if the final date is unclear. According to these data there should have been some connection between the Roman and the early medieval settlements, but the evidence about the former is so scarce that it is not possible to characterise it. No later occupations up to contemporary times have been identified in the zone.

It is difficult to define the layout and internal organisation of the early medieval settlement around Boadilla. The area investigated is large (at least 4 ha considering all the known campaigns), but it was excavated under various projects and there is no topographical continuity between them, so it is complicated to establish connections between the different sectors. Apparently domestic and productive areas, represented by the sites of Alameda del Señorío and Cárcavas, would have been located north of Boadilla stream; while funerary areas, comprising the cemetery of Boadilla and the grave of La Arboleda, would have been restricted to the south of the river. However, there was at least one human early medieval burial at Cárcavas (Domínguez Fernández & López Lancha 2010: 186). There are also still many unexplored areas both south and north of Boadilla stream, so none of these conclusions are definitive. In addition, there are accounts saying that the construction and successive enlargements of road A-42 and La Arboleda industrial park during the second half of 20th century destroyed archaeological remains, but the impact of these works is unknown because they were not overseen. Then, information on these areas is lost forever. Nevertheless, the data available are enough to characterise the site of Boadilla as a village (Vigil-Escalera 2007a: 243), in the sense that it looks to have been formed by several family units who shared a common cemetery as the material expression of the belonging to the community.

Focusing on the data available about the internal distribution of the residential area, both Alameda del Señorío (Catalán & Rojas 2009: 231–232) and Cárcavas (Domínguez Fernández & López Lancha 2010: 188–189) seem to have been organised in family plots, each one composed of a main domestic building, several silos (i.e. underground storage pits) and in some cases other productive structures, such as water wells, cooking ovens or a *tegula* or brick kiln. At Alameda del Señorío the only domestic structure excavated was a sunken featured building completely made in perishable materials. Instead, at Cárcavas three buildings on stone perimeters with *tegula* roofs were found. In addition, the traces of fences for dividing spaces were identified, as well as wide areas interpreted as gardens, enclosures or spaces for other agrarian tasks (Vigil-Escalera 2010).

The only chronological indicators available for the dating of Boadilla are pottery from the settlement and grave goods from the cemetery. The former set up the starting date of the village in the last quarter of the 5th century based on the presence of imported pottery fragments of this moment (Catalán *et al.* 2018: 496–497). This is consistent with the oldest grave goods found in the cemetery of Boadilla (Catalán & Rojas 2009: 227–230). Dating the abandonment of the village is more complicated. On one hand, the most recent grave goods from the cemetery of Boadilla are dated to the mid-7th century (Catalán & Rojas 2009: 230–231). On the other, the monographic study on the pottery from Alameda del Señorío did not recognise any item posterior to the first half of the 7th century (Catalán *et al.* 2018). However, there are a few facts which push the final date of the site to the middle of 8th century. First, the use of grave goods disappeared after the first half of the 7th century (Vigil-Escalera 2013b: 261), so burials from the latest phase would not be recognisable. Second, based on previous studies of big sites analysed in great detail, it is known that this type of settlements in the area around Madrid lasted until the middle of the 8th century (Quirós 2013). Finally, the paper about Cárcavas mentions the presence of emiral pottery, even if no further details are provided (Domínguez Fernández & López Lancha 2010: 186). For all these reasons it is feasible to extend the occupation of the village of Boadilla up to the mid-8th century. Then, it is assumed that some of the burials without grave goods belonged to the latest decades of its use and the absence of pottery from this period is attributed to the partiality of the excavations.

Among the material culture recovered in the residential areas associated with Boadilla pottery stands out because it was the most abundant type of material. The pottery assemblage from Alameda del Señorío was devoted a specialised study (Catalán *et al.* 2018). The authors identified six types: four finewares and three coarsewares. The first group was formed by just a few fragments. Among them a fragment of African red slip ware is especially relevant because it confirms the continuity of long-distance trade networks in inland Iberia at least until the end of the 5th century or the beginning of the 6th. The group of coarsewares was absolutely predominant. It can be divided into handmade and fast wheel productions, where the latter were the majority. Handmade items were restricted to clay pans, i.e. trays for cooking flat breads. Fast wheel productions included mainly pots and bowls, but also jugs, dishes, mugs, beakers, trays, amphorae and exceptionally a funnel. An early medieval kiln was found in Alameda del Señorío, but it was aimed at the production of construction material, possibly *tegulae*. Still, there must have been pottery kilns in the settlement, because at least one firing defect was identified on site. For Alameda del Señorío there is also a short unpublished report on other materials (Calvo & Catalán 2007). Glass was very scarce, as it usually is in the sites of this chronology. The most noteworthy item was an almost complete short green bowl. Metal items were also infrequent. They were mainly tools, such as nails, a weight and different types of unidentified plates. A fibula was also recovered. In addition, slags and a crucible, as evidence of productive processes, were found. Hand mills made of granite and quartzite were uncovered in some silos.

As for bioarchaeological records, only fauna and a few archaeobotanical samples have been analysed. A partial analysis of the animal remains from nine stratigraphic units from Alameda del Señorío (Rodríguez Monterrubio 2015) determined that the most frequent taxon according to the number of fragments were equids, followed by dogs, ovicaprids, pigs and cattle. This is quite an untypical distribution of taxa for early medieval contexts and it is probably biased by the selection of the sample. In the general inventory of the site (Calvo & Catalán 2007) cattle and afterwards ovicaprids were predominant and cats, birds and wild boar were identified too. The analysis of the archaeobotanical remains only comprised a burial from the cemetery of Boadilla and the filling of a sunken featured domestic structure from Alameda del Señorío (Pérez-Díaz *et al.* 2019: 361–363). The former contained seeds and pollen of Italian bugloss (*Anchusa azurea*), a ruderal plant with blue flowers which might have been placed in the grave as an offering. The latter only yielded a few oak and pine tree charcoals.

3.1.2.1.3 The funerary context

The only funerary context known at Boadilla was the community cemetery (figure 3.29, table 7.1, Catalán & Rojas 2009), also because the surrounding space was not excavated. However, it must be reminded that contemporary isolated burials were also detected in the sectors of La Arboleda and Cárcavas (figure 3.28B, Hernando & Iguácel 1994, Domínguez Fernández & López Lancha 2010), so it cannot be excluded there were other funerary areas being used at the same time. Still, this thesis focuses only on the human assemblage from Boadilla, because there was no detailed information about the other two contexts. The cemetery of Boadilla was located south of the homonymous stream and, according to the archaeological data available, it looks like the settlement developed exclusively north of this water course, even if it must be acknowledged that the areas excavated in this zone are considerably larger than those to the south. The graveyard was made up of 181 burials. Nevertheless, in the present spatial distribution there are many empty spaces, so it is likely that many of them, probably the shallowest ones, were lost before the archaeological intervention. They formed a roughly rectangular outline, which suggests the cemetery may have been physically delimited by a fence. All the burials whose orientation could be observed were placed in west-east direction with small deviations (n = 96/181 = 53.0%). However, in almost half of the cases orientation could not recorded (n = 85/181 = 47.0%) because graves did not contain any anatomical elements or the only ones preserved were in secondary deposits. None of the burials cut each other. This points at the existence originally of some kind of markers on the graves, which would have also facilitated their reuse. The whole cemetery is dated to between the end of the 5th century and the middle of the 8th century. It has been suggested that some internal phasing could be established based on the grave goods accompanying part of the individuals (Catalán 2013: 225). According to this proposal, the cemetery would have evolved from the centre towards the periphery, so as the burials in the central area would be older than those in the outer perimeter. In this way, three phases matching three concentric areas were defined. The central nucleus would cluster the oldest individuals corresponding to phase 1, dated to between the end of the 5th century and the beginning of the 6th century. Phase 2 would occupy the middle ring of the graveyard and would have developed during the second quarter of the 6th century approximately. The rest of the burial ground would constitute phase 3, which would cover all the span between the mid-6th and the mid-8th centuries.

Five different types of burials were found at Boadilla. The most common ones were simple pits (n = 140/181 = 77.3%), that is, bare cuts in the bedrock. Smaller proportions of graves were defined as slabs burials (n = 18/181 = 9.9%) and walls burials (n = 14/181 = 7.7%), which were made up of pits lined with vertical slabs or irregular stones piled forming rows respectively. Finally, a tiny percentage of the funerary structures excavated were burials elaborated with fragments of building material (n = 5/181 = 2.8%) and burials in mixed materials (n = 4/181 = 2.2%). At Boadilla the former consisted of tombs reinforced with *tegula* and more rarely brick fragments. The latter combined either vertical slabs and *tegulae* or they had walls in stone and *tegulae*, or bricks.

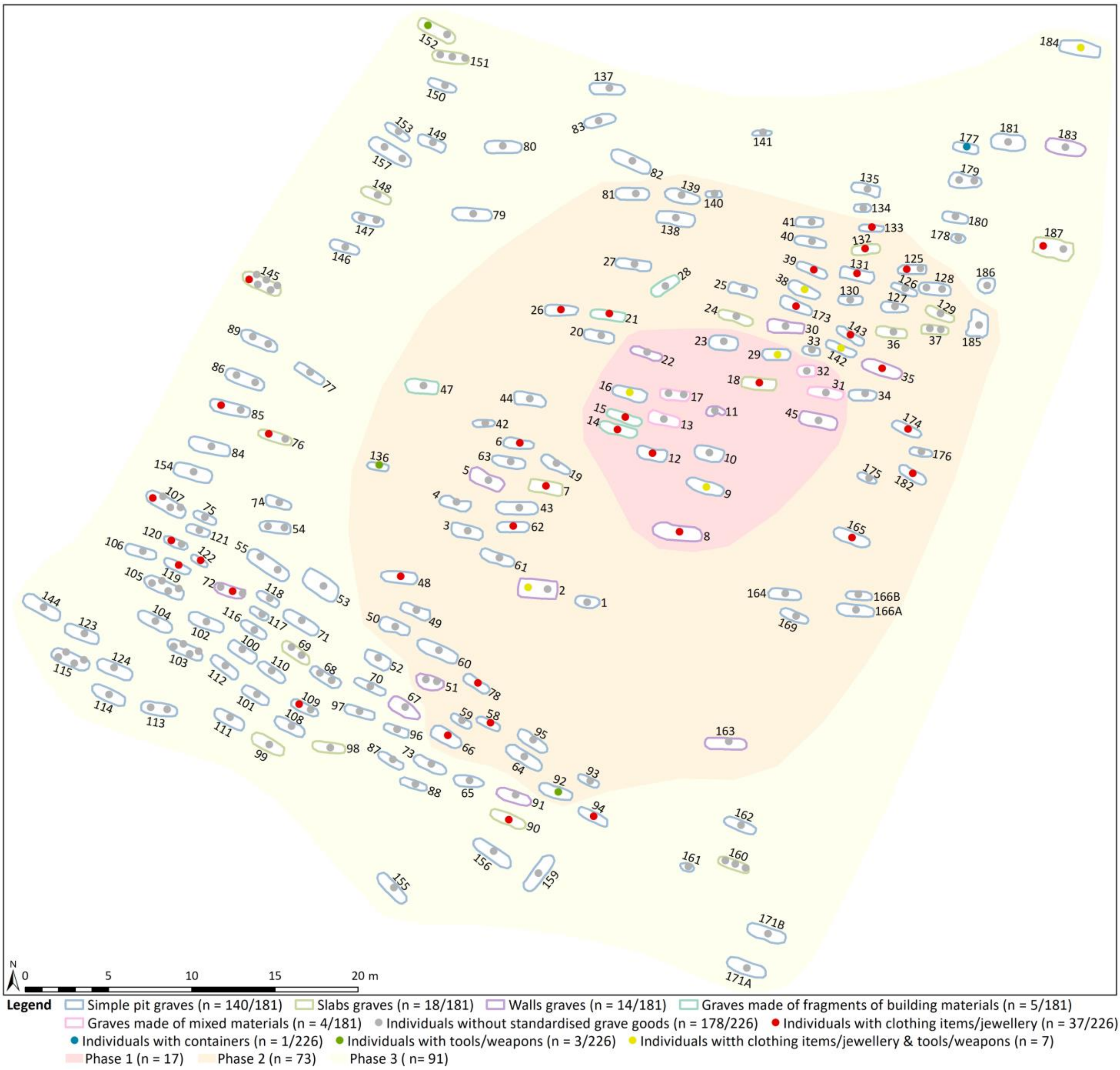


Figure 3.29. Boadilla, cemetery (Catalán & Rojas 2009: 225, modified). The outline of burials is represented with a solid line whose colour shows the type of funerary structure according to the legend. The number next to each burial is its identifier. Points symbolise the individuals recovered in each burial. Their colour indicates the presence or absence of grave goods as stated in the legend

The total number of individuals identified in the cemetery of Boadilla was 226. Therefore, the mean number of individuals per burial was 1.2. The greatest number of individuals found in a grave was six. The majority of the individuals were found in primary deposits and they were in supine position (n = 100/226 = 44.2%). A tenth of the population was recovered in reduction secondary deposits (n = 22/226 = 9.9%), that is, skeletal elements were piled up next to an individual in primary position. One ossuary (n = 1/226 = 0.4%), a funerary structure specifically created to gather the disarticulated anthropological remains of several individuals, was identified and there were a few other contexts with individuals in unspecified secondary deposits (n = 10/226 = 4.4%). Besides, there was a big proportion of the individuals whose position could not be determined (n = 93/226 = 41.4%).

Regarding the objects found in the burials, there was evidence, namely nails, that around one quarter of the individuals were buried in wooden coffins (n = 55/226 = 24.3%). In addition, approximately two fifths of the population were accompanied by some kind of grave goods (n = 50/226 = 22.1%). The most common ones were clothing items and jewellery (n = 44/226 = 19.4%), which included fibulae, belt plates, earrings, necklace beads, rings and other minor elements such as small buckles or buttons. Tools, comprising knives, personal hygiene items (i.e. tweezers), flint artefacts and an arrowhead, were considerably less frequent (n = 10/226 = 4.4%). Only one individual was accompanied by a pottery container (n = 1/226 = 0.4%). Moreover, a fauna fragment was found next to one of the individuals and in two cases unidentified metal objects were recovered (BOA 012-1, BOA 135-1).

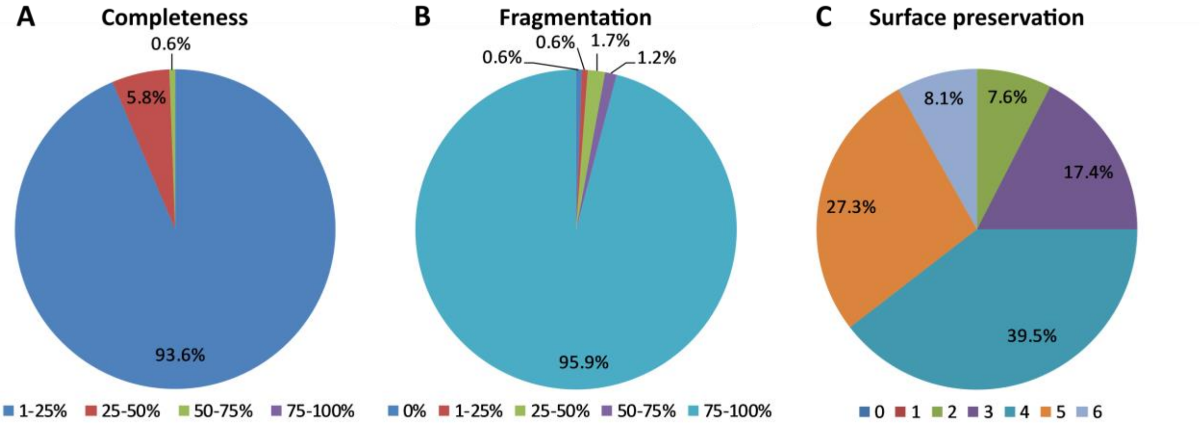


Figure 3.30. Pie charts representing the distribution of the three variables for the assessment of the macroscopic preservation of the human population from the cemetery of Boadilla. (A) Completeness. (B) Fragmentation. (C) Surface preservation

3.1.2.2 The human population

3.1.2.2.1 Macroscopic preservation

The preservation of the human osteological assemblage from the cemetery of Boadilla (figure 3.29) was overall poor (García-Collado *et al.* 2019). Although up to 226 individuals were identified in the 181 funerary structures excavated, only 172 individuals, approximately three quarters of the assemblage, could be recovered and studied in the laboratory (n = 172/226 = 76.1%, table 7.1). This was because in many cases it was possible to recognise the outline of skeletons in the field, but bones disintegrated when trying to recover them. Among the individuals who preserved any anatomical element, only 6.4% retained more than 25% of the skeleton (figure 3.30, table 7.7). Furthermore, more than 95% of the individuals had between 75% and 100% of the anatomical elements preserved fragmented. The preservation of bone surface among the individuals from Boadilla presented a distribution closer to normal. None of the individuals exhibited a fresh appearance (grade 0) or slight surface erosion (grade 1). Most of them ranged between having most of the surface eroded, with some details of the surface masked (grade 3), and heavy erosion on the entire surface, with some modifications of profile (grade 5). These preservation issues complicated anatomical identification and especially age estimation and sex determination, so they must be kept in mind when evaluating results.

3.1.2.2.2 Demography

A good number of individuals was recovered in the cemetery of Boadilla (table 3.8, figure 3.31, table 3.9, table 7.4, table 7.5, table 7.6). Actually, with a minimum number of 172 individuals, it is the second biggest assemblage studied here. However, results were significantly conditioned by incompleteness, fragmentation and bad bone surface conservation. Subadults formed 24.4% of the assemblage and adults 66.9%, so the subadult/adult ratio was 0.37. This would mean that subadults were slightly more than a third of the buried population. Still, this percentage is expected to have been bigger in the past, so it is very likely that subadults, especially the youngest ones, were underrepresented. In the same way, it was only possible to estimate age at death for a minimal portion of adults. Then, it is very difficult to elaborate any hypothesis about the evolution of mortality rates during adulthood. Besides, sex estimation was complicated too. As a consequence, the resulting sex ratio, which indicates there were just 25 males for every 100 women, is completely imbalanced and incompatible with any non-catastrophic demographic model. Therefore, this data is not deemed reliable and is considered an artefact caused by poor preservation. Nevertheless, when all adults are grouped together and plotted with subadults, the resulting curve of the probability of death (figure 3.31) resembles quite closely that of stable preindustrial agricultural populations (Chamberlain 2006: 64–68, Séguy & Buchet 2013: 114). These are distinguished by great mortality rates during the first years of life, which give the curve a high starting point, followed by a notable decrease between late childhood and adolescence and a gradual growth of the probability of death throughout adulthood. Yet, according to the evidence available, the risk of death of infans 1 from Boadilla is too low for such a model, reinforcing the idea of the underrepresentation of the youngest individuals in this assemblage. This bias is possibly also linked to the results of palaeodemographic estimators (table 3.9), since these parameters are strongly influenced by subadult mortality. The central value of life expectancy at birth was 35.2 years, which makes Boadilla one of the most long-lasting populations among those analysed in this thesis. Likewise, mortality rates during the first year and the first five years of life were lower than expected for historical premodern populations (Bocquet-Appel & Masset 1982: 328). Once again, this is very probably a consequence of the underrepresentation of subadults in this particular skeletal sample.

Table 3.8. Age and sex distribution by absolute frequencies of the human population from the cemetery of Boadilla. Key: F = fetus, < 40 weeks in utero; I1A = infans 1A, birth – 2 years; I1B = infans 1B, 3 – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; Ssp = subadult sp, < 20 years; YA = young adult, 20 – 34 years; YMA = young-middle adult, 20 – 45 years; MA = middle adult, 35 – 45 years; MOA = middle-old adult, > 35 years; OA = old adult, > 45 years; Asp = adult sp, > 20 years; UA = undetermined age; M = male individuals (including probably male individuals); F = female individuals (including probably female individuals); US = undetermined sex (including ambiguous individuals)

	F	*I1A*	*I1B*	*I2*	*J*	*Ssp*	*YA*	*YMA*	*MA*	*MOA*	*OA*	*Asp*	*UA*	*Total*
M	-	-	-	-	-	-	1	1	-	-	-	1	-	3
F	-	-	-	-	-	-	-	-	-	1	-	11	-	12
US	-	4	12	8	6	12	-	-	-	-	-	100	15	157
Total	0	4	12	8	6	12	1	1	0	1	0	112	15	172

Table 3.9. Demographic descriptive indicators and palaeodemographic estimators of the human population from the cemetery of Boadilla

Descriptive indicators	
MNI	172
%subad	24.4%
%ad	66.9%
S/A	0.37
M/F	0.25

Estimators	
JI	0.104
e_0	35.2
$_1q_0$	0.214
$_5q_0$	0.312

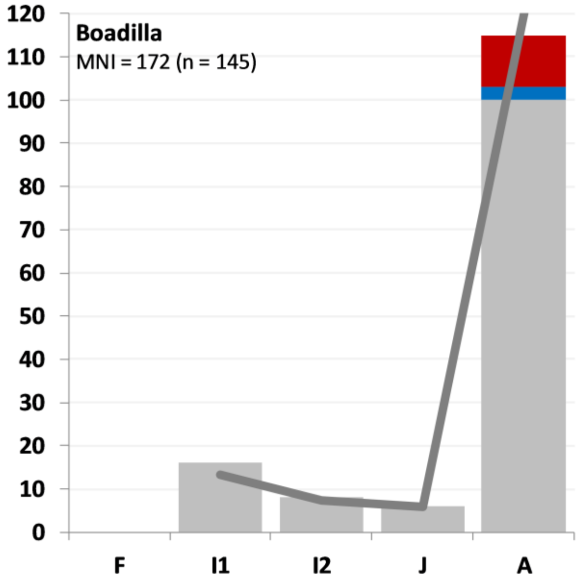


Figure 3.31. Demography chart of the human population from the cemetery of Boadilla. Bars represent the absolute frequencies of each age category (F = fetus, < 40 weeks in utero; I1 = infans 1, birth – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; A = adults, > 20 years), separated by sex whenever possible (blue = male individuals, red = female individuals, grey = undetermined sex). The line depicts the progression of the probability of death (q_x) along age categories, calculated according to G. Acsádi and J. Nemeskéri (1970: 65). The minimum number of individuals of the population (MNI) and the number of individuals represented in the chart (n) are shown on the upper left corner. These two numbers differ because subadults sp (< 20 years) and individuals of undetermined age are not displayed

When demographic data were crossed with the presence or absence of grave goods, the most obvious observation was that subadults were accompanied by grave goods less frequently than adults (individuals with grave goods: S = 5, A = 36, S/A = 0.14; individuals without grave goods: S = 37, A = 79, S/A = 0.47). In fact, the association between this feature of the funerary ritual and age was statistically significant, although the strength of the association was small (chi-squared test: n = 157, χ^2 = 6.001, d.f. = 1, p = 0.014, φ = -0.195). Moreover, grave goods were associated to female adults four times more often than to male adults (individuals with grave goods: M = 1, F = 4, M/F = 0.25; individuals without grave goods: M = 2, F = 8, M/F = 0.25). However, this was exactly the same sex ratio as that of the population as a whole, so it is not considered a relevant data (Fisher's exact test: n = 15, p = 1.000).

Regarding spatial organisation, the analysis of figure 3.32 does not bring out any pattern in the distribution of individuals by age or sex. Conversely, it looks like apparently the arrangement of the cemetery of Boadilla did not follow any demographic criterion. In addition, this figure shows that bad preservation was randomly distributed throughout the cemetery, since individuals not preserved for study are present in all the areas of the graveyard.

3.1.2.3 Faunal diet

3.1.2.3.1 Sampling

It was difficult to get fauna samples from Boadilla because the excavation only covered the cemetery and animal remains are rarely found in funerary contexts. For this reason, a double strategy was designed. On one hand, all the domestic fauna fragments mixed with human remains recovered in the cemetery were picked for analysis. These are the samples labelled with the acronym BOA. On the other, some contexts from the nearby settlement of Alameda del Señorío de Illescas were also sampled (see section 3.1.2.1.2). These were mostly silo fillings. The samples from the settlement were tagged with the acronym ASI. Both sites are contemporary, so samples are generically dated to between the end of the 5th century and the 7th century. Adding both sources, a total of 20 samples were gathered (table 7.8, figure 3.33). The assemblage included herbivores (Bos taurus, Ovis aries/Capra hircus, Equus sp), omnivores (Sus scrofa domesticus, Avis) and a domestic carnivore (Canis familiaris), all of them being adult specimens. All the samples were bone fragments.

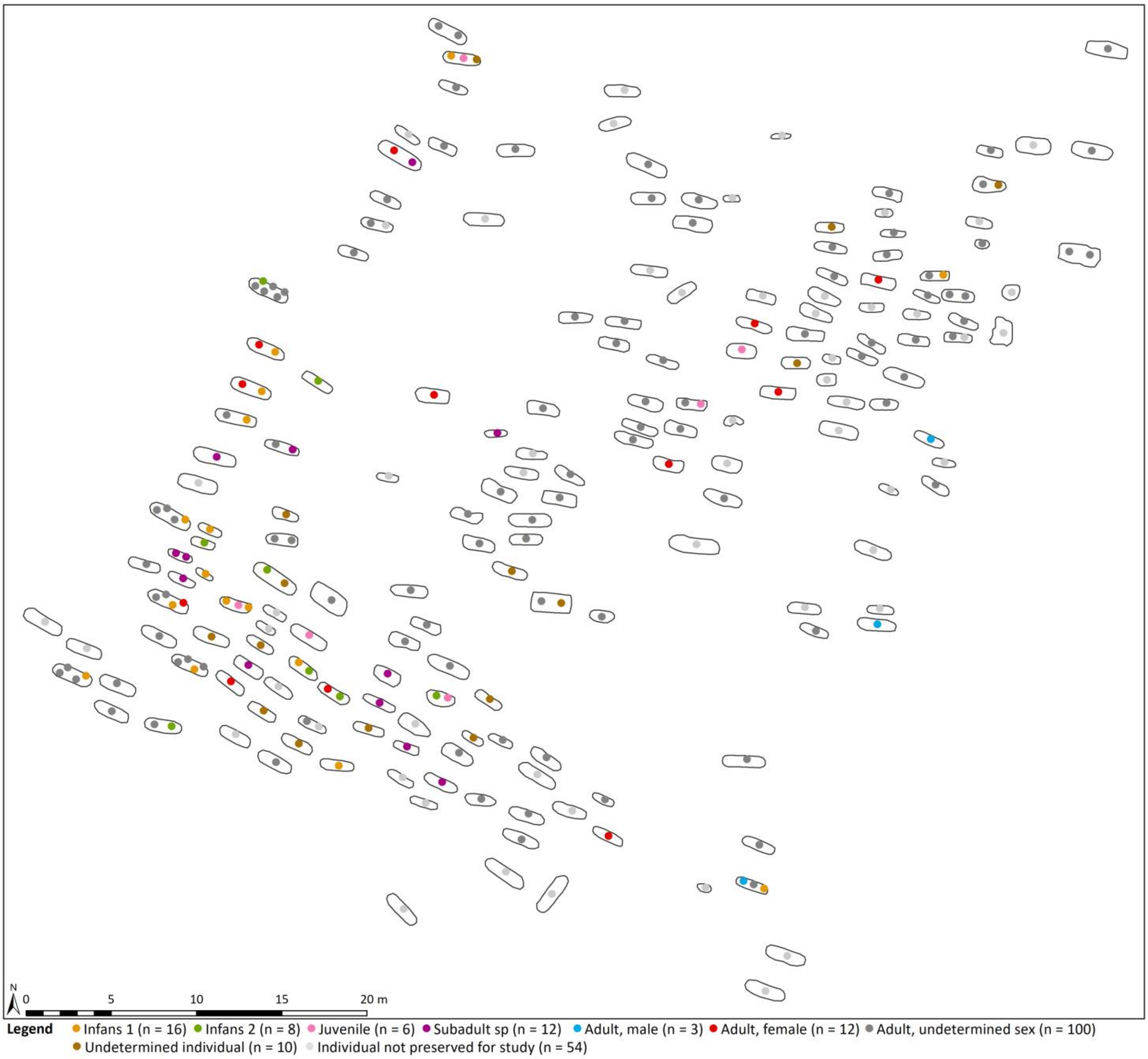


Figure 3.32. Boadilla, cemetery, spatial distribution of individuals by age and sex (Catalán & Rojas 2009: 225, modified). Points symbolise the individuals recovered in each burial. Their colour indicates their age and sex as stated in the legend

3.1.2.3.2 Collagen quality

The complete assemblage of fauna samples from Boadilla passed the collagen quality assessment (table 7.11, figure 3.33, figure 3.34), which means they had well preserved collagen. In every case collagen yield (%coll) was greater than 0.5% and in the vast majority of cases it was bigger than 1.0%, up to 13.5%. Carbon weight content (%C) ranged between 30.1% and 44.3% and nitrogen weight content (%N) between 10.4% and 15.9%. Then, carbon to nitrogen atomic ratio (C/N) showed a very narrow dispersion between 3.2 and 3.4. Therefore, all the samples were valid for palaeodietary reconstruction.

3.1.2.3.3 Results

The fauna assemblage from Boadilla was formed by twenty samples (table 3.10, table 7.11, figure 3.35, García-Collado *et al.* 2019: 3773–3774). Two thirds were herbivores, including cattle, ovicaprids and equids in similar proportions. Their mean δ^{13}C was -20.3‰ and they had a standard deviation of 0.7‰ and a range of 2.8‰.

This distribution indicates they were all exclusive C_3 eaters. However, there were some differences between taxa. Cattle and ovicaprids were very similar to each other. Instead, two out of four equids tended to very depleted $\delta^{13}C$ values, while the other two were assimilable to cattle and ovicaprids.

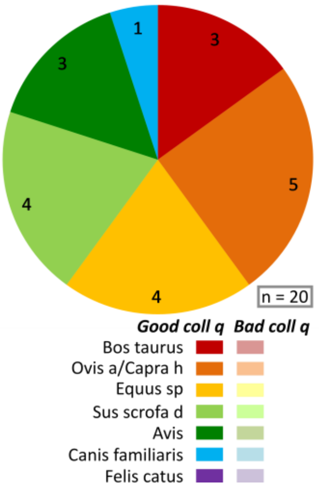


Figure 3.33. Pie chart representing the distribution of fauna samples from Boadilla by taxa and collagen quality. Numbers represent the absolute frequency of each group

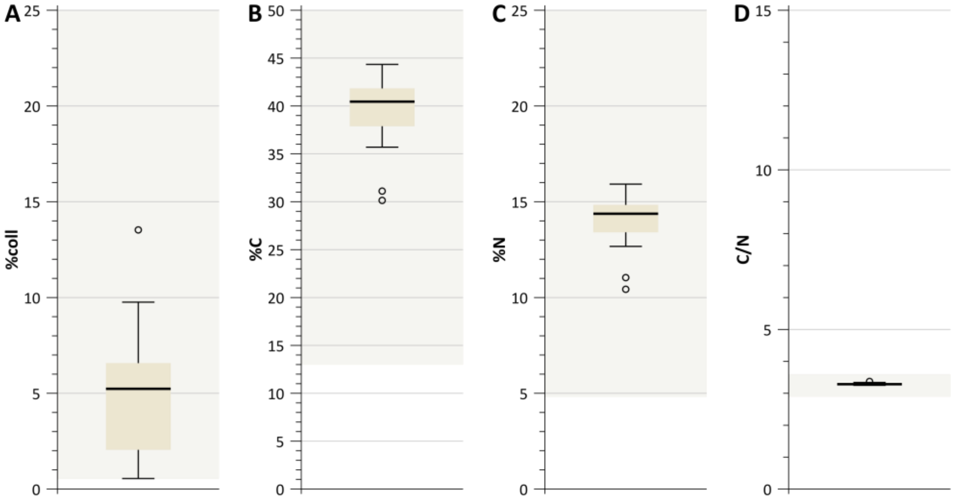


Figure 3.34. Boxplots representing the collagen quality indicators of fauna samples from Boadilla. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

Table 3.10. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of fauna samples from Boadilla. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All fauna	20	-20.0	0.9	-22.2	-18.0	4.2	8.4	1.1	6.1	10.0	3.9
Herbivores	12	-20.3	0.7	-22.2	-19.4	2.8	8.0	1.1	6.1	9.5	3.4
Bos taurus	3	-20.0	0.5	-20.3	-19.4	0.9	8.4	1.1	7.4	9.5	2.1
Ovis/Capra	5	-20.3	0.3	-20.6	-19.9	0.7	8.0	0.7	7.2	9.4	2.2
Equus sp	4	-20.7	1.2	-22.2	-19.6	2.6	7.8	1.5	6.1	9.4	3.3
Omnivores	7	-19.9	0.9	-21.6	-19.0	2.6	8.9	0.9	7.9	10.0	2.1
Sus scrofa d	4	-19.9	0.3	-20.3	-19.5	0.8	8.3	0.5	7.9	8.9	1.0
Avis	3	-19.9	1.5	-21.6	-19.0	2.6	9.8	0.2	9.6	10.0	0.4
Carnivores	1	-18.0	-	-	-	-	10.0	-	-	-	-
Canis familiaris	1	-18.0	-	-	-	-	10.0	-	-	-	-

Likewise, herbivores from Boadilla had a mean $\delta^{15}N$ of 8.0‰, a value exceptionally high for animals whose diet is made up only of plants, but similar to the distribution observed at Gózquez (see section 3.1.1.3.3). Their standard deviation was 1.1‰ and they had a range of 3.4‰. Cattle, which was the least represented taxon, presented quite a wide range of nitrogen isotope ratios, suggesting they were grazing in diverse locations with distinct isotopic baselines. Conversely, four out of the five ovicaprids analysed were concentrated around the lowest $\delta^{15}N$ values of their range and only one of them was comparable to the most enriched cattle. This could signify a greater homogeneity in the husbandry strategies regarding ovicaprids, but sample size is too small to make definite conclusions.

In any case, the enriched mean nitrogen isotope ratios of herbivores at Boadilla deserves some discussion. Because cattle, ovicaprids or equids do not eat any animal protein, the enrichment of their $\delta^{15}N$ values must be due to the elevated nitrogen isotope ratios at the base of the ecosystem where they grazed. Central Iberia is currently considered a semiarid zone (Paniagua *et al.* 2019), but it is unclear whether high temperatures and low precipitations were also predominant in the region during Early Middle Ages and if these conditions alone were enough to produce such an enrichment of nitrogen isotope ratios at the base of the food chain. For this reason, it is proposed that manuring could have played a central role in this phenomenon (Bogaard *et al.* 2007, Fraser *et al.* 2011), as it was already verified in the nearby site of Gózquez (see section 3.1.1.3.3) and maybe also at El Soto/El Encadenado (see section 3.1.3.3.3). The easiest way to accomplish this would have been to bring animals to graze in fields after harvest. While eating crop leftovers, livestock would have contributed with their own dung to manure plots, enriching soil $\delta^{15}N$ values. As a result, high nitrogen isotope ratios would be reflected in the bone collagen of the animals grazing in those fields annually. This agrarian practice is referred to as lifting of the fences or *derrota de las mieses* in Spanish and it is a good example of the early integration between agriculture and animal husbandry and of the cohesion of village communities such as the one living at Boadilla.

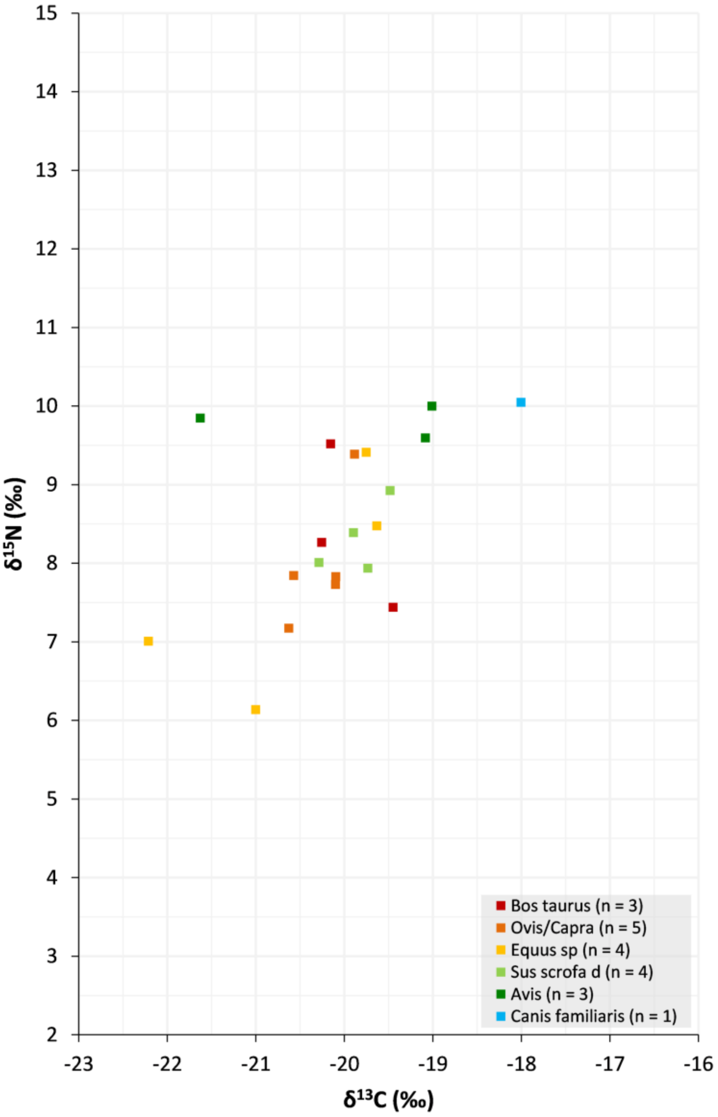


Figure 3.35. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of fauna from Boadilla grouped by taxa

Besides, equids were the herbivore taxon also with the greatest variability of $\delta^{15}N$. Two of the samples were similar to cattle, but the other two had the lowest $\delta^{15}N$ values of the assemblage. These were the same two specimens with very depleted $\delta^{13}C$, so these equids were outliers both for carbon and nitrogen stable isotope ratios. The stark difference in isotopic signatures between the two pairs of equids very likely means each couple was grazing in different pastures or was being fed with fodder from distinct areas. While those with $\delta^{13}C$ and $\delta^{15}N$ closer to cattle and ovicaprids might have been reared similarly to the other herbivore taxa, the two outliers were probably kept in a different regime. It is also possible that these two specimens came from a different region, so as they reflected the isotopic baseline of their place of origin. Taking into account equids were frequently used for transport, this would not be rare. Finally, considering the whole assemblage of herbivores from this site, in no case there were systematic differences between the samples collected from the cemetery of Boadilla itself and the excavation at the settlement of Alameda del Señorío de Illescas (see section 3.1.2.3.1).

Overall omnivores from Boadilla, which comprised pigs and fowl, had a mean $\delta^{13}C$ of -19.9‰, with a standard deviation of 0.9‰ and a range of 2.6‰, and a mean $\delta^{15}N$ of 8.9‰, with a standard deviation of 0.9‰ and a range of 2.1‰. Still, there were big differences in the distribution of each taxon, so they will be discussed separately. The isotopic signatures of pigs were quite homogeneous. Their $\delta^{13}C$ values were within the range for exclusive C_3 eaters and $\delta^{15}N$ values were close to cattle's, which indicates they were mostly herbivorous. Therefore, they were probably free-ranged, instead of being kept in courtyards next to households (Hammond & O'Connor 2013). Fowls behaved differently. Their $\delta^{13}C$ values were very widespread. In this way, one of the specimens had a very depleted carbon stable isotope ratio, similar to the two equid outliers. This points at a diet formed only by C_3 resources and possibly based on plants different to the ones eaten by most herbivores. The other two fowls analysed had the most enriched $\delta^{13}C$ values of the assemblage excluding the dog and they were very close to the values where some consumption of C_4 resources usually starts to be considered. Then, even if there is no doubt their diet was largely based on C_3 products, it would be no surprise if millets too made small contributions to their diets. In contrast, the range of $\delta^{15}N$ of fowl was very restricted. They were all slightly above the most enriched herbivores and alike the only dog included in the analyses, which leads to deduce they had omnivorous diets with analogous proportions of vegetable and animal protein between specimens. Possibly this means they were largely fed with domestic waste.

In addition, a single dog was also analysed. Its $\delta^{13}C$ was -18.0‰ and its $\delta^{15}N$ 10.0‰. These values point at a diet largely based on C_3 resources but with regular contributions of C_4 plants and possibly a moderate proportion of animal protein. Furthermore, the isotopic signature of this canid was within the range of human mean carbon and nitrogen stable isotope ratios (see section 3.1.2.4.3). This signifies it was probably fed mostly on human leftovers and it confirms the domestic nature of the specimen (Guiry 2012).

3.1.2.4 Human diet

3.1.2.4.1 Sampling

It was not possible to analyse all the individuals from the cemetery of Boadilla, because it was too large. For this reason, a set of 87 individuals were randomly selected (figure 3.36). The resulting assemblage was made up of almost a quarter of subadults and two thirds of adults. The rest were individuals whose age could not be estimated due to poor preservation. All subadult age categories were included. The only one missing were fetuses, which were not represented in the whole population either. Only a small proportion of the adults chosen for analysis were characterised as males or females. Still, the sampling reflects the overrepresentation of female over male individuals detected in the complete population. In most cases the anatomical element analysed were long bone fragments, because this was often the only part of the skeleton preserved.

3.1.2.4.2 Collagen quality

Despite poor macroscopic preservation, collagen quality of the human samples from Boadilla was reasonably good (table 7.9, table 7.10, figure 3.36, figure 3.37, García-Collado *et al.* 2019). Almost the complete assemblage produced collagen yields (%coll) greater than 0.5% and more than half were above 3.0%. The only exception was one sample with a collagen yield of 0.1%, which did not even preserve enough collagen to perform any measurement. Carbon weight contents (%C) were between 0.0% and 43.7% and nitrogen weight contents (%N) between 0.4% and 23.8%. However, most of the individuals were in the acceptable range and almost all the samples which were under the threshold for well preserved collagen on one of these variables were also low in the other one. As a consequence, carbon to nitrogen atomic ratios (C/N) showed quite a wide distribution between 0.0 and 3.7, but they clustered around suitable figures. All in all, it was concluded that 77 of the human samples from Boadilla had well preserved collagen and ten were dismissed for the opposite reason.

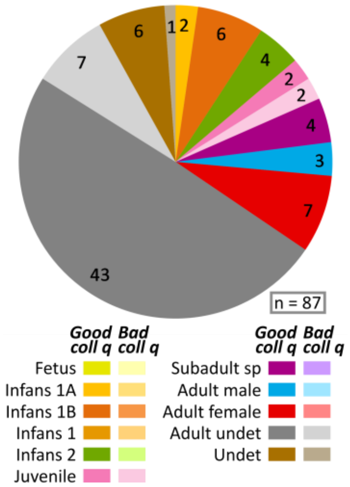


Figure 3.36. Pie chart representing the distribution of human samples from the cemetery of Boadilla by age, sex and collagen quality. Numbers represent the absolute frequency of each group

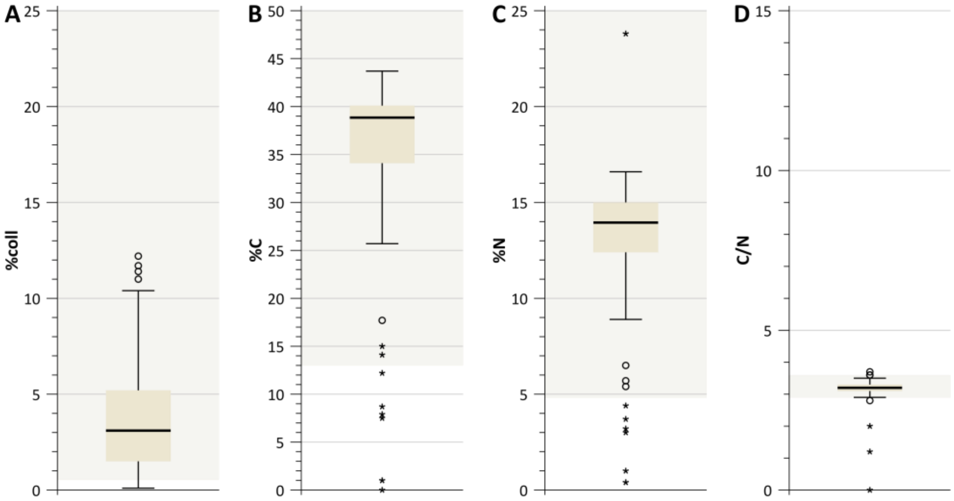


Figure 3.37. Boxplots representing the collagen quality indicators of human samples from the cemetery of Boadilla. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

3.1.2.4.3 Results

Thanks to the good preservation of collagen in the cemetery of Boadilla, it was possible to get the isotopic signatures of up to 77 individuals for the reconstruction of the diet of this community (table 3.11, table 7.9, figure 3.38, García-Collado et al. 2019). Starting with carbon stable isotope ratios, their distribution was striking because of its extreme homogeneity, especially keeping in mind this was the largest assemblage included in this thesis. The mean $\delta^{13}C$ of the population from the cemetery of Boadilla was -18.6‰, they had a standard deviation of 0.6‰ and a range of 4.0‰. These values are similar to other contexts tackled in this research and may not provide a reliable picture of the uniformity of $\delta^{13}C$ values at Boadilla. Instead, it may be easier to envision if it is said that 65 out of 77 samples were clustered in the range between -19.0‰ and -18.0‰. These results indicate that the predominant diet in this community was mainly based on C_3 resources, with small but consistent contributions of C_4 plants. Thus, the major food sources were probably winter crops, e.g. wheat, barley, rye or oats, alongside legumes, vegetables and fruits. In addition, spring crops, i.e. broomcorn and foxtail millets, would have meant a small but regular component of human diet. Direct consumption of C_4 resources by humans is supported by the relationship between carbon stable isotope ratios of humans and local fauna. The offset between the mean $\delta^{13}C$ of the individuals buried in the cemetery and the mean of the herbivores from Boadilla and Alameda del Señorío was 1.7‰ (see section 3.1.2.3.3). This is larger than the fractionation usually accepted for one single trophic level change (~1‰), so it implies there was an enriched carbon source contributing to their isotopic signature. Marine fish is not a sensible option in this context because of the great distance between Boadilla and the coast and the absence of any enrichment of δ^{15}N, as commonly observed on individuals whose diet relies on this type of resources. Besides, in this case it is also possible to rule out the option that the isotopic signal of C_4 plants was incorporated through fauna, since their analysis proved the diet of all herbivores and omnivores from Boadilla and Alameda del Señorío were exclusive C_3 eaters. It is difficult to quantify the proportion of C_4 plants in the typical diet at Boadilla. In a setting like this, where most protein came from C_3 sources, but energy (i.e. carbohydrates and lipids) also included C_4 resources, the contribution of the latter to the whole diet is known to be largely underrepresented in bulk bone collagen, because under normal nutritional status this body tissue prioritises proteins when being synthesised (Ambrose & Norr 1993, see section 2.4.1.4.4). Therefore, although millets would certainly not have been the main cereal for this population, it is likely they were eaten in small amounts but quite frequently.

Table 3.11. Summary statistics of carbon (δ^{13}C) and nitrogen (δ^{15}N) stable isotope ratios of human samples from the cemetery of Boadilla. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one. Key: C&J = clothing items & jewellery, Cont = containers, T&W = tools & weapons

	n	*δ^{13}C (‰)*					*δ^{15}N (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All humans	77	-18.6	0.6	-21.2	-17.2	4.0	10.1	1.0	6.4	12.9	6.5
Subadults	18	-18.6	0.7	-21.2	-17.6	3.6	9.9	1.2	8.1	12.9	4.8
Infans 1A	2	-17.9	-	-18.1	-17.6	0.5	11.4	-	9.8	12.9	3.1
Infans 1B	6	-19.0	1.1	-21.2	-18.2	3.0	9.2	0.9	8.1	10.7	2.6
Infans 2	4	-18.6	0.2	-18.7	-18.4	0.3	9.5	0.3	9.2	9.8	0.6
Juveniles	2	-18.5	-	-18.7	-18.3	0.4	10.4	-	9.9	10.9	1.0
Adults	53	-18.6	0.5	-21.0	-17.2	3.8	10.2	1.0	6.4	12.6	6.2
Male adults	3	-18.5	0.3	-18.8	-18.3	0.5	9.6	0.7	8.9	10.3	1.4
Female adults	7	-18.8	0.8	-20.5	-18.0	2.5	10.7	1.1	8.7	12.1	3.4
Grave g absence	52	-18.7	0.6	-21.2	-17.6	3.6	10.0	1.0	6.4	12.9	6.5
Grave g presence	25	-18.3	0.4	-18.9	-17.2	1.7	10.4	0.8	9.0	12.1	3.1
C&J presence	22	-18.3	0.4	-18.9	-17.2	1.7	10.5	0.8	9.0	12.1	3.1
Cont presence	1	-18.7	-	-	-	-	9.7	-	-	-	-
T&W presence	4	-18.3	0.2	-18.6	-18.1	0.5	10.5	0.5	9.8	11.0	1.2

The distribution of nitrogen isotope ratios among the humans from Boadilla shows a different arrangement. The mean δ^{15}N of the population was 10.1‰ and they had a standard deviation of 1.0‰ and a range of 6.5‰. This was the largest spread of nitrogen isotope ratios among all the human assemblages analysed for this thesis. However, it has to be acknowledged that removing outliers the range is reduced to 4.0‰ and, furthermore, 60 out of 77 samples were concentrated in the range between 9.0‰ and 11.0‰, so most of the population was within a range of 2‰. In this way, the difference between the mean human δ^{15}N and the mean δ^{15}N of herbivores from Boadilla and Alameda del Señorío was 2.1‰. This offset is smaller than the typical fractionation between trophic levels verified for nitrogen isotope ratios (~5‰). Then, in general terms the population buried in the cemetery of Boadilla was having limited proportions of animal protein and probably their diets were predominantly based on plant products. Nevertheless, taking into account the large range of δ^{15}N, there were surely significant differences between individuals in the access to animal protein.

Beyond this general pattern, seven individuals exhibited extreme δ^{13}C or δ^{15}N values which made them outliers. They can be divided in four groups showing approximately common dietary behaviours. First, there was individual BOA 105-3. This was an infans 1A who died between 1 and 2 years of age and had one of the most enriched δ^{13}C values in the assemblage and the highest δ^{15}N in Boadilla. Considering enrichment was verified in both variables and the age of the individual, it is reasonable to state this infans 1A was showing the effect of breastfeeding on its isotopic signature. Breastfed babies are one trophic level above their mothers because there is a conventional fractionation step between them (Beaumont *et al.* 2018, Dupras 2010, Reynard & Tuross 2015). Individual BOA 105-3 was 1.2‰ higher in δ^{13}C than the mean of local adult women and 2.2‰ in δ^{15}N. With these figures it is challenging to determine if the individual was still exclusively breastfed or it had already been partially weaned. Its age would point at the second hypothesis. In fact, the enrichment associated to breastfeeding does not disappear from bone collagen immediately when the individual is weaned, but it takes some weeks or months to be completed. Thereby, it is interesting to note that individual BOA 072-3, the only infans 1A analysed in addition to the outlier, did not show any sign of the breastfeeding effect. Still, this individual was older when it died (2-3 years). Consequently, it had more time to eliminate the influence of nursing.

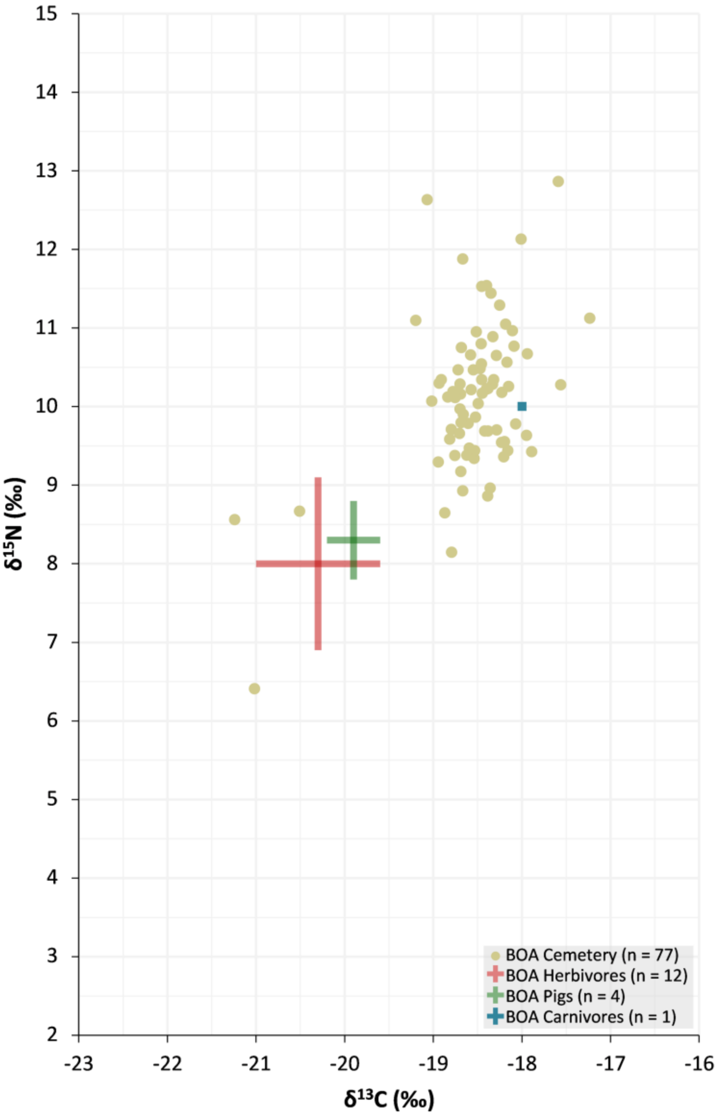


Figure 3.38. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of humans from Boadilla. Crosses represent mean and one standard deviation of the fauna from Boadilla grouped by feeding regime. Fowl are not displayed because they are very variable

The second group of outliers was formed by individuals BOA 179-2 and BOA 182-1. The two subjects had δ^{15}N values close to the mean of the population or somewhat above it and the most enriched δ^{13}C values (together with individual BOA 105-3). Hence, their diet must have included a greater proportion of C_4 plants. Both were buried in simple pit graves. BOA 179-2 was an undetermined individual without any grave goods. Instead, BOA 182-1 was an adult of undetermined sex buried with a single necklace bead. None of these features explain the particularity of the diet of these individuals, so the reason why they were eating more millets than their neighbours is unclear.

Individual BOA 139-1 constituted the third group of outliers. This adult of undetermined sex had the greatest nitrogen isotope ratio among the adults from Boadilla, pointing at a diet richer in animal protein than the average. Conversely, its δ^{13}C was slightly lower than most samples, although it was not an outlier. This suggests individual BOA 139-1 had an exclusive C_3 diet or very small contribution of millets. This individual was buried in a simple pit without any grave goods. Seemingly, there was nothing in its skeleton or funerary ritual which could explain its greater consumption of animal protein.

The last group of outliers in Boadilla was made up by individuals BOA 072-1, BOA 086-1 and BOA 138-1. They were characterised by very depleted δ^{13}C and quite low δ^{15}N, although only individual BOA 138-1 was an outlier on both variables. Carbon stable isotope ratios were especially remarkable because they were even lower than most herbivores. Meanwhile, nitrogen isotope ratios of two of these individuals were just above the mean of herbivores and omnivores and on the lower end of the core of human values. The other individual was even more depleted in δ^{15}N, being close to the equid with the lowest nitrogen isotope ratio of the whole assemblage. Altogether, the isotopic signatures of these individuals indicate their diets were exclusively based on C_3 resources and they ate very small proportions of animal protein. Actually, their carbon and nitrogen isotope ratios are so different to the mean of the population that it cannot be ruled out they were migrants from a region with a different isotopic baseline still retaining it. All these individuals did not belong to the same demographic category. Individual BOA 072-1 was an infans 1B who died between 3 and 5 years of age, individual BOA 086-1 was a probably female adult and individual BOA 138-1 was an adult of undetermined sex. None of them showed any meaningful pathologies in their skeletons. Both adults were buried in simple pit graves, while individual BOA 072-1 was in one of the few wall burials in the cemetery. Grave goods were not found next to any of these individuals. Based on the evidence available, it is difficult to determine the cause of the particular diet of this small group of individuals.

Although macroscopic preservation was poor and precise age estimation and sex determination could only be achieved for a small number of individuals (see section 3.1.2.2.1), it was interesting to analyse the evolution of diet throughout life at Boadilla and the possible differences in food consumption patterns between sexes. Figure 3.39 and figure 3.40 represent the distribution of carbon and nitrogen stable isotope ratios according to age and sex. Focusing on age, the first observation is there was a big difference between the behaviour of δ^{13}C and δ^{15}N along age categories. Omitting infans 1A, which were biased by outlier BOA 105-3 showing the effect of breastfeeding (see above), carbon stable isotope ratios were steady along all age groups (figure 3.40A), whereas nitrogen isotope ratios set off at infans 1B at the lowest median of all age categories to increase progressively until juveniles reached δ^{15}N values equivalent to adults (figure 3.40B). This is undoubtedly related to the greater homogeneity of δ^{13}C in the whole population in comparison to δ^{15}N, which was more widely spread. However, this does not diminish the relevance of this pattern. According to these data, there would have been no substantial changes in the type of cereals consumed as individuals grew older. In contrast, animal protein consumption would have been determined by age. Individuals under 7 years of age would have had restricted access to meat and other animal byproducts and subadult would only equate adult animal protein intake during adolescence, after the age of 15. This could be a hint for the definition of the threshold of adulthood in early medieval rural Iberia, that is, the age individuals started to be socially considered adults (Lewis *et al.* 2016). These conclusions are further supported by statistics. Even though there were no statistically significant differences between subadults and adults in either variable when the former are considered jointly (δ^{13}C BOA subadults (n = 18) vs adults (n = 53), Mann-Whitney U test: U = 450.500, z = -0.352, p = 0.725; δ^{15}N BOA subadults (n = 18) vs adults (n = 53), Mann-Whitney U test: U = 624.500, z = 1.952, p = 0.051); when subadult age categories are split down, the uniformity of δ^{13}C is strengthened and the differences between δ^{15}N values rise up (δ^{13}C BOA specific age categories, Kruskal-Wallis H test: n = 67, H =

6.119, d.f. = 4, p = 0.190; δ^{15}N BOA specific age categories, Kruskal-Wallis H test: n = 67, H = 11.337, d.f. = 4, p = 0.023). Considering this result, δ^{15}N of all age categories were compared pairwise. After Bonferroni correction there were no statistically significant differences in any pair, but the closest to the significance level was indeed the comparison between infans 1B and adults (δ^{15}N BOA infans 1B vs adults: p = 0.083).

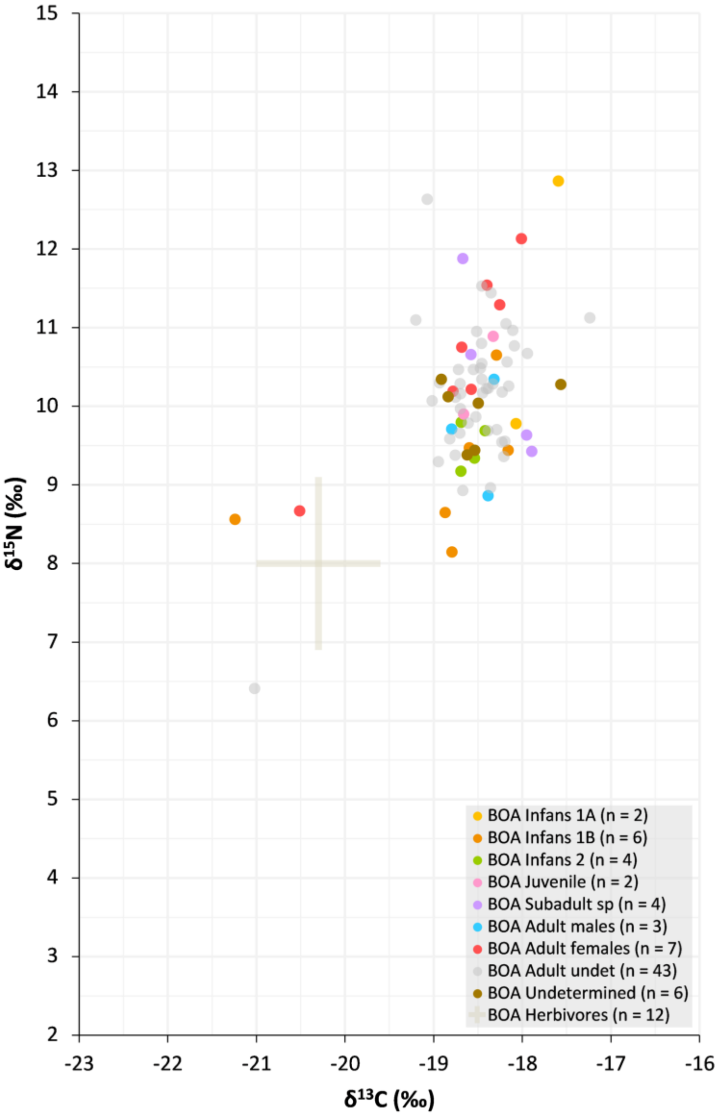


Figure 3.39. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of humans from the cemetery of Boadilla divided by demographic categories. Cross represents mean and one standard deviation of herbivores from Boadilla

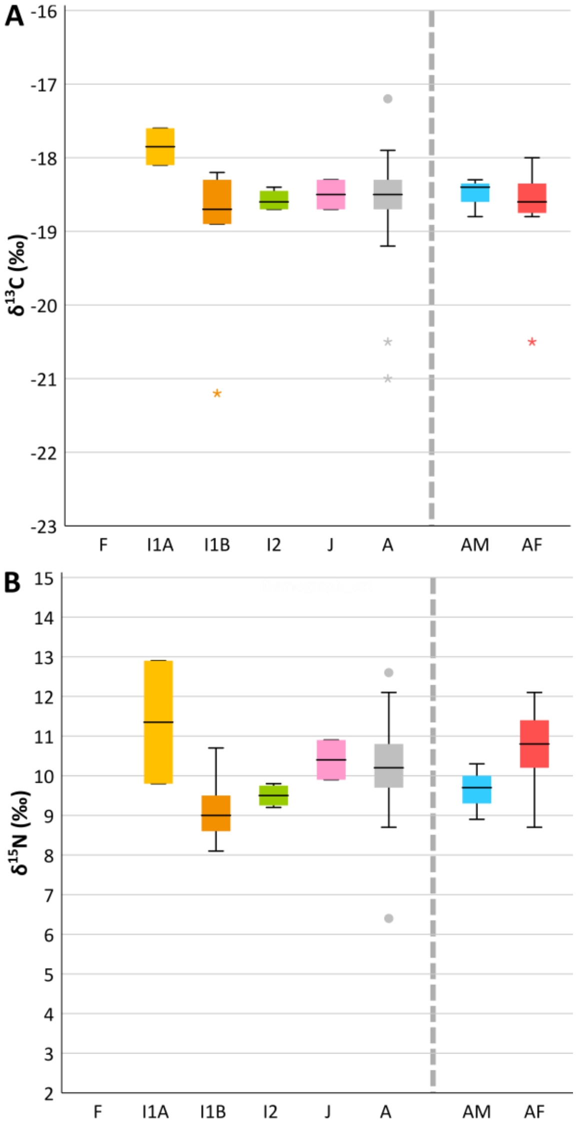


Figure 3.40. Boxplots representing (A) carbon stable isotope ratios (δ^{13}C) and (B) nitrogen isotope ratios (δ^{15}N) of humans from Boadilla divided by demographic categories. Key: F = fetus, I1A = infans 1A, I1B = infans 1B, I2 = infans 2, J = juvenile, A = adults, AM = adult males, AF = adult females

The number of adults whose sex could be determined was very small. Besides, it was strongly imbalanced in favour of women. For this reason, even if statistical analysis determines there were no significant differences in either δ^{13}C or δ^{15}N between adult males and females (δ^{13}C BOA adult males (n = 3) vs adult females (n = 7), Mann-Whitney U test: U = 9.500, z = -0.230, p = 0.833; δ^{15}N BOA adult males (n = 3) vs adult females (n = 7), Mann-Whitney U test: U = 16.000, z = 1.257, p = 0.267), results may not be as representative as required. Therefore, it is not really possible to define the relationship between male and female diets at Boadilla.

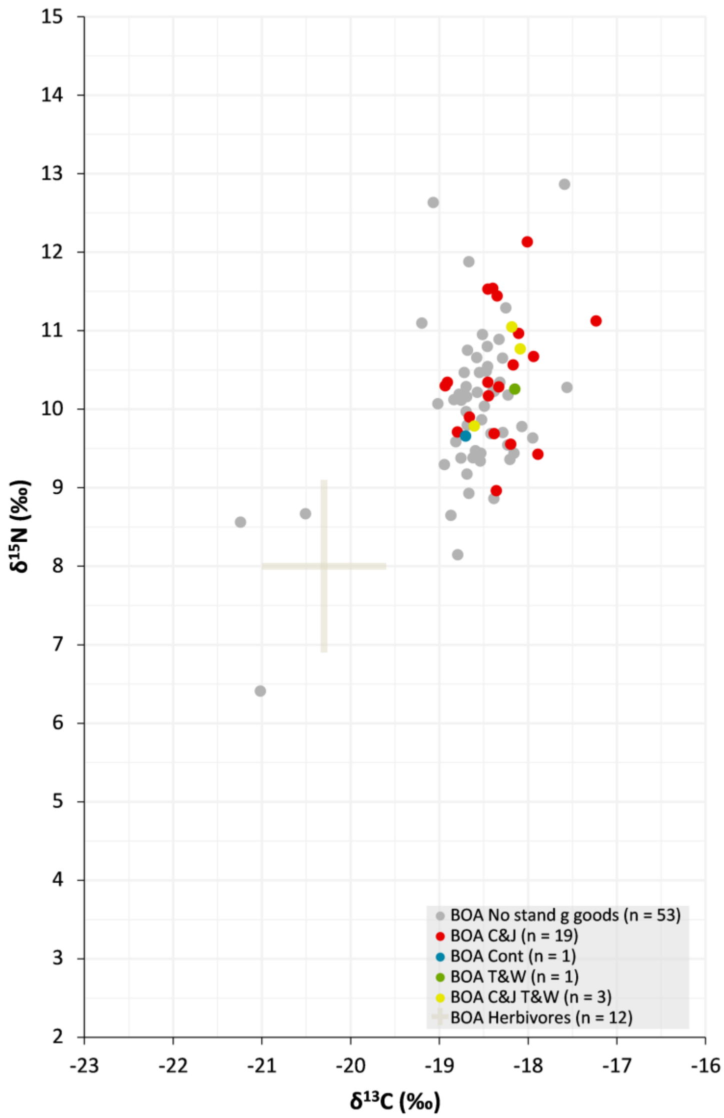


Figure 3.41. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from the cemetery of Boadilla divided by type of grave goods. Cross represents mean and one standard deviation of herbivores from Boadilla. Key: No stand g goods = no standardised grave goods, C&J = clothing items & jewellery, Cont = containers, T&W = tools & weapons

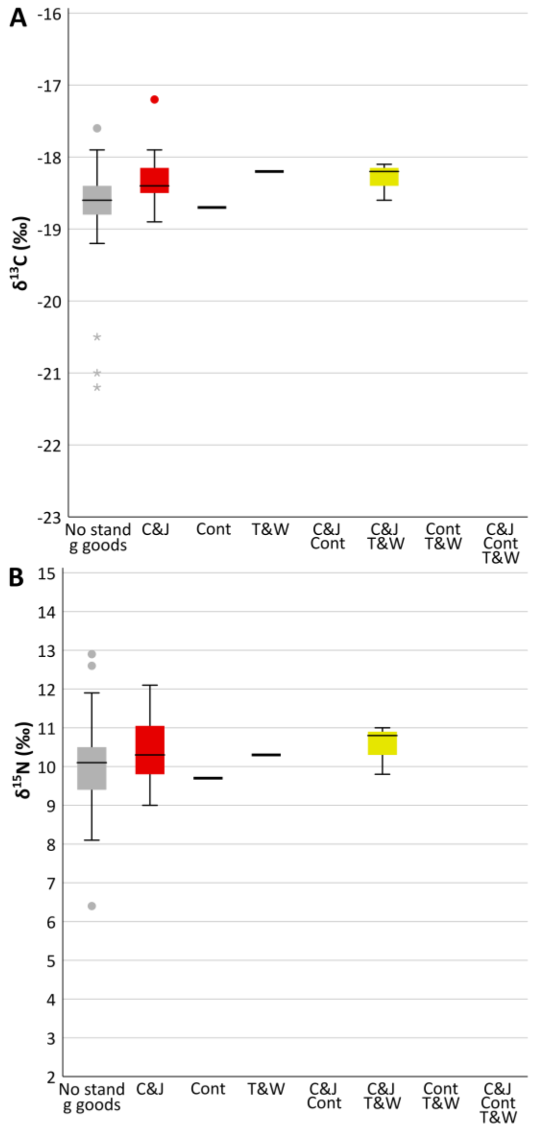


Figure 3.42. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from the cemetery of Boadilla divided by type of grave goods. Key: No stand g goods = no standardised grave goods, C&J = clothing items & jewellery, Cont = containers, T&W = tools & weapons

The comparison of carbon and nitrogen stable isotope ratios between individuals buried with and without grave goods is an interesting approach to explore the relationship between social status, as expressed in the funerary ritual, and diet, which can be considered an everyday marker of social status. Twenty-four of the individuals successfully analysed were buried with some kind of artefact, a proportion similar to the one recorded in the entire population (see section 3.1.2.1.3). The distribution of individuals without and with different combinations of grave goods is displayed in figure 3.41 and figure 3.42. All the individuals accompanied by any object were close to the mean $\delta^{13}C$ and $\delta^{15}N$ values of the population and only one of them was an outlier (BOA 182-1). Still, individuals with grave goods tended towards slightly enriched carbon and nitrogen stable isotope ratios. This means that individuals buried with artefacts probably ate greater proportions of C_4 plants and animal protein than the individuals without and none of the few individuals with exclusive C_3 diets had any grave goods. In fact, it was verified that the differences in the distributions of both $\delta^{13}C$ and $\delta^{15}N$ between individuals with and without grave goods were statistically significant ($\delta^{13}C$ BOA individuals without grave goods (n = 52) vs individuals with grave goods (n = 25), Mann-Whitney U test: U =

906.500, z = 2.804, p = 0.005; δ^{15}N BOA individuals without grave goods (n = 52) vs individuals with grave goods (n = 25), Mann-Whitney U test: U = 871.000, z = 2.408, p = 0.016). However, there were no further statistically significant differences when types of grave goods were considered separately (δ^{13}C BOA specific grave goods, Kruskal-Wallis H test: n = 77, H = 8.963, d.f. = 4, p = 0.062; δ^{15}N BOA specific grave goods, Kruskal-Wallis H test: n = 77, H = 5.813, d.f. = 4, p = 0.214), which was likely due to the fact that the majority of the artefacts belonged to a single category (i.e. clothing items & jewellery). In short, there is evidence to suggest at Boadilla there was some association between certain dietary patterns, such as the consumption of millets or the greater intake of animal protein, and the use of grave goods. Still, it is important to underline that these features were not exclusive of the individuals buried with artefacts.

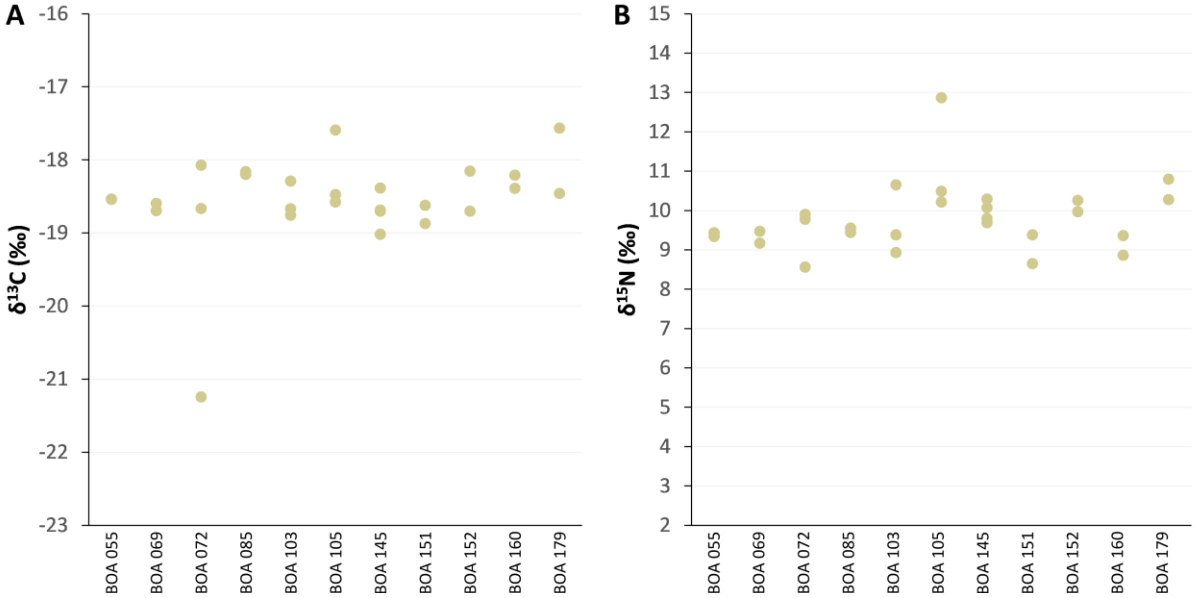


Figure 3.43. Scatterplots representing the spread of (A) carbon stable isotope ratios (δ^{13}C) and (B) nitrogen isotope ratios (δ^{15}N) of the individuals from Boadilla buried in the same funerary structure

It was also deemed interesting to pay attention to the variability of δ^{13}C and δ^{15}N among the individuals buried in the same grave, with the aim of trying to understand the criteria that could have determined this decision. There were eleven burials from which more than one and up to four individuals were analysed successfully (figure 3.43). The general trend is that individuals from the same grave show similar carbon and nitrogen stable isotope ratios. Actually, even outliers BOA 105-3 and BOA 179-2 were quite close to the individuals they shared funerary structure with and only outlier BOA 072-1 stood out notably in δ^{13}C in comparison to the other individuals in the burial. In this way, the δ^{13}C mean standard deviation of the individuals in the same grave was 0.4‰ and δ^{15}N mean standard deviation was 0.5‰. These values are lower than the standard deviation for the whole population, especially in the case of δ^{15}N, and they confirm that dietary variability was smaller among individuals buried together than within the entire cemetery of Boadilla. Then, these data provide evidence for the hypothesis that burials gathered individuals from groups with similar diets, which could correspond to domestic units where the same food resources were available more or less equally for everyone.

Table 3.12. Summary statistics of carbon (δ^{13}C) and nitrogen (δ^{15}N) stable isotope ratios of human samples from the cemetery of Boadilla divided by phase

	n	*δ^{13}C (‰)*					*δ^{15}N (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All humans	77	-18.6	0.6	-21.2	-17.2	4.0	10.1	1.0	6.4	12.9	6.5
Phase 1	7	-18.2	0.3	-18.6	-17.9	0.7	10.9	0.8	9.8	12.1	2.3
Phase 2	23	-18.6	0.6	-21.0	-17.2	3.8	10.3	1.1	6.4	12.6	6.2
Phase 3	47	-18.6	0.6	-21.2	-17.6	3.6	9.9	0.9	8.1	12.9	4.8

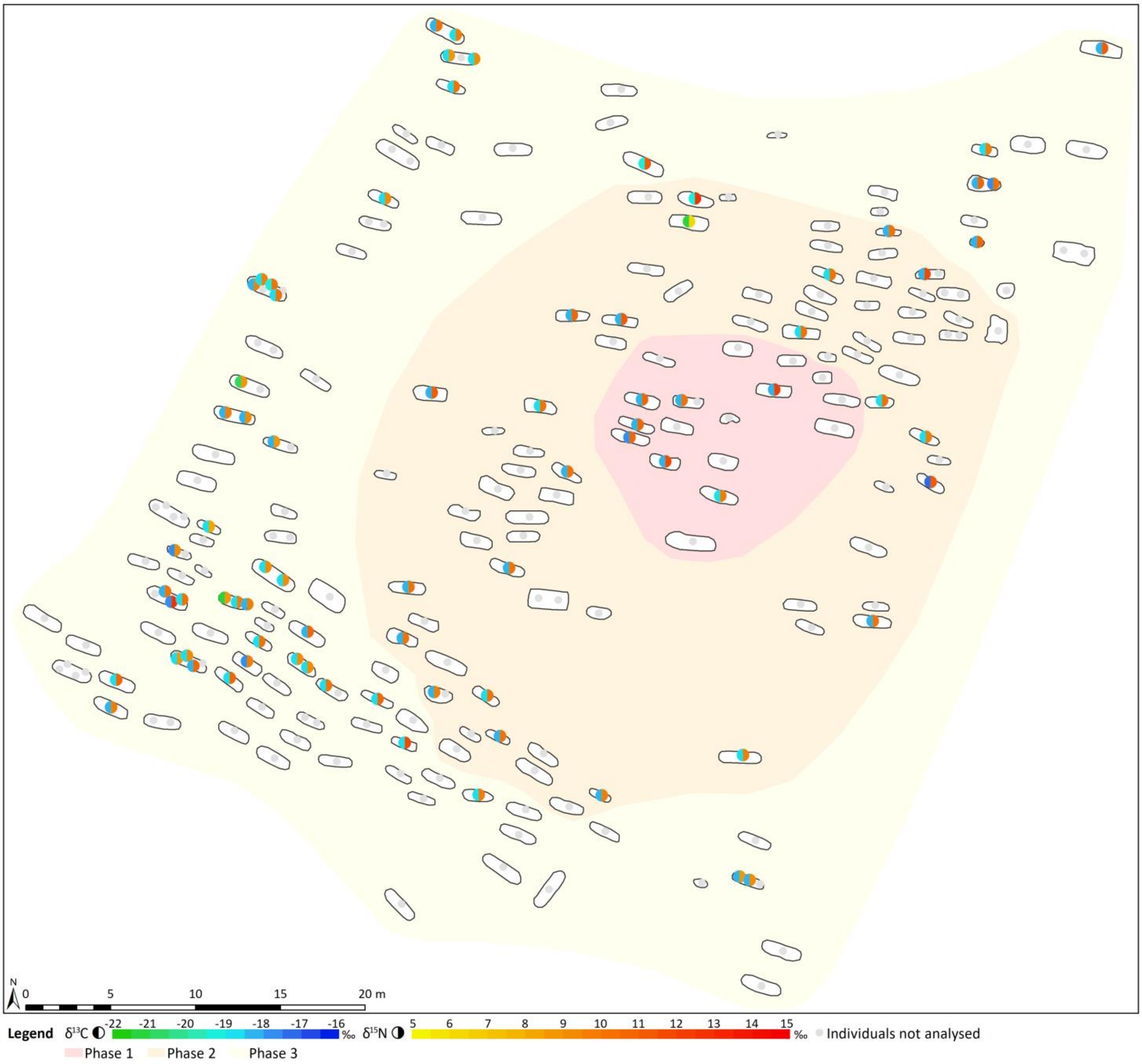


Figure 3.44. Boadilla, cemetery, spatial distribution of individuals divided by carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) (Catalán & Rojas 2009: 225, modified). Individuals successfully analysed are represented with a big circle divided in two. The left half symbolises $\delta^{13}C$ and the right half $\delta^{15}N$ according to the colour gradient shown in the legend. Individuals not analysed are depicted with a smaller grey point

Likewise, spatial distribution and diachronic evolution of carbon and nitrogen stable isotope ratios was examined. In the case of Boadilla, given the concentric development of the cemetery (see section 3.1.2.1.3), these two variables were intertwined. At first glance, the topographic distribution of isotopic signatures looks like random (figure 3.44). There were no clusters of individuals with similar diets, no clear spatial progression of either $\delta^{13}C$ or $\delta^{15}N$ was observed and outliers were scattered all around the graveyard. Hence, individuals with quite different diets were buried next to each other and the opposite happened too. As it was discussed in the previous paragraph, the only noticeable pattern was provided by individuals buried together in the same structure, which tended to have similar isotopic signatures. However, when the site was divided by phases (Catalán 2013: 225), meaningful differences arose (table 3.12, figure 3.45). Individuals of phase 1 showed greater homogeneity than any other phase and the assemblage as a whole. They were characterised by more enriched isotopic signatures both for $\delta^{13}C$ and $\delta^{15}N$, pointing at a more consistent consumption of millets and a greater intake of animal protein in comparison to the individuals dated to subsequent periods. The distributions of carbon stable isotope ratios were almost identical during phases 2 and 3 and they tended towards slightly more depleted values, which indicates that from the second quarter of the 6th century onwards individuals were having on average smaller proportions of C_4 crops. Mean nitrogen isotope ratios presented more variability, decreasing progressively from phase 1 to 3. This signifies that overall individuals of the foundational nucleus ate greater proportions of animal protein than during the later phases, yet the decline in the consumption of meat and other byproducts was not only between phases 1 and 2, but it was accelerated after the mid-6th century. In fact, when these trends were tested, statistically significant differences were detected in the distributions of both carbon and nitrogen stable isotope ratios between the three phases ($\delta^{13}C$ BOA phases, Kruskal-Wallis H test: n = 77, H = 6.148, d.f. = 2, p = 0.046; $\delta^{15}N$ BOA phases, Kruskal-Wallis H test: n = 77, H = 11.019, d.f. = 2, p = 0.004). Besides, *post hoc* pairwise comparison revealed more specifically differences lay in the contrast between phases 1 and 3 for either $\delta^{13}C$ and $\delta^{15}N$ ($\delta^{13}C$ phase 1 vs phase 3: p = 0.041; $\delta^{15}N$ phase 1 vs phase 3: p = 0.017), while the differences between any other combination of periods was not statistically significant in any case ($\delta^{13}C$ phase 1 vs phase 2: p = 0.092; $\delta^{13}C$ phase 2 vs phase 3: p = 1.000; $\delta^{15}N$ phase 1 vs phase 2: p = 0.680; $\delta^{15}N$ phase 2 vs phase 3: p = 0.055). Therefore, phase 2, that is, the second quarter of the 6th century, would have been some sort of transition between the initial and the final situation in terms of dietary patterns. All in all, assuming the internal phasing proposed is correct, which should be further confirmed by radiocarbon dating, there would have been a significant change in the diet of the population of Boadilla between the first individuals buried in the cemetery and the larger group who used the graveyard from the middle of the 6th century on. Interestingly, this evolution would have consisted in a gradual decrease of the consumption of both millets and animal protein.

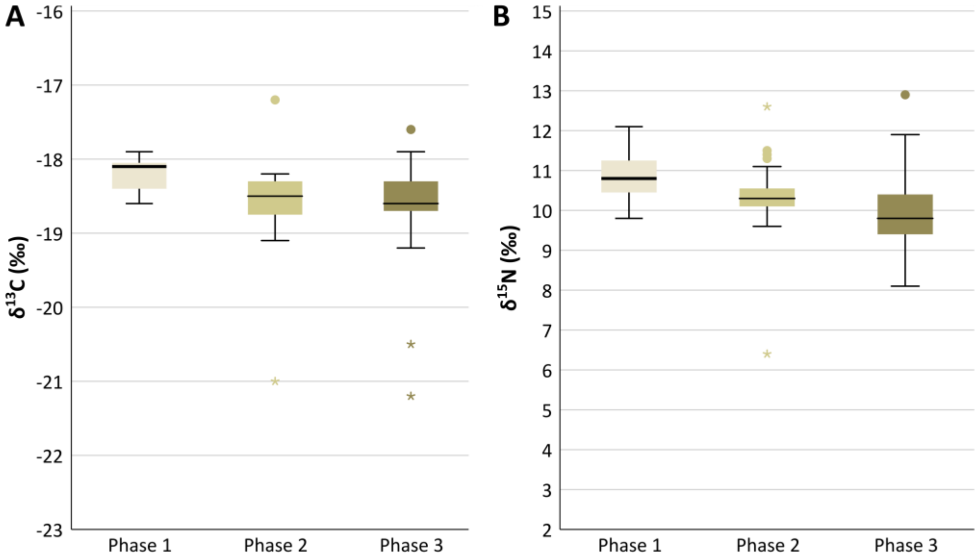


Figure 3.45. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from Boadilla divided by phase

3.1.3 EL SOTO/EL ENCADENADO

3.1.3.1 The site

3.1.3.1.1 Location and history of research

El Soto and El Encadenado were initially officially considered two independent archaeological sites. However, several archaeological interventions confirmed it was the same settlement. Therefore, this site is currently known as El Soto/El Encadenado. It is located east of the city of Madrid (figure 3.46), in the municipality of Barajas, and it is adjacent to Adolfo Suárez Madrid-Barajas Airport. Its UTM ETRS89 coordinates are 30T 454369 4481394 and it is 580 meters above sea level. It is 16 km northeast of Madrid city, 82 km north of Toledo and only 15 km west of the Roman city of Complutum (present Alcalá de Henares). Regarding the other archaeological sites from the same region included in this research, El Soto/El Encadenado is 28 km north of Gózquez, 46 km northeast of Boadilla and just 1.7 km south of La Huelga. Actually, El Soto/El Encadenado and La Huelga share many topographic and environmental features. They are both located on the right margin of the Jarama river, in a low and plain area very fertile for agriculture and pasture thanks to seasonal flooding. Still, it must be considered that the current riverbed of Jarama is different from its course during the Early Middle Ages, which could be recorded for this section during archaeological works. In addition, the Jarama valley is a natural corridor for north-south communications and it is very likely that an important road crossed the settlement. Besides, in this area there are various fords which would have facilitated mobility in east-west direction.

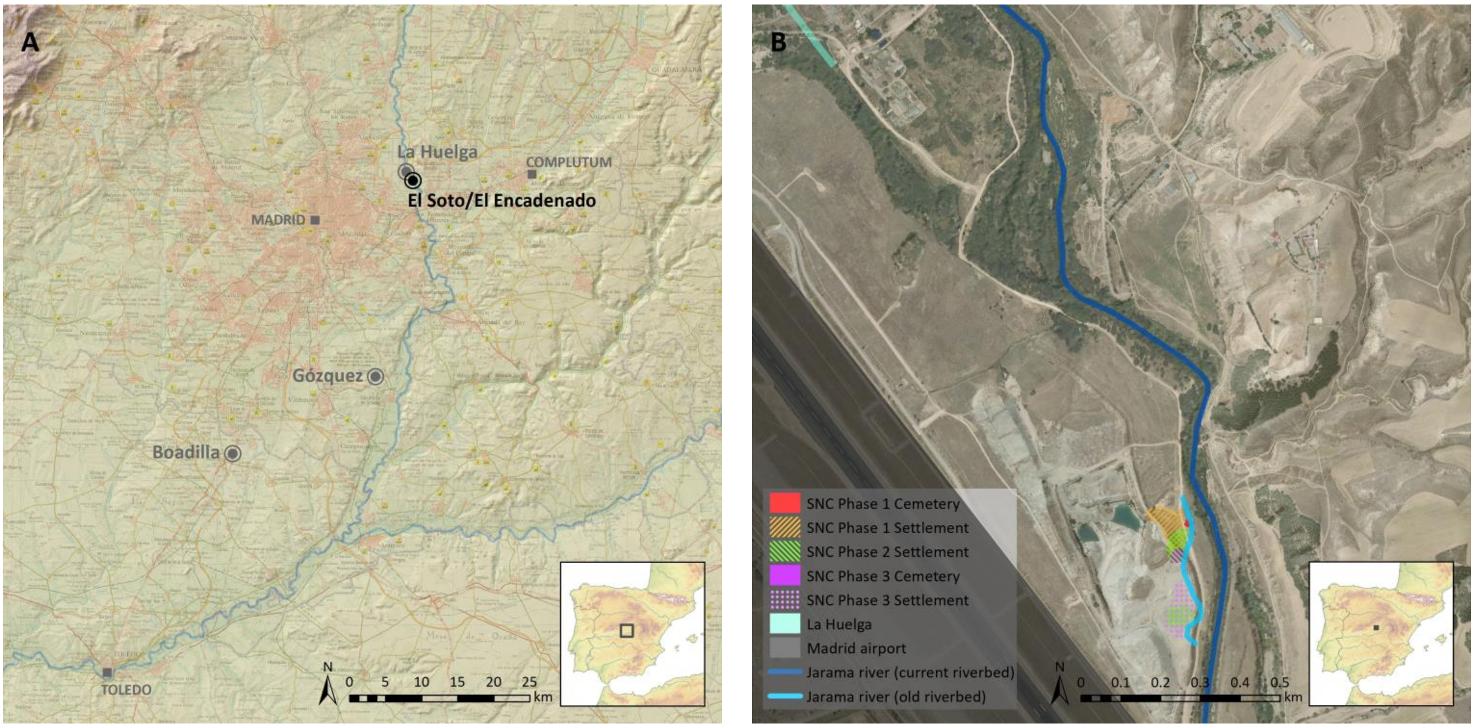


Figure 3.46. Geographical location of the site of El Soto/El Encadenado (Barajas, Madrid) (A) at the regional and (B) local scale

The records from El Soto/El Encadenado tackled in this thesis come from the archaeological excavations carried out by the cooperative society Área in 2003 and 2005. The first one was undertaken because of the burial of a high voltage electric line for the expansion of the airport. It was directed by M. M. Presas, J. L. Herce and A. Vigil-Escalera (2004) and it consisted of a long trench of 4000 m^2, where archaeological evidence was restricted to its southern end. In 2005 a new intervention was carried out under the direction of A. Vigil-Escalera and L. Vírseda (2007) for opening a new sector in a meerschaum mine. This new project covered 1.5

ha, which almost overlapped the trench dug in 2003. The results were richer both topographically and chronologically. The two cemeteries from El Soto/El Encadenado studied here come from this last intervention. The anthropological assemblage they generated is currently curated in the Regional Museum of Archaeology of Madrid, in Alcalá de Henares. Moreover, at least two other archaeological excavations were executed in El Soto/El Encadenado in the context of the expansion of the airport between 2002 and 2003 by the company Gestión del Patrimonio Cultural, but it was not possible to have any information on the results.

The settlement and the cemeteries of El Soto/El Encadenado have been the focus of several works. On one hand, there are the reports on the two archaeological campaigns cited above and a few descriptive publications on the settlement (Vigil-Escalera 2013d) and the cemeteries (Vigil-Escalera 2015c). El Soto/El Encadenado was part of the corpus of sites used by A. Vigil-Escalera (2007a) for the definition of early medieval farms and villages and it has also been included in various general overviews on landscape and settlement patterns (Ariño 2013, Quirós & Vigil-Escalera 2006, Vigil-Escalera 2003c, Vigil-Escalera 2005) and funerary practices (Vigil-Escalera 2013b, Vigil-Escalera 2015b) during this period. This site is especially important for the understanding of the first phases of Islamization in Iberia (Gutiérrez Lloret 2013, Gutiérrez Lloret 2015, Vigil-Escalera 2009b). Domestic architecture from El Soto/El Encadenado (Tejerizo 2013, Tejerizo 2014), as well as the internal arrangement of the settlement (Vigil-Escalera 2010), have also been analysed in detail. Regarding artefacts, only pottery (Serrano *et al.* 2016, Vigil-Escalera 2015d) and glass (Gómez de la Torre-Verdejo 2017) have been devoted specific attention. Fauna was studied by A. Morales and L. Llorente (2004a) in an unpublished report. The results of palynological analyses were published by J. A. López-Sáez *et al.* (2010) and reviewed by B. Hernández-Beloqui *et al.* (2013). The two human populations recovered at El Soto/El Encadenado were originally studied by A. García Rubio (2007). Her work was very useful as a first approach to the main characteristics of the assemblage. Still, all the individuals were re-analysed by the author in order to standardize methods and data collection. In addition, E. Fernández Domínguez *et al.* (2009) performed mitochondrial DNA analyses on some individuals from both cemeteries.

3.1.3.1.2 The settlement

El Soto/El Encadenado is a multi-period site with archaeological evidence from Late Prehistory to Late Middle Ages. The oldest archaeological remains consist of a group of poorly preserved pits containing scarce materials, which possibly date to the Bronze Age (Presas *et al.* 2004: 20). The place was not inhabited again until the Early Middle Ages, when several occupations followed one another between the first half of the 5th century and the middle of the 9th century. Apparently, there is no direct relationship between these settlements and the Roman period, but it is likely that they exploited the agrarian resources of the nearby villa of El Rasillo, just 3 km north of El Soto/El Encadenado. On top of the early medieval structures, two small farms dedicated to cereal, oil and wine production were established between 13th and 15th centuries (Vigil-Escalera & Vírseda 2007: 31–37). Focusing on the early medieval period (Vigil-Escalera 2013d), three distinct phases were defined based on stratigraphy, the detailed analysis of pottery and a few radiocarbon dates. The former criterion was especially relevant, because El Soto/El Encadenado is one of the few early medieval rural Iberian sites where a dense network of vertical stratigraphic relationships could be recorded. The following description of the settlements and the cemeteries associated to them will ensue this periodization.

During the first half of the 5th century a small farm was settled in the northern zone of the main sector excavated (phase 1, figure 3.47A). It was probably formed by a single domestic unit and it did not last more than one generation. Due to the ephemeral nature of this occupation, the material remains it generated were modest. On one hand, there was a possible residential area which included a building combining a sunken featured part and another one on a stone perimeter base, an oven and various landfills, as well as the uncertain traces of a road crossing the settlement in north-south direction. On the other hand, between the road and the riverbed, there was a small cemetery. This funerary area is interpreted as the burial ground of the family living in the contemporary farm. Around the middle of the 5th century the site was abandoned. It was occupied again during the second half of the 6th century, when two domestic units forming a new small farm settled at El Soto/El Encadenado (phase 2, figure 3.47B). One of them was established in the central area of the site and the other one to the south. Both were made up of sunken featured structures as residential buildings and a number of underground storage silos. No graveyard related to this period was identified. This phase ended at the beginning of the 8th century, when major changes in the urbanism of the site took place. Throughout the 8th century and up to the middle of the 9th century (phase 3, figure 3.47C), the southern domestic unit was quite stable. It was rebuilt several times, so there was a packed superposition of structures in this area, but it was always the same type of arrangement formed by sunken featured buildings and underground storage pits or silos. The most important change happened in the central area, where a new burial ground overlapped the former domestic unit occupying that zone during phase 2. Two consecutive events were identified within this cemetery: first, when the Christian funerary ritual was followed, and second, under the rule of the Islamic funerary ritual (see section 3.1.3.1.3). The early medieval farm, including its cemetery, was definitively abandoned at the middle of the 9th century. Summing up, throughout the Early Middle Ages the site of El Soto/El Encadenado was recurrently occupied by small family farms aimed at agrarian activities which only lasted for a few generations each (Vigil-Escalera 2007a: 258). Thus, El Soto/El Encadenado, together with La Huelga (see section 3.1.4, Vigil-Escalera 2013e), El Malecón (Rodríguez Cifuentes & de Juana 2006) or Las Charcas (Rodríguez Cifuentes & Domingo 2006), is part of the network of small scattered settlements which exploited the Jarama fertile plain.

Figure 3.47. El Soto/El Encadenado, diachronic evolution of the site (Vigil-Escalera 2013d: 217, Vigil-Escalera & Vírseda 2007: plates 2, 13, 23, modified)

The most abundant material at El Soto/El Encadenado was pottery. During phase 1 (Vigil-Escalera 2015d) fineware was still present. Hispanic late red slip ware was predominant but a simplification of shapes and decorations, as well as a worsening of the quality of productions, was already observable. Imports were reduced to a single item of African red slip ware. Among coarsewares pots prevailed and they started to show some of the features of purely early medieval productions, such as the use of slow wheel. Finewares and imports were completely absent from the pottery assemblages dated to phase 2 (Vigil-Escalera 2013d: 227–228), which was the only period of El Soto/El Encadenado when slow wheel and handmade productions were majority. During phase 3 all pottery was still coarseware and some handmade productions survived, but fast wheel reappeared for jugs, bowls and pots (Serrano *et al.* 2016). In general terms an improvement of productive processes is observable from the middle of the 8th century on, which can be interpreted as the result of the reduction and stabilization of production centres and the strengthening of regional exchange networks. Regarding the other types of materials, a few complete glass items were recovered in the cemetery dated to phase 1, but otherwise it was very scarce in every period. Bowls, dishes and drinking glasses mainly in green prevailed, but there were also fragments in blue and amber (Gómez de la Torre-Verdejo 2017: 331–342). Metals were also rare, consisting mainly of discarded tools such as nails, knives and undetermined plates. Exceptionally a decorated bronze plaque, a ring and a golden earring were found in structures dated to phases 2 and 3. In addition, two late Roman coins were found out of context. Surprisingly hand mills made of granite were proportionately scarcer than in other contemporary similar sites, even though a complete one was recovered from a silo.

There is not a lot of information on the bioarchaeological records from El Soto/El Encadenado, but still it is possible to have a general overview on landscape and productive strategies. Seeds have not been systematically studied yet, but it is known that at least a peach pit was found in a sunken featured structure of phase 2 (Vigil-Escalera 2013d: 230). This has been interpreted as evidence of the presence of fruit trees around the settlement, which would have been a sensible choice considering the riverine location of the site. In the zooarchaeological assemblage from El Soto/El Encadenado (Morales & Llorente 2004a) the dominant taxon were ovicaprids, followed by cattle, pigs and equids in that order. According to kill-off patterns ovicaprids were mainly aimed at meat and cattle was used for traction. Fowl, including chicken and goose, and dogs were also proportionately well represented. The only examples of game were wild boar and red deer. A marine shell too was recovered, most possibly used as an ornament rather than as food. It is noteworthy the identification of a high proportion of complete carcasses probably abandoned on the surface, instead of being dismembered and discarded with rubbish after consumption. Pollen analyses of samples from phases 2 and 3 (López-Sáez *et al.* 2010) determined the surroundings of El Soto/El Encadenado were severely deforested. Pasture with scattered holm oaks dominated the landscape, but there were also cereal fields close to the settlement, as indicated by the presence of cereal pollen in most of the samples. Finally, the genetic analysis of some of the individuals from the cemetery of phase 3 deserves some attention (Fernández Domínguez *et al.* 2009). This study only considered mitochondrial DNA, which provides information exclusively on maternal lineages. The results concluded that all the individuals had European mitochondrial haplogroups. Therefore, there was genetic continuity between Christian and Muslim individuals at least on the maternal lineage. In addition, maternal kinship was confirmed between two individuals buried following different rituals. Likewise, no maternal relationship was found between the individuals from two multiple graves.

3.1.3.1.3 The funerary contexts

At El Soto/El Encadenado there were two separate funerary areas: the necropolis corresponding to phase 1 and the cemetery dated to phase 3 (figure 3.47, table 7.1). The first graveyard (figure 3.48B, Vigil-Escalera 2015c, Vigil-Escalera & Vírseda 2007: 21–24) was located east of the residential area, in a narrow fringe between the road which crossed the settlement in north-south direction and the parallel course of the Jarama river. The excavation discovered nine burials (n = 9/42 = 21.4%), which meant two fifths of all the funerary structures excavated in the site. They formed a small group, all of them being oriented in south-north (n = 4/9 = 44.4%) or north-south direction (n = 2/9 = 22.2%) without intersecting each other. It was not possible to determine the orientation of the remaining burials (n = 3/9 = 33.3%) due to poor preservation. According to the features of the funerary ritual, especially grave goods, this small funerary assemblage is dated throughout the second half of the 5th century, contemporaneously to the adjacent settlement. All the burials in this phase were simple pits (n = 9/9 = 100.0%) and each one contained a single individual, so the number of individuals in this population was nine. In six of the burials it could be verified they were primary deposits with the individuals in supine position (n = 6/9 = 66.7%). In a third of the cases bad preservation did not allow to record the original arrangement of the individuals (n = 3/9 = 33.3%). Two thirds of the individuals were surrounded by nails (n = 6/9 = 66.7%, table 7.2), which indicates they were buried in wooden coffins. Another two thirds were accompanied by grave goods (n = 6/9 = 66.7%). All of them had containers in pottery or glass (n = 6/9 = 66.7%). In addition, a couple had jewellery deposited with them (n = 2/9 = 22.2%), more precisely a necklace made of eighteen beads and a ring. No tools (n = 0/9 = 0.0%) or other types of objects were used as grave goods in this small cemetery.

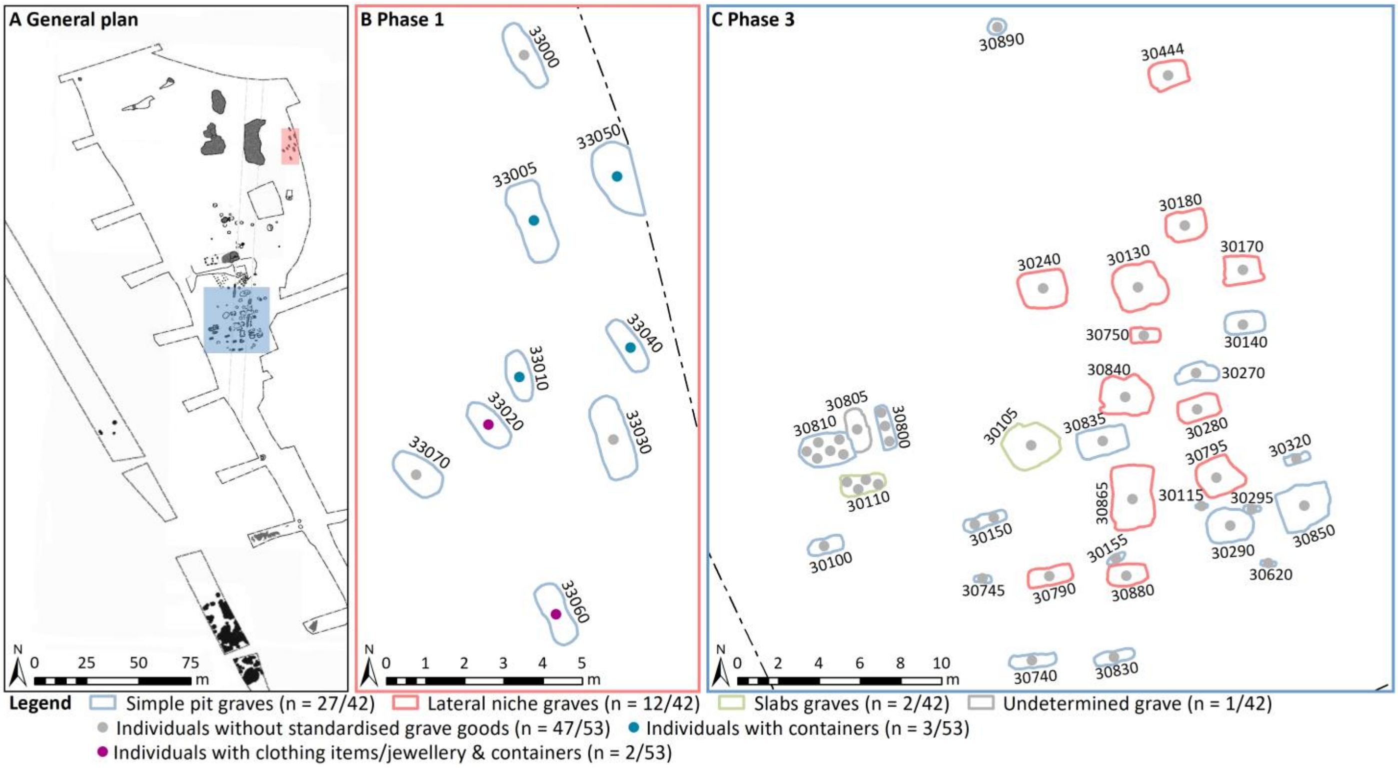


Figure 3.48. El Soto/El Encadenado, funerary contexts (Vigil-Escalera & Vírseda 2007: plates 7, 26, Vigil-Escalera 2015c: 171, modified). (A) General plan of the site highlighting the two areas with funerary contexts. The colour of each area matches that of the frame of their corresponding detailed plan to the right. (B) Cemetery of phase 1. (C) Cemetery of phase 3. The dashed line depicts the excavation limits. The outline of burials is represented with a solid line whose colour shows the type of funerary structure according to the legend. The number next to each burial is its identifier. Points symbolise the individuals recovered in each burial. Their colour indicates the presence or absence of grave goods as stated in the legend

No new funerary structures appeared at El Soto/El Encadenado until phase 3 (figure 3.48C, Vigil-Escalera 2009b, Vigil-Escalera & Vírseda 2007: 29–31). During this period the settlement concentrated on the southern end of the area excavated and the cemetery was established 50 m north of it, on top of the northern residential area of phase 2 (figure 3.47). That is, as it happened during phase 1, the funerary area was placed in a peripheral zone around the settlement. The necropolis of phase 3 was formed by 33 burials (n = 33/42 = 78.6%), almost three fifths of all the graves excavated at El Soto/El Encadenado. They were arranged in a small agglomeration with two clusters, a smaller one to the west and a bigger one to the east. Three groups of burials could be defined based on their formal features and relative chronology. The oldest two burials were SNC 30800 and SNC 30805. They were located next to each other in the western cluster and they were characterised by their north-south orientation. The second group, formed by burials SNC 30100, SNC 30110 and SNC 30810, completed the western cluster. They were different from the first one in their west-east orientation, but individuals were laid in supine position, as it happened in the former. It could be determined these three burials were more modern because one of them cut one of the burials in the first group (i.e. SNC 30810 cut SNC 30805). The eastern cluster was the most recent one. Here all the graves were oriented in west-east direction, they did not cut each other and individuals were placed in lateral position. The latter indicates the individuals in this sector were buried according to the Islamic funerary ritual. Conversely, the former two groups, as well as the individuals in the cemetery of phase 1, are assumed to have been Christians. Therefore, this graveyard is an excellent testimony of the process of early Islamisation of a rural local community, which, according to the material evidence in the settlement and the results of DNA analyses (Fernández Domínguez *et al.* 2009), did not imply a demographic replacement. Thanks to formal features and radiocarbon dates (table 7.3), this necropolis as a whole was dated between the beginning of the 8th century and the middle of the 9th century. Even if a relative sequence could be made, it was not possible to assign precise dates to each burial, also because there were some disagreements between radiocarbon measurements (Vigil-Escalera 2009b).

Summing up, the most frequent type of burial in the funerary area of phase 3 were simple pits (n = 18/33 = 54.5%), followed by lateral niche graves (n = 12/33 = 36.4%). The latter are characteristic of the Islamic funerary tradition (Vigil-Escalera 2015b), so it makes sense they were restricted to the eastern cluster of the cemetery and all the individuals buried in them were placed in lateral position. Besides, it was observed that in the eastern cluster simple pits were more frequently used for subadults and lateral niche graves for adults (simple pits: subadults = 8, adults = 6, lateral niche graves: subadults = 3, adults = 9). Next in number there were a couple of slabs burials (n = 2/33 = 6.1%) lined with big gypsum blocks. They were interesting because they belonged to individuals buried according to different funerary rituals but they were topographically very close, so they could have been the link between the Christian and the Islamic nuclei. The typology of one of the tombs could not be determined (n = 1/33 = 3.0%). As mentioned above, most of the burials were oriented in west-east direction (n = 26/33 = 78.8%), but there was also one in north-south direction (n = 1/33 = 3.0%) and a few cases where orientation could not be determined (n = 6/33 = 18.2%).

The total number of individuals identified in this cemetery was 44. This would imply a mean occupation rate of 1.3 individuals per burial. However, it is noteworthy that reuse was significantly more frequent in Christian graves (5 burials, 15 individuals, mean number of individuals per burial = 3.0, maximum number of individuals per burial = 6) than in Islamic ones (28 burials, 29 individuals, mean number of individuals per burial = 1.0, maximum number of individuals per burial = 2). Most of the individuals were found in primary deposits. The majority of them were in lateral position (n = 21/44 = 47.7%) and only a small proportion in supine position (subadults = 8, adults = 6), which makes sense considering the Islamic sector of the cemetery was bigger than the Christian one. Still, it must be mentioned that one of the individuals in supine position (SNC 30835-1-30837) was located in the eastern cluster, surrounded by individuals in lateral position. It is unclear whether this anomaly is the consequence of a postdepositional displacement of the corpse or it was actually buried like that, so it would have to be interpreted as a Christian. In addition, a quarter of the individuals were recovered in secondary deposits, either in clearly identifiable reductions (n = 5/44 = 11.4%), scattered in the fillings of burials (n = 1/44 = 2.3%) or in undetermined placements (n = 5/44 = 11.4%). In a small proportion of cases it was not possible to determine the original position of individuals (n = 7/44 = 15.9%). In another vein, none of the individuals from this cemetery had any elements which pointed at the use of wooden coffins (n = 0/44 = 0.0%) and none of them were accompanied by any kind of grave goods either (n = 0/44 = 0.0%, table 7.2).

3.1.3.2 The human populations

3.1.3.2.1 Macroscopic preservation

Two distinct human assemblages were identified at El Soto/El Encadenado. The first one corresponded to the necropolis dated to phase 1 (figure 3.48B), which was made up of nine burials hosting one individual each. However, only seven of the nine individuals kept any anatomical element to be studied (n = 7/9 = 77.8%, table 7.1). Besides, the individuals preserved were quite damaged (figure 3.49, table 7.7). Most of them only conserved less than 25% of the skeleton and none of them maintained more than 50% of it. In addition, in all the cases more than 75% of the skeletal elements preserved were fragmented. Conversely, bone surface preservation ranged between most of the surface being eroded with some details masked (grade 3) and all the surface being eroded with uneven distribution of the depth or degree of alterations (grade 4). Then, bone surface preservation can be considered acceptable and it allowed to carry out most of the observations required for a complete osteoarchaeological study.

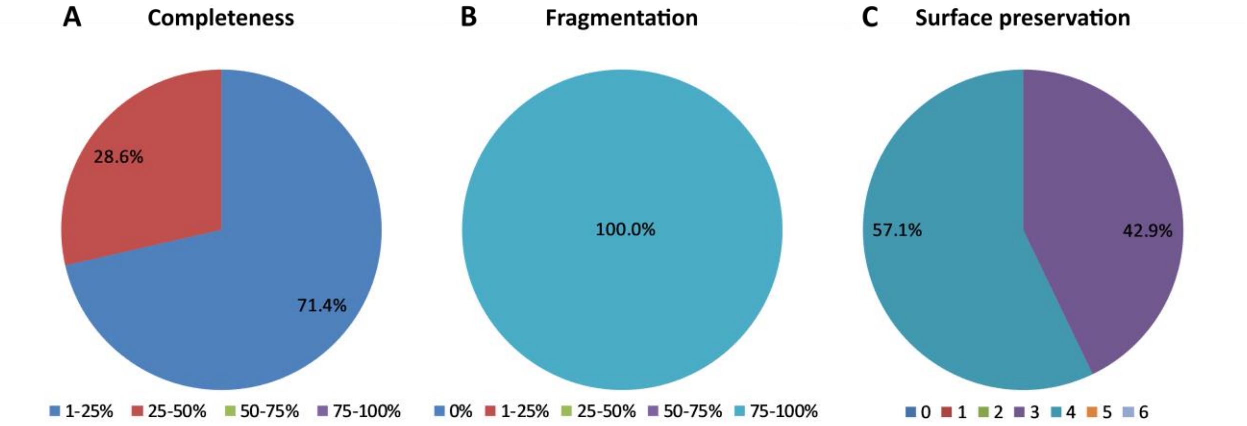


Figure 3.49. Pie charts representing the distribution of the three variables for the assessment of the macroscopic preservation of the human population from the cemetery of phase 1 of El Soto/El Encadenado. (A) Completeness. (B) Fragmentation. (C) Surface preservation

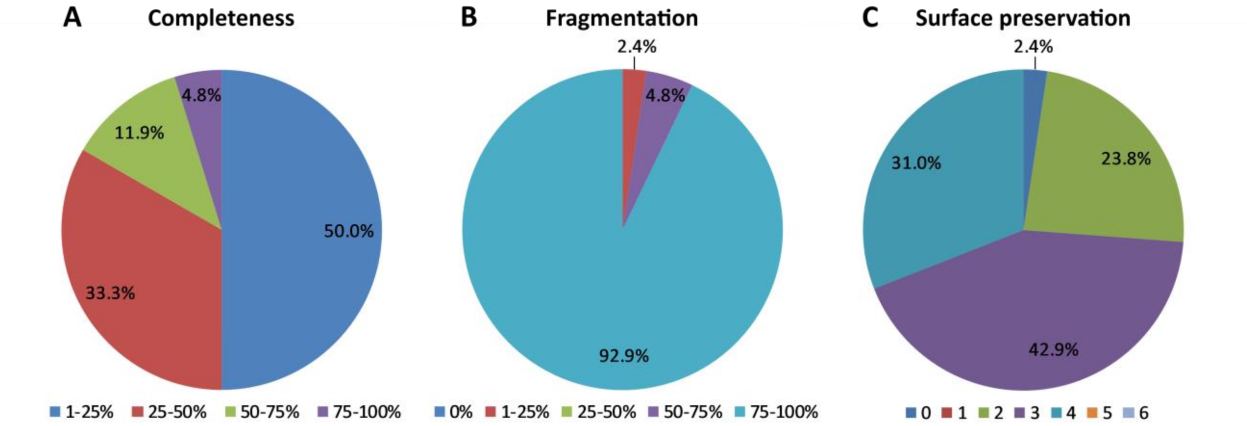


Figure 3.50. Pie charts representing the distribution of the three variables for the assessment of the macroscopic preservation of the human population from the cemetery of phase 3 of El Soto/El Encadenado. (A) Completeness. (B) Fragmentation. (C) Surface preservation

The second human assemblage recovered at El Soto/El Encadenado was formed by the individuals found in the cemetery of phase 3 (figure 3.48C). Here 44 individuals were identified in 33 funerary structures, but two of them did not preserve any anatomical element. Therefore, the total number of individuals studied was 42 (n = 42/44 = 95.5%, table 7.1). Regarding the specific indicators for the assessment of macroscopic preservation (figure 3.50, table 7.7), half of the individuals were represented by less than 25% of the skeleton, but a third preserved between 25% and 50% of it and the rest even more. Nevertheless, the vast majority were very fragmented, with more than 75% of the anatomical elements preserved broken. In contrast, in this case the conservation of bone surface was not bad either. The worse scenario were individuals with all the surface eroded with uneven distribution of depth or degree of alterations (grade 4), which accounted for almost a third of the assemblage. Still, the rest of the population showed better bone surface preservation and there was even one individual with fresh appearance (grade 0). All in all, the human assemblage from El Soto/El Encadenado was also moderately well preserved.

3.1.3.2.2 Demography

The two cemeteries of El Soto/El Encadenado showed similar demographic profiles, but they were very different in size, so the smallest and oldest one was more incomplete and difficult to interpret. The first necropolis corresponded to the phase 1 of the settlement. A minimum number of seven individuals were recovered (table 3.13, figure 3.51, table 3.14, table 7.4, table 7.5, table 7.6). More than half were subadults, which would have meant a very high subadult mortality rate. There were only three adults and just in one case was it possible to determine sex. Therefore, in this context sex ratio lacked any interpretative value. As a consequence of the small size of the population, it was not possible to calculate juvenility index and derived palaeodemographic estimators. Still, the curve of the probability of death (figure 3.51) traced a path similar to those of typical preindustrial agricultural populations (Chamberlain 2006: 64–68, Séguy & Buchet 2013: 114). Interestingly, it was verified that grave goods were more often associated to subadult individuals than to adults (individuals with grave goods: S = 3, A = 1, S/A = 3.00; individuals without grave goods: S = 1, A = 2, S/A = 0.50) in a proportion greater than the subadult/adult ratio of the entire population. However, the association between age and the presence of artifacts as part of the funerary ritual was not statistically significant (Fisher's exact test: n = 7, p = 0.486), possibly due to small sample size. Likewise, no pattern can be observed in the spatial distribution of individuals by age (figure 3.53B). In conclusion, this assemblage possibly represents a family unit which used the burial ground for one generation.

Table 3.13. Age and sex distribution by absolute frequencies of the human population from the cemetery of phase 1 of El Soto/El Encadenado. Key: F = fetus, < 40 weeks in utero; I1A = infans 1A, birth – 2 years; I1B = infans 1B, 3 – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; Ssp = subadult sp, < 20 years; YA = young adult, 20 – 34 years; YMA = young-middle adult, 20 – 45 years; MA = middle adult, 35 – 45 years; MOA = middle-old adult, > 35 years; OA = old adult, > 45 years; Asp = adult sp, > 20 years; UA = undetermined age; M = male individuals (including probably male individuals); F = female individuals (including probably female individuals); US = undetermined sex (including ambiguous individuals)

	F	*I1A*	*I1B*	*I2*	*J*	*Ssp*	*YA*	*YMA*	*MA*	*MOA*	*OA*	*Asp*	*UA*	*Total*
M	-	-	-	-	-	-	-	-	-	-	-	-	-	0
F	-	-	-	-	-	-	-	-	-	-	-	1	-	1
US	-	1	3	-	-	-	-	-	-	-	-	2	-	6
Total	0	1	3	0	0	0	0	0	0	0	0	3	0	7

Table 3.14. Demographic descriptive indicators of the human population from the cemetery of phase 1 of El Soto/El Encadenado. Palaeodemographic estimators are not reported because the MNI was smaller than ten

Descriptive indicators	
MNI	7
%subad	57.1%
%ad	42.9%
S/A	1.33
M/F	0.00

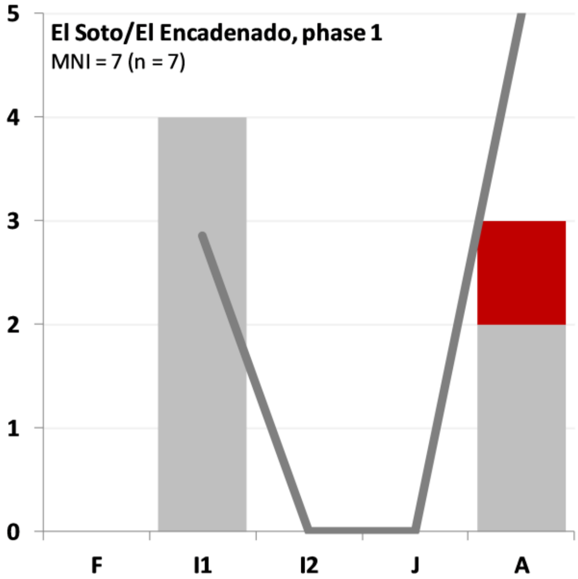


Figure 3.51. Demography chart of the human population from the cemetery of phase 1 of El Soto/El Encadenado. Bars represent the absolute frequencies of each age category (F = fetus, < 40 weeks in utero; I1A = infans 1, birth – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; A = adults, > 20 years), separated by sex whenever possible (blue = male individuals, red = female individuals, grey = undetermined sex). The line depicts the progression of the probability of death (q_x) along age categories, calculated according to G. Acsádi and J. Nemeskéri (1970: 65). The minimum number of individuals of the population (MNI) and the number of individuals represented in the chart (n) are shown on the upper left corner

The second cemetery of El Soto/El Encadenado was dated to phase 3. With a minimum number of 42 individuals preserved (table 3.16, figure 3.52, table 3.20, table 7.4, table 7.5, table 7.6) , it was significantly bigger than the former. Subadults made up almost half of the assemblage. All subadult age categories were represented, with predominance of infans 1, as it is expected in premodern demographic models. The identification of at least three fetuses is worth noting and it speaks about the high risk of death around birth in this population. Adults meant slightly more than half of the individuals preserved. Precise adult age estimation was possible only in one case, so no conclusions about adult mortality patterns could be made. In the same way, sex ratio was very imbalanced in favour of women, with only 25 men per every 100 women. This is an unusual scenario, which can be interpreted either as an effect of the lack of sex determination for more than half of the adult population or a real reflection of the higher risk of death of women during the relatively short period this cemetery was used. Coming back to the distribution of the population by age, the subadult/adult ratio of the cemetery of phase 3 of El Soto/El Encadenado was the highest among all the assemblages with more than ten individuals analysed in this thesis. This confers the curve of the probability of death (figure 3.52) the shape typical of preindustrial agricultural populations (Chamberlain 2006: 64–68, Séguy & Buchet 2013: 114), which normally starts at quite a high point for youngest individuals and descends during late childhood and adolescence, to grow steadily during adulthood. The strong weight of subadults in this population is probably also the cause of the low life expectancy at birth resulting from the juvenility index, which would have been of just 26.5 years. In the same way, mortality rates for individuals during the first and the first five years of life would have been quite high, revealing the risks in terms of diseases, malnutrition and poor hygiene this age group faced in this type of contexts (Lewis 2007). When it comes to the spatial organisation of the cemetery (figure 3.53C), it was verified individuals of all ages and sexes were distributed randomly throughout the cemetery. However, it must be underlined that subadults meant a significantly greater proportion of individuals in burials following the Christian funerary ritual than in those arranged according to the Islamic custom (Christian: subadults = 8, adults = 7, S/A = 1.14; Islamic: subadults = 10, adults = 16, S/A = 0.63). Then, it is possible there was a difference in mortality patterns between these two internal phases. Summing up, this assemblage is different from that of phase 1 in that it probably does not represent a family group, but a small community which used this funerary space for a few generations.

Table 3.15. Age and sex distribution by absolute frequencies of the human population from the cemetery of phase 3 of El Soto/El Encadenado. Key: F = fetus, < 40 weeks in utero; I1A = infans 1A, birth – 2 years; I1B = infans 1B, 3 – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; Ssp = subadult sp, < 20 years; YA = young adult, 20 – 34 years; YMA = young-middle adult, 20 – 45 years; MA = middle adult, 35 – 45 years; MOA = middle-old adult, > 35 years; OA = old adult, > 45 years; Asp = adult sp, > 20 years; UA = undetermined age; M = male individuals (including probably male individuals); F = female individuals (including probably female individuals); US = undetermined sex (including ambiguous individuals)

	F	*I1A*	*I1B*	*I2*	*J*	*Ssp*	*YA*	*YMA*	*MA*	*MOA*	*OA*	*Asp*	*UA*	*Total*
M	-	-	-	-	-	-	-	-	-	-	-	2	-	2
F	-	-	-	-	-	-	-	-	-	1	-	7	-	8
US	3	2	5	2	5	1	-	-	-	-	-	13	1	32
Total	3	2	5	2	5	1	0	0	0	1	0	22	1	42

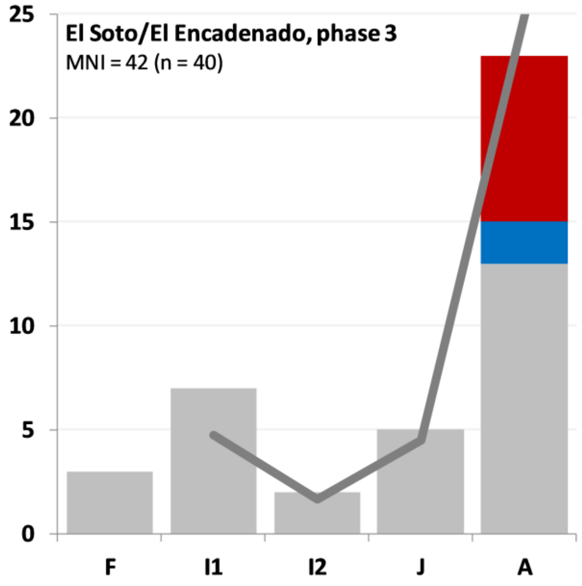


Figure 3.52. Demography chart of the human population from the cemetery of phase 3 of El Soto/El Encadenado. Bars represent the absolute frequencies of each age category (F = fetus, < 40 weeks in utero; I1 = infans 1, birth – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; A = adults, > 20 years), separated by sex whenever possible (blue = male individuals, red = female individuals, grey = undetermined sex). The line depicts the progression of the probability of death (q_x) along age categories, calculated according to G. Acsádi and J. Nemeskéri (1970: 65). The minimum number of individuals of the population (MNI) and the number of individuals represented in the chart (n) are shown on the upper left corner. These two numbers differ because subadults sp (< 20 years) and individuals of undetermined age are not displayed

Table 3.16. Demographic descriptive indicators and palaeodemographic estimators of the human population from the cemetery of phase 3 of El Soto/El Encadenado

Descriptive indicators	
MNI	42
%subad	42.9%
%ad	54.8%
S/A	0.78
M/F	0.25

Estimators	
JI	0.174
e_0	26.5
${}_1q_0$	0.267
${}_5q_0$	0.419

3.1.3.3 Faunal diet

3.1.3.3.1 Sampling

Fourteen fauna samples from El Soto/El Encadenado were analysed for carbon and nitrogen stable isotopes (table 7.8, figure 3.54). They came from landfills and the filling of a well dated to phases 1 and 3. Both herbivores (Bos taurus, Ovis aries/Capra hircus, Equus sp) and omnivores (Sus scrofa domesticus, Avis) were sampled, but the former outnumbered the latter. No carnivores were analysed. Most of the assemblage was formed by adult specimens but a sample from a cattle and another one from a pig belonged to subadult individuals. Then, they will be discussed separately. The majority of the samples were bone fragments, but in three cases teeth were chosen because there was no other anatomical element available to represent those taxa.

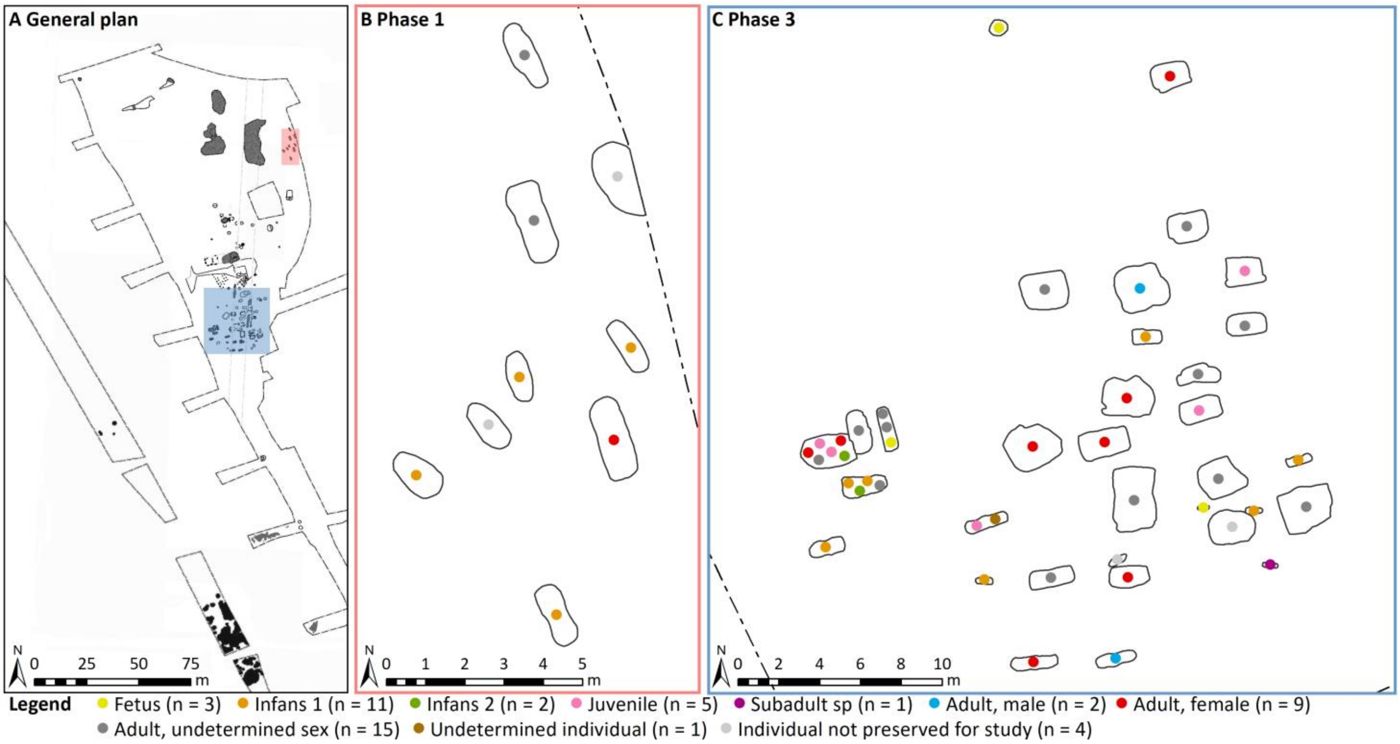


Figure 3.53. El Soto/El Encadenado, spatial distribution of individuals by age and sex (Vigil-Escalera & Vírseda 2007: plates 7, 26, Vigil-Escalera 2015c: 171, modified). (A) General plan of the site highlighting the two areas with funerary contexts. The colour of each area matches that of the frame of their corresponding detailed plan to the right. (B) Cemetery of phase 1. (C) Cemetery of phase 3. The dashed line depicts the excavation limits. Points symbolise the individuals recovered in each burial. Their colour indicates their age and sex as stated in the legend

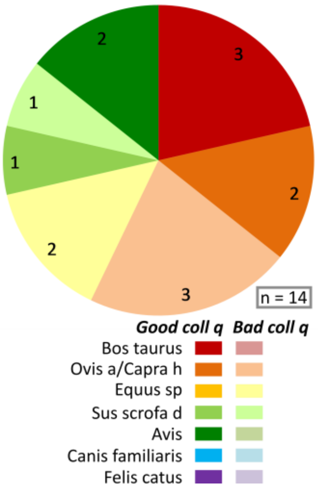


Figure 3.54. Pie chart representing the distribution of fauna samples from El Soto/El Encadenado by taxa and collagen quality. Numbers represent the absolute frequency of each group

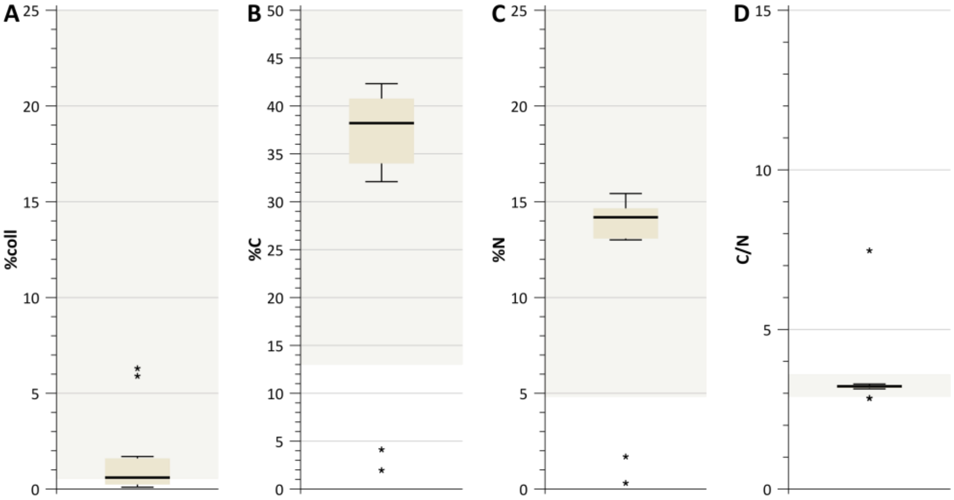


Figure 3.55. Boxplots representing the collagen quality indicators of fauna samples from El Soto/El Encadenado. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

3.1.3.3.2 Collagen quality

Collagen in the fauna samples from El Soto/El Encadenado was unevenly preserved (table 7.11, table 7.12, figure 3.54, figure 3.55). Five of them had very small collagen yields (%coll) under 0.5%. Three of these were teeth, which did not even produce collagen enough to measure them. Carbon weight content (%C) ranged between 2.0% and 42.3% and nitrogen weight content (%N) between 0.3% and 15.4%. However, the weight contents of most samples grouped together within acceptable ranks and only two samples were responsible of the lowest values for both variables (figure 3.55B, C). This distribution resulted in quite a wide distribution of carbon to nitrogen atomic ratios (C/N), which went from 2.8 to 7.5. Still, the minimum and maximum values are isolated outliers and most of the samples concentrated in a very narrow gap between 3.1 and 3.3. All in all, six out of fourteen samples had to be rejected and only eight were deemed useful to draw the local isotopic baseline.

3.1.3.3.3 Results

The fauna assemblage from El Soto/El Encadenado valid for palaeodietary reconstruction was formed by eight samples (table 3.17, table 7.11, figure 3.56). Most of them were herbivores, divided between cattle and ovicaprids. Their mean $\delta^{13}C$ was -20.8‰ and they had quite small standard deviation (0.4‰) and range (0.8‰). In this way, $\delta^{13}C$ values of all herbivores from El Soto/El Encadenado pointed at diets exclusively based on C_3 plants, such as wild grasses or winter crop fodder. Conversely, $\delta^{15}N$ was more widely spread. The mean $\delta^{15}N$ of herbivores was 7.4‰, but their standard deviation was 1.5‰ and the range 4.0‰, almost one complete trophic level. With a $\delta^{15}N$ mean of 6.6‰, all the three cattle analysed were on the lower end of the distribution. One of the cattle was a subadult. However, it does not seem to have retained the effect of suckling in its nitrogen isotope signature, since it was intermediate to the other two bovids, which were adults. Instead, both ovicaprids analysed had the most enriched $\delta^{15}N$ among herbivores and a mean $\delta^{15}N$ of 8.8‰. Presumably this means cattle and ovicaprids were grazing in different areas with distinct isotopic baselines. Actually, $\delta^{15}N$ values of ovicaprids from El Soto/El Encadenado were as high as those of herbivores from Gózquez (see section 3.1.1.3.3) or Boadilla (see section 3.1.2.3.3). Therefore, even if data are scant, it could be hypothesized ovicaprids from El Soto/El Encadenado were grazing in manured fields too (Bogaard *et al.* 2007, Fraser *et al.* 2011), which would denote certain degree of complexity of agrarian practices and cohesion also within farms.

Table 3.17. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of fauna samples from El Soto/El Encadenado. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All fauna	8	-20.3	0.8	-21.2	-19.0	2.2	8.3	2.0	5.2	11.2	6.0
Herbivores	5	-20.8	0.4	-21.2	-20.4	0.8	7.4	1.5	5.2	9.2	4.0
Bos taurus	3	-20.9	0.4	-21.2	-20.4	0.8	6.6	1.2	5.2	7.5	2.3
Ovis/Capra	2	-20.6	-	-20.7	-20.4	0.3	8.8	-	8.3	9.2	0.9
Omnivores	3	-19.5	0.5	-19.9	-19.0	0.9	9.8	1.9	7.7	11.2	3.5
Sus scrofa d	1	-19.9	-	-	-	-	7.7	-	-	-	-
Avis	2	-19.3	-	-19.5	-19.0	0.5	10.9	-	10.6	11.2	0.6

The group of omnivores, which included a pig and two fowl, had a mean $\delta^{13}C$ of -19.5‰ with a standard deviation of 0.5‰ and a range of 0.9‰, and a mean $\delta^{15}N$ of 9.8‰ with a standard deviation of 1.9‰ and a range 3.5‰. Still, both taxa were isotopically very different from each other. The pig was a subadult. According to $\delta^{13}C$ it probably had a C_3 diet. Besides, its $\delta^{15}N$ was intermediate between cattle and ovicaprids, so possibly this specimen had a diet close to herbivores', with quite limited access to animal protein. In other contexts this type of diet has been interpreted as a sign of swine being free-ranged (Hammond & O'Connor 2013), but at El Soto/El Encadenado evidence is too scarce to make any categorical statement. Regarding fowl, they were the group with the most distinct isotopic signature in comparison to the rest of the assemblage. They presented the most enriched isotopic signatures among the fauna of El Soto/El Encadenado both for $\delta^{13}C$ and

δ^{15}N. This indicates their food regimen was probably based largely on C_3 resources and they had a significant proportion of animal protein in their diet, maybe as a result of the use of domestic waste to feed them.

Although the fauna samples from El Soto/El Encadenado were dated to specific phases (table 7.8), it was not possible to analyse the diachronic evolution of animal diet over time, because sample size was too small and the distribution of taxa in each period was not homogeneous.

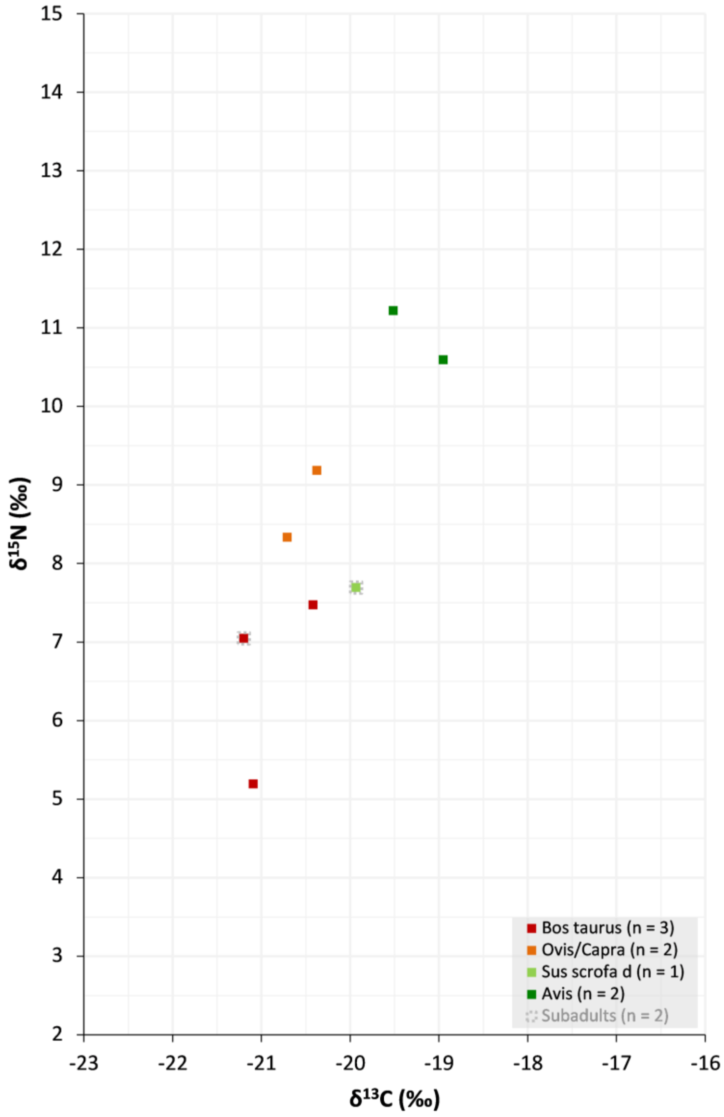


Figure 3.56. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of fauna from El Soto/El Encadenado grouped by taxa. Subadult specimens are highlighted with a dotted grey fringe around them

3.1.3.4 Human diet

3.1.3.4.1 Sampling

The sampling strategy applied to the two human populations from El Soto/El Encadenado prioritised the individuals with better macroscopic preservation. In this way, three individuals from the cemetery of phase 1 (figure 3.57) and fifteen from the cemetery of phase 3 (figure 3.59) were selected. The former included a subadult, an adult female and an adult of undetermined sex. The latter was more varied. One third of the assemblage was formed by subadults, comprising all age categories except fetuses and infans 2. The remaining two thirds were adults. Among them, female individuals were outstandingly overrepresented, as it happened in the population as a whole. Long bone and ribs were the preferred anatomical elements to sample for the individuals from El Soto/El Encadenado.

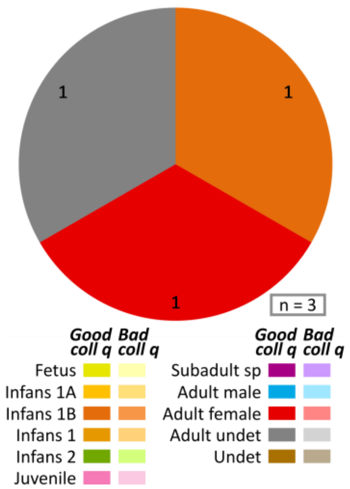


Figure 3.57. Pie chart representing the distribution of human samples from the cemetery of phase 1 of El Soto/El Encadenado by age, sex and collagen quality. Numbers represent the absolute frequency of each group

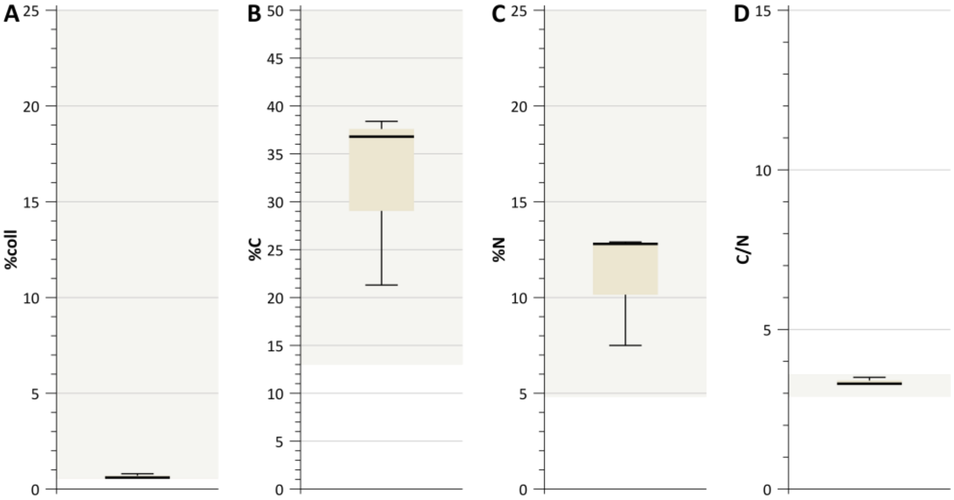


Figure 3.58. Boxplots representing the collagen quality indicators of human samples from the cemetery of phase 1 of El Soto/El Encadenado. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

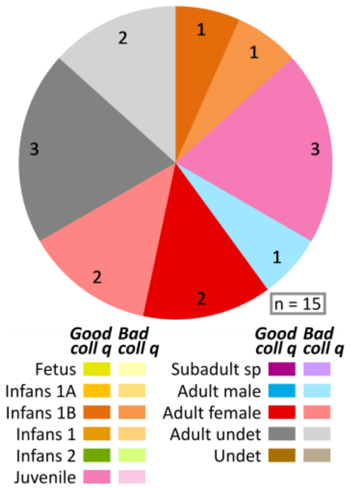


Figure 3.59. Pie chart representing the distribution of human samples from the cemetery of phase 3 of El Soto/El Encadenado by age, sex and collagen quality. Numbers represent the absolute frequency of each group

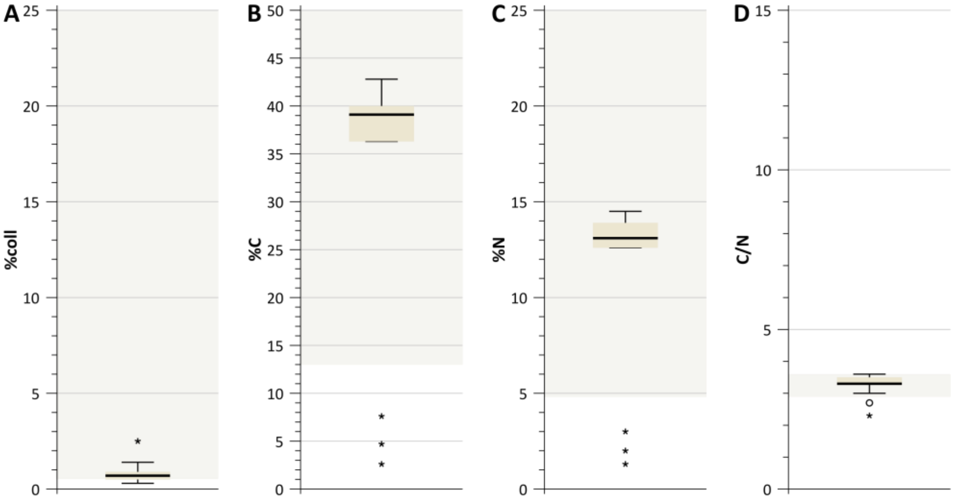


Figure 3.60. Boxplots representing the collagen quality indicators of human samples from the cemetery of phase 3 of El Soto/El Encadenado. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

3.1.3.4.2 Collagen quality

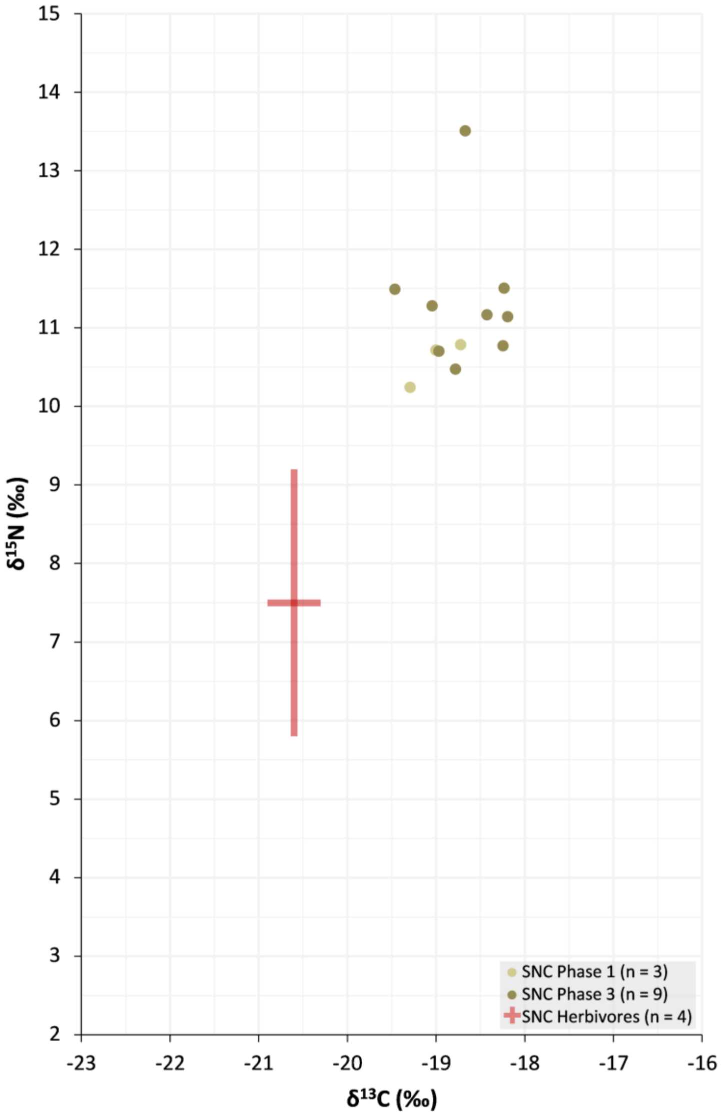
There was a substantial difference in collagen preservation between the individuals of phase 1 and 3 (table 7.9, table 7.10), although it may be an artefact caused by the disparity of sample sizes. On one side, all the collagen quality indicators of the individuals of phase 1 were within the ranges defined for well preserved samples (figure 3.57, figure 3.58). Collagen yield (%coll) was greater than 0.6%, carbon weight content (%C) was between 21.3% and 38.4%, nitrogen weight content (%N) was between 7.5% and 12.9% and carbon to nitrogen atomic ratio (C/N) was between 3.3 and 3.5. Therefore, all the three samples from the cemetery of phase 1 of El Soto/El Encadenado were valid for palaeodietary reconstruction. On the other side, the individuals dated to phase 3 had more heterogeneous collagen preservation (figure 3.59, figure 3.60). Three samples presented low collagen yields (%coll) below 0.5%, but most of them were above this threshold. Carbon weight contents (%C) ranged between 2.6% and 42.8% and nitrogen weight contents (%N) between 1.3% and 14.5%. The lowest values for both variables came from the same three samples. It has to be noted that it was not possible to record carbon and nitrogen weight contents for two samples because of technical issues during measurement and the unavailability of more material to repeat the extraction. Not being able to check their collagen quality, these two samples were discarded. Carbon to nitrogen atomic ratios (C/N), with a minimum of 2.3 and a maximum 3.6, presented some values too low for well preserved collagen. In short, six of the samples from the cemetery of phase 3 of El Soto/El Encadenado were rejected due to poor collagen quality and nine were considered well preserved and useful for further interpretation.

3.1.3.4.3 Results

The two human assemblages from El Soto/El Encadenado will be discussed separately. The population in the cemetery dated to phase 1 (first half 5th c.) was the smallest and only three out of seven individuals could be successfully analysed (table 3.18, table 7.9, figure 3.61, figure 3.62). Their distribution was very tight. Carbon stable isotope ratios had a mean of -19.0‰ with a standard deviation of 0.3‰ and a range of 0.6‰. Then, the offset between this group of humans and local adult herbivores was 1.6‰ (see section 3.1.3.3.3). These data indicate the diet of this population was largely based on C_3 resources, such as winter crops like wheat, barley, rye and oats, legumes, vegetables and fruits. Still, the appreciable difference in $\delta^{13}C$ between humans and herbivores suggests the existence of an additional carbon source with more enriched isotopic signature at least for the individual with the most positive value. If the increase in $\delta^{13}C$ was matched by analogous high $\delta^{15}N$ values, it could be interpreted as a sign of marine fish consumption, but this is not the case here. Therefore, at least the individual with the most positive carbon stable isotope ratio may have been complementing its diet with C_4 plants, i.e. millets. This hypothesis is even more robust when it is considered that all livestock from El Soto/El Encadenado, except maybe some fowl, were fed on C_3 resources, so the enrichment of $\delta^{13}C$ could not be due to indirect intake through animals. Summing up, these individuals were on the border between exclusive C_3 and mixed C_3-C_4 diets, and millet consumption would have been in any case proportionately small.

Table 3.18. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of human samples from the cemetery of phase 1 of El Soto/El Encadenado. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one. Key: C&J = clothing items & jewellery, Cont = containers

	n	*δ¹³C (‰)*					*δ¹⁵N (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All humans	3	-19.0	0.3	-19.3	-18.7	0.6	10.6	0.3	10.2	10.8	0.6
Subadults	1	-19.3	-	-	-	-	10.2	-	-	-	-
Infans 1B	1	-19.3	-	-	-	-	10.2	-	-	-	-
Adults	2	-18.9	-	-19.0	-18.7	0.3	10.8	-	10.7	10.8	0.1
Female adults	1	-19.0	-	-	-	-	10.7	-	-	-	-
Grave g absence	1	-19.0	-	-	-	-	10.7	-	-	-	-
Grave g presence	2	-19.0	-	-19.3	-18.7	0.6	10.5	-	10.2	10.8	0.6
C&J presence	1	-19.3	-	-	-	-	10.2	-	-	-	-
Cont presence	2	-19.0	-	-19.3	-18.7	0.6	10.5	-	10.2	10.8	0.6



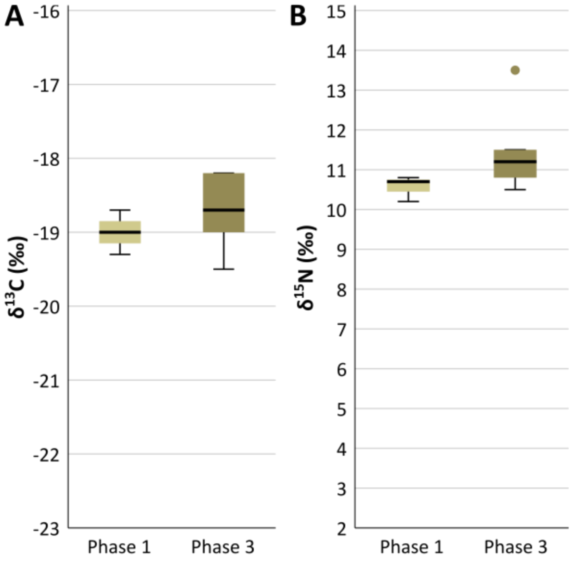


Figure 3.61. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from El Soto/El Encadenado divided by phase

Figure 3.62. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from El Soto/El Encadenado divided by phase. Cross represents mean and one standard deviation of the fauna from El Soto/El Encadenado grouped by feeding regime. Subadult specimens were excluded from the calculation of these parameters. Fowl are not displayed because they are very variable

Regarding nitrogen isotope ratios, the mean $\delta^{15}N$ of the individuals of phase 1 from El Soto/El Encadenado was 10.6‰. They had a standard deviation of 0.3‰ and a range of 0.6‰. The offset between them and the adult herbivores from the very site was 3.1‰ (see section 3.1.3.3.3). Two relevant conclusions can be driven from these data. First, animal protein consumption at El Soto/El Encadenado was moderate during the 5th century. The difference between human and herbivore nitrogen isotope ratios was more than the half of a full trophic level change (~5‰), which means a substantial proportion of protein intake came from animal sources. Second, according to the small range, protein consumption was quite homogeneous between individuals.

In fact, although the three individuals of this phase analysed belonged to different demographic categories, there were almost no differences between them (figure 3.63, figure 3.64). The only subadult was infans 1B who died 3 years and 6 months and 6 years and 6 months of age and it had the most depleted carbon and nitrogen stable isotope ratios of this phase, pointing possibly at an exclusive C_3 diet with the lowest consumption of animal protein in the assemblage. The remaining two adults, a probable female and an individual of undetermined sex, were even closer from each other. It is possible that they were eating slightly greater proportions of animal protein than the subadult and conceivably they could have also included small amounts of millets in their diet.

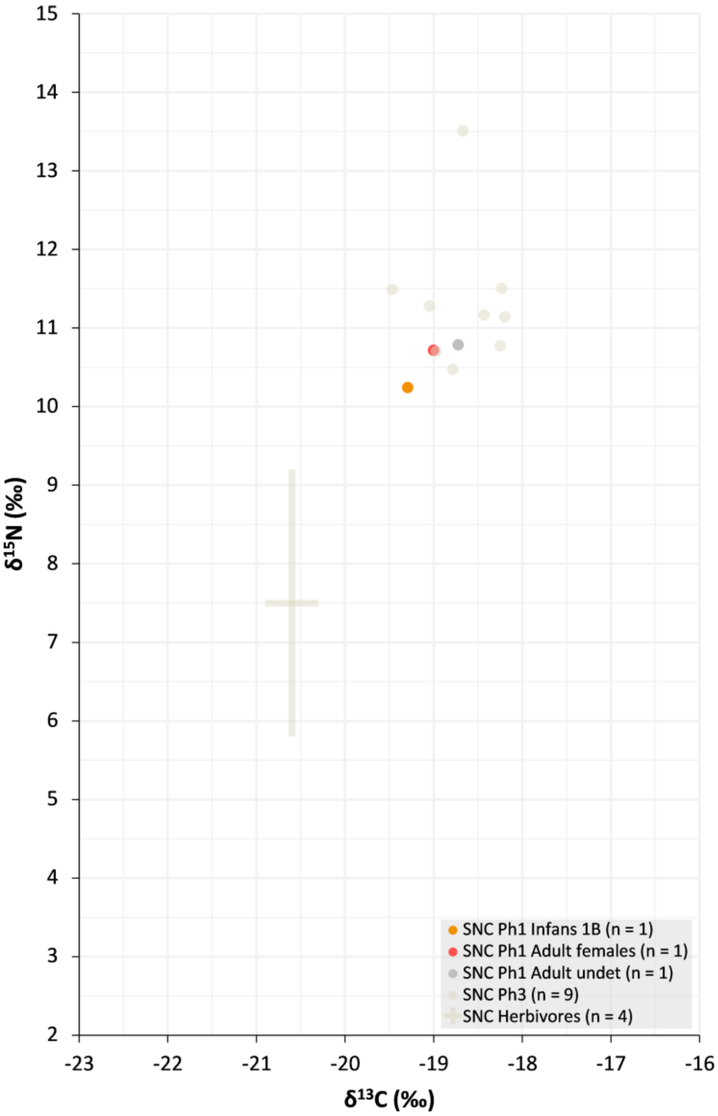


Figure 3.63. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from the cemetery of phase 1 of El Soto/El Encadenado divided by demographic categories. Cross represents mean and one standard deviation of herbivores from El Soto/El Encadenado excluding subadult specimens

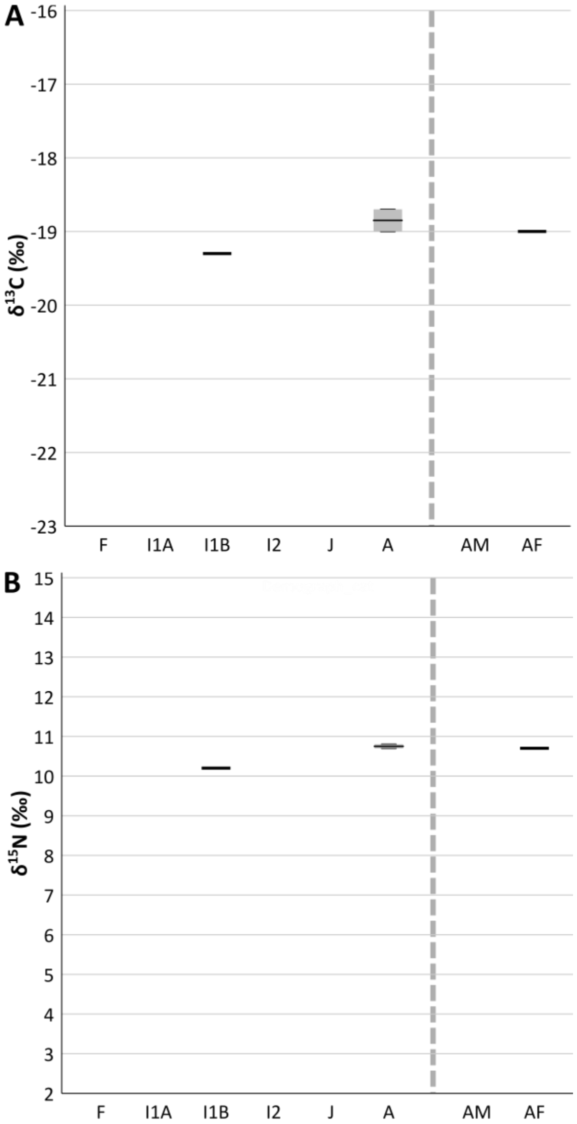


Figure 3.64. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from the cemetery of phase 1 of El Soto/El Encadenado divided by demographic categories. Key: F = fetus, I1A = infans 1A, I1B = infans 1B, I2 = infans 2, J = juvenile, A = adults, AM = adult males, AF = adult females

Moreover, two of the individuals from the cemetery of phase 1 of El Soto/El Encadenado were buried with grave goods (figure 3.65, figure 3.66), as it was the custom in this funerary context. Both of them were accompanied by pottery or glass containers and, in addition, the subadult had a ring. Interestingly, these were the individuals at both ends of the ranges of carbon and nitrogen stable isotope ratios. Thus, it can be proposed there were no outstanding differences between individuals buried with and without grave goods, and individuals with artefacts had different types of diets during life. However, small sample size prevents from making any stark conclusion.

The human assemblage dated to phase 3 (beginning 8th c.-mid-9th c.) from El Soto/El Encadenado was bigger and it provided nine samples with well-preserved collagen useful for palaeodietary reconstruction (table 3.19, table 7.9, figure 3.61, figure 3.62). Overall, these individuals had more enriched isotopic signatures for both $\delta^{13}C$ and $\delta^{15}N$ than their counterparts of phase 1. The mean $\delta^{13}C$ of this assemblage was -18.7‰, standard deviation 0.5‰ and range 1.3‰. In this way, the offset between this dataset and local adult herbivores was

1.9‰ (see section 3.1.3.3.3). This difference is greater than what observed in the population of phase 1. Then, human diet during the 8th century and the first half of the 9th century at El Soto/El Encadenado was still largely based on C_3 resources. These certainly included winter crops, such as wheat, barley, rye or oats, legumes, vegetables and fruits. Besides, most of the animal protein available was also C_3, as revealed by the isotopic signatures of the livestock raised on site, among which only a fowl may have gotten some millets in its diet. Therefore, having excluded the consumption of marine fish for the same reasons as for the assemblage of phase 1 (see above), the most likely source of enriched carbon in the carbon stable isotope ratios of the individuals of phase 3 are C_4 plants, either broomcorn or foxtail millets. These spring crops would have been a minor but consistent component of the diet of at least the four individuals with the highest $\delta^{13}C$ values. Conversely, the diet of the two individuals on the lowest end of the range probably did not comprise any millets and they were exclusively based on C_3 plants.

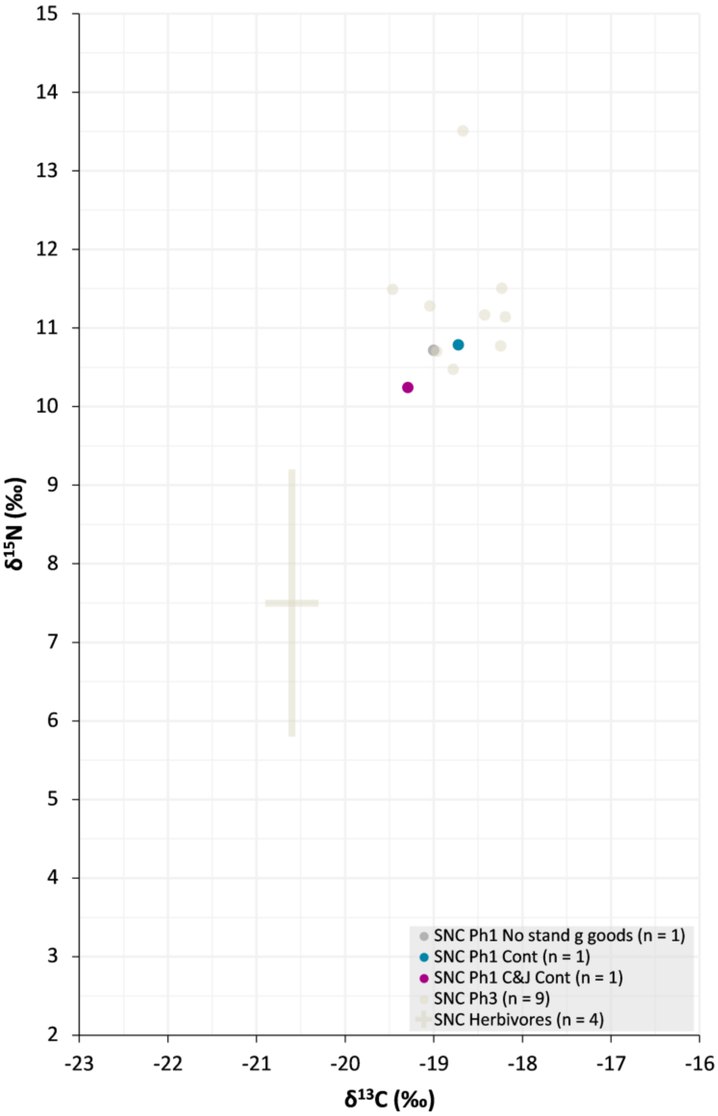


Figure 3.65. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from the cemetery of phase 1 of El Soto/El Encadenado divided by type of grave goods. Cross represents mean and one standard deviation of herbivores from El Soto/El Encadenado excluding subadult specimens. Key: No stand g goods = no standardised grave goods, C&J = clothing items & jewellery, Cont = containers, T&W = tools & weapons

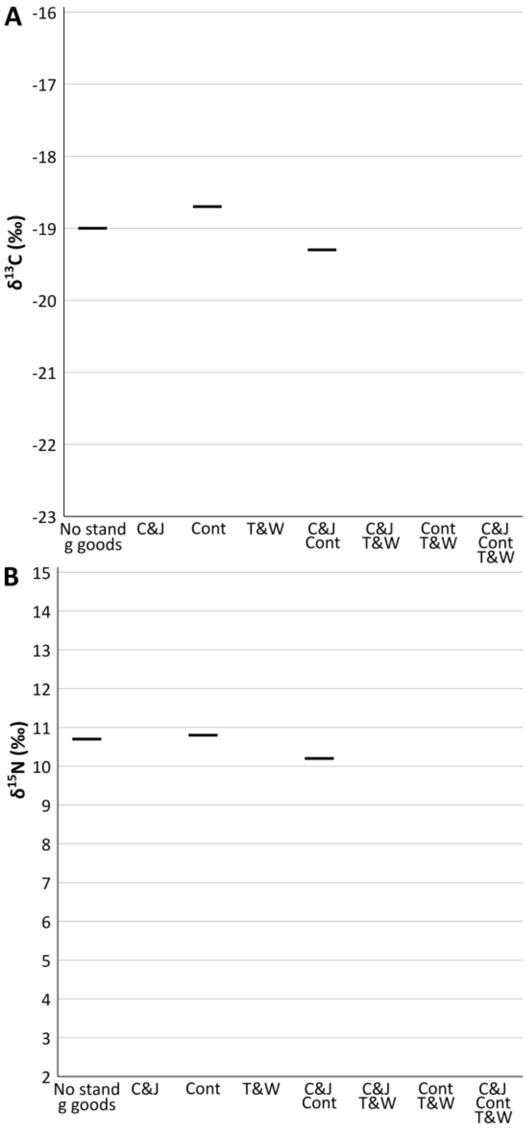


Figure 3.66. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from the cemetery of phase 1 of El Soto/El Encadenado divided by type of grave goods. Key: No stand g goods = no standardised grave goods, C&J = clothing items & jewellery, Cont = containers, T&W = tools & weapons

Table 3.19. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of human samples from the cemetery of phase 3 of El Soto/El Encadenado. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All humans	9	-18.7	0.5	-19.5	-18.2	1.3	11.3	0.9	10.5	13.5	3.0
Subadults	4	-18.7	0.6	-19.5	-18.2	1.3	11.1	0.5	10.5	11.5	1.0
Infans 1B	1	-19.5	-	-	-	-	11.5	-	-	-	-
Juveniles	3	-18.4	0.3	-18.8	-18.2	0.6	10.9	0.5	10.5	11.5	1.0
Adults	5	-18.7	0.4	-19.0	-18.2	0.8	11.6	1.1	10.7	13.5	2.8
Female adults	2	-18.6	-	-19.0	-18.2	0.8	11.2	-	11.1	11.3	0.2
Grave g absence	9	-18.7	0.5	-19.5	-18.2	1.3	11.3	0.9	10.5	13.5	3.0

Altogether nitrogen isotope ratios were also more enriched among the individuals of phase 3 than in the assemblage of phase 1. These nine individuals had a mean $\delta^{15}N$ of 11.3‰. This was the second greatest $\delta^{15}N$ average after the dataset of phase 3 of La Huelga, which was not only very close geographically but also strictly contemporaneous. The offset between the mean of humans and adult herbivores from El Soto/El Encadenado was 3.8‰ (see section 3.1.3.3.3). Such a big difference, which is not far from the fractionation usually attributed to a full trophic level change (~5‰), indicates animal protein consumption was abundant. Alternatively, high $\delta^{15}N$ values can also be reached through smaller amounts of higher trophic level animal protein. This could be the case if this population were eating predominantly pigs fed on domestic waste, for example. However, according to the zooarchaeological study the most frequent taxa aimed at meat consumption were ovicaprids (Morales & Llorente 2004a) and unfortunately only one pig sample could be successfully analysed, and it was a subadult specimen, so at the moment this hypothesis lacks support. In addition, excluding the only outlier, the rest of the individuals spread in a range of just 1.0‰. The absence of significant differences between individuals indicates the pattern of protein consumption was quite uniform within the population and there were no great internal differences.

There was only one outlier in this assemblage. It was individual SNC 30865-1-30869, whose $\delta^{15}N$ was enriched 2.0‰ in comparison to the closest individual. Meanwhile, its $\delta^{13}C$ was identical to the mean of the whole assemblage. It was an adult of undetermined sex buried according to the Islamic funerary ritual in a niche grave in the centre of the cemetery, in lateral position and without any grave goods. Then, the particular isotopic signature of this individual can be interpreted in different ways. It could be consuming greater proportions of animal protein than anyone else at El Soto/El Encadenado. Still, if the isotopic baseline of the site drawn on fauna is deemed reliable, the diet of this individual would have been completely carnivorous, since its $\delta^{15}N$ was 6.0‰ higher than the mean of local adult herbivores. This has no sense from a physiological point of view. Otherwise, this individual might have consumed mostly animal protein from omnivorous animals, so the nitrogen isotope ratios at the base of its diet would have been higher. Regrettably, the fauna assemblage was unable to characterise the diet of pigs at El Soto/El Encadenado, because just a subadult specimen had well-preserved collagen. Severe and sustained physiological stress could have also increased the nitrogen isotope ratio of this individual. There was no evidence of any pathological sign in its skeleton, although there are many diseases and deficiencies which do not leave any trace on bones or teeth. Finally, this individual could be a migrant from a zone with a different isotopic baseline. For instance, if it came from an arid region enriched $\delta^{15}N$ would be expected. Considering all the information available, the latter seems likely. Mitochondrial DNA analyses did not clear up this issue (Fernández Domínguez *et al.* 2009). The maternal lineage of this individual (i.e. haplogroup T) is not frequent in current western European populations, but it has been present in Europe since the Upper Palaeolithic. Despite its rarity, another four individuals from the Islamic sector of the cemetery of phase 3 of El Soto/El Encadenado (SNC 30280-1-30283, SNC 30790-1-30793, SNC 30740-1-30742, SNC 30850-1-30858) shared the same mitochondrial haplogroup. The fact that none of the individuals buried according to the Christian funerary ritual belonged to this maternal lineage looks like relevant. It is also interesting to point out that only another individual with the mitochondrial haplogroup T was analysed successfully for carbon and nitrogen stable isotopes, namely individual SNC 30280-1-30283, and its isotopic signature was close to the mean of the population on both δ^{13}C and δ^{15}N, so apparently there was not a direct correlation between maternal ancestry and diet.

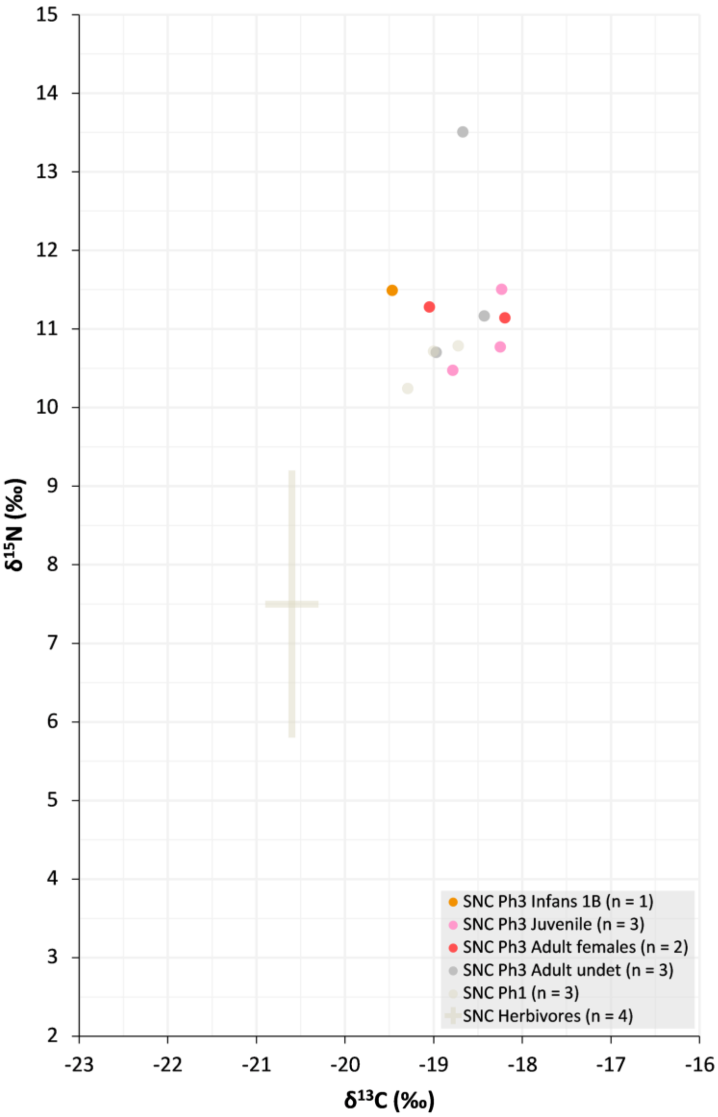


Figure 3.67. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of humans from the cemetery of phase 3 of El Soto/El Encadenado divided by demographic categories. Cross represents mean and one standard deviation of herbivores from El Soto/El Encadenado excluding subadult specimens

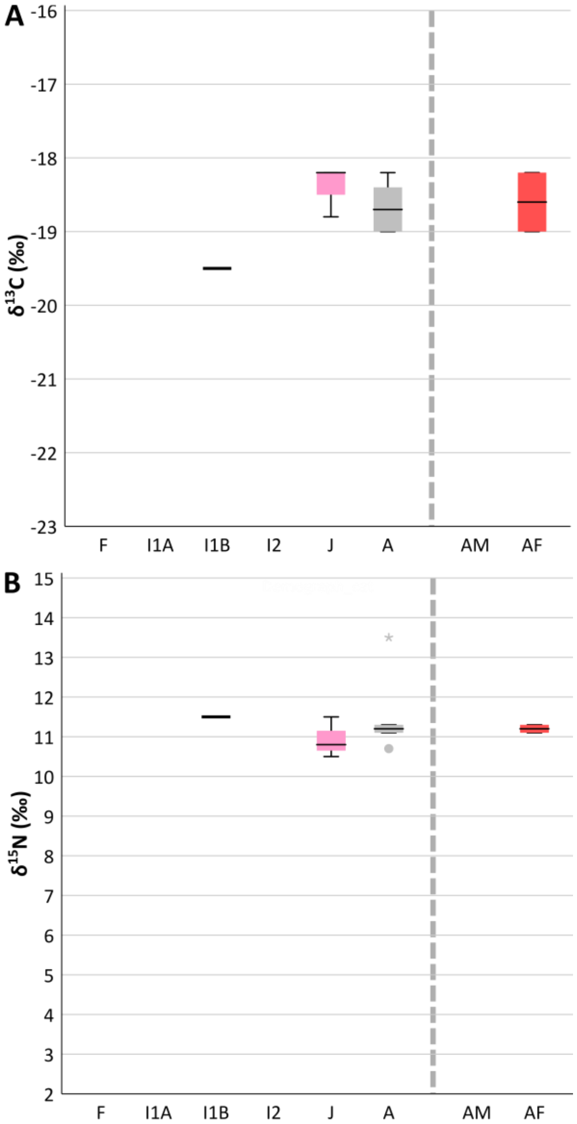


Figure 3.68. Boxplots representing (A) carbon stable isotope ratios (δ^{13}C) and (B) nitrogen isotope ratios (δ^{15}N) of humans from the cemetery of phase 3 of El Soto/El Encadenado divided by demographic categories. Key: F = fetus, I1A = infans 1A, I1B = infans 1B, I2 = infans 2, J = juvenile, A = adults, AM = adult males, AF = adult females

The demographic distribution of the individuals analysed, after having excluded those with poorly preserved collagen, did not represent evenly the structure of the whole population (figure 3.67, figure 3.68, see section 3.1.3.2.2). Yet there were a few interesting observations to be made. Despite the outlier, the main feature of the assemblage was homogeneity. This means there were no great differences between individuals based on age or sex. There were no meaningful differences either between the isotopic signatures of subadults and adults. The youngest individual of the dataset had the most depleted carbon isotope ratio and it was the only one which certainly had an exclusive C_3 diet. The other three subadults analysed were juveniles and they had some of the most positive $\delta^{13}C$ values, so it is likely they were one of the age groups with the most frequent intake of millets. Adults were mostly intermediate between these two ends. No meaningful patterns in the distribution of $\delta^{15}N$ according to age categories were detected. Differences between sexes could not be compared because it was not possible to get well-preserved collagen from any adult male.

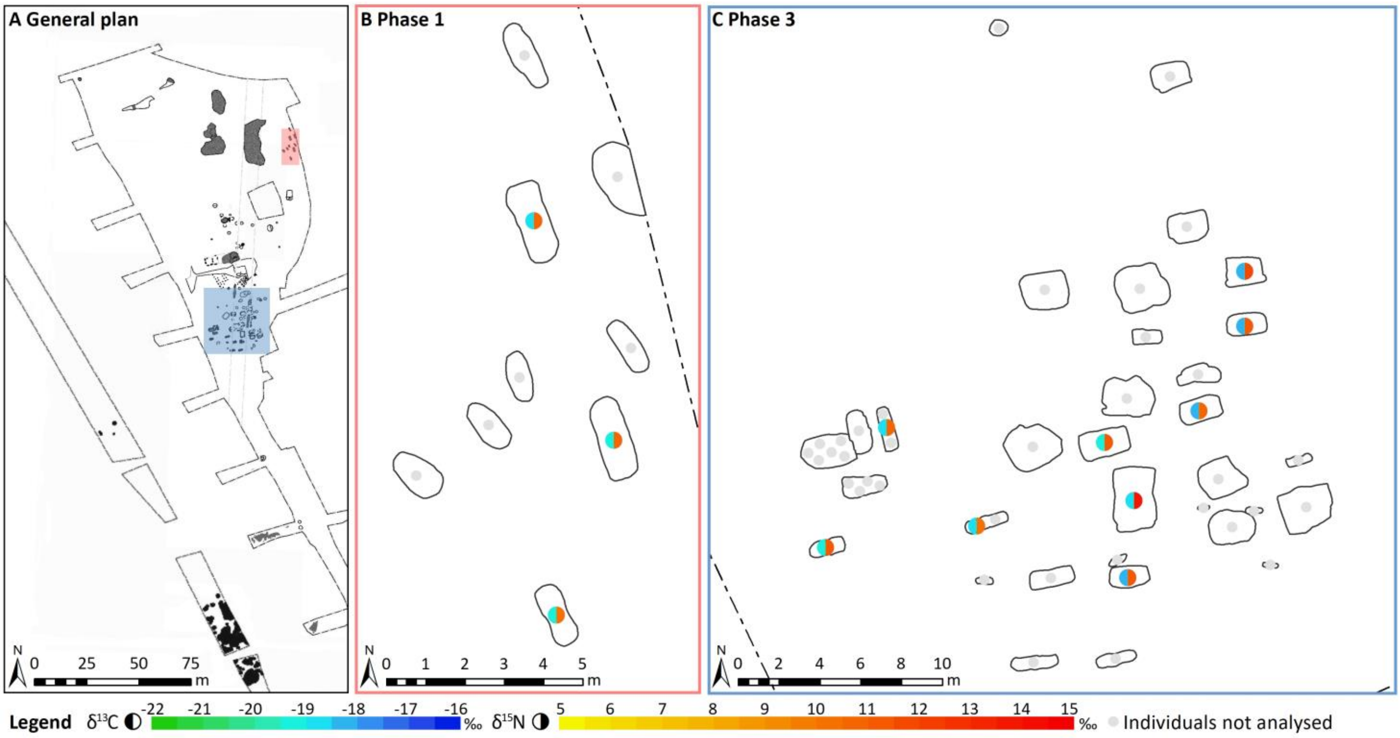


Figure 3.69. El Soto/El Encadenado, spatial distribution of individuals divided by carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) (Vigil-Escalera & Vírseda 2007: plates 7, 26, Vigil-Escalera 2015c: 171, modified). (A) General plan of the site highlighting the two areas with funerary contexts. The colour of each area matches that of the frame of their corresponding detailed plan to the right. (B) Cemetery of phase 1. (C) Cemetery of phase 3. The dashed line depicts the excavation limits. Individuals successfully analysed are represented with a big circle divided in two. The left half symbolises $\delta^{13}C$ and the right half $\delta^{15}N$ according to the colour gradient shown in the legend. Individuals not analysed are depicted with a smaller grey point

The spatial distribution of carbon and nitrogen stable isotope ratios was also examined (figure 3.69). First, the assemblage of phases 1 and 3 were compared (figure 3.61). No clear differences between them were observed, even though individuals of phase 3 tended in most cases towards more enriched values, pointing at the greater consumption of C_4 plants and animal protein during the later period. Still, it is likely that there was not a substantial modification of the type of resources available between both phases. The cemetery of phase 1 (figure 3.69B) was small and it was represented by only three samples, which hindered the possibility to identify any spatial trend. The cemetery of phase 3 was slightly better covered (figure 3.69C). Seemingly there was a weak pattern in the spread of $\delta^{13}C$, according to which the most depleted carbon stable isotope ratios were preferentially found in the western area of the graveyard. This was also the oldest zone of the cemetery, where individuals were buried in supine position, presumably according to the Christian funerary ritual. Then, this would suggest millet consumption was less frequent during the initial phase of use of the cemetery and it became more popular after the change to the Islamic funerary ritual. Besides, it is thought provoking that individual SNC 30835-1-30837, the only one in supine position in the eastern sector of the cemetery of phase 3, was also the individual with the highest $\delta^{13}C$ of this zone. Meanwhile, the distribution of $\delta^{15}N$ values was uniform among all the sectors of the burial ground.

3.1.4 LA HUELGA

3.1.4.1 The site

3.1.4.1.1 Location and history of research

The site of La Huelga is east of Madrid city (figure 3.70), within the municipality of Barajas and next to Adolfo Suárez Madrid-Barajas Airport. Its UTM ETRS89 coordinates are 30T 453576 4482664 and it is 575 meters above sea level. La Huelga is 16 km northeast the city of Madrid, 82 km north of Toledo and 16 km west of the Roman city of Complutum (nowadays Alcalá de Henares). As for the other sites from the region included in this thesis, La Huelga is 28 km north of Gózquez, 46 km northeast of Boadilla and only 1.7 km north of El Soto/El Encadenado, with which it shares many landscape characteristics due to their proximity. Like the latter, La Huelga is placed on the right margin of the Jarama river. This is a plain area at the same height as the riverbed, which would have favoured seasonal flooding and, therefore, the existence of very fertile soils for both agriculture and pasture. Moreover, the valley created by the Jarama river acted as a natural communication path in north-south direction and in the vicinity of La Huelga there were several fords to cross the river. Then, it is likely that some kind of road passed by the site, as it has been recorded in the neighbouring El Soto/El Encadenado (see section 3.1.3.1.2).

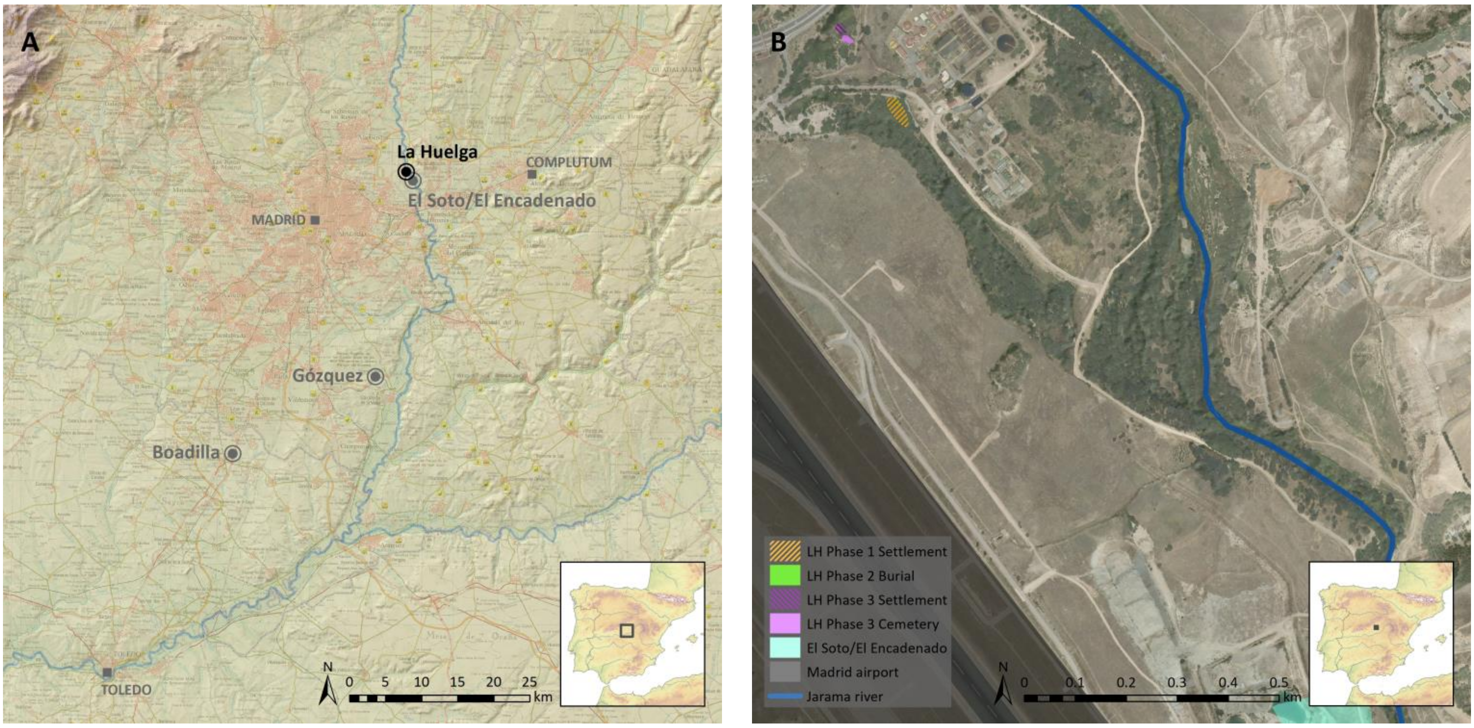


Figure 3.70. Geographical location of the site of La Huelga (Barajas, Madrid) (A) at the regional and (B) local scale

La Huelga was excavated on the occasion of the expansion of the airport. Several archaeological interventions were carried out on the site as part of this project. On one side, in 2003 the cooperative society Área carried out an excavation led by R. M. Domínguez Alonso, J. Rincón and A. Vigil-Escalera (2004) for the burial of a high voltage electric line. It was a long trench with northwest-southeast orientation of 0.5 ha divided in four sections, of which only the two southernmost preserved any archaeological evidence. The anthropological assemblage analysed here comes from this intervention and at present it is stored at the Regional Museum of Archaeology of Madrid, in Alcalá de Henares. On the other side, the company Gestión del Patrimonio Cultural also worked on La Huelga. First, they coordinated the assessment of the archaeological value of the site through test pits. During this intervention they discovered a burial containing an individual in supine position without any grave goods (Rodríguez Cifuentes & de Juana 2006: 420). However, there is no information about its precise location. Later, between 2003 and 2004 the same team under the direction of L. Á. de Juana excavated 300 m^2 ha for the installation of a plant for the management of hydrocarbon (Rodríguez Cifuentes & de Juana 2006), where they found residential and productive structures similar to those unearthed by Área. These are not integrated into the description in the next section because the information available did not allow to exactly position them.

The site of La Huelga does also have a number of publications. In addition to the excavation reports cited in the previous paragraph, there is a paper with a thorough description of the settlement (Vigil-Escalera 2013e) and a monographic article about the cemetery (Vigil-Escalera 2004). La Huelga is also included in general syntheses about early medieval settlement patterns in central Iberia (Ariño 2013, Quirós & Vigil-Escalera 2006, Vigil-Escalera 2005) and it was essential for the definition of the category of farms by A. Vigil-Escalera (2007a). Besides, the funerary record from La Huelga has been discussed in a review about funerary practices during this period (Vigil-Escalera 2013b) and it is an important case of study for the research on the onset of Islamization (Vigil-Escalera 2009b, Vigil-Escalera 2015b). The domestic architecture recorded at La Huelga was covered by several publications on the topic (Tejerizo 2013, Tejerizo 2014, Vigil-Escalera 2003a), as well as the ovens (Vigil-Escalera 2012). Pottery (Serrano *et al.* 2016) and glass (Gómez de la Torre-Verdejo 2017) from the site were also included in wider regional studies. Fauna from the two main interventions on La Huelga was analysed separately (Alarcón 2006, Morales & Llorente 2004b) and the assemblage has been included in general reviews about early medieval animal husbandry in central Iberia (Estaca-Gómez *et al.* 2019, Grau-Sologestoa 2013a). Concerning the anthropological record, there is an unpublished preliminary osteoarchaeological analysis by C. Sampedro (2004). Nevertheless, the complete assemblage was re-studied by the author with the aim of standardizing the methodologies applied. Moreover, some of the individuals from La Huelga were included in a regional study of mitochondrial DNA (Fernández Domínguez *et al.* 2009).

3.1.4.1.2 The settlement

One of the distinctive features of La Huelga is that it has quite a narrow chronology. The oldest evidence from the site dates to the Roman period (Vigil-Escalera 2013e: 234). Plenty of pottery of Imperial chronology was found out of context throughout the excavation, which indicates the presence of a Roman settlement in the vicinity. Actually, the Roman villa of El Rasillo was only 1.5 km north of La Huelga. Even if there was no direct relationship between it and the early medieval settlements, it is probable that the latter kept on exploiting the territory of the villa. Between the 6th and the mid-9th centuries there was the series of discontinuous occupations under research here. Afterwards the site was not inhabited again. However, in the immediate surroundings of La Huelga there are signs of a longer sequence. At the nearby sites of El Soto/El Encadenado (see section 3.1.3.1.2, Presas *et al.* 2004: 20) and El Malecón (Rodríguez Cifuentes & de Juana 2006: 419) late prehistoric structures and pottery were found and both were also occupied during the Late Middle Ages. Going into detail (Vigil-Escalera 2013e), the early medieval period can be divided into three phases based mostly on the analysis of pottery, since there were no vertical stratigraphic relationships and radiocarbon dates were restricted to funerary contexts. Next, the diachronic evolution of the site will be described phase by phase.

At the beginning of the 6th century possibly a single family established a small farm in the southern half of the area excavated (phase 1, figure 3.71A). It was a very short occupation, which did not go beyond the second third of the 6th century, so probably it only lasted for a generation. The domestic unit was formed by two sunken featured buildings, one of them with an oven, six storage silos and two wells. Long after the abandonment of this ensemble, an individual was buried in the filling of one of the sunken featured structures of the previous period (phase 2, figure 3.71B). It was a simple pit where the body was placed in supine position without any grave goods. Radiocarbon dated this burial throughout the 7th century (Vigil-Escalera 2009b: 103). Later, during the last decades of the 8th century, a new small farm was settled on the northern end of the excavation (phase 3, figure 3.71C). Its material features were very similar to the occupation of phase 1. It consisted of a main building on a stone perimeter base, a possible oven and a single silo. The paucity of these remains points, also in this case, to a single family occupying the site just for a generation. In addition, immediately south of the residential area there was a small cemetery formed by eight graves grouped in two clusters. Here all the individuals were buried in lateral position, according to the Islamic funerary ritual. This last phase ended around the middle of the 9th century. In conclusion, throughout the Early Middle Ages La Huelga, like the near sites of El Soto/El Encadenado (see section 3.1.3, Vigil-Escalera 2013d), El Malecón (Rodríguez Cifuentes & de Juana 2006) or Las Charcas (Rodríguez Cifuentes & Domingo 2006), integrated the network of small scattered settlements making the most of the fertile fields and pastures along the Jarama river. In this context, the ephemeral and diffuse nature of phases 1 and 3 of La Huelga fits well into the definition of farms (Vigil-Escalera 2007a: 258).

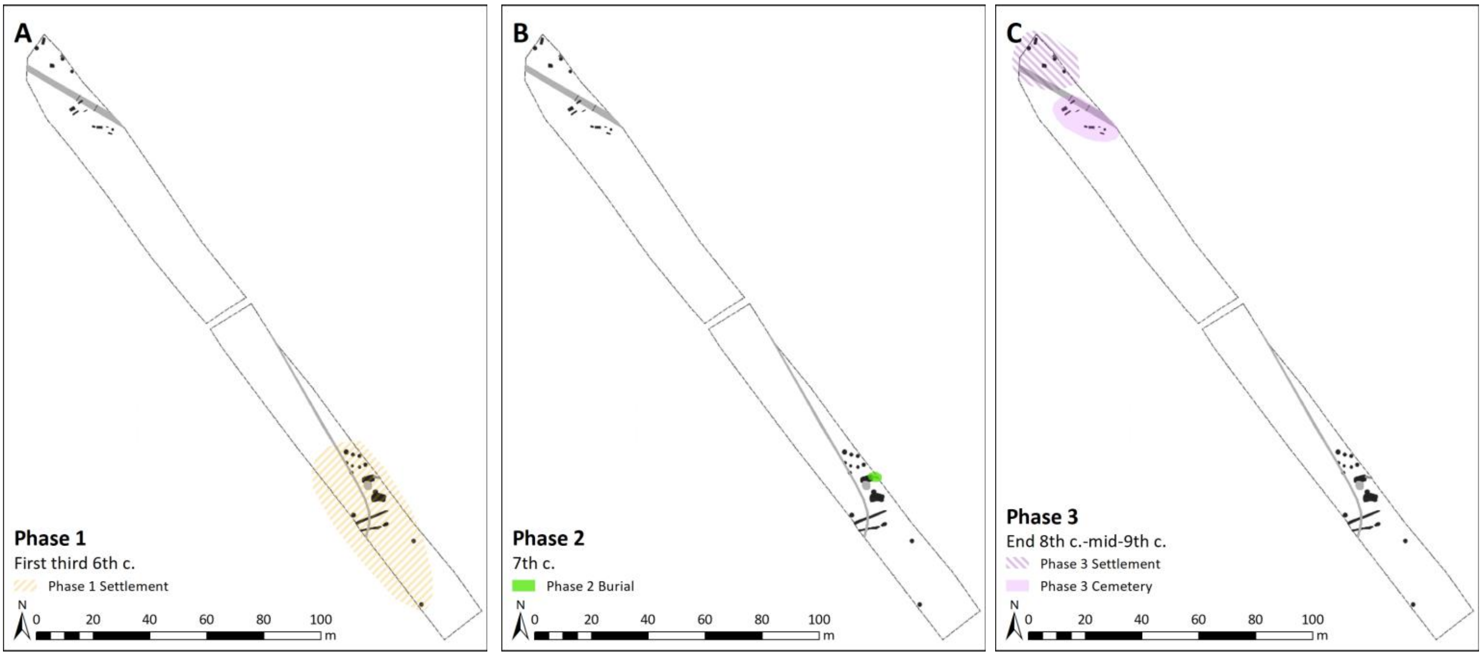


Figure 3.71. La Huelga, diachronic evolution of the site (Domínguez *et al.* 2004: 63, Vigil-Escalera 2013e: 233, modified)

Regarding material culture, the pottery from the phase 1 of La Huelga (Vigil-Escalera 2013e: 241–242) was characterised by the predominance of fast wheel productions, mostly bowls and jugs, including some imitations of Hispanic grey slip wares and Gallic late antique stamped types. The only items made with slow wheel were pots. Pottery dated to phase 3 was very scarce. There was evidence of handmade productions typical of the second hand of 8th century and only two fragments of pots made with fast wheel could possibly be identified with the first Islamic productions (Domínguez *et al.* 2004: 34–35). Glass was very scarce and it was recovered just from contexts dated to phase 1. There were a few green and blue fragments belonging to a bowl, a flask and other unidentified types (Gómez de la Torre-Verdejo 2017: 342–344). Metals were rare too. The only findings were some nails, a hinge and a set of slags. Granite hand mills were also present. Even a complete one, probably reused as lid, was found on the bottom of the only silo of phase 3.

The only bioarchaeological record from La Huelga already analysed is fauna. The assemblage of animal skeletal remains from the excavation carried out by Área (Morales & Llorente 2004b) was remarkable because there was a great number of complete carcasses, which suggests it may be not representative of animal consumption patterns on the site. According to the number of identified elements, the most abundant taxa were cattle, ovicaprids, equids and pigs in that order and there was evidence of dogs and fowl too, as well as one fragment red deer antler. Continuity was observed between the general features of the assemblages of phases 1 and 3, although there seemed to be a slight increase in the proportion of cattle during the latter. The zooarchaeological study of the fauna remains from the excavation performed by Gestión del Patrimonio Cultural (Alarcón 2006) did also find a big proportion of complete carcasses, but based on the number of identified fragments, the most frequent species were dogs, ovicaprids, cattle and chickens in this order. Equids, pigs and cats were incidental and there were a few fragments of red deer, frog and turtle. To conclude, the individual buried in phase 2 and four of the individuals of phase 3 were tested for mitochondrial DNA (Fernández Domínguez *et al.* 2009), which provides information about maternal ancestry. Interestingly, one of the individuals from the Islamic cemetery was confirmed to have an African maternal haplogroup. This does not necessarily mean the individual itself took part in the conquest of Iberia by Muslims in the 8th century, but just that one of its maternal ancestors was possibly original from Africa. All the remaining individuals showed European maternal lineages. In addition, it was verified there were no maternal kinship bounds between any of the individuals analysed.

3.1.4.1.3 The funerary contexts

Two of the three occupation phases of La Huelga included funerary contexts. First, there was the isolated burial of phase 2 (figure 3.72B, Domínguez *et al.* 2004: 24–25). It meant about a tenth of the funerary structures in La Huelga (n = 1/9 = 11.1%, table 7.1). It was located on the residential structures of phase 1 (figure 3.71B), which were abandoned at least seven decades before the installation of this burial. It consisted of a simple pit (n = 1/1 = 100.0%) with west-east orientation (n = 1/1 = 100.0%) containing a single individual in a primary deposit in supine position (n = 1/1 = 100.0%). It did not have any coffin items (n = 0/1 = 0.0%) or grave goods (n = 0/1 = 0.0%, table 7.2). According to its radiocarbon date, this individual died throughout the 7th century (table 7.3). This was the only evidence of this chronology recovered during the intervention at La Huelga considered in this thesis (Domínguez *et al.* 2004). However, it should be reminded that during the survey carried out by Gestión del Patrimonio Cultural in the surroundings they found another isolated burial with an individual in supine position without grave goods (Rodríguez Cifuentes & de Juana 2006: 420). This was not included in this research because there was basic information missing about it.

Then, during phase 3 a proper cemetery appeared on the northern end of the area excavated (figure 3.72C, Domínguez *et al.* 2004: 25–27, Vigil-Escalera 2004). It was a group of eight burials (n = 8/9 = 88.9%), which made up the bulk of the funerary structures in the site. The graveyard was a few meters south of the contemporary residential and productive structures (figure 3.71C). It was loosely organised in two groups of four burials each, one to the north closer to the settlement and the other one southeast of the former. In the northern cluster graves were oriented in southwest-northeast direction (n = 4/8 = 50.0%) and in the southern group in west-east direction (n = 4/8 = 50.0%). Burials did not cut each other in any case. A marker was recorded in at least one of the graves (LH 3). It was a standing slab next to the head. These elements would have contributed to preserve the individuality of burials. Considering the association and the homogeneity of formal features within each group, it can be presumed each cluster corresponded to a slightly different chronological period but, having only one radiocarbon date (table 7.3), it was not possible to be more precise. Therefore, the complete cemetery is dated altogether between the end of the 8th century and the 9th century. There were only two types of funerary structures. Almost all the burials were simple pits (n = 7/8 = 87.5%), even if several variations were identified. The remaining one was a lateral niche grave (n = 1/8 = 12.5%), a pit with a lateral chamber at the bottom to place the corpse. Every burial was occupied by a single individual, so there were eight individuals in total. All of them were recovered in primary deposits and lateral position (n = 8/8 = 100.0%). None of the individuals kept any element which pointed at the use of coffins (n = 0/8 = 0.0%) and no grave goods were found in any of the burials either (n = 0/8 = 0.0%, table 7.2).

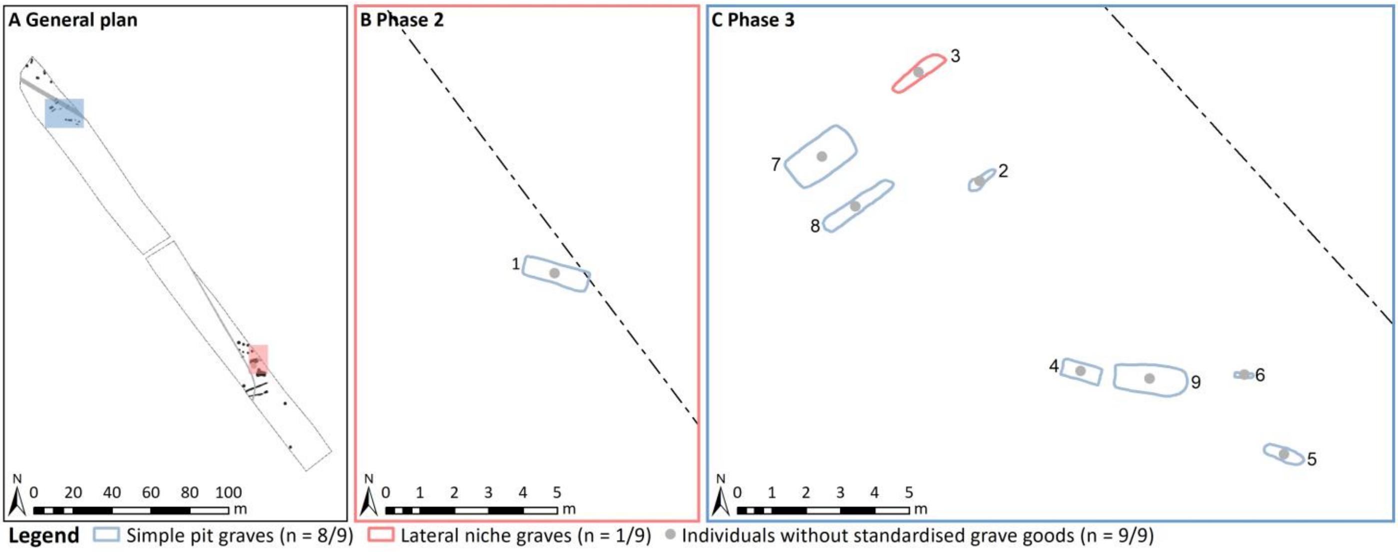


Figure 3.72. La Huelga, funerary contexts (Domínguez *et al.* 2004: 63–64, modified). (A) General plan of the site highlighting the two areas with funerary contexts. The colour of each area matches that of the frame of their corresponding detailed plan to the right. (B) Isolated burial of phase 2. (C) Cemetery of phase 3. The dashed line depicts the excavation limits. The outline of burials is represented with a solid line whose colour shows the type of funerary structure according to the legend. The number next to each burial is its identifier. Points symbolise the individuals recovered in each burial. Their colour indicates the presence or absence of grave goods as stated in the legend

3.1.4.2 The human populations

3.1.4.2.1 Macroscopic preservation

The macroscopic preservation of the two funerary assemblages recovered at La Huelga was assessed separately. On one side, there was the isolated burial of phase 2 (figure 3.72B), which contained a single individual. Its conservation was very good. It could be recovered from the field (n = 1/1 = 100.0%, table 7.1), it preserved between 50% and 75% of the skeleton and only between 50% and 75% of the skeletal elements preserved were fragmented (figure 3.73, table 7.7). Moreover, bone surface preservation was quite good too, with only extensive surface erosion with deeper penetration (grade 2).

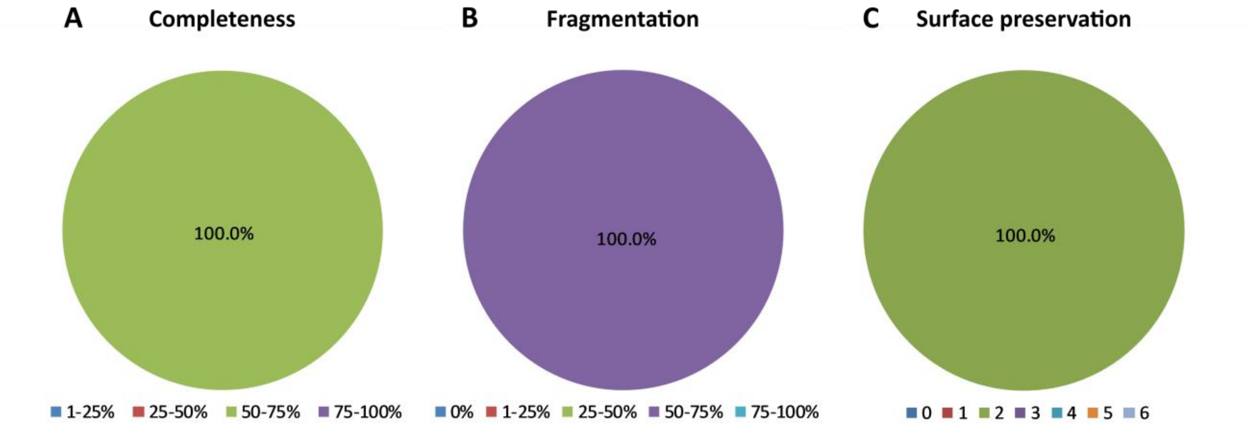


Figure 3.73. Pie charts representing the distribution of the three variables for the assessment of the macroscopic preservation of the isolated burial of phase 2 of La Huelga. (A) Completeness. (B) Fragmentation. (C) Surface preservation

On the other side, there was the cemetery dated to phase 3 (figure 3.72C). It was formed by eight burials, containing one individual each. Then, the total number of individuals in the population was also eight. All of them preserved some skeletal element (n = 8/8 = 100.0%, table 7.1). Completeness was very variable (figure 3.74, table 7.7). Approximately a third of the individuals conserved less than 25% of the skeleton, but the same proportion of individuals preserved more than 50%. In contrast, all the population showed the same fragmentation. They all had more than 75% of the skeletal elements preserved fragmented. Bone surface preservation was acceptable. Half of the population presented most of the surface eroded with some details masked (grade 3) and the rest only varied one grade up or down. Hence, it can be concluded macroscopic preservation did not affect significantly the results of the osteoarchaeological study of this human assemblage.

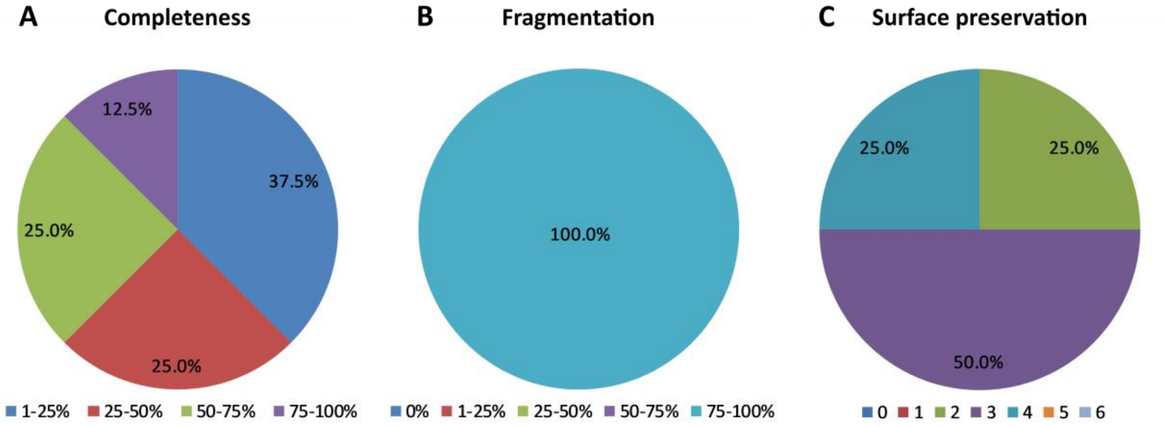


Figure 3.74. Pie charts representing the distribution of the three variables for the assessment of the macroscopic preservation of the human population from the cemetery of phase 3 of La Huelga. (A) Completeness. (B) Fragmentation. (C) Surface preservation

3.1.4.2.2 Demography

The funerary context of phase 2 from La Huelga was formed by a single isolated burial and just one individual, so it is not possible to elaborate a proper demographic profile. However, the demographic data of this individual are presented in table 3.20, figure 3.75 and table 3.21 (more information on table 7.4 and table 7.6). It was a female middle-old adult, which is interesting because the assemblage of phase 3 of the same site was also dominated by females.

Table 3.20. Age and sex distribution by absolute frequencies of the isolated burial of phase 2 of La Huelga. Key: F = fetus, < 40 weeks in utero; I1A = infans 1A, birth – 2 years; I1B = infans 1B, 3 – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; Ssp = subadult sp, < 20 years; YA = young adult, 20 – 34 years; YMA = young-middle adult, 20 – 45 years; MA = middle adult, 35 – 45 years; MOA = middle-old adult, > 35 years; OA = old adult, > 45 years; Asp = adult sp, > 20 years; UA = undetermined age; M = male individuals (including probably male individuals); F = female individuals (including probably female individuals); US = undetermined sex (including ambiguous individuals)

	F	*I1A*	*I1B*	*I2*	*J*	*Ssp*	*YA*	*YMA*	*MA*	*MOA*	*OA*	*Asp*	*UA*	*Total*
M	-	-	-	-	-	-	-	-	-	-	-	-	-	0
F	-	-	-	-	-	-	-	-	-	1	-	-	-	1
US	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Total	0	0	0	0	0	0	0	0	0	1	0	0	0	1

The cemetery of phase 3 of La Huelga was bigger than the former, but still it did not constitute a representative demographic assemblage. It was made up of a minimum of eight individuals (table 3.22, figure 3.76, table 3.23, table 7.4, table 7.5, table 7.6), who represent the totality of the sample available for this period. Exactly half of them were subadults and half adults. All the subadults were classified as infans 1, so they died at very young ages. Still, such high mortality rate during the first years of life is characteristic of premodern demography (Chamberlain 2006: 64–68, Séguy & Buchet 2013: 114). That is why, even if this is a small population, its curve of risk of death (figure 3.76) is quite close to the reference models for preindustrial agricultural populations. Adult age estimation was not possible in any case, but sex could be determined for all the adults. The result is a strongly imbalanced sex ratio in favour of women, according to which there would have been only 33 males per each 100 females. It is unlikely these figures are representative of the real configuration of La Huelga between the end of the 8th century and the mid-9th century. In contrast, this imbalanced sex ratio may be more of an indicator of differential mortality rates depending on sex. According to this hypothesis, women at La Huelga would have experienced higher risk of death during adulthood than men, a phenomenon already verified in other contexts which has often been linked to the hazards of pregnancy, childbirth and breastfeeding (Gowland & Halcrow 2020). Juvenility index and the palaeodemographic estimators derived from it were not calculated for this population, because the MNI was considered insufficient to be representative. Finally, a few observations can be made about the topographic distribution of individuals according to demographic variables (figure 3.77C). The northern cluster of the cemetery concentrated most of the adults, including individuals of both sexes, while the southern one was mainly formed by subadults and one woman. Then, it is clear burials were not organised by age or sex. It could be proposed they represented family groups, but mitochondrial DNA analyses did not find any maternal kinship between the four individuals analysed (Fernández Domínguez *et al.* 2009), not even between the woman and one of the subadults in the southern cluster. Summing up, the small human assemblage of phase 3 of La Huelga reflects the demographic dynamics of a small peasant community during a short period of time, possibly no more than one generation.

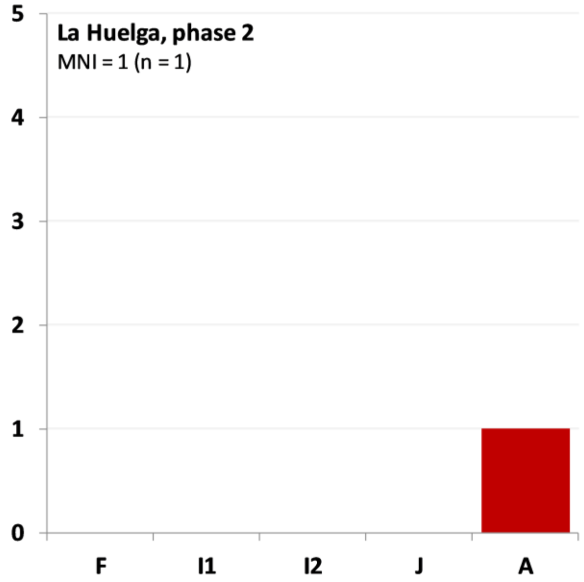


Figure 3.75. Demography chart of the isolated burial of phase 2 of La Huelga. Bars represent the absolute frequencies of each age category (F = fetus, < 40 weeks in utero; I1 = infans 1, birth – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; A = adults, > 20 years), separated by sex whenever possible (blue = male individuals, red = female individuals, grey = undetermined sex). The minimum number of individuals of the population (MNI) and the number of individuals represented in the chart (n) are shown on the upper left corner

Table 3.21. Demographic descriptive indicators of the human population from the isolated burial of phase 2 of La Huelga. Palaeodemographic estimators are not reported because the MNI was smaller than ten

Descriptive indicators	
MNI	1
%subad	0.0%
%ad	100.0%
S/A	0.00
M/F	0.00

Table 3.22. Age and sex distribution by absolute frequencies of the human population from the cemetery of phase 3 of La Huelga. Key: F = fetus, < 40 weeks in utero; I1A = infans 1A, birth – 2 years; I1B = infans 1B, 3 – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; Ssp = subadult sp, < 20 years; YA = young adult, 20 – 34 years; YMA = young-middle adult, 20 – 45 years; MA = middle adult, 35 – 45 years; MOA = middle-old adult, > 35 years; OA = old adult, > 45 years; Asp = adult sp, > 20 years; UA = undetermined age; M = male individuals (including probably male individuals); F = female individuals (including probably female individuals); US = undetermined sex (including ambiguous individuals)

	F	*I1A*	*I1B*	*I2*	*J*	*Ssp*	*YA*	*YMA*	*MA*	*MOA*	*OA*	*Asp*	*UA*	*Total*
M	-	-	-	-	-	-	-	-	-	-	-	1	-	1
F	-	-	-	-	-	-	-	-	-	-	-	3	-	3
US	-	3	1	-	-	-	-	-	-	-	-	-	-	4
Total	0	3	1	0	0	0	0	0	0	0	0	4	0	8

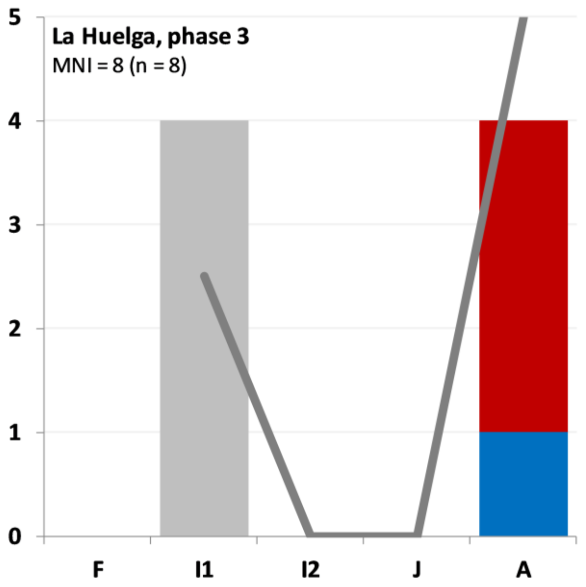


Figure 3.76. Demography chart of the human population from the cemetery of phase 3 of La Huelga. Bars represent the absolute frequencies of each age category (F = fetus, < 40 weeks in utero; I1 = infans 1, birth – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; A = adults, > 20 years), separated by sex whenever possible (blue = male individuals, red = female individuals, grey = undetermined sex). The line depicts the progression of the probability of death (q_x) along age categories, calculated according to G. Acsádi and J. Nemeskéri (1970: 65). The minimum number of individuals of the population (MNI) and the number of individuals represented in the chart (n) are shown on the upper left corner

Table 3.23. Demographic descriptive indicators of the human population from the cemetery of phase 3 of La Huelga. Palaeodemographic estimators are not reported because the MNI was smaller than ten

Descriptive indicators	
MNI	8
%subad	50.0%
%ad	50.0%
S/A	1.00
M/F	0.33

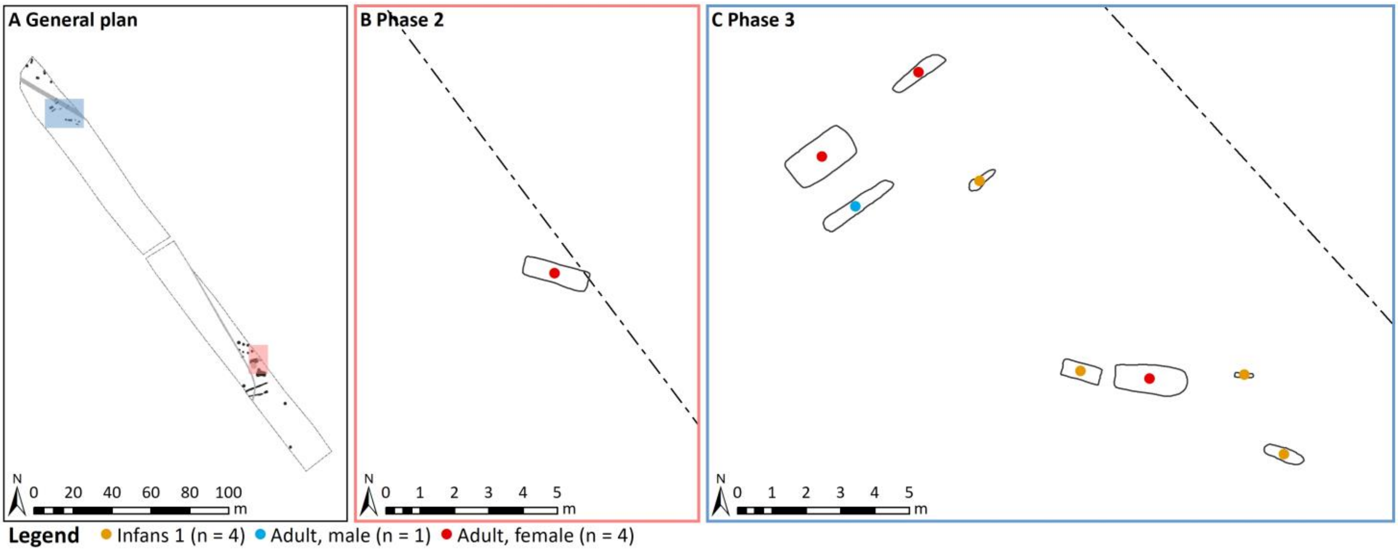


Figure 3.77. La Huelga, spatial distribution of individuals by age and sex (Domínguez *et al.* 2004: 63–64, modified). (A) General plan of the site highlighting the two areas with funerary contexts. The colour of each area matches that of the frame of their corresponding detailed plan to the right. (B) Isolated burial of phase 2. (C) Cemetery of phase 3. The dashed line depicts the excavation limits. Points symbolise the individuals recovered in each burial. Their colour indicates their age and sex as stated in the legend

3.1.4.3 Human diet

3.1.4.3.1 Sampling

Almost all the individuals from both phases with human burials from La Huelga were sampled for carbon and nitrogen stable isotope analyses. First, there was the individual from the isolated burial of phase 2 (figure

3.78), which was a female adult. Then, six individuals from the cemetery of phase 3 were selected (figure 3.80). Two of them were infans 1A, the only subadult age group present in the population, together with infans 1B. The remaining four samples included all the adults recovered in the cemetery, namely a male individual and three females. In most cases ribs were the anatomical element chosen for analysis and just in one instance a fragment of long bone was used.

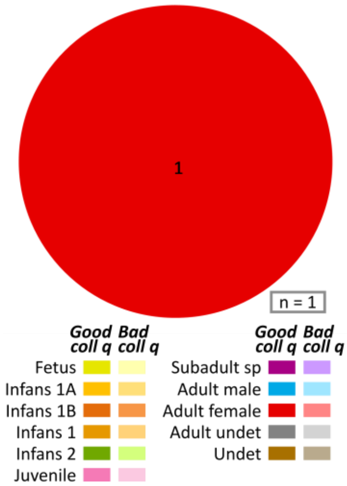


Figure 3.78. Pie chart representing the distribution of human samples from the isolated burial of phase 2 of La Huelga by age, sex and collagen quality. Numbers represent the absolute frequency of each group

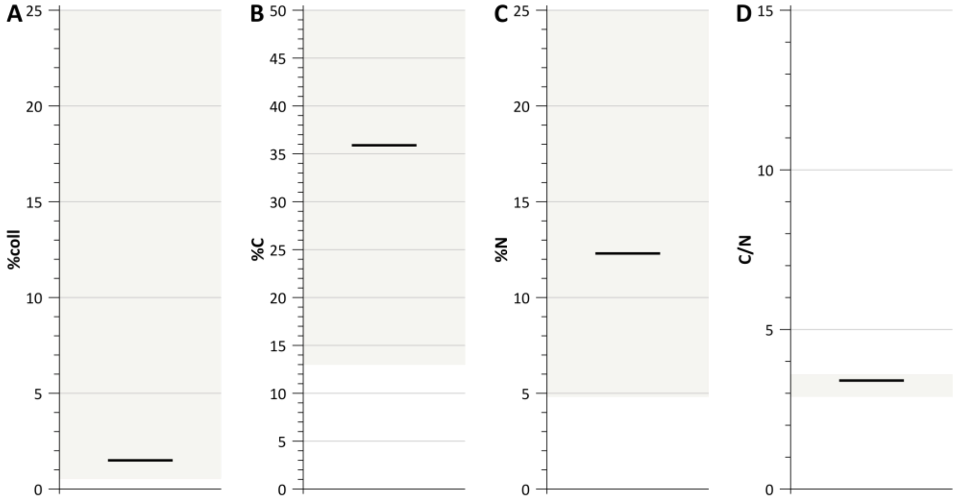


Figure 3.79. Boxplots representing the collagen quality indicators of human samples from the isolated burial of phase 2 of La Huelga. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

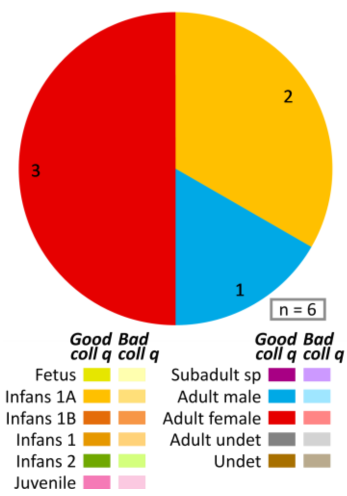


Figure 3.80. Pie chart representing the distribution of human samples from the cemetery of phase 3 of La Huelga by age, sex and collagen quality. Numbers represent the absolute frequency of each group

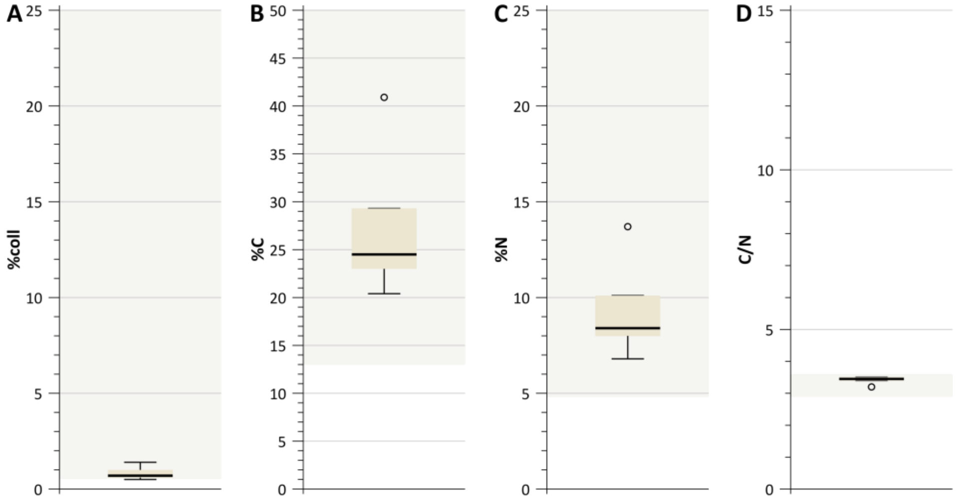


Figure 3.81. Boxplots representing the collagen quality indicators of human samples from the cemetery of phase 3 of La Huelga. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

3.1.4.3.2 Collagen quality

All the human samples from La Huelga preserved good quality collagen (table 7.9). The only individual dated to phase 2 (figure 3.78, figure 3.79) had 1.5% collagen yield (%coll), 35.9% carbon weight content (%C), 12.3% nitrogen weight content (%N) and 3.4 carbon to nitrogen atomic ratio (C/N). Then, its collagen can be considered to preserve the *in vivo* isotopic signature. Likewise, all the individuals of phase 3 (figure 3.80, figure 3.81) had collagen yields (%coll) greater than 0.5%. Besides, carbon weight contents (%C) ranged between 20.4% and 40.9% and nitrogen weight contents (%N) between 6.8% and 13.7%. Carbon to nitrogen atomic ratios (C/N) moved in a narrow gap between 3.2 and 3.5. Summing up, all the seven human samples from La Huelga were valid for palaeodietary reconstruction.

3.1.4.3.3 Results

No fauna samples from La Huelga were analysed for carbon and nitrogen stable isotope ratios. However, El Soto/El Encadenado was less than 2 km south, so the animal samples from this contemporary site will be used as the isotopic baseline for La Huelga too (see section 3.1.3.3). Although the present human dataset was one of the smallest included in this research, individuals could be classified in two well-defined phases.

Table 3.24. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of human samples from the isolated burial of phase 2 of La Huelga. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All humans	1	-18.8	-	-	-	-	11.0	-	-	-	-
Adults	1	-18.8	-	-	-	-	11.0	-	-	-	-
Female adults	1	-18.8	-	-	-	-	11.0	-	-	-	-
Grave g absence	1	-18.8	-	-	-	-	11.0	-	-	-	-

Phase 2 (7th c.) was represented by a single individual (table 3.24, table 7.9, figure 3.82, figure 3.83) with a $\delta^{13}C$ of -18.8‰ and a $\delta^{15}N$ of 11.0‰. These meant an offset of 1.8‰ in relation to the mean $\delta^{13}C$ of the adult herbivores from El Soto/El Encadenado and 2.5‰ in comparison to $\delta^{15}N$ (see section 3.1.3.3.3). The difference is especially significant in the case of carbon stable isotope ratios, whose fractionation between trophic levels is estimated to be around 1‰. According to these figures, the diet of this individual would have been largely based on C_3 resources. Still, it is likely that it also consumed small amounts of C_4 plants, which would have contributed to the enrichment it shows in $\delta^{13}C$. Similarly, the distance between human and fauna reference values indicates a moderate consumption of animal protein, since the individual was approximately halfway of completing a full trophic level shift (~5‰). In any case, taking into account this was an isolated individual and fauna samples used as baseline were not strictly from the same context, any interpretation must be taken with caution. Demography and funerary archaeology offered a few more data about this individual. It was a female middle-old adult who died between 33 and 57 years of age (figure 3.84, figure 3.85). It was buried in an isolated simple pit grave without any grave goods. Interestingly, its isotopic signature was similar to the adults of phase 3 from the same site. This would point at the continuity of dietary patterns between this individual and the population of the later cemetery, despite their difference of probably more than a century.

The assemblage dated to phase 3 (end 8th c.-mid-9th c.) was made up of six samples (table 3.25, table 7.9, figure 3.82, figure 3.83), which included almost all the individuals in the cemetery. This population was characterised by quite wide distributions of both carbon and nitrogen stable isotope ratios, especially of the latter. This is particularly remarkable considering the small size of the assemblage. The mean $\delta^{13}C$ of the individuals in the cemetery of phase 3 of La Huelga was -18.8‰. They had a standard deviation of 0.6‰ and a range of 1.8‰. Then, the offset between them and the adult herbivores from El Soto/El Encadenado was

1.8‰ (see section 3.1.3.3.3). In this way, this assemblage spread around the limit between exclusive C_3 and mixed C_3-C_4 diets. Presumably the two individuals with the most depleted $\delta^{13}C$ were only having winter crops, as well as legumes, vegetables and fruits; but it is possible that individuals with more enriched carbon stable isotope ratios were also consuming small amounts of C_4 plants. Otherwise, the enrichment of $\delta^{13}C$ shown by two thirds of the individuals could be explained by the intake of marine fish. However, this would have required a regular supply of fish to a small farm located in central Iberia, approximately 300 km from the closest point of either Mediterranean or Cantabrian Seas, which does not look like a plausible scenario in this particular historical context. Either way, millets consumption would have been small in all cases.

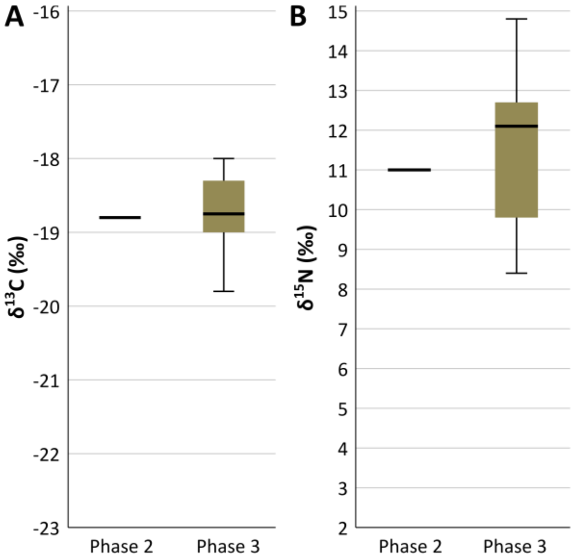


Figure 3.82. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from La Huelga divided by phase

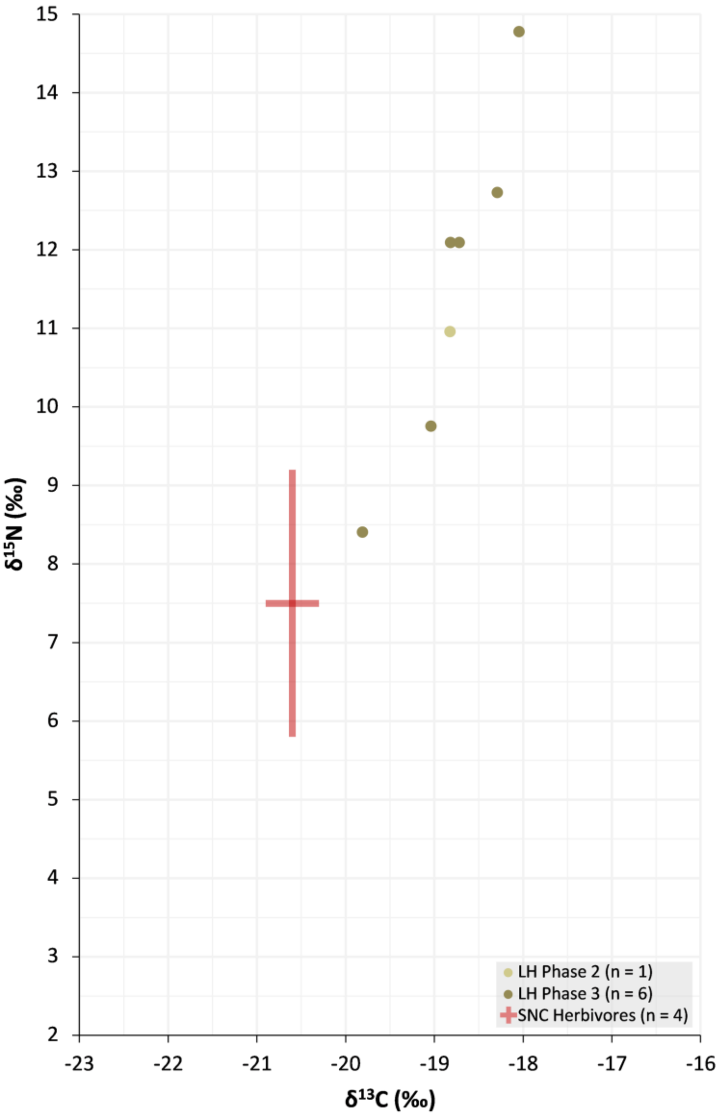


Figure 3.83. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from La Huelga divided by phase. Cross represents mean and one standard deviation of the fauna from El Soto/El Encadenado grouped by feeding regime. Subadult specimens were excluded from the calculation of these parameters. Fowl are not displayed because they are very variable

The spread of nitrogen isotope ratios among the individuals of phase 3 of La Huelga was really wide for such a small population. In fact, it was only exceeded by Boadilla, which was the largest assemblage included in this thesis. Focusing on actual values, the six individuals analysed had a mean $\delta^{15}N$ of 11.7‰, which was the greatest mean nitrogen isotope ratio among all the populations analysed in this thesis. Standard deviation was 2.3‰ and range 6.4‰. This meant an offset of 4.2‰ in comparison to the mean $\delta^{15}N$ of the adult herbivores from El Soto/El Encadenado (see section 3.1.3.3.3), which was one of the biggest gaps recorded in this work. Therefore, the individuals from La Huelga would have had on average a diet rich in animal protein. Nonetheless, the great width of the range indicates there were very different diets at La Huelga on this aspect. Demography can help to better understand this issue.

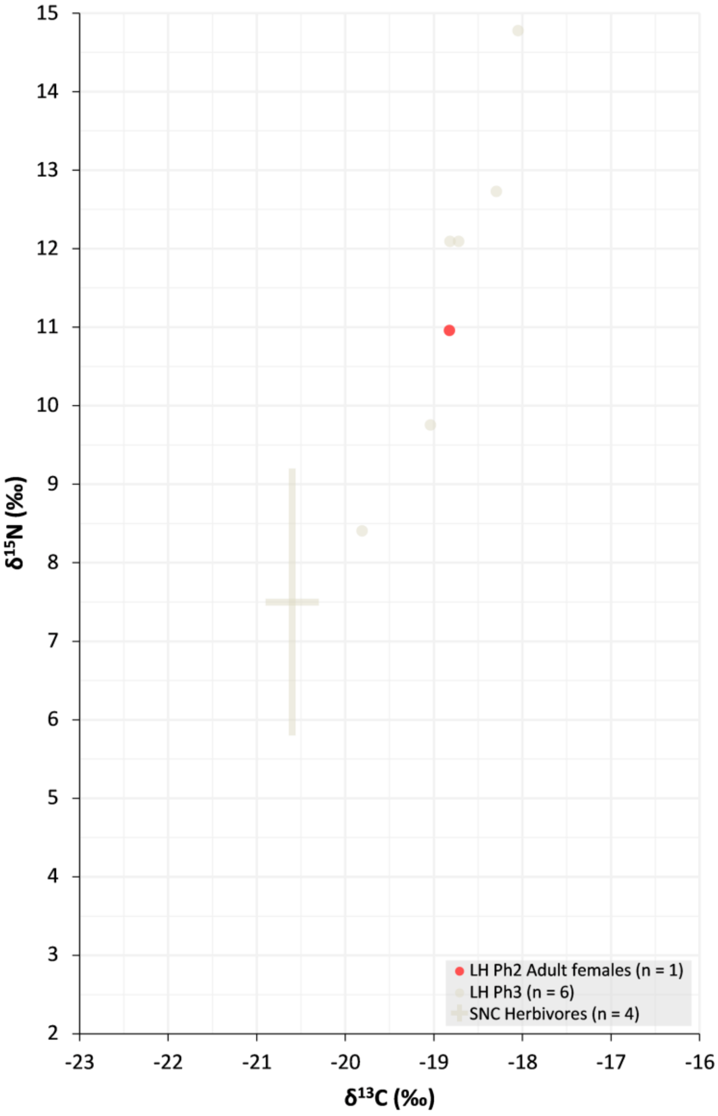


Figure 3.84. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from the isolated burial of phase 2 of La Huelga divided by demographic categories. Cross represents mean and one standard deviation of herbivores from El Soto/El Encadenado excluding subadult specimens

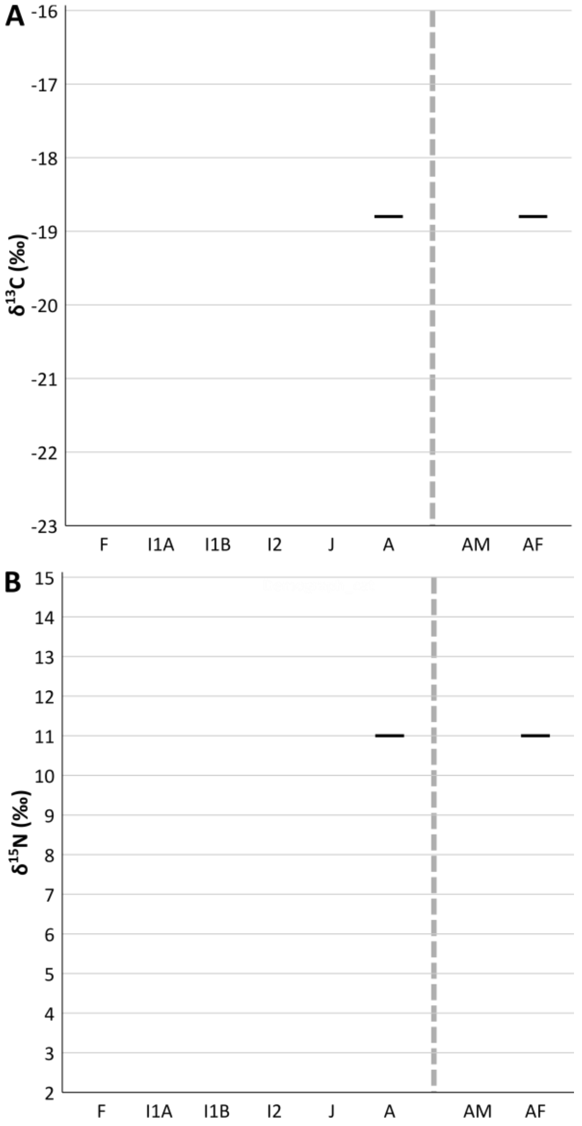


Figure 3.85. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from the isolated burial of phase 2 of La Huelga divided by demographic categories. Key: F = fetus, I1A = infans 1A, I1B = infans 1B, I2 = infans 2, J = juvenile, A = adults, AM = adult males, AF = adult females

Table 3.25. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of human samples from the cemetery of phase 3 of La Huelga. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All humans	6	-18.8	0.6	-19.8	-18.0	1.8	11.7	2.3	8.4	14.8	6.4
Subadults	2	-18.9	-	-19.8	-18.0	1.8	11.6	-	8.4	14.8	6.4
Infans 1A	2	-18.9	-	-19.8	-18.0	1.8	11.6	-	8.4	14.8	6.4
Adults	4	-18.7	0.3	-19.0	-18.3	0.7	11.7	1.3	9.8	12.7	2.9
Male adults	1	-18.7	-	-	-	-	12.1	-	-	-	-
Female adults	3	-18.7	0.4	-19.0	-18.3	0.7	11.5	1.5	9.8	12.7	2.9
Grave g absence	6	-18.8	0.6	-19.8	-18.0	1.8	11.7	2.3	8.4	14.8	6.4

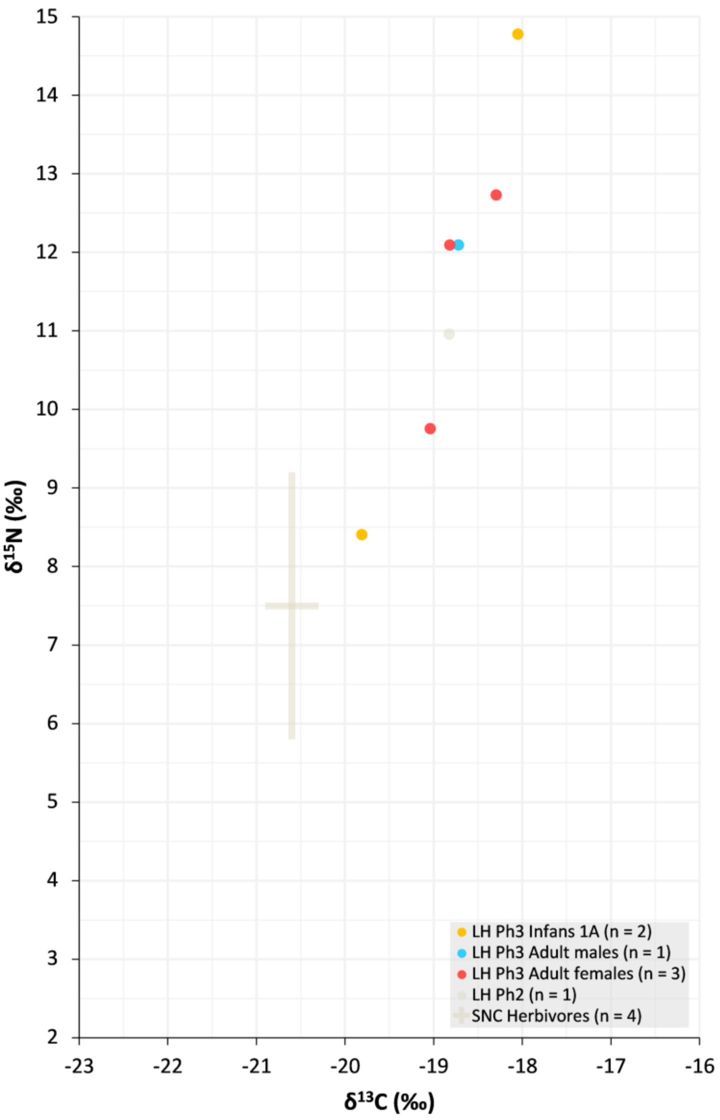


Figure 3.86. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from the cemetery of phase 3 of La Huelga divided by demographic categories. Cross represents mean and one standard deviation of herbivores from El Soto/El Encadenado excluding subadult specimens

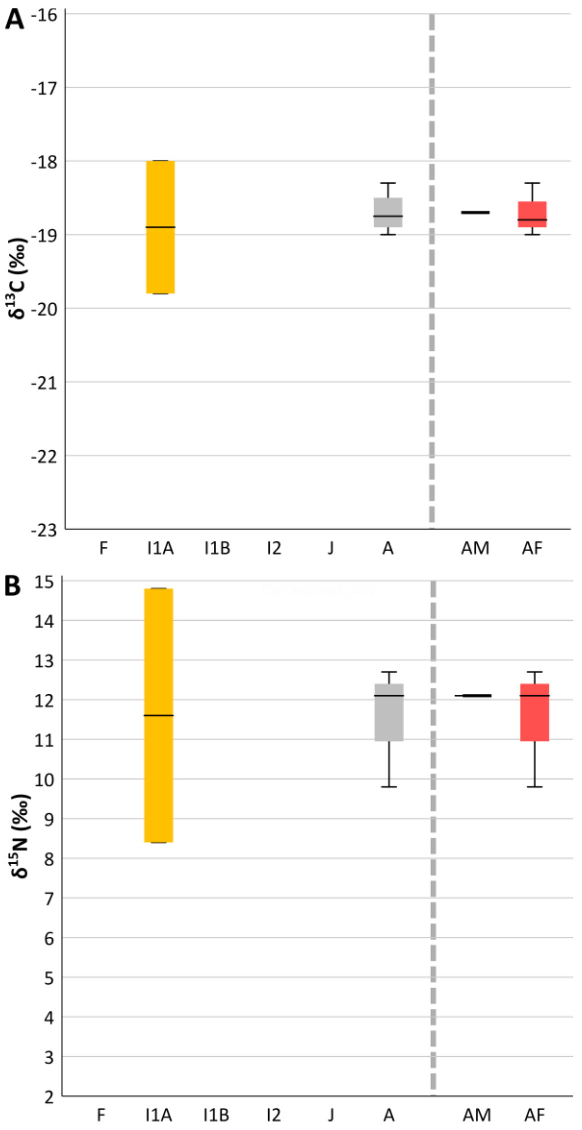


Figure 3.87. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from the cemetery of phase 3 of La Huelga divided by demographic categories. Key: F = fetus, I1A = infans 1A, I1B = infans 1B, I2 = infans 2, J = juvenile, A = adults, AM = adult males, AF = adult females

The four individuals from the assemblage of phase 3 closer to the mean for $\delta^{13}C$ and $\delta^{15}N$ were adults (figure 3.86, figure 3.87). Conversely, the two individuals at the ends of both variables were subadults, more precisely infans 1A. The individual with the highest carbon and nitrogen stable isotope ratios was between 1 year and 1 year and 6 months old at the time of death. For this reason, it is thought that its enrichment was probably due to the breastfeeding effect, that is, the fractionation caused by the fact that the baby is feeding on the mother's body tissues (Beaumont *et al.* 2018, Dupras 2010, Reynard & Tuross 2015). The offset between this individual and the adult females dated to phase 3 from La Huelga was 0.7‰ for $\delta^{13}C$ and 3.3‰ for $\delta^{15}N$. Hence, it is likely this individual was still being at least partially breastfed when it died or it was weaned shortly before death. In contrast, the other infans 1A presented the most depleted carbon and nitrogen stable isotope ratios of the assemblage. These values suggested it had already been completely weaned or maybe it was never breastfed. Moreover, they pointed at a diet exclusively based on C_3 resources and with very limited intake of animal protein, which had little to do with the food consumption patterns of the rest of the population. Still, being the only subadult analysed who was not affected by the breastfeeding effect, it is difficult to assess if this dietary behaviour was translatable to all the subadults at La Huelga. Removing subadults, adults kept virtually the same mean δ^{13}C and δ^{15}N, but they were more homogeneous and less scattered. In fact, the standard deviation and the range of adults was half of the same dispersion measures for the whole population. This means adult diet at La Huelga was more homogeneous than what it may seem in a first general approach and its variability was comparable to other contexts analysed in this research. Nevertheless, according to the data available, animal protein consumption among adults from La Huelga was in general abundant and greater than in most of the populations tackled here. The relationship between sexes was not further explored because adult males were represented by a single individual. Still, it is worth noting its isotopic signature was almost identical to an adult female, so in principle there would have been no differences based on sex in the access to food resources.

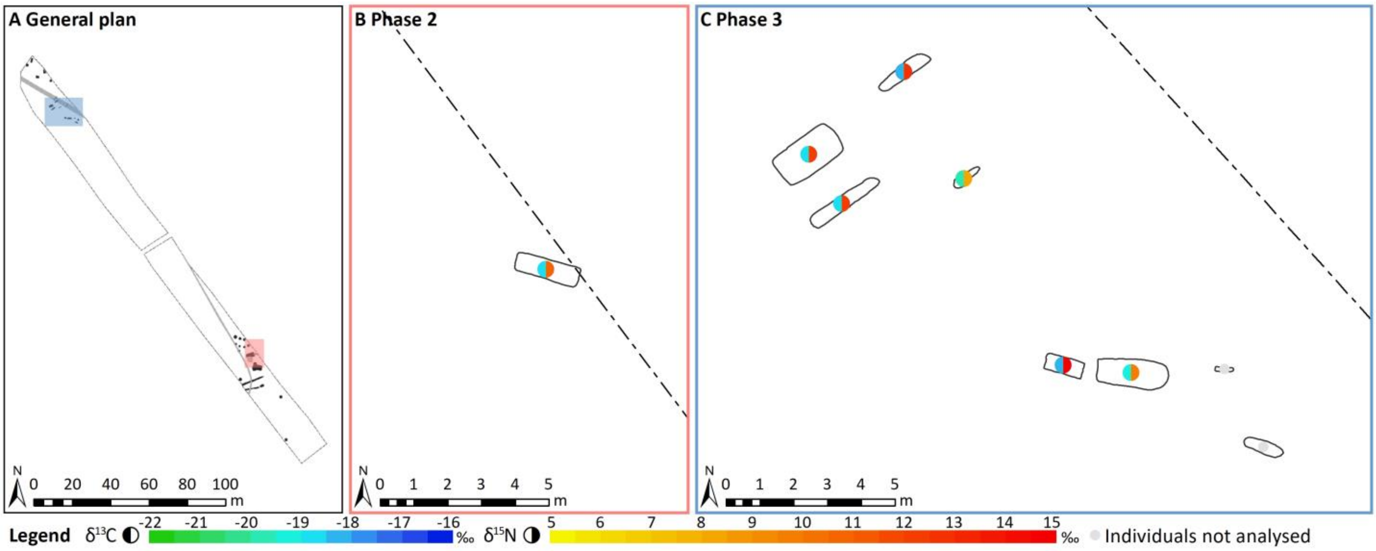


Figure 3.88. La Huelga, spatial distribution of individuals divided by carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) (Domínguez *et al.* 2004: 63–64, modified). (A) General plan of the site highlighting the two areas with funerary contexts. The colour of each area matches that of the frame of their corresponding detailed plan to the right. (B) Isolated burial of phase 2. (C) Cemetery of phase 3. The dashed line depicts the excavation limits. Individuals successfully analysed are represented with a big circle divided in two. The left half symbolises δ^{13}C and the right half δ^{15}N according to the colour gradient shown in the legend. Individuals not analysed are depicted with a smaller grey point

To conclude, figure 3.88 shows the spatial dispersion of carbon and nitrogen stable isotope ratios at La Huelga. No meaningful patterns or relevant differences are observed between the two clusters which formed the cemetery of phase 3 (figure 3.88C). The only remarkable observation is the proximity between the adult male and the adult female who had very similar δ^{13}C and δ^{15}N values. This would support the idea that these small groups possibly corresponded to family groups or domestic units, within which diets would have been quite uniform. Besides, the comparison between figure 3.88B and figure 3.88C underlines the likeness of dietary patterns between the two funerary contexts from La Huelga. This suggests that, although there was more than a century between them, the basis of productive strategies and consumption patterns possibly stayed stable, despite the change from Christian to Islamic funerary ritual.

3.2 BASQUE COUNTRY

3.2.1 ALDAIETA

3.2.1.1 The site

3.2.1.1.1 Location and history of research

Aldaieta is located north of the so called *Llanada Alavesa*, a vast plain occupying the north-eastern area of the province of Araba, and just at the boundary between Cantabrian and Mediterranean watersheds (figure 3.89). More precisely it is assigned to the municipality of Arrazua-Ubarrundia, whose closest currently inhabited place is Nanclares de Gamboa. Its UTM ETRS89 coordinates are 30T 534134 4752738 and it is 560 meters above sea level. It is 12 km northeast of Vitoria-Gasteiz, 47 km southeast of Bilbao, 66 km southwest of San Sebastián, 78 km west of Pamplona and 19 km northeast of the Roman city of Veleia. Relative to the other Basque sites included in this thesis, Aldaieta is 42 km southeast of Finaga and 11 km northwest of Dulantzi. The landscape where the site is located was deeply transformed by the construction of the Zadorra river dam in 1957, which in this area created the Ullibarri-Gamboa reservoir. But before that, this was a quite a flat valley crossed by the Zadorra river and surrounded by gentle mountains, which nowadays demarcate the reservoir. The proximity to the river, originally less than 100 m away from Aldaieta, would have created a very suitable area for agriculture. However, the cemetery was located on the north-facing slope of one of the hills bordering the valley. This was a location with very good visibility over the valley, which acted as a natural corridor between the *Llanada Alavesa* and the Cantabrian region.

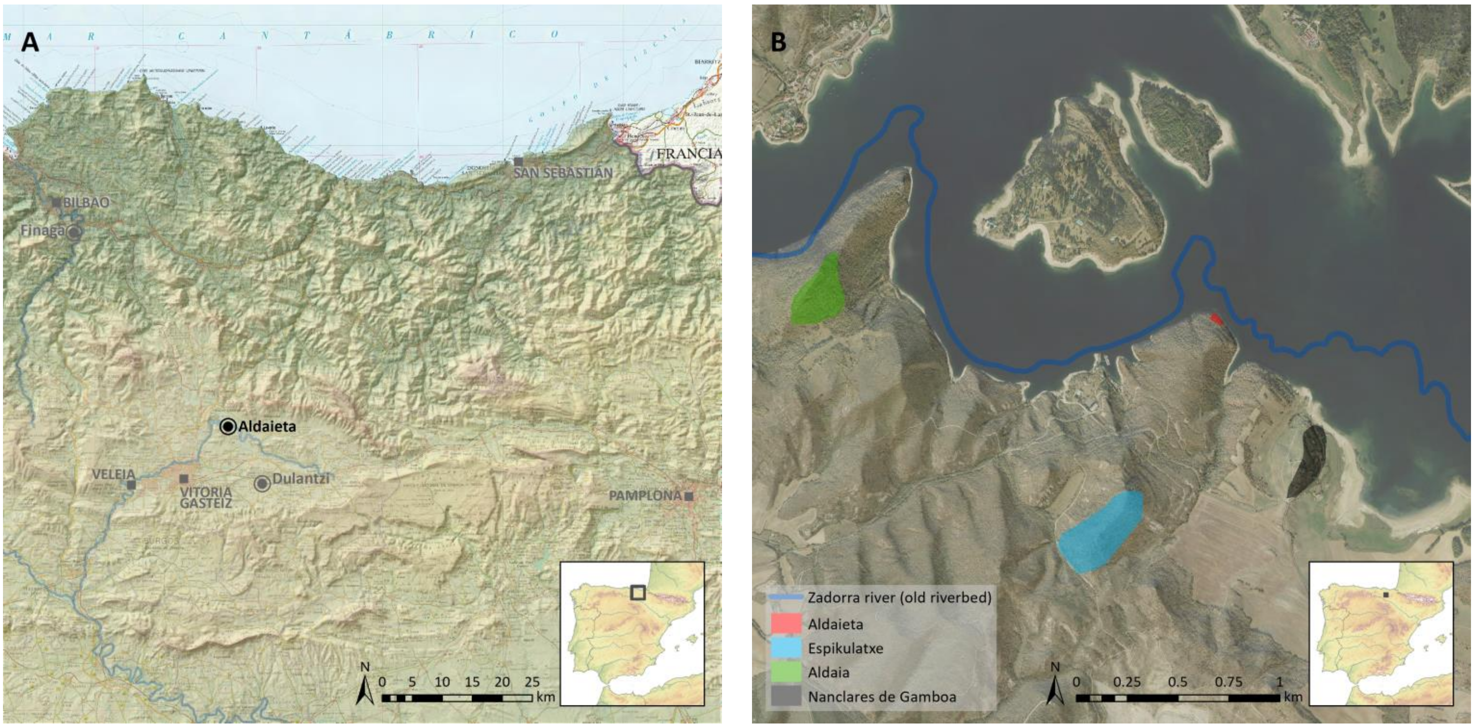


Figure 3.89. Geographical location of the site of Aldaieta (Nanclares de Gamboa, Araba) (A) at the regional and (B) local scale

The site was discovered by chance in 1987 by J. Á. Apellániz thanks to the drop of the water level in the reservoir due to drought, which uncovered an assemblage of human remains and artefacts on the shore. Immediately A. Azkarate got in charge and organised a survey to collect all the objects coming to the surface (Azkarate 1989). The next year, in 1988, making the most of the fact that drought persisted and water level was still low, a systematic survey was planned on the area normally underwater (sector A) and the first burials in primary position were uncovered (Azkarate 1990a). In 1989 excavations were extended to the upper zone of the slope, which is never covered by water (sector B), confirming the cemetery continued on this area too (Azkarate 1991a). Then, between 1990 and 1994 annual excavation campaigns were carried out on both sectors (Azkarate 1991b, Azkarate 1992, Azkarate 1993a, Azkarate 1994, Azkarate 1995) to cover a total area of approximately 2000 m^2 according to the published plan (Azkarate 1999: 75). This vast area allowed to be sure that the boundaries of the cemetery had been detected. The human assemblage recovered from Aldaieta is currently curated at the BIBAT Museum of Archaeology of Araba, in Vitoria-Gasteiz.

Aldaieta is probably the best-known early medieval site in the Basque Country, because its discovery led to a change of paradigm in the interpretation of this period. For this reason, it has been tackled in many publications. Certainly, the most relevant work on Aldaieta is the monograph by A. Azkarate (1999) including the complete records on the site, which adds to the yearly reports cited in the previous paragraph and a number of papers by the director of the project and other authors on the characteristics and interpretation of this cemetery (Azkarate 1993b, Azkarate 2004, Azkarate 2005, Böhme 2002, Catalán 2014). In addition, Aldaieta has been used as a case of study for many researches on Early Middle Ages in the Basque Country and northern Iberia (Azkarate 1990b, Azkarate 1991c, Azkarate 1996, Azkarate 2002, Azkarate 2003, Azkarate 2011, Azkarate 2018, Azkarate & García Camino 2012, Azkarate & García Camino 2013, García Camino 2016, Lanz 2016, Larrañaga 1993, Larrea 2009, Larrea 2011, Larrea 2016, Larrea & Pozo 2015, Martín Viso 2006, Navarro 2009, Plazaola 2000, Pozo 2016, Quirós 2003, Quirós 2010, Quirós 2011a, Quirós 2011b, Quirós *et al.* 2009) and as a parallel for artefacts (Azkarate 1997, Beguiristain *et al.* 2001, Catalán 2015, García Camino 2001, Hierro 2018, Iriarte 1998, Pinar 2009) or types of burials (McCormick 2015, McCormick 2016) found in other sites. Moreover, some records have been the focus of specific publications. For example, the pottery from Aldaieta has been included in wider studies about medieval pottery (Azkarate *et al.* 2003, Azkarate & Solaun 2016, Grassi *et al.* 2017). Likewise, the analysis of the fauna remains found in the cemetery was performed by P. Castaños (Azkarate 1999: 33) and the resulting data have been used in a number of papers about medieval animal husbandry (Grau-Sologestoa 2015a, Grau-Sologestoa 2016, Grau-Sologestoa 2017). The human osteoarchaeological assemblage from Aldaieta was originally analysed by J. I. Lorenzo Lizalde and C. de la Rúa and it is published along with the description of each grave in the monograph on the site (Azkarate 1999: 71). These data were employed by N. Argote, M. Botella and F. Etxeberria (2013) in their study on medieval Basque cemeteries. Besides, a set of individuals from Aldaieta was subjected to DNA analyses (Alzualde 2005, Alzualde *et al.* 2005, Alzualde *et al.* 2006, Alzualde *et al.* 2007, Izagirre *et al.* 2001, Izagirre, Alzualde, *et al.* 2005). Then, this population has been used to illustrate the advances of ancient DNA (de la Rúa *et al.* 2005, Hervella *et al.* 2009, Izagirre *et al.* 2006, Izagirre *et al.* 2009) and as a comparative dataset for other studies (de Miguel *et al.* 2016, Fontecha *et al.* 2012, Izagirre, Alonso, *et al.* 2005). Anyway, the whole anthropological collection was re-examined by the author because there was information missing about the methodologies applied and it was necessary to unify criteria in order to make results comparable with the other sites included in this research.

3.2.1.1.2 The settlement

Two of the particularities of Aldaieta are that it was only occupied during the Early Middle Ages, without any preceding or subsequent phases, and the sole type of structure identified were funerary ones. Then, the cemetery, located on a strategic position dominating the landscape, is well-known, but there is no clue about the settlement (one or many) where this population lived. While Aldaieta was being excavated, A. Azkarate (1994, 1995) proposed it may be at Espikulatxe, a steep hill 1 km to the south of the graveyard. Traces of walls and trenches were still observable surrounding a plateau of 13 ha, so surface and geophysical surveys were carried out and test pits were excavated. Evidence of uninterrupted occupation between the Iron Age and the

Middle Ages was found, but it was not possible to prove its direct link with Aldaieta. New research in 2008 (Plata *et al.* 2009) did not conclude anything different. There is another similar hill 2 km west of Aldaieta, known as Aldaia, where there are also defensive structures and terraces visible. It was investigated in 2011 through surface and magnetic survey, LiDAR modelling and test pits (Varón *et al.* 2011, Varón 2012). The evidence recovered was dated to between the Iron Age and the Roman period, so this settlement would have been abandoned when the cemetery of Aldaieta was used. An alternative hypothesis is that the settlement corresponding to Aldaieta could be currently underwater. In fact, before the construction of the dam, the river Zadorra traced a sharp meander immediately north of Aldaieta (figure 3.89B). This would have been a very suitable location for the settlement, since the river bend could have provided both protection and vast fertile fields. However, at present there is no way to prove this proposal. In conclusion, currently there is no data available on the location of the settlement associated with Aldaieta, nor on the type of domestic and productive structures they used.

The precise chronology of Aldaieta is difficult to establish due to the absence of a dense web of stratigraphic relationships, the scarcity of radiocarbon measurements and the great uncertainty of the dates provided by grave goods. Initially the cemetery was dated between 6th and 7th centuries based on the type of objects found in the burials (Azkarate 1990a), but later this range was refined. The initial date was moved to the middle of the 6th century because none of the grave good assemblages associated to the oldest individuals from the group burials could be dated before (Azkarate 2005). The abandonment of the cemetery was also shifted to the beginning of the 8th century after the identification of a ring with an Arab inscription (Azkarate 1999: 228, 236, 238, Azkarate & García Camino 2013: 91, 93), which would mean Aldaieta was still used after the Muslim conquest in 711. Therefore, the chronology that will be used for this site here is the period between the middle of the 6th century and the beginning of the 8th century (Azkarate 2011). However, it has to be mentioned that several researchers have questioned it. Some of the grave goods, such as hobnails, omega brooches or a Simancas type knife (Azkarate 1999: 89, 379, 473, 477), suggest an earlier starting date or at least the long persistence of certain artefacts (Catalán 2014). In the same way, the ring with the Arab inscription, which is the only evidence supporting the extension of the chronology of the site up to the 8th century, has not been properly published yet. Still, it is formally very different from those recovered in Pamplona (Faro *et al.* 2008: 265, Navascues 1976), so its identification is not completely verified (Labarta 2017: 312–313).[5]

The artefacts recovered at Aldaieta included coffin metallic parts, different types of clothing items and jewellery, containers made of various materials, weapons and other tools, but only pottery has been the object of specific studies (Azkarate *et al.* 2003, Azkarate & Solaun 2016, Grassi *et al.* 2017). They verified fineware was completely absent in Aldaieta and there were only two types of coarsewares. They were both characterised by the presence of plenty of tempers, handmade or slow wheel manufacture and smooth surfaces with comb decoration. They differed in the type of firing, either in oxidation or reduction atmosphere, which resulted into red or black vessels respectively. Shapes were quite limited too and they were restricted to pots and bowls. These were local productions carried out in a few scattered workshops or maybe by travelling specialised potters.

The data available about the fauna recovered from the burials in Aldaieta is not enough to draw any conclusions on animal husbandry (P. Castaños in Azkarate 1999). Most findings were teeth. Among domestic species cattle, ovicaprid and pig were present in this order of abundance. But the most remarkable discovery were wild species, which included brown bear and wolf (or dog), whose teeth were used as pendants. There was also a pierced shell for being sewn as a bead and a handle made of deer antler. No other bioarchaeological

---

[5] The author thanks J. Lorenzo for the discussion and the references on this topic.

record from Aldaieta has been studied in detail, except for the genetic analysis of the human population (Alzualde *et al.* 2005, Alzualde *et al.* 2006, Alzualde *et al.* 2007, Izagirre, Alzualde, *et al.* 2005). Seventy-six individuals from sector B went through the analysis of mitochondrial DNA and the Y-chromosome, which provide information on maternal and paternal ancestry respectively, with different rates of success. Most individuals had maternal lineages typical from Atlantic Europe, with little influence from continental Western Europe and high prevalence of haplotypes currently only present in the Cantabrian region. Variability of paternal lineages was extremely low possibly due to kinship and there was a great frequency of haplogroups from the Cantabrian region too. Still, two individuals with maternal lineages possibly coming from north-western Africa were identified. There was also some correlation between certain mitochondrial haplogroups and the deposition of weapons as grave goods, which would mean the individuals showing social status through these items would all belong to a few families. In addition, quite a few kinship relationships were spotted on the maternal line, interestingly more frequently within group burials than among those in rows.

3.2.1.1.3 The funerary context

The only funerary context known at Aldaieta is the cemetery (figure 3.90, table 7.1, Azkarate 1999). In fact, this is the only part of the site that was excavated. For this reason, it is only possible to speculate about the topographic relationship between the graveyard and nearby settlements. Having ruled out a contemporary residential area on Espikulatxe or Aldaia hills (figure 3.89B, Azkarate 1994, Azkarate 1995, Varón *et al.* 2011, Varón 2012), the most likely hypothesis is Aldaieta would have been the cemetery of a village located in the meander the river Zadorra traced just in front, about 300 m north. This spatial organisation would have made sense, since it would have set aside the necropolis to the zone with the greatest slopes, leaving plain and fertile areas for residential structures and agrarian activities. During the archaeological intervention the cemetery was divided in two sectors. Sector A, to the north, was the strip normally covered by the reservoir. Sector B was the area immediately south of the former, which does not usually get underwater. This distinction was useful for practical purposes during excavation works, but it is unlikely it had any meaning in the past.

At Aldaieta burials were distributed in small groups without any clear pattern, except for the arrangement in lines of some of the funerary structures. They did not intersect each other, but some burials were reused many times, putting individuals one on top of another. It is likely these collective graves were somehow marked on the surface, but no such evidence was preserved. There were large empty spaces between burials. Actually, according to the information available, all the area delimited in figure 3.90 was excavated, so blank zones would have been left free intentionally with the aim of spacing funerary structures. Nevertheless, it is difficult to evaluate accurately the impact of postdepositional processes on the site. Indeed, plenty of decontextualized anthropological remains and artefacts found on the surface and in secondary assemblages (Azkarate 1999: 79–100) indicate originally the cemetery would have been bigger. Southern and eastern limits of the cemetery are thought to have been well defined thanks to systematic surveying of the surroundings (Azkarate 1993a: 60, Azkarate 1994: 62, 64). However, it is sure that the graveyard continued downhill northward, under the waters of the reservoir, and probably also to the west. Overall, the cemetery of Aldaieta is dated between the middle of the 6th century and the beginning of the 8th century, even if there are certain chronological issues which should be discussed (see section 3.2.1.1.2). In the absence of a solid batch of radiocarbon dates (table 7.3), it is not possible to establish any internal phases. Still, based on the distribution of grave goods, it has been proposed that piled simple pits would be older than regular ones (Azkarate 2005: 408). That is, the cemetery would have developed from the south northward.

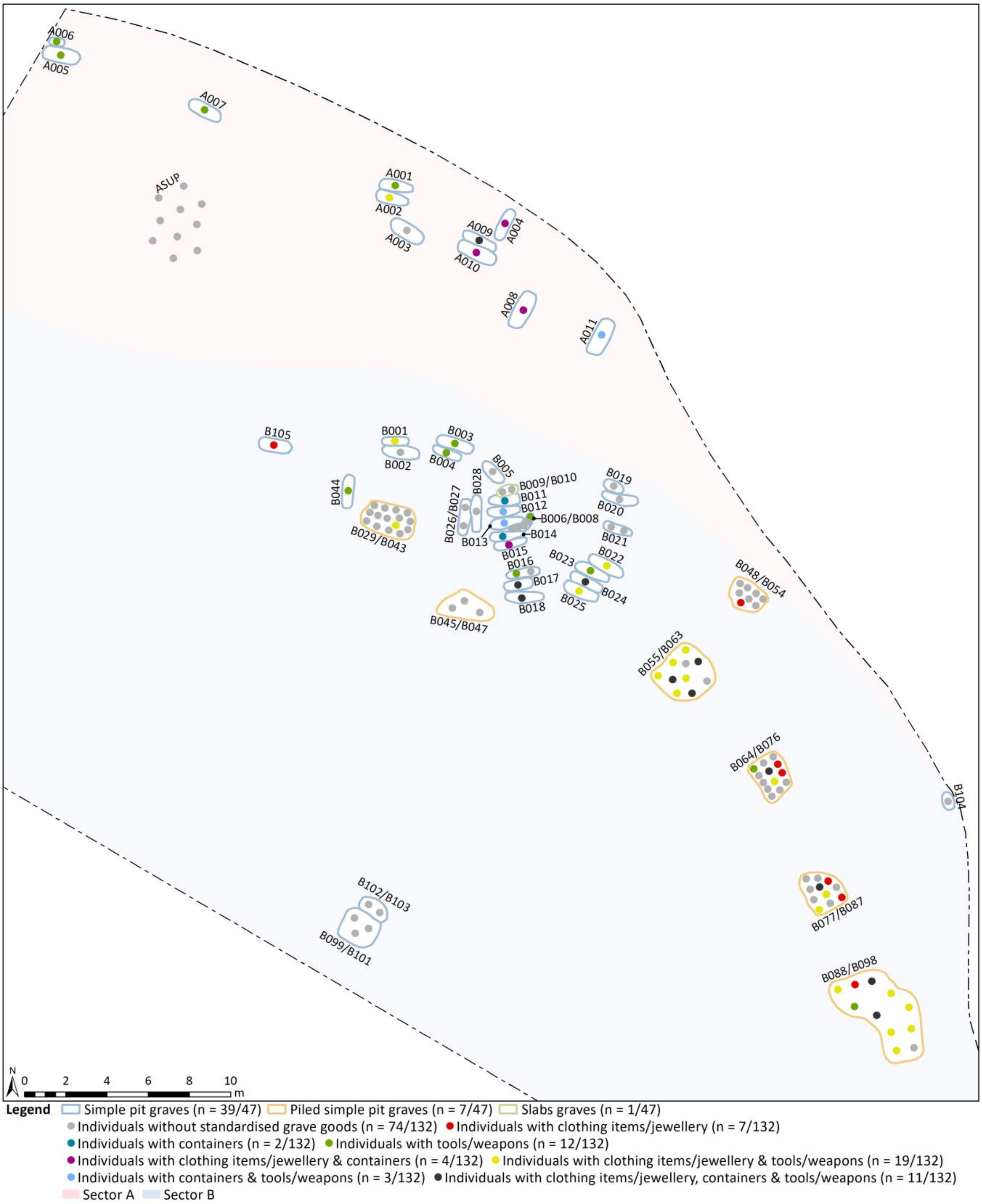


Figure 3.90. Aldaieta, cemetery (Azkarate 1999: 75, modified). The dashed line depicts the excavation limits. The outline of burials is represented with a solid line whose colour shows the type of funerary structure according to the legend. The code next to each burial is its identifier. Points symbolise the individuals recovered in each burial. Their colour indicates the presence or absence of grave goods as stated in the legend. The location of the individuals ALD ASUP is arbitrary, since they were found scattered on the surface of sector A

All the funerary structures excavated in Aldaieta were simple pit graves. The only exception was burial ALD B009/B010, which was partially delimited by slabs (n = 1/47 = 2.1%). Among simple pit graves two types were distinguished. On one hand, there were regular simple pit graves. These were individual burials or burials hosting a maximum of two individuals in primary position, in some cases with more individuals in secondary position. This was the most abundant type by number of funerary structures (n = 39/47 = 83.0%). On the other hand, there were the burials referred to here as piled simple pit graves. These were accumulations of burials overlapped in various layers which held up to ten individuals in primary position and several more as secondary deposits. As a type of funerary structure, piled simple pit graves were a minority at Aldaieta (n = 7/47 = 14.9%). However, due to their collective nature, they contained more than half of the population. The two main types of graves found at Aldaieta are differentially spatially distributed. Piled simple pit graves were concentrated in the south-eastern zone of the area excavated, while regular simple pits were predominant in the north-western sector. In the central area both types coexisted. In addition, a group of individuals was recovered scattered throughout sector A. They were grouped under the denomination ALD ASUP, but it was not possible to determine in which type of funerary structure they were originally buried. For this reason, the group ALD ASUP was not counted as a funerary structure for statistical purposes. The orientation of graves at Aldaieta was very variable. Most of the burials were placed in west-east direction with small fluctuations (n = 30/47 = 63.8%). Almost all the other possible orientations were represented by a few cases: east-west (n = 4/47 = 8.5%), north-south (n = 5/47 = 10.6%), south-west (n = 2/47 = 4.3%), northwest-southeast (n = 1/47 = 2.1%) and southwest-northeast (n = 1/47 = 2.1%). Moreover, in two of the piled simple pit graves several divergent orientations were recorded (n = 2/47 = 4.3%) and in another two cases it was not possible to establish the orientation of the funerary structure because it only contained skeletal remains in secondary deposits (n = 2/47 = 4.3%).

Overall, at Aldaieta 132 individuals were identified. Having subtracted the ten individuals from the assemblage ALD ASUP, whose funerary structure was not identified, the mean occupation rate of the 47 graves excavated was of 2.6 individuals per tomb. The maximum number of individuals in a single funerary structure was fifteen. These are by far the greatest figures among all the funerary contexts analysed in this thesis. Certainly, piled simple pit graves, a type of funerary structure unique to Aldaieta, contributed significantly to it. Only slightly more than half of all the individuals were found in primary deposits. The majority were in supine position (n = 67/132 = 50.8%), but there were also isolated examples of individuals in lateral (n = 2/132 = 1.5%) and foetal position (n = 1/132 = 0.8%). Heterogeneity seems to be one of the features of the funerary ritual followed at Aldaieta. Then, it does not seem like the two individuals in lateral position were necessarily buried according to the Islamic custom, also because at least one of them (ALD B055/B063-05(B059)) was recovered in a piled simple pit grave where all the remaining individuals in primary deposits were in supine position. This variation in the positioning of individuals could be the result of postdepositional processes, consequence of stacking up corpses in the reduced space of the piled simple pit grave or just chance variation. In any case, at Aldaieta there is no further evidence of the presence of Muslim individuals or material culture, except for the ring with the possible Arab inscription (Azkarate 1999: 228, 236, 238, Azkarate & García Camino 2013: 91, 93), which has been questioned by some specialists (Labarta 2017: 312–313). Going back to the arrangement of individuals, the other half of the population was recovered in secondary deposits of undetermined nature (n = 59/132 = 44.7%). This means that the individuals were not articulated, but it could not be determined if it was intentional (e.g. reductions) or due to postdepositional processes. In a small proportion of cases it was not possible to define even the type of deposit where the individual was found (n = 3/132 = 2.3%).

There was evidence that almost half of the individuals identified at Aldaieta were originally buried in wooden coffins (n = 62/132 = 47.0%). This could be verified thanks to the find of nails and brackets around the burials. The presence of grave goods in burials was also frequent and it included almost half of the individuals recovered (n = 60/132 = 45.5%, table 7.2). The most abundant category of grave goods were tools and weapons, which were found next to a third of the individuals (n = 45/132 = 34.1%). Weapons, especially spears and axes, were the most common, but there were also at least two short swords and a number of knives, whose interpretation as weapons or tools is still debated. In many cases an individual carried more than one of such items. The most repeated associations were formed by a knife together with a spear or an axe. Regarding tools, a bunch of individuals from Aldaieta had flint artefacts and there were a sickle and a tweezer too. Other unclassified weapons or tools comprised iron points, iron hooks, bronze needles, a deer antler handle, a horseshoe and the metallic structure of a leather helmet. Next in frequency there were clothing items and jewellery, present in almost one third of the burials (n = 41/132 = 31.1%). The most common types were necklaces, formed by amber, glass, stone and bone beads, as well as animal tooth pendants, and rings. Belt plates, earrings and bracelets were less frequent. Other miscellaneous clothing items included hobnails, which were found next to sixteen individuals, buckles, appliqués of various shapes, purse clasps, a wooden belt pouch and a metallic ribbon. Containers were the less abundant category of grave goods by number of individuals (n = 20/132 = 15.2%). The most frequent ones were wooden buckets, followed by pottery, glass and metal vessels in this order. In a few cases an individual was accompanied by more than one type of vessel. Among the individuals with any grave good, it was more typical to have objects belonging to more than one category than being accompanied by only one type of artefact. The most common combination were clothing items and jewellery together with tools and weapons, but the simultaneous presence of clothing items and jewellery, containers, and tools and weapons was almost as numerous. Other types of grave goods found at Aldaieta included fauna fragments, mostly teeth, a small silver cross and an unidentified metal item (ALD B012-1). To finish, it should not be forgotten that many of the artefacts found at Aldaieta could not be confidently associated to a specific individual. If they could have been correctly classified, the percentages of the presence of all kinds of grave goods would be significantly higher.

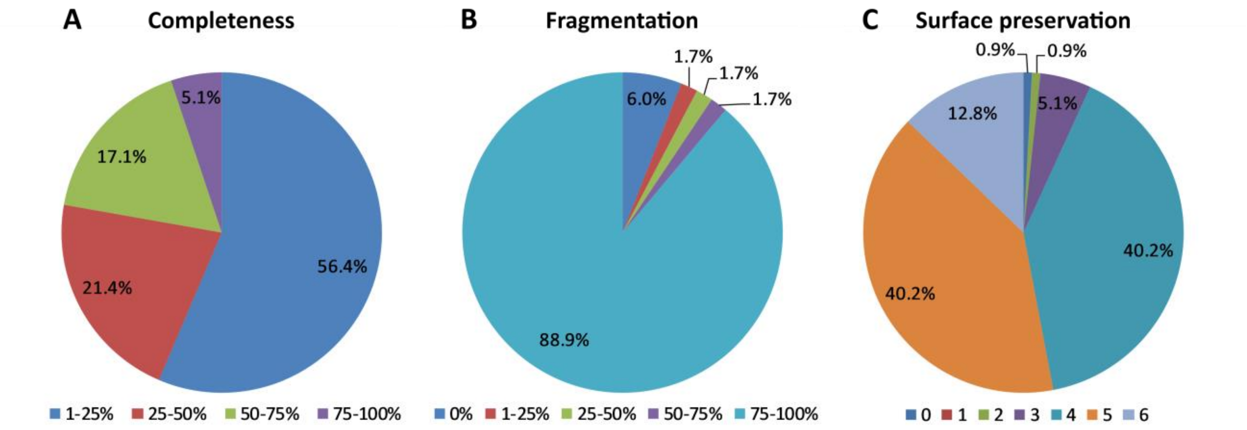


Figure 3.91. Pie charts representing the distribution of the three variables for the assessment of the macroscopic preservation of the human population from the cemetery of Aldaieta. (A) Completeness. (B) Fragmentation. (C) Surface preservation

3.2.1.2 The human population

3.2.1.2.1 Macroscopic preservation

The human population of Aldaieta was made up of 132 individuals distributed in 47 funerary structures and a group of scattered human remains (figure 3.90). Even so, only 117 were found at the facilities of the BIBAT Museum of Archaeology of Araba (n = 117/132 = 88.6%, table 7.1), where the material was stored. The remaining fifteen individuals are presented in the monograph about the site by A. Azkarate (1999), so it is certain that they preserved skeletal remains, but for unknown reasons they could not be tracked down. Therefore, they could not be analysed for this thesis. Anyway, the macroscopic preservation of the 117 individuals which could be examined was bad (figure 3.91, table 7.7). More than half of the population only preserved less than 25% of the skeleton and only one out twenty individuals conserved more than 75% of the skeleton when they arrived to the laboratory. In addition, almost 90% of the individuals had more than 75% of the skeletal remains preserved fragmented. Bone surface preservation was really bad. Most individuals were between having all bone surface eroded with an uneven distribution of the depth or degree of alterations (grade 4) and presenting heavy erosion on all bone surface with some modifications of profile (grade 5), and more than 10% of the assemblage was even worse. This poor preservation hindered the possibility to identify individuals more accurately and to estimate age and determine sex for a greater number of individuals. Then, it is a bias to be taken into account when evaluating the results of the study of this population.

3.2.1.2.2 Demography

With a minimum number of 117 individuals preserved for study (table 3.26, figure 3.92, table 3.27, table 7.4, table 7.5, table 7.6), the cemetery of Aldaieta was by far the Basque funerary context analysed in this thesis with more individuals and one of the most numerous ones among the three regions considered. Only 20.5% was formed by subadults. In addition, the category of infans 1A was represented by a single individual. This age group is made up of the individuals who died between birth and 2 years of age, which is typically the range with the greatest risk of death in premodern populations. These facts suggest the youngest individuals from Aldaieta were significantly underrepresented, probably due to the bad preservation of the site. The remaining 78.6% of the population were adults. Also because of the severe fragmentation and erosion suffered by skeletal remains, age could only be estimated with some precision for a negligible proportion of adults.

Table 3.26. Age and sex distribution by absolute frequencies of the human population from the cemetery of Aldaieta. Key: F = fetus, < 40 weeks in utero; I1A = infans 1A, birth – 2 years; I1B = infans 1B, 3 – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; Ssp = subadult sp, < 20 years; YA = young adult, 20 – 34 years; YMA = young-middle adult, 20 – 45 years; MA = middle adult, 35 – 45 years; MOA = middle-old adult, > 35 years; OA = old adult, > 45 years; Asp = adult sp, > 20 years; UA = undetermined age; M = male individuals (including probably male individuals); F = female individuals (including probably female individuals); US = undetermined sex (including ambiguous individuals)

	F	*I1A*	*I1B*	*I2*	*J*	*Ssp*	*YA*	*YMA*	*MA*	*MOA*	*OA*	*Asp*	*UA*	*Total*
M	-	-	-	1	2	-	2	-	-	-	-	39	-	44
F	-	-	1	-	1	-	-	-	-	-	-	22	-	24
US	-	1	7	5	2	4	-	-	-	-	-	29	1	49
Total	0	1	8	6	5	4	2	0	0	0	0	90	1	117

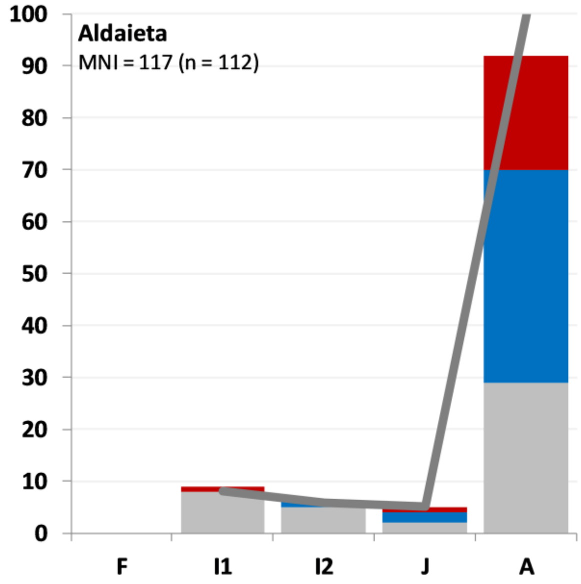


Figure 3.92. Demography chart of the human population from the cemetery of Aldaieta. Bars represent the absolute frequencies of each age category (F = fetus, < 40 weeks in utero; I1 = infans 1, birth – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; A = adults, > 20 years), separated by sex whenever possible (blue = male individuals, red = female individuals, grey = undetermined sex). The line depicts the progression of the probability of death (q_x) along age categories, calculated according to G. Acsádi and J. Nemeskéri (1970: 65). The minimum number of individuals of the population (MNI) and the number of individuals represented in the chart (n) are shown on the upper left corner. These two numbers differ because subadults sp (< 20 years) and individuals of undetermined age are not displayed

Table 3.27. Demographic descriptive indicators and palaeodemographic estimators of the human population from the cemetery of Aldaieta

Descriptive indicators	
MNI	117
%subad	20.5%
%ad	78.6%
S/A	0.26
M/F	1.83

Estimators	
JI	0.098
e_0	36.4
${}_1q_0$	0.207
${}_5q_0$	0.297

In contrast, the issue of sex determination was overcome thanks to the DNA analyses carried out by A. Alzualde and her colleagues (2007). This allowed to have sex determinations also for some of the subadults. Moreover, the availability of DNA data was a rare opportunity to check the accuracy of macroscopic sex determination techniques. It was verified that in 94.3% of the cases (n = 33/35) sex determination based on macroscopic methods agreed with the determination by DNA analyses. Then, combining both techniques it was possible to determine the sex of a good number of individuals. A number of conclusions could be driven from this data.

First, with a proportion of 186 per every 100 women, the sex ratio of the population recovered was very imbalanced. It is difficult to determine the cause of this asymmetry. It could be due to bad preservation, although taphonomic processes should have affected both sexes similarly. There is also a whole body of literature about the underrepresentation of women in other early medieval European populations (Barbiera 2008, Barbiera 2012, Barbiera 2018, Barbiera *et al.* 2017), which does not really seem to have a clear explanation, and this may also be the case in Aldaieta.

Second, it was confirmed there was an association between sex and the presence of grave goods, a hypothesis initially proposed by the researchers in charge of genetic analyses (Alzualde *et al.* 2007: 160–161). Male individuals were more frequently accompanied by grave goods than female individuals, in such a way that the sex ratio among individuals with grave goods was the double of those without (individuals with grave goods: M = 29, F = 12, M/F = 2.42; individuals without grave goods: M = 15, F = 12, M/F = 1.25). That is, it was twice as probable for a male individual to have grave goods than for a female individual, even if the association between these two variables was not statistically significant (chi-squared test: n = 68, χ^2 = 1.642, d.f. = 1, p = 0.200). Splitting grave goods by type, the differences in their presence or absence between males and females was the smallest for containers (individuals with containers: M = 11, F = 4, M/F = 2.75; individuals without containers: M = 33, F = 20, M/F = 1.65; chi-squared test: n = 68, χ^2 = 0.627, d.f. = 1, p = 0.428), it increased for clothing items and jewellery (individuals with clothing items & jewellery: M = 23, F = 7, M/F = 3.29; individuals without clothing items & jewellery: M = 21, F = 17, M/F = 1.24; chi-squared test: n = 68, χ^2 = 3.363, d.f. = 1, p = 0.067) and it was statistically significant for tools and weapons (individuals with tools & weapons: M = 26, F = 7, M/F = 3.71; individuals without tools & weapons: M = 18, F = 17, M/F = 1.06; chi-squared test: n = 68, χ^2 = 5.567, d.f. = 1, p = 0.018, φ = 0.286). Nevertheless, according to φ, the association between the presence or absence of tools and weapons and sex was small. It has to be said there are some differences between the figures presented here and those by A. Alzualde *et al.* (2007). These lie in the facts that, on one hand, grave goods were classified and grouped in slightly different manners and, on the other, in this thesis five additional individuals whose sex was determined only through macroscopic examination were incorporated. However, the conclusions are essentially similar. Just to conclude the topic of the distribution of grave goods according to demographic variables, it has to be said that adults were more frequently accompanied by artefacts in their burials than subadults (individuals with grave goods: S = 9, A = 44, S/A = 0.20; individuals without grave goods: S = 15, A = 48, S/A = 0.31). Still, the proportion between subadults and adults among those with grave goods, those without them and the whole population was very similar, so it was not deemed meaningful (chi-squared test: n = 116, χ^2 = 0.818, d.f. = 1, p = 0.366).

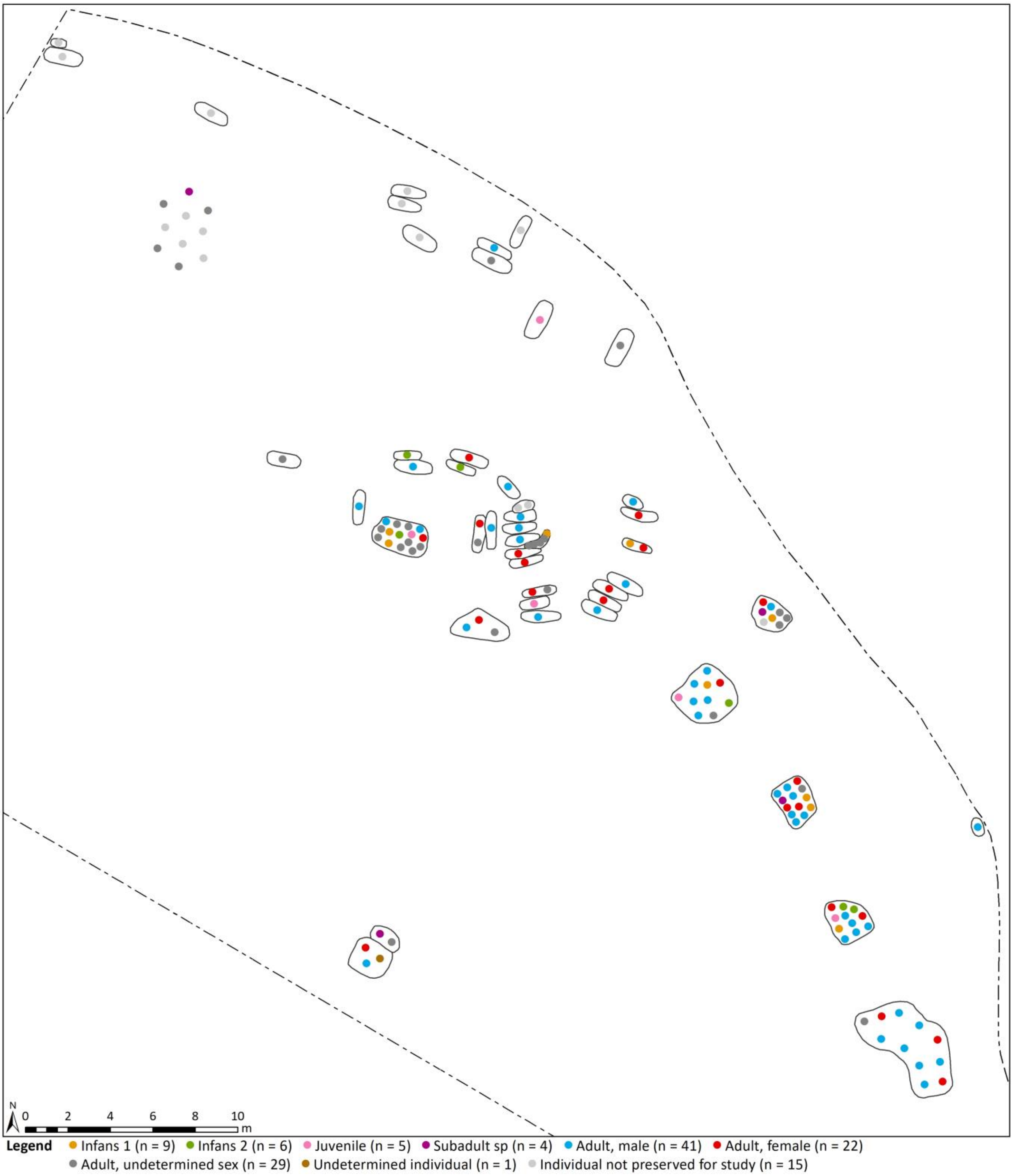


Figure 3.93. Aldaieta, cemetery, spatial distribution of individuals by age and sex (Azkarate 1999: 75, modified). The dashed line depicts the excavation limits. Points symbolise the individuals recovered in each burial. Their colour indicates their age and sex as stated in the legend. The location of the individuals ALD ASUP is arbitrary, since they were found scattered on the surface of sector A

Third, it was observed male individuals were more frequently buried in piled simple pit graves than women, so as the sex ratio in this type of funerary structure was greater than in regular simple pits (piled simple pit graves: M = 29, F = 14, M/F = 2.07; simple pit graves: M = 15, F = 10, M/F = 1.50). This association was not statistically significant (chi-squared test: n = 68, χ^2 = 0.383, d.f. = 1, p = 0.563), but it was not meaningless. It could be interpreted in two ways. If the whole burial ground is considered more or less synchronous, the difference in sex ratios between the types of graves would mean men were preferentially buried in piled simple pits, while women were placed in piled simple pits or in regular simple pits without distinction. Alternatively, based on the distribution of grave goods, it has been proposed that the cemetery developed from south to north (Azkarate 2005: 408). Then, piled simple pit graves, which contained the oldest grave goods, would be older than regular simple pits. In demographic terms, this would mean that sex ratio experienced a change over time, from a situation where men doubled women to a more balanced scenario, yet always in favour of males.

Coming back to the general demographic structure of the population from Aldaieta, figure 3.92 shows that age distribution resembled approximately the curve of the probability of death typical of stable preindustrial agricultural populations (Chamberlain 2006: 64–68, Séguy & Buchet 2013: 114). The greatest difference was in the proportion of infans 1, which were strongly underrepresented. Still, the trend expected in these populations can be faintly observed: the greatest risk of death corresponded to the youngest individuals, it declined during late childhood and adolescence and rose again in adulthood. In any case, these demographic data do not support the hypothesis that Aldaieta is the result of a mortality crisis (Chamberlain 2006: 69–80), neither due to warfare (Böhme 2002) nor to an epidemic (McCormick 2016: 1026). Concerning palaeodemographic estimators (table 3.27), the juvenility index of the human population of Aldaieta was slightly below the threshold to be acceptable. Even so, it was decided to apply it because the difference to the cut-off point was minimal. The underrepresentation of subadults already detected in this assemblage was certainly related with the great life expectancy at birth obtained. Actually, with a central value of 36.4 years, it was the greatest among all the populations analysed in this thesis.

Finally, the spatial analysis of the distribution of individuals by age and sex (figure 3.93) confirms some of the observations discussed above. There were no exclusive areas for specific demographic groups. However, it was noticed that in piled simple pit graves male adults were significantly more frequent than female adults, while in regular simple pit graves the proportion between sexes was more balanced. It was interesting to note too that subadults of all ages were present in almost all piled simple pit graves. This fact reinforces the hypothesis that piled simple pit graves represented extended family groups. The results of DNA analyses (Alzualde *et al.* 2007) also point in this direction. In piled simple pit graves, cases of both maternal and paternal kinship were spotted more frequently than among conventional simple pit burials. In fact, it was suggested that these collective funerary structures were organised based on matrilineal lineages.

3.2.1.3 Faunal diet

3.2.1.3.1 Sampling

Since at Aldaieta only the cemetery was excavated and the settlement is unknown, it was complicated to find fauna samples. Still, a few fragments of animals of economic interest were recovered, in most cases commingled with human remains and at least in one instance as part of grave goods (i.e. ALD FB077/B087-CN, which had a perforation to be used as a pendant). Eventually, fifteen samples were collected (table 7.8, figure 3.94). All of them were generically dated to between the middle of the 6th century and the beginning of the 8th century, contemporaneously to the burials. The assemblage was made up of mostly herbivores (Bos taurus, Ovis aries/Capra hircus), a few omnivores (Sus scrofa domesticus) and a carnivore. The latter was a canid, probably a dog, but maybe a wolf. Two of the specimens analysed, a cattle and a pig, belonged to subadult specimens, so they will be treated differently. Besides, the assemblage of fauna samples from Aldaieta was special because, due to the scarcity of animal remains in the site, it was mainly formed by teeth. Actually, only one bone sample was obtained. Then, the possible retention of the isotopic signature of lactation even in adult specimens (Balasse 2014: 4125–4127) will be considered in each case.

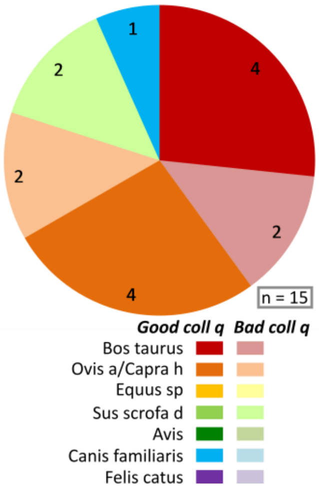


Figure 3.94. Pie chart representing the distribution of fauna samples from Aldaieta by taxa and collagen quality. Numbers represent the absolute frequency of each group

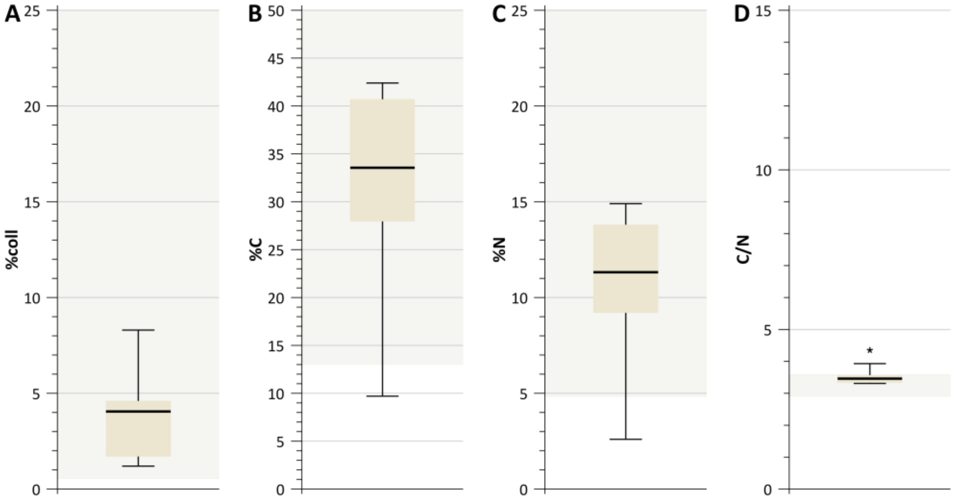


Figure 3.95. Boxplots representing the collagen quality indicators of fauna samples from Aldaieta. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

3.2.1.3.2 Collagen quality

Most of the fauna samples from Aldaieta had well preserved collagen, but there was a set of problematic samples (table 7.11, table 7.12, figure 3.94, figure 3.95). Collagen yields (%coll) were greater than 1.0% in every case, except for one sample where there was virtually no collagen at all. Carbon weight content (%C) varied between 9.7% and 42.4% and nitrogen weight content (%N) between 2.6% and 14.9%. Therefore, carbon to nitrogen atomic ratios (C/N) resulted in values between 3.3 and 4.4. Thus, only two samples were outside the rank defined for well preserved collagen. Nevertheless, four additional samples were rejected because carbon and nitrogen weight contents could not be measured due to technical issues and there was no more material to repeat the extraction. Summing up, nine out of the fifteen fauna samples from Aldaieta met all the collagen quality criteria established and six had to be dismissed.

Table 3.28. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of fauna samples from Aldaieta. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All fauna	9	-21.6	0.6	-22.4	-20.5	1.9	7.0	1.6	4.8	10.1	5.3
Herbivores	8	-21.7	0.5	-22.4	-21.0	1.4	6.6	1.2	4.8	8.1	3.3
Bos taurus	4	-22.1	0.2	-22.4	-21.9	0.5	5.8	0.8	4.8	6.7	1.9
Ovis/Capra	4	-21.3	0.3	-21.6	-21.0	0.6	7.5	1.0	6.1	8.1	2.0
Carnivores	1	-20.5	-	-	-	-	10.1	-	-	-	-
Canis familiaris	1	-20.5	-	-	-	-	10.1	-	-	-	-

3.2.1.3.3 Results

Fauna from Aldaieta with well-preserved collagen was scarce and only nine samples could be used to reconstruct the isotopic baseline of the site (table 3.28, table 7.11, figure 3.96). Most of them were herbivores, namely cattle and ovicaprids equally distributed. All of them had similar $\delta^{13}C$ values, with a mean of -21.7‰ and a standard deviation of just 0.5‰. These figures indicate all of them were eating exclusively C_3 plants, even though ovicaprids had slightly more enriched carbon stable isotope signatures than cattle. It is worth noting that the fauna from Aldaieta was by far the assemblage with the lowest mean carbon stable isotope ratio. Conversely, δ^{15}N of herbivores showed greater variability. Their mean value was 6.6‰ and the standard deviation of 1.2‰. With a δ^{15}N mean of 5.8‰, cattle were all grouped together around the lowest values of the range. The only cattle specimen which could be certainly identified as a subadult was the one with the most enriched δ^{15}N. Most ovicaprids were also assembled, but they had a higher mean δ^{15}N of 7.5‰. The only exception to this clustered distribution was an ovicaprid which was closer in δ^{15}N to cattle than to its peers. This arrangement of herbivore carbon and nitrogen stable isotope ratios suggests all herbivores grazed on similar plants, but in different areas with distinct nitrogen isotope baselines.

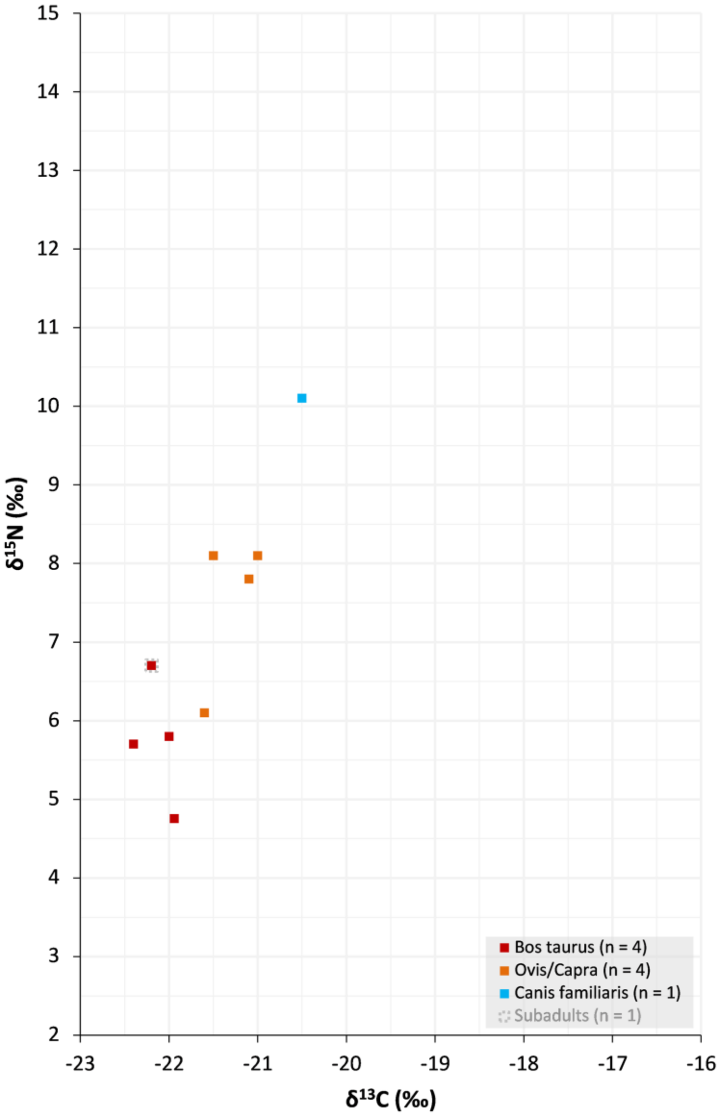


Figure 3.96. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of fauna from Aldaieta grouped by taxa. Subadult specimens are highlighted with a dotted grey fringe around them

Considering the majority of herbivore samples from Aldaieta were teeth, it is difficult to assess the effect of suckling in their isotopic signature (Balasse 2014: 4125–4127). The mean δ^{15}N of herbivores from Aldaieta is very close to the average δ^{15}N of all the herbivores analysed in this research (6.7‰). Since in the other sites most fauna samples were bone fragments from verified adult specimens, this similarity would mean the teeth from Aldaieta were not severely affected by suckling. However, the δ^{15}N herbivore mean from Aldaieta is slightly higher than the mean of the herbivores from Dulantzi, which is geographically the nearest site. Then, if Aldaieta and Dulantzi are assumed to be isotopically the closest, it could be concluded that the herbivores from Aldaieta were showing at least some influence of suckling in their isotopic signatures. This would be further supported by the only herbivore bone sample analysed, which was the specimen with the lowest δ^{15}N of the assemblage. Therefore, measurements on teeth need to be interpreted with caution when using them for defining the local isotopic baseline. Nonetheless, in the case of Aldaieta all herbivore samples will be employed for this purpose, because no clear outliers affected by the suckling effect could be identified.

In addition to herbivores, a single canine was analysed. It was only a little bit more enriched in δ^{13}C (-20.5‰) than herbivores, but the difference in δ^{15}N (10.1‰) was more notable and it meant almost a complete trophic step in comparison to cattle. These values indicate the diet of this dog or wolf was completely based on C_3 resources and it had a considerable contribution of animal protein, as it is expected for a carnivorous animal. The fact that it did not overlap the range of human carbon and nitrogen stable isotope ratios (see section 3.2.1.4.3), favours its identification as a wolf living in nature, rather than a domestic dog (Guiry 2012). The use of wild carnivore teeth for the elaboration of personal adornment items is not an exception at Aldaieta. At least another pendant made of a canid tooth and four perforated bear canines were recovered (Azkarate 1999: 117, 309, 380, 381, 488). Still, this type of grave goods is unparalleled in the other contemporary sites of the region and rare in early medieval Iberia in general, so it would be interesting to explore the origin of these pieces and their meaning in this specific context.

3.2.1.4 Human diet

3.2.1.4.1 Sampling

All the human individuals from Aldaieta which preserved suitable anatomical elements were sampled for carbon and nitrogen stable isotope analyses (figure 3.97). As a result, 91 individuals were subjected to this technique. About a sixth of the individuals included were subadults, comprising all age groups except fetuses, which were not present in the whole population either. Adults made up the rest of the assemblage. Slightly more than a third of it was formed by male individuals. Female individuals constituted a little bit more than a quarter of all adults. The remaining adults were of undetermined sex and there was also an individual of undetermined age. Various anatomical elements were selected because completeness of skeletons was very heterogeneous. Ribs, followed by different types of long bones, were the most frequent ones.

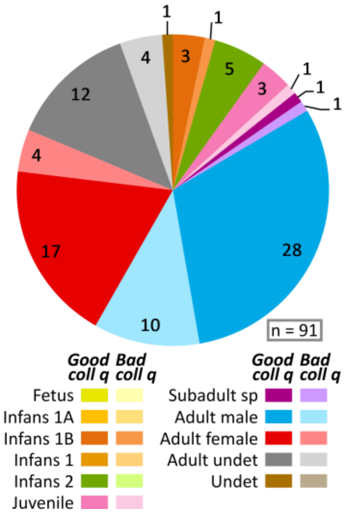


Figure 3.97. Pie chart representing the distribution of human samples from the cemetery of Aldaieta by age, sex and collagen quality. Numbers represent the absolute frequency of each group

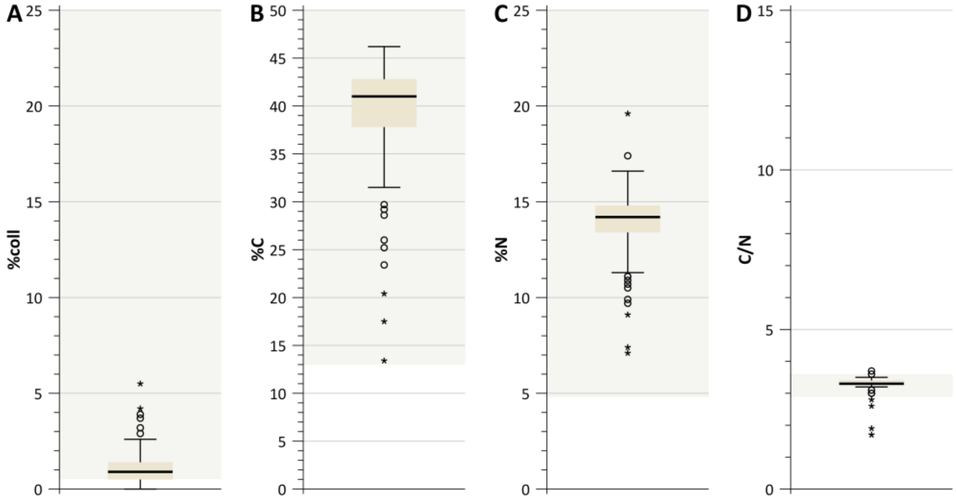


Figure 3.98. Boxplots representing the collagen quality indicators of human samples from the cemetery of Aldaieta. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

3.2.1.4.2 Collagen quality

Collagen quality among the human samples from Aldaieta was uneven (table 7.9, table 7.10, figure 3.97, figure 3.98). Most of the samples produced collagen yields (%coll) greater than 0.5%, but twenty samples did not reach this threshold. Actually, the collagen yield of two samples was so low that there was no material to perform any measurement. Carbon (%C) and nitrogen weight contents (%N) presented very wide distributions but all the samples were within the values for well preserved collagen. The former ranged between 13.4% and 46.2% and the latter between 7.1% and 19.6%. In contrast, not all the samples had carbon to nitrogen atomic ratios (C/N) within the acceptable figures, the minimum being 1.7 and the maximum 3.7. Finally, 21 samples out of 91 were dismissed due to poor collagen quality, but 70 could be used for palaeodietary reconstruction.

3.2.1.4.3 Results

Despite poor macroscopic preservation (see section 3.2.1.2.1), the quality of bone collagen in the individuals from Aldaieta was reasonably good (see section 3.2.1.4.2) and up to 70 individuals could be successfully analysed for carbon and nitrogen stable isotope ratios. Thus, with almost two thirds of the individuals preserved analysed (table 3.29, table 7.9, figure 3.99), the human population from Aldaieta is the best represented assemblage in this thesis among those with more than fifty individuals. The main feature of this dataset was uniformity. Despite the big size of the assemblage, both δ^{13}C and δ^{15}N had small standard deviations, there was only one real outlier and, once it was removed, ranges of both variables were really narrow. This indicates that, regardless subtle differences in carbon and nitrogen stable isotope ratios, most of the individuals buried at Aldaieta had very similar dietary patterns.

Table 3.29. Summary statistics of carbon (δ^{13}C) and nitrogen (δ^{15}N) stable isotope ratios of human samples from Aldaieta. Key: C&J = clothing items & jewellery, Cont = containers, T&W = tools & weapons

	n	*δ^{13}C (‰)*					*δ^{15}N (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All humans	70	-18.3	0.7	-20.8	-16.8	4.0	9.1	0.6	7.5	10.3	2.8
Subadults	12	-18.6	0.8	-20.8	-17.3	3.5	8.9	0.9	7.5	10.0	2.5
Infans 1B	3	-18.6	0.3	-18.9	-18.3	0.6	9.7	0.4	9.3	10.0	0.7
Infans 2	5	-18.6	1.3	-20.8	-17.3	3.5	8.7	0.7	8.1	9.6	1.5
Juveniles	3	-18.4	0.4	-18.7	-18.0	0.7	8.6	1.1	7.5	9.7	2.2
Adults	57	-18.2	0.6	-19.6	-16.8	2.8	9.1	0.6	7.6	10.3	2.7
Male adults	28	-18.0	0.6	-19.6	-16.8	2.8	9.2	0.6	7.6	10.3	2.7
Female adults	17	-18.4	0.6	-19.2	-17.0	2.2	9.1	0.6	8.4	10.1	1.7
Grave g absence	28	-18.4	0.6	-19.6	-17.4	2.2	9.0	0.6	7.9	10.3	2.4
Grave g presence	42	-18.2	0.7	-20.8	-16.8	4.0	9.1	0.6	7.5	10.1	2.6
C&J presence	30	-18.2	0.8	-20.8	-16.8	4.0	9.1	0.7	7.5	10.1	2.6
Cont presence	16	-18.2	0.5	-18.7	-17.0	1.7	9.2	0.5	8.6	10.1	1.5
T&W presence	33	-18.1	0.6	-19.2	-16.8	2.4	9.2	0.7	7.5	10.1	2.6

Carbon stable isotope ratios of the individuals from Aldaieta had a mean of -18.3‰, a standard deviation of 0.7‰ and a range of 4.0‰. Although the range may seem large, it has to be considered that a single outlier was responsible of more than a quarter of this variability and, when it was removed, δ^{13}C range was reduced to 2.8‰. Besides, two thirds of the individuals were clustered between -19.0‰ and -18.0‰ and a little bit more than a fifth between -18.0‰ and -17.0‰. In this way, the offset between the mean δ^{13}C of humans from Aldaieta and local adult herbivores was 3.4‰ (see section 3.2.1.3.3). This is significantly more than the fractionation normally accepted for a trophic level transition (~1‰) and it points at the existence of enriched sources of carbon in the diet of this population. Marine resources can definitively be discarded, not only because of the distance between the site and the sea, but also because individuals lack the increase of δ^{15}N simultaneously caused by marine fish consumption. Therefore, in this context C_4 plants are very likely the origin of the generalised enrichment of human $\delta^{13}C$ values. Thus, the diet of the population from Aldaieta was certainly still largely based on C_3 resources, and winter crops, such as wheat, barley, rye and oats, alongside legumes, vegetables and fruits were surely staple foods. In addition, broomcorn and foxtail millets, the only C_4 plants available in early medieval Iberia, were a significant component of diet. These were possibly quantitatively less relevant than C_3 crops, but abundant, frequent and regular enough to be clearly detectable on bone collagen. Besides, it has to be taken into account that all the specimens in the small set of herbivores from Aldaieta analysed (see section 3.2.1.3.3) resulted in $\delta^{13}C$ values indicative of pure C_3 feeding regimes. Then, indirect acquisition of the isotopic signal of C_4 plants by humans through the consumption of animal products can be ruled out. That is, it is for sure that at Aldaieta millets were directly eaten by humans. Moreover, the routing effect should not be disregarded (Ambrose & Norr 1993, see section 2.4.1.4.4). This is the underrepresentation of the photosynthetic pathway of energy when it is not the same as protein's, which is exactly what would have happened at Aldaieta. In other words, it is possible that the importance of C_4 plants in carbon stable isotope ratios of bone collagen is underestimated. The last thing to say about carbon isotope ratios at Aldaieta is that, despite the general homogeneity of the dataset, naturally there were some differences between individuals in the proportions of plants consumed. Those with the most positive $\delta^{13}C$ values would have been the ones with the greater intake of millets and it is even possible that the individuals in the most negative end of the range had exclusive or almost completely C_3 diets. The latter was the case of the only true outlier identified, which will be discussed below.

Nitrogen isotope ratios also showed a small dispersion. They were even more uniformly distributed and they had no outliers. Their mean was 9.1‰, standard deviation 0.6‰ and range 2.8‰. The offset between the mean $\delta^{15}N$ of humans and adult herbivores from Aldaieta was 2.1‰ (see section 3.2.1.3.3). This is less than half the fractionation usually attributed to the transition between trophic levels (~5‰) and it indicates in general terms animal protein consumption at Aldaieta was limited. In fact, nitrogen isotope ratios of some of the humans overlapped herbivores and not even individuals on the upper end of the range would have had an abundant proportion of animal protein in their diets. Nevertheless, it has to be acknowledged that the range of nitrogen isotope ratios was enough to result into a significant difference in the proportions of animal protein intake between the individuals at the ends of the distribution, so as those with more enriched $\delta^{15}N$ values would have clearly had access to greater proportions of animal products than the individuals with the most depleted $\delta^{15}N$ values.

The only true outlier identified in the assemblage of Aldaieta was individual ALD B077/B087-08(B084). This was an infans 2 who had between 9 years and 6 months and 15 years at death. Thanks to DNA analysis it was determined to be a male (Alzualde *et al.* 2007). It was buried in piled single pit burial together with at least another ten individuals and it had two rings and hobnails as grave goods. It was defined as an outlier because it had an extremely depleted $\delta^{13}C$ in comparison with the bulk of the population, while its $\delta^{15}N$ was on the lower half of the range, but it was comparable to many of the individuals in the same assemblage. These values indicate the diet of ALD B077/B087-08(B084) was exclusively based on C_3 resources and it did not include any millets, as opposed to the majority of the individuals from Aldaieta, which had mixed C_3-C_4 diets. Meanwhile, animal protein consumption was as restricted as for many other individuals in the same cemetery. The reasons why this individual had such a different diet are unclear. Despite its relatively good macroscopic preservation, it did not present any pathological sign which could explain maybe a hypothetical adapted feeding regime. There is the possibility it was a migrant from a region with a different isotopic baseline, so as any interpretation would have to be reconsidered. However, the facts that it was the only outlier, it was a subadult and it was buried in a collective funerary structure, implying possibly some kind of kinship to the individuals in the same grave (Alzualde *et al.* 2007), make this hypothesis unlikely. Individual ALD B088/B098-05(B092) had the most enriched δ^{13}C of the assemblage and it was also a statistical outlier on this variable, because it was more than 1.5 times the interquartile range away from the median. However, the difference between it and the closest individual in the axis of carbon stable isotope ratios was just 0.1‰, so it cannot be considered a real outlier in interpretative terms. For this reason, it will not be further discussed. Instead, there are individuals ALD B055/B063-01(B055) and ALD B077/B087-01(B077), who had the lowest nitrogen isotope ratios, but were not statistical outliers. Still, there was a gap of 0.3‰ to 0.4‰ between them and the nearest individual from Aldaieta. Therefore, it looks like these two individuals were having significantly smaller proportions of animal protein than their counterparts. They had a few things in common. ALD B055/B063-01(B055) was a juvenile between 12 and 18 years of age at death, while ALD B077/B087-01(B077) could only be defined as adult. Both were subjected to DNA analyses and were found to be males (Alzualde *et al.* 2007). None of them showed any relevant pathological sign. They were buried in separated piled simple pit graves, but it is striking that both were on the upper layer of their respective burials. The two of them were accompanied by similar sets of clothing items, jewellery, tools and weapons. Hobnails and spears were found together with both individuals. All in all, there is no clue to understand why these individuals had smaller proportions of animal protein in their diets, but from these data it is clear that males with weapons, which *a priori* could be considered the individuals of higher status, did not necessarily have the greatest intake of animal protein.

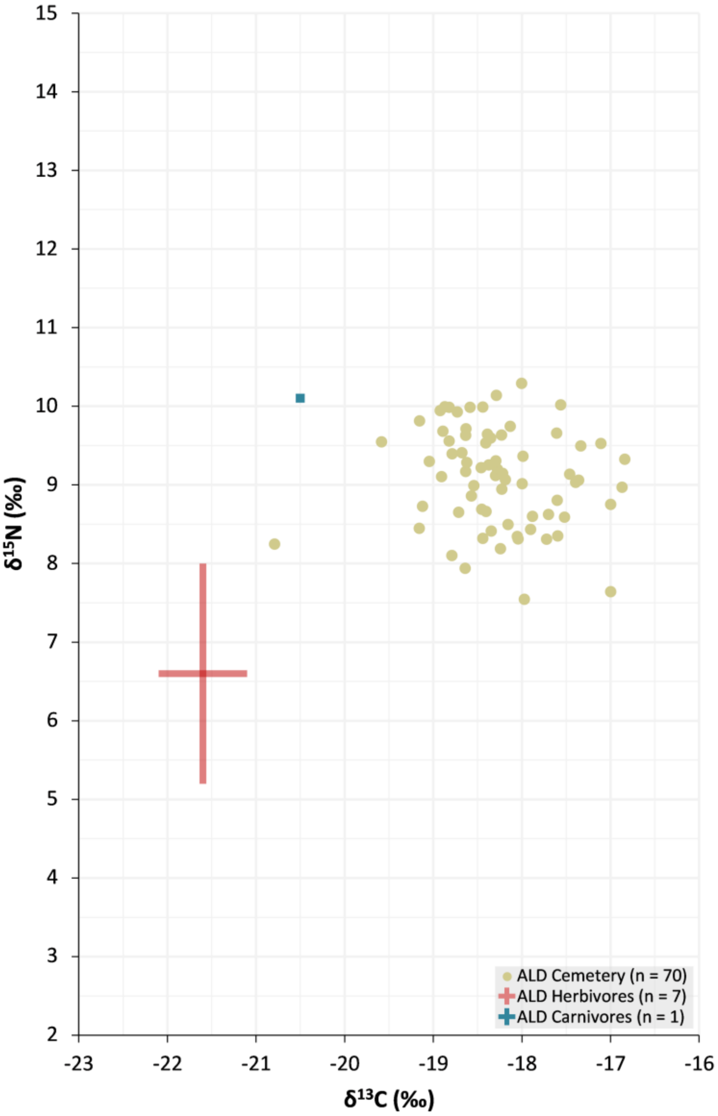


Figure 3.99. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of humans from Aldaieta. Crosses represent mean and one standard deviation of the fauna from Aldaieta grouped by feeding regime. Subadult specimens were excluded from the calculation of these parameters

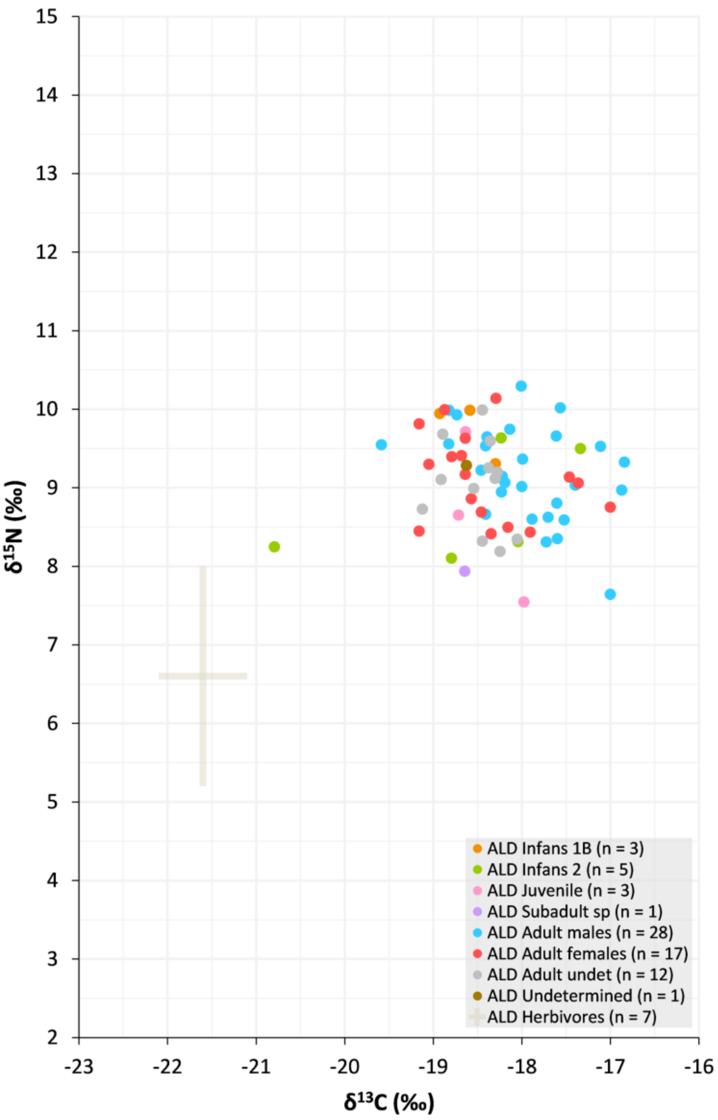


Figure 3.100. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of humans from the cemetery Aldaieta divided by demographic categories. Cross represents mean and one standard deviation of herbivores from Aldaieta excluding subadult specimens

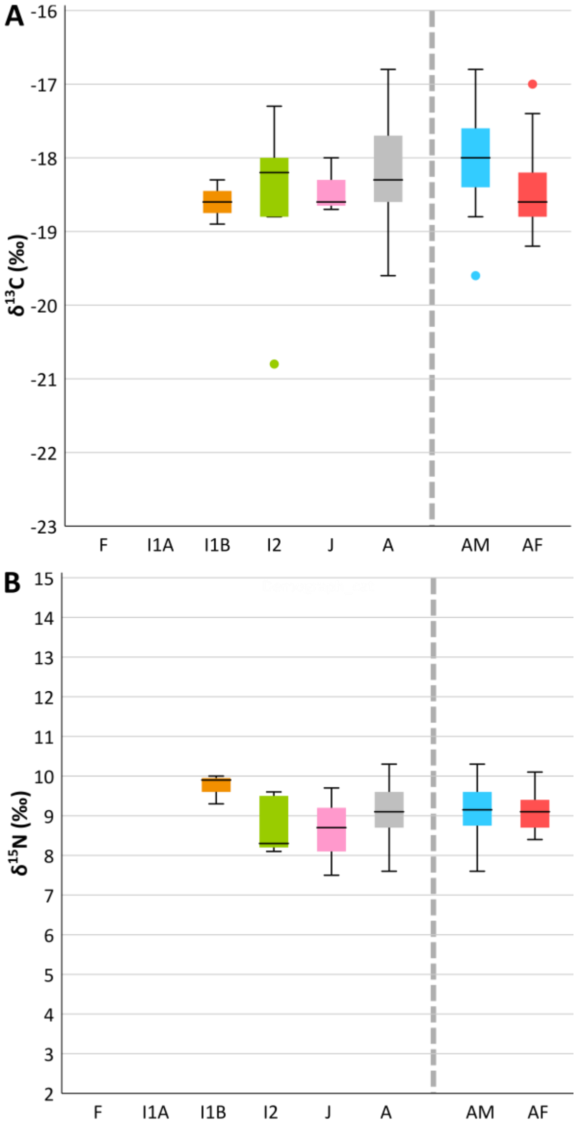


Figure 3.101. Boxplots representing (A) carbon stable isotope ratios (δ^{13}C) and (B) nitrogen isotope ratios (δ^{15}N) of humans from the cemetery Aldaieta divided by demographic categories. Key: F = fetus, I1A = infans 1A, I1B = infans 1B, I2 = infans 2, J = juvenile, A = adults, AM = adult males, AF = adult females

There was no direct relationship between diet and demography at Aldaieta, but some interesting trends were observed (figure 3.100, figure 3.101). Subadults and adults had similar dietary patterns and all age categories were present along the entire ranges of both carbon and nitrogen stable isotope ratios. In this way, there were no statistically significant differences between subadults and adults in the distributions of either δ^{13}C or δ^{15}N (δ^{13}C ALD subadults (n = 12) vs adults (n = 57), Mann-Whitney U test: U = 423.000, z = 1.285, p = 0.199; δ^{15}N ALD subadults (n = 12) vs adults (n = 57), Mann-Whitney U test: U = 392.500, z = 0.801, p = 0.423) and the result was the same when specific age categories were considered separately (δ^{13}C ALD specific age categories, Kruskal-Wallis H test: n = 68, H = 1.926, d.f. = 3, p = 0.588; δ^{15}N ALD specific age categories, one-way ANOVA: n = 68, F = 0.946, d.f.1 = 3, d.f.2 = 64, p = 0.083), which means there were no restrictions to the access to specific foodstuffs due to age. There was only one appealing observation about the distribution of carbon and nitrogen stable isotope ratios in relation to age and it was the tendency of infans 1B, the youngest individuals in the assemblage, towards enriched δ^{15}N. They were only three individuals, but all of them were on the upper half of the range of this variable. Considering their ages at death, between 3 and 8 years, it is improbable they were showing the effect of breastfeeding and sample size is too small to make any reliable inferences. However, it seems like the youngest subadults at Aldaieta may have been getting greater proportions of animal protein than older children or adolescents from the same site. Unfortunately, the absence of any infans 1A among the individuals analysed does not allow to have a more complete perspective about the evolution of diet throughout life.

Instead, thanks to the contribution of DNA analyses (Alzualde *et al.* 2007), there was plenty of data to explore the similarities and differences between the diets of male and female adults. On one side, the difference between the distributions of δ^{13}C of adult males and adult females was statistically significant (δ^{13}C ALD adult males (n = 28) vs adult females (n = 17), Mann-Whitney U test: U = 138.500, z = -2.333, p = 0.020). Although their ranges largely overlapped, adult females tended to more depleted carbon stable isotope ratios, while adult males were more frequently on the opposite end of the range, so as the mean δ^{13}C of adult females was 0.4‰ lower than adult males. This signifies adult males were more likely to get greater amounts of C_4 plants in their diet or, in other words, in general the diet of adult females buried at Aldaieta tended to be made up of larger proportions of C_3 resources. Interestingly, a few subadults too had sex determined through DNA analyses (ALD B017-1, ALD B055/B063-01(B055), ALD B064/B076-08(B071), ALD B077/B087-08(B084); Alzualde *et al.* 2007) and their δ^{13}C were closer to adult females regardless their sex (ALD subadults with sex determined through DNA analyses: n = 4, δ^{13}C mean = -18.5‰, δ^{13}C SD = 1.3‰; ALD subadult males with sex determined through DNA analyses: n = 3, δ^{13}C mean = -18.9‰, δ^{13}C SD = 1.3‰; ALD subadult females with sex determined through DNA analyses: n = 1, δ^{13}C = -18.3‰). This suggests millets could have been a product preferentially devoted to adult males, but more data would be needed in order to support this statement. On the other side, the distributions of nitrogen isotope ratios of adult males and females were virtually identical (δ^{15}N ALD adult males (n = 28) vs adult females (n = 17), independent samples t-test: t = 0.286, d.f. = 43, p = 0.776). In fact, their means only differed in 0.1‰. Still, the range of δ^{15}N of adult males was larger, because the individuals with the lowest δ^{15}N values always belonged to this demographic category. Then, it can be concluded there were no meaningful differences between adult males and females in animal protein consumption, so, unlike cereals, the access to this type of foodstuff was not determined by sex.

Grave goods, as an expression of social status, is also an interesting variable of the funerary ritual to be compared with diet, which can contribute to understand the identity of the individuals carrying these artefacts and the criteria for placing them in certain burials but not in others. Forty-one out of the seventy individuals with well-preserved collagen were accompanied by some kind of standardised grave good, which is a proportion slightly greater than the one recorded in the complete assemblage (see section 3.2.1.1.3). The data available produce an image of uniformity. Looking at figure 3.102 and figure 3.103, it seems that there were individuals with all kinds and combinations of grave goods, and also without any, over the whole span of δ^{13}C and δ^{15}N. Even so, going into detail, some interesting patterns arise. First, individuals were divided into two groups according to the presence or absence of any grave goods, and their carbon and nitrogen stable isotope ratios were compared. Statistically significant differences between the distributions of δ^{13}C of individuals with and without grave goods were detected (δ^{13}C ALD individuals without grave goods (n = 29) vs individuals with grave goods (n = 41), Mann-Whitney U test: U = 762.500, z = 2.096, p = 0.036), highlighting the tendency of individuals found together with any artefact to have more enriched carbon stable isotope ratios. Because outlier ALD B077/B087-08(B084) might be biasing the results, the test was run again excluding this individual. The result confirmed the statistically significant difference between the δ^{13}C means of the individuals with and without grave goods after removing the outlier (δ^{13}C ALD excluding ALD B077/B087-08(B084), individuals without grave goods (n = 28) vs individuals with grave goods (n = 41), independent samples t-test: t = -2.392, d.f. = 67, p = 0.020, d = 0.578). Therefore, it can be concluded that it was more likely that individuals buried with any artefact had more enriched carbon stable isotope ratios. That is, individuals with greater proportions of millets in their diets were more prone to be buried with any kind of grave good. This was not the case with nitrogen isotope ratios. No statistically significant differences were found in the distribution of δ^{15}N between the individuals classified according to the presence or absence of artefacts (δ^{15}N ALD individuals without grave goods (n = 29) vs individuals with grave goods (n = 41), independent samples t-test: t = -0.538, d.f. = 68, p = 0.592), pointing at the inexistence of any meaningful difference in the consumption of animal protein between the individuals with and without grave goods.

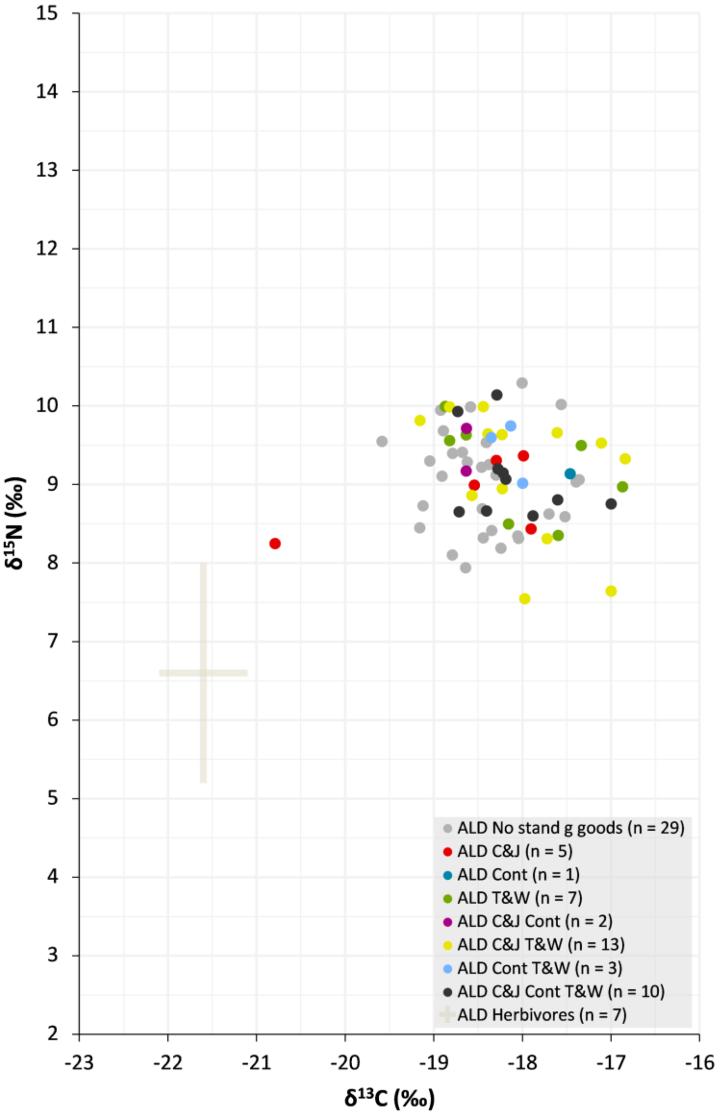


Figure 3.102. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of humans from the cemetery of Aldaieta divided by type of grave goods. Cross represents mean and one standard deviation of herbivores from Aldaieta excluding subadult specimens. Key: No stand g goods = no standardised grave goods, C&J = clothing items & jewellery, Cont = containers, T&W = tools & weapons

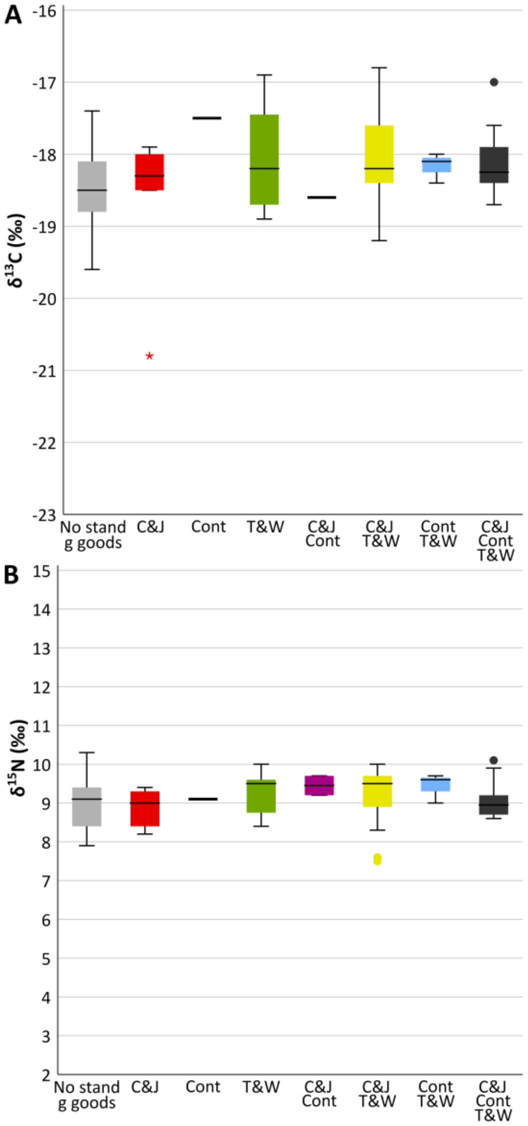


Figure 3.103. Boxplots representing (A) carbon stable isotope ratios (δ^{13}C) and (B) nitrogen isotope ratios (δ^{15}N) of humans from the cemetery of Aldaieta divided by type of grave goods. Key: No stand g goods = no standardised grave goods, C&J = clothing items & jewellery, Cont = containers, T&W = tools & weapons

In order to try to understand if this pattern was the same regardless the type of grave goods, carbon and nitrogen stable isotope ratios were compared between individuals with and without the three categories of artefacts defined in this research: clothing items and jewellery, containers, and tools and weapons. No statistically significant differences were noticed based on the presence or absence of clothing items and jewellery ($\delta^{13}C$ ALD individuals without clothing items & jewellery (n = 40) vs individuals with clothing items & jewellery (n = 30), Mann-Whitney U test: U = 697.500, z = 1.159, p = 0.246; $\delta^{15}N$ ALD individuals without clothing items & jewellery (n = 40) vs individuals with clothing items & jewellery (n = 30), independent samples t-test: t = -0.043, d.f. = 68, p = 0.966) or containers ($\delta^{13}C$ ALD individuals without containers (n = 54) vs individuals with containers (n = 16), Mann-Whitney U test: U = 496.500, z = 0.904, p = 0.366; $\delta^{15}N$ ALD individuals without containers (n = 54) vs individuals with containers (n = 16), independent samples t-test: t = -0.816, d.f. = 68, p = 0.418). However, it is worth noting that standard deviations and ranges of both $\delta^{13}C$ and $\delta^{15}N$ of individuals with containers were considerably narrower than individuals' with any other type of grave goods or without them. Thereby, individuals accompanied by vessels formed the most homogeneous group in isotopic terms, which would have been characterised by mixed C_3-C_4 diets with variable proportions of millets and animal protein consumption levels around or above the mean of the population. Conversely, the comparison of individuals with and without tools and weapons did result in a relevant finding. There was a statistically significant difference in the distribution of $\delta^{13}C$ between individuals carrying tools and weapons in their graves and those without ($\delta^{13}C$ ALD individuals without tools & weapons (n = 37) vs individuals with tools & weapons (n = 33), Mann-Whitney U test: U = 796.500, z = 2.193, p = 0.028) and it kept on being so even after removing outlier ALD B077/B087-08(B084) from the assemblage ($\delta^{13}C$ ALD excluding ALD B077/B087-08(B084), individuals without tools & weapons (n = 36) vs individuals with tools & weapons (n = 33), independent samples t-test: t = -2.284, d.f. = 67, p = 0.026, d = 0.550). In this way, individuals buried with this kind of artefacts tended towards more enriched $\delta^{13}C$ values, indicating individuals with tools and weapons were more likely to have had greater proportions of millets in their diets than individuals without this specific type of grave goods. This was the same tendency observed when all grave goods were considered together. The convergence of results is explained by the fact that tools and weapons was the most frequent category of grave goods at Aldaieta, so they had a large weight in the ensemble of individuals with grave goods. Besides, it should be remembered there was a statistically significant association between tools and weapons and adult male individuals (see section 3.2.1.2.2). Thus, it is no surprise that the conclusions about the dietary patterns of these two groups are the same even when they are analysed under different criteria. In contrast, there was no statistically significant difference in the distribution of $\delta^{15}N$ between the individuals from Aldaieta classified according to the presence of tools and weapons ($\delta^{15}N$ ALD individuals without tools & weapons (n = 37) vs individuals with tools & weapons (n = 33), Mann-Whitney U test: U = 714.500, z = 1.225, p = 0.220), so the use of this type of grave goods was not related to the consumption of animal protein.

To conclude with the analysis of the relationship between diet and grave goods at Aldaieta, carbon and nitrogen stable isotope ratios of individuals without any artefacts and with all the possible combinations of grave goods were compared. No statistically significant differences were detected in neither of the two variables ($\delta^{13}C$ ALD specific grave goods, Kruskal-Wallis H test: n = 70, H = 7.881, d.f. = 6, p = 0.343; $\delta^{15}N$ ALD specific grave goods, Kruskal-Wallis H test: n = 70, H = 4.130, d.f. = 7, p = 0.765). This means that, when the actual assemblages of artefacts are considered, the importance of tools and weapons in the determination of $\delta^{13}C$ is blurred. This appraisal is even more relevant when it is observed that only in a fifth of the cases tools and weapons were found as the only category of artefact, while in most instances they were recovered together with clothing items and jewellery and, less frequently, containers. On the whole, it is difficult to discern any clear pattern in the distribution of either $\delta^{13}C$ or $\delta^{15}N$ in relation to grave goods and it is only possible to spot some weak tendencies, which may nevertheless be meaningful.

Lastly, diet was confronted with the location of burials. On one hand, variability within collective funerary structures was explored (figure 3.104). There were eight burials from which more than one individual was analysed and they ranged between two and nine individuals per grave. The mean standard deviation within these structures was 0.5‰ for both $\delta^{13}C$ and $\delta^{15}N$, which is smaller than the standard deviations of the whole population for the two variables. These data suggest isotopic variability among the individuals buried together might have been slightly smaller than within the entire assemblage, but the difference is not big enough to be deemed relevant. Actually, outlier ALD B077/B087-08(B084) was located precisely in one of these collective funerary structures. The other four individuals found in the same grave showed great variation of $\delta^{13}C$ not only in comparison to the outlier but also between them. If it is accepted that piled simple pit graves were formed by extended families or kinship groups, as proposed by DNA analyses (Alzualde *et al.* 2006, Alzualde *et al.* 2007), it would mean there was significant variability in dietary patterns within this groups, especially regarding the proportions of C_3 and C_4 resources consumed.

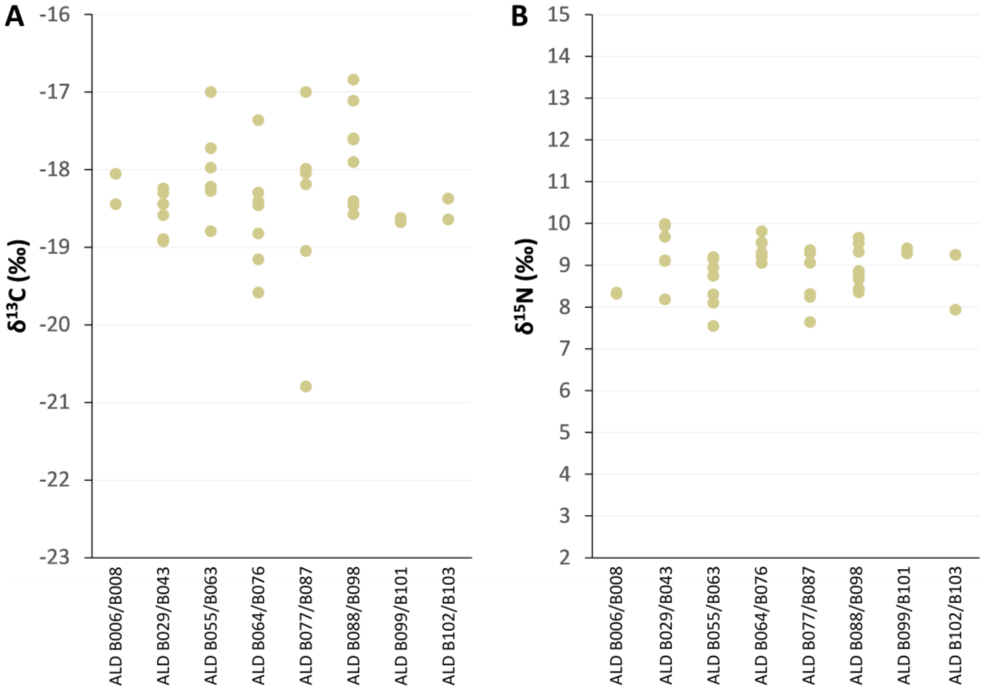


Figure 3.104. Scatterplots representing the spread of (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of the individuals from Aldaieta buried in the same funerary structure

On the other hand, the topographic distribution of carbon and nitrogen stable isotope ratios was examined (figure 3.105). It did not seem reasonable to parallel directly individuals from sectors A and B for two reasons. The first one was that, due to poor collagen preservation, only three individuals from sector A could be successfully analysed, so the comparison with the 67 individuals from sector B would be very imbalanced. The second reason was grounded on the fact that this division was purely practical, aimed at distinguishing the area normally flooded from the zone never affected by the reservoir. Then, it is unlikely these sectors had any historical meaning beyond elevation. Still, it was observed that piled simple pit graves were preferentially located in the south-eastern zone of the site, while regular simple pit burials were predominant in the north-western area (see section 3.2.1.1.3). Besides, thanks to the study of grave goods, it was proposed piled simple pit burials could be older than conventional simple pit graves (Azkarate 2005: 408), so it was considered interesting to confront these two types of funerary structures in order to verify the existence of any diachronic pattern in carbon and nitrogen stable isotope ratios. Statistical analyses did not reveal any statistically significant differences between the individuals in simple pit and piled simple pit burials on either $\delta^{13}C$ or $\delta^{15}N$ ($\delta^{13}C$ ALD individuals in simple pit graves (n = 32) vs individuals in piled simple pit graves (n = 38), Mann-Whitney U test: U = 624.000, z = 0.189, p = 0.850; $\delta^{15}N$ ALD individuals in simple pit graves (n = 32) vs individuals in piled simple pit graves (n = 38), independent samples t-test: t = 1.665, d.f. = 68, p = 0.100). According to these results, the hypothesis of a dietary change throughout the period of use of the cemetery of Aldaieta, which would have matched the replacement of the main type of funerary structure, can be ruled out. Likewise, visual inspection of the spread of δ^{13}C and δ^{15}N does not result in any consistent pattern either, which is possibly related to the variability verified within collective burials. Thus, these observations reject the existence of clusters of individuals with similar diets or any other clear spatial pattern in the distribution of carbon and nitrogen stable isotope ratios at Aldaieta.

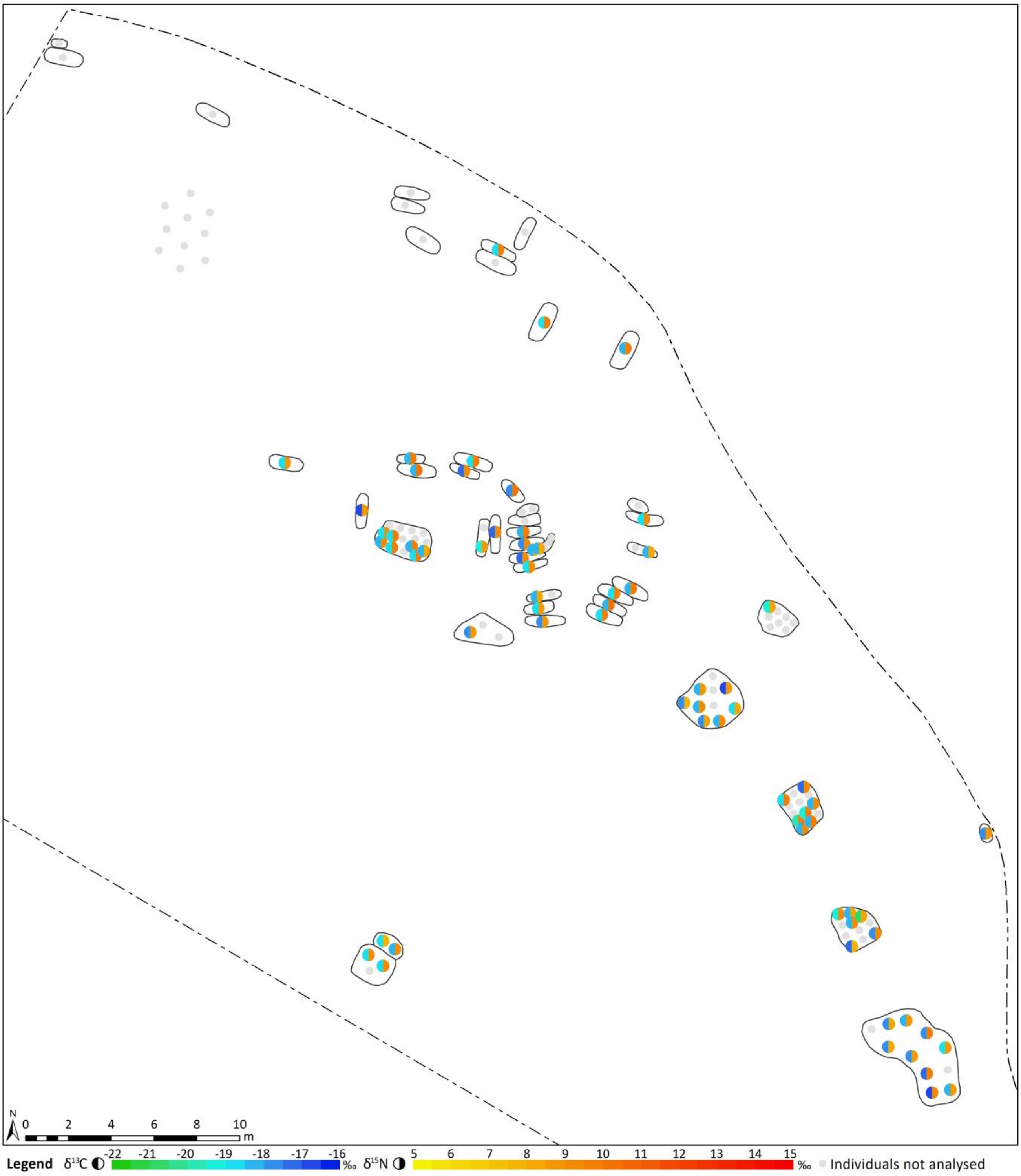


Figure 3.105. Aldaieta, cemetery, spatial distribution of individuals divided by carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) (Azkarate 1999: 75, modified). The dashed line depicts the excavation limits. Individuals successfully analysed are represented with a big circle divided in two. The left half symbolises δ^{13}C and the right half δ^{15}N according to the colour gradient shown in the legend. Individuals not analysed are depicted with a smaller grey point

3.2.2 FINAGA

3.2.2.1 The site

3.2.2.1.1 Location and history of research

Finaga is the most northern site analysed in this thesis. It is within the municipality of Basauri, in the province of Bizkaia (figure 3.106). Its UTM ETRS89 coordinates are 30T 508098 4785440 and it is 208 meters above sea level. Finaga is just 6 km southeast of Bilbao, but farther from other reference places: 45 km northwest of Vitoria-Gasteiz, 75 km west of San Sebastián, 112 km northwest of Pamplona and 43 km north of the Roman city of Veleia. As for the other sites from the Basque Country considered here, Finaga is 42 km northwest of Aldaieta and 52 km northwest of Dulantzi. Finaga is the only site included in this research located in a mountainous landscape. It is on a terrace on the southern slope of Malmasin mountain and less than 1 km from the Nervión riverbed at the nearest point. This location would have provided access to one of the few wide arable plains in the immediate surroundings. In addition, it offered great visibility over the intersection between Nervión and Ibaizabal rivers.

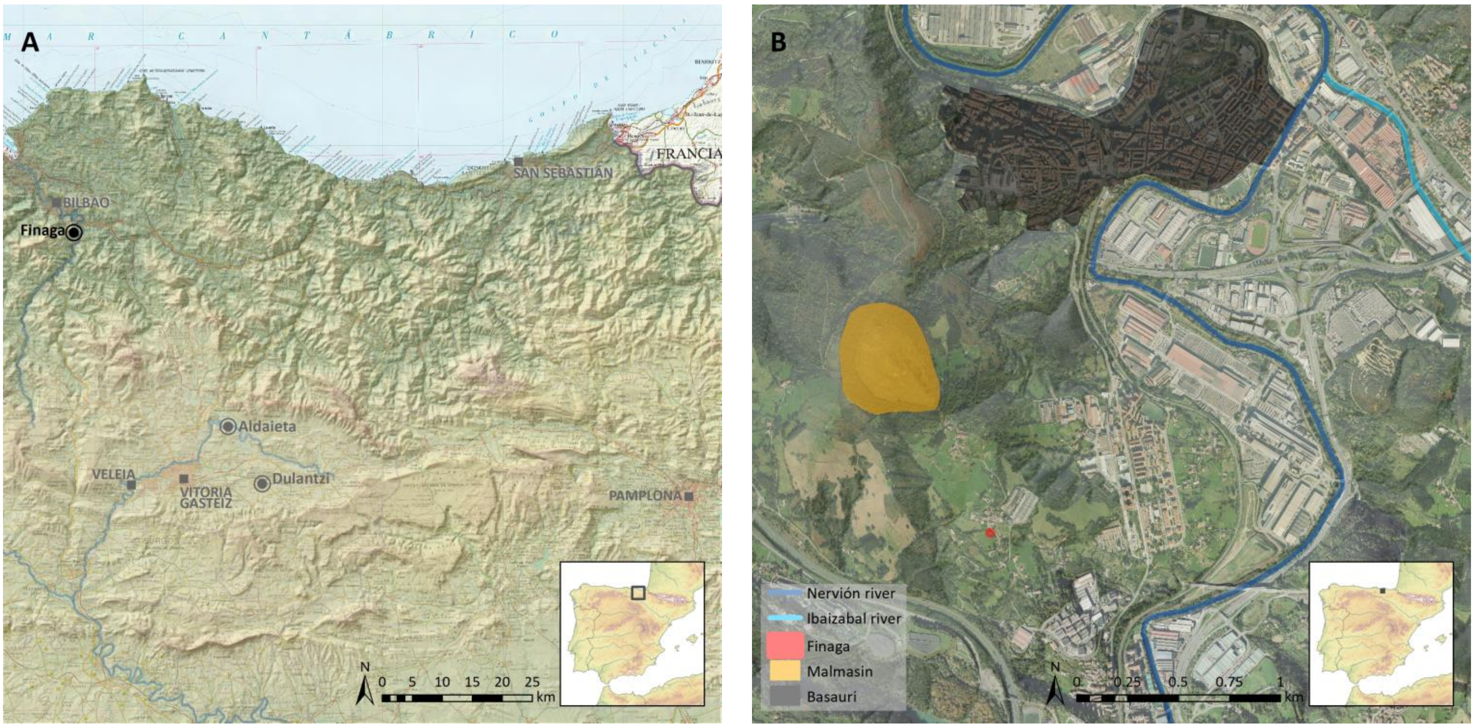


Figure 3.106. Geographical location of the site of Finaga (Basauri, Bizkaia) (A) at the regional and (B) local scale

At the end of the 20th century, the Early Modern Age chapel of San Martín de Finaga was threatening to collapse. Then, in 1994 the town council of Basauri promoted a full restoration, carried out by the Service for Historical Heritage of the provincial council of Bizkaia under the direction of I. García Camino and M. Unzueta. In this context, they excavated completely the inside of the chapel (53 m^2), where they found an early medieval church and fifteen burials (García Camino & Unzueta 1995). Considering the great results obtained in that campaign, the next year they commissioned to the company Math geofísica consultores a magnetic and electric survey over an area of 5679 m^2 and 900 m^2 respectively on the terrace around the chapel. Afterwards, they checked through test pits the most interesting points indicated by the geophysicists, but all of them were negative and it was concluded they were likely caused by the agrarian use of the terrace (Azkarate & García Camino 1996). In 2014 the chapel needed to be restored again. This new intervention, also funded by the provincial council of Bizkaia and supervised by J. J. Cepeda and M. Unzueta, implied a detailed topographic record of the site and the remodelling of both the inside and the outside. For this purpose, they excavated a trench of unspecified size around the external walls of the building, revealing two new burials (Cepeda & Unzueta 2015). Currently, the anthropological material from the excavation of 1994 is curated at the Museum of Archaeology of Bizkaia, in Bilbao, while the human remains from the two graves discovered in 2014 are still under the custody of the directors of the intervention.

Finaga is one of the oldest churches in the Cantabrian region and this has awoken the interest of many researchers. I. García Camino (2002: 61–78, 228–230), one of the directors of the first intervention, dedicated it a chapter in his thesis, which is so far the most detailed account on the site. Recently, J. J. Cepeda (2019) published an update on the chronology and the interpretation of the ensemble. Besides, Finaga has been used as a case of study for works about early medieval Basque cemeteries (Azkarate 2004, Catalán 2014) and Early Middle Ages in Bizkaia and the Basque Country (Azkarate 1996, Azkarate 2002, Azkarate 2003, Azkarate 2011, Azkarate 2018, Azkarate & García Camino 2012, Azkarate & García Camino 2013, García Camino 1996, García Camino 2001, García Camino 2004, García Camino 2011, García Camino 2016, Larrea 2009, Larrea 2016, Larrea & Pozo 2015, Martín Viso 2006, Martín Viso 2014, Pozo 2016, Quirós 2009, Quirós 2011a, Quirós 2011c, Quirós 2011b, Quirós *et al.* 2009). Some of the grave goods from Finaga have also been used as a parallel for other sites (Catalán 2015, Fernández Mier 2015, Iriarte 1998). Otherwise, the materials recovered in this site, either artefacts or bioarchaeological ones, have not been the object of any specialised publication.

3.2.2.1.2 The settlement

The site of Finaga preserves a wide chronological sequence in quite a narrow space, which complicates its understanding and has led to different interpretations on the periodisation of the site. The original proposal by I. García Camino (2002: 61–78) was recently overtook by the review by J. J. Cepeda (2019), which benefited from some new radiocarbon dates. This updated sequence, with a few modifications, is the one that will be followed in this thesis.

The oldest evidence in Finaga is a squared building made of rubble masonry about 5 m wide with 17 m^2 of internal area (phase 1, figure 3.107A, García Camino 2002: 63–64). There were traces of fire on its oldest floor. According to stratigraphy and the find of Hispanic red slip ware fragments, its construction is dated to the 4th century (Cepeda 2019: 244). Its function is unclear, but the most convincing hypothesis is that it was a funerary building or mausoleum. This is supported by the similarity with other nearby contemporary funerary structures, such as those in Tribisburu in Bermeo (Bizkaia, Cepeda & Cortés 2018) or Santa Elena in Irun (Gipuzkoa, Barandiarán *et al.* 1999), and it would mean the continuity of the functionality of the site in the following phases. In addition, five fragments of stelae dated to between the Iron Age and the Roman period embedded in the walls of the modern chapel of Finaga suggest there was a cemetery of this chronology in the surroundings.

In the 5th century the building was modified to become a church (phase 2, figure 3.107B, García Camino 2002: 63–65). An opening was created on the eastern wall and a rectangular apse was built against the mausoleum with a similar construction technique. This created a new small space of slightly less than 3 m^2. The threshold between the mausoleum transformed into nave and the apse was narrowed by two pedestals for holding columns, one of which reused a Roman gravestone. The religious function of this building is confirmed by a cut in the middle of the apse which fits the size of an altar stand reused in the communion table of the modern chapel. The dating of this transformation is provided by the oldest inhumations, which adapted their layout to the apse. The eleven burials of this phase were identified based on radiocarbon dates, grave goods and orientation and they spread between 5th and 8th centuries. Fragments of two funerary stelae dated to 7th and 8th centuries were also found in the walls of the modern chapel (Azkarate & García Camino 1996: 168–171).

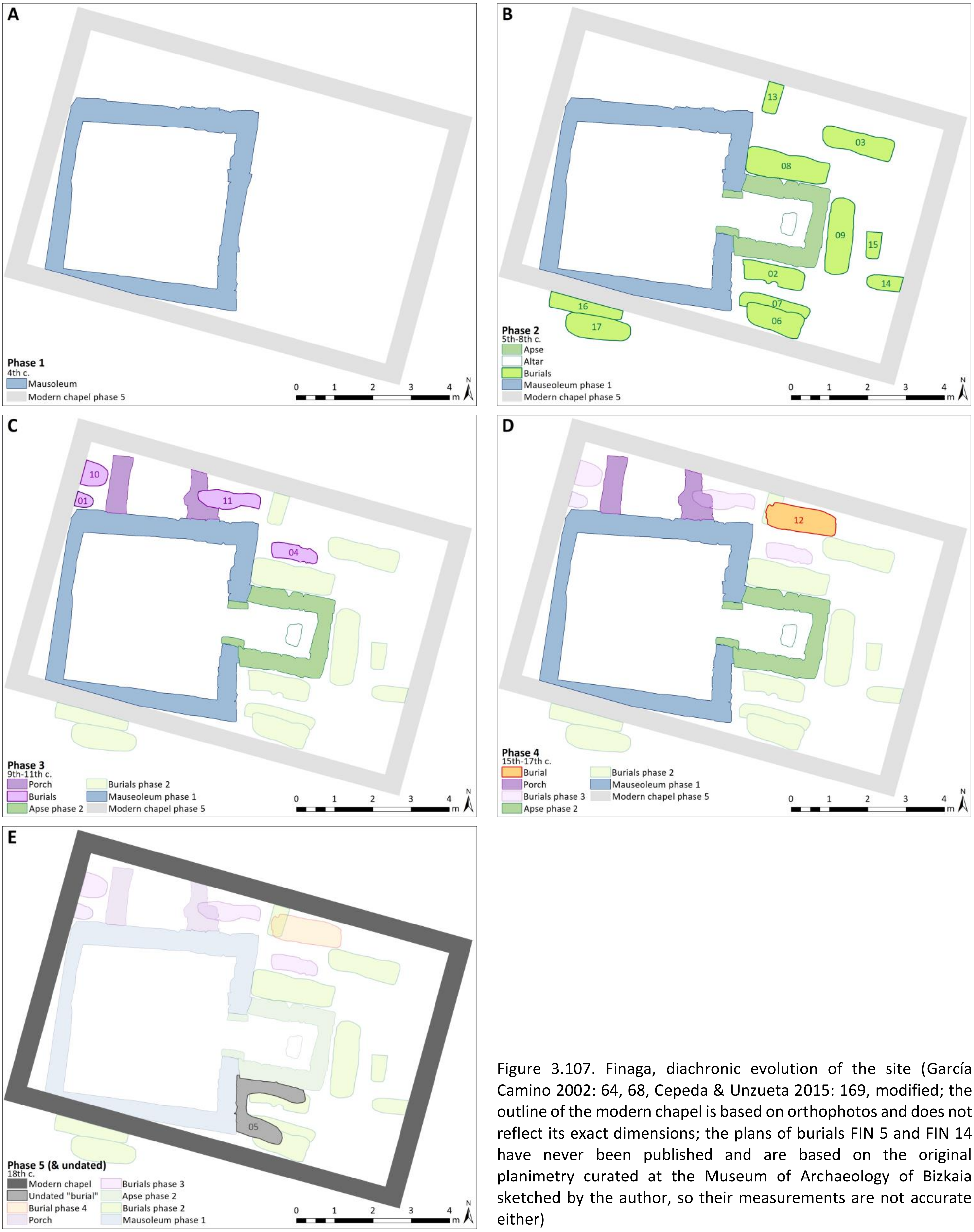


Figure 3.107. Finaga, diachronic evolution of the site (García Camino 2002: 64, 68, Cepeda & Unzueta 2015: 169, modified; the outline of the modern chapel is based on orthophotos and does not reflect its exact dimensions; the plans of burials FIN 5 and FIN 14 have never been published and are based on the original planimetry curated at the Museum of Archaeology of Bizkaia sketched by the author, so their measurements are not accurate either)

Before going ahead, it is necessary to make clear the criteria used to identify the individuals belonging to phase 2, because in the various publications on Finaga there have different proposals and the one presented here does not exactly fit any of them. First of all, when there was more than one individual in a burial, all of them were assigned the same chronology. Radiocarbon dates (table 7.3) were the main criterion, but there is a problem with them which needs to be addressed (figure 3.108). Initially, I. García Camino (2002) presented the radiocarbon dates of six individuals (FIN 02-1-44, p. 71; FIN 04-1-59, FIN 08-1-56, FIN 09-1-60, FIN 10-1-63, FIN 11-1-64, p. 70) and a layer (SU 16, p. 67). Later, J. J. Cepeda and M. Unzueta (2015: 170) gathered five of those radiocarbon dates (FIN 04-1-59, FIN 08-1-56, FIN 09-1-60, FIN 10-1-63, FIN 11-1-64) and released four new ones (FIN 03-1-50, FIN 06-1-53, FIN 07-1-57, FIN 12-1-68). In addition, they published again the radiocarbon dates assigned by I. García Camino to individual FIN 02-1-44 (UA-4589, 1645 ± 60 BP) and layer SU 16 (UA-4588, 870 ± 55 BP), but as belonging to other contexts (FIN 09-1-60 and FIN 05-1-13 respectively). Considering there was no way to determine which publication was right, it was decided to maintain them as reported by I. García Camino, who was the original author. Following this criterion six of the individuals with radiocarbon dates were assigned to phase 2. The presence of grave goods, which were very similar to those from Aldaieta and Dulantzi, was another indicator to identify the burials of this period. Individual FIN 12-1-68 was the only one which had any grave goods and was not assigned to this phase, because priority was given to its radiocarbon date and the needle it was accompanied by was not meaningful. It was also verified that coffin nails were only recovered in the burials of phase 2. Finally, north-south orientation was also considered a distinctive feature of the burials between 5th and 8th centuries, as it is known that such variations of the standard west-east orientation were rare afterwards. Besides, the radiocarbon measurement of individual FIN 09-1-60 confirmed its dating in phase 2. These eleven burials, accounting for twelve individuals, are the only ones which will be further analysed for demography and paleodiet in this thesis, even if originally the whole cemetery was studied.

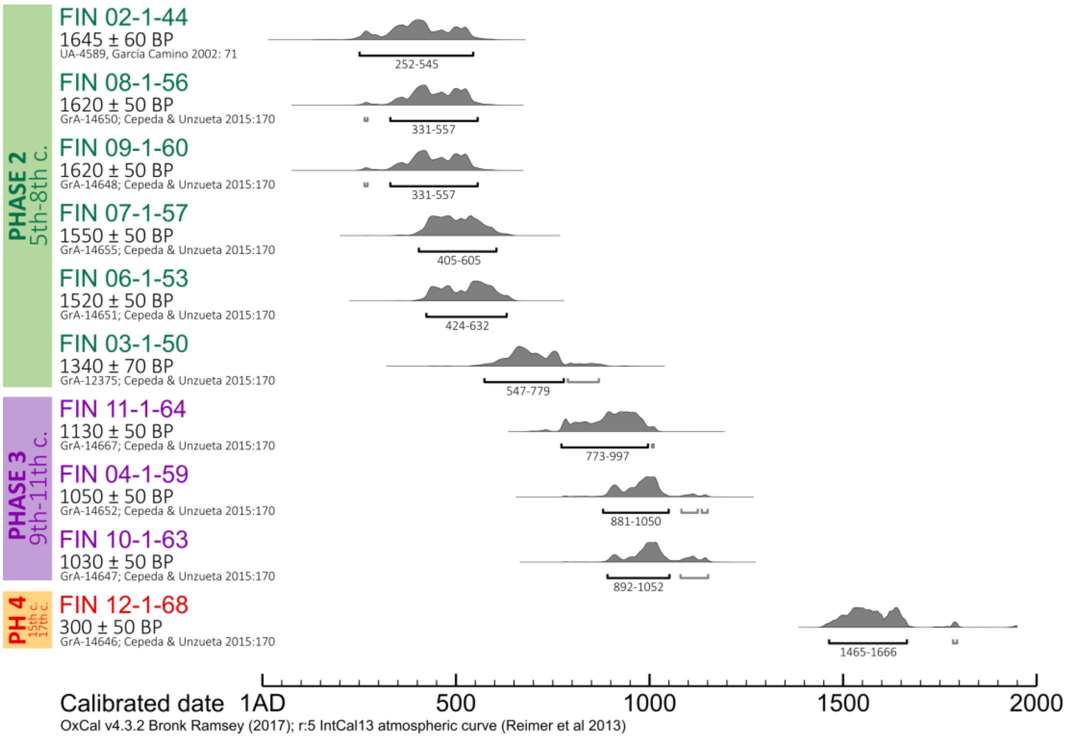


Figure 3.108. Finaga, radiocarbon dates (Cepeda & Unzueta 2015: 170, García Camino 2002: 71; modified)

The resulting arrangement for phase 2 may be surprising because it groups together burials previously considered different based on their grave goods. In the original work by I. García Camino (2002: 70–75) two distinct funerary phases were defined: a Late Roman one, dated to the 4th century, represented by individual

FIN 07-1-57, who was buried with a bowl of plain late Hispanic red slip ware, and a Late Antique one, dated to between the middle of the 6th and the 8th centuries, characterised by individuals FIN 03-1-50 and FIN 06-1-53, both accompanied by weapons. This would mean there was a hiatus in the use of the cemetery throughout the 5th century. However, the recent review by J. J. Cepeda and M. Unzueta (2015, Cepeda 2019) proposed a later chronology for the pottery bowl in the 5th century (Paz 2008). Most importantly, they released the radiocarbon dates of individuals FIN 03-1-50 and FIN 06-1-53 (figure 3.108), which demonstrated the burial with the late Hispanic red slip ware (FIN 07-1-57: 1550 ± 50 BP, 405-605 cal. 95.4%) and those with weapons (especially FIN 06-1-53: 1520 ± 50 BP, 424-632 cal. 95.4%) were virtually indistinguishable. The radiocarbon dates of the other individuals assigned to phase 2 based on grave goods or orientation did not allow to draw a clear internal division either, so that is why it was decided to consider all the burials between 5th and 8th centuries a single phase, even if there might have been some differences in the funerary ritual between them.

Continuing with the sequence, between 9th and 11th centuries a new structure was built against the northern wall of the nave (phase 3, figure 3.107C, García Camino 2002: 67). It is interpreted as a porch. At least four new burials were made too. Individuals FIN 04-1-59, FIN 10-1-63 and FIN 11-1-64 were assigned to this phase thanks to radiocarbon dates. There was no absolute dating for the two individuals from burial 1 (FIN 01-1-41, FIN 01-2-41), but they were set in this period due to their proximity to individual FIN 10-1-63 and because they did not present any of the characteristic features of phase 2. After this, no new activities were detected until an undetermined moment between 15th and 17th centuries (phase 4, figure 3.107D), when burial FIN 12 containing individuals FIN 12-1-68 and FIN 12-2-66 was dug. This phase could only be recognised thanks to radiocarbon dating. Finally, in the 18th century the original church was substituted by the current chapel (phase 5, figure 3.107E, Cepeda 2019: 244). There is still another context with human remains which has not been brought out yet. According to the original records kept at the Museum of Archaeology of Bizkaia, the so-called burial FIN 5 (individuals FIN 05-1-13 and FIN 05-2-13, figure 3.107E) was a commingled assemblage of anthropological material together with construction waste laying on burials FIN 02, FIN 06 and FIN 07, not a primary inhumation, and there were no chronological indicators to date it.

This is the only archaeological evidence known so far in Finaga, which means there is no data about the settlement where the individuals buried here lived. I. García Camino (1996: 87, 2002: 75–76, 78) suggested the settlement could be in Malmasin, a mountain less than 1 km northwest of Finaga used as a hillfort at least between the Iron Age and the Roman period. In the absence of any archaeological interventions on the site, the continuation of the occupation throughout the Early Middle Ages cannot be confirmed or ruled out. The possibility that the settlement was located on the same terrace as the church has not been considered before. However, the geophysical surveys conducted in 1995 did already determine the area was too altered by contemporary agricultural works to preserve any evidence of the settlement or productive structures (García Camino & Unzueta 1996). To conclude, so far Finaga lacks any specialised study on the artefacts, as well as on bioarchaeological records, so these elements cannot add any new data on the social or economic organisation of the community buried here.

3.2.2.1.3 The funerary context

This thesis analyses in detail solely the funerary assemblage of the phase 2 of Finaga. The only funerary space of this period known at the site developed around the contemporary church (figure 3.109; table 7.1; Cepeda & Unzueta 2015, García Camino 2002: 61–78). However, since most of the area excavated was within the walls of the modern chapel, the burials located further away are barely known. All the eleven burials identified were located outside their contemporary temple (n = 11/11 = 100.0%). They concentrated mainly around the apse, but this may be a bias caused by the fact that the space around the nave was either deeply modified by posterior structures and burials to the north, or very partially investigated to the south. The eagerness to place burials as close as possible from the apse lead to at least one intersection (i.e. burial FIN 06 cut burial FIN 07), even if the discovery of fragments of funerary stelae dated to this phase embedded in the walls of the modern chapel (Azkarate & García Camino 1996: 168–171) suggests at least some of the burials were marked on the surface. In addition, this desire was probably also the reason of the atypical orientation of some of the burials. While most of them followed the conventional west-east orientation (n = 8/11 = 72.7%), three were placed in north-south direction (n = 3/11 = 27.3%). All the assemblage is dated to between 5th and 8th centuries, as it is explained in greater detail under the former heading (see section 3.2.2.1.3). Still, it is possible to establish more precise dates for some of the individuals thanks to radiocarbon measurements (table 7.3) and certain grave goods.

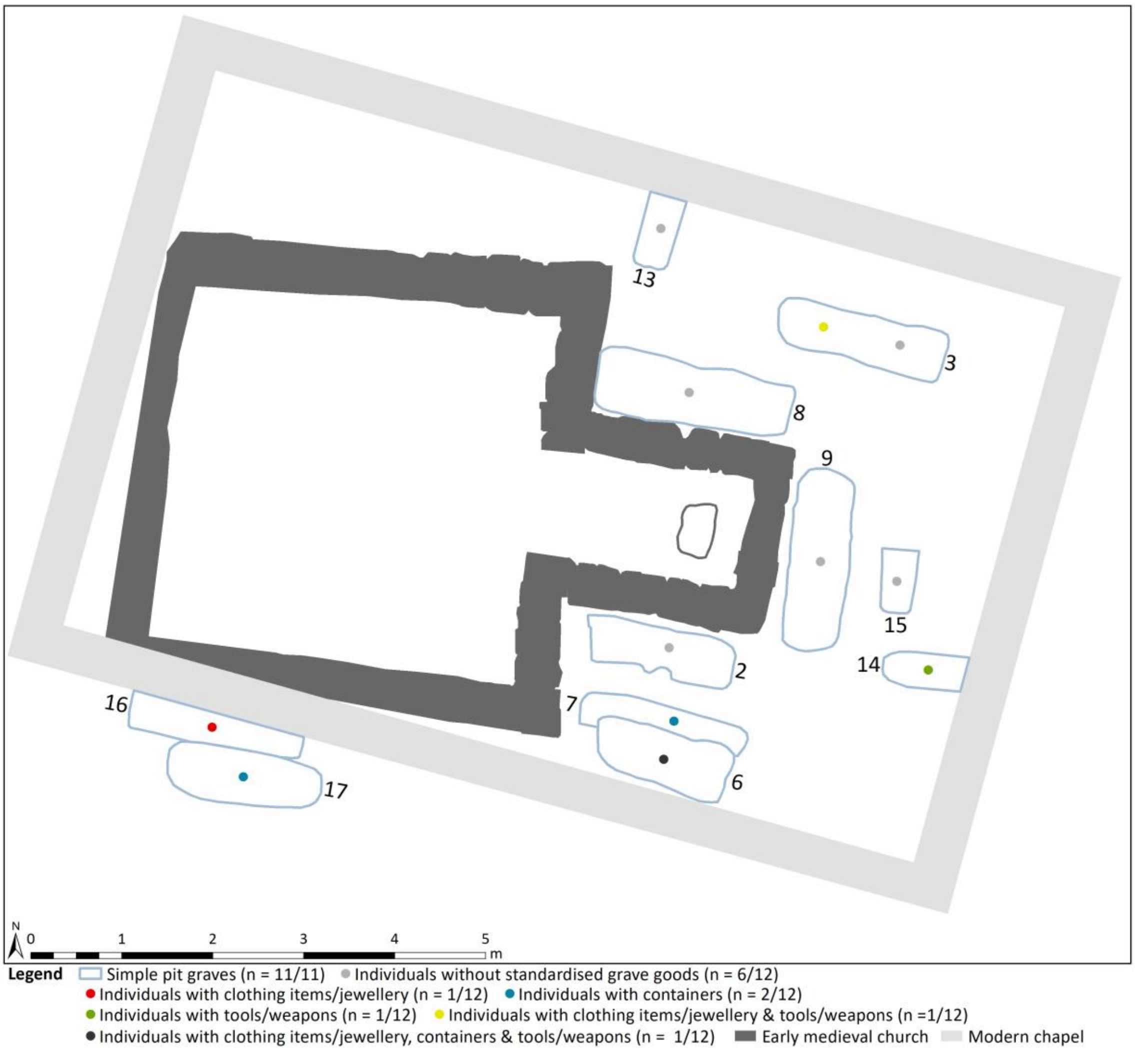


Figure 3.109. Finaga, cemetery of phase 2 around the early medieval church (García Camino 2002: 64, 68, Cepeda & Unzueta 2015: 169, modified). The outline of the modern chapel is based on orthophotos and does not reflect its exact dimensions. The plan of burial FIN 14 has never been published and is based on the original planimetry curated at the Museum of Archaeology of Bizkaia sketched by the author, so its measurements are not accurate either. The outline of burials is represented with a solid line whose colour shows the type of funerary structure according to the legend. The number next to each burial is its identifier. Points symbolise the individuals recovered in each burial. Their colour indicates the presence or absence of grave goods as stated in the legend

Formally all the burials from Finaga corresponding to this phase were very similar. They were all simple pits excavated in the bedrock (n = 11/11 = 100.0%). The vast majority of them were occupied by a single individual and only in one case two individuals were identified in the same funerary structure. Then, the population of this period was formed by twelve individuals and the mean number of individuals per grave was 1.1. Most of them were found in primary deposits and in supine position (n = 11/12 = 91.7%). Only in the burial with two individuals, there was one whose original position could not be determined (n = 1/12 = 8.3%).

Thanks to the recovery of nails and other metallic rivets it could be verified that a great proportion of the individuals was buried in wooden coffins (n = 9/12 = 75.0%). Besides, the percentage of individuals with grave goods at Finaga was quite high. Half of the individuals were found to be accompanied by some kind of object (n = 6/12 = 50.0%). When quantified by number of individuals, clothing items and jewellery (n = 3/12 = 25.0%), containers (n = 3/12 = 25.0%) and tools and weapons (n = 3/12 = 25.0%) were equally abundant. The former included a ring, a small buckle and a set of hobnails. Two of the containers found were made of glass and there was also a late Roman red slip ware bowl. In the third category there were a long sword, an assemblage formed by two spears and an axe, and a flint tool.

3.2.2.2 The human population

3.2.2.2.1 Macroscopic preservation

The cemetery of Finaga dated to phase 2 (figure 3.109) was formed by eleven burials which accommodated twelve individuals. In principle all of them were preserved. Nevertheless, at the time the osteoarchaeological study and sampling of this assemblage was carried out, the human remains of the two graves discovered in 2014 (see section 3.2.2.1.1) were still not deposited at the Museum of Archaeology of Bizkaia. For this reason, they could not be analysed. Therefore, only 10 of the individuals from the phase 2 of Finaga were examined for this thesis (n = 10/12 = 83.3%, table 7.1). The macroscopic preservation of these individuals was quite poor (figure 3.110, table 7.7). More than three quarters of the individuals preserved less than 25% of the skeleton and the remainder only between 25% and 50% of it. Moreover, in all the cases more than 75% of the skeletal elements preserved were fragmented. As for bone surface preservation, the most frequent situation were individuals with all the surface eroded and uneven distribution of depth or degree of alterations (grade 4). In view of these data, the informative potential of the human assemblage of phase 2 of Finaga at the macroscopic level was quite limited.

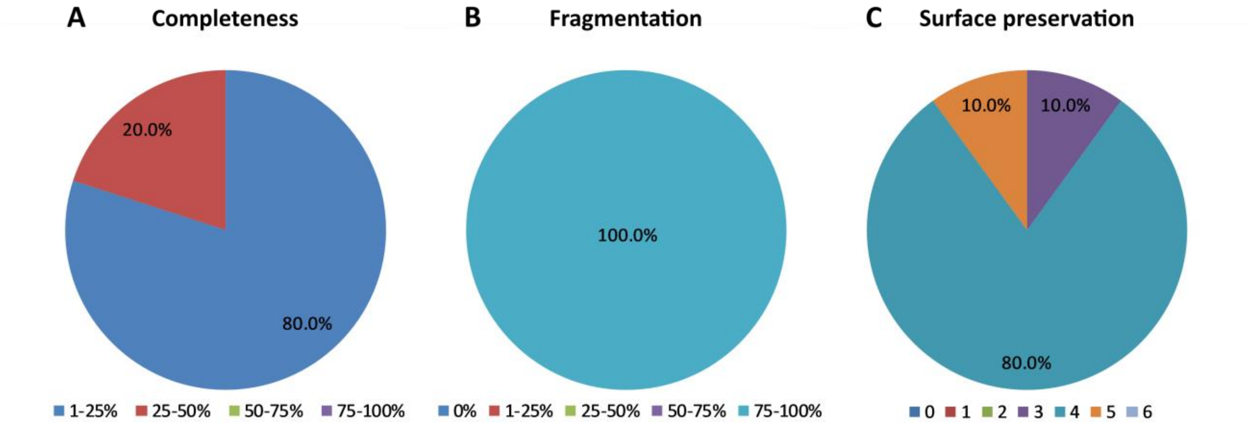


Figure 3.110. Pie charts representing the distribution of the three variables for the assessment of the macroscopic preservation of the human population from the cemetery of phase 2 of Finaga. (A) Completeness. (B) Fragmentation. (C) Surface preservation

3.2.2.2.2 Demography

The human population corresponding to the phase 2 of Finaga available for study was made up of a minimum number of just ten individuals (table 3.30, figure 3.111, table 3.31, table 7.4, table 7.5, table 7.6). Two out of these ten individuals were subadults (20.0%) and the rest were adults (80.0%). The youngest age category was formed by a single individual older than 3 years of age at death and the other subadult identified was an older child (infans 2). This means subadults were underrepresented. Adult age estimation was not possible in any case due to poor preservation and sex determination could only be accomplished for half of the adults. Among them, three out of four were female and just one was identified as a male. Therefore, according to these figures, the sex ratio of this population (0.33) would be strongly imbalanced in favour of women. This distribution of ages and sexes results in the demographic profile shown in figure 3.111. It is striking that the curve of the probability of death does not look like the typical profile of preindustrial agricultural populations (Chamberlain 2006: 64–68, Séguy & Buchet 2013: 114), which are normally characterised by great risk of death during the first years of life. It is difficult to assess if this unusual demographic profile is a consequence of the biases affecting the assemblage or a reliable representation of the group using this funerary area. On one hand, it is clear only a portion of the cemetery was preserved and excavated, but it is complicated to determine how much is missing and to what extent this affected the present dataset. On the other, it would not be rare that the use of the burial ground around the early medieval church was restricted to some individuals, for example, the owner family. In this case, the demographic profile of the cemetery would not have to match a conventional rural population. Likewise, the palaeodemographic estimators of this assemblage are also very influenced by the underrepresentation of subadults. This is why life expectancy at birth, calculated to have been 32.2 years, was one of the highest among all the populations considered in this research. The small sample size did not allow to make thorough analyses about associations between grave goods and age or sex or the spatial distribution of individuals based on demographic variables (figure 3.112). Still, it was observed that all the individuals in contact with the apse were adults, and mostly women, and subadults were placed in more peripheral locations.

Table 3.30. Age and sex distribution by absolute frequencies of the human population from the cemetery of phase 2 of Finaga. Key: F = fetus, < 40 weeks in utero; I1A = infans 1A, birth – 2 years; I1B = infans 1B, 3 – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; Ssp = subadult sp, < 20 years; YA = young adult, 20 – 34 years; YMA = young-middle adult, 20 – 45 years; MA = middle adult, 35 – 45 years; MOA = middle-old adult, > 35 years; OA = old adult, > 45 years; Asp = adult sp, > 20 years; UA = undetermined age; M = male individuals (including probably male individuals); F = female individuals (including probably female individuals); US = undetermined sex (including ambiguous individuals)

	F	*I1A*	*I1B*	*I2*	*J*	*Ssp*	*YA*	*YMA*	*MA*	*MOA*	*OA*	*Asp*	*UA*	*Total*
M	-	-	-	-	-	-	-	-	-	-	-	1	-	1
F	-	-	-	-	-	-	-	-	-	-	-	3	-	3
US	-	-	1	1	-	-	-	-	-	-	-	4	-	6
Total	0	0	1	1	0	0	0	0	0	0	0	8	0	10

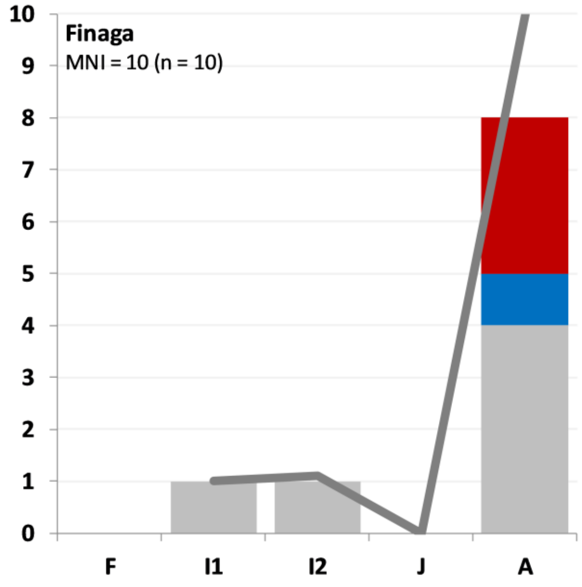


Figure 3.111. Demography chart of the human population from the cemetery of phase 2 of Finaga. Bars represent the absolute frequencies of each age category (F = fetus, < 40 weeks in utero; I1 = infans 1, birth – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; A = adults, > 20 years), separated by sex whenever possible (blue = male individuals, red = female individuals, grey = undetermined sex). The line depicts the progression of the probability of death (q_x) along age categories, calculated according to G. Acsádi and J. Nemeskéri (1970: 65). The minimum number of individuals of the population (MNI) and the number of individuals represented in the chart (n) are shown on the upper left corner

Table 3.31. Demographic descriptive indicators and palaeodemographic estimators of the human population from the cemetery of phase 2 of Finaga

Descriptive indicators		*Estimators*	
MNI	10	*JI*	0.125
%subad	20.0%	e_0	32.2
%ad	80.0%	$_1q_0$	0.234
S/A	0.25	$_5q_0$	0.350
M/F	0.33		

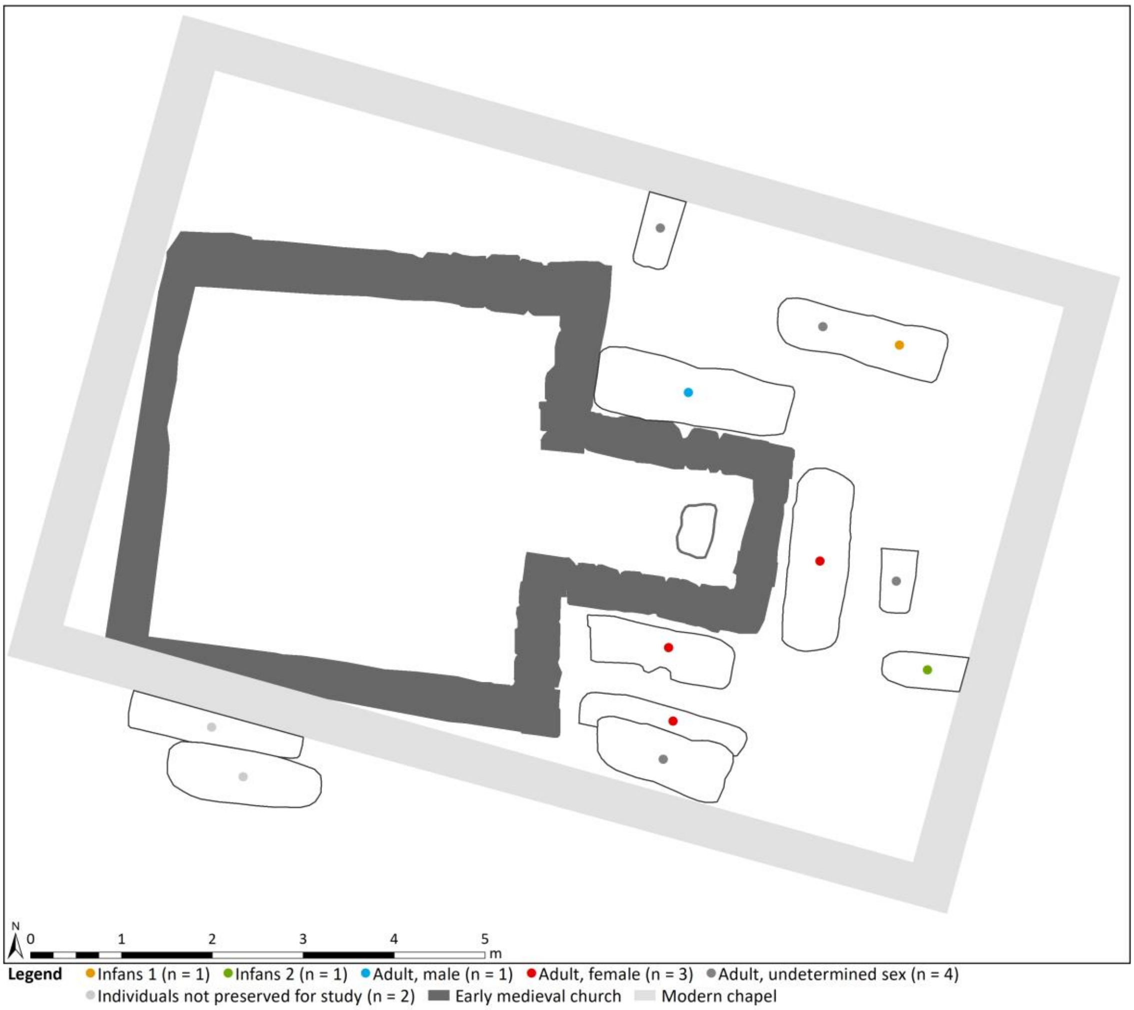


Figure 3.112. Finaga, cemetery of phase 2 around the early medieval church, spatial distribution of individuals by age and sex (García Camino 2002: 64, 68, Cepeda & Unzueta 2015: 169, modified). The outline of the modern chapel is based on orthophotos and does not reflect its exact dimensions. The plan of burial FIN 14 has never been published and is based on the original planimetry curated at the Museum of Archaeology of Bizkaia sketched by the author, so its measurements are not accurate either. Points symbolise the individuals recovered in each burial. Their colour indicates their age and sex as stated in the legend

3.2.2.3 Human diet

3.2.2.3.1 Sampling

The sampling strategy put in place for the human population of phase 2 of Finaga was aimed at including the entire assemblage. However, the two burials excavated in 2014 were not accessible and one of the individuals of the excavation of 1994 did not preserve any appropriate anatomical elements. The latter was an infans 1B, the youngest individual identified in this phase. Hence, finally nine individuals assigned to the phase 2 of Finaga were sampled (figure 3.113). They included the only remaining subadult, namely an infans 2, and eight adults.

One of the adults was a male individual and another three were female individuals, reflecting the imbalanced sex ratio of the population as a whole. The anatomical elements sampled for this assemblage were very heterogeneous due to the incompleteness of skeletons. In this way, they were mostly long bone fragments.

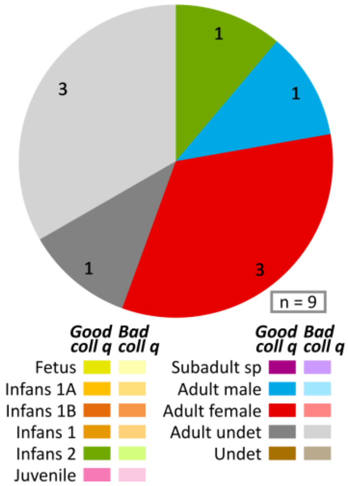


Figure 3.113. Pie chart representing the distribution of human samples from the cemetery of phase 2 of Finaga by age, sex and collagen quality. Numbers represent the absolute frequency of each group

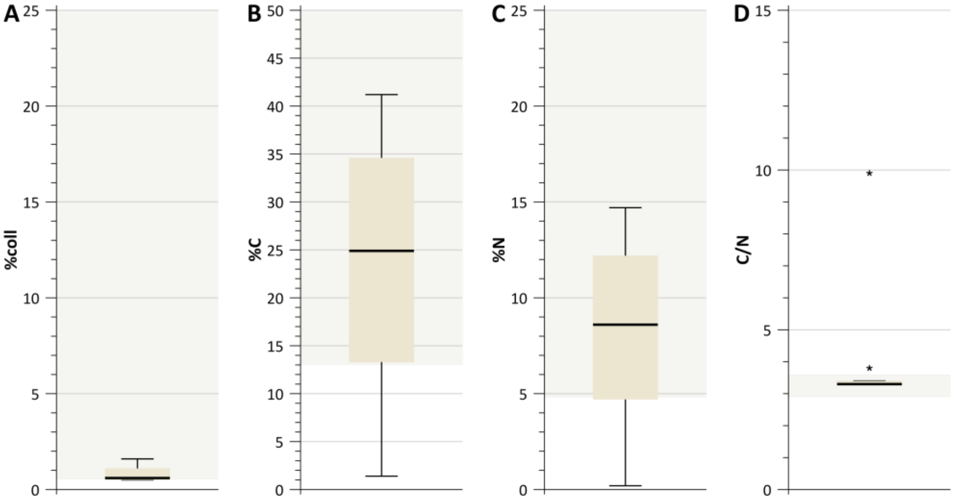


Figure 3.114. Boxplots representing the collagen quality indicators of human samples from the cemetery of phase 2 of Finaga. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

3.2.2.3.2 Collagen quality

The collagen quality of the human samples of phase 2 from Finaga was not generally good (table 7.9, table 7.10, figure 3.113, figure 3.114). Collagen yield (%coll) was greater than 0.5% in every case. Conversely, in a third of cases carbon (%C) and nitrogen weight contents (%N) were too low. Carbon weight contents had a minimum of 1.4% and a maximum of 41.2%, while nitrogen weight contents started at 0.2% and arrived up to 14.7%, and carbon to nitrogen atomic ratios (C/N) spread between 3.3 and 9.9. As a result, three samples did not meet the criteria for well preserved collagen and only six individuals from the phase 2 of Finaga were valid for further elaborations.

3.2.2.3.3 Results

The population from the cemetery of phase 2 (5th-8th c.) of Finaga constitutes one of the smallest assemblages included in this thesis. Still, it can be considered quite representative, since half of the individuals dated to this period were successfully analysed. Before going ahead, there is a handicap for the interpretation of this dataset that deserves some attention. There were no fauna samples from the very site available in order to draw the isotopic baseline of the environment and to characterise isotopically the food resources consumed by the group buried around the early medieval church. Nor was there any contemporary site in the vicinity which could provide suitable samples. Then, it was decided to use the fauna from the sites of Aldaieta (see section 3.2.1.3) and Dulantzi (see section 3.2.3.3) to solve this issue. For this purpose, the average of all adult herbivore samples from both sites was calculated (adult herbivores Aldaieta & Dulantzi: n = 18; δ^{13}C, mean = -21.2‰, SD = 0.7‰; δ^{15}N, mean = 6.5‰, SD = 1.5‰). Recently an isotopic study on a site geographically closer to Finaga was published. This is the high medieval cemetery of San Juan de Momoitio (Guede *et al.* 2020), dated to between 9th and 12th centuries and located in Garai (Bizkaia), 24 km east of Finaga. It was good to verify that the mean isotopic signature of the herbivores from this site (herbivores San Juan de Momoitio: n =

10; δ^{13}C, mean = -21.3‰, SD = 0.6‰; δ^{15}N, mean = 6.1‰, SD = 1.4‰) was virtually identical to the joint values from Aldaieta and Dulantzi.

Table 3.32. Summary statistics of carbon (δ^{13}C) and nitrogen (δ^{15}N) stable isotope ratios of human samples from the cemetery of phase 2 of Finaga. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one. Key: Cont = containers, T&W = tools & weapons

	n	*δ^{13}C (‰)*					*δ^{15}N (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All humans	6	-18.0	0.4	-18.4	-17.5	0.9	10.5	0.3	10.1	10.9	0.8
Subadults	1	-17.5	-	-	-	-	10.6	-	-	-	-
Infans 2	1	-17.5	-	-	-	-	10.6	-	-	-	-
Adults	5	-18.1	0.3	-18.4	-17.7	0.7	10.5	0.4	10.1	10.9	0.8
Male adults	1	-18.2	-	-	-	-	10.8	-	-	-	-
Female adults	3	-18.0	0.3	-18.2	-17.7	0.5	10.4	0.5	10.1	10.9	0.8
Grave g absence	4	-18.1	0.3	-18.4	-17.7	0.7	10.4	0.4	10.1	10.8	0.7
Grave g presence	2	-17.9	-	-18.2	-17.5	0.7	10.8	-	10.6	10.9	0.3
Cont presence	1	-18.2	-	-	-	-	10.9	-	-	-	-
T&W presence	1	-17.5	-	-	-	-	10.6	-	-	-	-

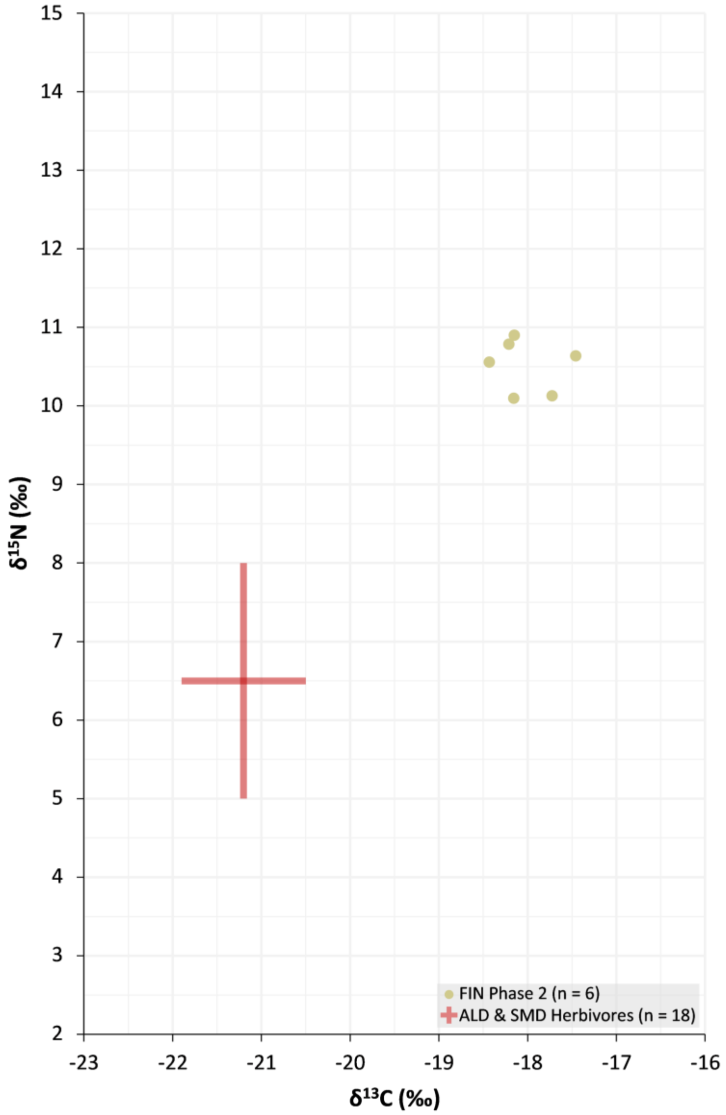


Figure 3.115. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of humans from the phase 2 of Finaga. Cross represents mean and one standard deviation of the fauna from Aldaieta and Dulantzi. Subadult specimens were excluded from the calculation of these parameters

Going back to humans, the main feature of this assemblage was homogeneity (table 3.32, table 7.9, figure 3.115). There were no outliers neither for δ^{13}C nor for δ^{15}N and in both cases ranges were smaller than 1.0‰.

This means the diet of this group of individuals was in general terms quite uniform and they had more or less equal access to the same type of products, although there may have been differences in qualities or preparations.

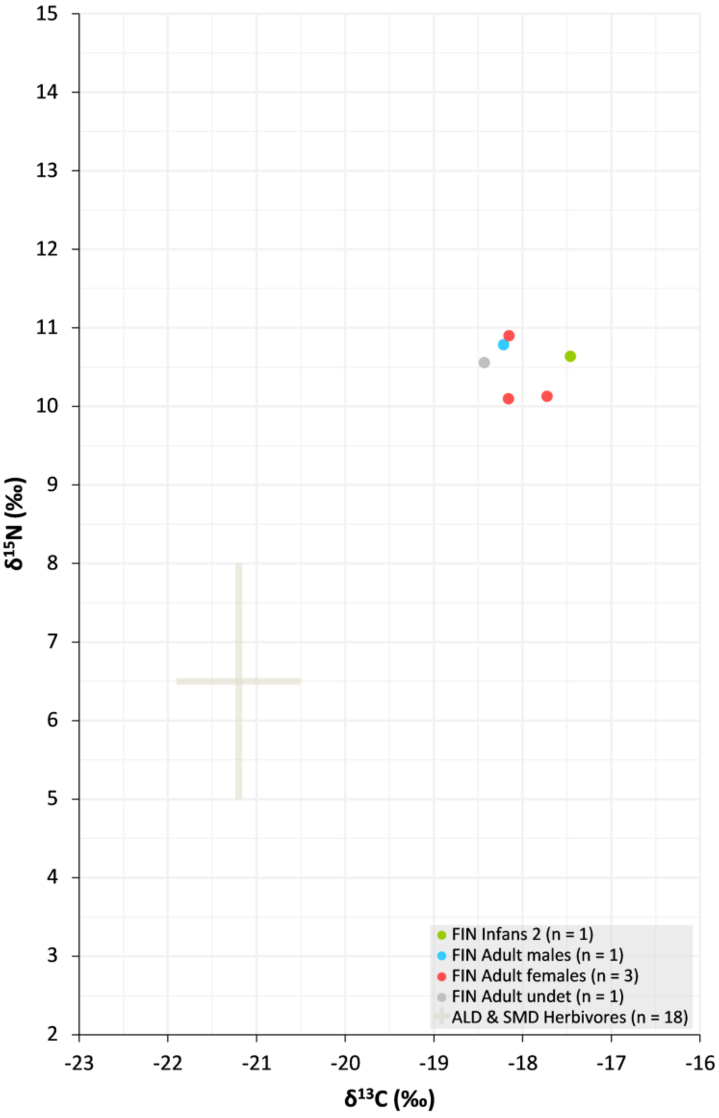


Figure 3.116. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from the cemetery of phase 2 of Finaga divided by demographic categories. Cross represents mean and one standard deviation of herbivores from Aldaieta and Dulantzi excluding subadult specimens

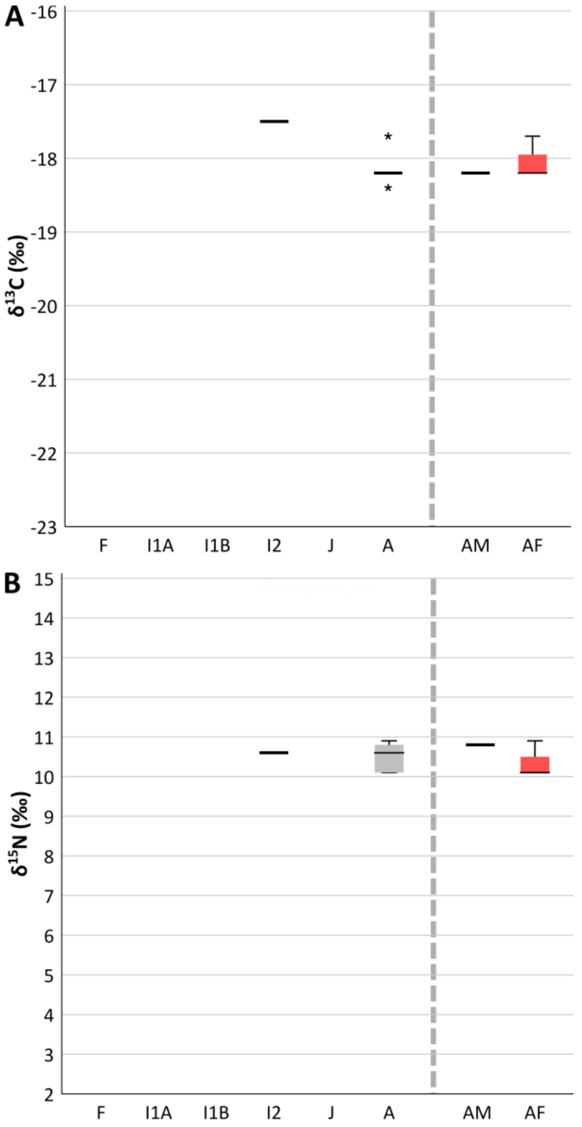


Figure 3.117. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from the cemetery of phase 2 of Finaga divided by demographic categories. Key: F = fetus, I1A = infans 1A, I1B = infans 1B, I2 = infans 2, J = juvenile, A = adults, AM = adult males, AF = adult females

More specifically, the mean $\delta^{13}C$ of the individuals of phase 2 from Finaga was -18.0‰ and they had a standard deviation of 0.4‰ and a range of 0.9‰. Therefore, there was an offset of 3.2‰ between them and the set of adult herbivores from Aldaieta and Dulantzi, exceeding by far the fractionation usually accepted for one trophic level shift (~1‰). According to these data, it is likely that the diet of the individuals from this context was largely based on C_3 resources, but C_4 plants would have also played a relevant role. In this way, the main type of plants consumed would have been winter crops, such as wheat, barley, rye or oats, as well as legumes, vegetables and fruits. At the same time, broomcorn and foxtail millets, which were the only C_4 plants available in this context, would have made proportionately smaller but significant contributions to the diet of these individuals. This is the most comprehensive explanation to the enrichment of humans' $\delta^{13}C$ in comparison to reference herbivores. Potentially, marine fish consumption could have also caused the increase of carbon stable isotope ratios. However, despite the proximity of Finaga to the coast, which is less than 15 km away, marine fish was probably not a major component of the diet of these individuals, because they lack the corresponding enrichment of δ^{15}N associated to this foodstuff. It is difficult to estimate the importance of C$_4$ resources in the diet of the individuals buried around the early medieval church, especially due to the impossibility to characterise properly the local isotopic baseline and husbandry strategies. Considering that in the Basque sites studied livestock was almost exclusively fed on C$_3$ resource, in the present context millets must have been consumed directly by humans and, in order to attain those δ^{13}C values, they must have been a regular and frequent ingredient in the diet of these individuals.

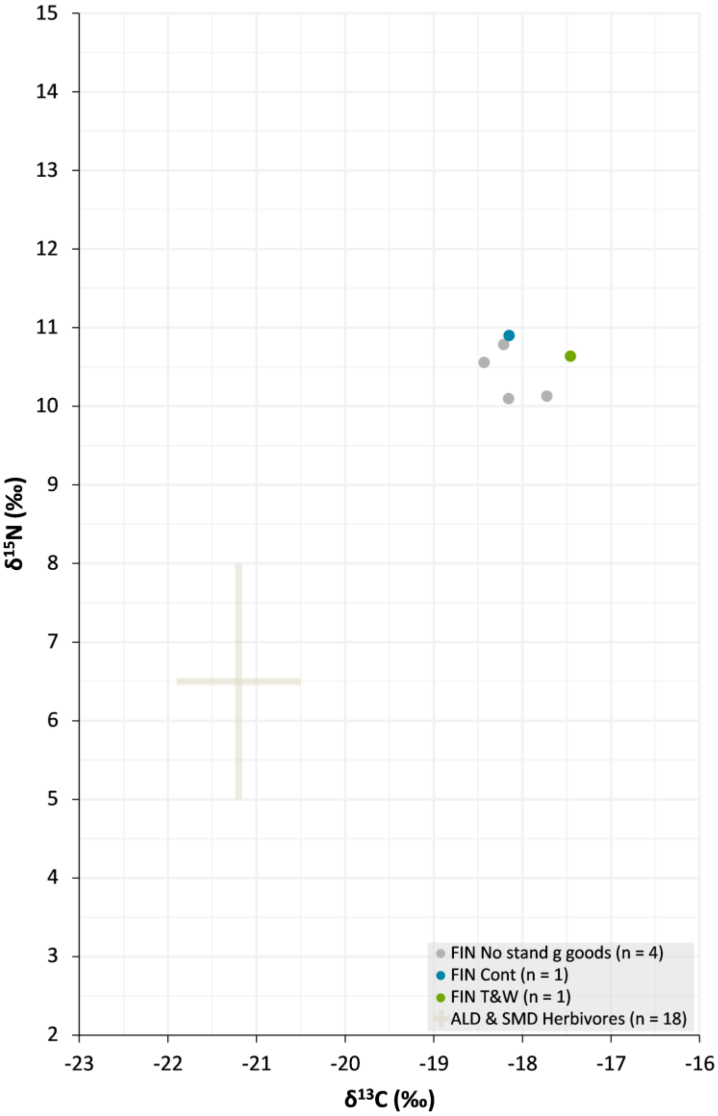


Figure 3.118. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of humans from the cemetery of phase 2 of Finaga divided by type of grave goods. Cross represents mean and one standard deviation of herbivores from Aldaieta and Dulantzi excluding subadult specimens. Key: No stand g goods = no standardised grave goods, C&J = clothing items & jewellery, Cont = containers, T&W = tools & weapons

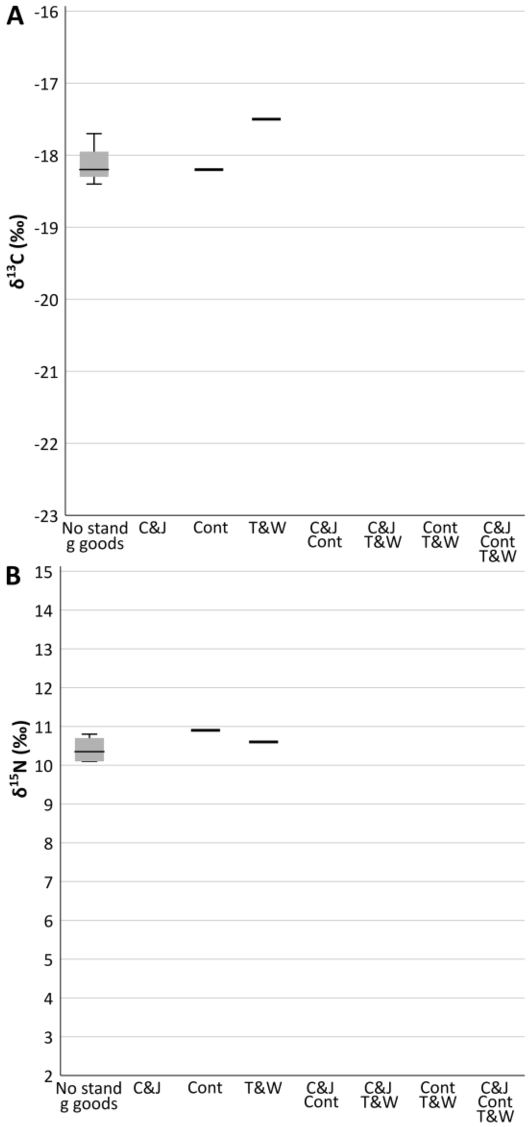


Figure 3.119. Boxplots representing (A) carbon stable isotope ratios (δ^{13}C) and (B) nitrogen isotope ratios (δ^{15}N) of humans from the cemetery of phase 2 of Finaga divided by type of grave goods. Key: No stand g goods = no standardised grave goods, C&J = clothing items & jewellery, Cont = containers, T&W = tools & weapons

Regarding δ^{15}N, the assemblage of phase 2 from Finaga had a mean of 10.5‰, a standard deviation of 0.3‰ and a range of 0.8‰, showing again a remarkable uniformity. The offset between these individuals and the combination of adult herbivores from Aldaieta and Dulantzi was 4.0‰. This is the equivalent to almost a complete trophic level change (~5‰), so it would point at abundant consumption of animal protein by the individuals forming this dataset. Nevertheless, if the type of animals preferentially eaten were high in the food chain, like pigs or other omnivores, this statement would have to be nuanced, because in this case a smaller proportion of animal protein would be enough to reach such nitrogen isotope ratios. Unfortunately, the absence of any contemporary zooarchaeological assemblage in the surroundings of the site prevented to obtain any data on meat consumption trends around early medieval Finaga and to get samples for carbon and nitrogen stable isotope analyses to refine the interpretation of human diet. The contribution of small amounts of marine fish to these individuals' diet cannot be entirely ruled out either, but they do not show clearly the typical pattern associated to it.

Figure 3.120. Finaga, cemetery of phase 2 around the early medieval church, spatial distribution of individuals divided by carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) (García Camino 2002: 64, 68, Cepeda & Unzueta 2015: 169, modified). The outline of the modern chapel is based on orthophotos and does not reflect its exact dimensions. The plan of burial FIN 14 has never been published and is based on the original planimetry curated at the Museum of Archaeology of Bizkaia sketched by the author, so its measurements are not accurate either. Individuals successfully analysed are represented with a big circle divided in two. The left half symbolises δ^{13}C and the right half δ^{15}N according to the colour gradient shown in the legend. Individuals not analysed are depicted with a smaller grey point

It is a challenge to make any inference about the relationship between diet and demography (figure 3.116, figure 3.117) or the presence of grave goods in burials (figure 3.118, figure 3.119) during the phase 2 of Finaga, not only because of the small sample size of the assemblage, but also due to its homogeneity in both carbon and nitrogen stable isotope ratios. Only one subadult, an infans 2 who died between 9 years and 6 month and 14 years and 6 months of age, was analysed. It had the most enriched δ^{13}C value of the dataset, so it is clear both subadults and adults buried at Finaga had access to C_4 resources, but the evidence is too weak to talk about preferential consumption of millets by subadults. All the remaining individuals were adults. Sex based differences could not be explored because only one adult male was identified and it was close to the mean for both δ^{13}C and δ^{15}N. Conversely, at least three female adults were analysed. Their isotopic signatures showed a variability comparable to the entire assemblage. Likewise, only two of the individuals analysed were accompanied by any grave goods. One of them had a pottery bowl and the other one a flint tool. They were both on the upper end of the range of δ^{15}N and they tended towards enriched δ^{13}C values. However, the assemblage was so homogeneous that it is unlikely these differences were really meaningful. Thus, there were probably no significant differences between the diet of the individuals from the cemetery of phase 2 of Finaga buried with and without grave goods. Unfortunately, none of the two individuals with weapons preserved good quality collagen, so their diets cannot be discussed.

Lastly, looking at the spatial distribution of carbon and nitrogen stable isotope ratios (figure 3.120), no relevant clusters or patterns can be observed. The small size and the homogeneity of the assemblage certainly determined this fact. Anyway, it is interesting to verify that all the three individuals buried closer to the apse of the early medieval church had very similar isotopic signatures, so they shared the same food consumption habits and possibly they came from the similar social environment. In contrast, the only subadult analysed, who was the individual with the most singular diet of the assemblage, was in the grave furthest from the temple.

3.2.3 DULANTZI

3.2.3.1 The site

3.2.3.1.1 Location and history of research

The site of San Martín de Dulantzi (henceforth only Dulantzi) is located east of the plain known as *Llanada Alavesa*, within the urban area of the village of Alegría-Dulantzi, in the province of Araba (figure 3.121). Its UTM ETRS89 coordinates are 30T 539372 4743689 and it is 562 meters above sea level. It is 13 km east of Vitoria-Gasteiz, 57 km southeast of Bilbao, 68 km southwest of San Sebastián, and 72 km west and 23 km east of the Roman cities of Pamplona and Veleia respectively. Relative to the other sites from the same region analysed in this thesis, Dulantzi is 11 km southeast of Aldaieta and 52 km southeast of Finaga. This is a flat area with a few scattered hills and crossed by many small watercourses. The main one is the Alegría stream, which flowed in east-west direction less than 100 m south of Dulantzi. Vast plains and plenty of water availability would have created excellent conditions for agriculture and animal husbandry around the settlement. In addition, the Roman road *Iter XXXIV* passed also in west-east direction about 200 m north of the site (Varón 2018). During the Early Middle Ages it was still used and maintained (Nuñez *et al.* 2004), so Dulantzi would have been an important landmark in the route.

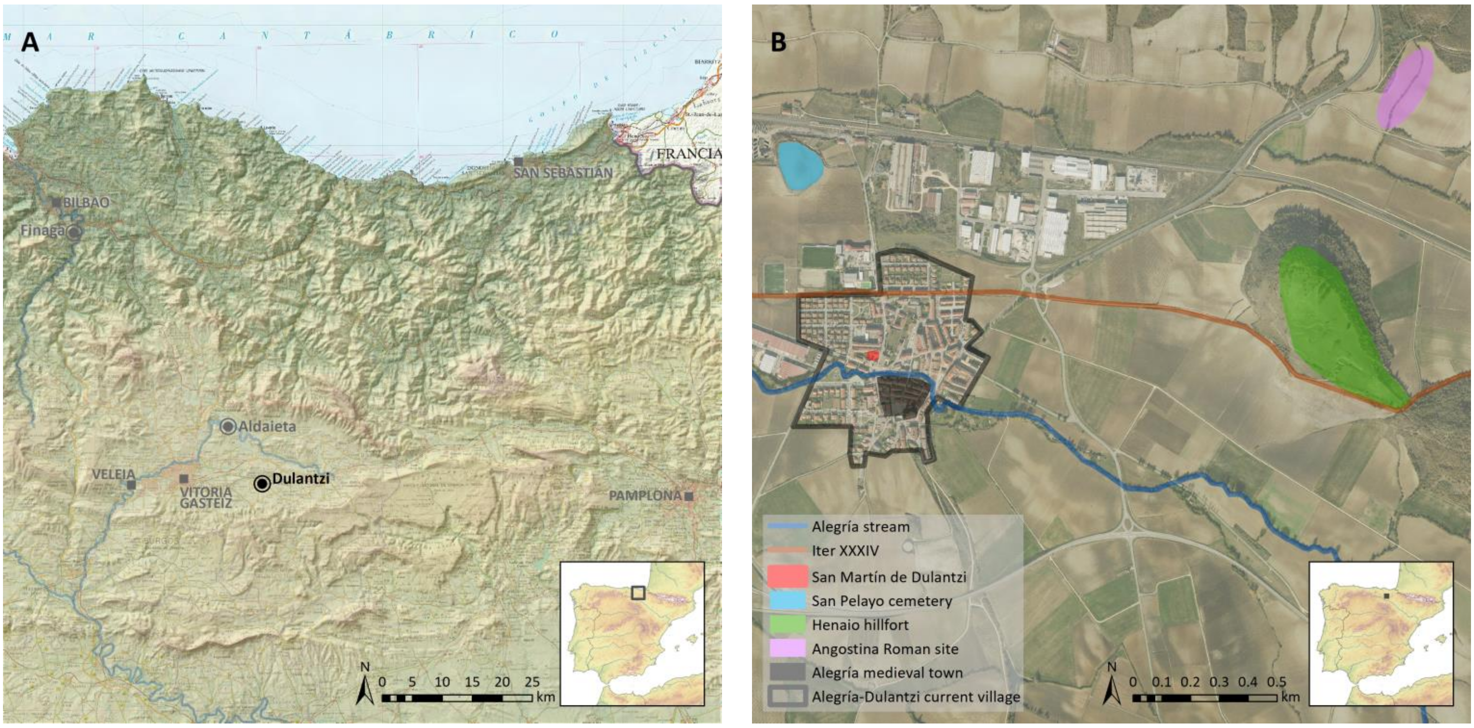


Figure 3.121. Geographical location of the site of Dulantzi (Alegría-Dulantzi, Araba) (A) at the regional and (B) local scale

The first campaign at the site was promoted by the council of Alegría-Dulantzi for the remodelling of San Martín and Nuestra Señora de Ayala streets. It was carried out by the cooperative society Iterbide between 2009 and 2010 under the direction of J. Niso and it covered 800 m^2 (Loza & Niso 2012, Niso 2014). Considering the outstanding results obtained in the first intervention, in 2014 the excavation was extended 80 m^2 to the space under a neighbouring building. This second phase was directed by M. Loza, also a member of Iterbide (Loza & Niso 2015). In addition, during 2015 the nearby streets Gasteiz and Baratzaldea, located south and east of the archaeological site, were also remodelled. The works were supervised by M. Loza (2016), but no archaeological evidence was found. The human remains recovered during the first two interventions are stored in the BIBAT Museum of Archaeology of Araba, in Vitoria-Gasteiz.

The discovery of Dulantzi meant a turning point for early medieval archaeology in the Basque Country and that is why the site has been discussed in a number of publications. In addition to the reports on each intervention cited in the paragraph above, M. Loza and J. Niso (2016) published a comprehensive synthesis of the complete occupation sequence, as well as specific papers together with other colleagues on particular topics such as privileged burials (Alfaro *et al.* 2019) or storage silos (Alfaro *et al.* 2017). Other researchers have used Dulantzi as a case of study for wider approaches to Early Middle Ages in the Basque Country (Azkarate 2011, Azkarate & García Camino 2012, Azkarate & García Camino 2013, Azkarate 2018, Catalán 2014, García Camino 2016, Larrea 2009, Larrea & Pozo 2015, Larrea & Pozo 2019, Pozo 2016, Quirós 2011a, Quirós 2011d), some of them with an emphasis on religious architecture and its meaning (Alfaro 2015, Larrea 2016, Quirós & Santos 2015). Pottery (Azkarate & Solaun 2016), coins (Sánchez Rincón *et al.* 2014) and the liturgical spoons (Velázquez *et al.* 2017) from Dulantzi have been object of specialized studies too. Regarding bioarchaeological records, I. Grau-Sologestoa (2015a) analysed the fauna recovered in the first campaign and she has compared it with other contexts in various publications (Grau-Sologestoa 2013b, Grau-Sologestoa 2014, Grau-Sologestoa 2015b, Grau-Sologestoa 2016, Grau-Sologestoa 2017). Human remains were initially examined by T. Fernandez-Crespo (2011a, 2011b). Nevertheless, the complete population was analysed again by the author in order to include the individuals excavated in 2014 and to homogenise the methods applied. Moreover, most of the carbon and nitrogen stable isotopes analyses of humans and fauna from Dulantzi have already been published before together with other medieval Basque sites by the author and colleagues (Lubritto *et al.* 2017, Quirós *et al.* 2012, Quirós *et al.* 2013, Sirignano *et al.* 2014) and the results have also been used by other researchers for comparison (Guede *et al.* 2017, Jiménez-Brobeil *et al.* 2016). The point of including this dataset here is to focus only on early medieval individuals and to compare them with other contemporary populations across Iberia, which has not been done before. Besides, strontium isotope analyses to trace mobility have also been performed on the population buried in Dulantzi (Guede *et al.* 2013, Ortega *et al.* 2012, Ortega *et al.* 2013, Quirós *et al.* 2013) and oral microbiome from dental calculus has also been investigated (Fagernäs *et al.* 2020).

3.2.3.1.2 The settlement

Dulantzi covers in a limited space the complete chronological sequence from the Early Roman Empire to nowadays, with an initial occupation without continuity during Late Prehistory. For this reason, the oldest phases are seriously affected by postdepositional processes and they are more difficult to interpret. The most ancient archaeological evidence found at Dulantzi consists of several big sunken featured structures excavated in the bedrock and probably dated to the Bronze Age, based on the little material culture recovered (phase 1, 2nd millennium BC, Loza & Niso 2012: 35). Then, the site was not occupied again until the Early Roman Empire (phase 2, 1st-4th c. AD, Loza & Niso 2012: 36–37), when a succession of domestic structures was identified. First, there was a group of post holes and trenches, which point at structures built in perishable materials. Between the end of the 1st century and the beginning of the 2nd century AD the organisation of the settlement was modified. New structures made of rubble masonry were built, all of them with the same orientation, indicating some kind of urban planning was implemented. Still, by the 3rd century all these structures were abandoned and the only archaeological evidence up to the end of the 4th century is a well and a massive deposit covering a great part of the area excavated. During this phase Roman Dulantzi, which has been identified as the *mansio* of Tullonium (Loza & Niso 2012: 36–37), coexisted with other contemporary settlements in the surroundings (figure 3.121B). About 1.5 km east there was the hillfort of Henayo (Llanos *et al.* 1975), whose main occupation is dated to the Iron Age, but which probably persisted at least during the initial stages of the Roman period. In addition, 2 km northeast of Dulantzi there is the Roman site of Angostina (Filloy 1995). This is a poorly known site which could be either another sector of Tullonium or a suburban villa.

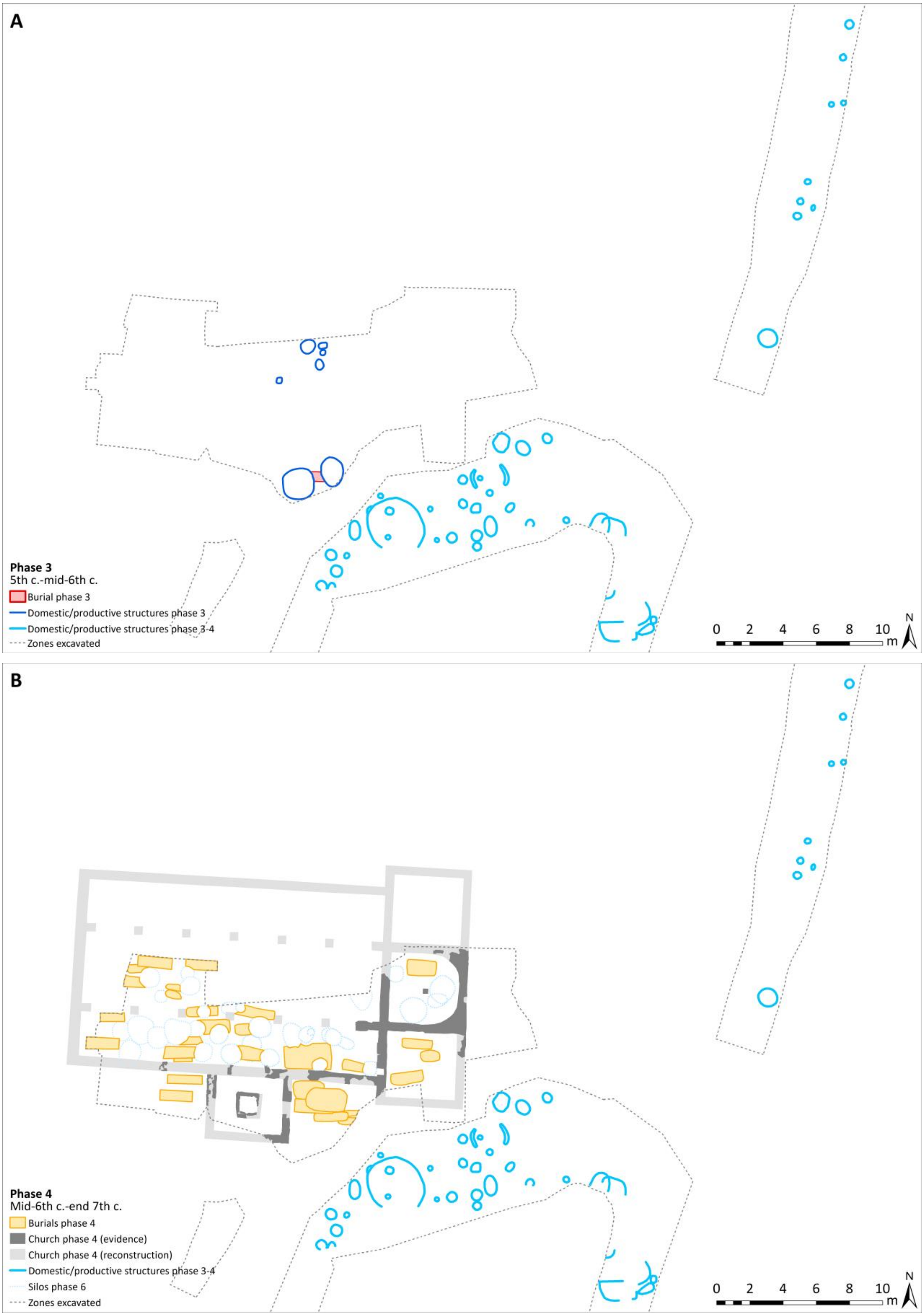


Figure 3.122. Dulantzi, diachronic evolution of the site during phases 3 and 4 (Alfaro *et al.* 2017, Loza & Niso 2012, Loza & Niso 2016, modified)

By the 5th century the area was inhabited again (phase 3, 5th c.-mid-6th c., figure 3.122A, Loza & Niso 2012: 37–39). On one hand, a group of structures in perishable materials (i.e. sunken featured structures, post holes, trenches) was built. Some of them were cut by the construction of the church in the following period and could be certainly dated to between the 5th century and the first half of the 6th century. Conversely, others did not have any direct stratigraphic relationship with posterior structures, so it is unclear whether they belonged to phases 3 or 4. Therefore, they are loosely dated to between 5th and 7th centuries. On the other hand, the first funerary evidence appeared. Only grave SMD 3181 could be assigned to this period, thanks to radiocarbon (table 7.3) and the fact that it was cut by two structures also dated to phase 3. However, it is likely that there might have been more in the zones not excavated or that part of this cemetery might have been destroyed by posterior activities. Likewise, it must be noted that two other individuals dated to this moment were identified in structures of the next phase, so they could only be recognised through absolute dating (table 7.3). This is especially relevant because both of them were placed in preeminent locations (Alfaro *et al.* 2019): individual SMD 2811-1-2810(181) was in a privileged tomb in the apse of the church and individual SMD 3461-1-3460(246) in the only sarcophagus found at the foot of the temple. Nevertheless, there is no evidence these two individuals were originally buried in the funerary area of phase 3.

At the middle of the 6th century intense construction activity was launched at Dulantzi (phase 4, mid-6th c.-end 7th c., figure 3.122B, Loza & Niso 2016: 96–107). A building with a basilica-like plan was erected on the north-western angle of the area excavated, in the surroundings of the burial dated to phase 3 and cutting previous domestic or productive structures. Only about one third of the building was excavated, but it was enough to make an approximate reconstruction of its complete outline. It consisted of three naves oriented in east-west direction and separated by columns, each with a distinguished square room on the eastern end. The central nave was wider than the lateral ones and its corresponding eastern room had a semicircular inner outline creating an apse, while lateral rooms were also square in the inside. At the centre of the apse an upright Roman stela reused as a table stand was found and the fragmented tabletop was recovered in the fill associated to the collapse of the structure. There was another square room halfway up the southern nave, which had a stepped basin in the middle. The entrance to the building was not uncovered, but possibly it was located on the western end. It is estimated that the construction would have had 24 m of maximum length and 14.5 m of maximum width at the eastern end, accounting for an area of around 315 m^2. The internal distribution, the table in the apse and the room with the pile, interpreted as a baptistery, identify this building as a church, which would have shared many features with other contemporary temples in Iberia (Utrero 2006). The whole structure was built in rubble masonry and, even though only a few centimetres of perimetral walls were preserved, other architectural and decorative elements recovered in abandonment fills, such as column shafts, keystones, lattice fragments and stuccoes, were useful for reconstructing the original appearance of the church. The stratigraphic analysis of walls determined the whole ensemble was erected in a single event, but it was not possible to directly date it because foundation trenches did not contain any archaeological material. However, stratigraphy and the analysis of pottery contributed to solve this issue (Loza & Niso 2016: 119–120). The key were the negative structures dated to phase 3, which were directly cut by the church (figure 3.122A). On one hand, one of them cut burial SMD 3181, radiocarbon dated to between the 5th century and the middle of the 6th century (table 7.3). On the other, the pottery assemblages found in the sunken featured structures and silos of phase 3 were all coarse local productions, dated from the 6th century on. Then, the construction of the church was established along the central decades of the 6th century, which is also consistent with the funerary evidence associated to it.

The temple had funerary functions since its foundation, as demonstrated by the presence of burials dated from the middle of the 6th century onwards inside and closely around it (Loza & Niso 2016: 107–116). Although they were severely affected by the silos opened during phase 6, originally graves occupied the central and southern naves, the distinguished room east of the southern nave and the area immediately outside the building along the southern wall. The only zones free of conventional burials were the baptistery, the apse and the space just in front of it, which most likely was reserved for special religious functions. One of these funerary structures deserves special attention, because probably it was part of the design of the church. It was tomb SMD 2811, located in the apse, north of the altar (Alfaro *et al.* 2019: 150–152). It was built in rubble masonry walls coated in reddish stuccoes and covered with big squared slabs. It only contained the skeletal remains in secondary position of an adult woman (individual SMD 2811-1-2810(181)) piled in a corner, together with a pig tooth and a roe deer skull with both antlers chopped. Its location, construction technique and content were unique in the site. The radiocarbon date of the individual (table 7.3) gave a chronology between the middle of the 4th century and the first third of the 6th century, that is, before the construction of the church of Dulantzi. All this evidence suggests these may have been the remains of a relevant individual deposited during the foundation of the temple as relics. It must be mentioned there was another individual contemporary to this one buried in a funerary structure dated to phase 4. It was precisely individual SMD 3461-1-3460(246), one of the two individuals found in the sarcophagus SMD 3461, the only grave of this type recovered at Dulantzi. The burials assigned to this phase were identified based on stratigraphy, radiocarbon dating and the features of the funerary ritual, and they also contributed to the dating of the construction of the church. On one side, they were the oldest graves in the stratigraphic sequence (excluding burial SMD 3181, the only one dated to phase 3) and radiocarbon confirmed they died between 6th and 7th centuries (table 7.3). On the other, many of the individuals were buried with grave goods and none of them could be dated to the first half of the 6th century (Loza & Niso 2016: 110). Then, the funerary assemblage of phase 4 was dated from the middle of the 6th century onwards, agreeing with the chronology proposed for the construction of the church. Finally, during phase 4 the remaining area excavated was still occupied by domestic and productive structures in perishable materials (Loza & Niso 2012: 39, 48), but it is not possible to neatly distinguish them from those of phase 3.

The new religious centre of Dulantzi coexisted with at least another contemporary funerary area in the vicinity. About 700 m northwest of the site, on the hill of San Pelayo (figure 3.121B), plenty of objects similar to those from Aldaieta, Finaga and Dulantzi were recovered scattered on the surface, but no significant evidence was preserved in primary position (Azkarate 1997, Azkarate 2005, Iriarte 1998). The data available suggest there was another cemetery at San Pelayo being used at the same time as Dulantzi, but it is not possible to determine what was the relationship between the groups buried in each one.

For this thesis only the human remains dated to phases 3 and 4 were considered, although the whole assemblage underwent full osteoarchaeological study. Still, only the individuals excavated between 2009 and 2010 were sampled for carbon and nitrogen stable isotope analyses, because they were processed before the second campaign on the site. The only individuals recovered during 2014 included in palaeodietary reconstruction are the two from sarcophagus SMD 3461. They were tested by Beta Analytics for radiocarbon and they supplied $\delta^{13}C$ and $\delta^{15}N$ measurements from IRMS too. Even though inevitably the pretreatment protocol and measurement settings of this laboratory are slightly different from the methods stated in this thesis, it was decided to include them because procedures were considered compatible and the information they provided was relevant.

It was not until the end of the 7th century that the church of Dulantzi and its surroundings suffered relevant modifications (phase 5, end 7th c.-mid-10th c., Loza & Niso 2012: 48–52). At that moment the temple was still standing without any substantial transformation, but there was a change in the use of the funerary space. No more burials were made inside the church and the cemetery expanded around it up to 30 m east and south, occupying the areas previously used as domestic and productive spaces. This can be interpreted as a consequence of demographic growth, probably linked to the emergence and consolidation of the village of Dulantzi during this phase. However, it also indicates a deep social change in the community who used this funerary space. If originally it would have been exclusively reserved for a small group showing off status through the funerary ritual, at one point it was opened to a wider and more heterogeneous population both in demographic and material terms, which apparently did not consider burial as the expression of social position any more, or at least not in the same way. This might have also been linked to a shift in the nature of the church, from its initial private ownership by local elites to the acquisition of parish functions comprising the whole village community approximately from the end of the 7th century on (Alfaro 2015: 129–132, Quirós & Santos 2015: 55–56), even though this is something difficult to assess without any written evidence. During this phase, which lasted until the middle of the 10th century, domestic and productive structures kept on taking up the spaces free of burials, underlining the dense occupation of the settlement. The novelty of this phase was the appearance of the first non-monumental structures in stone after the Roman period.

The main feature of the next phase (phase 6, mid-10th c.-mid-12th c., figure 3.122) was the transformation of the church into a barn. For this purpose, several tens of silos were excavated occupying most of the naves and the apse (Alfaro *et al.* 2017: 252–258). Still, not all of them were used at the same time, but they were opened and closed in several successive cycles between the middle of the 10th century and the beginning of the 12th century. Silos were probably hidden under a wooden floor, so as the church could keep liturgical functions. In this way, silos are the material evidence of the seigneurial control over the church during this phase, whose private lord, either secular or religious, would have used the temple as the storage space for the grain collected as rent (Alfaro *et al.* 2017: 265–269). In addition, the temple underwent some functional modifications at the beginning of this phase, since the baptistery and possibly also the southern distinguished room were dismantled along the 10th century (Loza & Niso 2012: 52–53). Meanwhile, the outside of the church carried on being used as a cemetery, with burials so similar to those of phase 5 that many of them were indistinguishable (Loza & Niso 2012: 54). Besides, the area south of the church continued being used for domestic or productive activities, as shown by a big sunken featured structure, three silos intersecting previous and later burials, and a wall of uncertain function overlapping the former baptistery (Loza & Niso 2012: 54–55). At the end of phase 6, during the first decades of the 12th century, the early medieval church of Dulantzi was abandoned, looted and, finally, collapsed (Loza & Niso 2012: 52).

Hence, there was no church functioning in the area during at least fifty years, until the second half of 12th century (phase 7, mid-12th c.-14th c.), when a new temple was erected. First, the zone was levelled with a massive fill covering completely the ruins of the 6th century church and a few burials were made on them during the last decades of phase 6 (Loza & Niso 2012: 55). Then, a new church in Romanesque style was built 18 m west of the former (Alfaro 2015: 127–129, Loza & Niso 2015: 24–26, Loza & Niso 2016: 124–125). Only a portion of the apse could be excavated. It was made of slightly standardised rubble masonry and it had the outline of a stilted arch, with 4.3 m of inner maximum diameter. The walls were around 1.3 m thick and they had even wider foundations, which indicates at least the apse was probably vaulted in stone. The pottery recovered in the foundation trenches dates the construction unambiguously during the second half of 12th century. One of the most striking features of this new church is that it was aligned with the sarcophagus SMD 3461 of phase 4 (Alfaro *et al.* 2019: 152–154). Apparently before starting the works, most of the anthropological remains of the two individuals lying in it would have been removed in a gesture interpreted as a *traslatio*, which would suggest they were especially relevant individuals. Then, the sarcophagus was sealed again and the area was levelled, so the sarcophagus was not visible in the Romanesque church and yet it was centred and aligned with its main axis. A new funerary space was also created at least east and south of the new temple (Loza & Niso 2012: 55, Loza & Niso 2015: 26, Loza & Niso 2016: 126). The only structures dated to this phase not directly linked to the church were a big cistern abandoned during the 13th century and some paved zones above the older funerary areas (Loza & Niso 2012: 57). The Romanesque temple kept the status of parish church beyond the foundation of the town of Alegría in 1337 (Loza & Niso 2016: 126), but it is unclear whether it lost it in 14th or 15th centuries. Anyway, after the end of the Middle Ages it was relegated to chapel and it stood up like this until the 19th century (Loza & Niso 2015: 26–27).

Focusing again on phases 3 and 4, up to the moment specialised studies are available only on a few materials. Pottery dated to phase 4 was analysed by A. Azkarate and J. L. Solaun (2016). The assemblage was very similar to those from other contemporary Basque sites: fineware was completely absent and coarsewares dominated absolutely. Only cooking vessels were present, some of them with combed decorations. It is worth noting that there were no differences in pottery between funerary and domestic contexts. Among grave goods, only the two liturgical spoons (*cochlearia*) found in one of the burials of phase 4 have been analysed in detail (Velázquez *et al.* 2017). They were both made in silver and, according to their formal features, they would have been produced in a Byzantine workshop. One of them was unadorned and the other one showed Theseus fighting against the Minotaur and a name, possibly the owner's. This would be one of the earliest appearances of this myth in a Christian context.

Regarding bioarchaeological records, I. Grau-Sologestoa (2015a: 88–93) analysed the fauna assemblage from Dulantzi. She only analysed the fauna remains of the first archaeological campaign and, since they were not very numerous, phases 3 and 4 were considered together. The most abundant taxa were ovicaprids, possibly aimed at wool production, since most of them were adults (Grau-Sologestoa 2017: 66). Sheep and goats were followed in frequency by pigs and cattle. Fowl were quite well represented too and isolated remains of roe deer, equids, dogs and clam were also identified. Here it is necessary to state that not all the fauna remains analysed for palaeodietary reconstruction were strictly contemporary to the human populations considered in this thesis. Animal samples dated to phases 4 and 5 were included in order to create the most robust isotopic baseline possible. There is also some indirect information about the carpological record from Dulantzi, analysed by I. Sopelana (Alfaro *et al.* 2017: 263–264). Broomcorn and foxtail millets made up to 85% of the seed assemblage recovered in the two 6th century silos studied, while wheat and barley only represented a small proportion of it. This is interesting, especially considering wheat became predominant from the 10th century on.

Besides carbon and nitrogen stable isotope analyses, some of the individuals and fauna from Dulantzi also underwent strontium isotope analyses with the objective of studying geographic mobility. Thirty-two humans dated to between phases 3 and 6 were analysed, as well as eleven fauna samples, all of them dated to phase 4. The paper by Ortega *et al.* (2013) concluded the vast majority of the individuals were local and migrants were present equally along all the phases. No differences were detected in the distribution of strontium isotope values between men and women and neither between individuals with and without grave goods.

However, this study is problematic because it considered undistinguishably measurements performed on dental enamel, dentine and bone. Normally only dental enamel is used for strontium isotope analyses on archaeological populations, since it is the only skeletal tissue with a finely crystalline structure (Hillson 2005: 155) which can prevent strontium from the burial context to contaminate it, while bone and dentine are more prone to diagenesis due to their porous nature (Bentley 2006: 163–169, Budd *et al.* 2000, Slovak & Paytan 2011: 747–749). Ortega and his colleagues (2013) made sure to test preservation of bones through Fourier transform infrared spectroscopy (FTIR) and the results were satisfactory, but from the information available it seems they only checked seven out of twenty-one bone samples included in the paper and no dentine sample was verified. Moreover, further statistical elaboration of the results by the author advised against using human bone samples in the specific case of Dulantzi. Under the premise that local strontium isotope baseline can be defined by the ensemble of soil (n = 6) and fauna enamel (n = 5) samples, the distributions of $^{87}Sr/^{86}Sr$ measurements on each fraction analysed (human dental enamel: n = 11, human dentine: n = 11, human bone: n = 22, fauna bone: n = 6, baseline: n = 11) were tested for statistically significant differences. As it was expected, the various fractions had statistically significantly different strontium isotope distributions (Kruskal-Wallis H test: n = 61, H = 37.955, d.f. = 4, $p < 0.001$). Most interestingly, *post hoc* pairwise comparison revealed there were no statistically significant differences between the distributions of baseline and human bone ($p = 0.874$), but there were between the baseline and human dental enamel ($p < 0.001$) and between the baseline and dentine samples ($p < 0.001$). These results suggest a substantial proportion of human bone samples were in fact affected by diagenesis, since they would have assimilated the isotopic values of the burial environment. Conversely, they confirm it is likely that dental enamel and dentine would have preserved the *in vivo* variability, even if dentine is usually also considered liable to suffer diagenesis (Budd *et al.* 2000). The latter would also be supported by the absence of statistically significant differences between the distributions of strontium isotope signatures of human dental enamel and dentine samples ($p = 1.000$). Then, it is concluded that, for an unbiased interpretation, human bone samples should be discarded. In addition, dentine samples can also be excluded, because every individual from Dulantzi whose dentine was sampled also had dental enamel analysed, both tissues provide information on the same period of life of the individual and dental enamel is more reliable.

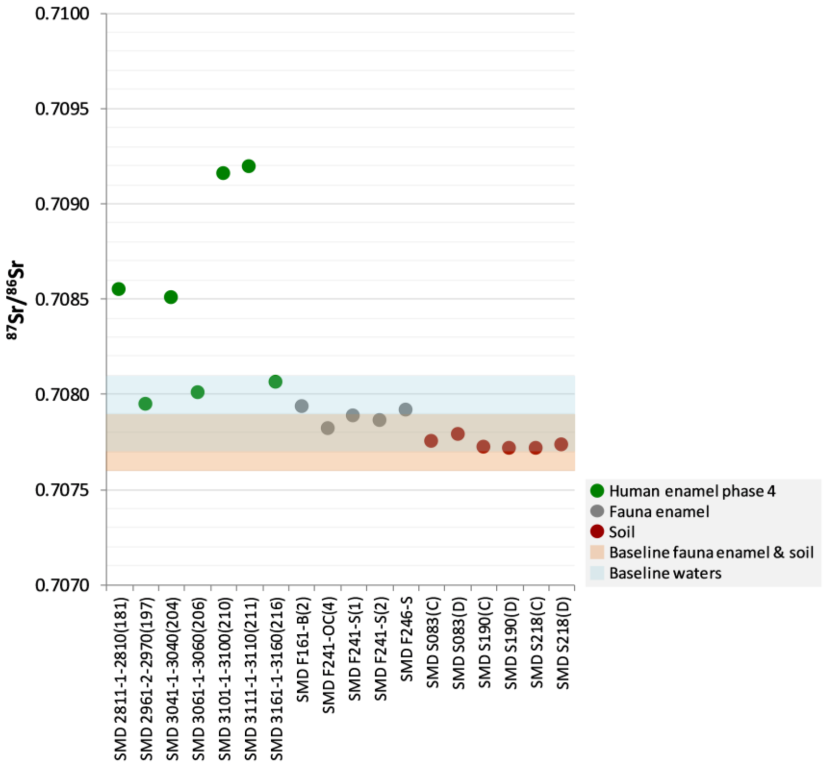


Figure 3.123. Strontium isotope ratios of human enamel of phase 4, fauna enamel and soil samples from Dulantzi (Ortega *et al.* 2013) compared with the local baseline defined by soil and fauna enamel samples (mean ± 2SD) and the local baseline based on waters elaborated by I. Fernández de Ortega (2007)

Therefore, the assemblage of strontium isotope measurements from Dulantzi would be restricted to eleven individuals, only seven of which were dated to phase 4. The $^{87}Sr/^{86}Sr$ measurements of these individuals, together with the samples used for defining the local baseline (calculated as the mean ± 2SD of fauna enamel and soil samples) and the baseline based on local waters elaborated by I. Fernández de Ortega (2007), are represented in figure 3.123. This new approach only classifies three individuals as locals and the remaining four would be allochthonous, coming from two different geographic areas. As a result, the proportion of local vs migrant individuals during phase 4, and consequently any historical interpretation derived from it, would be quite different from the conclusions of the original paper (Ortega *et al.* 2013).

Still, after having discarded problematic measurements, sample size is very small, so it is not possible to conduct further statistical analyses and any inference should be considered with caution. On one side, the new dataset confirms the foreign origin of individual SMD 2811-1-2018(181), the one reburied in the singular grave in the apse, and it backs up the presence of another individual (SMD 3041-1-3040(204)) probably from the same area. It has to be remembered burial SMD 2811 was allocated to phase 4, but radiocarbon dating of the individual revealed it died during phase 3 (table 7.3). On the other, in line with the original study, comparison of descriptive statistics and boxplots points at the absence of significant differences between males and females ($^{87}Sr/^{86}Sr$ males: n = 3, mean = 0.7082, SD = 0.0003; $^{87}Sr/^{86}Sr$ females: n = 3, mean = 0.7088, SD = 0.0006; figure 3.124A) and between the individuals buried with and without grave goods ($^{87}Sr/^{86}Sr$ grave good presence: n = 3, mean = 0.7086, SD = 0.0006; $^{87}Sr/^{86}Sr$ grave good absence: n = 3, mean = 0.7084, SD = 0.0006; figure 3.124B), as well as between burials inside and outside the church ($^{87}Sr/^{86}Sr$ inside church: n = 4, mean = 0.7084, SD = 0.006; $^{87}Sr/^{86}Sr$ outside church: n = 2, mean = 0.7086, SD = 0.0008; figure 3.124C). (For these comparisons individual SMD 2811-1-2018(181) was excluded because anthropological remains were not dated to phase 4.) These statements agree with the conclusions of the original study by Ortega *et al.* (2013). Summing up, based on the data available, it was concluded that approximately half of the individuals buried in the church of Dulantzi between the middle of the 6th century and the 7th century were allochthonous, even though that did not determine the features of their funerary ritual.

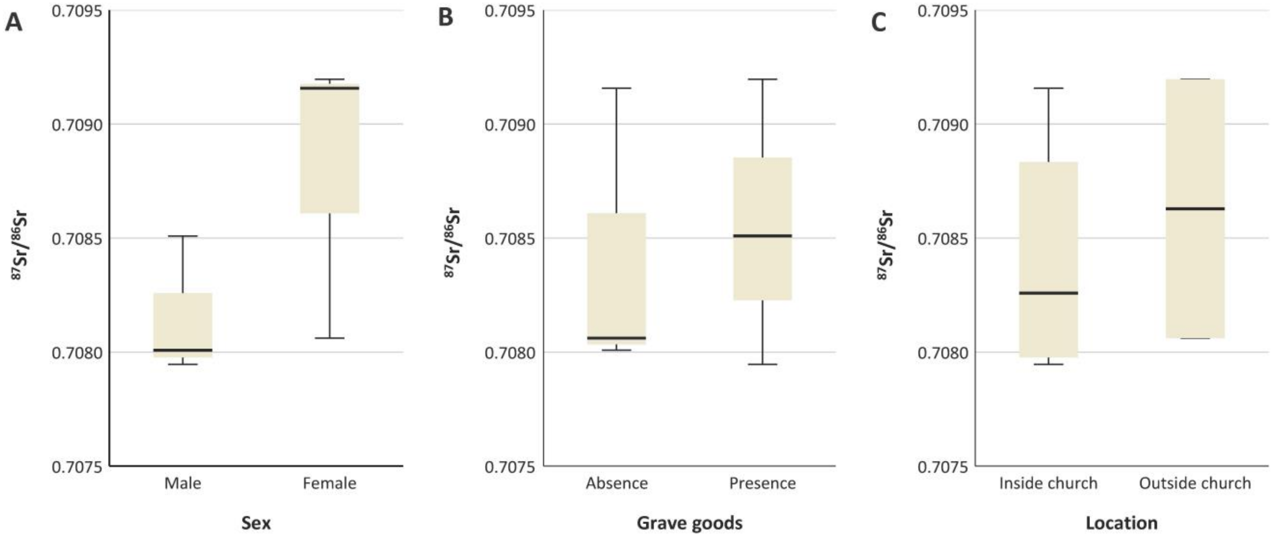


Figure 3.124. Strontium isotope ratios of human enamel samples of phase 4 from Dulantzi (Ortega *et al.* 2013) grouped by (A) sex, (B) grave goods and (C) location

3.2.3.1.3 The funerary contexts

This research tackles exclusively the funerary evidence from Dulantzi dated to phases 3 and 4, which cover the period between 5th and 7th centuries (table 7.1; Alfaro *et al.* 2017, Loza & Niso 2012, Loza & Niso 2016). The first funerary space (figure 3.125A) was made up of a single burial (n = 1/31 = 3.2%), representing a minimal part of the burials from Dulantzi analysed here. It was located south of the early medieval church, although the building did not exist yet at that moment. According to both stratigraphy and radiocarbon analysis (table 7.3), it was dated between the 5th century and the first half of the 6th century. The only elements contemporary to this burial were several negative structures, two of which actually cut it. Then, it is unclear whether this was an isolated tomb or it was part of a more extensive funerary area largely destroyed by posterior constructive activities. However, it must be noted that, thanks to radiocarbon dating, it was possible to identify another two individuals recovered in funerary structures of phase 4 but who lived and died during phase 3. It is significant they were both found in highly symbolic funerary structures: individual SMD 2811-1-2810(181) in the distinguished stuccoed grave in the apse and individual SMD 3461-1-3460(246) in the sarcophagus in the western end of the church. Going back to the only burial in context of phase 3, it was a simple pit grave (n = 1/1 = 100.0%) oriented in west-east direction (n = 1/1 = 100.0%). Inside there was only one individual in supine position in a primary deposit (n = 1/1 = 100.0%). There was no evidence of the use of wooden coffin (n = 0/1 = 0.0%) and the burial did not contain grave goods either (n = 0/1 = 0.0%, table 7.2).

The funerary evidence in Dulantzi acquired a significant size during phase 4 (figure 3.125B). This change was directly linked to the construction of the early medieval church, erected during the central years of the 6th century. Since its foundation the temple had funerary functions, with a cemetery which developed both inside and around the temple. Thirty burials assigned to this period were excavated. This figure represents most of the funerary structures from Dulantzi analysed in this thesis (n = 30/31 = 96.8%), but it probably underestimates the original dimensions of the first necropolis associated to the church. This is not only because just one third of the church was excavated, but also because most of the inner space of the building was pierced by the silos opened during phase 6, which caused an unavoidable loss of information. Almost three quarters of the burials identified (n = 22/30 = 73.3%) were located inside the church. Most of them were placed in the naves, but there were also three in the distinguished room south of the presbyterium and a single one in the apse. The only inner spaces excavated free of burials were the baptistery and the area of the central nave immediately in front of the altar. It has been proposed this may have been a space reserved for the clergy or specific religious functions, such as the choir. Both in the central and southern naves a few of the burials cut each other and some funerary structures were used by several individuals. This is a sign of the pressure to be buried inside the church, which resulted in a densely occupied funerary area. In addition, about a quarter of the graves of this period were located outside the temple (n = 8/30 = 26.7%). They were all in the space immediately south of the church, no more than 3 m away from it. It was verified there were no funerary structures of this period east of the temple, but northern and western areas could not be explored. The graves outside the church did also intersect each other and in some cases they were reused, underlining the influence of the building as an attraction point for burials. All the graves discussed in this paragraph are dated generically to between the middle of the 6th century and the 7th century, based on stratigraphy, radiocarbon dates (table 7.3) and the study of material culture. That is, these are the burials made between the construction of the church and the change that happened at the end of the 7th century, whereby the interior of the temple stopped being used as a funerary space and the cemetery expanded notably around it.

The majority of the burials of phase 4 from Dulantzi, independently of their location, were single pit graves excavated in the underlying geological substratum (n = 28/30 = 93.3%). The only two different burials corresponded to special types which denoted certain prestige due to the investment they required, their location and rarity. In fact, in both cases the examples of Dulantzi are the only ones among the whole assemblage analysed in this thesis. On one hand, there was the stuccoed walls grave (n = 1/30 = 3.3%). It was a pit reinforced with a wall of rubble masonry lined with reddish stuccoes. Moreover, it was located in the apse, north of the altar, in an undoubtedly prestigious position. On the other hand, there was the limestone monolithic sarcophagus located at the foot of the southern nave (n = 1/30 = 3.3%). Most of the burials were oriented in west-east direction (n = 26/30 = 86.7%), as it is common in the Christian funerary ritual. Only one burial (SMD 3151) was placed in the opposite direction (n = 1/30 = 3.3%). This opposite orientation is often considered an indicator of the role of the individual as a cleric. In a few cases it was not possible to determine the orientation of the graves because they were exclusively formed by secondary deposits (n = 3/30 = 10.0%).

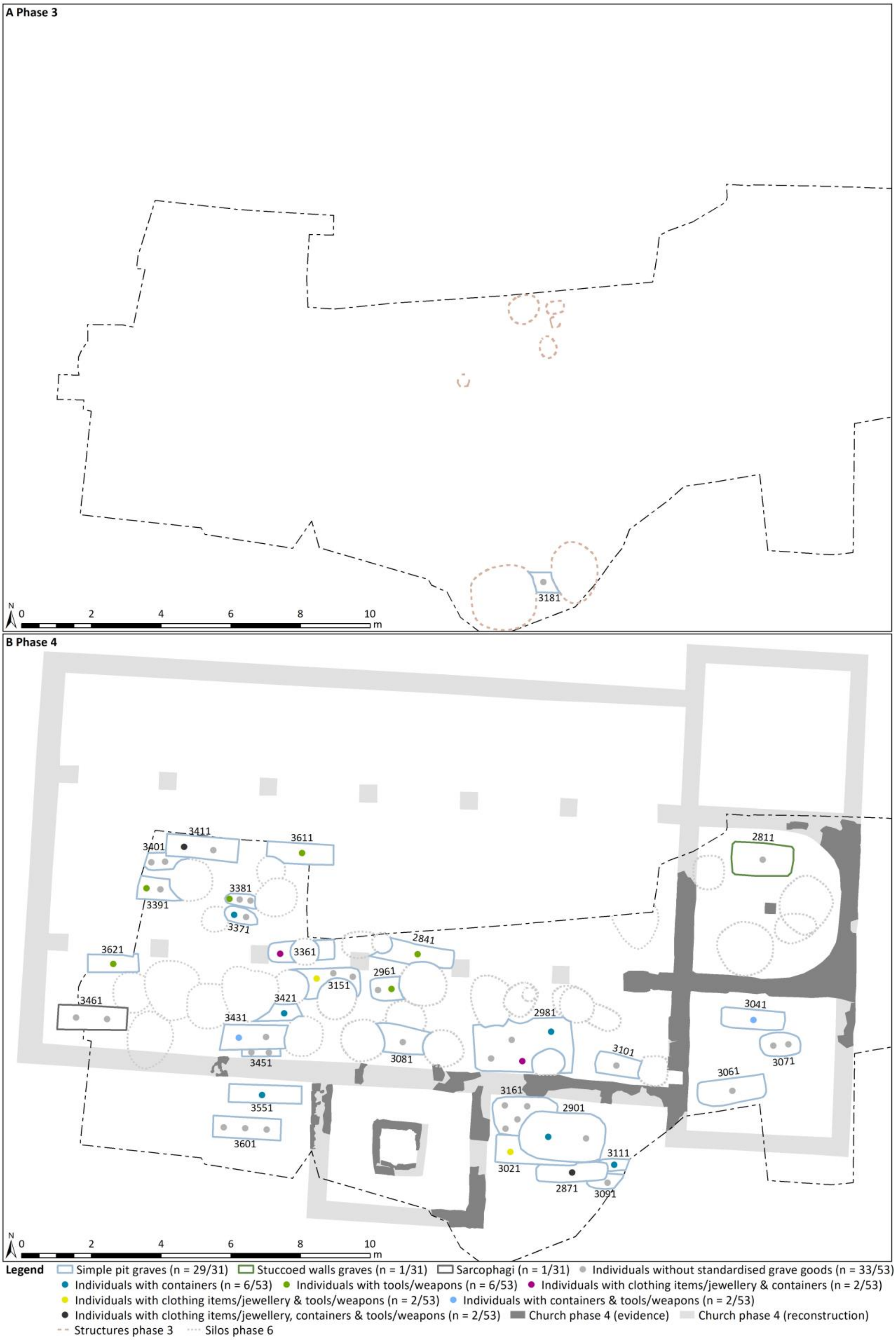


Figure 3.125. Dulantzi, funerary contexts (Alfaro *et al.* 2017, Loza & Niso 2012, Loza & Niso 2016, modified). (A) Cemetery of phase 3. (B) Cemetery of phase 4. The dashed black line depicts the excavation limits. The outline of burials is represented with a solid line whose colour shows the type of funerary structure according to the legend. The number next to each burial is its identifier. Points symbolise the individuals recovered in each burial. Their colour indicates the presence or absence of grave goods as stated in the legend

Altogether the population buried at Dulantzi during phase 4 was formed by 52 individuals. Therefore, the mean rate of occupation of burials was of 1.7 individuals per funerary structure. The maximum number of individuals in a single burial was four. More than half of the individuals were recovered in primary deposits. All of them were in supine position (n = 30/52 = 57.7%), except for one which was found in prone position (n = 1/52 = 1.9%), which is very untypical and has no obvious explanation. A small proportion of the assemblage was formed by secondary deposits which could clearly be identified as reductions (n = 3/52 = 5.8%). The only individual in the stuccoed walls grave of the apse was defined as an ossuary (n = 1/52 = 1.9%). Once skeletonised, its skeletal remains were wrapped in some kind of fabric and deposited in one of the angles of the tomb. Finally, approximately a third of the individuals came from undetermined secondary deposits (n = 17/52 = 32.7%). Actually, some of these individuals could belong to posterior burials scrambled and leaked into the fillings of older graves. This is so mainly because their original position could not be recorded in the field and they were only identified in the laboratory, but also because the dense occupation of the site would have favoured it. However, at the moment there is no way to identify these anachronistic individuals, so all of them are considered as dated to phase 4. Still, as a precaution, none was included in palaeodietary reconstruction. The only exceptions were the two individuals in the sarcophagus, which were radiocarbon dated, but they will be discussed together with the other individuals assigned to phase 3.

Only one of the individuals from Dulantzi dated to phase 4 had evidence of having being buried in a wooden coffin (n = 1/52 = 1.9%). The percentage of individuals with grave goods was greater (table 7.2). Slightly more than one third of the individuals were accompanied by some kind of object (n = 21/52 = 40.0%). Both containers (n = 12/52 = 23.1%) and tools and weapons (n = 12/52 = 23.1%) were found next to almost a quarter of the individuals. Pottery and wooden containers were the most common ones, followed by metallic ones and those made of glass. In three cases the individual had two vessels, always one in pottery and another one in wood or metal. At Dulantzi weapons were especially well represented. Most of them were spears, but there were also a few axes. In no case both types of weapons appeared next to the same individual. In addition, tools were also present: one individual had a billhook, one a comb and another one an unidentified iron object. Clothing items and jewellery were notably less frequent (n = 6/52 = 11.5%). The most abundant ones were rings. Belt plates, earrings and necklace items were represented once each. Besides, one individual had a shield-shaped appliqué and another one hobnails. There were also other types of non-standardised grave goods. The individual in the distinguished grave of the apse (SMD 2811-1-2810(181)) had two pieces of fauna mixed with the human remains: a roe deer frontal bone with antlers chopped and pig tooth. Also, two individuals in one of the graves inside the church (SMD 2981-1-2990(199), SMD 2981-2-3120(212)) were holding *cochlearia* or liturgical spoons (Velázquez *et al.* 2017). Based on this evidence, it has been proposed they could have been members of the clergy. There were no differences in the presence or absence of any standardised category of grave goods based on the location inside or outside the temple.

3.2.3.2 The human populations

3.2.3.2.1 Macroscopic preservation

Two human assemblages from the site of Dulantzi were analysed for this thesis. The first one corresponded to the individuals dated to phase 3. This group included the only burial dated to phase 3 itself (figure 3.125A) and the two individuals buried in funerary structures of phase 4 but radiocarbon dated to phase 3 (see section 3.2.2.1.3). The latter were individual SMD 2811-1-2810(181), found in the distinguished stuccoed grave in the apse, and individual SMD 3461-1-3460(246), one of the two individuals recovered in the sarcophagus at the foot of the nave. The preservation of these three individuals was very heterogeneous. All of them preserved skeletal remains that could be analysed (n = 3/3 = 100.0%, table 7.1). However, while the individual in the privileged burial in the apse was almost complete, the other two conserved less than 25% of their skeletons (figure 3.126, table 7.7). Each individual showed a different degree of fragmentation, ranging from no fragmentation at all to presenting more than 75% of the anatomical elements preserved fragmented. Bone surface preservation was also quite polarised. Surprisingly the two individuals redeposited in funerary structures of phase 4 exhibited excellent conservation, with only slight surface erosion (grade 1). Conversely, the only burial in primary position of phase 3 presented heavy erosion on all the surface with some modifications of profile (grade 5). This would indicate the individual in the apse and that in the sarcophagus received an especially careful treatment, although they were moved possibly more than once.

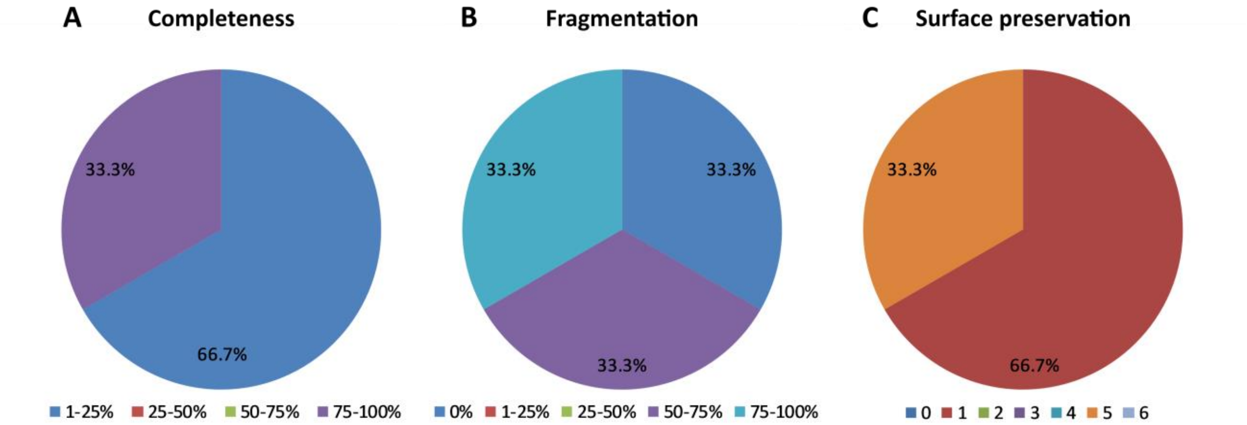


Figure 3.126. Pie charts representing the distribution of the three variables for the assessment of the macroscopic preservation of the human population of phase 3 of Dulantzi. (A) Completeness. (B) Fragmentation. (C) Surface preservation

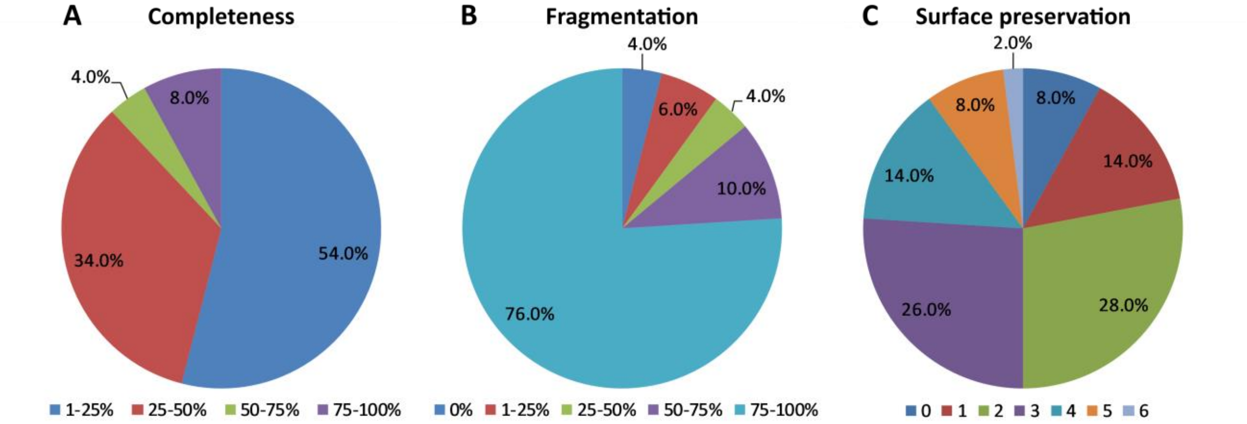


Figure 3.127. Pie charts representing the distribution of the three variables for the assessment of the macroscopic preservation of the human population from the cemetery of phase 4 of Dulantzi. (A) Completeness. (B) Fragmentation. (C) Surface preservation

The cemetery developed around and inside the early medieval church during phase 4 was more numerous (figure 3.125B). In the area excavated there were 30 funerary structures hosting 52 individuals. Excluding the two individuals radiocarbon dated to phase 3 discussed in the previous paragraph, the number of individuals assigned to phase 4 were 50. All of them preserved skeletal remains (n = 50/50 = 100.0%, table 7.1), so they could be included in this research. Macroscopic preservation of this assemblage was heterogenous but in general quite acceptable (figure 3.127, table 7.7). Slightly more than half of the individuals preserved less than 25% of the skeleton, but a third conserved between 25% and 50% of it and more than a tenth of the individuals kept more than half of the skeleton to be analysed. Fragmentation affected severely three quarters of the individuals, who had more than 75% of the anatomical elements preserved fragmented, but there were also small proportions of individuals where fragmentation was recorded in less than half of the skeletal remains preserved. Regarding bone surface preservation, all the grades considered were present. The most frequent ones were more extensive surface erosions with deeper penetration (grade 2) and most surface eroded with some details of the surface masked (grade 3), so the mildest forms of erosion were prevalent.

3.2.3.2.2 Demography

The group of individuals from Dulantzi dated to phase 3 was made up of a minimum number of three individuals, but did not really form a consistent demographic assemblage (table 3.33, figure 3.128, table 3.34, table 7.4, table 7.6). One of the main reasons is that two of them came from secondary deposits and it was not possible to clarify their origin. Then, it is unclear whether they were originally buried in the cemetery of phase 3 and later moved to the locations where they were found, or they were brought from somewhere else. Two of them were adults. In addition, in one case it was possible to estimate age with precision and to determine sex. The remaining individual was so poorly preserved that it was not even possible to get an approximation to its age. Palaeodemographic estimators of this assemblage were not calculated because sample size was too small and analysing the spatial distribution (figure 3.130) is also considered meaningless.

Table 3.33. Age and sex distribution by absolute frequencies of the human population of phase 3 of Dulantzi. Key: F = fetus, < 40 weeks in utero; I1A = infans 1A, birth – 2 years; I1B = infans 1B, 3 – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; Ssp = subadult sp, < 20 years; YA = young adult, 20 – 34 years; YMA = young-middle adult, 20 – 45 years; MA = middle adult, 35 – 45 years; MOA = middle-old adult, > 35 years; OA = old adult, > 45 years; Asp = adult sp, > 20 years; UA = undetermined age; M = male individuals (including probably male individuals); F = female individuals (including probably female individuals); US = undetermined sex (including ambiguous individuals)

	F	*I1A*	*I1B*	*I2*	*J*	*Ssp*	*YA*	*YMA*	*MA*	*MOA*	*OA*	*Asp*	*UA*	*Total*
M	-	-	-	-	-	-	-	-	-	-	-	-	-	0
F	-	-	-	-	-	-	1	-	-	-	-	-	-	1
US	-	-	-	-	-	-	-	-	-	-	-	1	1	2
Total	0	0	0	0	0	0	1	0	0	0	0	1	1	3

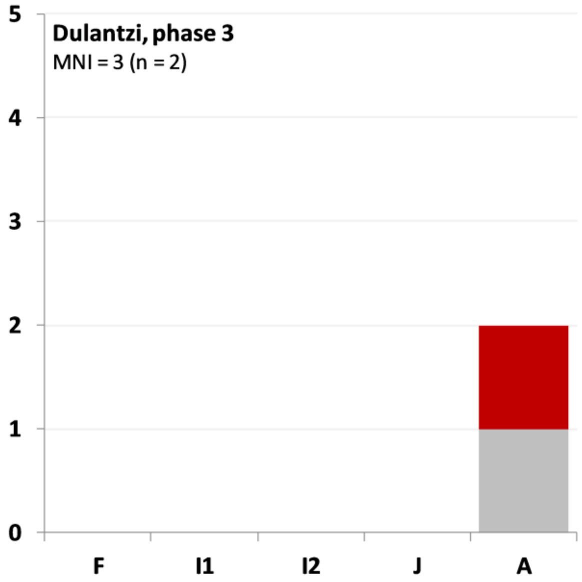


Figure 3.128. Demography chart of the human population of phase 3 of Dulantzi. Bars represent the absolute frequencies of each age category (F = fetus, < 40 weeks in utero; I1 = infans 1, birth – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; A = adults, > 20 years), separated by sex whenever possible (blue = male individuals, red = female individuals, grey = undetermined sex). The minimum number of individuals of the population (MNI) and the number of individuals represented in the chart (n) are shown on the upper left corner. These two numbers differ because subadults sp (< 20 years) and individuals of undetermined age are not displayed

Table 3.34. Demographic descriptive indicators of the human population of phase 3 of Dulantzi Palaeodemographic estimators are not reported because the MNI was smaller than ten

Descriptive indicators	
MNI	3
%subad	0.0%
%ad	100.0%
S/A	0.00
M/F	0.00

Table 3.35. Age and sex distribution by absolute frequencies of the human population from the cemetery of phase 4 of Dulantzi. Key: F = fetus, < 40 weeks in utero; I1A = infans 1A, birth – 2 years; I1B = infans 1B, 3 – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; Ssp = subadult sp, < 20 years; YA = young adult, 20 – 34 years; YMA = young-middle adult, 20 – 45 years; MA = middle adult, 35 – 45 years; MOA = middle-old adult, > 35 years; OA = old adult, > 45 years; Asp = adult sp, > 20 years; UA = undetermined age; M = male individuals (including probably male individuals); F = female individuals (including probably female individuals); US = undetermined sex (including ambiguous individuals)

	F	*I1A*	*I1B*	*I2*	*J*	*Ssp*	*YA*	*YMA*	*MA*	*MOA*	*OA*	*Asp*	*UA*	*Total*
M	-	-	-	-	-	-	1	1	-	6	3	6	-	17
F	-	-	-	-	-	-	-	-	-	-	1	9	-	10
US	1	3	2	-	1	4	-	-	-	1	1	10	-	23
Total	1	3	2	0	1	4	1	1	0	7	5	25	0	50

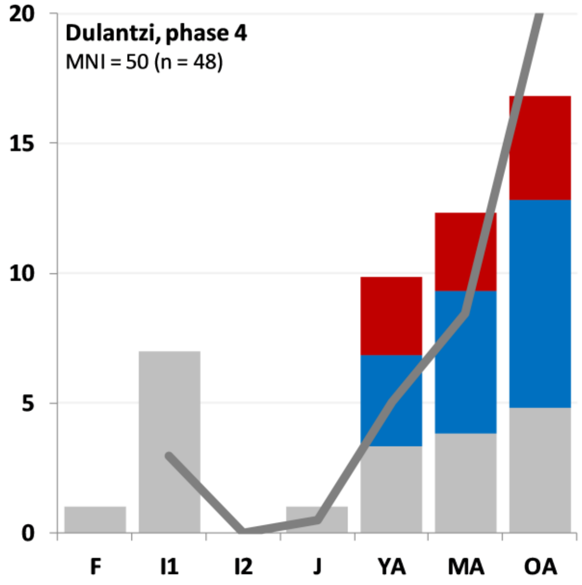


Figure 3.129. Demography chart of the human population from the cemetery of phase 4 of Dulantzi. Bars represent the absolute frequencies of each age category (F = fetus, < 40 weeks in utero; I1 = infans 1, birth – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; YA = young adult, 20 – 34 years; MA = middle adult, 35 – 45 years; OA = old adult, > 45 years), separated by sex whenever possible (blue = male individuals, red = female individuals, grey = undetermined sex). The line depicts the progression of the probability of death (q_x) along age categories, calculated according to G. Acsádi and J. Nemeskéri (1970: 65). The minimum number of individuals of the population (MNI) and the number of individuals represented in the chart (n) are shown on the upper left corner. These two numbers differ because subadults sp (< 20 years) and individuals of undetermined age are not displayed

Table 3.36. Demographic descriptive indicators and palaeodemographic estimators of the human population from the cemetery of phase 4 of Dulantzi. Only in this case life expectancy at birth was calculated with the life table following the procedure proposed by G. Acsadi and J. Nemeskéri (1970: 60–65) because juvenility index could not be obtained due to the absence of individuals between 5 and 14 years of age at death

Descriptive indicators		*Estimators*	
MNI	50	*e_0*	36.0
%subad	22.0%		
%ad	78.0%		
S/A	0.28		
M/F	1.70		

In contrast, the individuals dated to phase 4 did constitute a well-articulated population in demographic terms. All the individuals identified on site were available for study, making a minimum number of 50 individuals (table 3.35, figure 3.129, table 3.36, table 7.4, table 7.5, table 7.6). Since macroscopic preservation was quite good (see section 3.2.3.2.1), it was possible to recover and identify individuals belonging to almost all age categories and sexes. Subadults made 22.0% of the assemblage, with a predominance of infans 1, which is what is expected in preindustrial agricultural populations. In this sense, there are two remarkable facts: the discovery of the remains of a fetus and the absence of any individual in the category infans 2. Even though the latter is typically one of the categories with the lowest risk of death, it is not common to find it completely empty in a skeletal sample of this size. As for adults, they formed 78.0% of the assemblage. It was possible to estimate age with some precision for approximately a third of them and it was interesting to verify that the great majority were middle-old adults or old adults. Likewise, sex could be determined for about two thirds of the individuals and there was a clear prevalence of males. As a result, sex ratio (1.70) was very imbalanced, indicating there would have been 170 men for every 100 women. All in all, the most abundant demographic group in the cemetery of phase 4 of Dulantzi were males over 35 years old.

This is quite an unusual demographic structure both for age and sex. On one hand, it is not frequent to identify such a great proportion of old adults. In archaeological populations the most abundant adult age category is normally that of young adults (Séguy & Buchet 2013: 29), either for taphonomic (Gowland 2007: 161–162) or methodological issues (Bocquet-Appel & Masset 1982). Nevertheless, it has to be acknowledged that the trend observed in the assemblages analysed in this thesis seems different. Actually, only two populations met the criteria to be considered representative of adult mortality dynamics, namely, to be made up of a minimum number of ten individuals and to be have precise age estimations for at least a third of adults. These were the one being analysed in these lines (i.e. Dulantzi, phase 4) and Sant Menna (see section 3.3.3.2.2). The fact that both were organised around churches is a confounding factor difficult to overcome without more well-preserved assemblages of other type. On the other hand, imbalanced sex ratios seem to be the rule among the populations included in this thesis and, in big populations (MNI > 10) and with a good proportion of individuals with valid sex determinations, they tend to be in favour of males. The underrepresentation of females has already been discussed in other early medieval European contexts (Barbiera 2008, Barbiera 2012, Barbiera 2018, Barbiera *et al.* 2017), but it does not really seem to have a straightforward explanation. However, in this particular context the predominance of older male individuals may be linked to the religious nature of the site. It has already been proposed that at least three of the individuals buried inside the church could have been clerics: individuals SMD 2981-1-2990(199) and SMD 2981-2-3120(212), based on the finding of liturgical spoons as part of their grave goods (Velázquez *et al.* 2017), and individual SMD 3151-1-3150(215), because of its east-west orientation. It is interesting to note that all of them were male individuals and two were middle-old adults, while the other one was classified as a young adult. This evidence would support the hypothesis that the great proportion of males, and more specifically middle aged and old ones, during phase 4 of Dulantzi could be due to the preferential burial of clerics in the early medieval church.

Despite the overrepresentation of male old adults, the demographic profile of this population matched quite well that of typical preindustrial agricultural populations (Chamberlain 2006: 64–68, Séguy & Buchet 2013: 114), as it can be observed in figure 3.129. The youngest individuals would be expected to be more numerous in order to reach the mortality rates characteristic of the first years of life in these contexts, but in general the curve of the probability of death fits the models known. This would mean that, in spite of the possible preferential treatment of old males, the group using the funerary space created inside and around the early medieval church of Dulantzi was a conventional stable population, with a more or less equitable representation of all demographic groups. Still, this does not clarify the issue of whether the burial ground of phase 4 was used by the whole community living in Dulantzi or it was restricted to a specific family or portion of the society. Moreover, because of the absence of individuals aged 5 to 14, it was not possible to calculate the palaeodemographic estimators of this population following the methodology generally applied in this thesis (see section 2.2.7). Even so, since this assemblage was considered relevant, an exception was made and life expectancy at birth was obtained using the life table as defined by G. Acsadi and J. Nemeskéri (1970: 60–65). The result places life expectancy at birth for the population of phase 4 from Dulantzi at 36.0 years. This is one of the highest values among all the assemblages included in this research. Given the great proportion of middle and old adults, such a great value makes sense. However, it should not be forgotten that infans 1 were underrepresented. Therefore, the real life expectancy at birth of the original population may have been smaller.

Figure 3.130. Dulantzi, spatial distribution of individuals by age and sex (Alfaro *et al.* 2017, Loza & Niso 2012, Loza & Niso 2016, modified). (A) Cemetery of phase 3. (B) Cemetery of phase 4. The dashed black line depicts the excavation limits. Points symbolise the individuals recovered in each burial. Their colour indicates their age and sex as stated in the legend

In this assemblage grave goods were not homogenously distributed among age and sex categories. Artefacts were more frequently found accompanying adults and the finding of any object next to subadults was incidental (individuals with grave goods: S = 2, A = 18, S/A = 0.11; individuals without grave goods: S = 9, A = 21, S/A = 0.43). Still, there was not a statistically significant association between the presence of grave goods and age (Fisher's exact test: n = 50, p = 0.163). In the same way, male adults were notably more likely than female adults to be buried with artefacts (individuals with grave goods: M = 12, F = 3, M/F = 4.00; individuals without grave goods: M = 5, F = 7, M/F = 0.71), even if the association between these two variables was not statistically significant (Fisher's exact test: n = 27, p = 0.057). Then, in the phase 4 of Dulantzi male adults was clearly the demographic group with the richest grave goods. The smallest difference between sexes was in containers (individuals with containers: M = 7, F = 3, M/F = 2.33; individuals without containers: M = 10, F = 7, M/F = 1.42; Fisher's exact test: n = 27, p = 0.692), which was the type of grave good most often found next to female individuals. The contrast between adult male and female funerary rituals was bigger regarding clothing items and jewellery (individuals with clothing items & jewellery: M = 4, F = 1, M/F = 4.00; individuals without clothing items & jewellery: M = 13, F = 9, M/F = 1.44; Fisher's exact test: n = 27, p = 0.621) and it became outstanding when looking at tools and weapons. Only male adults were accompanied by this kind of artefacts (individuals with tools & weapons: M = 9, F = 0, M/F > 9.00; individuals without tools & weapons: M = 8 F = 10, M/F = 0.8; Fisher's exact test: n = 27, p = 0.009), so the association between the presence of tools and weapons and sex was statistically significant and very meaningful in order to understand the configuration of the funerary ritual in this context.

Finally, the spatial distribution of individuals depending on age and sex was investigated (figure 3.130B). Both the inside and the outside of the church were used for funerary functions. In the interior of the building, all the areas excavated were occupied by burials, except for the baptistery. However, the only individual in the distinguished grave of the apse was radiocarbon dated to phase 3, so no individual from this room is included in this analysis. The exterior accommodated less graves, also because the space excavated was smaller. The distribution of individuals by age was quite uniform (individuals inside the church: S = 7, A = 29, S/A = 0.24; individuals outside the church: S = 4, A = 10, S/A = 0.40) and, even if there was a smaller proportion of subadults inside than outside the church, the difference was not relevant (Fisher's exact test: n = 50, p = 0.476). Nevertheless, it is worth mentioning that all the subadults recovered in the naves were concentrated in the western third. Still, two individuals younger than 5 years of age at death (infans 1) were identified in the distinguished room south of the apse. The differences in the distribution of male and female adults were clearer (individuals inside the church: M = 16, F = 6, M/F = 2.67; individuals outside the church: M = 1, F = 4, M/F = 0.25). Male individuals were predominant inside the church. Actually, they were more than the double of the female individuals recovered. Conversely, among the few adults with sex determination outside the temple, most were females and only one was identified as male. This meant that the association between the location of burials and sex was statistically significant (Fisher's exact test: n = 27, p = 0.047) and, therefore, sex was likely an important criterion to define the location of burials.

3.2.3.3 Faunal diet

3.2.3.3.1 Sampling

The fauna samples from Dulantzi were originally analysed as part of a research on animal husbandry and dietary patterns in the Basque Country throughout the Middle Ages (Lubritto *et al.* 2017, Sirignano *et al.* 2014). Because it was a diachronic study, fauna samples from the fillings of silos and sunken featured structures dated to different phases between 6th and 9th centuries (phases 4 and 5) were included. This means some of the fauna samples are not contemporary to the humans discussed here. However, large variations between contiguous phases are not expected. Then, it was decided to use all the samples available in order to create the most robust isotopic baseline possible. Altogether, eighteen fauna samples were analysed (table 7.8, figure 3.131). Almost two thirds came from herbivores (Bos taurus, Ovis aries/Capra hircus) and the rest were omnivores (Sus scrofa domesticus). No carnivores were included. All the samples belonged to adult specimens, except for a pig, which will be considered independently. Six of the samples consisted of bone fragments. Instead, in twelve cases teeth were sampled. This is not the ideal scenario because teeth can retain the isotopic signal of suckling even on adult specimens (Balasse 2014: 4125–4127). For this reason, the results from these samples will be interpreted with caution.

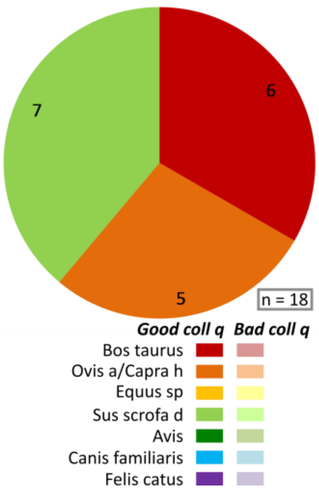


Figure 3.131. Pie chart representing the distribution of fauna samples from Dulantzi by taxa and collagen quality. Numbers represent the absolute frequency of each group

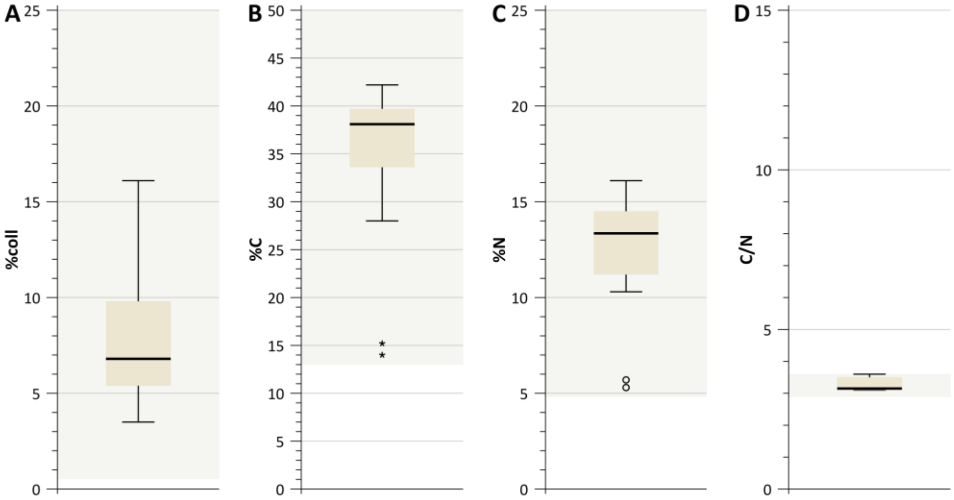


Figure 3.132. Boxplots representing the collagen quality indicators of fauna samples from Dulantzi. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

3.2.3.3.2 Collagen quality

All the eighteen fauna samples from Dulantzi preserved good quality collagen (table 7.11, figure 3.131, figure 3.132). In every case collagen yield (%coll) was greater than 3.5%. Carbon weight contents (%C) were between 14.0% and 42.2% and nitrogen weight contents (%N) between 5.3% and 16.1%. Likewise, carbon to nitrogen atomic ratios (C/N) had a minimum of 3.1 and a maximum of 3.6. Therefore, all the samples fall within the ranges defined for well preserved collagen and they could be used for palaeodietary reconstruction.

3.2.3.3.3 Results

The fauna assemblage from Dulantzi was difficult to interpret because it mixed bone and tooth samples. Altogether it was formed by eighteen samples (table 3.37, table 7.11, figure 3.133, Sirignano *et al.* 2014). Almost two thirds belonged to herbivores, namely cattle and ovicaprids represented equally. Their mean δ^{13}C was -20.9‰, with a standard deviation of 0.7‰ and a range of 2.3‰. According to these values, all the herbivores fed on C$_3$ plants. Actually, carbon stable isotope ratios of cattle and ovicaprids were similar, even if the former tended towards slightly more depleted values. Similarly, herbivores from Dulantzi had a mean δ^{15}N of 6.4‰, a standard deviation of 1.7‰ and a range of 5.9‰. Both cattle and ovicaprids had quite wide ranges. However, cattle were more clustered and they showed a lower mean nitrogen isotope ratio, while ovicaprids were more scattered and their mean δ^{15}N was higher. There was not a systematic difference between bone and tooth samples. Interestingly, in the case of cattle, tooth samples had very homogenous δ^{15}N values and they were placed in the middle of the range for their taxon. Actually, the minimum and maximum δ^{15}N values of cattle were obtained on bone samples. This suggests the suckling effect is not biasing the results systematically. Instead, in the case of ovicaprids measurements on teeth did report the most enriched δ^{15}N, so it is likely that this taxon retained the suckling effect more clearly. Nevertheless, it should be noted that the lowest δ^{15}N value from an ovicaprid was also obtained from a tooth.

Table 3.37. Summary statistics of carbon (δ^{13}C) and nitrogen (δ^{15}N) stable isotope ratios of fauna samples from Dulantzi

	n	*δ^{13}C (‰)*					*δ^{15}N (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All fauna	18	-20.8	0.7	-22.1	-19.3	2.8	6.2	1.5	3.9	9.8	5.9
Herbivores	11	-20.9	0.7	-22.1	-19.8	2.3	6.4	1.7	3.9	9.8	5.9
Bos taurus	6	-21.1	0.8	-22.1	-20.2	1.9	5.6	1.2	3.9	7.7	3.8
Ovis/Capra	5	-20.7	0.6	-21.2	-19.8	1.4	7.5	1.7	5.5	9.8	4.3
Omnivores	7	-20.7	0.7	-21.5	-19.3	2.2	5.8	1.1	4.6	7.1	2.5
Sus scrofa d	7	-20.7	0.7	-21.5	-19.3	2.2	5.8	1.1	4.6	7.1	2.5

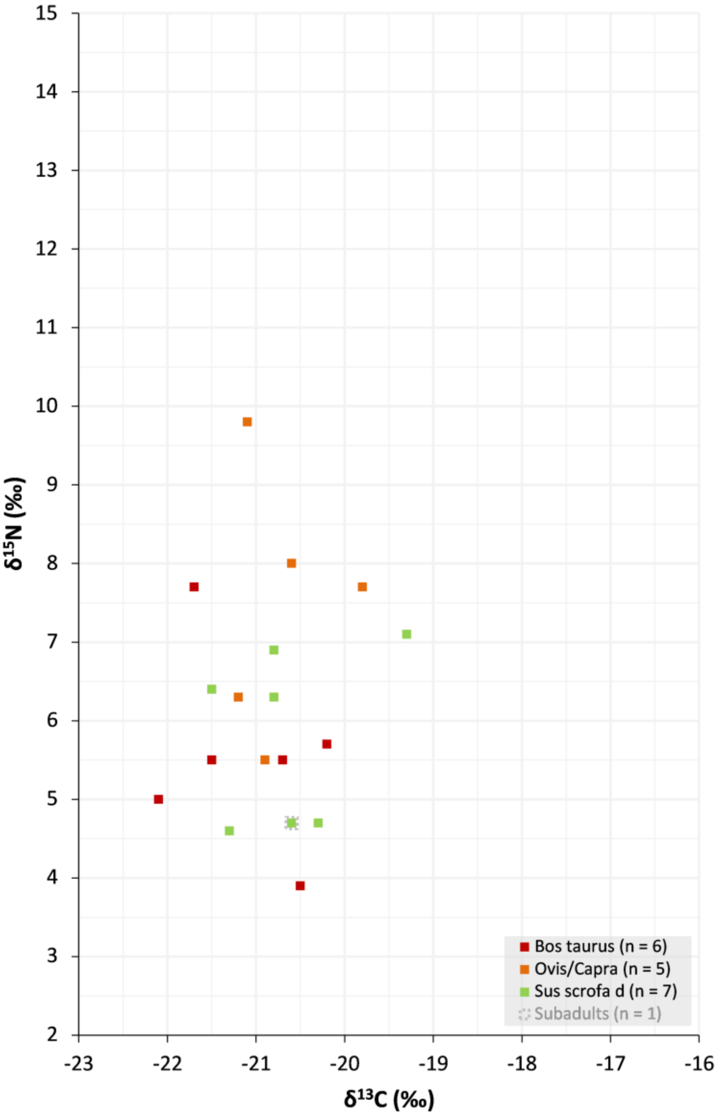


Figure 3.133. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of fauna from Dulantzi grouped by taxa. Subadult specimens are highlighted with a dotted grey fringe around them

All the omnivores from Dulantzi analysed were pigs. Their mean δ^{13}C was -20.7‰, with a standard deviation of 0.7‰ and a range of 2.2‰, and they had a mean δ^{15}N of 5.8‰, with a standard deviation of 1.1‰ and a range of 2.5‰. These values indicate the diet of all of them was based exclusively on C$_3$ plants and their consumption of animal protein, if any, was quite restricted. In fact, the isotopic signatures of pigs were very similar to herbivores' and many of them had δ^{15}N values even lower than some cattle or ovicaprids. According to these data, it is likely that the pigs consumed at Dulantzi were free-ranged, rather than being kept in courtyards close to households and feeding them with domestic waste (Hammond & O'Connor 2013). Most of the pig samples from Dulantzi were teeth, but their isotopic signatures did not show a systematic enrichment of either $\delta^{13}C$ or $\delta^{15}N$ which could make clear the effect of suckling. Still, the impact of this phenomenon cannot be ruled out.

Summing up, it is complicated to compare measurements performed on bone and teeth and to assess the impact of suckling on the results without a previous assessment of suckling and weaning patterns of each taxon in this specific context. However, these are the only data available to characterise the isotopic baseline of the population from Dulantzi, so they will be used with caution. For this reason, it was not deemed convenient to explore the diachronic differences in dietary patterns of the livestock from Dulantzi, even if most samples could be dated with precision (table 7.8).

3.2.3.4 Human diet

3.2.3.4.1 Sampling

Individuals from the two phases of Dulantzi tackled in this thesis were sampled for carbon and nitrogen stable isotope analyses. Most of them were originally part of a larger project aimed at studying diet from a diachronic perspective along the Middle Ages in the Basque Country (Lubritto *et al.* 2017), which only included the burials excavated between 2009 and 2010. Besides, after the new intervention of 2014, two more individuals were added to the dataset thanks to the fact that $\delta^{13}C$ and $\delta^{15}N$ were provided together with radiocarbon dates (Alfaro *et al.* 2019). Regarding phase 3, two out of three individuals were sampled (figure 3.134). The individual excluded was the only one found in a primary context. Then, this small assemblage was formed by two adults, one of them identified as female. As for the population of phase 4, the sampling strategy prioritised adult individuals and those with grave goods, resulting in a set of sixteen samples (figure 3.136). In this way, the only subadult included was one of the individuals excavated during 2014, whose carbon and nitrogen stable isotope signatures are known thanks to radiocarbon dating. Therefore, almost two thirds of the set of samples was formed by adult males and less than a quarter was made up of female adults. This imbalanced sex ratio is in line with the results of the palaeodemographic study of the entire population, but in this assemblage it is even more accentuated. This is certainly linked with the aim of sampling preferentially individuals with grave goods, which were predominantly associated to male adults. Both for phases 3 and 4, the preferred anatomical element to sample were ribs.

3.2.3.4.2 Collagen quality

All the human samples from both phases 3 and 4 of Dulantzi had well preserved collagen (table 7.9). Among the two individuals dated to phase 3 (figure 3.134, figure 3.135), collagen yield (%C) was only available for one of them, because this parameter was not recorded by the laboratory which performed the radiocarbon and carbon and nitrogen stable isotope measurements. The collagen yield of the other sample was 22.5%, well above the minimum acceptable value. Moreover, carbon weight contents (%C) of these two samples were between 33.0% and 40.7%, nitrogen weight contents (%N) between 10.6% and 14.4% and carbon to nitrogen atomic ratios (C/N) between 3.3 and 3.6. That is, both individuals were within the acceptable ranges for good quality collagen. The samples corresponding to phase 4 had similar collagen quality indicators (figure 3.136, figure 3.137). Collagen yield (%coll) was in all the cases greater than 6.0%. Still, this parameter was missing for the only sample from the campaign of 2014, originally measured for radiocarbon. Carbon weight contents (%C) presented a wide distribution, with a minimum of 21.4% and a maximum of 45.4%. Similarly, nitrogen weight contents (%N) ranged between 6.9% and 16.0%. As for carbon to nitrogen atomic ratios (C/N), they covered almost the complete gap of acceptable values, from 3.0 to 3.6. Summing up, all the sixteen human samples of phase 4 from Dulantzi were valid for palaeodietary reconstruction.

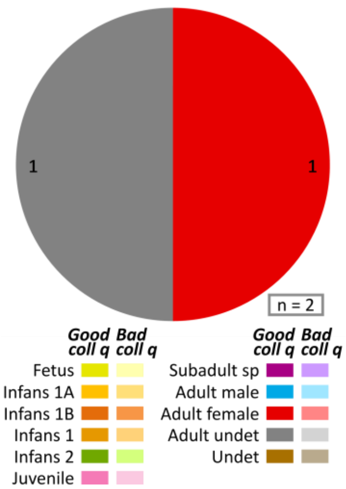


Figure 3.134. Pie chart representing the distribution of human samples from the individuals of phase 3 of Dulantzi by age, sex and collagen quality. Numbers represent the absolute frequency of each group

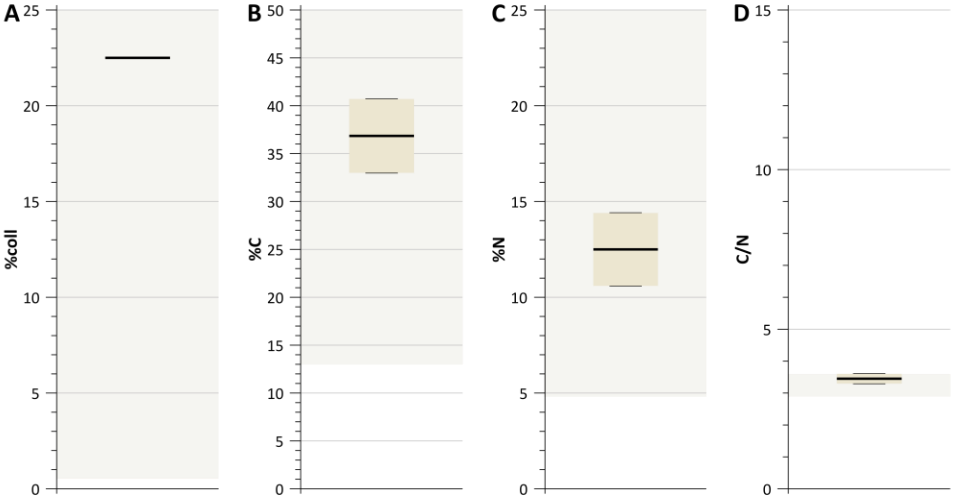


Figure 3.135. Boxplots representing the collagen quality indicators of human samples from the individuals of phase 3 of Dulantzi. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

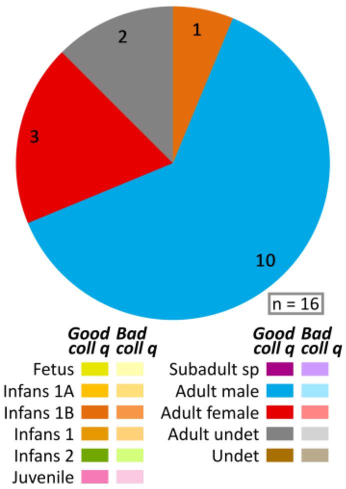


Figure 3.136. Pie chart representing the distribution of human samples from the cemetery of phase 4 of Dulantzi by age, sex and collagen quality. Numbers represent the absolute frequency of each group

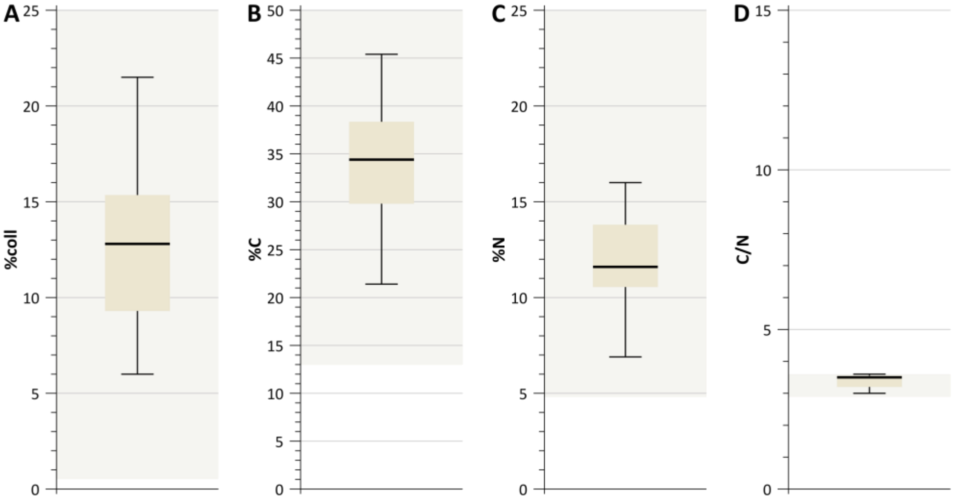


Figure 3.137. Boxplots representing the collagen quality indicators of human samples from the cemetery of phase 4 of Dulantzi. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

3.2.3.4.3 Results

The case of Dulantzi was represented by individuals belonging to two different chronological phases. For this reason, they will be presented separately (Lubritto *et al.* 2017). Only two individuals dated to phase 3 (5th c.-mid-6th c.) were analysed (table 3.38, table 7.9, figure 3.138, figure 3.139, figure 3.140, figure 3.141). Both of them were found as secondary deposits in funerary structures built during phase 4 and they occupied undoubtedly preeminent positions in the church. Their isotopic signatures were not very different from each other, but they will be discussed individually because there is no evidence that they were originally part of the same population.

Table 3.38. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of human samples from the individuals of phase 3 of Dulantzi. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All humans	2	-18.9	-	-19.1	-18.7	0.4	10.5	-	10.1	10.8	0.7
Adults	2	-18.9	-	-19.1	-18.7	0.4	10.5	-	10.1	10.8	0.7
Female adults	1	-19.1	-	-	-	-	10.1	-	-	-	-
Grave g absence	1	-18.7	-	-	-	-	10.8	-	-	-	-
Grave g presence	1	-19.1	-	-	-	-	10.1	-	-	-	-

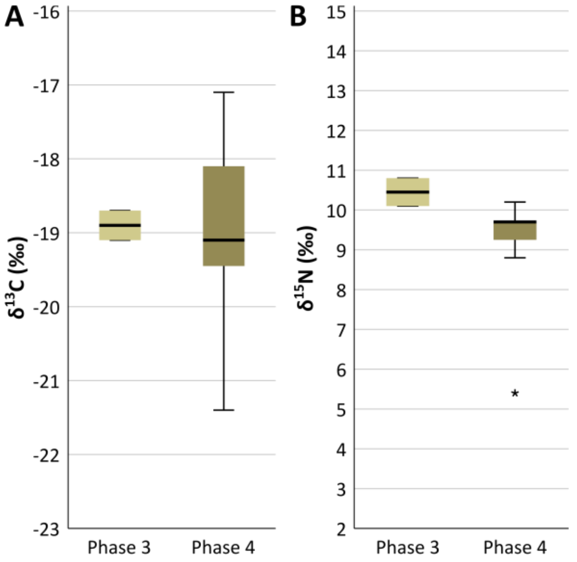


Figure 3.138. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from Dulantzi divided by phase

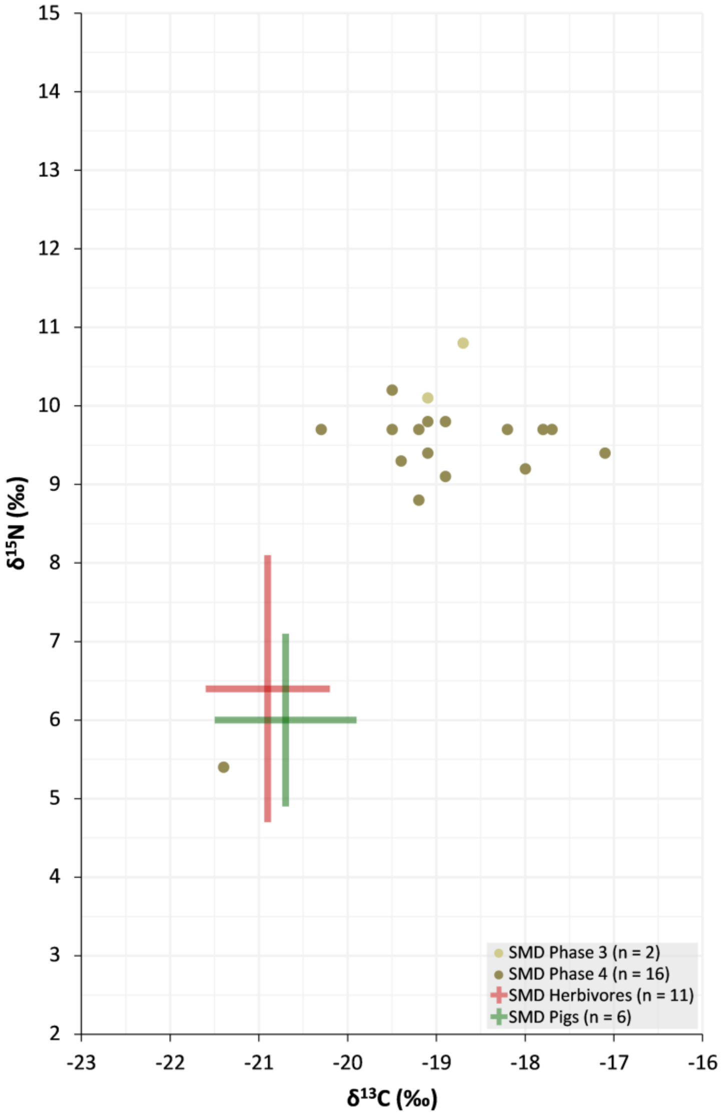


Figure 3.139. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from Dulantzi divided by phase. Crosses represent mean and one standard deviation of the fauna from Dulantzi grouped by feeding regime. Subadult specimens were excluded from the calculation of these parameters

One of these individuals was SMD 2811-1-2810(181), which was recovered in the singular grave in the apse of the church together with a roe deer's frontal and chopped antlers and a pig tooth. It was a young adult female who died between 25 and 38 years of age and was dated to between the second half of the 4th century and the first third of the 6th century (table 7.3). The only relevant pathological sign it exhibited was healed bilateral cribra orbitalia (Brickley 2018, Cole & Waldron 2019), which indicates it suffered at least one episode of non-specific stress during life, but which was over by the time it died. Besides, thanks to strontium isotope analyses

(Ortega *et al.* 2013, see section 3.2.3.1.2), it can be proposed it did not spend childhood in the surroundings of Dulantzi. Instead, it possibly came from the same geological area as individual SMD 3041-1-3040(204), who was buried in the distinguished room south of the apse. Then, focusing on the diet of this individual, it had a δ^{13}C of -19.1‰ and a δ^{15}N of 10.1‰. It is difficult to interpret these values because, knowing this was probably an allochthonous individual, the isotopic baseline based on fauna from Dulantzi may be useless in this case. Anyway, the carbon and nitrogen stable isotope ratios of this individual point at a diet exclusively based on C_3 resources and potentially a significant proportion of animal protein. This is in line with the dietary patterns of the majority of the population of phase 4 from Dulantzi, although it is worth noting this particular individual would have been on the upper end of the range of δ^{15}N. In this way, palaeodietary reconstruction does not clear up the identity of this individual, but it assimilates it to the general trends observed in this site.

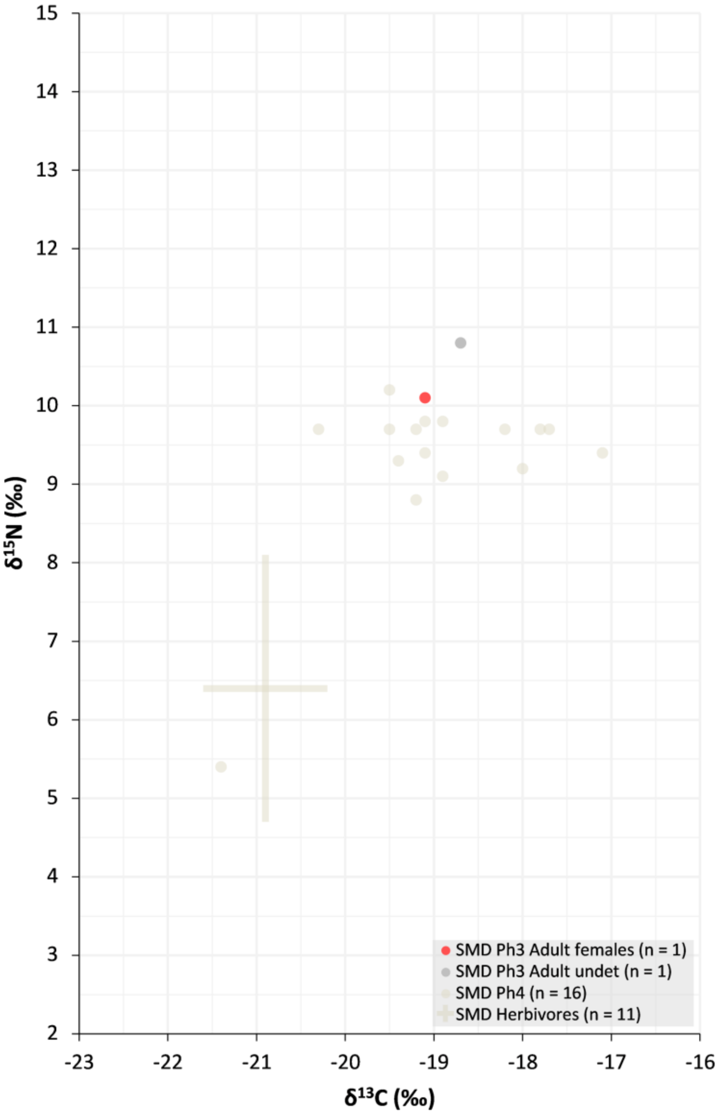


Figure 3.140. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of the human population of phase 3 of Dulantzi divided by demographic categories. Cross represents mean and one standard deviation of herbivores from Dulantzi

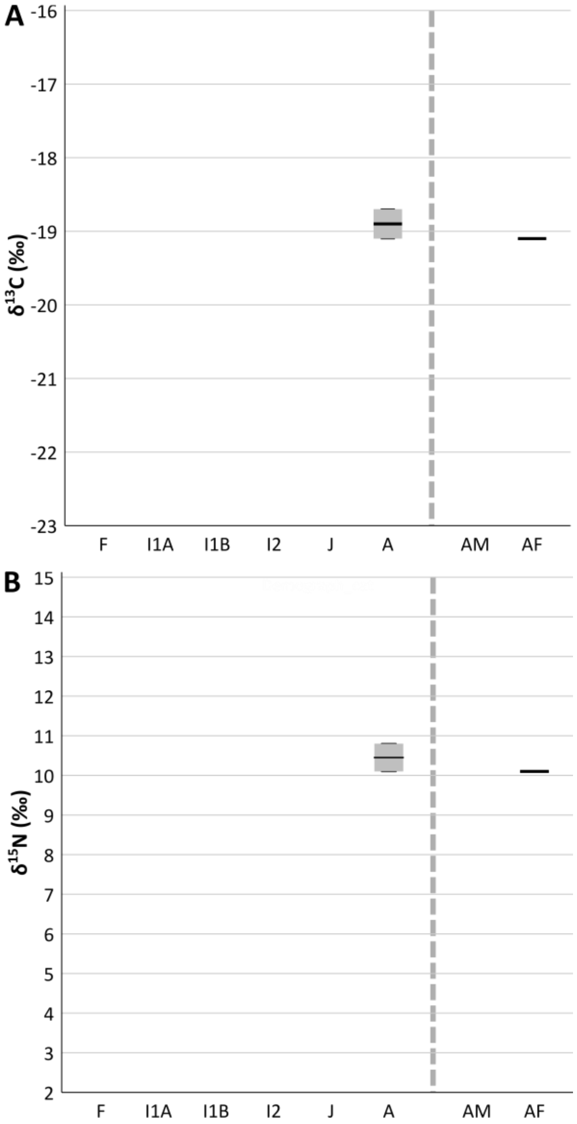


Figure 3.141. Boxplots representing (A) carbon stable isotope ratios (δ^{13}C) and (B) nitrogen isotope ratios (δ^{15}N) of the human population of phase 3 of Dulantzi divided by demographic categories. Key: F = fetus, I1A = infans 1A, I1B = infans 1B, I2 = infans 2, J = juvenile, A = adults, AM = adult males, AF = adult females

The other individual of the phase 3 from Dulantzi analysed was SMD 3461-1-3460(246). This was one of the two individuals found in the sarcophagus at the western end of the southern nave. It preserved just a few feet bones, so it could only be identified as an adult of undetermined sex. Still, it was possible to radiocarbon date it to between the second half of the 3rd century and the first quarter of the 5th century (table 7.3). Strontium isotope analyses were not measured on this individual, so it is not possible to determine its origin, but it has to be considered that the interpretation of carbon and nitrogen stable isotope ratios of this individual may be biased by the lack of information about the isotopic baseline of the environment and the chronology where it lived. The $\delta^{13}C$ of individual SMD 3461-1-3460(246) was -18.7‰, pointing at a diet mostly based on C_3 resources, possibly with some minor contribution of C_4 plants. In this sense, the food consumption pattern of this individual would have been comparable to the assemblage of phase 4. Conversely, the $\delta^{15}N$ value of this individual, which was 10.8‰, stood out because it was the most enriched of all the individuals from Dulantzi included in this thesis. If the isotopic baseline drawn on local early medieval fauna is deemed accurate for this purpose, it would mean a slightly greater consumption of animal protein by this individual in comparison to the other individual of phase 3 and all the assemblage of phase 4. In other contexts, abundant animal protein intake has been interpreted as a marker of high social status (Knipper *et al.* 2015). This could agree with the distinguished position and funerary architecture of the grave where this individual was found, as well as with the key role it seems to have played in the configuration of the later Romanesque church. Nevertheless, the evidence available in this case are so partial and faint, that it is not possible to make any conclusive interpretation.

The individuals of the phase 4 (mid-6th c.-end 7th c.) from Dulantzi analysed formed a bigger and more consistent assemblage (table 3.39, table 7.9, figure 3.138, figure 3.139). All the sixteen samples collected had well-preserved collagen. Despite the impression that summary statistics may give, the distributions of carbon and nitrogen stable isotope ratios were quite different. In principle the two parameters have the same standard deviation and similar ranges. However, most of this variability is due to a single individual, who was an outlier on $\delta^{15}N$ but and also had quite an extreme $\delta^{13}C$. When this individual is excluded averages are almost unchanged, but dispersion measurements are considerably reduced. This supports the picture gotten from the graphic representation of data (figure 3.139), which show a much larger spread of $\delta^{13}C$ than $\delta^{15}N$. The specificities of these distributions will be presented in the following paragraphs.

Table 3.39. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of human samples from the cemetery of phase 4 of Dulantzi. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one. Key: C&J = clothing items & jewellery, Cont = containers, T&W = tools & weapons

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All humans	16	-19.0	1.1	-21.4	-17.1	4.3	9.3	1.1	5.4	10.2	4.8
Subadults	1	-19.4	-	-	-	-	9.3	-	-	-	-
Infans 1B	1	-19.4	-	-	-	-	9.3	-	-	-	-
Adults	15	-18.9	1.1	-21.4	-17.1	4.3	9.3	1.1	5.4	10.2	4.8
Male adults	10	-19.1	1.1	-21.4	-17.8	3.6	9.2	1.4	5.4	10.2	4.8
Female adults	3	-18.0	1.1	-19.2	-17.1	2.1	9.6	0.2	9.4	9.7	0.3
Grave g absence	8	-19.4	1.1	-21.4	-17.7	3.7	8.9	1.4	5.4	9.7	4.3
Grave g presence	8	-18.5	0.9	-19.5	-17.1	2.4	9.7	0.3	9.2	10.2	1.0
C&J presence	4	-18.9	0.8	-19.5	-17.8	1.7	9.9	0.2	9.7	10.2	0.5
Cont presence	4	-18.4	1.1	-19.5	-17.1	2.4	9.8	0.3	9.4	10.2	0.8
T&W presence	5	-18.5	0.7	-19.5	-17.8	1.7	9.6	0.2	9.2	9.8	0.6

Going into detail, the mean carbon nitrogen ratio of the assemblage of phase 4 from Dulantzi was -19.0‰, and it had a standard deviation of 1.1‰ and a range of 4.3‰. These values change minimally when individual SMD 2981-3-3030(203), which was the one with the $\delta^{13}C$ furthest from the mean, is dismissed ($\delta^{13}C$ Dulantzi phase 4 without SMD 2981-3-3030(203): mean = -18.8‰, SD = 0.9‰, range = 3.2‰). Summing up, this distribution indicates there was significant variability in the sources of carbon of these individuals and the most likely cause of variation in this context was the consumption of various proportions of plants from different photosynthetic pathways. The offset between the mean $\delta^{13}C$ of the human assemblage and local herbivores was 1.9‰ (see section 3.2.3.3.3), but this figure is not very relevant in this setting because of the large spread of the population. Only one individual was less than 1‰ more positive than the mean of herbivores, which is the fractionation usually accepted for one trophic level shift. This individual certainly had an exclusive C_3 diet. Winter crops, more precisely wheat and barley, as revealed by carpological analyses (Alfaro *et al.* 2017: 263), as well as legumes, vegetables and fruits were probably at the base of its feeding regime. Next, there was a group of nine tightly clustered individuals with $\delta^{13}C$ values between -19.5‰ and -18.9‰. They were on average 1.7‰ more positive than the mean of local herbivores, but it is very likely their diet was also exclusively based on the same C_3 resources as the former. Lastly, there were five individuals who had the most enriched carbon stable isotope ratios ranging between -18.2‰ and -17.1‰. Such positive $\delta^{13}C$ must be due to the contribution of an enriched carbon source. Marine fish consumption could cause this effect, but there is no evidence of the intake of significant amounts of ichthyic resources from the ocean in this context. Besides, these individuals lack the increase of nitrogen isotope ratios associated to this foodstuff. Hence, the most likely hypothesis is that the enrichment of carbon stable isotope ratios observed in these individuals is due to the regular consumption of C_4 plants. The diet of these five individuals would have still been largely based on C_3 resources, but broomcorn and foxtail millets, the only domestic C_4 crops known in early medieval Iberia, would have contributed to a lesser extent but significantly to it. This is no surprise, considering up to 85% of the seeds from two of the silos of phase 4 whose fillings were studied consisted of broomcorn and foxtail millet, while wheat and barley only represented 15% of the contents (Alfaro *et al.* 2017: 263). Moreover, it is important to remind that the great majority of the livestock from Dulantzi was only fed on C_3 plants (see section 3.2.3.3.3). Under these circumstances, carbon stable isotope ratios of humans may underrepresent the importance of C_4 plants on diet due to the routing effect (Ambrose & Norr 1993, see section 2.4.1.4.4), which favours the contribution of protein food sources to bone collagen. In other words, the role of millets in the diet of the individuals of phase 4 may be even greater than it seems.

In contrast, as it was said above, the distribution of nitrogen isotope ratios was quite narrow. The mean $\delta^{15}N$ of the assemblage of phase 4 was 9.3‰, with a standard deviation of 1.1‰ and a range of 4.8‰. However, when outlier SMD 2981-3-3030(203) was disregarded, the average $\delta^{15}N$ of the core of the population increased slightly up to 9.5‰, but the change was especially noticeable in the standard deviation, which was reduced to 0.3‰, and the range, that was downsized to 1.4‰. Therefore, the offset between the mean nitrogen isotope ratio of humans dated to phase 4 and herbivores from Dulantzi would be 2.9‰ if the entire assemblage is considered and 3.1‰ after excluding the outlier (see section 3.2.3.3.3). This would point to a moderate proportion of animal protein in the diet of the majority of the individuals in this phase. Most importantly, it is the homogeneity of the population that should be underlined, mainly because, due to the many uncertainties linked to this method, it is always complicated to translate these interpretations into quantitative estimations. All the samples, except the outlier, moved in quite a narrow range of $\delta^{15}N$. In addition, most individuals were very close to the mean. Actually, nine out the fifteen samples in the core of the population were less than 0.2‰ away from the average. This suggests that in general the differences in protein consumption patterns between the individuals from phase 4 of Dulantzi were negligible. In this case it is unlikely that the preferential consumption of herbivores or omnivores meant any difference, because their isotopic signatures were almost indistinguishable (see section 3.2.3.3.3).

Outlier SMD 2981-3-3030(203) has already been mentioned several times, because it was so different from the majority of the assemblage that its isotopic signature really distorted statistics. This was a middle-old male adult who died between 40 and 64 years of age. It was recovered in a simple pit grave in the southern nave of the church. There were four individuals in it. All of them were adult males. Individuals SMD 2981-1-2990(199) and SMD 2981-2-3120(212) were side by side on the bottom of the grave. Both of them were accompanied by rich sets of grave goods. The most remarkable items were the liturgical spoons held by each one of them (Velázquez *et al.* 2017), which point at their possible role as clerics. Outlier SMD 2981-3-3030(203) was placed on top of individual SMD 2981-2-3120(212) and it did not have any artefacts. SMD 2981-4-2980(198) was the fourth individual in the grave. It overlapped individuals SMD 2981-1-2990(199) and SMD 2981-3-3030(203) and it did not carry any grave goods either. Then, individual SMD 2981-3-3030(203) had a δ^{13}C of -21.4‰ and a δ^{15}N of 5.4‰. The former was the carbon stable isotope ratio of the assemblage of phase 4 furthest from the mean, but it did not constitute a true outlier on this variable because of the great dispersion of the distribution. Instead, the nitrogen isotope ratio of this individual was not only an outlier within this population, but it was the smallest δ^{15}N measured on any human in this thesis. In fact, it was so depleted that it was even lower than the mean of local fauna. Thus, these values indicate that the diet of this individual was very different from the general trends observed in the bulk of the assemblage. The carbon stable isotope signature points clearly to a diet solely based on C_3 resources. That is, this individual would have eaten mainly wheat and barley alongside legumes, vegetables and fruits, and millets would not have been part of its diet at all. Meanwhile, the nitrogen isotope ratio denotes this individual very probably did not have any animal protein, but it a had a completely vegan diet made up only by plants. As a matter of fact, the isotopic signature of this individual was more similar to local herbivores than to the other humans from the phase 4 of Dulantzi. The reason why the dietary habits of individual SMD 2981-3-3030(203) were so different from the rest of the contemporary population is unclear. All the three other individuals from the same grave had δ^{13}C values between -19.5‰ and -18.9‰ and δ^{15}N values between 9.1‰ and 10.2‰, meaning their diets were also based on C_3 resources, but they had moderate intakes of animal protein. The two bottom individuals (i.e. SMD 2981-1-2990(199), SMD 2981-2-3120(212)) were, indeed, on the upper end of the range of nitrogen isotope ratios of the assemblage. Hence, outlier SMD 2981-3-3030(203) was very different also in comparison to the individuals buried in the same funerary structure. In a purely speculative scenario, a diet entirely based on vegetal products could be associated with the ascetic archetype and identify this individual as a monk (Riera 2017). This would not be rare, considering that two of the individuals in the same burial are suspected of having been clerics according to their grave goods. Alternatively, the atypical isotopic signature of this individual could be due to its origin in a region with a completely different isotopic baseline, which would bias any interpretation. Unfortunately, proper strontium isotope analyses could not be run on this individual because it did not preserve any tooth, so its origin cannot be determined (Ortega *et al.* 2013, see section 3.2.3.1.2). Nevertheless, even if it was a migrant, its carbon and nitrogen stable isotope ratios are so extreme that it is likely they would have to be interpreted in a similar way.

Figure 3.142 and figure 3.143 display the distribution of δ^{13}C and δ^{15}N of the assemblage of phase 4 from Dulantzi broken down by demographic categories. Only one subadult individual was analysed, because the sampling strategy initially applied on this population prioritised adult individuals (see section 3.2.3.4.1). For this reason, in this site it is not possible to address the evolution of diet along different age categories. Anyway, it is worth commenting the results of this subadult. SMD 3461-2-3460 was an infans 1B who died between 3 and 5 years of age. It was recovered in the sarcophagus at the western end of the church, together with the individual of phase 3 SMD 3461-1-3460(246). With a δ^{13}C of -19.4‰ and a δ^{15}N of 9.3‰, it was very close to the means of the assemblage. Therefore, although the evidence is very scarce, it can be said that possibly age did not determine diet at early medieval Dulantzi, but this subadult apparently had consumption patterns comparable to adults. Besides, nine of the adults successfully analysed had age estimated with certain precision. One of them was a young adult ($\delta^{13}C$ = -19.1‰, $\delta^{15}N$ = 9.8‰), five were middle-old adults ($\delta^{13}C$ mean ± SD = -19.3‰ ± 1.3, $\delta^{15}N$ mean ± SD = 8.7‰ ± 1.9) and three old adults ($\delta^{13}C$ mean ± SD = -19.5‰ ± 0.7, $\delta^{15}N$ mean ± SD = 9.3‰ ± 0.5) and all of them were males, except for an ambiguous individual. Despite the seeming decrease of $\delta^{13}C$ mean values as age increased, no real pattern could be observed in the evolution of diet throughout life, either regarding the type of plants consumed or the intake of animal protein.

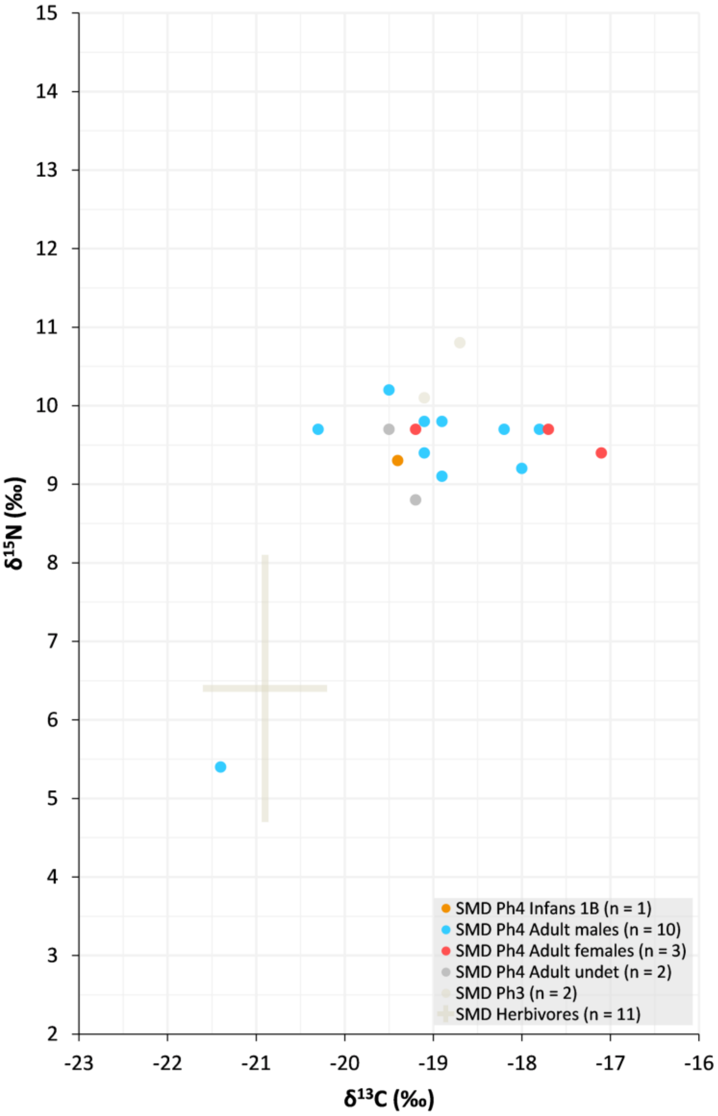


Figure 3.142. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from the cemetery of phase 4 of Dulantzi divided by demographic categories. Cross represents mean and one standard deviation of herbivores from Dulantzi

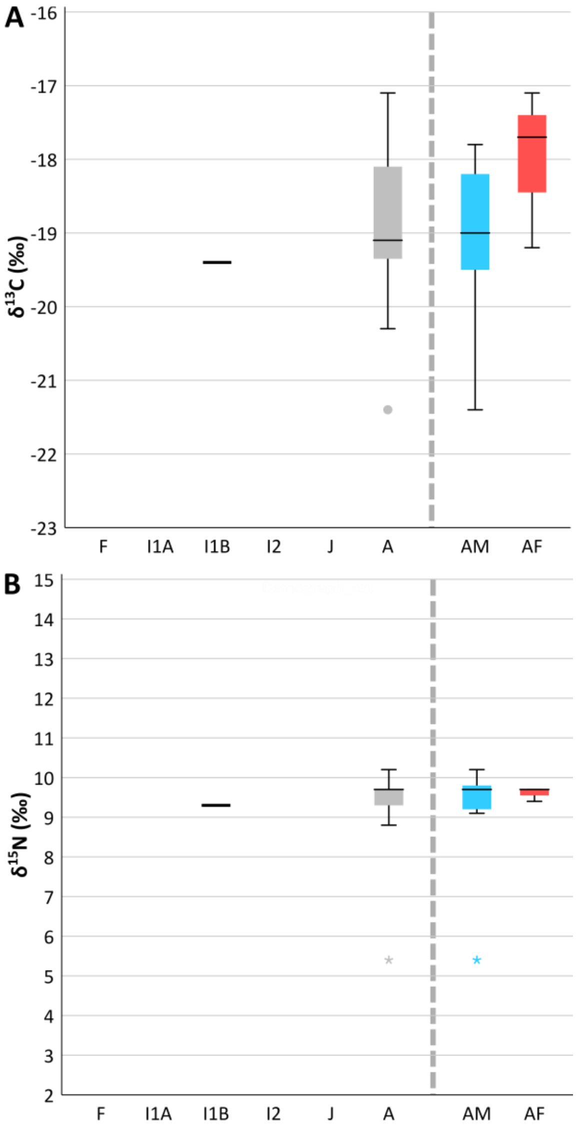


Figure 3.143. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from the cemetery of phase 4 of Dulantzi divided by demographic categories. Key: F = fetus, I1A = infans 1A, I1B = infans 1B, I2 = infans 2, J = juvenile, A = adults, AM = adult males, AF = adult females

Similarly, thanks to generally good macroscopic preservation, most adults could have sex determined. However, in the attempt to include in carbon and nitrogen stable isotope analyses as many individuals with grave goods as possible, the sex ratio of the resulting assemblage was even more imbalanced in favour of males than the entire population (see section 3.2.3.2.2). Observing figure 3.142 and figure 3.143, it seems that adult females tended towards more enriched $\delta^{13}C$ values than adult males, while nitrogen isotope ratios were similar for both sexes, even though adult females' were more tightly clustered. This could mean adult females were more prone to include millets in their diet and there were less differences in animal protein consumption between them than among adult males. Still, the differences in the distribution between male and female individuals were not statistically significant neither for $\delta^{13}C$ nor for $\delta^{15}N$ ($\delta^{13}C$ SMD phase 4 adult males (n = 10) vs adult females (n = 3), Mann-Whitney U test: U = 23.000, z = 1.356, p = 0.217; $\delta^{15}N$ SMD phase 4 adult males (n = 10) vs adult females (n = 3), Mann-Whitney U test: U = 14.500, z = -0.087, p = 0.937), so any conclusion should be taken with caution.

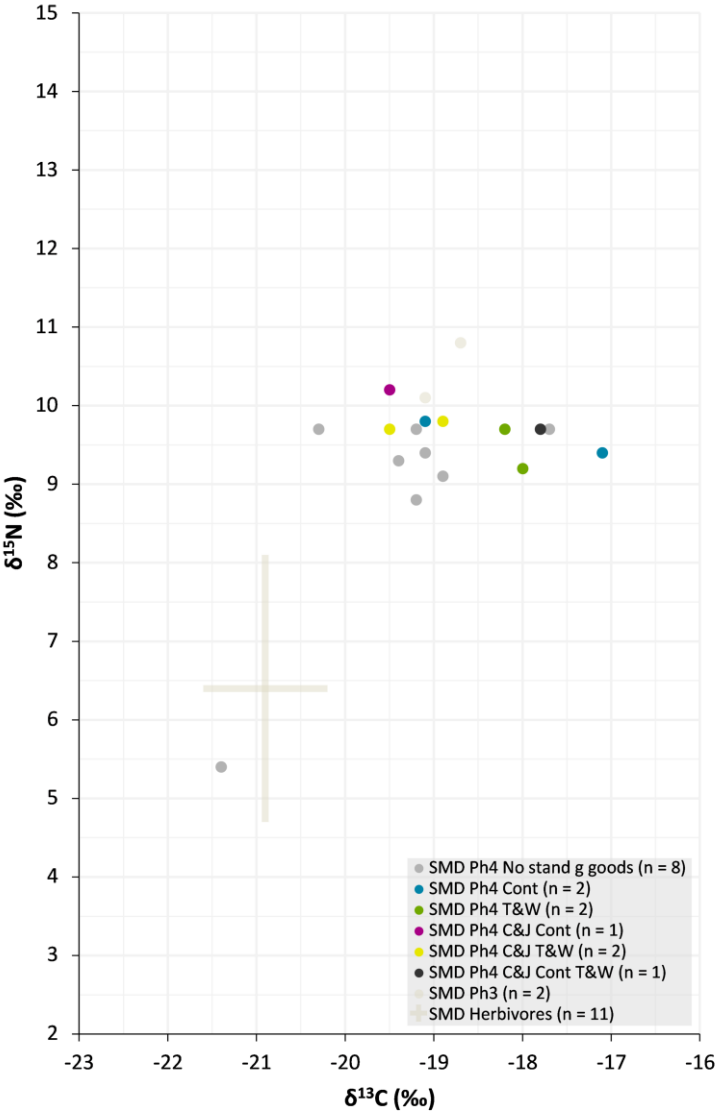


Figure 3.144. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from the cemetery of phase 4 of Dulantzi divided by type of grave goods. Cross represents mean and one standard deviation of herbivores from Dulantzi. Key: No stand g goods = no standardised grave goods, C&J = clothing items & jewellery, Cont = containers, T&W = tools & weapons

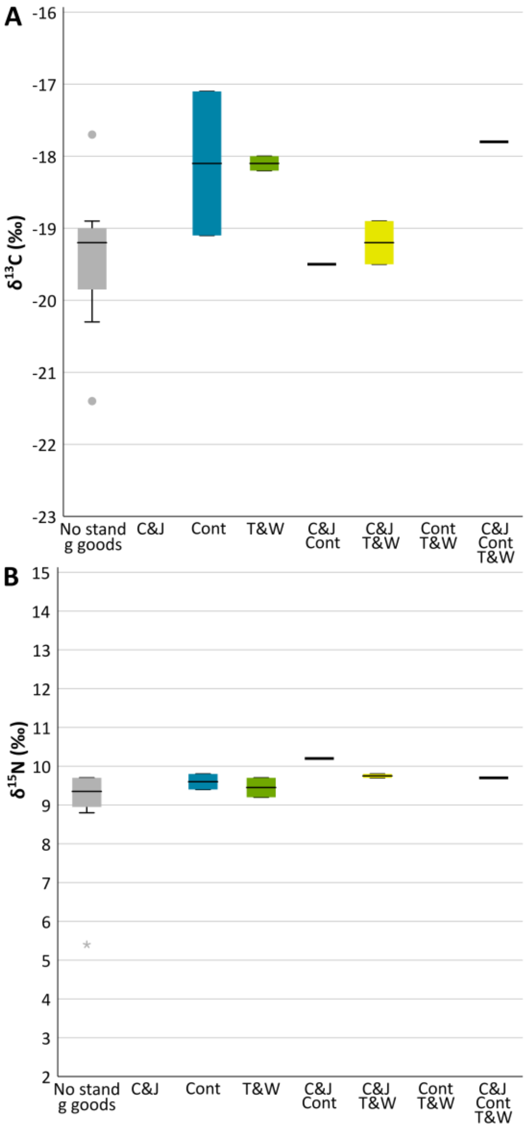


Figure 3.145. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from the cemetery of phase 4 of Dulantzi divided by type of grave goods. Key: No stand g goods = no standardised grave goods, C&J = clothing items & jewellery, Cont = containers, T&W = tools & weapons

The relationship between diet and the use of grave goods in the funerary ritual is also interesting (figure 3.144, figure 3.145). Half of the individuals analysed were accompanied by some kind of artefact, which is a proportion slightly greater than verified in the whole population. When all individuals with grave goods are considered together, it can be observed that individuals with any kind of artefacts tended towards more enriched $\delta^{13}C$ values. In this way, it is more likely that the individuals which were buried with grave goods included any millets in their diets, but there were also a few individuals with grave goods with diets based only on C_3 crops. Likewise, most of the individuals without any object had exclusively C_3 diets or very low intake of C_4 plants. Nevertheless, the differences in the distribution of $\delta^{13}C$ between individuals with and without grave goods were not statistically significant ($\delta^{13}C$ SMD phase 4 individuals without grave goods (n = 8) vs individuals with grave goods (n = 8), Mann-Whitney U test: U = 45.000, z = 1.369, p = 0.195). As for nitrogen isotope ratios, at first sight it looks like there were not meaningful differences between individuals with and without grave goods, since both were present along the entire range of $\delta^{15}N$. Even so, surprisingly the difference between the distributions of nitrogen isotope ratios of the individuals with and without grave goods were statistically significant ($\delta^{15}N$ SMD phase 4 individuals without grave goods (n = 8) vs individuals with grave goods (n = 8), Mann-Whitney U test: U = 51.000, z = 2.052, p = 0.050). This was certainly due to the effect caused by outlier SMD 2981-3-3030(203), which had an extremely low $\delta^{15}N$. In fact, when this individual was removed from the dataset, statistically significant differences in the distribution of nitrogen isotope ratios between individuals with and without grave goods disappeared ($\delta^{15}N$ SMD phase 4 excluding SMD 2981-3-3030(203), individuals without grave goods (n = 7) vs individuals with grave goods (n = 8), Mann-Whitney U test: U = 43.000, z = 1.796, p = 0.094), while the distributions of carbon stable isotope ratios continued showing no statistically significant difference ($\delta^{13}C$ SMD phase 4 excluding SMD 2981-3-3030(203), individuals without grave goods (n = 7) vs individuals with grave goods (n = 8), Mann-Whitney U test: U = 37.000, z = 1.045, p = 0.336). This means there were not really relevant differences in the animal protein consumption patterns between individuals with and without grave goods. Still, it is true individuals accompanied by artefacts tended to consume greater proportions of animal products, since their $\delta^{15}N$ were on average greater. No statistically significant differences were detected either for $\delta^{13}C$ or $\delta^{15}N$ when grave good types or specific assemblages were compared individually ($\delta^{13}C$ SMD phase 4 specific grave goods, Kruskal-Wallis H test: n = 16, H = 6.257, d.f. = 5, p = 0.282; $\delta^{15}N$ SMD phase 4 specific grave goods, Kruskal-Wallis H test: n = 16, H = 6.928, d.f. = 5, p = 0.226). All in all, it does not look like there was a correlation between diet and the presence of grave goods in the burials of certain individuals.

The last matter to look at in the assemblage of phase 4 of Dulantzi, was the connection between diet and the location of burials. Figure 3.146 displays the distribution of the individuals analysed according to their carbon and nitrogen stable isotope ratios. Examining the plans, it is not possible to observe any pattern in the arrangement of $\delta^{13}C$ or $\delta^{15}N$ and no clusters of individuals with similar dietary patterns can be identified either. Actually, when the isotopic signatures of individuals inside and outside the church were compared, no statistically significant differences were found in none of the two variables analysed ($\delta^{13}C$ SMD phase 4 individuals inside church (n = 11) vs individuals outside church (n = 5), Mann-Whitney U test: U = 31.500, z = 0.454, p = 0.661; $\delta^{15}N$ SMD phase 4 individuals inside church (n = 11) vs individuals outside church (n = 5), Mann-Whitney U test: U = 25.000, z = -0.291, p = 0.827). Then, it is clear that individuals with distinct diets were buried in the same spaces, even close to each other. Based on this evidence, it can be concluded that the factors which determined access to food resources such as wheat, barley, millets or animal protein were not decisive in the location of the burial of individuals.

Figure 3.146. Dulantzi, spatial distribution of individuals divided by carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) (Alfaro *et al.* 2017, Loza & Niso 2012, Loza & Niso 2016, modified). (A) Cemetery of phase 3. (B) Cemetery of phase 4. The dashed black line depicts the excavation limits. Individuals successfully analysed are represented with a big circle divided in two. The left half symbolises δ^{13}C and the right half δ^{15}N according to the colour gradient shown in the legend. Individuals not analysed are depicted with a smaller grey point

3.3 CATALONIA

3.3.1 CAN GAMBÚS

3.3.1.1 The site

3.3.1.1.1 Location and history of research

Can Gambús is a vast archaeological site located west of Sabadell (figure 3.147), in the region of western Vallès in the province of Barcelona. Its UTM ETRS89 coordinates are 31T 423885 4599094 and it is 196 meters above sea level. It is 19 km northwest of Barcelona, 79 km southwest of Girona and only 6 km southeast of the early medieval bishopric of Egara, current Terrasa. Relative to the other Catalonian sites included in this research, Can Gambús is 9 km south of Castellar del Vallès and 9 km southwest of Sant Menna. Altogether the site covers around 60 ha. It extends along a gentle long hill oriented in northwest-southeast direction named Can Gambús after the *masia* or country house placed on the top. The surrounding landscape is characterised by other smooth mountain ranges crossed by numerous water courses. The closest to Can Gambús would have been Vallcorba torrent, which is currently very modified due to its underground channelling along C-58 highway. The bigger stable rivers of Ripoll and Riusec would have only been 3 km east and 2 km south of the site respectively. These conditions would have created a very suitable environment for agrarian activities with plenty of fertile fields and pastures nearby.

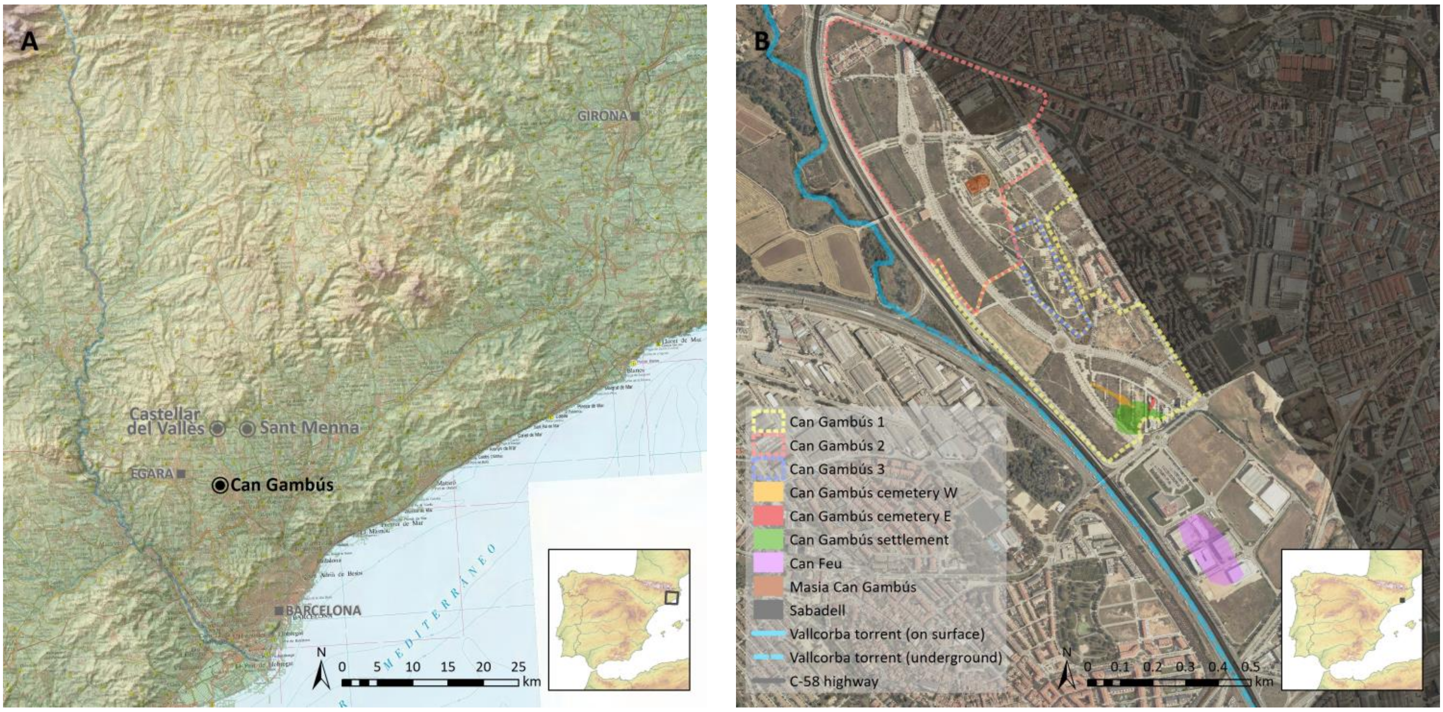


Figure 3.147. Geographical location of the site of Can Gambús (Sabadell, Barcelona) (A) at the regional and (B) local scale

The existence of an archaeological site at Can Gambús was known since the 1950s, when S. Garriga and R. Subirana collected an assemblage of pottery of different periods, currently curated at the Museum of History of Sabadell (Artigues, Bravo, *et al.* 2007: 239). At the beginning of the 21st century the hill was still devoted to agrarian activities, but it was decided to urbanise it. Then, considering the large area of the site, it was divided in three zones (figure 3.147B). The southern half, covering approximately 30 ha, was named Can Gambús 1. It was excavated by the company Arrago under the direction of J. Roig and J. M. Coll (2007a). The northern half of the site, which also had about 30 ha, was designated Can Gambús 2. Its excavation was assigned to the company Codex under the supervision of P. L. Artigues, P. Bravo and E. Hinojo (2007). Both zones were excavated contemporaneously between 2003 and 2004. Initially the central sector of the site, Can Gambús 3, was kept intact. It spread over 3 ha, including the top of the hill and the areas with the greatest slopes. It was allocated to be a park, so its development was not a priority. It was excavated between 2005 and 2006 by the companies Janus and Codex under the direction of D. Codina and P. L. Artigues (Artigues, Codina, *et al.* 2007). Despite the huge area excavated, only the sector Can Gambús 1 preserved archaeological evidence dated to between 6th and 8th centuries. Therefore, henceforth the settlement and the cemetery attributed to this phase, which are the focus of this section, will be referred to simply as Can Gambús. All the archaeological materials recovered in the site, including human remains, are currently stored in the Museum of History of Sabadell.

Can Gambús has become a reference for early medieval rural archaeology in Catalonia, since it is one of the few sites where both the settlement and the cemetery are extensively known. For this reason, in addition to the monographic papers cited above, it is included in various syntheses on the features and evolution of rural settlement patterns in Catalonia (Roig 2009, Roig 2011a, Roig 2013) and Iberia (Ariño 2013). Sunken featured structures in perishable materials were part of a review of such constructions in Iberia (Tejerizo 2014). Can Gambús is also a reference when it comes to silos or underground storage structures (Picazo *et al.* 2016). Likewise, this site has been important for the understanding of funerary practices during Early Middle Ages both in Catalonia (Roig 2015, Roig 2019, Roig & Coll 2012a) and Iberia (Martín Viso 2014), with an especial emphasis on deviant burials in non-funerary structures (Gutiérrez Lloret 2013, Roig & Coll 2011a, Vigil-Escalera 2013c). Regarding archaeological materials, there are some specialised studies focusing on the pottery from Can Gambús (Roig & Coll 2011b, Roig & Coll 2012b), including archaeometric characterisation (Riutort *et al.* 2018) and organic residue analyses (Inserra *et al.* 2015a), and glass was tackled in a wider research comprising several Catalonian contexts (Coll 2011). Among bioarchaeological records, fauna was devoted a specific study (J.A. Molina 2008a), whose results have been used by other researchers to draw a wider picture of early medieval husbandry in Iberia (Grau-Sologestoa 2015a). Human remains were also previously analysed (Ruiz *et al.* 2007). However, the whole assemblage was completely re-examined by the author in order to homogenise methods and integrate the results with those from the other sites considered in this thesis. Moreover, the early medieval human population from Can Gambús has also been subjected to DNA analyses (C. L. Gomes, personal communication), but preservation was not good and outcome has not been published yet.

3.3.1.1.2 The settlement

Considering the three sectors of Can Gambús altogether, the site presents a wide chronological sequence from the Neolithic to nowadays, even though that does not mean continuity in functional terms. The oldest evidence are a few scattered Early Neolithic silos characterised by the presence of cardium pottery in their fillings (Artigues, Bravo, *et al.* 2007: 113, Roig & Coll 2007a: 91). The Middle Neolithic period was especially relevant at Can Gambús. The hill became a funerary space where individuals were buried in individual pits in flexed position, often accompanied by numerous grave goods (Artigues, Bravo, *et al.* 2007: 113–116, Fontanals-Coll *et al.* 2015, Roig & Coll 2007a: 91–94, Roig *et al.* 2010). During the Late Neolithic the site transformed into a settlement, including sunken featured structures, fireplaces and silos (Roig & Coll 2007a: 94–95). In the Early Bronze Age domestic and productive structures (i.e. sunken features structures, ovens and silos) spread over the hill of Can Gambús (Artigues, Bravo, *et al.* 2007: 116–121, Roig & Coll 2007a: 95–97). In addition, the southern half was occupied again by funerary structures, in this case hypogeum-like collective burials (Roig & Coll 2007a: 97–99). The Late Bronze Age, the first Iron Age and the Iberian period were represented by sunken featured structures and mostly silos all over the site (Artigues, Bravo, *et al.* 2007: 121–132, Roig & Coll 2007a: 99–100). Regarding the latter phase, a water channel coated in custom-made pottery items (Artigues, Bravo, *et al.* 2007: 128–130) and a pendant with an inscription in Iberian (Artigues, Codina, *et al.* 2007) are especially relevant. During the Roman period Can Gambús was almost depopulated. The only structure dated to this period was an underground aqueduct running in north-south direction which was destroyed purposely during the 2nd century AD (Roig & Coll 2007a: 100–104). There are vague news about the existence of Imperial age structures on the top of the hill (Artigues, Codina, *et al.* 2007: 240–241), but information is incomplete. This change may be related with the foundation of the Roman villa of Can Feu (Martín *et al.* 1988), less than 1 km south of Can Gambús (figure 3.147B). The data available indicate the villa was abandoned in the 3rd century AD (Martín *et al.* 1988) and it was not until the 6th century that Can Gambús was inhabited again, occupying only a small area in the most southern end of the site. This means there was no continuity between Roman and early medieval phases. After the 6th to 8th century village, which will be developed in greater detail below, the whole hill was occupied again. A number of sunken featured structures, silos and a kiln dated to between 9th and 11th centuries were recovered (Artigues, Bravo, *et al.* 2007: 132–135, Roig & Coll 2007a: 107–108). In addition, five contemporary anthropomorphous burials were identified on the north-eastern zone of the site (Artigues, Bravo, *et al.* 2007: 133). Twelfth to thirteenth centuries were represented by sunken features structures and silos too (Artigues, Bravo, *et al.* 2007: 137–139) and there were also some late medieval underground structures on the northern end and around the *masia* (Artigues, Bravo, *et al.* 2007: 135–137, Roig & Coll 2007a: 108). Modern Age and contemporary structures will not be covered here.

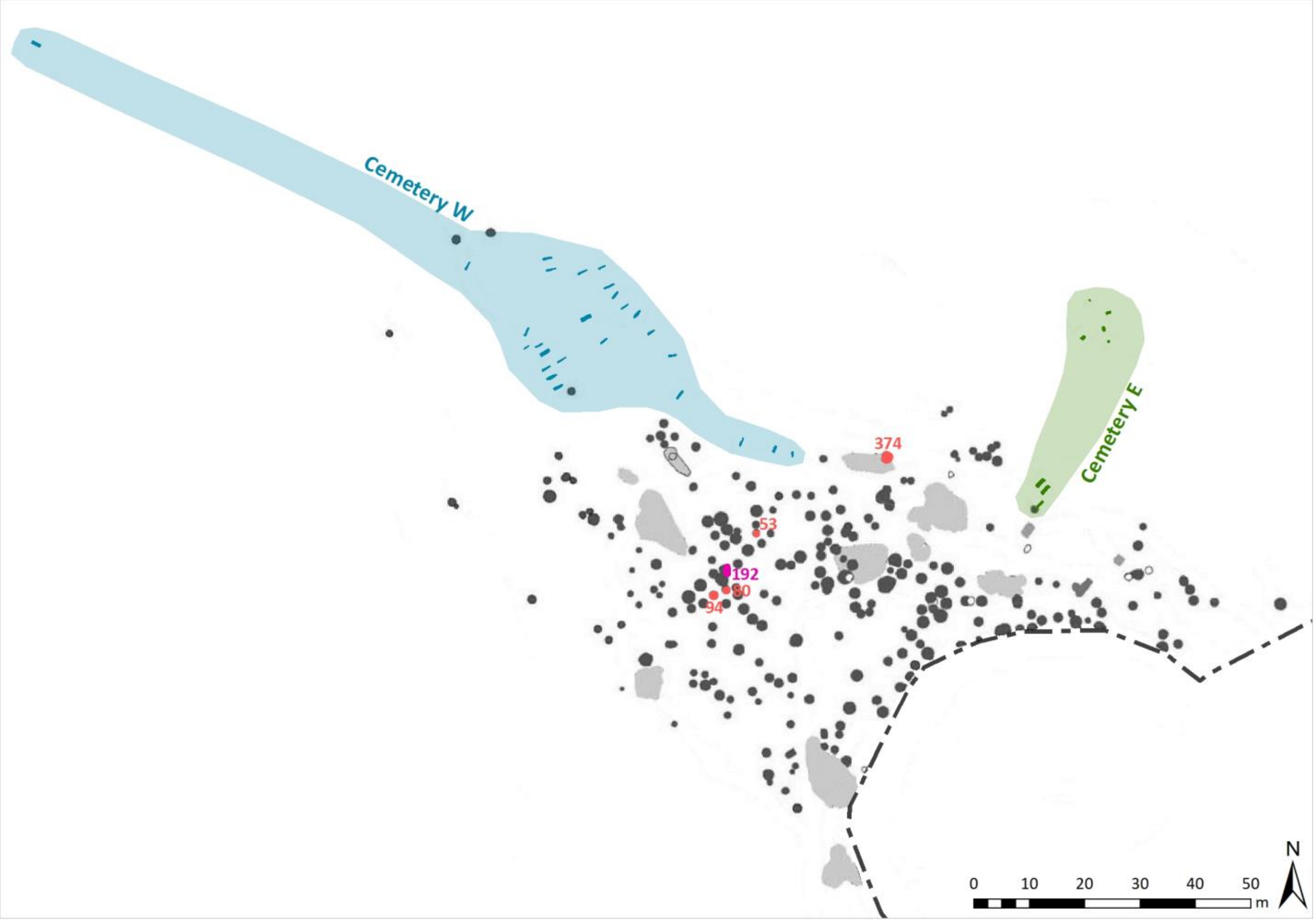


Figure 3.148. Can Gambús, complete plan of the early medieval village (6th-8th c.; Roig 2011b: 233, modified). Light grey features represent sunken featured structures and dark grey features symbolise silos and wells. Those containing deviant burials (CG 053, CG 080, CG 094, CG 374) are highlighted in red. The only burial located in the middle of the settlement (CG 192) is emphasised in pink

Focusing on the period of interest for this thesis, a small village was established in the southern end of the hill of Can Gambús around the 6th century (figure 3.148, Roig & Coll 2007a: 104–107). It was formed by a dense assemblage of negative structures covering an area of approximately 1.7 ha. On one hand, there were ten sunken featured structures, which would have been completed in perishable materials to create domestic buildings and productive facilities. The former would have been the core of domestic units, which are estimated to have been between four and five at Can Gambús. The latter would have been located preferentially in the outskirts of the settlement. The most remarkable one was a sunken featured structure which incorporated a cooking oven (Roig 2009: 226–227). On the other hand, 233 silos or underground storage structures were excavated (Roig 2013: 147–151). Their capacities ranged between 500 and 9700 litres, so, even if not all of them were used at the same time, this peasant community would have had a great ability to accumulate grain. For this reason, it has been suggested they might have been producing surplus for the market or to pay rents to the nearby bishopric of Egara (Roig 2009: 225). Besides, other types of productive structures were also identified in the outer fringe of the settlement. There were two water wells, two *lacus* aimed at wine or oil production and four clustered cuts to fit *dolia* for liquid storage. Finally, the northern part of the site was used as cemetery, within which two sectors with different chronologies were distinguished. These characteristics fit well the definition of village proposed by A. Vigil-Escalera (2007a: 243), according to which essentially the settlement would have been an assemblage of families who exploited a common territory and whose identity was expressed in the community cemetery.

As mentioned above, Can Gambús was occupied between 6th and 8th centuries, as it was determined by stratigraphy, the analysis of pottery and radiocarbon dates (Roig 2009: 226). In addition, thanks to ceramics it was possible to define three different phases (Roig & Coll 2012b). Phase 1 (500-575) was characterised by the last imports of Gallic and African finewares and amphorae from Tunisia and Syria-Palestine, and the coexistence of oxidation finewares, mostly represented by jars for liquids, and reduction grey cooking coarsewares, including pots, jars, bottles and bowls, both local or regionally produced with fast wheel. Phase 2 (575-675) saw the disappearance of imports, the scarcity of oxidation fineware, small jars being the only type, and the prevalence of reduction grey cooking coarsewares. For the latter, slow wheel was introduced and types were downsized to pots and jars, some of them decorated with incised lines. Phase 3 (675-775) confirmed the predominance of reduction grey cooking coarsewares. However, fast wheel productions vanished, so pots and jars were made with slow wheel or by hand and they were not decorated any more. Concurrently, big *dolia*-like handmade containers were present throughout the complete occupation sequence of the site. Archaeometric analyses on the pottery from Can Gambús also contributed with some interesting new data. It was possible to verify that reduction grey cooking coarsewares, the most frequent type of pottery, was probably locally produced, since raw materials are available in the immediate vicinity of the site (Riutort *et al.* 2018). Moreover, analysis of organic residues (Inserra *et al.* 2015a) revealed not only pots and pans, but also jars, were used for cooking, and it identified traces of animal and vegetal fats, including dairy products. Wine was also detected in all types of vessels, so it was probably employed as an ingredient for food elaboration. Furthermore, it was observed that all containers were coated with beeswax or resin of *Pinaceae* trees to waterproof them.

Can Gambús was rich in glass too (Coll 2011). During the 6th century the most abundant productions were aquamarine and yellowish and the variety of types was quite wide, including bowls, drinking glasses with and without stem and flasks. Instead, in the 7th century the predominant productions were greenish or bluish, mostly drinking glasses with stem and big bowls. The presence of glass was significantly reduced during the last phase of the village. Metals were also recovered from Can Gambús (Roig 2009: 228). Iron was the most frequent one. It was used for tools, such as knives, ladles, sickles, nails, hooks or bells. Bronze was only represented by a few personal adornment items, namely rings, bracelets, buckles and pins. Exceptionally, a round golden plate of 1.5 cm of diameter, probably ornamental, was found in a silo. Hand mills, most of them made of volcanic rocks, were also frequent.

Regarding bioarchaeological records, fauna is the only one which has been studied so far (J.A. Molina 2008a). Doubtlessly the most frequent taxa were ovicaprids, followed by pigs, cattle, chickens, equids, dogs and cats in this order. The group of ovicaprids was dominated by sheep. According to kill-off patterns, they were raised for wool. Cattle and equids were used primarily for traction. These three taxa were only consumed when the animals were old, even if it is unclear whether equids were considered food. Instead pigs were genuinely aimed at producing meat, so they tended to be slaughtered at their maximum size. Chicken were devoted to egg and meat production equally. Dogs of different sizes were identified. They stood out because they presented several traumas, which could be due to the tasks they were assigned, such as hunting or protecting herds, or to abuse. In general terms all these domestic taxa were smaller than their Roman equivalents. Among wild animals rabbits, red deer, wild boar and badger were recognised. Some unidentified fish fragments were recovered too.

3.3.1.1.3 The funerary contexts

There were two distinct types of funerary contexts at Can Gambús (table 7.1). On one side, there was the cemetery and, on the other, the burials scattered within the settlement. The cemetery (figure 3.149B, C, figure 3.150, Roig & Coll 2015) was located on the northern area of the site, slightly displaced from residential and productive areas. Although a vast area was excavated, it was formed by just 34 burials, which meant the majority of the funerary structures of this chronology excavated in the site (n = 34/39 = 87.2%). Still, several signs suggest originally the graveyard could have been bigger. First, there were many empty spaces between graves. Second, the tombs preserved were quite shallow, which indicates more superficial ones could have been easily destroyed by erosion and agrarian activities. Third, the number of individuals recovered seems too small for the size of the settlement. The cemetery was organised in two sectors. According to the types of graves present, the eastern zone of the necropolis (figure 3.149B) was used throughout the 6th century, so it was the oldest. It was organised in two small groups, one to the north and one to the south, separated approximately 25 m. Within clusters burials did not cut each other. The western sector of the graveyard (figure 3.150) was about 40 m apart from the former. It was dated to between the middle of the 6th century and the 8th century, based on the chronotypology of funerary structures and the only radiocarbon measurement available for the cemetery (table 7.3). In this zone most graves were arranged in rows, but there were a few isolated ones too. The case of burial CG 519 (figure 3.149C) was especially striking, because it was 85 m northwest the nearest contemporary tomb. In this sector funerary structures did not intersect either.

Only two types of funerary structures were identified at the cemetery of Can Gambús: simple pit and *tegulae* graves. Most of them belonged to the first category (n = 27/34 = 79.4%) and they consisted of bare cuts in the bedrock. A smaller proportion of burials were defined as *tegulae* graves (n = 7/34 = 20.6%). These are simple pits lined with plain Roman-style *tegulae* and gabled covers made up of opposing *tegulae* too. This latter type, which was abandoned after the 6th century, was predominant in the eastern sector of the cemetery. This was also the worst preserved area of the necropolis, so it was difficult to recognise them. Actually, the only clear example of *tegulae* grave (CG 385) was found in the centre of the western sector. Orientation of burials at Can Gambús was quite heterogeneous. More than two thirds were roughly oriented to the west. Almost half were placed in west-east direction (n = 14/34 = 41.1%) and a quarter in southwest-northeast direction (n = 9/34 = 26.5%). A few burials were recorded to follow the opposite orientation, i.e. they lay in east-west direction (n = 5/34 = 14.7%). There was also one burial oriented in south-north direction (n = 1/34 = 2.9%). In some cases, it was not possible to determine orientation due to preservation issues (n = 5/34 = 14.7%).

In the cemetery of Can Gambús a total of 36 individuals were identified. Therefore, the mean occupation rate was of 1.1 individuals per funerary structure, which indicates most burials accommodated a single individual. In fact, the maximum number of individuals in a single funerary structure was two. The bulk were primary deposits with individuals in supine position (n = 28/36 = 77.8%). There was also a primary deposit with an individual in lateral position (n = 1/36 = 2.7%), certainly due to the determination to put it in a narrow grave where there was already another one. Only in one case a proper reduction in a secondary deposit was identified (n = 1/36 = 2.7%). For the remaining individuals, it was impossible to define their original position because they were very poorly preserved (n = 6/36 = 16.7%).

Figure 3.149. Can Gambús, funerary contexts (Roig & Coll 2008a: plans 4, 12, 13, Roig 2011b: 233, Roig 2019: 443, modified). (A) General plan of the site highlighting the three areas represented in greater detail in figure 3.149B, C and figure 3.150. The colour of each area matches that of the frame of their corresponding detailed plan. (B) Cemetery, eastern sector. (C) Cemetery, western sector, outlier. The outline of burials is represented with a solid line whose colour shows the type of funerary structure according to the legend. The number next to each burial is its identifier. Points symbolise the individuals recovered in each burial. Their colour indicates the presence or absence of grave goods as stated in the legend

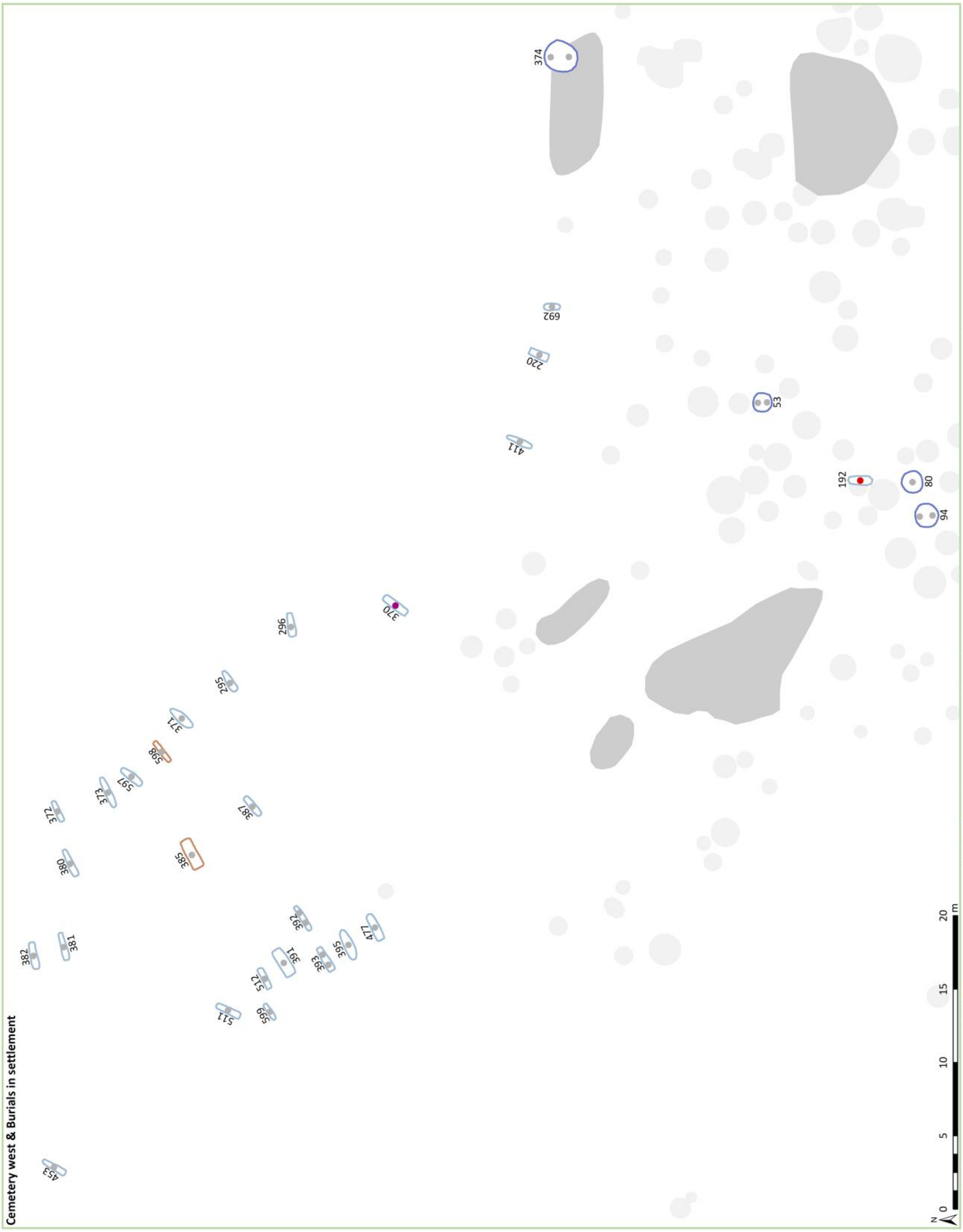


Figure 3.150. Can Gambús, funerary contexts (Roig & Coll 2008a: plans 4, 12, 13, Roig 2011b: 233, Roig 2019: 443, modified). Cemetery, western sector. Its location corresponds to the area in green in figure 3.149A. The outline of burials is represented with a solid line whose colour shows the type of funerary structure according to the legend. The number next to each burial is its identifier. Points symbolise the individuals recovered in each burial. Their colour indicates the presence or absence of grave goods as stated in the legend

There was no evidence of the use of wooden coffins at Can Gambús (n = 0/36 = 0.0%) and the presence of grave goods was also rare (n = 1/36 = 2.7%, table 7.2). There was only one individual who was accompanied by a pottery container (n = 1/36 = 2.7%). Moreover, the same individual had a necklace bead, the only clothing or jewellery piece recovered in the cemetery (n = 1/36 = 2.7%). No tools or weapons at all were found (n = 0/36 = 0.0%).

Besides the cemetery, at Can Gambús there were also several burials scattered around the settlement (figure 3.150, Roig & Coll 2015). They were five structures (n = 5/39 = 12.8%), which represented about an eighth of all the funerary evidence in the site. Within this group, there were also two different types funerary contexts. On one hand, there was burial CG 192. This was a regular simple pit grave (n = 1/5 = 20.0%), but it had a distinctive feature. Instead of being in the cemetery, it was located in the middle of the residential area of the settlement. Based on its similarity to the western sector of the cemetery, it was dated between the mid-6th century and the 8th century. On the other hand, there were non-funerary structures reused for burials, which made the majority of the funerary contexts within the settlement (n = 4/5 = 80.0%). Three were silos reused after they were no longer useful for storage. They were quite close from each other and to burial CG 192. The other one was further northeast and originally it was a well. According to the only radiocarbon date available (table 7.3), these non-funerary structures were dated to the last two centuries of the site, that is, between 7th and 8th centuries. The simple pit grave and one of the silos held one individual each, and the other two silos and the well contained individuals two per structure. Therefore, there were eight individuals buried in the settlement and the number of individuals per structure was 1.3. All of them were primary deposits, but only the one in the simple pit grave and the individual alone in one of the silos were in supine position (n = 2/8 = 25.0%). The former was placed in north-south direction (n = 1/8 = 12.5%) and the latter in east-west direction (n = 1/8 = 12.5%). The remaining six individuals (n = 6/8 = 75.0%), distributed in pairs in two silos and the well, were found in unnatural and forced positions, which indicates they were thrown with little care into the structures. For this reason, their orientation was not assessed (n = 6/8 = 75.0%). The absence of nails or other type of metallic items rules out the idea that individuals could have been placed in wooden coffins (n = 0/8 = 0.0%). Likewise, due to their deviant nature, it was not expected the individuals buried in the settlement to be accompanied by any grave goods, especially considering they were not common in the cemetery either. Still, the individual in the simple pit grave had at least one element (n = 1/8 = 12.5%). It was buried with a clothing item (n = 1/8 = 12.5%), namely, an iron buckle. No more such artefacts, containers (n = 0/8 = 0.0%) or tools or weapons (n = 0/8 = 0.0%) were found together with the individuals in the silos and the well.

3.3.1.2 The human populations

3.3.1.2.1 Macroscopic preservation

The human assemblage from Can Gambús was divided in two groups: the individuals buried in the cemetery and those scattered around the settlement. Originally in the graveyard there were 36 individuals distributed in 34 burials (figure 3.149B, C, figure 3.150). However, two of them did not preserve any anatomical element, so only 34 could be analysed (n = 34/36 = 94.4%, table 7.1). The macroscopic preservation of this assemblage was the worse among all the populations included in this thesis (figure 3.151, table 7.7). Paradoxically, completeness was not bad in comparison with other contexts. About a third of the individuals only preserved less than 25% of the skeleton, but approximately another third conserved between 25% and 50% of it and the rest of the individuals maintained up to 75% of their skeletons. In contrast, in all the cases more than 75% of the skeletal elements preserved were fragmented and bone surface preservation was really bad. More than three quarters of the individuals presented all the surface heavily eroded with some modifications of profile (grade 5) and a little bit more than 10% of the population did even show substantial modifications of profile (grade 6). This poor macroscopic preservation complicated significantly the osteoarchaeological study of the assemblage, so it is an important factor to keep in mind when assessing the results.

The individuals from Can Gambús recovered in the settlement formed a smaller group (figure 3.150). They were eight individuals allotted in five structures. All of them were preserved and available to be studied (n = 8/8 = 100.0%, table 7.1). Almost two thirds preserved between 50% and 75% of the skeleton, but the rest were more incomplete (figure 3.152, table 7.7). The complete assemblage was very fragmented, with more than

75% of the skeletal elements fragmented in all the cases. Bone surface preservation was similar to that of the individuals in the cemetery. Most of the individual had all the surface heavily eroded with some modifications of profile (grade 5). The exception were the two individuals in the well CG 374, which were significantly better preserved. They only showed most of the surface eroded and some details masked (grade 3). It is thought that the specific taphonomic conditions of the well may have favoured the conservation of these two individuals.

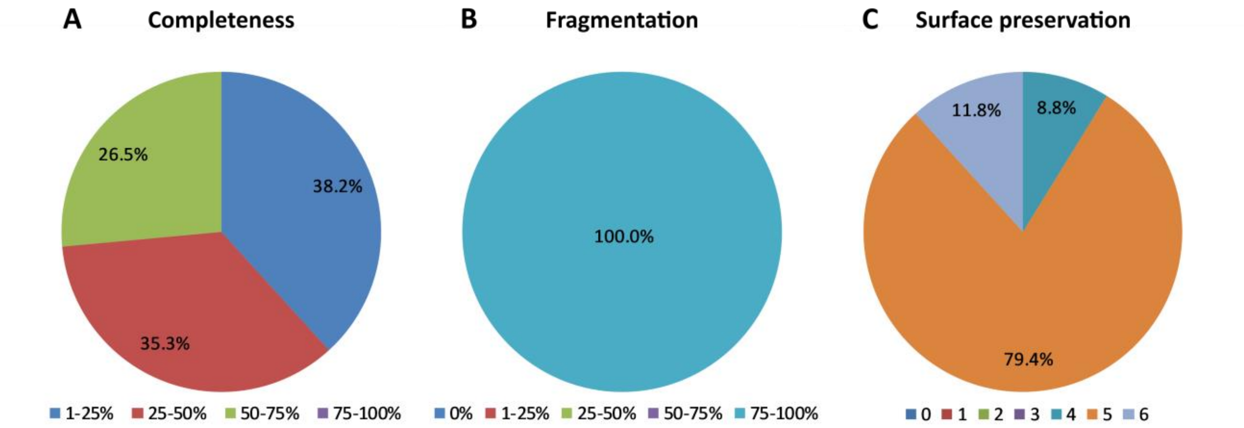


Figure 3.151. Pie charts representing the distribution of the three variables for the assessment of the macroscopic preservation of the human population from the cemetery of Can Gambús. (A) Completeness. (B) Fragmentation. (C) Surface preservation

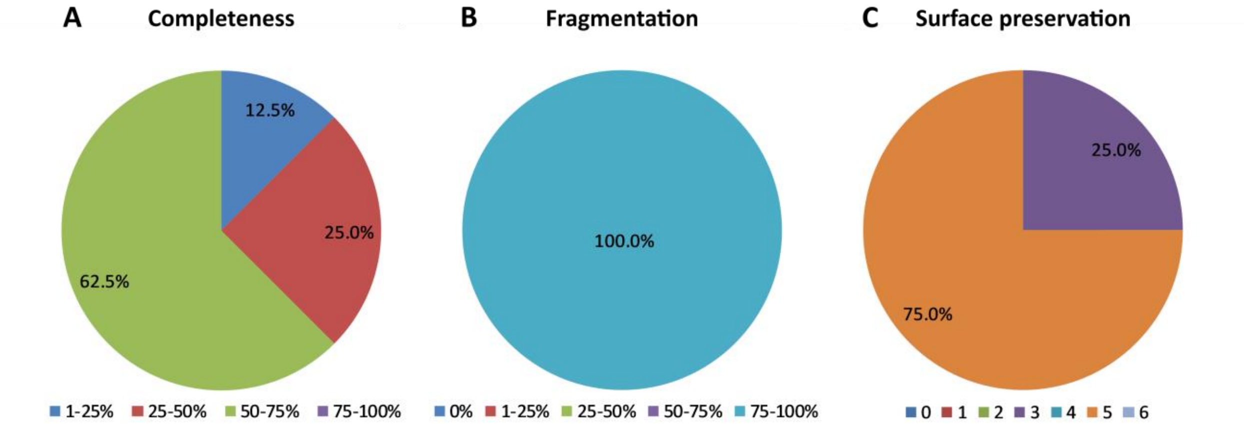


Figure 3.152. Pie charts representing the distribution of the three variables for the assessment of the macroscopic preservation of the human population from the settlement of Can Gambús. (A) Completeness. (B) Fragmentation. (C) Surface preservation

3.3.1.2.2 Demography

The two human assemblages from Can Gambús showed different demographic profiles. On one side, there was the population buried in the community cemetery. A minimum number of 34 individuals were preserved for study (table 3.40, figure 3.153, table 3.41, table 7.4, table 7.5, table 7.6). Approximately a fifth of them (20.6%) were subadults. Among them, the most numerous age category was infans 2. In contrast, just one infans 1 was identified. This is an unusual pattern in the distribution of subadults in premodern populations, since the youngest individuals tend to have the highest mortality rate. However, it is consistent with the awful conservation of the assemblage (see section 3.3.1.2.1), which typically affects more severely the youngest individuals (Bello & Andrews 2006). Then, it is likely that subadults, specially infans 1, were underrepresented in this skeletal sample. Adults meant 79.4% of the individuals recovered, but the understanding of their mortality patterns was also difficult because of poor preservation. Actually, it was not possible to estimate age at death with precision for any adult. Conversely, sex could be determined for almost two thirds of the adults.

The results point at a reasonably balanced sex ratio, with 113 males for every 100 females. These data combine in the demographic profile in figure 3.153, where the curve of the probability of death draws an abnormal peak at infans 2, due to the greater representation of the latter over infans 1. Nevertheless, if it is assumed that the youngest individuals were underrepresented, the remaining age categories draw the profile typical of preindustrial agricultural populations (Chamberlain 2006: 64–68, Séguy & Buchet 2013: 114), with the typical drop in the risk of death between late childhood and adolescence and the increase during adulthood. The scarcity of infans 1 does not affect juvenility index and palaeodemographic estimators derived from it, so those for the population from the cemetery of Can Gambús are considered quite accurate. Life expectancy at birth was 25.4 years. Mortality rates derived from the juvenility index indicate more than a quarter of individuals died during the first year of life (${}_1q_0$ = 0.273) and almost half of them before their fifth birthday (${}_5q_0$ = 0.431). The spatial distribution of individuals by age or sex (figure 3.155B, C, figure 3.156) did not reveal any patterns, since virtually all demographic groups were present in both sectors of the cemetery.

Table 3.40. Age and sex distribution by absolute frequencies of the human population from the cemetery of Can Gambús. Key: F = fetus, < 40 weeks in utero; I1A = infans 1A, birth – 2 years; I1B = infans 1B, 3 – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; Ssp = subadult sp, < 20 years; YA = young adult, 20 – 34 years; YMA = young-middle adult, 20 – 45 years; MA = middle adult, 35 – 45 years; MOA = middle-old adult, > 35 years; OA = old adult, > 45 years; Asp = adult sp, > 20 years; UA = undetermined age; M = male individuals (including probably male individuals); F = female individuals (including probably female individuals); US = undetermined sex (including ambiguous individuals)

	F	*I1A*	*I1B*	*I2*	*J*	*Ssp*	*YA*	*YMA*	*MA*	*MOA*	*OA*	*Asp*	*UA*	*Total*
M	-	-	-	-	-	-	-	-	-	-	-	9	-	9
F	-	-	-	-	-	-	-	-	-	-	-	8	-	8
US	-	-	1	5	1	-	-	-	-	-	-	10	-	17
Total	0	0	1	5	1	0	0	0	0	0	0	27	0	34

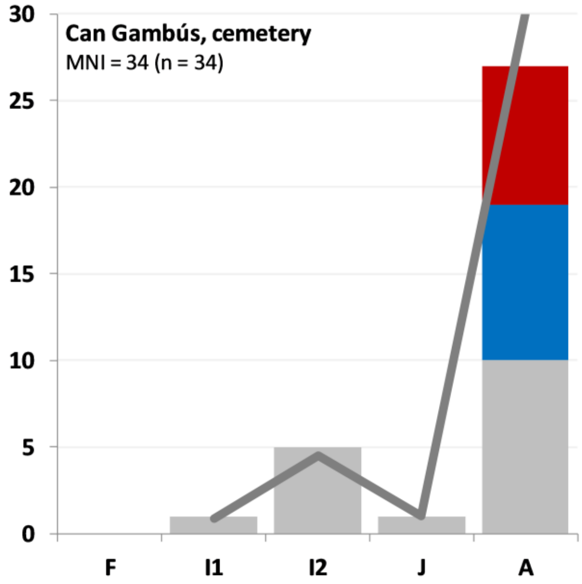


Figure 3.153. Demography chart of the human population from the cemetery of Can Gambús. Bars represent the absolute frequencies of each age category (F = fetus, < 40 weeks in utero; I1 = infans 1, birth – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; A = adults, > 20 years), separated by sex whenever possible (blue = male individuals, red = female individuals, grey = undetermined sex). The line depicts the progression of the probability of death (q_x) along age categories, calculated according to G. Acsádi and J. Nemeskéri (1970: 65). The minimum number of individuals of the population (MNI) and the number of individuals represented in the chart (n) are shown on the upper left corner

Table 3.41. Demographic descriptive indicators and palaeodemographic estimators of the human population from the cemetery of Can Gambús

Descriptive indicators		*Estimators*	
MNI	34	*JI*	0.185
%subad	20.6%	e_0	25.4
%ad	79.4%	${}_1q_0$	0.273
S/A	0.26	${}_5q_0$	0.431
M/F	1.13		

Table 3.42. Age and sex distribution by absolute frequencies of the human population from the settlement of Can Gambús. Key: F = fetus, < 40 weeks in utero; I1A = infans 1A, birth – 2 years; I1B = infans 1B, 3 – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; Ssp = subadult sp, < 20 years; YA = young adult, 20 – 34 years; YMA = young-middle adult, 20 – 45 years; MA = middle adult, 35 – 45 years; MOA = middle-old adult, > 35 years; OA = old adult, > 45 years; Asp = adult sp, > 20 years; UA = undetermined age; M = male individuals (including probably male individuals); F = female individuals (including probably female individuals); US = undetermined sex (including ambiguous individuals)

	F	*I1A*	*I1B*	*I2*	*J*	*Ssp*	*YA*	*YMA*	*MA*	*MOA*	*OA*	*Asp*	*UA*	*Total*
M	-	-	-	-	-	-	-	1	-	-	-	1	-	2
F	-	-	-	-	-	-	-	-	-	-	-	1	-	1
US	-	-	2	1	1	-	-	-	-	-	-	1	-	5
Total	0	0	2	1	1	0	0	1	0	0	0	3	0	8

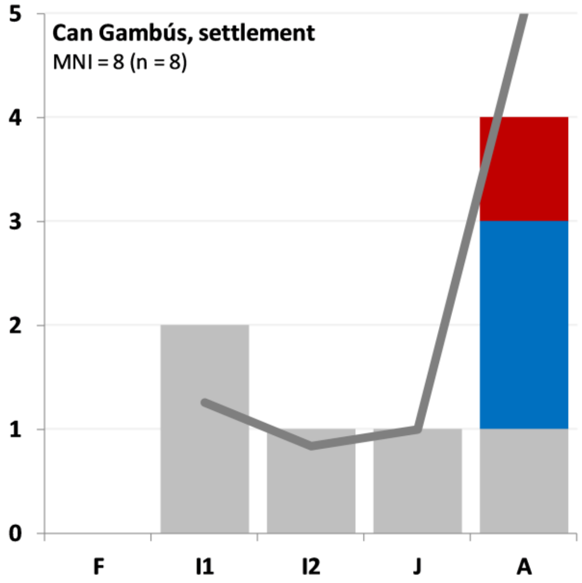


Figure 3.154. Demography chart of the human population from the settlement of Can Gambús. Bars represent the absolute frequencies of each age category (F = fetus, < 40 weeks in utero; I1 = infans 1, birth – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; A = adults, > 20 years), separated by sex whenever possible (blue = male individuals, red = female individuals, grey = undetermined sex). The line depicts the progression of the probability of death (q_x) along age categories, calculated according to G. Acsádi and J. Nemeskéri (1970: 65). The minimum number of individuals of the population (MNI) and the number of individuals represented in the chart (n) are shown on the upper left corner

Table 3.43. Demographic descriptive indicators of the human population from the settlement of Can Gambús. Palaeodemographic estimators are not reported because the MNI was smaller than ten

Descriptive indicators	
MNI	8
%subad	50.0%
%ad	50.0%
S/A	1.00
M/F	2.00

On the other side, there were the individuals found in different types of structures scattered around the settlement. They made a minimum number of eight individuals (table 3.42, figure 3.154, table 3.43, table 7.4, table 7.5, table 7.6). Half of them were subadults and the other half were adults. Paradoxically, there were more infans 1 in the settlement than in the cemetery. This was probably due to the fact that the skeletons in the village were slightly better preserved than those in the graveyard (see section 3.3.1.2.1). Almost all the four adults recovered could have sex determined. The resulting sex ratio indicated that males doubled females. This data cannot be considered representative of the composition of the source population of these individuals. However, it may reflect the preference of males over females to be buried in the settlement, even if the evidence is very weak. Palaeodemographic estimators for this assemblage were not calculated because of its small size. Still, the demographic profile of this group of individuals (figure 3.154) was close to what is expected for preindustrial agricultural populations (Chamberlain 2006: 64–68, Séguy & Buchet 2013: 114). This suggests that the assemblage formed by the individuals in deviant burials had a demographic profile similar to those in the conventional necropolis. The spatial distribution of these non-normative burials is also interesting (figure 3.156). On one hand, two of them accommodated a single individual. One of them was an infans 1B and the other one an adult of undetermined sex. The latter was the only individual in the assemblage who was laid in supine position in a proper grave, while all the others were thrown into non-funerary structures. On the other hand, three structures held two individuals each. In no case their age or sex was the same. One couple was formed by an infans 1 and an infans 2, another one by a juvenile and an adult male, and the last one by an adult male and an adult female. Therefore, no pattern can be observed in the selection of the individuals buried in the settlement and their arrangement.

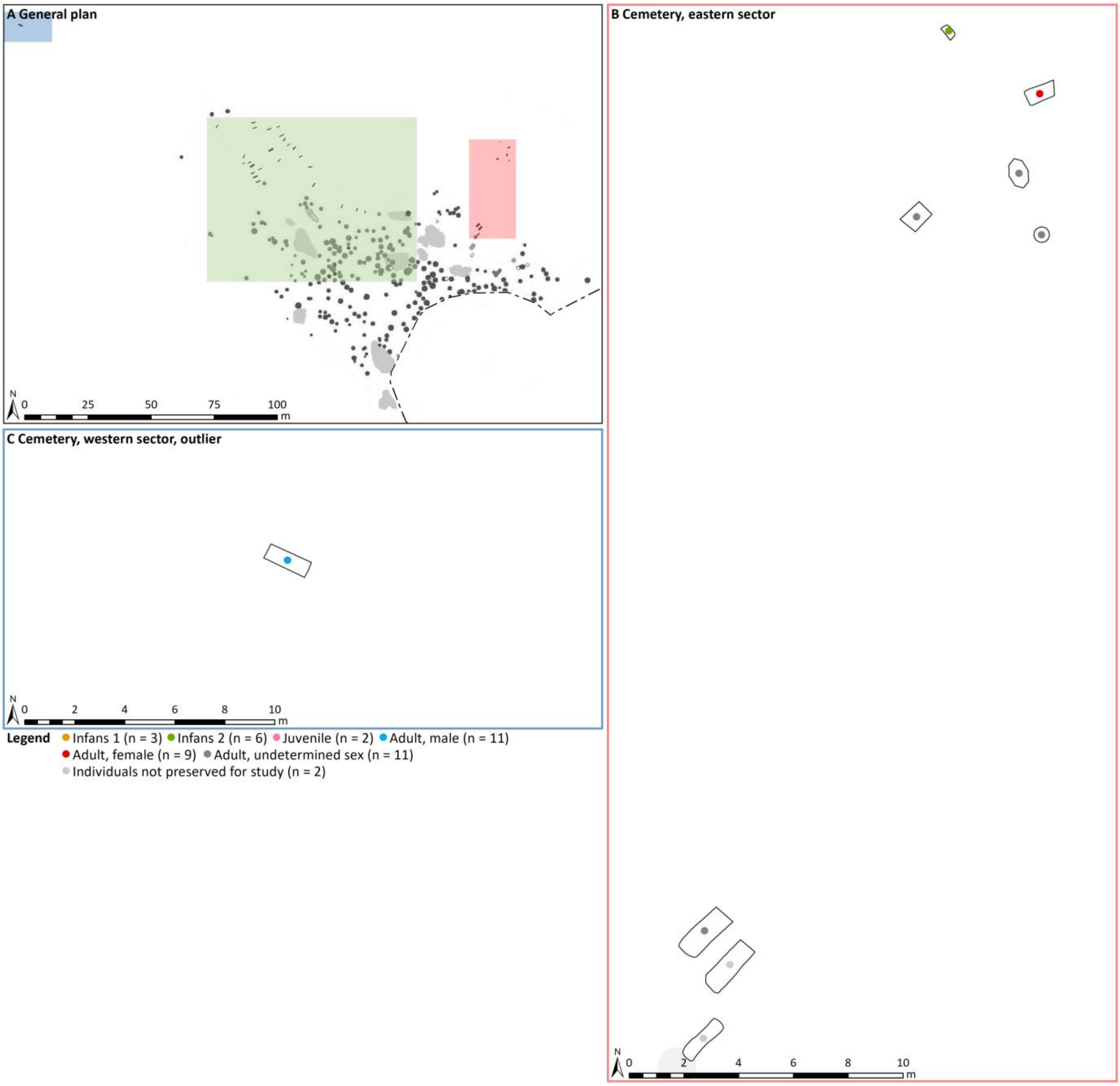


Figure 3.155. Can Gambús, spatial distribution of individuals by age and sex (Roig & Coll 2008a: plans 4, 12, 13, Roig 2011b: 233, Roig 2019: 443, modified). (A) General plan of the site highlighting the three areas represented in greater detail in figure 3.155B, C and figure 3.156. The colour of each area matches that of the frame of their corresponding detailed plan. (B) Cemetery, eastern sector. (C) Cemetery, western sector, outlier. Points symbolise the individuals recovered in each burial. Their colour indicates their age and sex as stated in the legend

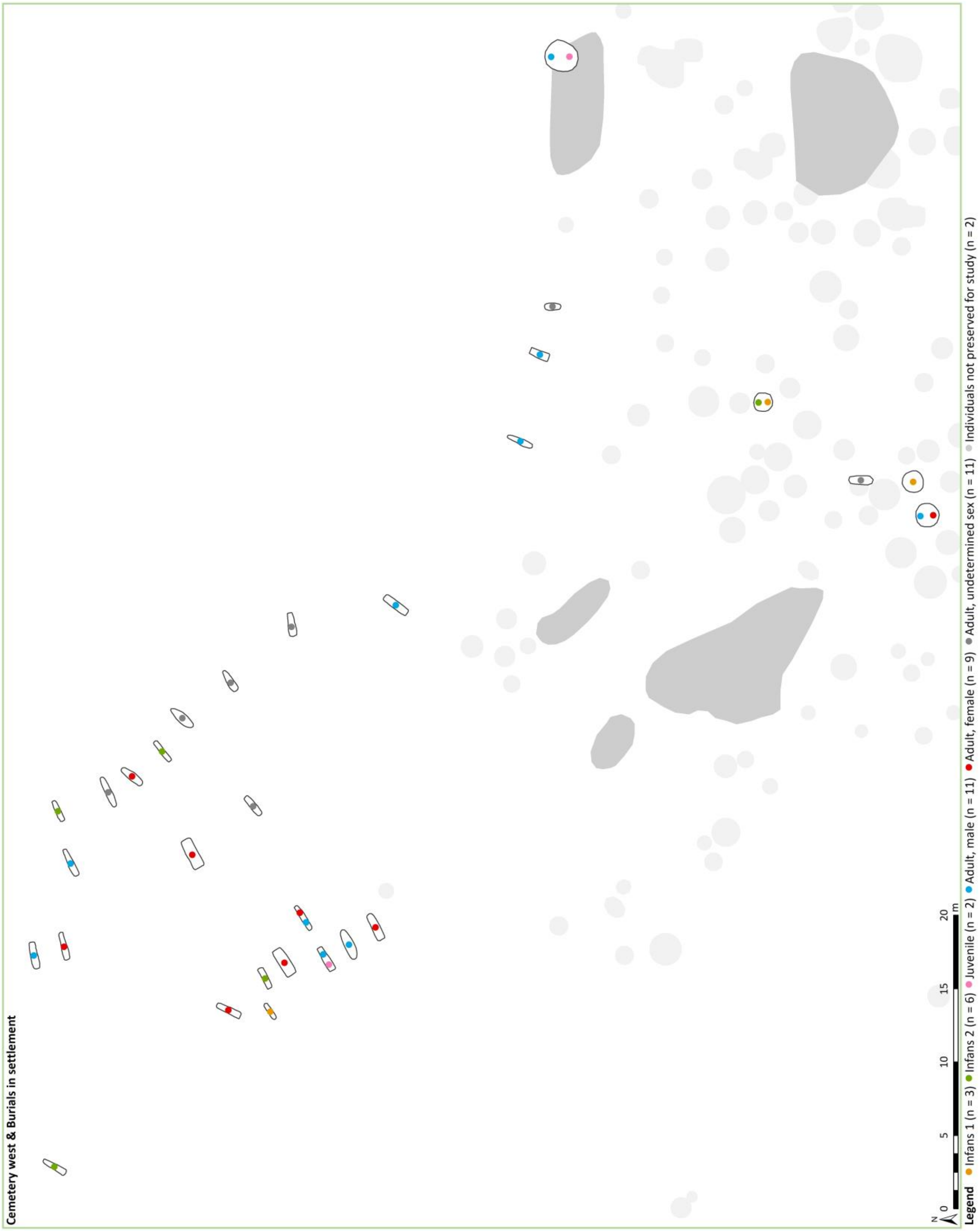


Figure 3.156. Can Gambús, spatial distribution of individuals by age and sex (Roig & Coll 2008a: plans 4, 12, 13, Roig 2011b: 233, Roig 2019: 443, modified). Cemetery, western sector. Its location corresponds to the area in green in figure 3.155A. Points symbolise the individuals recovered in each burial. Their colour indicates their age and sex as stated in the legend

3.3.1.3 Faunal diet

3.3.1.3.1 Sampling

Thirty fauna samples from Can Gambús were analysed in order to characterise the isotopic baseline of the local ecosystem (table 7.8, figure 3.157). Samples were obtained from the fillings of sunken featured structures, silos and a well located in the settlement. They were dated to between 6th and 7th centuries. Almost half of the samples belonged to herbivores (Bos taurus, Ovis aries/Capra hircus, Equus sp), one third to omnivores (Sus scrofa domesticus, Avis) and the rest were carnivores (Canis familiaris, Felis catus). Virtually the whole assemblage was formed by adult specimens. There was only an exception: a subadult pig, which will be discussed separately. All the samples consisted of bone fragments.

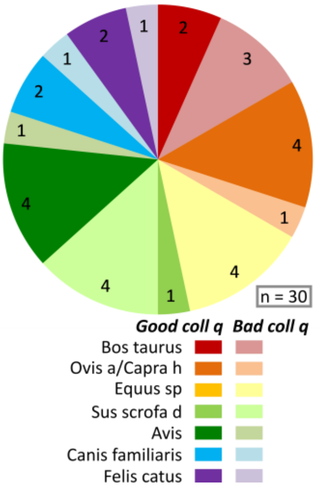


Figure 3.157. Pie chart representing the distribution of fauna samples from Can Gambús by taxa and collagen quality. Numbers represent the absolute frequency of each group

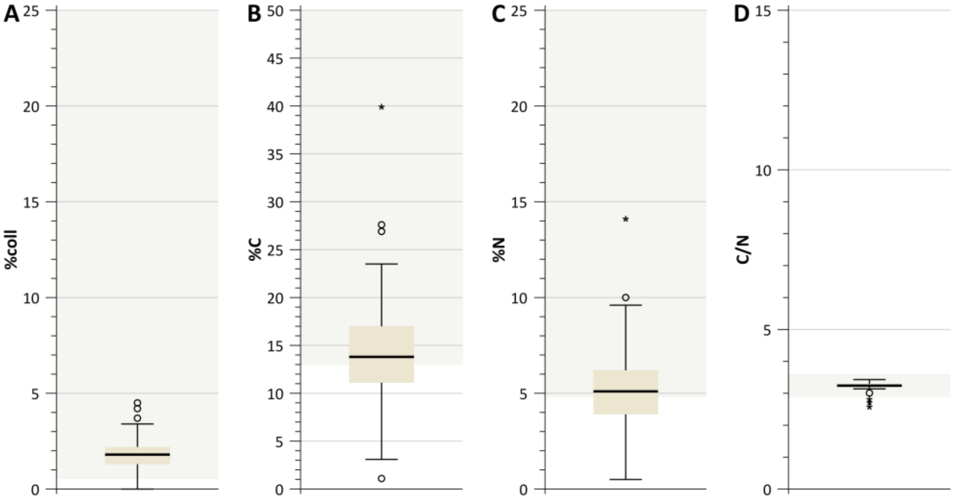


Figure 3.158. Boxplots representing the collagen quality indicators of fauna samples from Can Gambús. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

3.3.1.3.2 Collagen quality

Overall, the fauna assemblage from Can Gambús did not provide well preserved collagen (table 7.11, table 7.12, figure 3.157, figure 3.158). The vast majority had acceptable collagen yields (%coll) greater than 0.7% and only one sample produced a collagen yield too low. Both carbon weight content (%C) and nitrogen weight contents (%N) presented a distribution of values notably skewed towards low values. Carbon weight content ranged between 1.1% and 39.9% and nitrogen weight content between 0.5% and 14.1%. Actually, the samples with values close to the median of the accepted rank were statistical outliers. In this way, carbon to nitrogen atomic ratios (C/N) spanned between 2.6 and 3.4. These results forced to dismiss fifteen out of the thirty samples analysed. As a consequence, only fifteen fauna samples from Can Gambús were valid for being employed on further interpretations.

3.3.1.3.3 Results

Due to collagen preservation issues the fauna assemblage from Can Gambús useful for palaeodietary reconstruction was reduced to fifteen samples (table 3.44, table 7.8, figure 3.159). Only around one third were herbivores. They included cattle and ovicaprids. As it is expected for herbivores, they were characterised by depleted carbon and nitrogen stable isotope ratios, especially in comparison to the other taxa analysed. Their mean $\delta^{13}C$ was -19.8‰, with a standard deviation of 0.5‰ and a range of 1.6‰. However, four out of five were clustered in a very narrow range between -20.4‰ and -19.6‰, pointing at feeding regimes based solely on C_3 plants. They were two cattle and two ovicaprids. The third ovicaprid had a slightly more enriched $\delta^{13}C$ value. This suggests it might have been grazing in a different environment or its diet may have been supplemented with small proportions of C_4 plants. Nitrogen isotope ratios showed a similar distribution. The mean $\delta^{15}N$ of herbivores from Can Gambús was 5.4‰, and they had a standard deviation of 1.3‰ and a range of 3.2‰. Again, two cattle and two ovicaprids were grouped around the most depleted values of the whole assemblage, spanning between 4.0‰ and 6.3‰. Meanwhile, the ovicaprid with an enriched $\delta^{13}C$ also had a greater $\delta^{15}N$, supporting the hypothesis that it was probably grazing in pastures with a different isotopic baseline. Alternatively, this specimen could be an undetected subadult retaining the suckling effect on its isotopic signature.

Table 3.44. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of fauna samples from Can Gambús. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one

	n	*δ¹³C (‰)*					*δ¹⁵N (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All fauna	15	-19.1	0.9	-20.4	-17.4	3.0	7.1	1.7	4.0	9.2	5.2
Herbivores	6	-19.8	0.5	-20.4	-18.8	1.6	5.4	1.3	4.0	7.2	3.2
Bos taurus	2	-19.8	-	-19.9	-19.6	0.3	5.2	-	4.2	6.1	1.9
Ovis/Capra	4	-19.8	0.7	-20.4	-18.8	1.6	5.6	1.4	4.0	7.2	3.2
Omnivores	5	-18.3	0.7	-19.1	-17.4	1.7	8.5	0.7	7.8	9.2	1.4
Sus scrofa d	1	-18.8	-	-	-	-	9.2	-	-	-	-
Avis	4	-18.2	0.7	-19.1	-17.4	1.7	8.4	0.7	7.8	9.2	1.4
Carnivores	4	-19.0	0.8	-20.0	-18.3	1.7	7.6	0.8	6.5	8.3	1.8
Canis familiaris	2	-18.8	-	-19.2	-18.3	0.9	8.2	-	8.0	8.3	0.3
Felis catus	2	-19.2	-	-20.0	-18.3	1.7	7.1	-	6.5	7.7	1.2

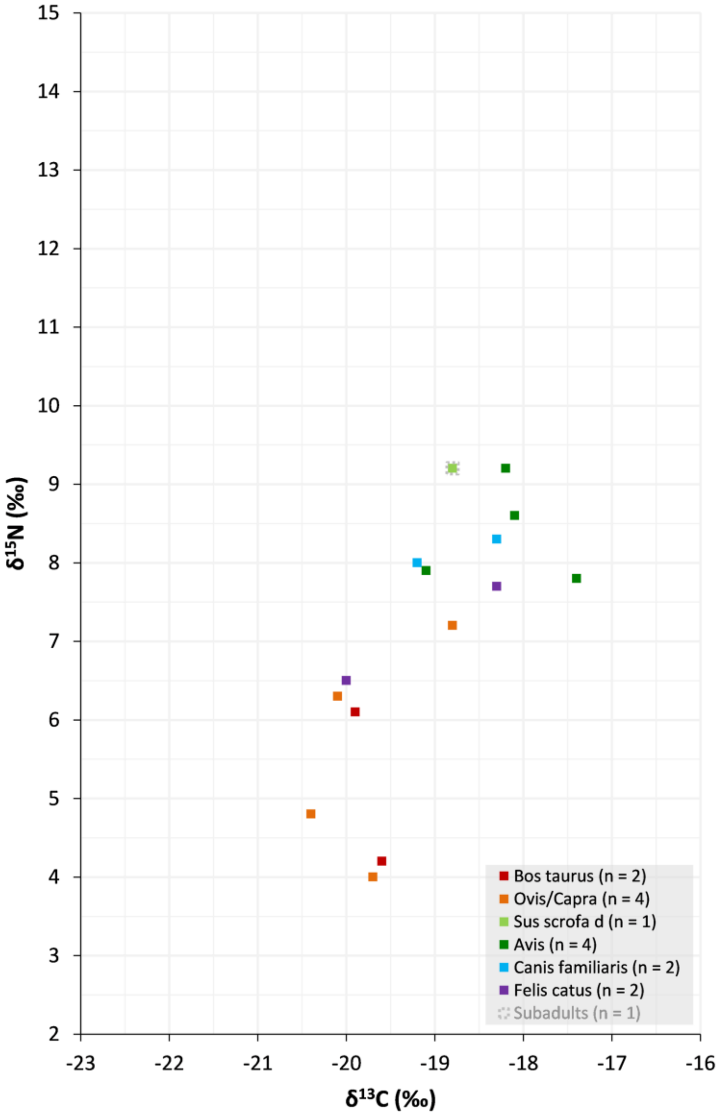


Figure 3.159. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of fauna from Can Gambús grouped by taxa. Subadult specimens are highlighted with a dotted grey fringe around them

Another third of the assemblage was formed by omnivorous animals, comprising a pig and four fowls. They were the group with the most enriched isotopic signatures on the two elements analysed. They had a mean δ^{13}C of -18.3‰, a standard deviation of 0.7‰ and a range of 1.7‰, and a mean δ^{15}N of 8.5‰, a standard deviation of 0.7‰ and a range of 1.4‰. The only pig with well-preserved collagen had a δ^{13}C identical to the most enriched value for herbivores, so its diet was probably largely based on C_3 plants. Likewise, it had one of the highest δ^{15}N of the assemblage. However, it has to be noted this was a subadult specimen, so it is likely its isotopic signature was biased by the enrichment caused by suckling. Considering this together with the fact it is the only sample of this taxon available, the usefulness of this specimen to reconstruct the dietary patterns of swine at Can Gambús is incidental. Otherwise, fowl δ^{13}C values ranged between -19.1‰ and -17.4‰ and they had the most enriched mean δ^{13}C (-18.2‰) of the dataset. These figures indicate they were having substantial amounts of C_4 plants in their diets, although the contribution of C_3 resources was probably still predominant. In addition, fowl also had enriched δ^{15}N values, similar to pig's and in some cases higher than carnivores'. This suggests chicken were eating a significant proportion of animal protein, which probably came from domestic waste. Based on this evidence, it is likely that fowls were kept in the vicinity of households.

Lastly, another third of the fauna samples from Can Gambús consisted of carnivores, namely dogs and cats. Their isotopic signatures were intermediate between herbivores and omnivores. Altogether, they had a mean δ^{13}C of -19.0‰, with a standard deviation of 0.8‰ and a range of 1.7‰. The two canids were close from each other within the range usually attributed to specimens fed predominantly on C_3 resources with small contributions of C_4 plants. One of the cats was also in this position, but the other one had a δ^{13}C notably more depleted, pointing at an exclusive C_3 diet. Nitrogen isotope ratios showed similar variability. The mean δ^{15}N of carnivores was 7.6‰ and they had a standard deviation of 0.8‰ and a range of 1.8‰. Two dogs and a cat showed enriched δ^{15}N values comparable to fowls', which indicate they had important proportions of animal protein in their diet. These were the same specimens which were also similar to each other on δ^{13}C. Then, it is likely that the three of them had resembling diets. The remaining cat was as depleted in δ^{15}N as it was in δ^{13}C, so as its isotopic signature was almost equivalent to herbivores. Accordingly, this specimen was not having as much as animal protein as its peers. In addition, the isotopic signatures of the carnivores from Can Gambús were near to the range of carbon and nitrogen stable isotope ratios of their human counterparts (see section 3.3.1.4.3), even if all carnivores were more depleted in δ^{15}N than any human. This points at the domestic nature of these animals, but it also suggests their consumption of animal protein was not comparable to humans'.

All the fauna samples from Can Gambús were precisely dated to between 6th and 7th centuries (table 7.8). However, 6th century specimens were overrepresented and no 7th century herbivores or pigs could be successfully analysed. Therefore, it was not possible to get a diachronic perspective of the evolution of animal diet over time.

3.3.1.4 Human diet

3.3.1.4.1 Sampling

All the individuals from Can Gambús from both the cemetery and the settlement which preserved any suitable anatomical element were sampled for carbon and nitrogen stable isotope analyses. On one hand, 33 individuals buried in the graveyard were included in the study (figure 3.160). This selection only left one individual apart, namely the youngest individual in the assemblage, an infans 1B which only preserved teeth. Therefore, no individuals under the age of 8 were represented in the set of samples from the cemetery. On the other hand, all the eight individuals recovered in the settlement were sampled (figure 3.162). Since the sampling included most of the individuals from both the burial ground and the residential area, the demographic structure of these assemblages basically replicated that of the original populations. Ribs and long bone fragments were the anatomical elements more frequently chosen for samples.

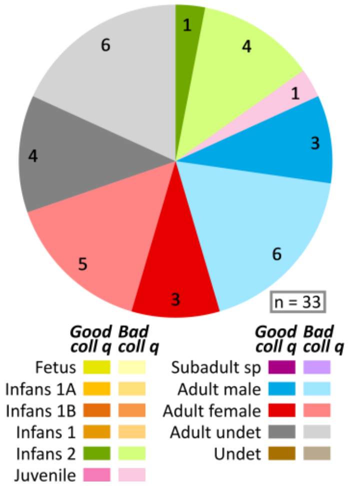


Figure 3.160. Pie chart representing the distribution of human samples from the cemetery of Can Gambús by age, sex and collagen quality. Numbers represent the absolute frequency of each group

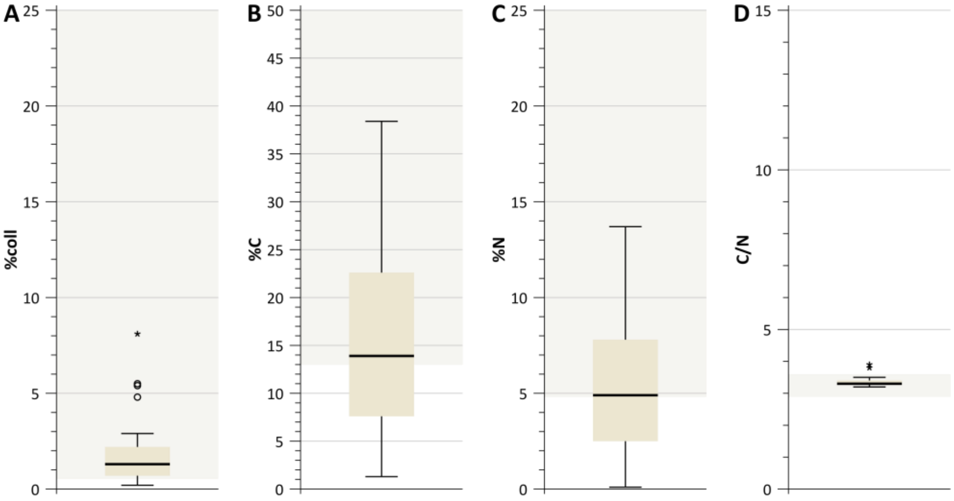


Figure 3.161. Boxplots representing the collagen quality indicators of human samples from the cemetery of Can Gambús. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

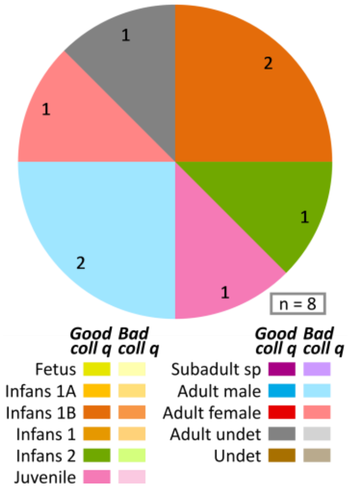


Figure 3.162. Pie chart representing the distribution of human samples from the settlement of Can Gambús by age, sex and collagen quality. Numbers represent the absolute frequency of each group

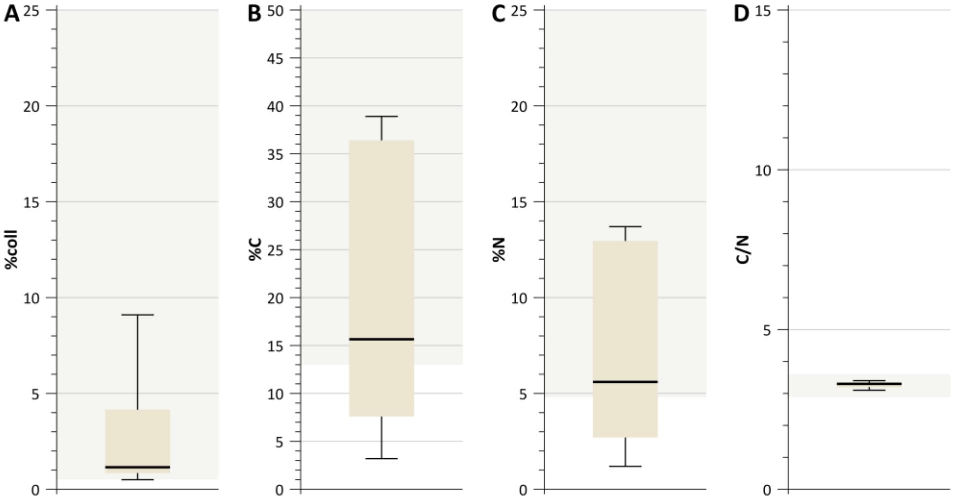


Figure 3.163. Boxplots representing the collagen quality indicators of human samples from the settlement of Can Gambús. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

3.3.1.4.2 Collagen quality

The preservation of collagen in the human samples from Can Gambús was not good in general (table 7.9, table 7.10). Most of the individuals from the cemetery (figure 3.160, figure 3.161) had collagen yields (%coll) greater than 0.5%, but four samples did not reach this threshold and produced collagen yields as low as 0.2%. Carbon weight contents (%C) ranged between 1.3% and 38.4% and nitrogen weight contents (%N) between 0.1% and

13.7%. Besides, it was not possible to get carbon and nitrogen weight contents for eight samples due to technical issues during measurement and the unavailability of more material to repeat extractions, so these samples were directly discarded. Carbon to nitrogen atomic ratios (C/N) showed a particularly wide distribution, with a minimum value of 3.2 and a maximum of 15.2, an extreme outlier very far away from the accepted values for this variable. All in all, only eleven out of 33 samples could be considered to preserve good quality collagen. The individuals scattered within the settlement showed slightly better collagen preservation (figure 3.162, figure 3.163). All of them had collagen yields (%coll) above 0.5%. However, carbon (%C) and nitrogen weight contents (%N) were as dispersed as in the cemetery. The minimum carbon weight content recorded was 3.2% and the maximum 38.9%. Likewise, the minimum nitrogen weight content measured among the individuals from the settlement was 1.2% and the maximum 13.7%. Conversely, carbon to nitrogen atomic ratios (C/N) clustered in quite a narrow gap between 3.1 and 3.4. Therefore, five out of the eight individuals found in the settlement of Can Gambús met the criteria of well-preserved collagen and three had to be discarded.

3.3.1.4.3 Results

Unfortunately, the preservation of collagen at Can Gambús was not good and only sixteen individuals were useful for palaeodietary reconstruction. Eleven came from the cemetery and five were scattered in the settlement, the latter assemblage showing proportionately much better preservation (see section 3.3.1.4.2). Both datasets presented quite similar dietary patterns, but they will be presented separately because the fact they were buried in such different contexts raises doubts about whether they really belonged to the same population or they participated in the same consumption dynamics.

Table 3.45. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of human samples from the cemetery of Can Gambús. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one. Key: C&J = clothing items & jewellery, Cont = containers

	n	*δ¹³C (‰)*					*δ¹⁵N (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All humans	11	-19.2	0.7	-20.7	-18.3	2.4	9.7	0.6	8.6	10.6	2.0
Subadults	1	-18.8	-	-	-	-	8.7	-	-	-	-
Infans 2	1	-18.8	-	-	-	-	8.7	-	-	-	-
Adults	10	-19.3	0.8	-20.7	-18.3	2.4	9.9	0.6	8.6	10.6	2.0
Male adults	3	-18.9	0.7	-19.6	-18.3	1.3	10.0	0.2	9.9	10.3	0.4
Female adults	3	-19.1	0.4	-19.3	-18.6	0.7	9.7	0.4	9.3	10.0	0.7
Grave g absence	10	-19.2	0.8	-20.7	-18.3	2.4	9.7	0.7	8.6	10.6	2.0
Grave g presence	1	-19.6	-	-	-	-	9.9	-	-	-	-
C&J presence	1	-19.6	-	-	-	-	9.9	-	-	-	-
Cont presence	1	-19.6	-	-	-	-	9.9	-	-	-	-

The population buried in the cemetery was represented by just eleven individuals (table 3.45, table 7.9, figure 3.164, figure 3.165), which meant about one third of the individuals recovered. Considering the small number of samples, the assemblage looked like very dispersed, but the variability it presented was comparable to many of the contexts included in this thesis. The mean $\delta^{13}C$ of the individuals successfully analysed from the cemetery of Can Gambús was -19.2‰ and they had a standard deviation of 0.7‰ and a range of 2.4‰. This was one of the most depleted mean carbon isotope ratios recorded in this research, only surpassed by the individuals from the settlement of the same site. In this way, the offset between the mean of humans and local herbivores was 0.6‰ (see section 3.3.1.3.3). This figure was also remarkably small in comparison with the values obtained for other cases of study included in this work. According to these data, the diet of these individuals was based on C_3 resources, so some of the main components were probably winter crops, for example wheat, barley, rye or oats, and also legumes, vegetables and fruits. Still, the carbon stable isotope ratios on the most positive end of the range are difficult to explain just by the consumption of C_3 plants. Marine fish, which can be a source of enrichment of $\delta^{13}C$, does not seem to have had a relevant role in the diet of the population from Can Gambús, since these individuals do not show the analogous increase of $\delta^{15}N$ that comes with it. For this reason, in this context the most likely cause of the enrichment of carbon isotope ratios are C_4 plants, that in early medieval Iberia were restricted to broomcorn and foxtail millets. Nevertheless, it is likely that in this case the isotopic signal of millets did not arrive to humans through direct consumption, but across the intake of products from animals fed on these spring crops. There are two main arguments to support this hypothesis. First, there is the small offset between humans and herbivores, which is significantly smaller than the approximately 1‰ fractionation normally accepted for $\delta^{13}C$ between adjacent trophic levels. This means herbivores and humans were using the same photosynthetic pathways. Second, the isotopic signatures of local fauna (see section 3.3.1.3.3) corroborated the employment of C_4 plants to feed some of the local livestock, particularly fowl, so the availability of these crops in the village of Can Gambús is confirmed. However, many relevant fauna samples which would have been key to understand this issue, such as pigs, did not meet collagen quality requirements. Then, with the present dataset it is difficult to be more specific about millets consumption by humans at Can Gambús.

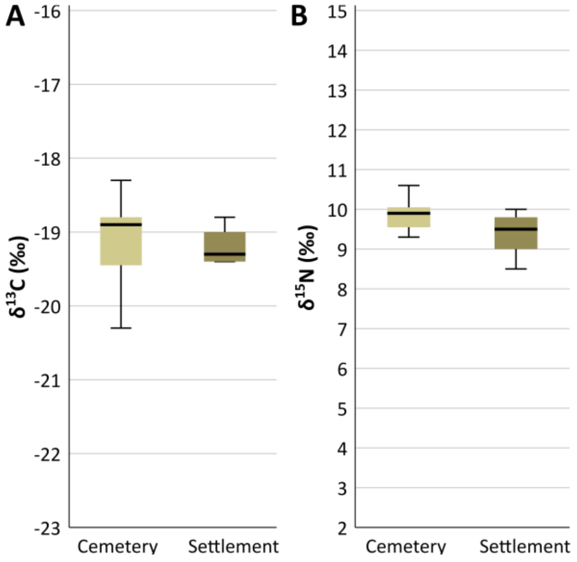


Figure 3.164. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from Can Gambús divided by location of burials

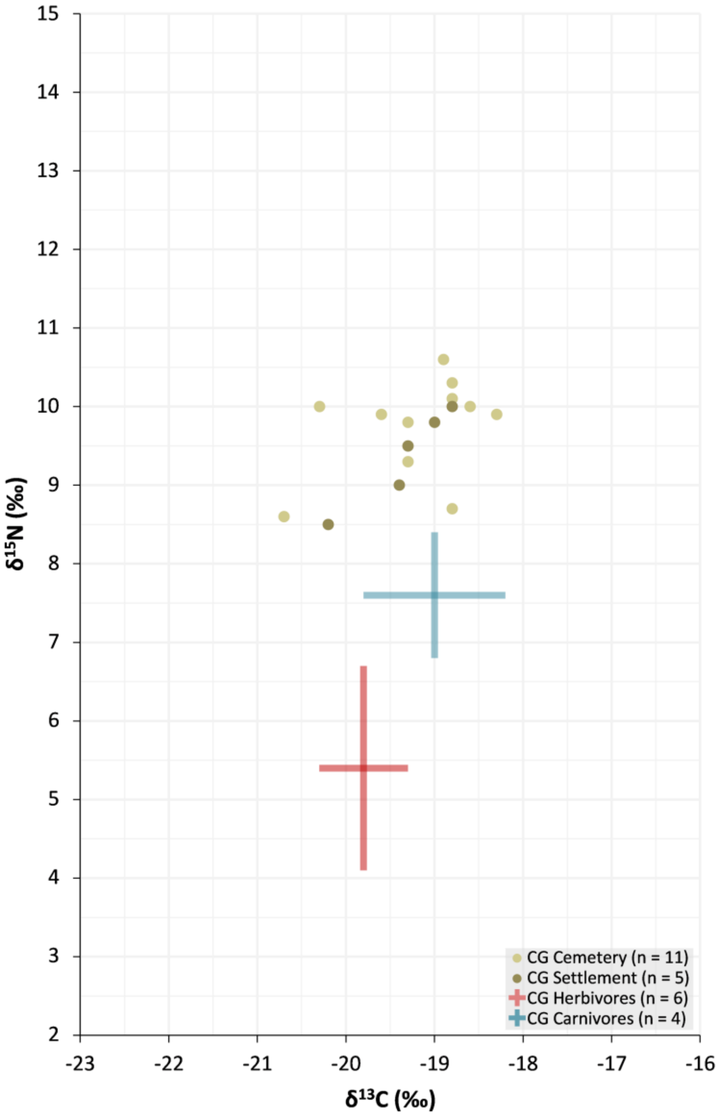


Figure 3.165. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from Can Gambús divided by assemblage. Crosses represent mean and one standard deviation of the fauna from Can Gambús grouped by feeding regime. Fowl are not displayed because they are very variable. Subadult specimens were excluded from the calculation of these parameters

Regarding $\delta^{15}N$, the mean of the individuals in the cemetery of Can Gambús was 9.7‰, with a standard deviation of 0.6‰ and a range of 2.0‰. This implies an offset of 4.3‰ between the mean of humans and local herbivores (see section 3.3.1.3.3), which is close to the fractionation usually reported for a complete trophic level shift (~5‰). This large gap between humans and herbivores can be interpreted in two ways. On one side, humans from Can Gambús would have eaten great proportions of animal protein in comparison to other sources of this macronutrient. On the other, the preferential consumption of animal protein from high trophic level species would have contributed to the further enrichment of $\delta^{15}N$. The results of the zooarchaeological study (J.A. Molina 2008a) sustain this interpretation. Pig and fowl were the taxa with the most enriched nitrogen isotope ratios and, according to kill-off patterns, they were also the taxa preferably aimed at meat production. Anyhow, these two hypotheses are not mutually exclusive, but complementary. In other words, animal protein consumption at Can Gambús was probably abundant, especially in comparison with other assemblages considered in this thesis, but the enrichment of human $\delta^{15}N$ values probably also has to do with the consumption of primarily high trophic level omnivorous species. Besides, the range of nitrogen isotope ratios in this assemblage was not too wide, but it was enough to have meant small differences in the animal protein consumption patterns between the individuals in both ends of the span.

Despite the small number of individuals from the cemetery of Can Gambús with valid carbon and nitrogen stable isotope measurements, it has already been said that the dataset was quite dispersed. Then, it is no surprise that two statistical outliers were identified. One of them was individual CG 444-1-0957, an adult of undetermined sex located on the northern cluster of the eastern sector of the cemetery. It exhibited the most depleted values in the entire assemblage for both $\delta^{13}C$ and $\delta^{15}N$, which point at a diet exclusively made up of C_3 resources with a smaller intake of animal protein than its peers but still quite abundant. There is no other feature of the funerary ritual or pathological sign in the skeleton of this individual to understand better its singular diet within the assemblage. The other outlier was individual CG 512-1-1440. This was an infans 2 who died between 7 years and 6 months and 12 years and 6 months of age. In fact, it was the only subadult with well-preserved collagen in the assemblage. Isotopically it had a slightly enriched carbon stable isotope ratio and one of the most depleted nitrogen isotope ratios of the dataset. These values can be interpreted as the result of a diet largely based on C_3 resources but with smaller proportions of animal protein or animal protein of lower trophic level than the core of the population. Because this individual was the only one of its age category among the samples from the cemetery of Can Gambús useful for palaeodietary reconstruction, it is not possible to determine if the lower trophic level of this individual was due to a generalised dietary pattern characteristic of subadults or it was really an individual with a different diet. Nonetheless, it is worth noting that the two outliers from this assemblage had very similar $\delta^{15}N$ values, but they were at most 0.7‰ away from the closest counterpart, and there was another individual in the settlement with a resembling nitrogen isotope ratio. This is to say that these individuals may be statistical outliers, but they were not so different from the bulk of the assemblage as the outliers from other contexts.

The human assemblage from the cemetery of Can Gambús was not only poorly preserved at the molecular level (see section 3.3.1.4.2), but also macroscopically (see section 3.3.1.2.1), so only a few individuals could have age and sex estimated. As a consequence, the present dataset is difficult to interpreted in demographic terms (figure 3.166, figure 3.167). The only subadult successfully analysed has already been discussed in the previous paragraph, as it was a statistical outlier. No other of the individuals with well-preserved collagen had precise age estimations, so the relationship between adult age and diet could not be explored. In the same way, the scarce number of adults with sex determined did not allow for comparing them statistically. Only three adult males and three adult females were identified. Their mean carbon and nitrogen stable isotope ratios were very similar. The only meaningful difference between them may be in the distribution of $\delta^{15}N$, as the values of adult males were slightly higher than adult females'. Still, sample size is too small to make any well-grounded conclusions.

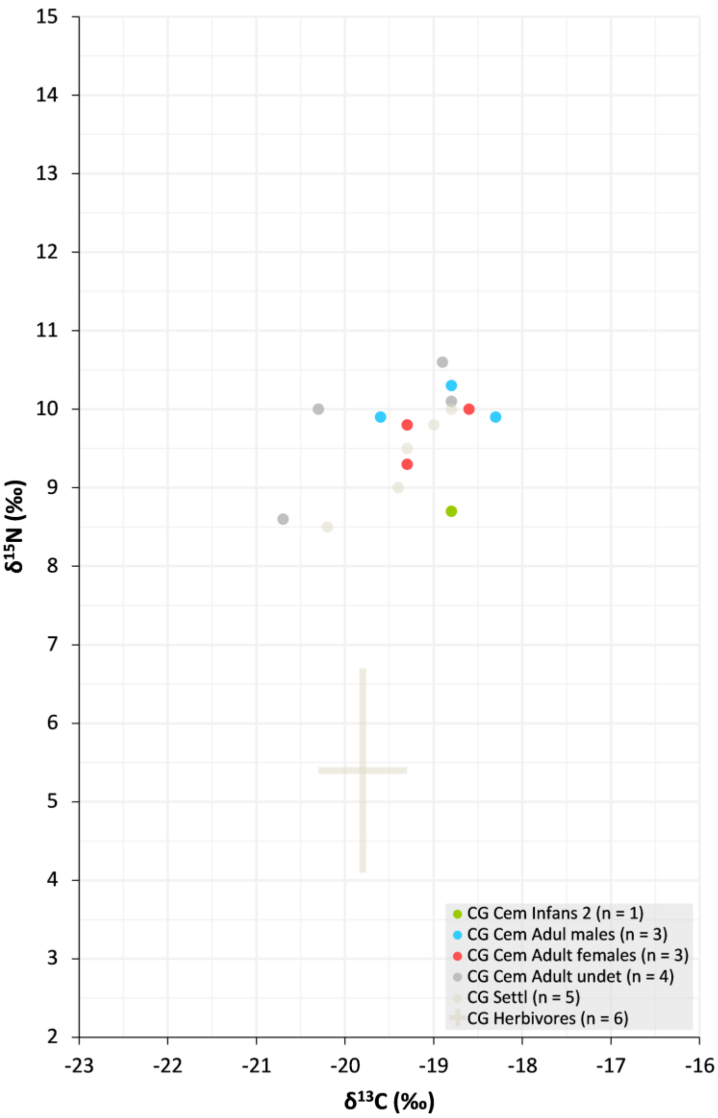


Figure 3.166. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from the cemetery of Can Gambús divided by demographic categories. Cross represents mean and one standard deviation of herbivores from Can Gambús

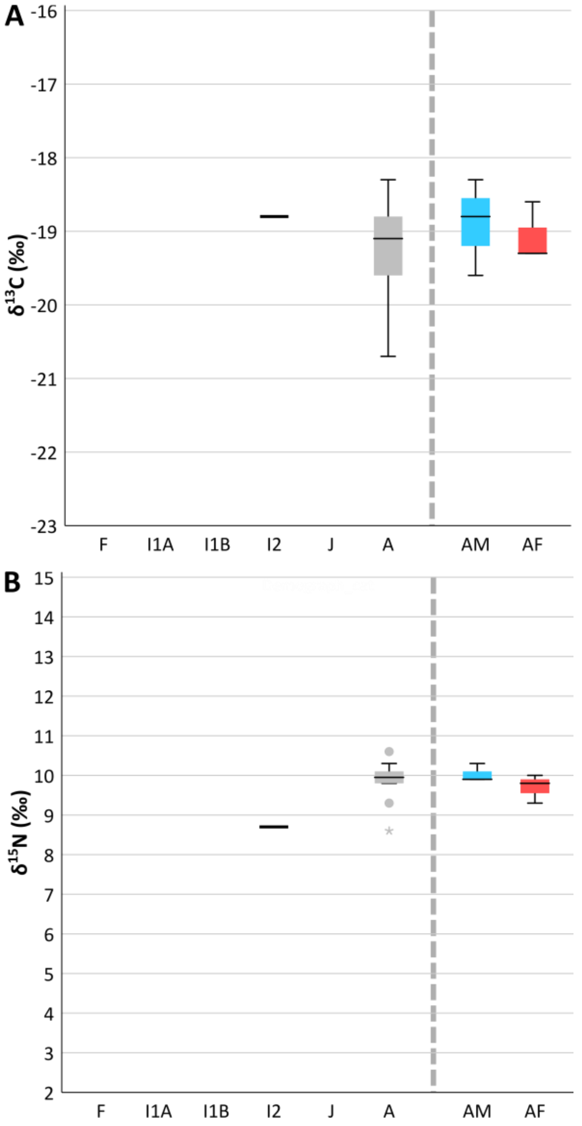


Figure 3.167. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from the cemetery of Can Gambús divided by demographic categories. Key: F = fetus, I1A = infans 1A, I1B = infans 1B, I2 = infans 2, J = juvenile, A = adults, AM = adult males, AF = adult females

Table 3.46. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of human samples from the settlement of Can Gambús. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one. Key: C&J = clothing items & jewellery

	n	*δ13C (‰)*					*δ15N (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All humans	5	-19.3	0.5	-20.2	-18.8	1.4	9.4	0.6	8.5	10.0	1.5
Subadults	4	-19.1	0.3	-19.4	-18.8	0.6	9.6	0.4	9.0	10.0	1.0
Infans 1B	2	-18.9	-	-19.0	-18.8	0.2	9.9	-	9.8	10.0	0.2
Infans 2	1	-19.3	-	-	-	-	9.5	-	-	-	-
Juveniles	1	-19.4	-	-	-	-	9.0	-	-	-	-
Adults	1	-20.2	-	-	-	-	8.5	-	-	-	-
Grave g absence	4	-19.1	0.3	-19.4	-18.8	0.6	9.6	0.4	9.0	10.0	1.0
Grave g presence	1	-20.2	-	-	-	-	8.5	-	-	-	-
C&J presence	1	-20.2	-	-	-	-	8.5	-	-	-	-

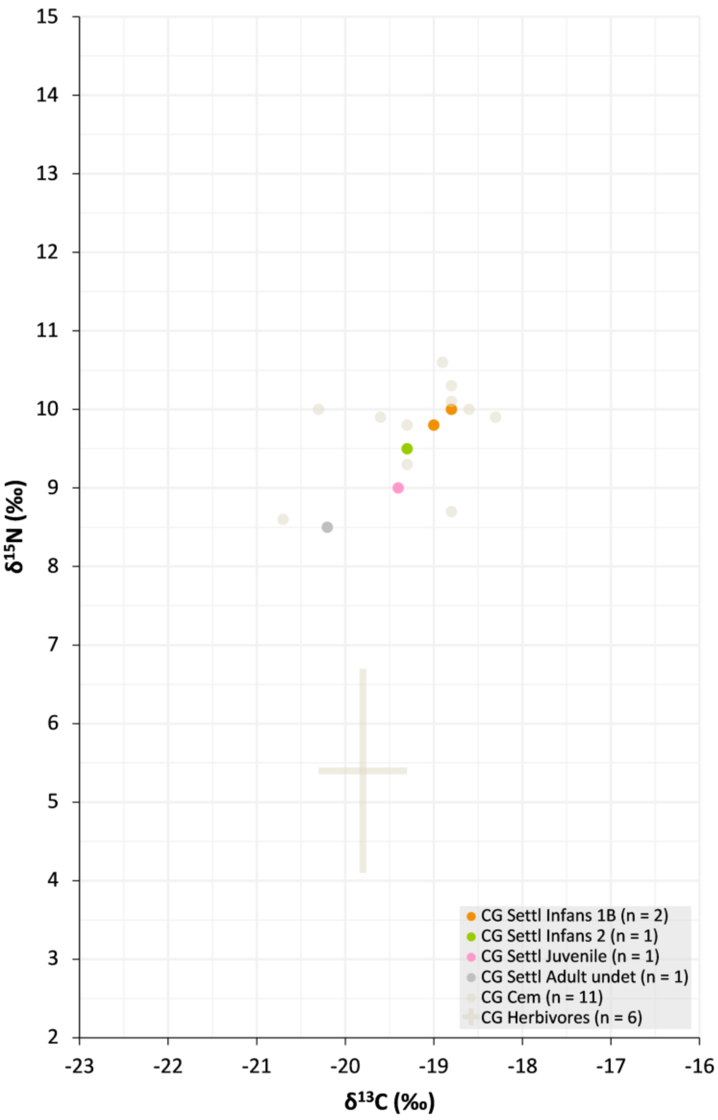


Figure 3.168. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from the settlement of Can Gambús divided by demographic categories. Cross represents mean and one standard deviation of herbivores from Can Gambús

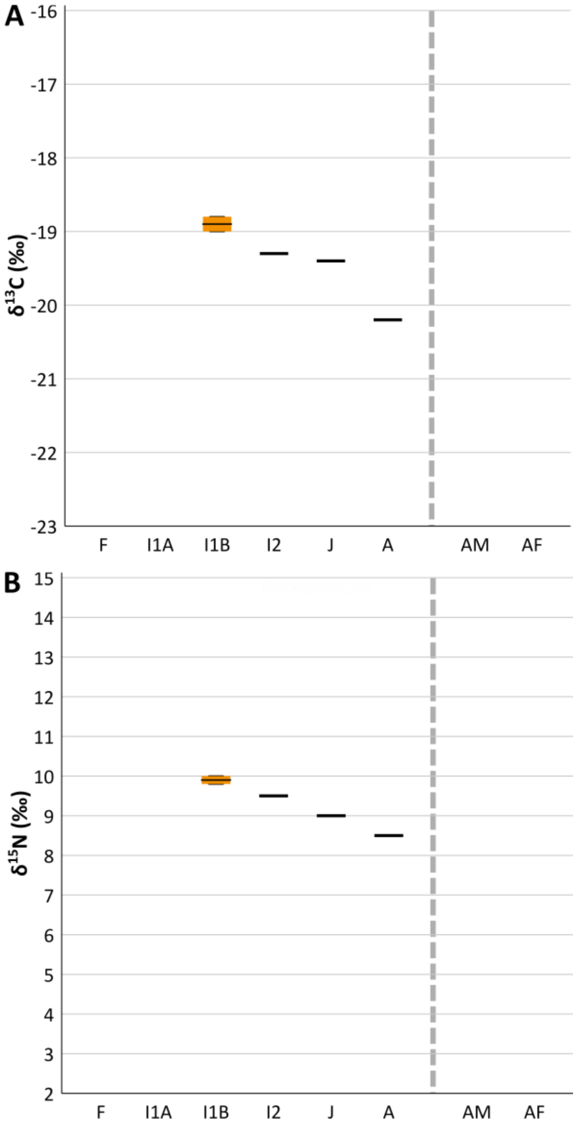


Figure 3.169. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from the settlement of Can Gambús divided by demographic categories. Key: F = fetus, I1A = infans 1A, I1B = infans 1B, I2 = infans 2, J = juvenile, A = adults, AM = adult males, AF = adult females

To conclude with the assemblage of individuals from the cemetery, it has to be said that one of the individuals was accompanied by grave goods, more precisely a necklace bead and a pottery vessel. It was individual CG 370-1-0916, an adult probably male located in the western sector of the burial ground. Its isotopic signature was close to the mean for both carbon and nitrogen stable isotope ratios, so there was nothing in its diet that could explain why it was the only individual with grave goods in the cemetery.

The isotopic signatures and, hence, the diet of the individuals buried in the settlement was similar to the assemblage of individuals from the cemetery (table 3.46, table 7.9, figure 3.164, figure 3.165). Five individuals had well-preserved collagen and could be included in the study. Their mean $\delta^{13}C$ was -19.3‰, with a standard deviation of 0.5‰ and a range of 1.4‰, and the mean $\delta^{15}N$ was 9.4‰, with a standard deviation of 0.6‰ and a range of 1.5‰. Thus, the offset between the mean of the individuals recovered in the settlement and local herbivores was 0.5‰ for $\delta^{13}C$ and 4.0‰ for $\delta^{15}N$. These figures are very similar to the assemblage from the cemetery and they indicate the dietary patterns of the individuals from the settlement was virtually the same.

They would all have had diets exclusively based on C_3 plants and in no case was there any hint about the consumption of C_4 plants by the individuals in these deviant burials. Similarly, their animal protein intake would have been analogous to the core of the individuals in the cemetery. That is, they probably had great proportions of animal protein in their diets and it is possible that they also preferred omnivorous animals for meat and other by-products, which would have contributed to the enrichment of their nitrogen isotope ratios.

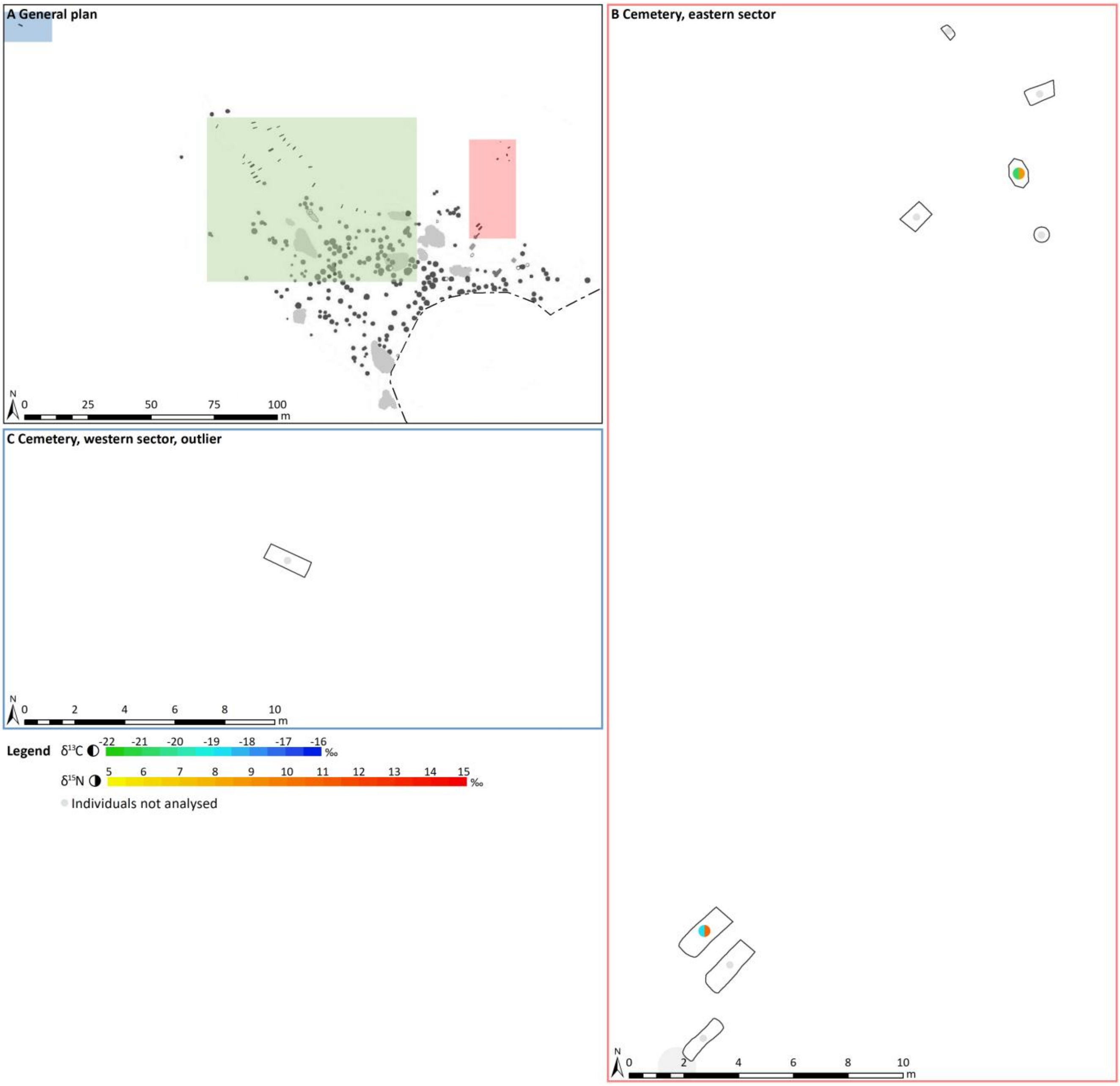


Figure 3.170. Can Gambús, spatial distribution of individuals divided by carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) (Roig & Coll 2008a: plans 4, 12, 13, Roig 2011b: 233, Roig 2019: 443, modified). (A) General plan of the site highlighting the three areas represented in greater detail in figure 3.155B, C and figure 3.156. The colour of each area matches that of the frame of their corresponding detailed plan. (B) Cemetery, eastern sector. (C) Cemetery, western sector, outlier. Individuals successfully analysed are represented with a big circle divided in two. The left half symbolises $\delta^{13}C$ and the right half $\delta^{15}N$ according to the colour gradient shown in the legend. Individuals not analysed are depicted with a smaller grey point

Figure 3.171. Can Gambús, spatial distribution of individuals divided by carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) (Roig & Coll 2008a: plans 4, 12, 13, Roig 2011b: 233, Roig 2019: 443, modified). Cemetery, western sector. Its location corresponds to the area in green in figure 3.155A. Individuals successfully analysed are represented with a big circle divided in two. The left half symbolises $\delta^{13}C$ and the right half $\delta^{15}N$ according to the colour gradient shown in the legend. Individuals not analysed are depicted with a smaller grey point

The mean $\delta^{15}N$ of the individuals in the settlement was slightly lower than in the assemblage from the cemetery due to the presence of an outlier in such a small dataset. It was individual CG 192-1-0353, the only one in the cemetery which was not thrown into a non-funerary structure but placed in a proper grave in the middle of the village. Besides, it was also the only individual in the settlement with any kind of grave goods, namely a buckle. It was an adult of undetermined sex and it was defined as an outlier because it had the most depleted $\delta^{15}N$ among all the individuals from Can Gambús. This means that it did not get such a big proportion of animal protein as the individuals buried in the cemetery or the other individuals from the settlement or that its animal protein sources were of lower trophic level, for example herbivores. Nevertheless, it has to be taken into account that, even though individual CG 192-1-0353 was pointed out as a statistical outlier, it was just 0.5‰ from the closest individual from the same assemblage and 0.1‰ from the nearest individual from the cemetery. That is to say its diet was not that different from the bulk of the population from Can Gambús. All things considered, it is difficult to determine the origin of all the particularities that affected this individual.

The other four individuals from the settlement successfully analysed were all subadults (figure 3.168, figure 3.169). There were two infans 1B between 3 and 8 years of age at death, an infans 2 between 12 and 14 years and a juvenile between 15 and 20 years old. All of them were recovered in non-funerary structures and the position of three out of four indicated they were thrown with little care into them. Interestingly, carbon and nitrogen stable isotope ratios decreased with age, so as the infans 1B were more enriched in both variables than the infans 2 and this one than the juvenile. This would point at a decrease of animal protein intake as individuals grew. However, sample size is very small and in this particular case it is very difficult to discern if any dietary pattern observed may just be variability associated to age or it was due to the exclusion these individuals suffered in death. Unfortunately, it was not possible to get valid carbon and nitrogen stable isotope measurements from a good number of subadults from the cemetery in order to compare them with those buried in the settlement. Still, it was verified that the infans 2 from the settlement was not very close to the only individual of the same age from the cemetery analysed, but the differences in their isotopic signatures did not imply significantly distinct dietary patterns.

In conclusion, there were no statistically significant differences in either $\delta^{13}C$ or $\delta^{15}N$ between the individuals from the cemetery and those in the settlement ($\delta^{13}C$ CG cemetery (n = 11) vs settlement (n = 5), Mann-Whitney U test: U = 21.500, z = -0.687, p = 0.510; $\delta^{15}N$ CG cemetery (n = 11) vs settlement (n = 5), Mann-Whitney U test: U = 15.500, z = -1.365, p = 0.180). Instead, it could be said that they had access to the same products and they had similar consumption patterns. This is also appreciable on figure 3.170 and figure 3.171, which display the topographic distribution of individuals according to their carbon and nitrogen stable isotope ratios. In them it can be seen that there is no clear spatial pattern in the scattering of isotopic signatures and individuals are not clustered by similar diets either. Therefore, it seems that the factors which determined the configuration of diet were not relevant for the choice of the location of burials inside or outside the cemetery or the spatial organisation of the graveyard. Likewise, potentially it would also be possible to explore the diachronic evolution of diet within this population, since each sector of the cemetery was dated to a specific period. The eastern sector was the oldest and it was used during the 6th century, while the western sector of the graveyard was occupied between the middle of the 6th century and the 8th century. Apparently, there were no meaningful differences between both phases, but it was not possible to run any statistical test to verify it because, due to poor collagen preservation, the eastern sector of the cemetery was only represented by two individuals.

3.3.2 CASTELLAR DEL VALLÈS

3.3.2.1 The site

3.3.2.1.1 Location and history of research

Castellar del Vallès is the name that will be used in this thesis for the early medieval farm located in the current homonymous town (figure 3.172), within the region of western Vallès in the province of Barcelona. Originally this site was considered to be two separate entities, so it was given two different names: Plaça Major de Castellar del Vallès and Horts de Can Torras. However, it was soon understood that the structures from both interventions were part of the same settlement, which was consistent with their close proximity. Therefore, this is how it will be considered also here. The UTM ETRS89 coordinates of the site are 424011 4607621 and it is 333 meters above sea level. Castellar del Vallès is 27 km northwest of Barcelona, 74 km southwest of Girona and 8 km northeast of the seat of the bishopric of Egara, present Terrasa. Regarding the other sites from the same area analysed here, Castellar del Vallès is 9 km north of Can Gambús and 4 km west of Sant Menna. The site was situated at the foot of the Catalan Pre-Coastal mountain range, in the upper Ripoll valley, less than 1 km from the riverbed. In addition, the area is crossed by many seasonal watercourses originating in the nearby mountains, such as Canyelles torrent. This location would have provided plenty of fertile fields for agrarian activities to the inhabitants of Castellar del Vallès and, thanks to the vicinity to the mountains, forest and other altitude resources would have been readily available too.

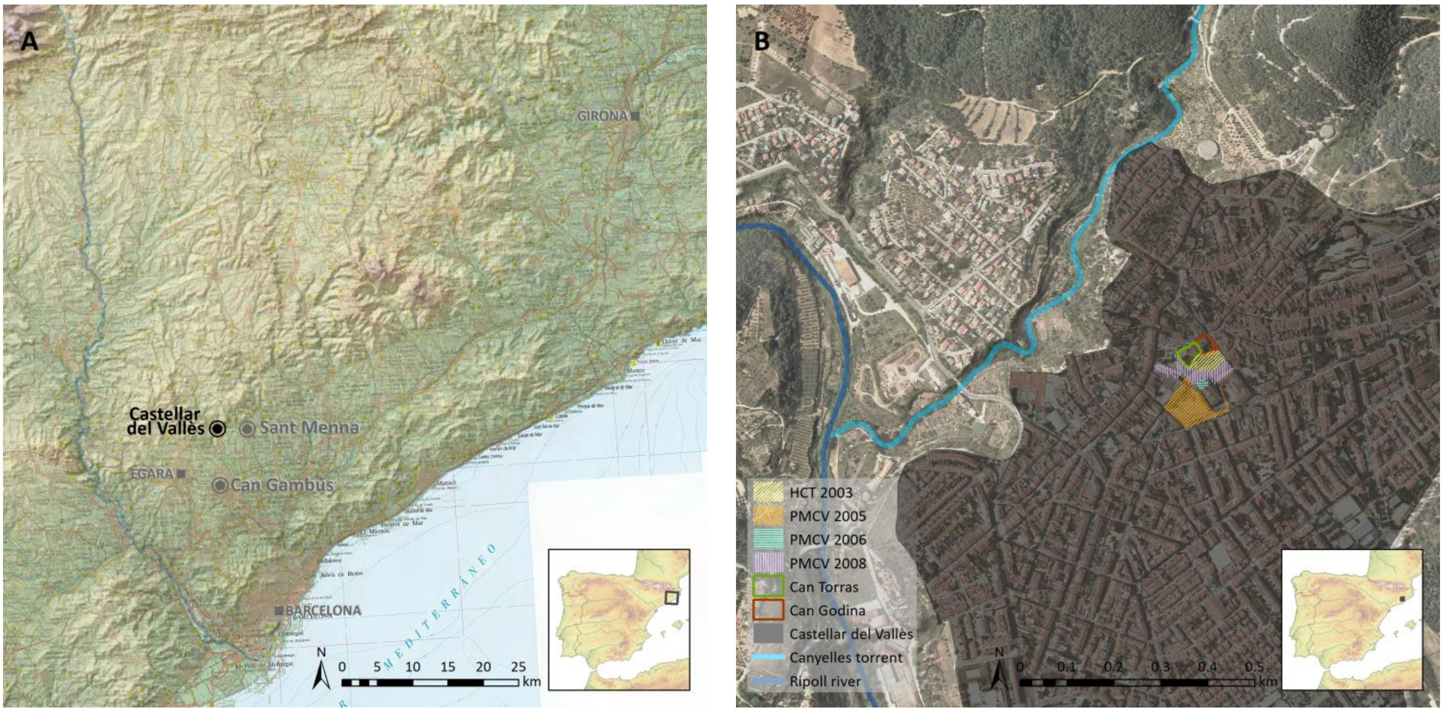


Figure 3.172. Geographical location of the site of Castellar del Vallès (Barcelona) (A) at the regional and (B) local scale

The existence of an archaeological site in the heart of Castellar del Vallès was discovered in the late 1980s by J. M. Coll and J. Roig while they were doing the municipal inventory of archaeological heritage (Coll & Roig 2006: 113). Still, the first archaeological intervention did not take place until 2003, when the council of Castellar del Vallès decided to develop the zone behind Can Torras, so far used as vegetable gardens. The excavation covered approximately 2200 m^2, but all the findings were concentrated at the northern end of the area in a space of 800 m^2 (Horts de Can Torras, 2003: Coll & Roig 2005, Coll & Roig 2006, Coll & Roig 2008). In 2005 an underground car park was to be built in the neighbouring plot, so 6750 m^2 were excavated as a mitigation measure (Plaça Major de Castellar del Vallès, 2005: Roig & Coll 2007b, Roig & Coll 2008b). The next year a smaller area of 360 m^2 corresponding to a playground was intervened in order to join some of the structures dug in the previous campaigns (Plaça Major de Castellar del Vallès, 2006: Roig 2006). Finally, in 2008 the completion of the development of the area and the construction of a residential building led to the excavation of about 4000 m^2 more (Plaça Major de Castellar del Vallès, 2008: D. Molina & Roig 2008, Roig & Coll 2010a, Roig & Coll 2010b). Summing up, up to 1.3 ha were excavated in the centre of Castellar del Vallès. All these archaeological interventions were carried out by the company Arrago under the direction of J. M. Coll and J. Roig. Currently the human remains from this site dated to the Early Middle Ages are kept in the facilities of Arrago.

Thanks to the opportunity to excavate such a vast area, Castellar del Vallès is one of the best known early medieval sites in Iberia. Therefore, it has been frequently cited in reviews and syntheses about the period in Catalonia (Coll & Roig 2011, Roig 2009, Roig 2011a, Roig 2011b) and Iberia (Ariño 2013, Diarte-Blasco 2016), and also in specialised studies about sunken featured structures (Tejerizo 2014) or silos (Roig 2013). Castellar del Vallès is also a reference when it comes to early medieval funerary practices (Roig & Coll 2012a, Roig 2015, Roig 2019). As for specific materials, pottery (Roig & Coll 2011b) and glass (Coll 2011) from Castellar del Vallès were included into wider approaches to the material culture of between 6th and 8th centuries. Besides, ceramics were also archaeometrically investigated for the characterisation of raw materials (Riutort *et al.* 2018, Riutort *et al.* 2020) and organic residue analyses (Inserra *et al.* 2015b). Fauna is the only bioarchaeological record from Castellar del Vallès which had previous specialised studies (J.A. Molina 2008b, J.A. Molina 2008c). In fact, the results have been exploited by other zooarchaeologists for researches on medieval husbandry at the Iberian level (Grau-Sologestoa 2015a).

3.3.2.1.2 The settlement

The archaeological evidence recovered at Castellar del Vallès represented several periods from the Neolithic to the Early Middle Ages. The oldest structures were two storage silos with cardium pottery in their fillings dated to the Early Neolithic (Roig & Coll 2011a). Another five silos from the Middle Neolithic were also identified (Coll & Roig 2006: 115–122, Roig & Coll 2010b: 189–197, Roig & Coll 2015). The novelty was that two of them were reused for human burials, one of them individual and the other multiple (Roig 2018, Roig & Coll 2018, Subirà *et al.* 2004, Ruiz & Subirà 2010). After that, apparently the site was not occupied until the Iron Age (8th-7th c. BC), when they built a canal in east-west direction to guide the watercourses coming from the nearby mountains (Roig & Coll 2010b: 197–199). This suggests that during this phase the settlement might have been slightly further south.

The area excavated was inhabited again during the late Roman period. Between 4th and 5th centuries AD the southern sector of the site became an artisanal quarter (figure 3.173A, Roig & Coll 2010b: 200–204). On one hand, there was a big a kiln for the production of ceramic building materials and, on the other, a sunken featured structure with a cooking oven, possibly also used for storage. According to their spatial distribution, it is thought they would have belonged to the *pars rustica* of a late imperial Roman villa, whose residential part would have been under present Can Torras and Can Godina. Both productive facilities were abandoned along the 5th century and they were reused as landfills. Plenty of high-quality domestic waste, including fine pottery, glass, coins and metallic personal adornment objects, were recovered in them, supporting the existence of a Roman villa in the surroundings.

During the first half of the 6th century the former artisanal quarter was reoccupied by a small peasant settlement, sealing the continuity between Roman and early medieval phases. It lasted until the 8th century with at least one short-distance displacement. Its characteristics and size match the definition of farm proposed by A. Vigil-Escalera (2007a: 243). Initially the main domestic and productive areas were located in the southern sector of the site (phase 1, 6th c., figure 3.173B, Coll & Roig 2006: 122–127, Roig & Coll 2010b: 204–208). The core of the settlement was formed by a sunken featured domestic building with perimetral posts and traces of wooden furniture inside, a storage structure on posts to the north, a smaller construction with cuts for two *dolia* to the east and a big dump to the south. Contemporaneously several productive nuclei were established in the vicinity, but slightly separated from the residential area. The kiln of the late Roman period was transformed into a food elaboration complex with the construction of three cooking ovens. An oil or wine production area consisting of the base for a press and two *lacus* was installed next to the main residential area and there was another isolated *lacus* too. In addition, there were a number of trenches and small canals which probably demarcated an irrigated space of vegetable gardens or orchards. Lastly, in the northern end of the site there was a storage area with around twenty silos. The cemetery corresponding to this phase was located east of the residential zone. During the second half of the 6th century this occupation was abandoned and all the structures were progressively filled with domestic waste. Then, in an imprecise moment between the end of the 6th century and the 7th century the habitat moved to the northern sector of the site (phase 2, 7th-8th c., figure 3.173C, Coll & Roig 2006: 122–127, Roig & Coll 2010b: 206). Here it was not possible to identify a clear residential area, but more than thirty silos, a *lacus* and three cooking ovens were excavated around Can Torras. During this period the original graveyard continued to be used and it expanded northwards. All these structures, as well as the necropolis, were abandoned from the middle of the 8th century on.

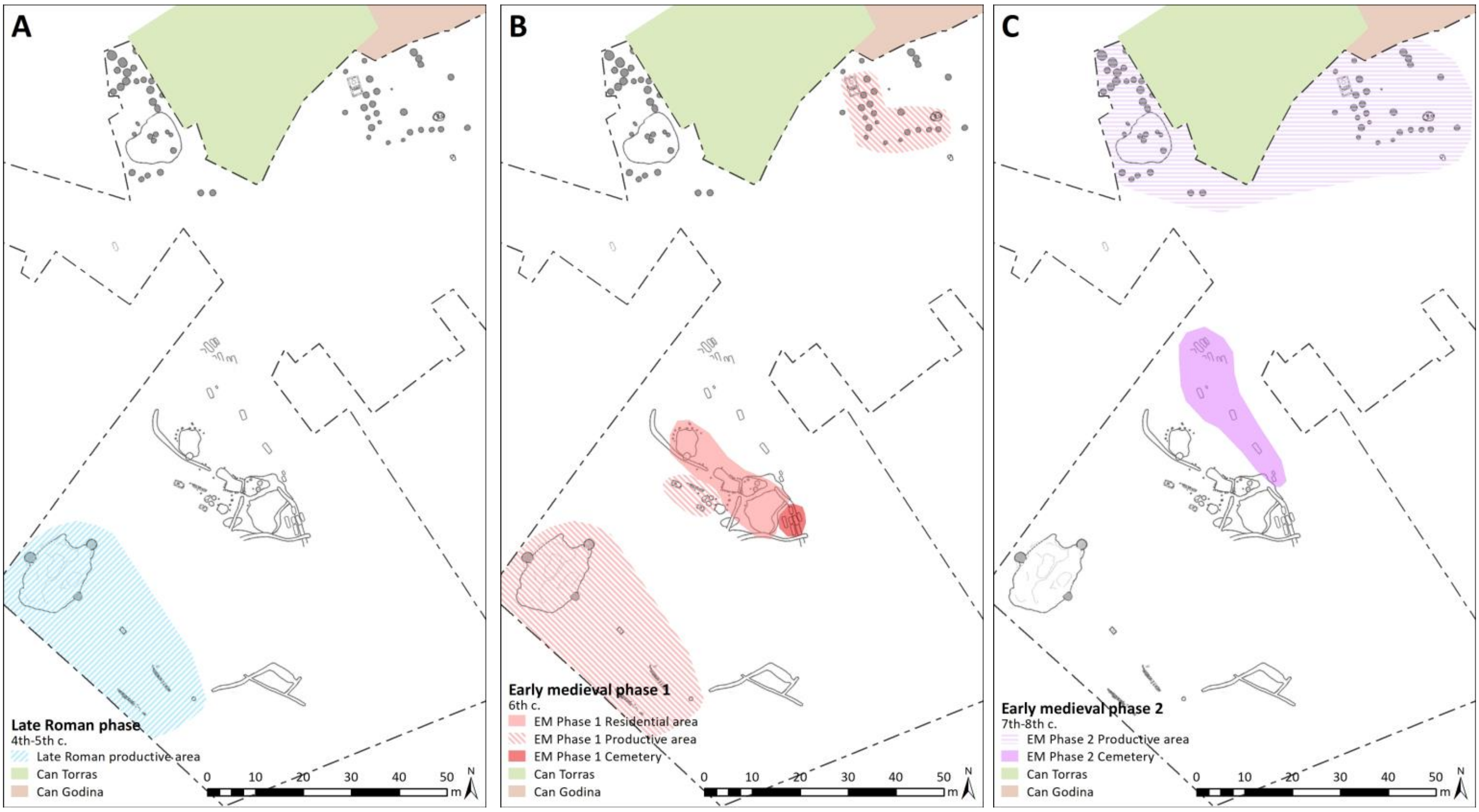


Figure 3.173. Castellar del Vallès, diachronic evolution of the site (Roig & Coll 2010a: 87, modified)

The material culture from the early medieval farm of Castellar del Vallès was very similar to that from the village of Can Gambús. Pottery fineware imports coexisted with regional or local oxidation finewares and reduction grey cooking coarsewares during the first three quarters of the 6th century. Afterwards, the former disappeared and during the 7th century reduction grey cooking coarsewares predominated over oxidation finewares. As in the first phase, most pieces were still elaborated with fast wheel, but the first slow wheel productions appeared in this moment. Since the end of the 7th century oxidation finewares too stopped being produced, so reduction grey cooking coarsewares was the only type of pottery available. Besides, the use of fast wheel stopped and, in addition to slow wheel, handmade productions were introduced. The most common forms during the complete occupation of the site were pots and jars, but during the initial phases the repertoire was more varied and it included also dishes, bowls and bottles. Big handmade containers, i.e. *dolia*, were recovered in all the phases (Roig & Coll 2011b). Thin-section analysis and X-ray fluorescence spectrometry of reduction grey cooking and common coarsewares from Castellar del Vallès concluded they were compatible with raw materials locally available (Riutort *et al.* 2018, Riutort *et al.* 2020). Organic residue analyses were also performed on pots, jars and *dolia* (Inserra *et al.* 2015b). They revealed both pots and jars were used for cooking, since vegetal and animal fats were identified in them. Moreover, most of them preserved traces of wine, which would mean it was used for seasoning food. According to the results, *dolia* were exclusively devoted to wine storage. It was also possible to verify that all containers were waterproofed with beeswax or *Pinaceae* resin. In another vein, a significant assemblage of early medieval glass was recovered (Coll 2011). Those from phase 1 were predominantly aquamarine, but during 7th and 8th centuries yellowish, bluish and greenish productions became standard. The most frequent types in any period were bowls and drinking glasses with stem. Among metallic items, the most common findings were iron knives, hooks and nails (Coll & Roig 2006: 125). Likewise, the recovery of two 6th century fibulae in one of the abandonment fillings of phase 1 deserves to be underlined (Roig & Coll 2010b: 207).

Fauna is the only bioarchaeological record from the early medieval contexts of Castellar del Vallès analysed so far. Only the animal remains from the interventions of the years 2003 and 2005 were studied and there were some differences in the results between them. Within the assemblage of 2005 (J.A. Molina 2008c), which included mostly contexts of phase 1, the most frequent taxa in decreasing order of importance were ovicaprids, chickens, pigs, cattle, dogs and donkeys. Meanwhile, in the collection of 2003 (J.A. Molina 2008b), which covered the complete chronology of the site, the decreasing ranking was formed by ovicaprids, cattle, pigs, horses, chicken and cats. Therefore, it is clear that the most abundant livestock were ovicaprids, among which sheep prevailed over goats. Around half of them were young individuals killed for meat consumption. Instead, the other half were aimed at wool production and they were only killed at old ages. Cattle, as well as horses and donkeys, were mostly used for traction and only old adults were consumed once they were not serviceable any more. Still, it is not obvious whether equids were deemed edible. Pig was the only animal raised exclusively for meat production. Therefore, most of them were killed when they reached their maximum size, but there were also a few subadult individuals which would have been a highly appreciated foodstuff. As for chickens, they were all adults, probably primarily dedicated to egg production. Dogs and cats were possibly kept both as working animals and pets. By and large, the domestic animals from Castellar del Vallès were smaller than their Roman counterparts. Within the category of wild animals, only rabbits, red deer and wild boar were represented in small numbers. In addition, some fragments of fish and marine molluscs were also recovered.

3.3.2.1.3 The funerary context

All the funerary evidence found at Castellar del Vallès was concentrated in the cemetery (table 7.1, figure 3.174, Roig 2015: 349–351, Roig 2019: 442–444). The graveyard was located east of the residential quarter founded in the early medieval phase 1 (figure 3.173B) and it became peripheral after its abandonment and the displacement of the settlement to the north during the early medieval phase 2 (figure 3.173C). The necropolis had a linear outline arranged in northwest-southeast direction. There were 21 burials and they were organised in three groups. According to the chronotypology of graves, the southern cluster was the oldest and it would have been used only during the 6th century. The cemetery expanded to the north at the end of the 6th century and the septentrional nucleus was utilised until the 8th century. The intermediate area of the cemetery was exploited between 7th and 8th centuries. Burials only intersected in one case (i.e. burial PMCV 49 cut burial PMCV 57). Otherwise, they respected previous funerary structures, even if it was clear there was an intention to place them close from each other.

Figure 3.174. Castellar del Vallès, cemetery (Roig & Coll 2010a: 87, Roig 2015: 350, modified). The dashed line depicts the excavation limits. The outline of burials is represented with a solid line whose colour shows the type of funerary structure according to the legend. The number next to each burial is its identifier. Points symbolise the individuals recovered in each burial. Their colour indicates the presence or absence of grave goods as stated in the legend

Considering the small size of the necropolis of Castellar del Vallès, the variety of grave types was remarkable. Almost two thirds were *tegulae* graves (n = 13/21 = 61.9%). They were cuts in the natural clay with plain *tegulae* coating the floor and roof-like covers formed by opposing *tegulae*. This was the only type of grave present in the southern cluster of the cemetery and it was also predominant in the northern nucleus, but it was absent in the central zone. Then, there were a few graves made of mixed material (n = 3/21 = 14.3%), which combined *tegulae* (and in one case *dolia* fragments) for the floor and slabs to make flat covers, and also a small group of burials with floor, walls and cover entirely made of stone slabs (n = 3/21 = 14.3%). The less common type of funerary structure were simple pits (n = 2/21 = 9.5%). Orientation of graves was quite regular. The burials in the southern cluster and a couple more in northern and central areas were oriented in north-south direction (n = 8/21 = 38.1%), and most of the graves in the northern and central groups were placed in northwest-southeast direction (n = 8/21 = 38.1%). It was not possible to determine the orientation of about a quarter of the funerary structures (n = 5/21 = 23.8%) due to poor preservation.

The total number of individuals recovered in the cemetery of Castellar del Vallès was 33. There was a mean of 1.6 individuals per funerary structure, so reuse of burials was quite frequent. In fact, almost half of the graves contained more than one individual and the greatest number of individuals identified in a single burial was four. Only slightly more than half of the individuals were found in primary deposits and all of them were in supine position (n = 18/33 = 54.5%). Conversely, a third of the individuals were in secondary deposits. Most of them came from well-defined reductions (n = 5/33 = 15.2%), that is, accumulations of skeletal remains next to another individual. In addition, a few individuals were found in the tumulus on top of some of the burials (n = 3/33 = 9.1%). There was another small group of individuals which were recovered in undetermined secondary deposits (n = 3/33 = 9.1%). In some poorly preserved cases it was not possible to define the original position of the individuals (n = 4/33 = 12.1%).

None of the individuals from Castellar del Vallès had any element which pointed at the use of wooden coffins (n = 0/33 = 0.0%). Likewise, grave goods were extremely rare (n = 2/33 = 6.1%, table 7.2). No clothing items or jewellery (n = 0/33 = 0.0%), containers (n = 0/33 = 0.0%), or tools or weapons (n = 0/33 = 0.0%) were found. Instead, eggs were placed next to two individuals located in the southern cluster of the cemetery. This type of funerary deposit is unique among all the sites considered in this thesis.

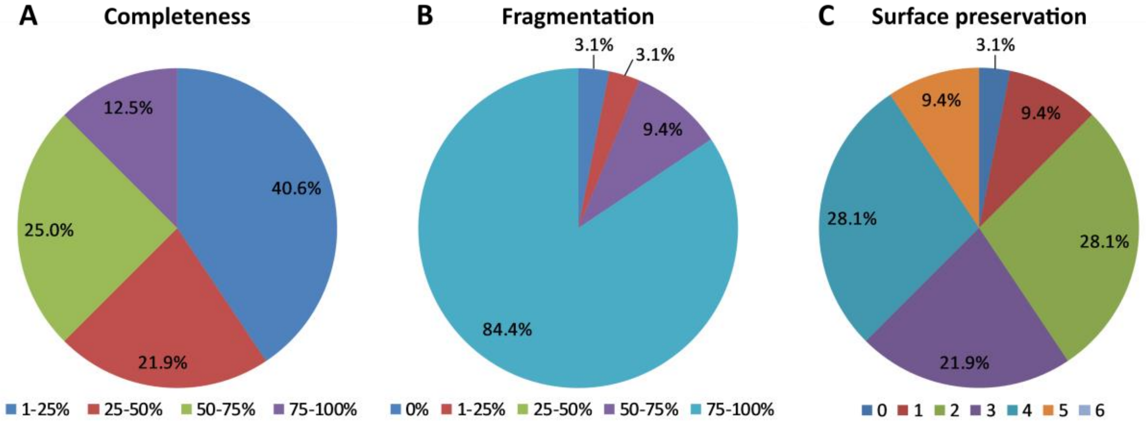


Figure 3.175. Pie charts representing the distribution of the three variables for the assessment of the macroscopic preservation of the human population from the cemetery of Castellar del Vallès. (A) Completeness. (B) Fragmentation. (C) Surface preservation

3.3.2.2 The human population

3.3.2.2.1 Macroscopic preservation

The human population buried in the cemetery of Castellar del Vallès was formed 21 burials accommodating 33 individuals (figure 3.174). All of them except one were preserved, so 32 individuals could be included in this research (n = 32/33 = 97.0%, table 7.1). A little bit more than a third of the individuals preserved less than 25% of the skeleton (figure 3.175, table 7.7), but at the same time almost a quarter conserved between 25% and 50% of it and another quarter between 50% and 75%. The great majority of the individuals had more than 75% of the skeletal elements preserved fragmented. Still, almost one out of ten had between 50% and 75% of the skeletal elements preserved fragmented and in around 6% of the cases less than half of the skeletal elements preserved were fragmented. The distribution of bone surface preservation was close to normal. Almost two thirds of the individuals ranged between having more extensive surface erosion with deeper penetration (grade 2) to showing all the surface eroded with uneven distribution of the depth or degree of alterations (grade 4). All the other bone surface preservation options were also present, except for the worst one. Summing up, the macroscopic preservation of the assemblage from Castellar del Vallès was moderately good and it enabled to carry out quite a detailed characterisation of the population.

3.3.2.2.2 Demography

The human population buried in the cemetery of Castellar del Vallès was made up of a minimum number of 32 individuals available for study (table 3.47, table 3.48, figure 3.177, table 7.4, table 7.5, table 7.6). One quarter were subadults (25.0%). Among them, the most numerous age category was that of infans 1, as it expected in premodern populations. However, most of them were older than 3 years of age at death (infans 1B), which indicates this age group was probably underrepresented. The identification of a fetus is worth mentioning. Adults formed 71.9% of the assemblage. In a quarter of the cases it was possible to estimate their age at death with some precision and it was found that young adults predominated, but very likely middle and old adults were present too. Sex estimation revealed a sex ratio very imbalanced in favour of men, according to which there would have been 175 males per every 100 females. This phenomenon has been identified in other populations included in this thesis and also in other European early medieval contexts (Barbiera 2008, Barbiera 2012, Barbiera 2018, Barbiera *et al.* 2017), but it is difficult to explain. Still, the small sample size of the individuals with sex determination and the fact that they only meant approximately half of all the adults, advises to be cautious with conclusions. Anyway, the demographic profile of the population (figure 3.177) was close to the models for preindustrial agricultural populations (Chamberlain 2006: 64–68, Séguy & Buchet 2013: 114). The youngest individuals were those with the greatest risk of death, which decreased among older children and adolescents, only to reach the maximum during adulthood. The juvenility index estimated life expectancy at birth at 26.5 years. This is one of the smallest values among all the human assemblages of more than ten individuals analysed for this research, but it is comparable with other populations which were considered reasonably representative. In the same way, mortality rates derived from the juvenility index concluded that approximately a quarter of the individuals died during the first year of life and more than 40% did not survived beyond age five. These subadult mortality figures are notably high but in line with typical demographic dynamics in premodern populations. Spatial analysis did not reveal any pattern in the distribution of individuals according to age or sex (figure 3.176). Subadults and adults were similarly spread in the three sectors of the cemetery and individuals of both sexes were present in all of them too. In this sense, the southern sector stands out because it was the area with the greatest proportion of subadults. It is no coincidence that this was also the zone with the better-preserved individuals.

Table 3.47. Age and sex distribution by absolute frequencies of the human population from the cemetery of Castellar del Vallès. Key: F = fetus, < 40 weeks in utero; I1A = infans 1A, birth – 2 years; I1B = infans 1B, 3 – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; Ssp = subadult sp, < 20 years; YA = young adult, 20 – 34 years; YMA = young-middle adult, 20 – 45 years; MA = middle adult, 35 – 45 years; MOA = middle-old adult, > 35 years; OA = old adult, > 45 years; Asp = adult sp, > 20 years; UA = undetermined age; M = male individuals (including probably male individuals); F = female individuals (including probably female individuals); US = undetermined sex (including ambiguous individuals)

	F	*I1A*	*I1B*	*I2*	*J*	*Ssp*	*YA*	*YMA*	*MA*	*MOA*	*OA*	*Asp*	*UA*	*Total*
M	-	-	-	-	-	-	2	-	-	1	-	4	-	7
F	-	-	-	-	-	-	1	-	-	2	-	1	-	4
US	1	1	4	2	-	-	-	-	-	-	-	12	1	21
Total	1	1	4	2	0	0	3	0	0	3	0	17	1	32

Table 3.48. Demographic descriptive indicators and palaeodemographic estimators of the human population from the cemetery of Castellar del Vallès

Descriptive indicators		*Estimators*	
MNI	32	*JI*	0.174
%subad	25.0%	e_0	26.5
%ad	71.9%	$_1q_0$	0.267
S/A	0.35	$_5q_0$	0.419
M/F	1.75		

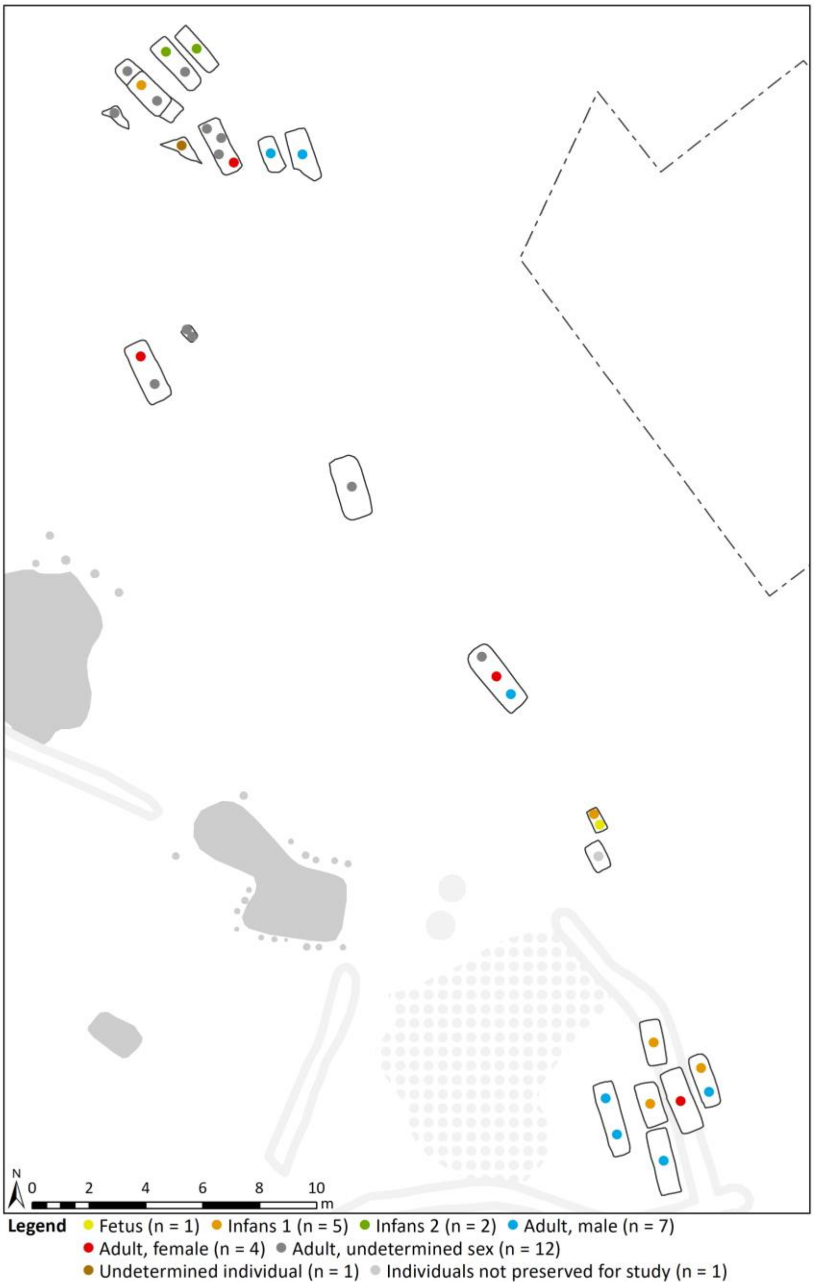


Figure 3.176. Castellar del Vallès, cemetery, spatial distribution of individuals by age and sex (Roig & Coll 2010a: 87, Roig 2015: 350, modified). The dashed line depicts the excavation limits. Points symbolise the individuals recovered in each burial. Their colour indicates their age and sex as stated in the legend

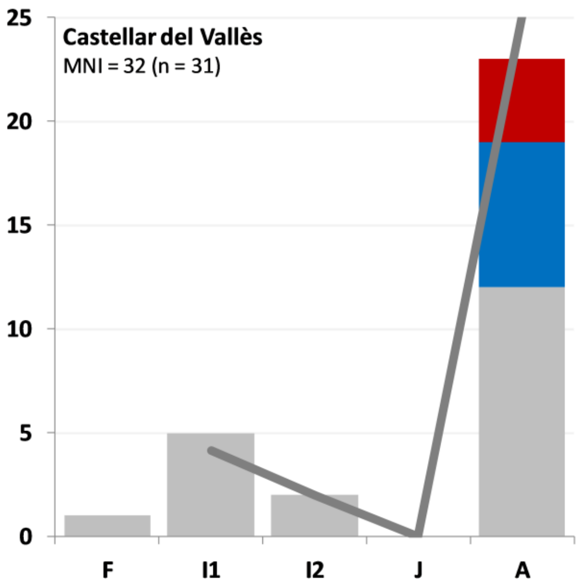


Figure 3.177. Demography chart of the human population from the cemetery of Castellar del Vallès. Bars represent the absolute frequencies of each age category (F = fetus, < 40 weeks in utero; I1 = infans 1, birth – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; A = adults, > 20 years), separated by sex whenever possible (blue = male individuals, red = female individuals, grey = undetermined sex). The line depicts the progression of the probability of death (q_x) along age categories, calculated according to G. Acsádi and J. Nemeskéri (1970: 65). The minimum number of individuals of the population (MNI) and the number of individuals represented in the chart (n) are shown on the upper left corner. These two numbers differ because subadults sp (< 20 years) and individuals of undetermined age are not displayed

3.3.2.3 Faunal diet

3.3.2.3.1 Sampling

Sixteen samples from Castellar del Vallès were analysed for carbon and nitrogen stable isotope ratios. Some of them came from a landfill dated to the 6th century in the sector of Plaça Major de Castellar del Vallès. They were labelled with the acronym PMCV. Other samples were collected from two silos in the neighbouring excavation area of Horts de Can Torras. They dated to between 7th and 8th centuries. These samples were tagged with the acronym HCT. Two thirds of the assemblage were formed by herbivores (Bos taurus, Ovis aries/Capra hircus) and the other third were omnivores (Sus scrofa domesticus). No carnivores were included. Most of the specimens analysed were adults. Still, an ovicaprid sample and two pig samples came from subadult specimens, so they will be interpreted cautiously. All the samples were bone fragments.

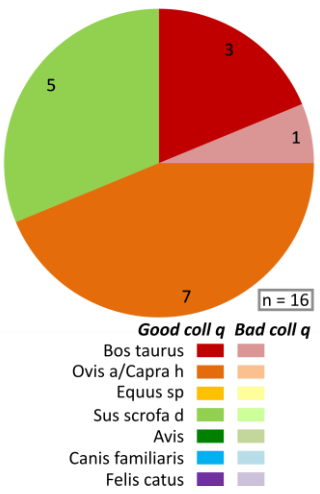


Figure 3.178. Pie chart representing the distribution of fauna samples from Castellar del Vallès by taxa and collagen quality. Numbers represent the absolute frequency of each group

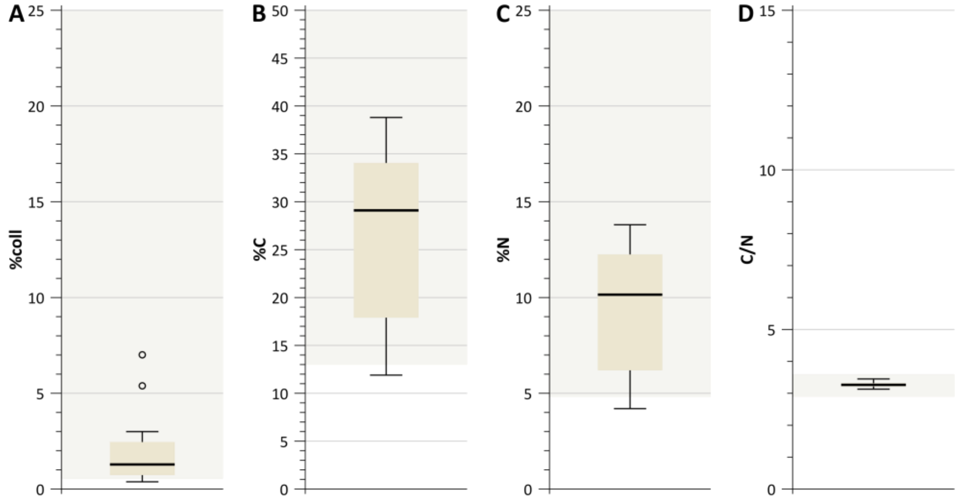


Figure 3.179. Boxplots representing the collagen quality indicators of fauna samples from Castellar del Vallès. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

3.3.2.3.2 Collagen quality

Most of the fauna samples from Castellar del Vallès had well preserved collagen (table 7.11, table 7.12, figure 3.178, figure 3.179). In almost all the cases collagen yield (%coll) was greater than 0.5% and only one sample showed a value under this threshold. The same happened with carbon (%C) and nitrogen weight contents (%N). The former moved between 11.9% and 38.8% and the latter between 4.2% and 13.8%. The same sample was responsible of the minimum values on both variables, so it was discarded. Carbon to nitrogen atomic ratios (C/N) were restricted to a narrow gap between 3.1 and 3.5. Summing up, one sample out of sixteen could not be utilised for palaeodietary reconstruction because collagen probably did not preserve the *in vivo* isotopic signal, but fifteen measurements were valid and ready to be used.

3.3.2.3.3 Results

At Castellar del Vallès there were fifteen fauna samples with well-preserved collagen to draw the isotopic baseline of the site and explore the dietary patterns of local livestock (table 3.49, table 7.11, figure 3.180). Two thirds were herbivores. Among them, ovicaprids doubled cattle. Altogether they had a mean δ^{13}C of -19.8‰, a standard deviation of 0.5‰ and a range of 1.8‰. These values indicate the diet of herbivores at Castellar del Vallès was based only on C_3 plants, possibly wild grasses and maybe fodder from winter crops. However, there was an interesting difference between the patterns of carbon stable isotope ratios of cattle and ovicaprids. Their means were similar (cattle, mean δ^{13}C: -19.6‰; ovicaprids, mean δ^{13}C: -19.9‰). Still, while cattle had a standard deviation of 0.9‰ and a range of 1.8‰, ovicaprids had a standard deviation of just 0.2‰ and a range of 0.7‰. That is, the values of ovicaprids were notably more concentrated than cattle's. This is even more striking considering ovicaprid samples outnumbered by far cattle samples successfully analysed. Instead, the distribution of herbivore nitrogen isotope ratios gave the opposite picture. Their joint δ^{15}N mean was 4.6‰, with a standard deviation of 1.3‰ and a range of 5.0‰. Likewise, the mean δ^{15}N of each taxon were also close from each other (cattle, mean δ^{15}N: 4.9‰; ovicaprids, mean δ^{15}N: 4.3‰), although ovicaprids tended systematically towards more depleted δ^{15}N values, except for a specimen with the most enriched δ^{15}N of the whole assemblage. But, in this case, contrary to what observed for carbon stable isotope ratios, ovicaprids was the taxon with the greatest variability. Cattle had a δ^{15}N standard deviation of 0.3‰ and a range of just 0.5‰, whereas ovicaprids had a standard deviation of 1.6‰ and a range of 5.0‰, the equivalent to a complete trophic level. One of the ovicaprids analysed was a subadult, but its δ^{15}N was actually close to the mean of the taxa, so it is unlikely it was showing the effect of suckling. It is difficult to interpret these differences in the distribution of cattle and ovicaprid isotopic signatures. It is clear that all herbivores from Castellar del Vallès were eating exclusively C_3 plants and their δ^{15}N values were compatible with the isotopic baselines expected in a temperate ecosystem like this. However, it is likely each taxon was exploiting different specific areas or pastures with distinct ranges of isotopic signatures, which would explain the variabilities observed.

Table 3.49. Summary statistics of carbon (δ^{13}C) and nitrogen (δ^{15}N) stable isotope ratios of fauna samples from Castellar del Vallès

	n	*δ^{13}C (‰)*					*δ^{15}N (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All fauna	15	-19.9	0.5	-20.8	-18.9	1.9	4.9	1.3	2.6	7.6	5.0
Herbivores	10	-19.8	0.5	-20.7	-18.9	1.8	4.6	1.3	2.6	7.6	5.0
Bos taurus	3	-19.6	0.9	-20.7	-18.9	1.8	4.9	0.3	4.7	5.2	0.5
Ovis/Capra	7	-19.9	0.2	-20.3	-19.6	0.7	4.3	1.6	2.6	7.6	5.0
Omnivores	5	-20.2	0.5	-20.8	-19.5	1.3	5.6	0.8	4.3	6.4	2.1
Sus scrofa d	5	-20.2	0.5	-20.8	-19.5	1.3	5.6	0.8	4.3	6.4	2.1

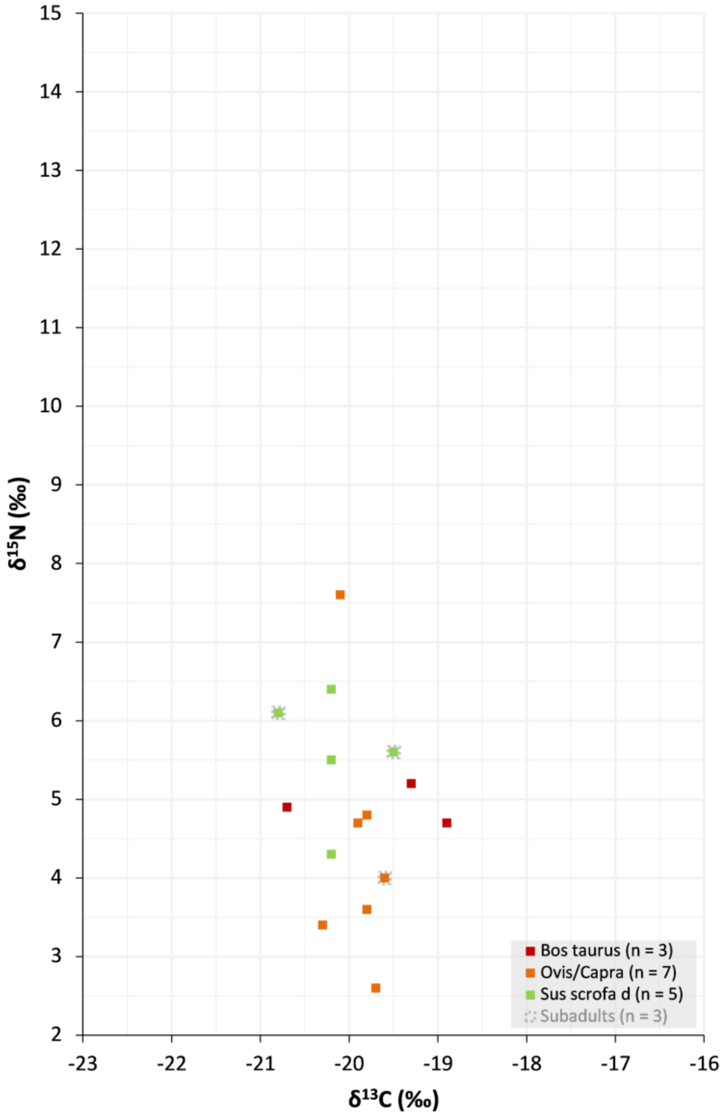


Figure 3.180. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of fauna from Castellar del Vallès grouped by taxa. Subadult specimens are highlighted with a dotted grey fringe around them

Regarding omnivores, all the specimens analysed were pigs. Their mean $\delta^{13}C$ was -20.2‰, standard deviation 0.5‰ and range 1.3‰. These figures identify them as exclusive C_3 eaters. Also, their carbon stable isotope ratios were quite homogeneous, so they were probably feeding in the same area or on the same type of resources. Conversely, the distribution of pig nitrogen isotope ratios was more variable. They had a $\delta^{15}N$ mean of 5.6‰ with a standard deviation 0.8‰ and a range of 2.1‰. This means pigs at Castellar del Vallès had variable proportions of animal protein in their diet. Interestingly, the two samples corresponding to subadults did not show the most enriched $\delta^{15}N$ values, as it would be expected for younger specimens retaining the isotopic signature of suckling. In this way, most pigs had higher $\delta^{15}N$ values than herbivores, which suggests they were feeding in areas with isotopic baselines different from those where cattle and ovicaprids grazed or, more likely, their diet was being supplemented with domestic waste (Hammond & O'Connor 2013). If the latter was true, at Castellar del Vallès pigs would have been kept close to households at least for some periods.

Although the assemblage was not large, it was possible to explore the diachronic evolution of animal diet thanks to the precise dating of all the samples. Figure 3.181 displays the comparison of $\delta^{13}C$ and $\delta^{15}N$ values of each taxa between 6th and 8th centuries. No clear patterns were observed for none of the taxa regarding $\delta^{13}C$. At the same time, there seems to have been a progressive enrichment of $\delta^{15}N$ for all taxa, which could indicate a change in the areas chosen for livestock to graze or in agrarian practices (i.e. manuring). Nevertheless, these hypotheses have to be taken with caution because of the small sample size of the dataset.

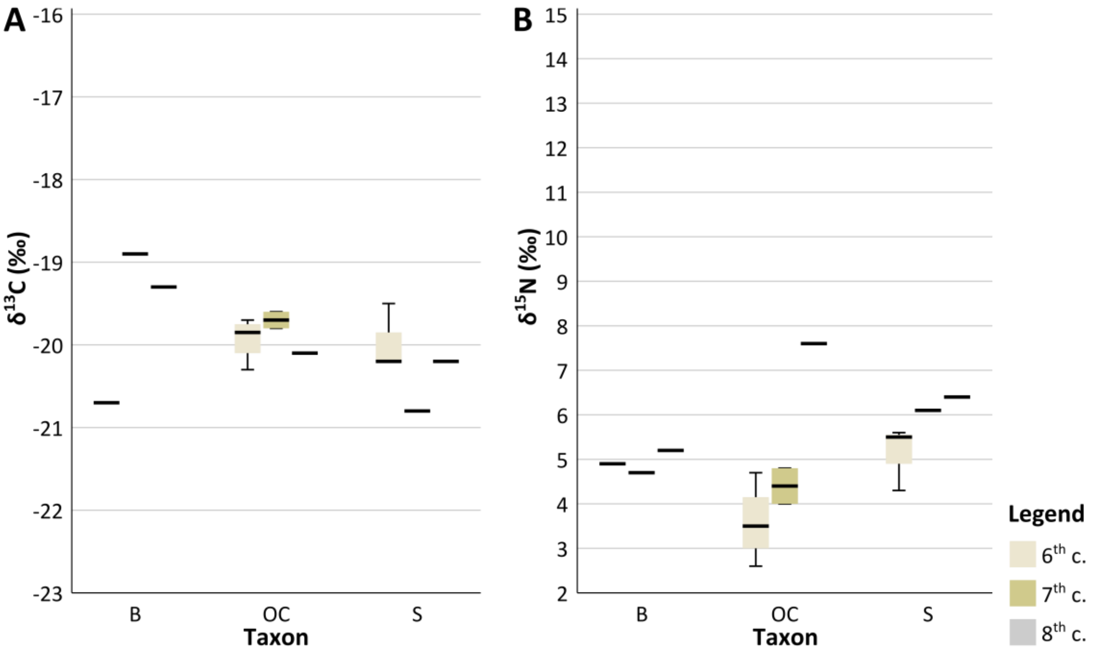
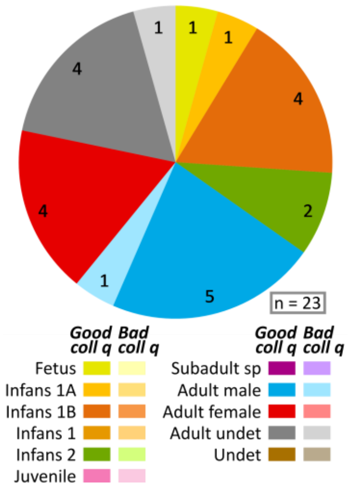


Figure 3.181. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of fauna from Castellar del Vallès grouped by taxa and chronology. Key: B = Bos taurus, OC = Ovis/Capra, S = Sus scrofa domesticus



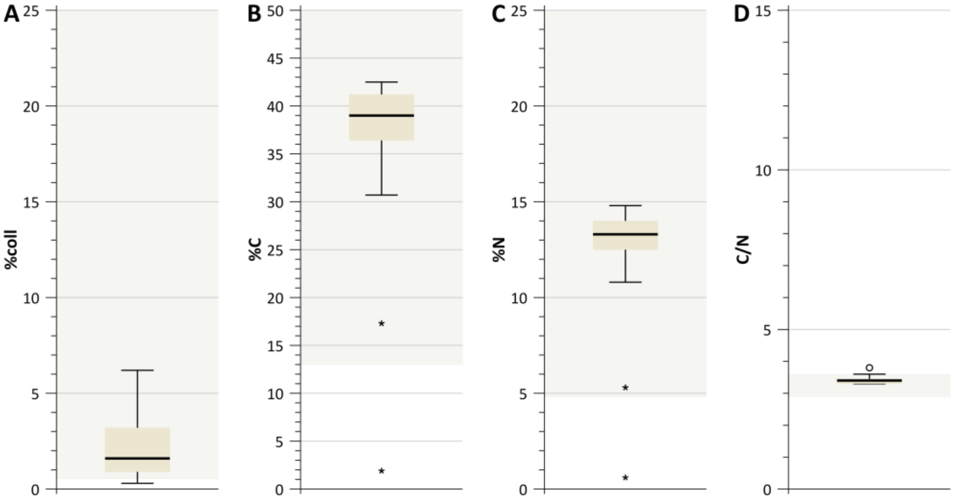


Figure 3.182. Pie chart representing the distribution of human samples from the cemetery of Castellar del Vallès by age, sex and collagen quality. Numbers represent the absolute frequency of each group

Figure 3.183. Boxplots representing the collagen quality indicators of human samples from the cemetery of Castellar del Vallès. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

3.3.2.4 Human diet

3.3.2.4.1 Sampling

Twenty-three individuals from the cemetery of Castellar del Vallès were sampled for being included in the palaeodietary study (figure 3.182). All the individuals which preserved any suitable anatomical element were sampled. Only a few individuals very partially preserved which were identified in secondary deposits on top of burials (i.e. secondary deposit in tumulus) were excluded, because it was difficult to trace their origin confidently and avoiding duplicate samples was a priority. About a third of the final assemblage was formed by subadults, comprising a fetus. The only subadult age category absent were juveniles, since it was not present either in the complete population. The remaining two thirds were made up by adults, among which male and female individuals were approximately in the same proportion as in the whole population. In most instances the anatomical element sampled were ribs, but in a few cases where these were not available long bone fragments were used.

3.3.2.4.2 Collagen quality

Collagen quality of the human samples from Castellar del Vallès was reasonably good (table 7.9, table 7.10, figure 3.182, figure 3.183). Most of the samples had collagen yields (%coll) greater than 0.5% and only one individual with a collagen yield of 0.3% was below this threshold. The minimum carbon weight content (%C) recorded was 1.9% and the maximum 42.5%. Similarly, nitrogen weight contents (%N) spread between 0.6% and 14.8%. Two samples concentrated the lowest values on both variables. Carbon to nitrogen atomic ratios (C/N) were between 3.3 and 3.8, but only one sample was outside the acceptable range. In addition, it was the sample with the lowest collagen yield. Eventually, 21 out of 23 samples were valid for further interpretations, while two were rejected due to poor collagen preservation.

3.3.2.4.3 Results

Thanks to good collagen preservation, twenty-one of the individuals from Castellar del Vallès were useful for palaeodietary reconstruction (table 3.50, table 7.9, figure 3.184). This means two thirds of the total of individuals recovered and it makes this population one of the best represented in this thesis. Most of the dataset was quite homogeneous for both carbon and nitrogen stable isotope ratios, but especially for the former. There was also a number of outliers, which added significant variability to the assemblage and must be interpreted in demographic terms.

Table 3.50. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of human samples from the cemetery of Castellar del Vallès. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All humans	21	-18.7	0.6	-19.8	-17.3	2.5	9.3	1.1	8.2	12.9	4.7
Subadults	8	-18.7	0.8	-19.8	-17.3	2.5	9.9	1.6	8.2	12.9	4.7
Fetus	1	-17.8	-	-	-	-	10.3	-	-	-	-
Infans 1A	1	-17.3	-	-	-	-	11.7	-	-	-	-
Infans 1B	4	-19.2	0.5	-19.8	-18.6	1.2	8.8	0.5	8.2	9.4	1.2
Infans 2	2	-18.9	-	-19.1	-18.6	0.5	11.0	-	9.0	12.9	3.9
Adults	13	-18.7	0.4	-19.3	-18.0	1.3	9.0	0.4	8.4	9.7	1.3
Male adults	5	-18.7	0.5	-19.3	-18.1	1.2	9.1	0.2	8.8	9.4	0.6
Female adults	4	-18.7	0.5	-19.2	-18.0	1.2	9.1	0.5	8.4	9.7	1.3
Grave g absence	20	-18.7	0.6	-19.8	-17.3	2.5	9.4	1.1	8.2	12.9	4.7
Grave g presence	1	-19.1	-	-	-	-	8.7	-	-	-	-

Starting with $\delta^{13}C$, the mean of the individuals from Castellar del Vallès was -18.7‰ and they had a standard deviation of 0.6‰ and a range of 2.5‰. These figures indicate most samples were tightly clustered around the mean but there were also a few individuals diverging notably from it, which were the cause of the relatively big range. The offset between the mean $\delta^{13}C$ of humans and adult herbivores from Castellar del Vallès was 1.1‰ (see section 3.3.2.3.3). This is slightly more than the fractionation typically assumed for the transition between trophic levels (~1‰). According to these data, the diet of the population from Castellar del Vallès would have been predominantly based on C_3 resources, so as winter crops, such as wheat, barley, rye and oats, would have been one of the main components, probably together with legumes, vegetables and fruits.

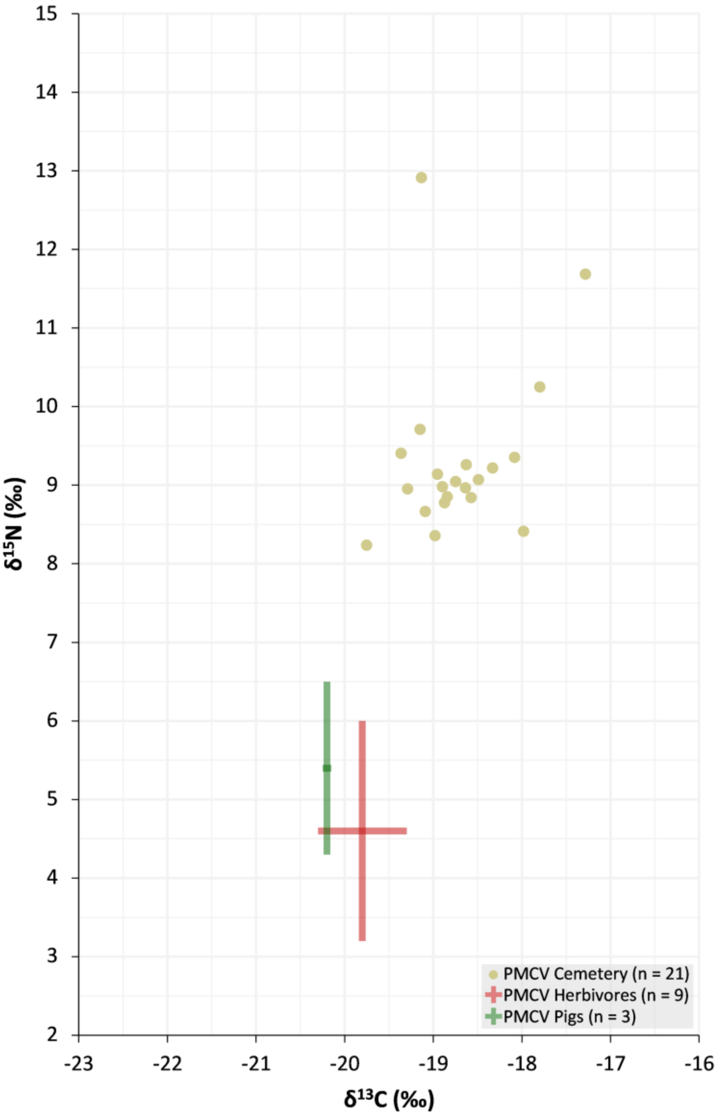


Figure 3.184. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from Castellar del Vallès. Crosses represent mean and one standard deviation of the fauna from Castellar del Vallès grouped by feeding regime. Subadult specimens were excluded from the calculation of these parameters

However, there are several signs which point at the consumption of small but regular amounts of C_4 plants by some of the individuals with the most enriched $\delta^{13}C$ values. Carbon stable isotope ratios of the adults above -18.5‰ are difficult to explain only on the basis of C_3 resources, even more when the majority of local livestock is known to have had exclusive C_3 diets, so the enriched isotopic signal of millets could not have arrived to humans through animal products. For these reasons, it is likely there was an enriched carbon source in the diet of at least some of the individuals from Castellar del Vallès. Theoretically this could have been marine fish, which is characterised by carbon stable isotope ratios notably more positive than terrestrial resources, and the proximity of the site to the coast would not make it impossible. Nevertheless, the individuals in this assemblage lack the simultaneous enrichment of nitrogen isotope ratios caused by marine fish consumption, so the regular intake of this food resource can be ruled out. Still, it is possible that marine fish was eaten at Castellar del Vallès occasionally. All things considered, the most probable source of enrichment of $\delta^{13}C$ in this assemblage were C_4 plants, almost certainly broomcorn and foxtail millets, which were the only crops of this type known in early medieval Iberia. In any case, the consumption of millets at Castellar del Vallès would not have been widespread. It would have been a minor component of the diet of between a third and half the individuals, but its intake would have been regular enough to be noticeable on bone collagen. There is a further argument which supports the consumption of millets by at least some of the individuals of this assemblage and it is the so-called routing effect (Ambrose & Norr 1993, see section

2.4.1.4.4). This phenomenon implies that in situations where protein comes principally from C_3 sources, while energy does also include C_4 plants, the isotopic signal of the latter will be underrepresented on bone collagen because this tissue is preferentially formed from the protein fraction of diet. This is just to warn that the importance of millets at Castellar del Vallès may be underestimated due to the nature of the proxy analysed.

Nitrogen isotope ratios offered a significantly more homogeneous picture, although it may not look like so at first. The mean $\delta^{15}N$ of the humans from Castellar del Vallès was 9.3‰, with a standard deviation of 1.1‰ and a range of 4.7‰. Measures of statistical dispersion of this assemblage may seem large, but they are mostly due to the presence of two extreme outliers and an individual that, without being a statistical outlier, had a very different $\delta^{15}N$ value in comparison to the dataset as a whole. In fact, when these three individuals are excluded, eighteen out of the twenty-one samples successfully analysed clustered in a range of 1.5‰. The offset between the mean nitrogen isotope ratio of the humans and the adult herbivores from Castellar del Vallès was 4.7‰ (see section 3.3.2.3.3), which is almost the equivalent to a complete trophic level shift (~5‰). This would indicate that in general the proportion of animal protein consumed by these individuals was great. Besides, considering the uniformity of $\delta^{15}N$ values within the core of the assemblage, there would not have been relevant internal differences in the access to this type of food resource. The elevated $\delta^{15}N$ values of this human assemblage regarding local herbivores could also be explained by the consumption of high trophic level animal protein. On one side, the pigs from Castellar del Vallès, the only omnivores from this site analysed, tended towards greater $\delta^{15}N$ values than herbivores, indicating they had variable proportions of animal protein possibly coming from domestic waste (see section 3.3.2.3.3, Hammond & O'Connor 2013). Thus, if the individuals in this assemblage were getting their animal protein preferentially from pigs, the quantitative importance of animal products in the whole diet would have been smaller. On the other, zooarchaeological analyses observed a significant proportion of both ovicaprids and pigs killed at young ages for meat consumption (J.A. Molina 2008b, J.A. Molina 2008c). Such young specimens would have very likely retained the enriched isotopic signature of suckling (Balasse 2014: 4125–4127), so the humans eating them would have resulted into elevated nitrogen isotope ratios without the intake of quantitatively large proportions of animal protein. At the moment it is not possible to determine which one of the two hypotheses proposed, the intake of great proportions of animal protein or the preferential consumption of high trophic level animal protein, was responsible of the high $\delta^{15}N$ values of the humans from Castellar del Vallès, but probably both factors contributed somehow to it. The outliers identified on this variable will be commented on the next paragraph, because they are easier to understand in relation to age.

The assemblage from Castellar del Vallès was probably not big enough to be able to draw meaningful conclusions about the relationship between food consumption patterns and demographic variables such as age and sex (figure 3.185, figure 3.186). Still, a few interesting observations can be made. Overall, the main difference between subadults and adults was variability, which was much greater among the former. However, the differences between the distribution of carbon and nitrogen stable isotope ratios of subadults and adults were not statistically significant ($\delta^{13}C$ PMCV subadults (n = 8) vs adults (n = 13), Mann-Whitney U test: U = 57.000, z = 0.363, p = 0.750; $\delta^{15}N$ PMCV subadults (n = 8) vs adults (n = 13), Mann-Whitney U test: U = 43.500, z = -0.618, p = 0.547). Actually, the mean $\delta^{13}C$ of subadults and adults was exactly the same. Both age groups were present along the complete range of carbon stable isotope ratios, but what distinguished subadults was the monopolisation of the most extreme values on either end. The differences were clearer on nitrogen isotope ratios. The mean $\delta^{15}N$ of adults was 0.9‰ smaller than subadults' and, while adults were scattered in a range of 1.3‰, subadults spanned up to 4.7‰. This was obviously due to the presence of two extreme outliers and a deviant individual which will be discussed below.

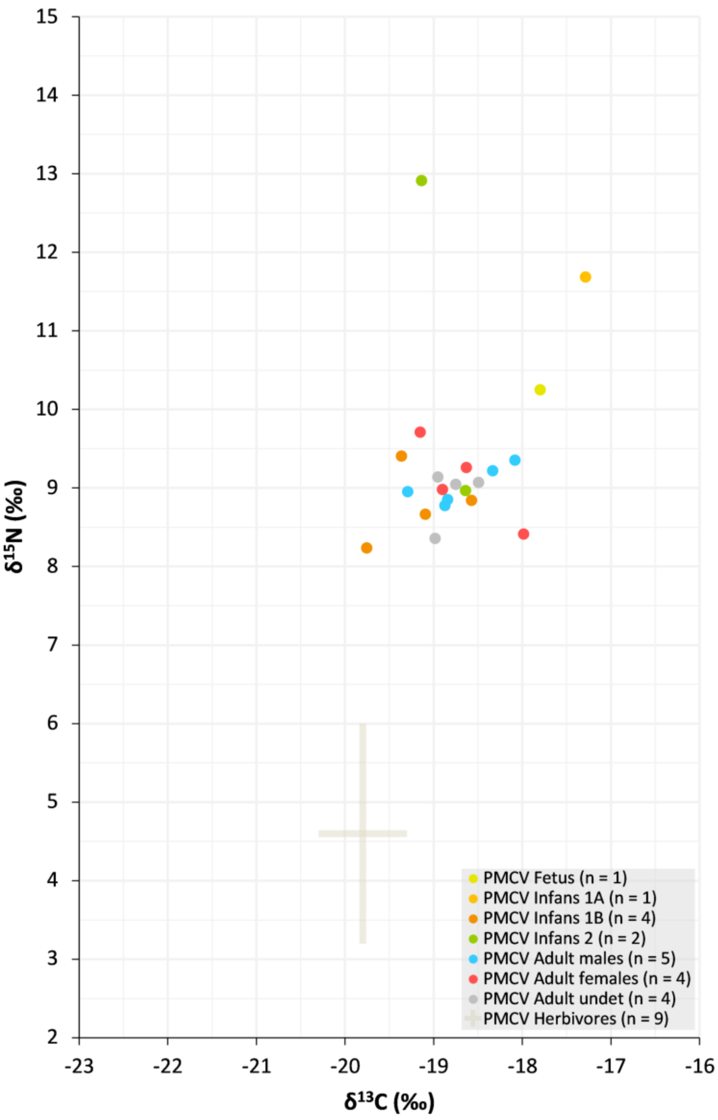


Figure 3.185. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from the cemetery of Castellar del Vallès divided by demographic categories. Cross represents mean and one standard deviation of herbivores from Castellar del Vallès excluding subadult specimens

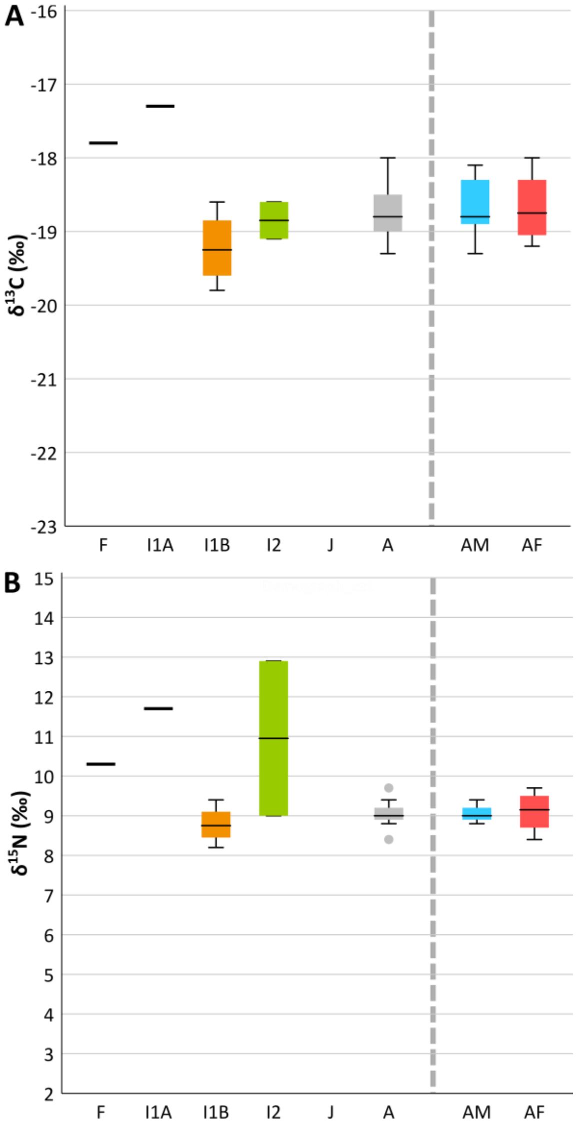


Figure 3.186. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from the cemetery of Castellar del Vallès divided by demographic categories. Key: F = fetus, I1A = infans 1A, I1B = infans 1B, I2 = infans 2, J = juvenile, A = adults, AM = adult males, AF = adult females

One of the outliers was individual PMCV 16-1-103, an infans 1A who died between 3 and 9 months of age. This individual had the most enriched $\delta^{13}C$ in the entire assemblage, but what really stuck out was $\delta^{15}N$. The enrichment on both variables, together with the age of the individual, denotes this individual was being breastfed around the time of death. Breastfeeding babies are one trophic level above their mothers due to the fractionation that takes place between them (Beaumont *et al.* 2018, Dupras 2010, Reynard & Tuross 2015). In this case, individual PMCV 16-1-103 was 2.6‰ above the mean $\delta^{15}N$ of local adult females and the enrichment shown by the individual on $\delta^{13}C$ is probably also due to this phenomenon. Interestingly, when it died, this individual presented bilateral active cribra orbitalia (Brickley 2018, Cole & Waldron 2019), a non-specific sign of metabolic stress, which points at the existence of some kind of nutritional stress or underlying pathology, which could not be identified. In the same grave there was another individual who was interesting for similar reasons. This was individual PMCV 16-2-102, who was identified as a fetus who died between 38 and 40 weeks in utero. Its isotopic signature was not as extreme as that of individual PMCV 16-1-103, but it also showed notably enriched carbon and nitrogen isotope ratios in comparison to the bulk of the assemblage, without being an outlier though. This suggests this individual might have been born alive and been breastfed for a few days or weeks before dying. This would explain why it exhibits the same tendency as individual PMCV 16-1-103 but without having achieved so enriched values, instead of being closer to female adults, which is what would be expected for an unborn fetus. The fact that these two individuals, who were the youngest of the whole population (see section 3.3.2.2.2) and had similar life histories, were buried together is remarkable.

The other proper outlier identified at Castellar del Vallès was individual PMCV 50-1-458/472. This was an infans 2 between 11 years and 14 years and 6 months of age at death. It had a carbon stable isotope ratio close to the mean, but inclined towards depleted δ^{13}C values, pointing at the exclusive consumption of C_3 resources, and it was an extreme outlier on the variable of nitrogen isotope ratios. This individual's δ^{15}N was 3.6‰ above the mean of the assemblage and 1.2‰ more enriched than the closest counterpart. The offset with local adult herbivores was 8.3‰ and, even considering the specimen with the most enriched δ^{15}N, the difference was 5.3‰. These figures exceed by far the fractionation defined for one trophic level change, so it is unlikely such an extreme enrichment of δ^{15}N was only due to abundant animal protein intake or the consumption of high trophic level terrestrial protein. Such an isotopic signature could be caused by a diet based on freshwater fish, but this is unlikely since no other individual from the site shows a dietary pattern like this. Otherwise, this individual may be a migrant from a region with a different isotopic baseline, so its diet would be very difficult to interpret without more data. The last and most plausible option is that this individual was affected by an unknown type of stressful process, for example, malnutrition, disease or maybe the growth spur (D'Ortenzio *et al.* 2015, Richards & Montgomery 2012, Waters-Rist & Katzenberg 2010), which could have caused the enrichment of δ^{15}N for reasons unrelated to diet. This hypothesis would be supported by the finding of a linear enamel hypoplasia on the lower left inferior permanent canine (33), a non-specific indicator of stress that would indicate the existence of a source of stress since an early age, as the crown of this tooth is formed between 4 months and 6 years of age (Gustafson & Koch 1974). Unfortunately, the macroscopic preservation of the skeleton of individual PMCV 50-1-458/472 was not good and no other relevant pathological signs were recorded.

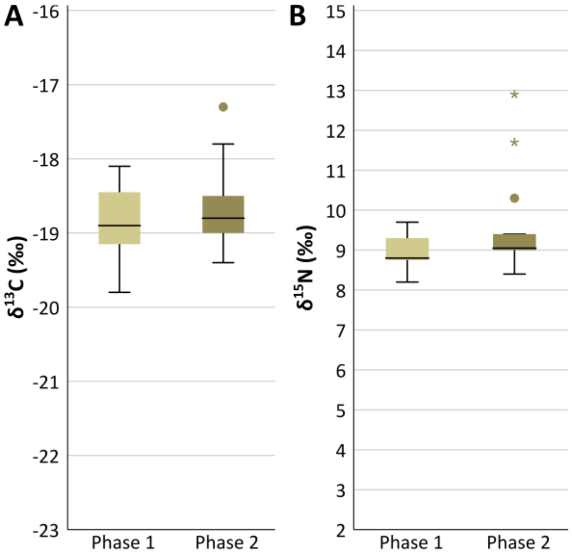


Figure 3.187. Boxplots representing (A) carbon stable isotope ratios (δ^{13}C) and (B) nitrogen isotope ratios (δ^{15}N) of humans from Castellar del Vallès divided by phase

Only nine out the fourteen adults successfully analysed had sex estimated, so the sample size to make comparisons between them was quite scarce. Nonetheless, it was possible to verify the mean δ^{13}C and δ^{15}N of adult males and females were exactly the same and there were no statistically significant differences between them (δ^{13}C PMCV adult males (n = 5) vs adult females (n = 4), independent samples t-test: t = -0.015, d.f. = 7, p = 0.988; δ^{15}N PMCV adult males (n = 5) vs adult females (n = 4), independent samples t-test: t

= -0.148, d.f. = 7, p = 0.886). The only difference observable was that the range of δ^{15}N of adult females was more than the double of adult males. That is, the nitrogen isotope ratios of adult females were more dispersed than adult males' or, in other words, adult females had more varying proportions of animal protein in their diets, with individuals well above and below the mean. Instead, the protein consumption pattern of all adult males seems to have been quite uniform. Anyhow, the small sample size these observations are based on should not be disregarded.

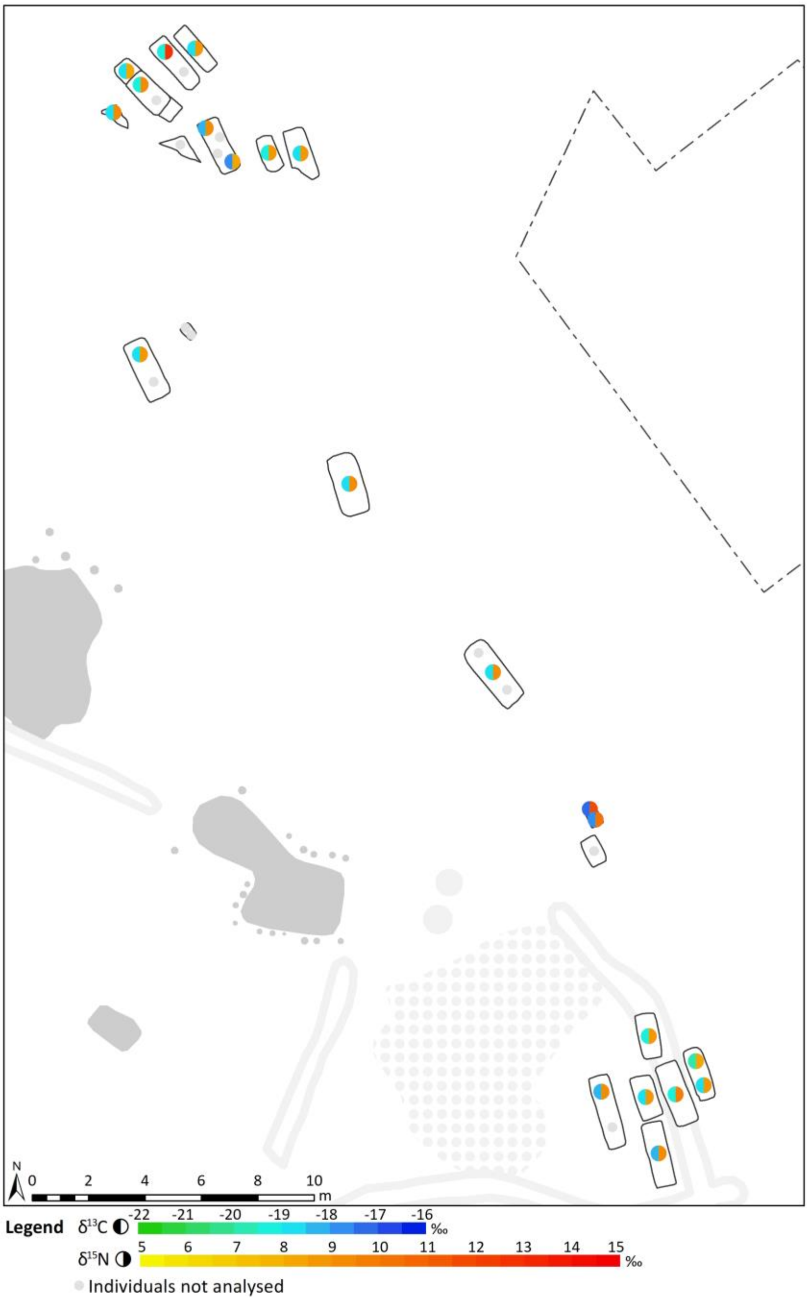


Figure 3.188. Castellar del Vallès, cemetery, spatial distribution of individuals divided by carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) (Roig & Coll 2010a: 87, Roig 2015: 350, modified). The dashed line depicts the excavation limits. Individuals successfully analysed are represented with a big circle divided in two. The left half symbolises δ^{13}C and the right half δ^{15}N according to the colour gradient shown in the legend. Individuals not analysed are depicted with a smaller grey point

Only one of the individuals from Castellar del Vallès successfully analysed had any grave goods. It was individual PMCV 18-1-114, an infans 1B who died between 2 and 4 years of age and was buried together with an egg. It had a δ^{13}C of -19.1‰ and a δ^{15}N of 8.7‰. These values are close to the mean of the population on both variables and indicate the use of grave goods during the funerary ritual of this individual did not imply a different diet or privileged access to any food resource during life. In this cemetery there was also another individual (PMCV 19-2-141) who had an egg as grave good. It was a probably male young adult deceased between 22 and 25 years of age. The graves of both individuals were located in the southern cluster of the graveyard, very close from each other. Unfortunately, this was one of the individuals with poorly preserved collagen, so it was not possible to get a more in-depth perspective on the relationship between diet and grave goods in this context.

Despite its modest dimensions, the cemetery of Castellar del Vallès was clearly organised on three well-dated sectors (see sector 3.3.2.1.3). Thanks to that, it was possible to compare the isotopic signatures of the individuals of phases 1 and 2 in order to check if there was any relevant transformation of food consumption patterns over time (figure 3.187). Seven of the individuals successfully analysed were located in the southern nucleus of the graveyard, dated to phase 1 (6th c.). The remaining fourteen individuals belonged to phase 2 (7th-8th c.) and they were distributed between the central and the northern sectors. The means and dispersion of carbon and nitrogen stable isotope ratios were very similar between both phases and in fact there were no statistically significant differences on either variable (δ^{13}C PMCV phase 1 (n = 7) vs phase 2 (n = 14), Mann-Whitney U test: U = 57.000, z = 0.598, p = 0.585; δ^{15}N PMCV phase 1 (n = 7) vs phase 2 (n = 14), Mann-Whitney U test: U = 61.500, z = 0.937, p = 0.360). Therefore, it does not look like there was a change in the diet of the population from Castellar del Vallès between phases 1 and 2. Likewise, observing the spatial distribution of individuals according to δ^{13}C and δ^{15}N (figure 3.188), no cluster grouping individuals with similar dietary patters was identified. Instead, individuals with very different isotopic signatures were buried next to each other and even individuals buried in the same grave differed notably. In this way, it can be concluded that the factors which determined the access to food resources were probably not relevant for the internal arrangement of the cemetery.

3.3.3 SANT MENNA

3.3.3.1 The site

3.3.3.1.1 Location and history of research

Sant Menna is the archaeological site around the early medieval church of the same name. It is located south of the town of Sentmenat (figure 3.189), in the region of western Vallès in the province of Barcelona. Its UTM ETRS89 coordinates are 31T 428039 4606370 and it is 203 meters above sea level. Sant Menna is 25 km north of Barcelona, 71 km southwest of Girona and 11 km northeast of the early medieval bishopric of Egara, current Terrasa. As for the other sites from the region included in this thesis, Sant Menna is 9 km northeast of Can Gambús and 4 km east of Castellar del Vallès. More precisely the site was situated on a small hill in a meander of the river Sentmenat, which is less than 100 m away. This would have been a location with great visibility and it would have guaranteed access to vast fertile fields for the community living around the church. In addition, the Catalan Pre-Coastal range is also close, so mountain pastures and forest resources would have been easily reachable too.

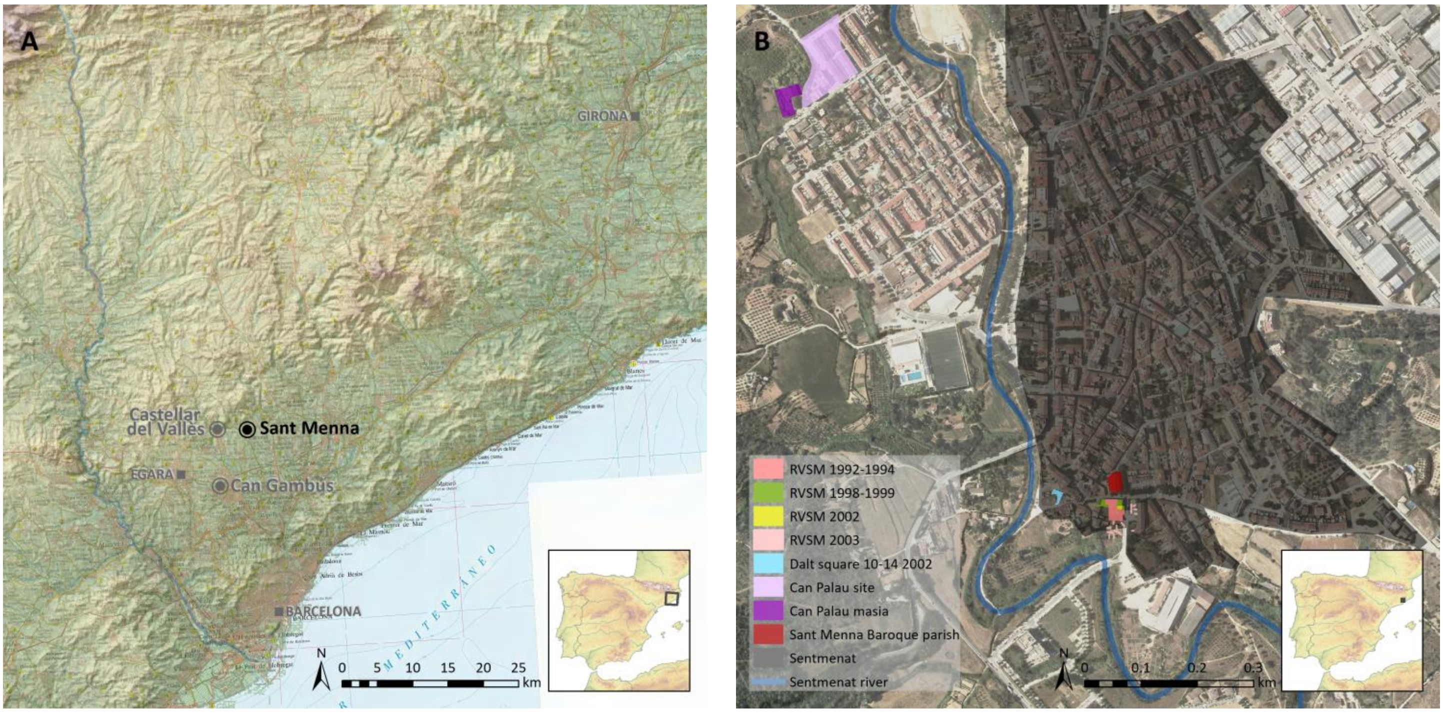


Figure 3.189. Geographical location of the site of Sant Menna (Sentmenat, Barcelona) (A) at the regional and (B) local scale

The first archaeological intervention on the site was carried out in 1992. At that moment the only church of Sant Menna known in the area was the 18th century Baroque parish. To the south there was the old rectory (i.e. the priest's house), which included a Romanesque bell tower and a large plot previously used as vegetable garden. At the beginning of the 1990s the whole complex was abandoned and in ruins. For this reason, in 1990 the council of Sentmenat decided to undertake the restoration of the rectory and its surroundings through the creation of a School Workshop. In 1992 the first archaeological evidence appeared while lowering the ground level of one of the rooms of the rectory. Then, it was decided to create a Module of Archaeology and between 1992 and 1994 around 850 m^2 were excavated under the old rectory, inside the bell tower and on part of the former vegetable garden. These works were directed by J. M. Coll, J. Roig and J. A. Molina (Roig *et al.* 1995). In the following years restoration works continued normally, but in 1998 they affected again archaeological deposits, so a new intervention was executed. Between 1998 and 1999 the initial excavation area was extended 340 m^2 under the supervision of J. M. Coll (1999). In 2002 the complex of the old rectory suffered new modifications, because one of its rooms was to be transformed into an assembly hall. This sector of approximately 60 m^2 was included within the excavation area intervened in 1998-1999 but its stratigraphy had not been completely dug. Hence, J. M. Coll (2005) directed the last archaeological campaign within the limits of the old rectory. One year later, in 2003, the plot surrounding the rectory to the east and south was surveyed before the start of a construction project. Fifteen test pits covering in total 150 m^2 were scattered around the 2400 m^2 of the field affected. This intervention was accomplished by the company Arqueociència under the direction of A. Pancorbo (2003). Archaeological evidence and human remains corresponding to the period of interest of this thesis were only recovered during the first campaign, accomplished between 1992 and 1994. At the moment the resulting findings are curated at the storage facilities of the Museum of Archaeology of Catalonia in Cervera.

The publication of the monography about the first archaeological campaign in Sant Menna by J. Roig, J. M. Coll and J. A. Molina (1995) was exemplary. Besides, the same authors published a few papers on specific periods of the site (Coll *et al.* 1997, Coll *et al.* 2003). Given that it covers the whole Middle Ages, the case of Sant Menna has been used to illustrate several topics such as rural settlement patterns (Roig 2009, Roig 2011b), storage systems (Roig 2013) and funerary practices (Roig & Coll 2012a, Roig 2015, Roig 2019). Except for early medieval pottery imports (Pociña 1995), the archaeological materials from Sant Menna have only been analysed together with those from other sites in the same region (Coll & Roig 2003, Coll 2011). In general, bioarchaeological records have not been studied. The only exception is an unpublished short report about the fauna remains from the intervention of 2002 (J.A. Molina 2005), which did not affect any context dated to between 5th and 8th centuries. The human assemblage dated to the first early medieval phase was preliminarily assessed by A. Mestre (1995). Still, she did not complete the study, so the entire population was analysed by the author, also with the aim of putting methods at the same level of the other cases included in this research.

3.3.3.1.2 The settlement

The site of Sant Menna covers a wide historical sequence since the very beginning of the medieval period until nowadays. The oldest evidence was the construction of the first church of Sant Menna during the second half of the 5th century. No previous archaeological remains were found in the site or in its immediate vicinity. The closest direct precedent is at Can Palau (figure 3.189B, Coll 2003), a site on the other side of the river Sentmenat, 1 km northwest of Sant Menna. Here a late Roman funerary area dated to the 4th century, including a mausoleum and several inhumations, as well as a contemporary productive area, were excavated. The evidence suggests this was part of a Roman villa whose *pars urbana* would have been under the current *masia* of Can Palau. This site is also interesting because, even if it was abandoned in the middle of the 5th century, it was reoccupied during the 6th century by a small peasant community, so it would have been inhabited at the same time as Sant Menna.

Coming back to Sant Menna, as mentioned above, the sequence started with the construction of a church during the second half of the 5th century (phase 1A, mid-5th-6th c., figure 3.190A, Roig *et al.* 1995: 26–43). It was a building of approximately 80 m^2 formed by a single nave with a square apse on the eastern end and a separated room against the northern wall. The specific function of the latter is unknown, but, considering the existence of a circular cut on its floor, it is proposed here that it could have been a baptistery. The church was built in rubble masonry made of pebbles, the floor was of *opus signinum*, the roof was probably covered with Roman-style *tegulae* and *imbrices*, and there is evidence that part of the temple would have been decorated with frescos. A table stand probably belonging to this phase was identified inserted in a pillar of the Baroque parish. It was made of a reused Roman marble piece and interestingly it was full of 10th century graffiti with names of priests. Since the first moment the church assumed funerary functions and a cemetery developed inside and around it. There were also other types of structures dated to this phase. On the north-western corner of the site there was a landfill with plenty of material dated to the second half of the 5th century, that is, contemporary to the construction of the temple. Moreover, two silos located south of the church were dated to between mid-5th and 6th centuries. From the 7th century on it is possible to distinguish a new phase (phase 1B, 7th-8th c., figure 3.190B, Roig *et al.* 1995: 44–57), especially when it comes to the cemetery and silos. The church stayed unchanged until the 8th century, but the graveyard grew. Burials inside the temple ceased and some of the new tombs in the outside overlapped those of phase 1A. In addition, three silos were assigned to this chronology. All of them were placed inside the church. Only the human assemblage dated to this period is included in this thesis.

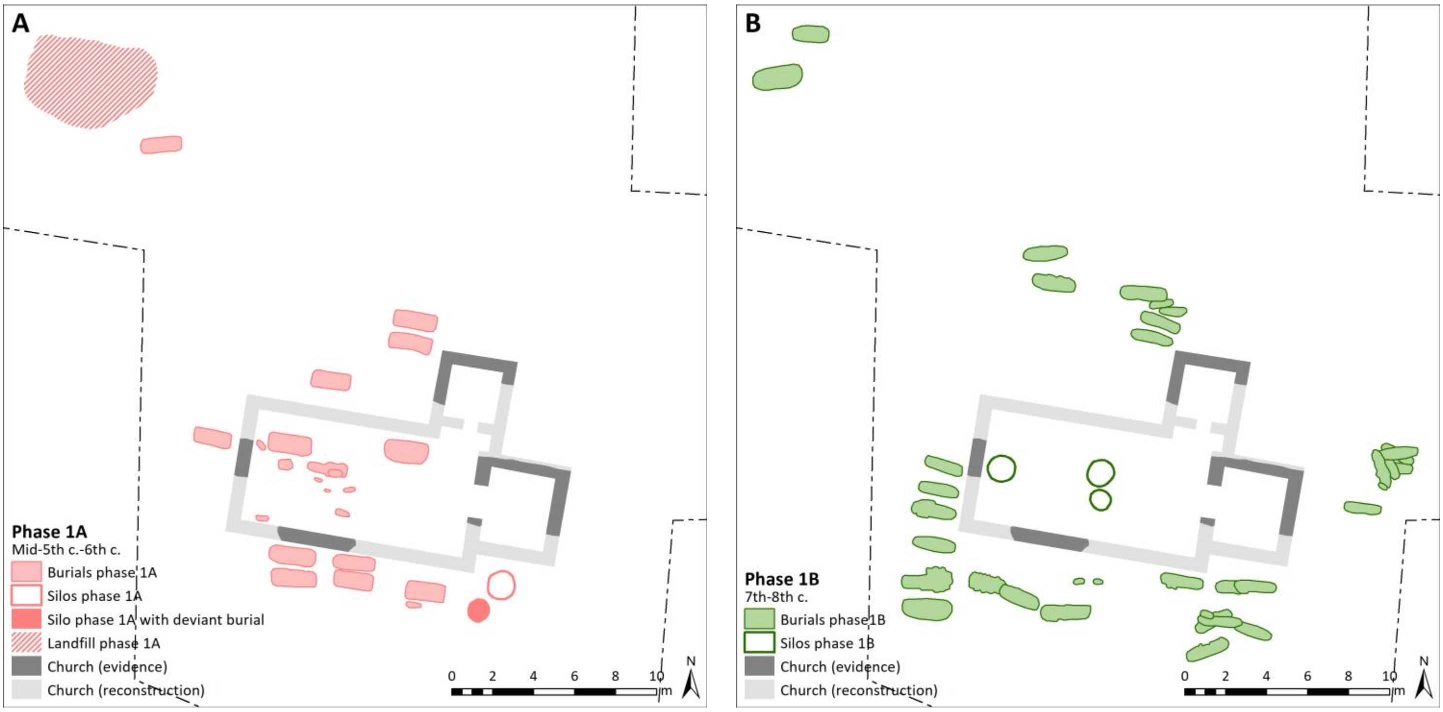


Figure 3.190. Sant Menna, diachronic evolution of the site (Roig *et al.* 1995: 27, 44, modified)

However, in the following lines the subsequent development of the site will be briefly described in order to provide a complete perspective. During the next phase (phase 2, 9th c.-mid-11th c., Roig *et al.* 1995: 60–71) the greatest change was the transformation of the room north of the church into a bell tower through the addition of a new section on top. Besides, the cemetery continued to grow around the church but respecting the previous burials. For this reason, the graves of phase 2 were further away from the temple. Moreover, thirteen new silos were opened, most of them inside the church. At the middle of the 11th century the original church was demolished and a new one was built in the same location in Romanesque style (phase 3, mid-11th c.-13th c., Roig *et al.* 1995: 72–85). It consisted on a single rectangular nave with a semicircular apse on the east and a small apsidiole north of it. A little bit later, during the 12th century, the bell tower, which was the only element maintained from the previous phase, was enlarged in height. At the same time a porch was built south of the church. Its function was not only to protect the entrance, but also to reinforce the slope of the hill on this side, where it was steeper. During this phase the community of Sant Menna kept on growing and the cemetery expanded as far as Dalt square (figure 3.189B, Belmonte 2006), 100 m west of the church. Silos were also scattered throughout all the space around the new Romanesque building and there was also one inside. At the end of the 13th century the new rectory was erected north of the church (phase 4, end 13th c.-15th c., Coll *et al.* 2003, Roig *et al.* 1995: 86–91). Initially it was a simple rectangular building divided by two arches. The last silo of the sequence, filled in the 14th century, was found inside. In the 15th century a new section was added to the east and the space between the church and the rectory was paved. The only modification that the Romanesque church suffered during these centuries was the installation of a choir on the western end. Likewise, the cemetery was moved south of the porch. Since that area was not excavated, almost no burials of this period are known. During the first part of the next phase (phase 5, 16th-18th c., Coll *et al.* 2003, Roig *et al.* 1995: 92–99) new blocks were added to the rectory and the internal distribution was adapted to accommodate productive activities on the ground floor. But the greatest change happened at the beginning of the 18th century, when the Romanesque church was demolished and the current Baroque one was built 50 m north of the former. Only the bell tower survived. As a consequence of this rearrangement, some years later the main façade of the rectory was transferred from the south of the building to the north, so as it faced the new parish. Simultaneously, the space previously occupied by the early medieval and the Romanesque churches was levelled with a massive agrarian filling in order to be used it as a vegetable garden. During 19th and 20th centuries (phase 6, Roig *et al.* 1995: 100–101) the complex did not undergo significant changes and it degraded progressively.

There are no specific analyses about the material culture from the first phase of Sant Menna but, according to the regional studies available, it was similar to that from other contemporary contexts. There were pottery imports until the 6th century, which included Gallic and African finewares and amphorae from Baetica and Africa (Pociña 1995). Otherwise, the predominant type of pottery was reduction grey cooking coarseware, mainly pots, jars and bowls (Coll & Roig 2003). Along the 7th century the fast wheel stopped being the most common tool to produce vessels and during the 8th century they were mainly made with the slow wheel or by hand. Glass was abundant at Sant Menna (Coll 2011), especially during phase 1A. It was mostly transparent or aquamarine, as it was typical in the productions of up to the middle of the 6th century, and the most common items were drinking glasses and bowls. Metals were almost absent from the first early medieval phase of Sant Menna. Fauna and other bioarchaeological materials were not, but there are no studies available about them.

3.3.3.1.3 The funerary context

One of the main focuses of the archaeological interventions carried out at Sant Menna were the early medieval church and the cemetery developed around and inside it. Here only the funerary contexts assigned to phases 1A and 1B will be addressed (table 7.1, figure 3.191, Roig *et al.* 1995: 26–43). The church was built during the central decades of the 5th century and immediately the space inside and outside the temple started to be used for burials. Almost no contemporary residential or productive structures were found, except for the silos identified in both phases. Then, the relationship between the church, its cemetery and the rest of the settlement where it was certainly integrated is difficult to characterise. Fifty-eight funerary structures were assigned to phase 1. Thanks to stratigraphy, the chronotypology of graves and a radiocarbon date (table 7.3), burials could be divided in two phases. Phase 1A run between the middle of the 5th century and the 6th century and it included 23 graves distributed both inside and outside the church. In the interior of the temple they were restricted to the nave and they concentrated on the western end. Outside they were scattered north, west and south of the building, in most cases very close from the walls. The burials of phase 1A did not cut each other. Phase 1B covered 7th and 8th centuries. Thirty-five graves were opened during this period. All of them were located outside the church, surrounding it completely. Since they tended to respect the burials from the previous phase, some graves of phase 1B were quite far away from the temple. Besides, there were a few groups of tombs which intersected each other.

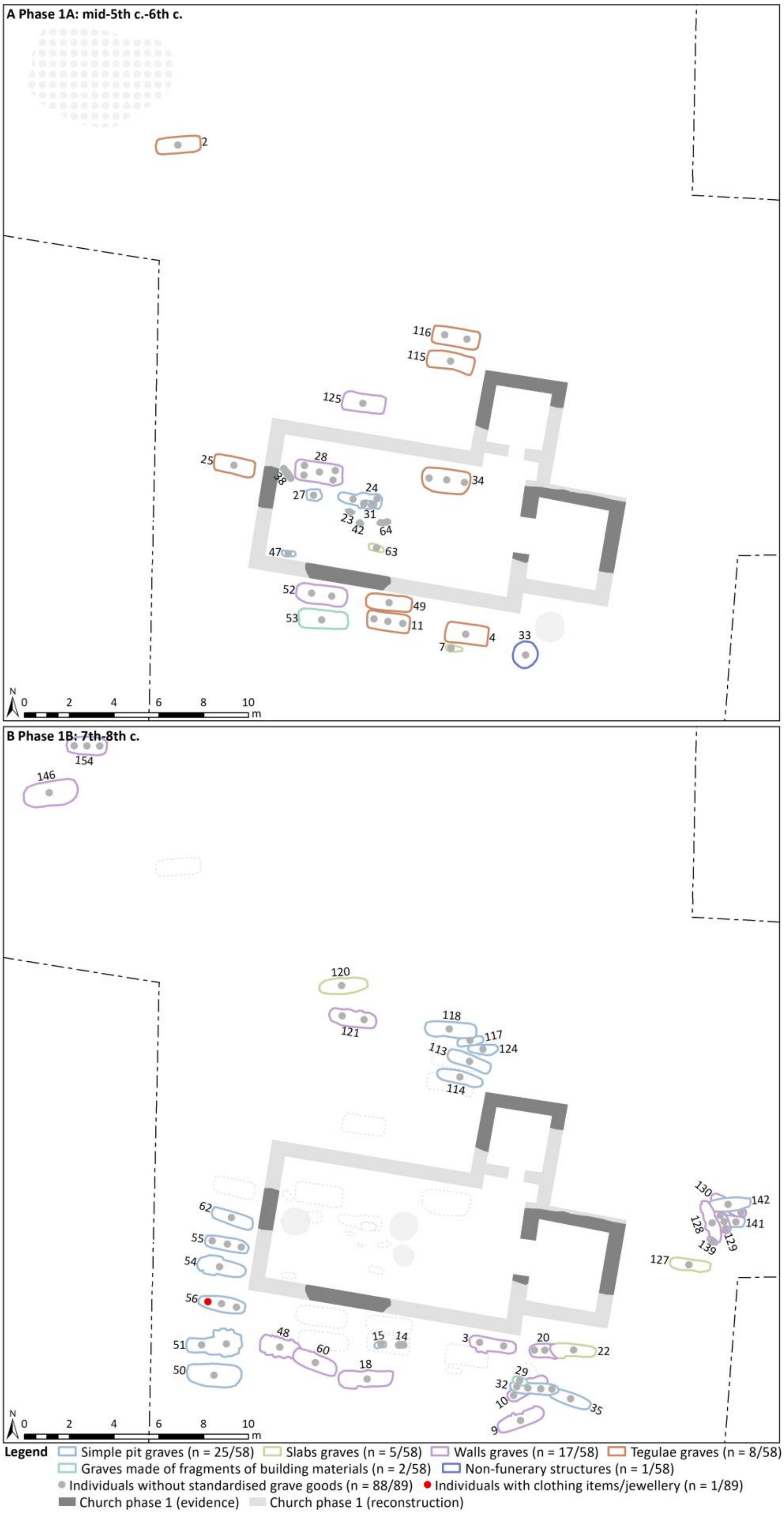


Figure 3.191. Sant Menna, cemetery around and inside the early medieval church (Roig et al. 1995: 27, 44, modified). (A) Phase 1A, mid-5th c.-6th c. (B) Phase 1B, 7th-8th c. The dashed black line depicts the excavation limits. The outline of burials is represented with a solid line whose colour shows the type of funerary structure according to the legend. The number next to each burial is its identifier. In (B) the outline of the burials of phase 1A is illustrated with a dotted line in order to facilitate the interpretation of the whole assemblage. Points symbolise the individuals recovered in each burial. Their colour indicates the presence or absence of grave goods as stated in the legend

Grave types were quite varied at Sant Menna. *Tegulae* graves was the only type of funerary structure exclusive to phase 1A. They were made up of several plain *tegulae* on the floor and a gabled cover formed also by opposing *tegulae*. They were found both inside and outside the church, accounting for slightly more than a tenth of the whole assemblage (n = 8/58 = 13.8%), but a third of the funerary structures of phase 1A. The other types of graves were present in both phases. Simple pits were the most abundant ones (n = 23/58 = 43.1%). During phase 1A they were predominantly associated to the subadult burials inside the church, but during phase 1B they became widespread. Walls graves, pits reinforced with perimetral rubble masonry walls, were also frequent (n = 17/58 = 29.3%), especially during phase 1B. Slabs graves differed from the former in that they were lined with vertical thin stone pieces. They were also scarcer (n = 5/58 = 8.6%), but they were equally represented in both periods. There were a couple of examples of graves made of fragments of building materials too (n = 2/58 = 3.4%), more specifically brick and *dolia* fragments. Lastly, south of the church there was a burial in a silo (n = 1/58 = 1.7%), that is, a non-funerary structure reused for the interment of an individual. The great majority of the funerary structures in Sant Menna were oriented in west-east direction (n = 47/58 = 81.0%). There were only a few variations with graves in northwest-southeast (n = 3/58 = 5.2%) and southwest-northeast direction (n = 2/58 = 3.4). The individual in the silo was the only one in north-south direction (n = 1/58 = 1.7%). In some cases it was not possible to determine orientation because the burials were not well preserved (n = 5/58 = 8.6%).

The burials from Sant Menna dated to phase 1 made a total of 89 individuals. The mean occupation rate was 1.5 individuals per funerary structure and the maximum number of individuals found in a single burial was five. There were no significative differences in these figures between phases. Almost two thirds of the individuals were found in primary deposits. Most of them were laid in supine position (n = 53/89 = 59.6%), but there was also a minority in foetal position (n = 3/89 = 3.4%). Two of them were fetuses, which is one of the only cases when this position is considered conventional. Instead, the other one was an adult, actually the one buried in the silo. It has to be underlined this position did not indicate the individual was thrown into the silo, as it was observed in other sites. Certain care was put into the burial of this individual. The deviation lies in the fact that neither the funerary container nor the position of the corpse were comparable to the funerary ritual applied to the rest of the population. Another third of the individuals were recovered in secondary deposits. A tenth were found in easily recognisable reductions next to other individuals (n = 10/89 = 11.2%), another tenth in the filling of burials (n = 11/89 = 12.4%) and another one in uncharacterised secondary deposits (n = 10/89 = 11.2%). In a few cases the original position of the individuals could not be determined (n = 2/89 = 2.2%) due to poor preservation.

According to the evidence available, i.e. nails and brackets, at Sant Menna only a few individuals were buried in wooden coffins (n = 3/89 = 3.4%). Interestingly, all of them were dated to phase 1A. In the same way, the finding of grave goods was incidental (table 7.2). Only two individuals, both of them dated to phase 1B, were accompanied by any kind of artefact (n = 2/89 = 2.2%). In one case it was a clothing item or a jewellery piece (n = 1/89 = 1.1%), more specifically a bead. In the other (RVSM 032-1-130(038b)) it was an unidentified object made of bone. No containers (n = 0/89 = 0.0%) or standardised tools or weapons (n = 0/89 = 0.0%) were recovered.

3.3.3.2 The human population

3.3.3.2.1 Macroscopic preservation

The human population corresponding to the phase 1 of Sant Menna was made up of 89 individuals distributed in 58 burials inside and outside the contemporary church (figure 3.191). According to the data available (Roig *et al.* 1995), all the individuals preserved at least some skeletal elements. However, thirteen individuals were missing at the storage facilities of the Museum of Archaeology of Catalonia in Cervera, where all the materials from Sant Menna are curated. It was not possible to clear up the location of this small set of individuals, but it is known that, right after the excavation, the human assemblage was sent to the Laboratory of Physical Anthropology of the Museum of Archaeology of Catalonia in Barcelona to be studied and afterwards they were transferred to the storage unit of the same institution in Girona. It is likely they went missing in one of these moves. Whatever the reason may be, only 76 out of the 89 individuals recorded could be studied (n = 76/89 = 85.4%, table 7.1). The macroscopic preservation of this human assemblage was the best among all the populations analysed for this thesis (figure 3.192, table 7.7). Even though more than half of the individuals only preserved less than 25% of the skeleton, a quarter conserved between 25% and 50% of it and almost five out of twenty up to 75%. Most of the assemblage was very fragmented, with slightly more than 80% of the individuals with more than 75% of the skeletal elements preserved fragmented. However, there was almost a tenth of the individuals which had less than 25% of the skeletal elements preserved fragmented. Besides, more than two thirds of the population presented excellent bone surface preservation, with slight surface erosion (grade 1) at most. The worst preserved individuals were between having most of the surface eroded with uneven distribution of the depth or degree of the alterations (grade 3) and presenting heavy erosion on all the surface with some modifications of profile (grade 5), but quantitatively they meant less than a tenth of the assemblage. These favourable preservation conditions allowed for quite a detailed osteoarchaeological study of the human population of the phase 1 of Sant Menna, with precise age estimation and sex determination for a good number of individuals.

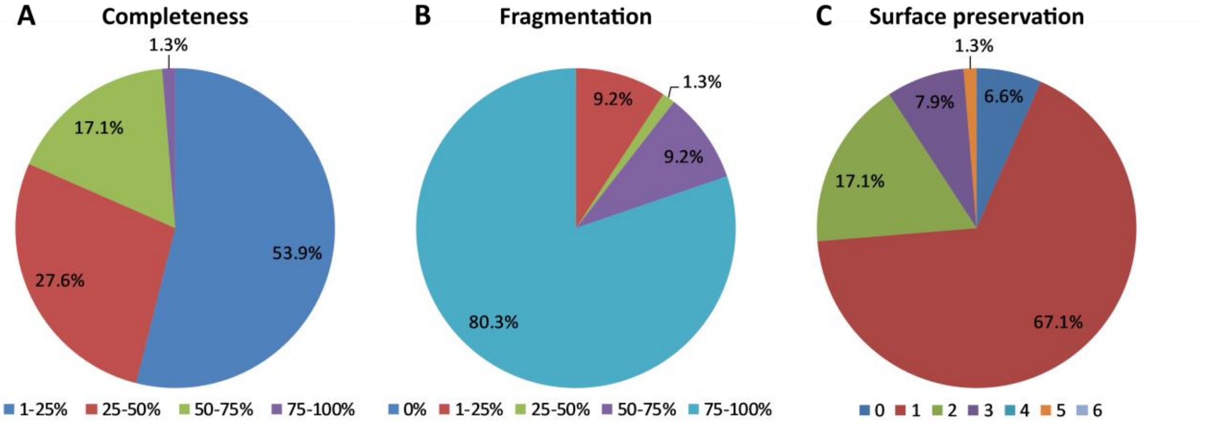


Figure 3.192. Pie charts representing the distribution of the three variables for the assessment of the macroscopic preservation of the human population from the cemetery of phase 1 of Sant Menna. (A) Completeness. (B) Fragmentation. (C) Surface preservation

3.3.3.2.2 Demography

The human assemblage corresponding to the phase 1 of Sant Menna was possibly the population analysed in this thesis which resembled more closely premodern demographic models. A minimum number of 76 individuals were available for study (table 3.51, figure 3.193, table 3.52, table 7.4, table 7.5, table 7.6). Almost four out of ten (39.5%) were subadults, with a clear predominance of infans 1. This age category meant nearly a quarter of the assemblage and among them individuals under two years of age at death were especially numerous. This points at a great mortality rate during the first years of life, which would be in line with preindustrial demographic dynamics as those expected for a rural community like Sant Menna. Besides, up to five fetuses were identified. This finding confirms the good preservation of the assemblage and it supports the idea that the period around birth was one of the moments of life with the greatest risk of death. Adults formed 60.5% of the population. Thanks to the good preservation of skeletal material, it was possible to estimate age with precision and to determine sex of more than half of them. Then, on one hand, it was revealed a predominance of old adults, that is, of individuals died after age 45. This is uncommon in archaeological populations because both the preservation bias (Gowland 2007: 161–162) and methodological issues (Bocquet-Appel & Masset 1982) benefit the easier recovery and identification of younger adults (Séguy & Buchet 2013: 29). However, in the two only cases analysed in this thesis where it was possible to estimate adult age at death with precision for a reasonable proportion of individuals (i.e. Dulantzi, phase 4, and Sant Menna), older adults prevailed. Still, it is difficult to decide if this could be a trend translatable to the other early medieval rural contexts studied here, if it may be a distinctive feature of the burial grounds organised around religious buildings or if it is just a coincidence caused by the small number of cases with valid data for analysing this issue. It is interesting to note that the only individual from Sant Menna buried in a non-funerary structure, namely, a silo, was also an old adult. On the other hand, with a result of 87 males per every 100 females, the sex ratio of Sant Menna depicted quite a balanced situation. Actually, this was one of the assemblages included in this research closest to parity. In addition, the slight imbalance detected was in favour of women, which is also rare among the case studies tackled here.

Table 3.51. Age and sex distribution by absolute frequencies of the human population from the cemetery of phase 1 of Sant Menna. Key: F = fetus, < 40 weeks in utero; I1A = infans 1A, birth – 2 years; I1B = infans 1B, 3 – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; Ssp = subadult sp, < 20 years; YA = young adult, 20 – 34 years; YMA = young-middle adult, 20 – 45 years; MA = middle adult, 35 – 45 years; MOA = middle-old adult, > 35 years; OA = old adult, > 45 years; Asp = adult sp, > 20 years; UA = undetermined age; M = male individuals (including probably male individuals); F = female individuals (including probably female individuals); US = undetermined sex (including ambiguous individuals)

	F	*I1A*	*I1B*	*I2*	*J*	*Ssp*	*YA*	*YMA*	*MA*	*MOA*	*OA*	*Asp*	*UA*	*Total*
M	-	-	-	-	-	-	4	2	-	5	1	1	-	13
F	-	-	-	-	-	-	2	4	-	-	5	4	-	15
US	5	13	5	2	1	4	-	-	-	-	2	16	-	48
Total	5	13	5	2	1	4	6	6	0	5	8	21	0	76

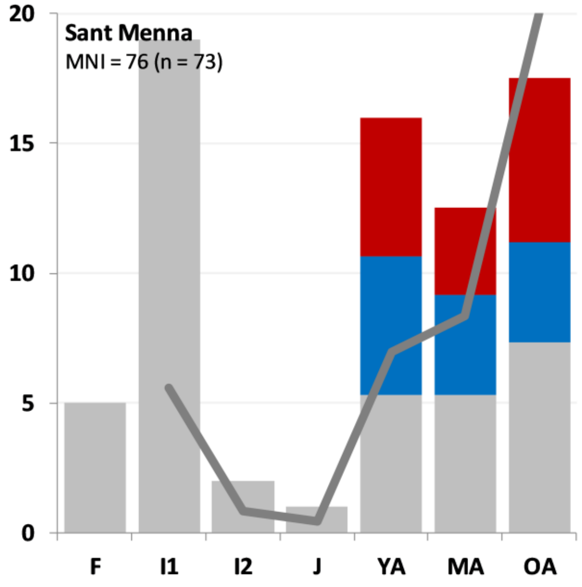


Figure 3.193. Demography chart of the human population from the cemetery of phase 1 of Sant Menna. Bars represent the absolute frequencies of each age category (F = fetus, < 40 weeks in utero; I1 = infans 1, birth – 7 years; I2 = infans 2, 8 – 14 years; J = juvenile, 15 – 19 years; YA = young adult, 20 – 34 years; MA = middle adult, 35 – 45 years; OA = old adult, > 45 years), separated by sex whenever possible (blue = male individuals, red = female individuals, grey = undetermined sex). The line depicts the progression of the probability of death (q_x) along age categories, calculated according to G. Acsádi and J. Nemeskéri (1970: 65). The minimum number of individuals of the population (MNI) and the number of individuals represented in the chart (n) are shown on the upper left corner. These two numbers differ because subadults sp (< 20 years) and individuals of undetermined age are not displayed

Table 3.52. Demographic descriptive indicators and palaeodemographic estimators of the human population from the cemetery of phase 1 of Sant Menna

Descriptive indicators	
MNI	76
%subad	39.5%
%ad	60.5%
S/A	0.65
M/F	0.87

Estimators	
JI	0.130
e_0	31.4
${}_1q_0$	0.238
${}_5q_0$	0.359

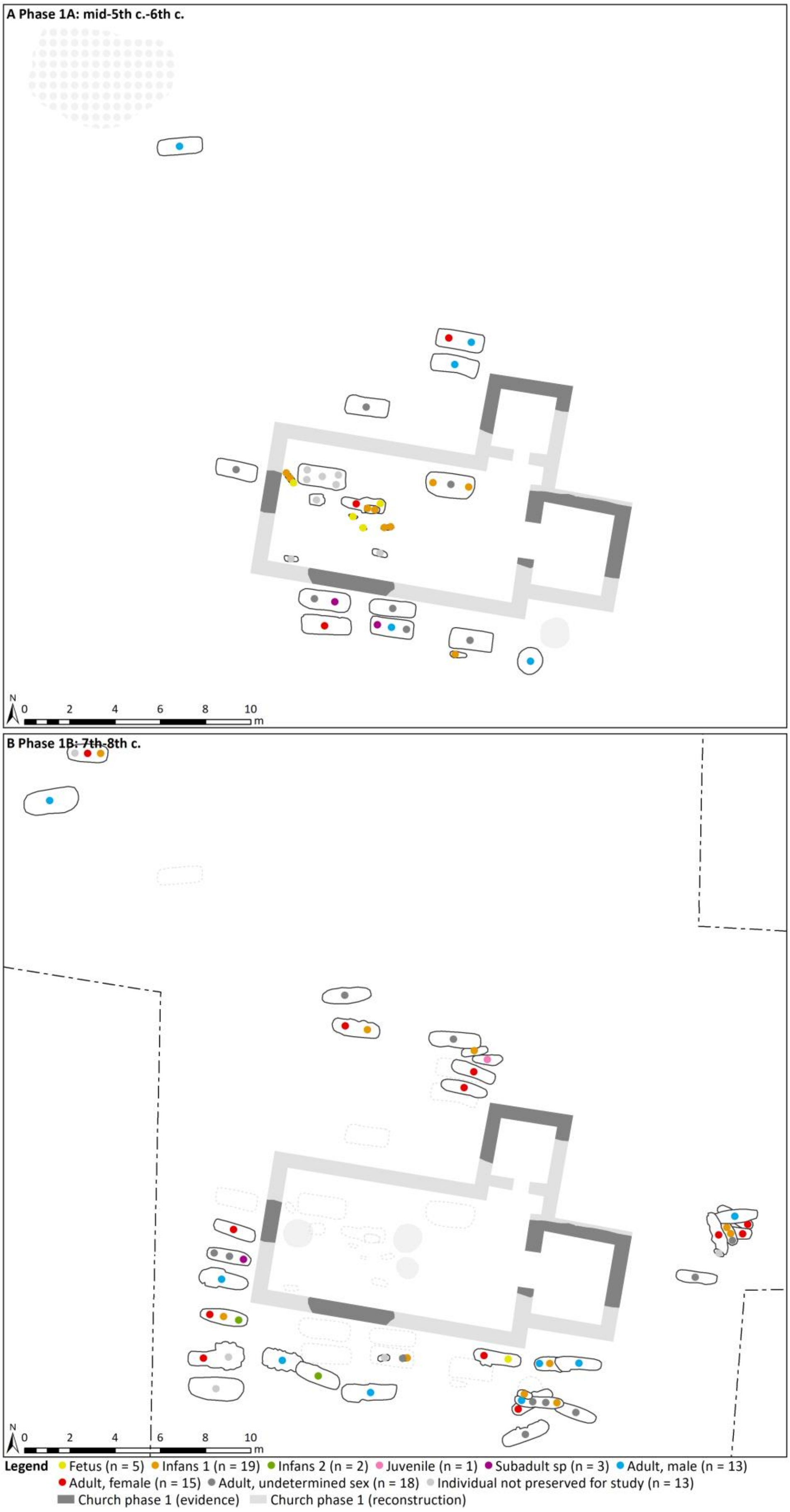


Figure 3.194. Sant Menna, cemetery around and inside the early medieval church, spatial distribution of individuals by age and sex (Roig et al. 1995: 27, 44, modified). (A) Phase 1A, mid-5th c.-6th c. (B) Phase 1B, 7th-8th c. The dashed black line depicts the excavation limits. In (B) the outline of the burials of phase 1A is illustrated with a dotted line in order to facilitate the interpretation of the whole assemblage. Points symbolise the individuals recovered in each burial. Their colour indicates their age and sex as stated in the legend

Altogether, the demographic profile of the assemblage of phase 1 from Sant Menna (figure 3.193) resembles the models for preindustrial agricultural populations (Chamberlain 2006: 64–68, Séguy & Buchet 2013: 114). The curve of the probability of death set off from infans 1 at a very high point, it dropped abruptly at infans 2 and even a little bit more at juveniles. Next, the risk of death of young adults reached a value similar to infans 1 and it continued growing along the subsequent adult age categories. This chart also reveals that sex ratio changed slightly across age groups. Among young adults, male individuals predominated (M/F = 2.00), but female individuals were majority among old adults (M/F = 0.20). Based on these data, males bore greater mortality rates during early adulthood than females, and female adults enjoyed longer longevity than their male counterparts. According to this distribution, the juvenility index estimated life expectancy at birth around 31.4 years, which looks like a plausible result considering the high mortality of youngest individuals and the weight of old adults in the assemblage. Likewise, mortality rates during the first years of life indicated almost a quarter of individuals died before turning one and around 35% between birth and the fifth birthday.

The analysis of the spatial distribution of this population based on age and sex (figure 3.194) suffered especially the loss of the skeletal remains of some of the individuals (see section 3.3.3.2.1), because the great majority of those disappeared came from the interior of the church, so it was not possible to get a complete picture of the differences between the individuals buried inside and outside the building. Burials inside the temple were only made during phase 1A and they were preferentially used for subadults. All of them were infans 1A, that is, individuals died before age 3, and four out of the five fetuses recorded were found here. Besides subadults, only a female young adult and an adult of undetermined sex were identified inside the church. Actually, the association between age and the location of burials was statistically significant (individuals inside the church: S = 12, A = 2, S/A = 6.00; individuals outside the church: S = 18, A = 44, S/A = 0.41; Fisher's exact test: n = 76, $p < 0.001$). Outside the temple subadults were randomly distributed all around the building. Unlike in the interior, they were not restricted to infans 1A and subadults of all ages were represented. The location of adult burials around the church did not follow any pattern either. Also, when there was more than one individual in a funerary structure, they were always of different ages or sex, and the same happened with the clusters of superimposed graves north, east and south of the building.

3.3.3.3 Faunal diet

3.3.3.3.1 Sampling

It was difficult to get fauna samples from Sant Menna contemporary to the human burials analysed here because most of the elements of phase 1 excavated were funerary structures and they do not tend to be rich in this kind of material. Then, on one hand, the few animal remains found in contexts of phase 1 were sampled. These were the landfill of phase 1A and the fillings of two graves, assigned to phases 1A and 1B respectively. On the other hand, samples were also taken from the filling of a silo located in the rectory and dated to the 14th century (phase 4), because it was known to have a good assemblage of animal remains. Even though these samples are not synchronous to the human population analysed, they can be useful to characterise the local isotopic baseline, which should not have suffered substantial transformations during this lapse of time. Nevertheless, only ten fauna samples from Sant Menna could be gathered (table 7.8, figure 3.195). Most of them were identified as herbivores (Bos taurus, Ovis aries/Capra hircus), but there were also a few omnivores (Sus scrofa domesticus, Avis). No samples from carnivores could be included. The whole assemblage was formed by adult specimens. Likewise, all the samples consisted of bone fragments.

3.3.3.3.2 Collagen quality

The fauna samples from Sant Menna presented quite variable collagen preservations (table 7.11, table 7.12, figure 3.195, figure 3.196). Half of them had collagen yields (%coll) below 1.0% and in two cases it was even lower than 0.5%, so the latter were discarded. Carbon weight content (%C) ranged between 2.8% and 48.9% and nitrogen weight content (%N) between 1.0% and 18.7%. Then, three samples fall outside the accepted ranges for carbon and nitrogen weight contents and were dismissed. Two of them were those which did not meet the requirement for collagen yield either. Carbon to nitrogen atomic ratios (C/N) spread between 3.1 and 3.9. The only sample outside the C/N values defined for well preserved collagen was also wrong in all the other indicators. Finally, three out of ten samples were rejected due to poor preservation and only seven could be used for further interpretation. It is interesting to note that all the samples which had to be discarded were dated to phase 1, while all the samples from phase 4 had well preserved collagen.

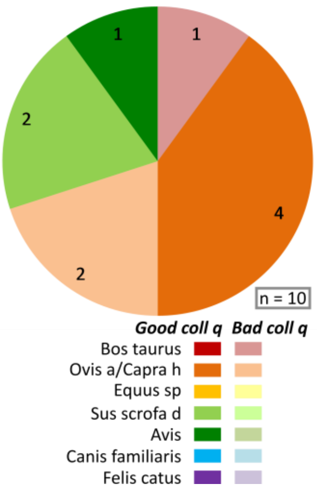


Figure 3.195. Pie chart representing the distribution of fauna samples from Sant Menna by taxa and collagen quality. Numbers represent the absolute frequency of each group

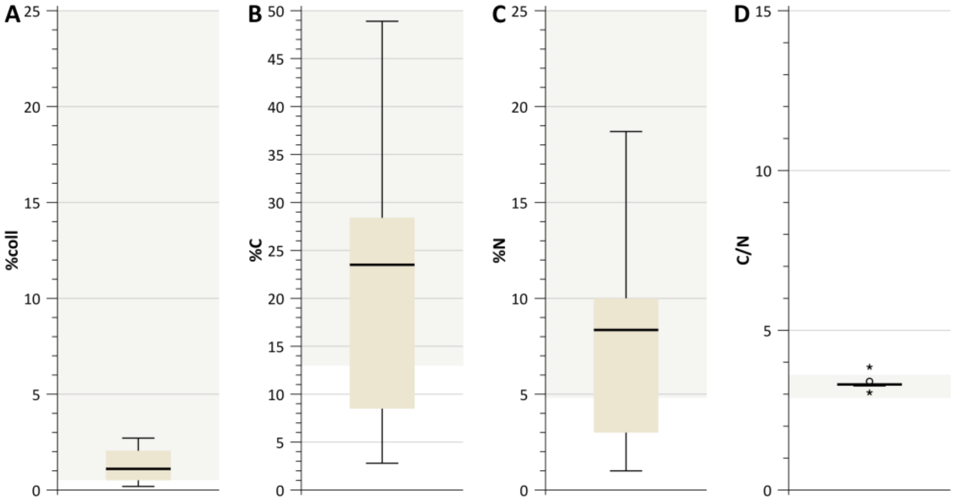


Figure 3.196. Boxplots representing the collagen quality indicators of fauna samples from Sant Menna. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

Table 3.53. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of fauna samples from Sant Menna. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one

	n	*δ¹³C (‰)*					*δ¹⁵N (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All fauna	7	-19.7	1.1	-21.2	-17.9	3.3	5.8	2.0	3.5	9.4	5.9
Herbivores	4	-20.0	1.0	-21.2	-18.7	2.5	4.6	1.1	3.5	6.1	2.6
Ovis/Capra	4	-20.0	1.0	-21.2	-18.7	2.5	4.6	1.1	3.5	6.1	2.6
Omnivores	3	-19.2	1.3	-20.6	-17.9	2.7	7.4	1.8	6.3	9.4	3.1
Sus scrofa d	2	-19.3	-	-20.6	-17.9	2.7	7.9	-	6.4	9.4	3.0
Avis	1	-19.2	-	-	-	-	6.3	-	-	-	-

3.3.3.3.3 Results

The fauna assemblage from Sant Menna (table 3.53, table 7.11, figure 3.197) was atypical because, due to the limitations to get samples and preservation issues, it was formed by just seven specimens successfully analysed, so it was the smallest in this thesis. All the four herbivores studied were ovicaprids. Their mean $\delta^{13}C$ was -20.0‰ and they had a standard deviation of 1.0‰. These $\delta^{13}C$ values are within the range usually interpreted as exclusive of C_3 eaters. However, one of the ovicaprids had a slightly enriched carbon isotope signature, which could point at the occasional consumption of C_4 plants too. Nitrogen isotope ratios of herbivores had a mean of 4.6‰ and a standard deviation of 1.1‰. These values are quite low, as it is expected for herbivores. The same ovicaprid which was enriched in δ^{13}C was also higher in δ^{15}N than the other specimens of the same taxon. Although these four ovicaprids were dated to two very different periods (phase 1: mid-5th-6th c., phase 4: 14th c.; see section 3.3.3.3.1), there was no association between chronology and their carbon or nitrogen stable isotope ratios.

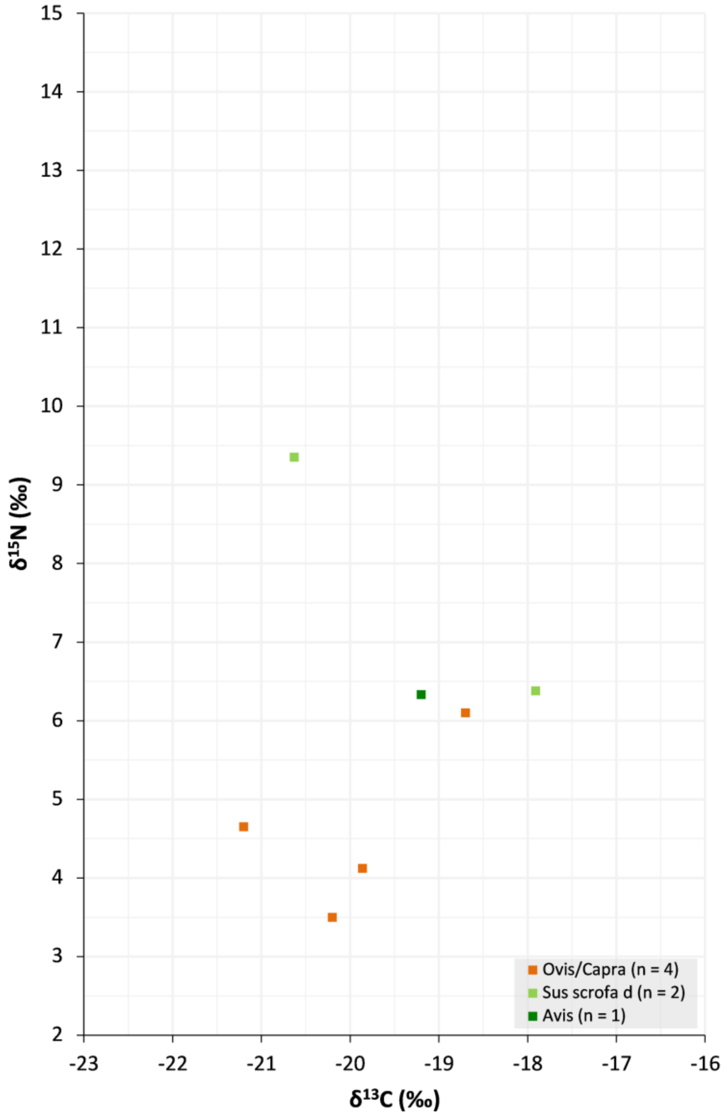


Figure 3.197. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of fauna from Sant Menna grouped by taxa

Omnivores from Sant Menna included two pigs and a fowl. Their δ^{13}C mean (-19.2‰) was slightly higher than herbivores' and they also had a wider standard deviation (1.3‰). Similarly, mean δ^{15}N of omnivores (7.4‰) was greater than for herbivores and standard deviation (1.8‰) was also broader. Going into detail, one of the swine was dated to phase 1 and the other one to phase 4. The former was the specimen with the highest δ^{13}C of the whole assemblage, which indicates its diet was mainly made up of C_3 resources, but it also had consistent amounts of C_4 plants. Considering it was an omnivorous animal, C_4 crops (i.e. millets) could have been consumed directly by the pig or indirectly through the intake of animal products from specimens fed on millets. Nonetheless, since the δ^{15}N of this pig was very similar to the contemporary ovicaprid RVSM F0118-OC, it seems reasonable to propose that the contribution of animal protein to the diet of this pig was not very relevant, so most of the enrichment of δ^{13}C would be due to the direct intake of millets by itself. Alternatively, this pig could come from an ecosystem with an isotopic baseline completely different from that of Sant Menna, maybe as a result of trade. Still, it has to be noted this is one of the highest δ^{13}C measurements obtained for the whole fauna assemblage analysed in this thesis. This means this pig is not comparable to any of the analogous samples in the same regions or in the others under study here. This fact reinforces the hypothesis that this pig was fed with significant amounts of C_4 plants, although the reason is unknown. The other pig analysed had a $\delta^{13}C$ values within the range of exclusive C_3 eaters and a quite enriched $\delta^{15}N$. The latter is consistent with a notable proportion of animal protein in its diet, which is consistent with the omnivorous diet of swine and suggests this specimen was kept next to the house and was probably fed with domestic waste. Finally, the only fowl analysed, a late medieval chicken, was also fed solely on C_3 foods according to $\delta^{13}C$ and its $\delta^{15}N$ was on the upper range of the ovicaprids and considerably below the late medieval pig.

3.3.3.4 Human diet

3.3.3.4.1 Sampling

Sixty-five individuals from the cemetery of phase 1 of Sant Menna were sampled for carbon and nitrogen stable isotope analyses (figure 3.198). The selection was as thorough as possible and only excluded the individuals which did not preserve anatomical elements appropriate for analyses and some individuals recovered in poorly characterised contexts (i.e. secondary deposit in filling, undetermined secondary deposits) which could potentially be duplicating other samples. The resulting assemblage was formed by approximately a third of subadults and two thirds of adults, a proportion similar to the one verified for the whole population. All subadult age categories were present. Likewise, male and female adults were equally represented. The preferred anatomical element to sample were ribs, but long bone fragments were also used in a good number of cases.

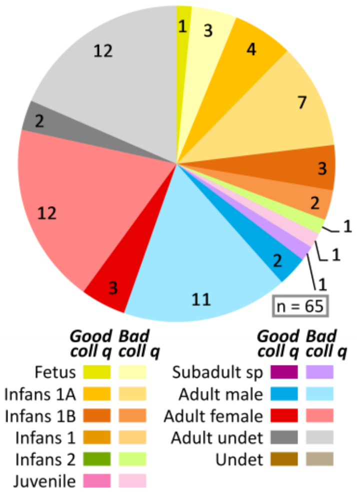


Figure 3.198. Pie chart representing the distribution of human samples from the cemetery of phase 1 of Sant Menna by age, sex and collagen quality. Numbers represent the absolute frequency of each group

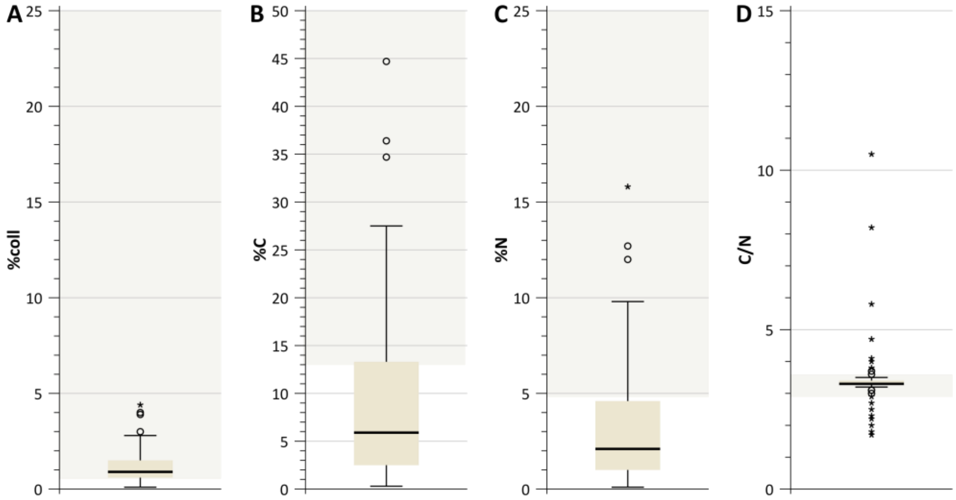


Figure 3.199. Boxplots representing the collagen quality indicators of human samples from the cemetery of phase 1 of Sant Menna. Samples with well and poorly preserved collagen are displayed together. (A) %coll, collagen yield. (B) %C, carbon weight content. (C) %N, nitrogen weight content. (D) C/N, carbon to nitrogen atomic ratio. The shaded area in each graph highlights the range of values indicating good collagen preservation

3.3.3.4.2 Collagen quality

Collagen preservation of the human samples corresponding to the cemetery of phase 1 of Sant Menna was largely poor (table 7.9, table 7.10, figure 3.198, figure 3.199). Eleven samples produced collagen yields (%coll) under 0.5%. The rest were above this threshold. The maximum collagen yield recorded was 4.4%. Both carbon (%C) and nitrogen weight contents (%N) tended to low values. In fact, medians of both variables were significantly below the accepted figures. The minimum carbon weight content measured in this assemblage was 0.3% and the maximum 44.7%. Correspondingly, nitrogen weight content ranged between 0.1% and

15.8%. As a consequence of this great variability, carbon to nitrogen atomic ratios (C/N) too had a wide distribution between 1.7 and 10.5. Nevertheless, most samples concentrated within the acceptable gap. Summing up, only fifteen human samples of the phase 1 of Sant Menna met the collagen quality criteria and could be used for palaeodietary reconstruction, and up to fifty were dismissed due to poor preservation.

3.3.3.4.3 Results

The human assemblage from the cemetery of phase 1 (mid-5th-8th c.) of Sant Menna was strongly affected by poor collage preservation, so it was complicated to make a comprehensive interpretation of the dietary patterns of the population based on the data available. In addition, the resulting assemblage of acceptable samples was very imbalanced in favour of subadults. This can pose an interpretative problem, since the youngest individuals often present dietary patterns different to the bulk of the population. Besides, the isotopic baseline built on local fauna was not as solid as desirable, because the dataset was small and not all the samples were contemporary to the humans analysed (see section 3.3.3.3). Nevertheless, fifteen individuals had well-preserved collagen and, based on them, it is possible to outline the main dietary features of the population (table 3.54, table 7.9, figure 3.200). The human assemblage dated to phase 1 from Sant Menna was characterised by a relatively narrow range of carbon stable isotope ratios and a larger spread of nitrogen isotope ratios. The greater dispersion of $\delta^{15}N$ was due to the presence of three outliers and, when they were ruled out, the range became very narrow. Therefore, as a matter of fact diet at early medieval Sant Menna would have been quite homogeneous. This general overview will be further discussed below.

Table 3.54. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of human samples from the cemetery of phase 1 of Sant Menna. Standard deviation is only reported if sample size is greater than two. Minimum, maximum and range are not reported when sample size is one

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All humans	15	-18.6	0.6	-19.4	-17.6	1.8	9.7	1.1	7.7	12.9	5.2
Subadults	8	-18.4	0.7	-19.4	-17.6	1.8	10.0	1.4	7.7	12.9	5.2
Fetus	1	-17.9	-	-	-	-	10.0	-	-	-	-
Infans 1A	4	-18.3	0.6	-18.9	-17.8	1.1	10.9	1.4	10.1	12.9	2.8
Infans 1B	3	-18.7	0.9	-19.4	-17.6	1.8	8.8	1.0	7.7	9.5	1.8
Adults	7	-18.8	0.4	-19.3	-18.2	1.1	9.4	0.5	8.4	9.9	1.5
Male adults	2	-18.8	-	-18.8	-18.8	0.0	9.8	-	9.6	9.9	0.3
Female adults	3	-19.1	0.3	-19.3	-18.8	0.5	9.0	0.6	8.4	9.5	1.1
Grave g absence	15	-18.6	0.6	-19.4	-17.6	1.8	9.7	1.1	7.7	12.9	5.2

The mean $\delta^{13}C$ of the assemblage of phase 1 from Sant Menna was -18.6‰ and it had a standard deviation of 0.6‰ and a range of 1.8‰. Thus, the offset between the mean carbon stable isotope ratio of humans and local herbivores was 1.4‰ (see section 3.3.3.3.3). These values indicate human diet was largely dominated by C_3 resources. In this way, winter crops, such as wheat, barley, rye and oats, as well as legumes, vegetables and fruits would have made up an important proportion of the diet. However, the spacing between humans and herbivores, exceeding the fractionation usually accepted by one trophic level change (~1‰), points at the use of enriched carbon stable isotope sources, quite clearly at least for the individuals on the most positive end of the range of $\delta^{13}C$. This could be caused by two types of foodstuff: marine fish or C_4 plants. Taking into account the proximity of Sant Menna to the coast, the consumption of significant proportions of marine fish would be plausible. Still, marine fish intake also generates the enrichment of $\delta^{15}N$, causing a correlation between both variables. In this assemblage such a pattern is not observable, so it is unlikely marine fish meant a quantitatively relevant food source in early medieval Sant Menna, although it is not possible to dismiss sporadic consumption. Consequently, broomcorn and foxtail millets, the only C_4 plants known to have been cultivated in this period, are most probably the foodstuffs producing the slight enrichment of $\delta^{13}C$ measured on some individuals. Nonetheless, millets consumption would have been limited in every case. Otherwise, the greater $\delta^{13}C$ values of some of the individuals could be due to the preferential consumption of animal protein from livestock fed on C_4 plants. One of the ovicaprids and a pig from the fauna assemblage of Sant Menna showed evidence of certain intake of millets (see section 3.3.3.3.3). This is good because it confirms the existence and use of spring crops at Sant Menna during Early Middle Ages, but it also complicates the task to elucidate if they were directly eaten by humans or their isotopic signal was acquired indirectly through animal products. Unfortunately, without a greater and more consistent dataset of both human and fauna samples it is not possible to solve this issue.

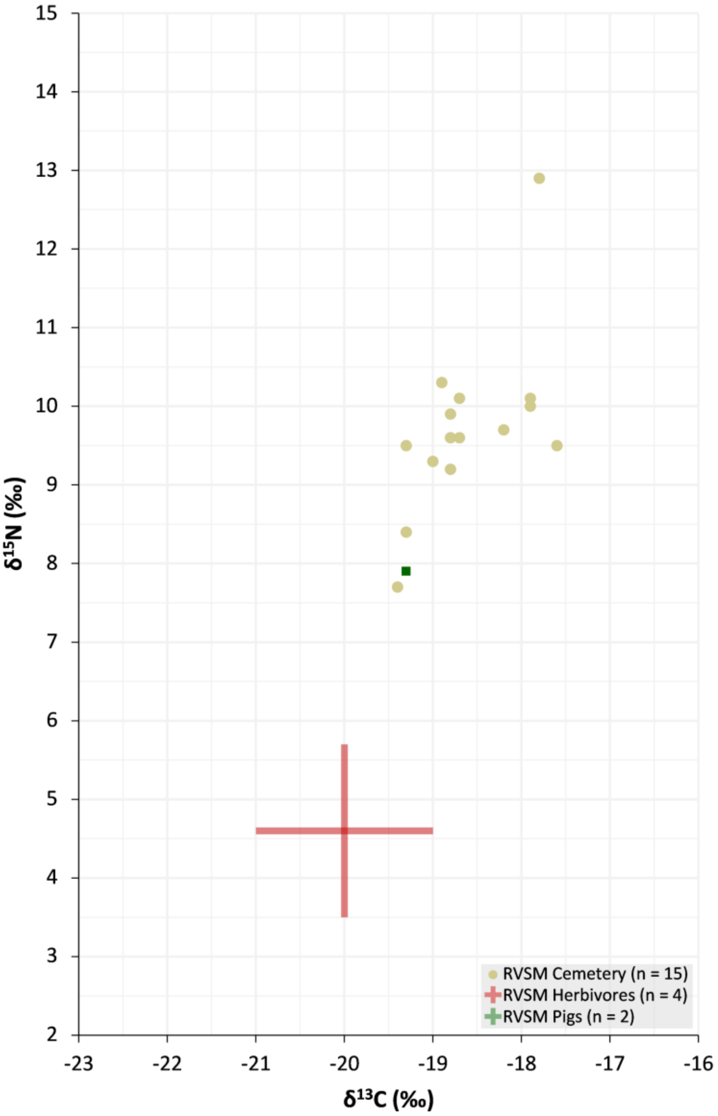


Figure 3.200. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from Sant Menna. Crosses represent mean and one standard deviation of the fauna from Sant Menna grouped by feeding regime. Fowl are not displayed because they are very variable

Nitrogen isotope ratios exhibited a greater dispersion, mostly due to the presence of three outliers. The mean of the ensemble was 9.7‰, with a standard deviation of 1.1‰ and a range of 5.2‰, so the offset between the mean $\delta^{15}N$ of humans and local herbivores was 5.1‰ (see section 3.3.3.3.3). This was the greatest difference recorded among all the assemblages analysed in this thesis and it would imply a great proportion of animal protein in the diet of these individuals. Because a great part of the dataset was formed by very young subadults, it could be thought that the high mean $\delta^{15}N$ of the assemblage and the great offset in comparison to herbivores was due to subadults being affected by the breastfeeding effect. However, it does not seem so, since the mean of adults alone was only 0.3‰ smaller than the whole population. It is also worth noting that, leaving outliers aside the range of nitrogen isotope ratios was reduced to 1.1‰. Then, it can be said that the proportion of animal protein consumed among the individuals in this assemblage was actually quite uniform. Moreover, the mean of the assemblage without outliers was exactly the same as for the entire dataset. Therefore, going back to the offset in comparison with herbivores, the interpretation that diet at early medieval Sant Menna included a great proportion of animal protein is reinforced. Still, the caveats of the fauna isotopic baseline for this site should not be disregarded, so any statement should be taken with caution. Considering outliers are better understood in relation to the age and sex of individuals, they will be discussed in the following paragraph together with the analysis of the relationship between diet and demography.

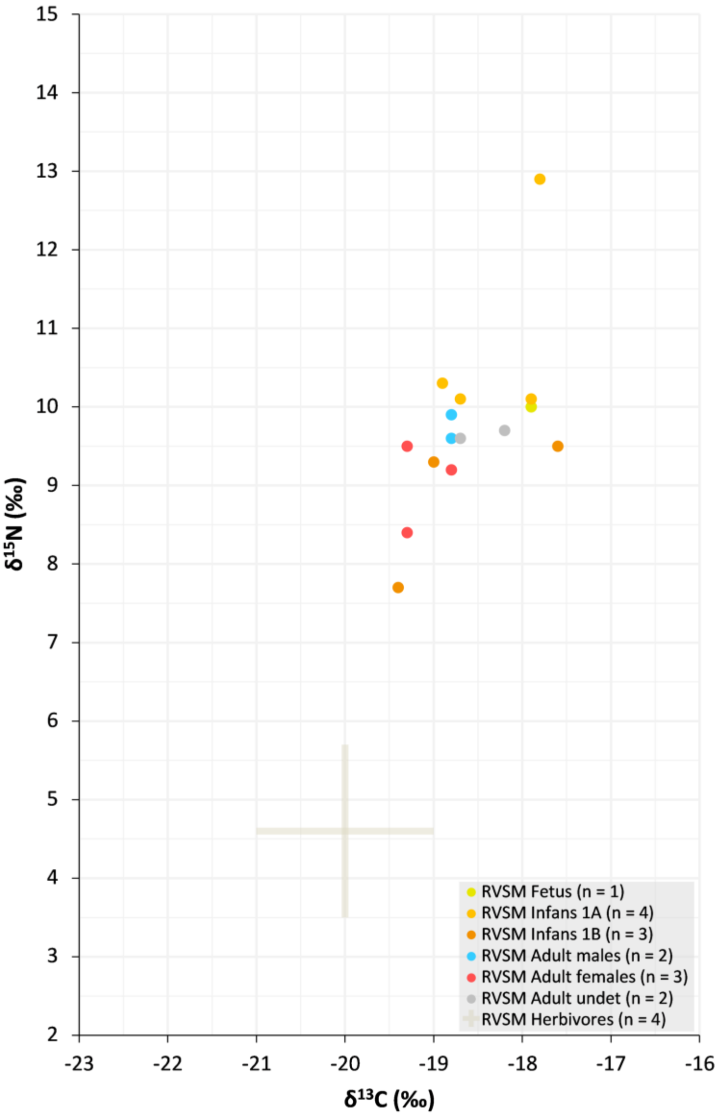


Figure 3.201. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from the cemetery of phase 1 of Sant Menna divided by demographic categories. Cross represents mean and one standard deviation of herbivores from Sant Menna

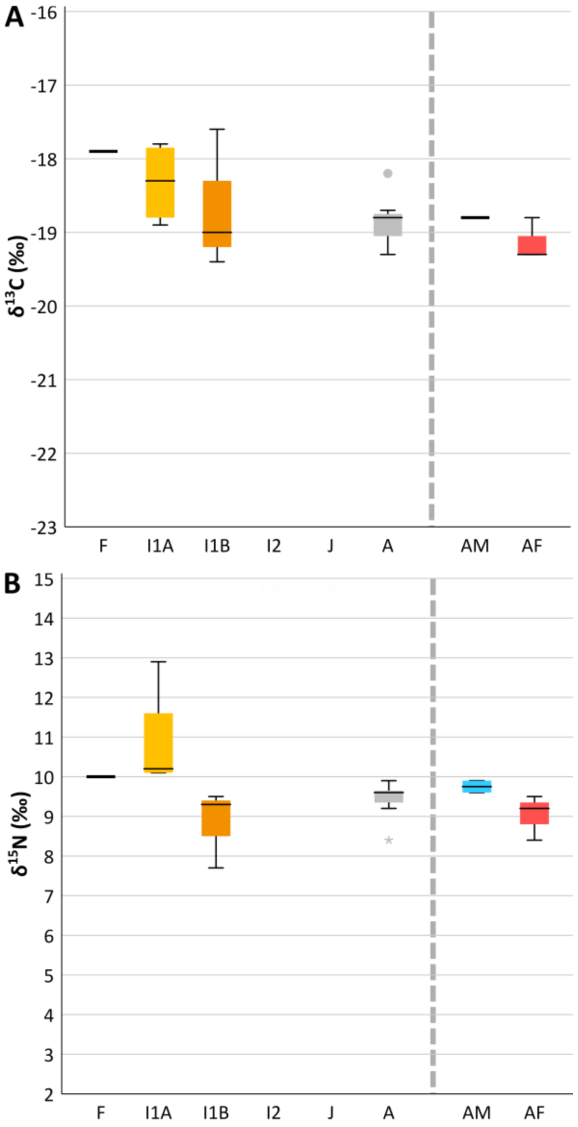


Figure 3.202. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from the cemetery of phase 1 of Sant Menna divided by demographic categories. Key: F = fetus, I1A = infans 1A, I1B = infans 1B, I2 = infans 2, J = juvenile, A = adults, AM = adult males, AF = adult females

The majority of the individuals successfully analysed from Sant Menna were subadults. Besides, all of them were younger than 7 years of age and there was even a fetus. The distributions of carbon and nitrogen stable isotope ratios of subadults and adults were quite different (figure 3.201, figure 3.202). Subadults had greater standard deviations and wider ranges on both variables, but especially on $\delta^{15}N$, and they tended towards more enriched carbon and nitrogen stable isotope ratios. Conversely, adults showed smaller dispersion, i.e. standard deviation and range, also on both indicators and they were clustered around more depleted δ^{13}C and δ^{15}N values. That is, subadults were more prone to include some millets in their diet, while adults were more likely to have exclusively C_3 diets, although the ranges of both age groups overlapped largely, so differences would not have been stark. Likewise, nitrogen isotope ratios would point at a greater consumption of animal protein by subadults in comparison to adults. Yet, subadults may be influenced by the breastfeeding effect. For this reason, they will be tackled in greater detail beneath. Nevertheless, the differences in the distributions of carbon and nitrogen stable isotope ratios between subadults and adults were not statistically significant (δ^{13}C RVSM subadults (n = 8) vs adults (n = 7), Mann-Whitney U test: U = 18.500, z = -1.106, p = 0.281; δ^{15}N RVSM subadults (n = 8) vs adults (n = 7), Mann-Whitney U test: U = 16.500, z = -1.334, p = 0.189).

Going into the specific, the category of infans 1A was represented by four individuals. Two of them had very similar isotopic signatures, with δ^{13}C close to adults and the greatest δ^{15}N of the assemblage excluding outliers. One of these individuals died between birth and the first year of life (RVSM 032-4-129(038a3)) and the other one between 1 and 2 years old (RVSM 031-2-128(035)). Their isotopic signatures can be interpreted as the result of diets mostly based on C_3 resources and ample intake of animal protein. However, high δ^{15}N values could also be a consequence of the marginal retention of the isotopic signature of breast-milk, which is enriched in ^{15}N in comparison to the mother due to fractionation (Beaumont *et al.* 2018, Dupras 2010, Reynard & Tuross 2015). Still, it is clear these two individuals were weaned well before death. The youngest infans 1A from the assemblage (RVSM 020-2-096(037)), who died between 3 and 9 months of age, was similar in δ^{15}N to the former two, but it presented a notably enriched δ^{13}C. Then, despite its young age, it is unlikely this individual was breastfed and, instead, it probably ate C_4 plants regularly. This is an indication of the use of millets for feeding non-breastfed babies. Interestingly, the only fetus analysed from this assemblage (RVSM 024-2-118(027b)) had virtually the same isotopic signature as the former individual. It died at the developmental stage equivalent to between 36 and 38 weeks in utero, so it was a full-term fetus and it is possible that it lived for a few days or weeks. This would explain the similarity of its isotopic signature to individual RVSM 020-2-096(037), as both of them would have been fed since birth with the same mixture of C_3 and C_4 plants together with great proportions of animal protein. There is no way to know why these two individuals were not breastfed and if this fact affected their survivorship. Otherwise, if this fetus was not born alive, its isotopic signature would mirror the diet of its mother. Nonetheless, no adult female with so enriched δ^{13}C has been identified. The last infans 1A from the phase 1 of Sant Menna (RVSM 014-1-086(014a)) was the only one showing clear evidence of being breastfed around the time of death. Surprisingly, it was between 1 and 2 years old when it died, so it was the same age as one of the first two individuals discussed, but it exhibited a very different isotopic signature. It had one of the highest δ^{13}C in the assemblage, but where it really stood out was in δ^{15}N, where it was 2.6‰ higher than the closest counterpart and 2.9‰ more enriched than the mean of local adult females. Breastfeeding would explain the enrichment of the nitrogen isotope ratio of this individual, because there is a fractionation step equivalent to a trophic level shift between the mother and the nursing baby (Beaumont *et al.* 2018, Dupras 2010, Reynard & Tuross 2015). Therefore, this individual was probably breastfed at least during the entire first year of life, although it is possible that it was partially weaned shortly before death, since the isotopic signature on bone collagen requires some weeks or months to remodel. To conclude with subadults, there were three infans 1B, who constituted a demographic group with great dispersion too. The youngest was between 4 and 7 years old at death (RVSM 129-1-415(142a)) and it had depleted δ^{13}C and δ^{15}N, but within the core of the assemblage. Thus, its diet would have been mainly made up of C_3 resources and an abundant intake of animal protein, although smaller than infans 1A, assimilating it to the dietary patterns of adults. The next individual in age died between 5 and 7 years old (RVSM 117-1-393(130)). It stuck out because of its strongly enriched δ^{13}C, which was the highest of the assemblage, while its $\delta^{15}N$ was similar to the adults and the former infans 1B. In this way, this was the individual from the phase 1 of Sant Menna with the largest intake of C_4 plants, even though it is likely its diet was still vastly based on C_3 resources. The consumption of millets relates this individual with fetus RVSM 024-2-118(027b) and infans 1A RVSM 020-2-096(037). The oldest infans 1B was between 5 and 9 years old when it died (RVSM 154-3-462(165a)). It was remarkable because it had the most depleted values of the assemblage for both carbon and nitrogen stable isotope ratios, even though it was a statistical outlier only on $\delta^{15}N$. Hence, the diet of this individual would have been exclusively formed by C_3 plants and the intake of animal protein would have probably been quite restricted. That is, the dietary patterns of this individuals had nothing in common with the other subadults from the same assemblage. Notwithstanding, it is interesting to note the isotopic signature of this infans 1B was similar to the other individual from the same grave analysed. This relationship will be commented in the next paragraph. All in all, heterogeneity seems the only rule in the diet of the subadults of phase 1 from Sant Menna and, despite the availability of data from a good number of very young individuals, it is not possible to draw solid conclusions about breastfeeding and weaning patterns in this context.

Dietary differences between sexes could not be thoroughly explored because only five adult individuals had sex determined. Even so, it is noteworthy that the two adult males were very near from each other, indicating they probably had almost identical diets based on C_3 plants and abundant proportions of animal protein. Two of the adult females were also close between them and they were just slightly depleted in $\delta^{15}N$ in comparison to adult males, suggesting somewhat smaller proportions of animal protein in their diets. This idea is further supported by outlier RVSM 154-2-462(165b). This was a female old adult who died between 53 and 86 years of age. It had quite a depleted $\delta^{13}C$, pointing at an exclusive C_3 diet in line with the other adults from the assemblage, but $\delta^{15}N$ was the variable that really stood out in it. Actually, it was a statistical outlier on this variable due to its low nitrogen isotope ratio, which indicates this individual had a proportion of animal protein smaller than the rest of the adults from the phase 1 of Sant Menna. This is particularly interesting because the other individual from the same funerary structure, the infans 1B RVSM 154-3-462(165a) discussed above, was also an outlier for the same reason. Thus, in spite of their age difference, both individuals from the burial of phase 1B RVSM 154 shared a diet atypical in this context. This can be interpreted in two ways. On one side, it could be read as an indicator of the belonging of both individuals to a group, e.g. the domestic unit or extended family, where uniform dietary patterns were followed. On the other side, these two individuals could be migrants from a region with a different isotopic baseline, which would explain their exceptionally low nitrogen isotope ratios. Moreover, in both hypotheses, the fact that burial RVSM 154 was on the north-western angle of the area excavated, quite far from the church and the core of the cemetery, emphasises the singularity of these two individuals. Unfortunately, the third individual in the same funerary structure and the individual in the nearby grave RVSM 146 could not be included in the palaeodietary reconstruction for different reasons, so it is not possible to characterise better this marginal sector of the graveyard.

In order to close this section about the relationship between diet and demography, it should be remembered that Sant Menna was one of the assemblages with the greatest proportion of adult individuals whose age at death could be estimated with some precision (see section 3.3.3.2.2), but only six of them had well-preserved collagen. They were allocated into three age categories, whose mean $\delta^{13}C$ and $\delta^{15}N$ were almost indistinguishable (young adults: n = 1, $\delta^{13}C$ = -18.8‰, $\delta^{15}N$ = 9.9‰; young-middle adults: n = 2, mean $\delta^{13}C$ = -18.8‰, mean $\delta^{15}N$ = 9.4‰; old adults: n = 3, mean ± SD $\delta^{13}C$ = -19.1‰ ± 0.3, mean $\delta^{15}N$ = 9.2‰ ± 0.7). However, considering the small number of individuals in each category, it is not possible to draw any well-founded conclusion about the variability of diet in relation to adult age.

This thesis also aimed at exploring the diachronic evolution and spatial arrangement of individuals according to their carbon and nitrogen stable isotope ratios. Unhappily, in the population corresponding to the phase 1 of Sant Menna this was not always possible due to the poor collagen preservation of the individuals (see section 3.3.3.4.2). Regarding chronology, the individuals with well-preserved collagen were not evenly divided between the two phases defined, but phase 1A was represented by three individuals and the remaining nine individuals were dated to phase 1B. As a consequence, it was not possible to carry out any statistical analyses. Nevertheless, it is worth noting that the three individuals assigned to phase 1A, a fetus, an infans 1A and a probable male young adult, had nearly identical nitrogen isotope ratios ranging between 9.9‰ and 10.1‰. Therefore, all the variability of $\delta^{15}N$ has to be attributed to the individuals of phase 1B. The analysis of the topographic distribution of individuals suffered the same problem due to bad collagen preservation (figure 3.203). It was not possible to compare the isotopic signatures and dietary patterns of the individuals buried inside and outside the church because only two individuals from inside the temple were successfully analysed. Still, not even among the individuals of phase 1B, which were all outside the church, was it possible to observe any significant arrangement in the distribution of carbon and nitrogen stable isotope ratios. It is true that the two individuals from burial 154 had very similar isotopic signatures and the three individuals from the cluster formed by burials RVSM 128, RVSM 129 and RVSM 141 were also alike, but this is not evidence enough to defend the existence of an spatial organisation according to which individuals with analogous diets were buried next to each other. Finally, it is necessary to comment briefly the case of individual RVSM 033-1-132(039). This was the only individual in Sant Menna buried in a silo, instead of a proper funerary structure (see section 3.3.3.1.3). For this reason, it was interesting to contrast its dietary patterns with the rest of the assemblage, in order to verify if there was any difference which could give a hint on the reasons why this individual was excluded from the conventional funerary ritual. Unluckily, this was one of the individuals with poorly preserved collagen, so its diet could not be assessed and the singularity of this individual cannot be further explained.

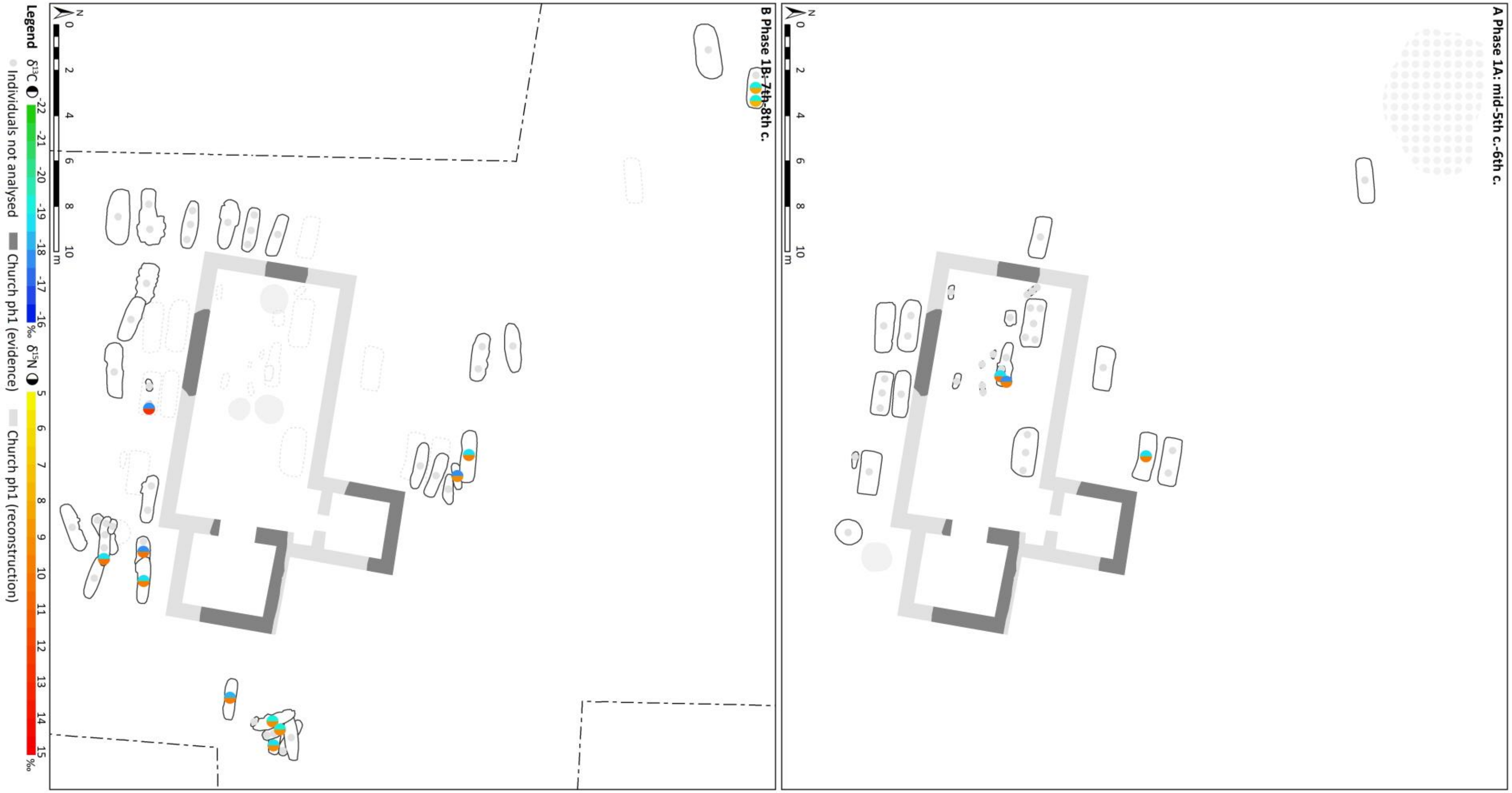


Figure 3.203. Sant Menna, cemetery around and inside the early medieval church, spatial distribution of individuals divided by carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) (Roig et al. 1995: 27, 44, modified). (A) Phase 1A, mid-5th c.-6th c. (B) Phase 1B, 7th-8th c. The dashed black line depicts the excavation limits. In (B) the outline of the burials of phase 1A is illustrated with a dotted line in order to facilitate the interpretation of the whole assemblage. Individuals successfully analysed are represented with a big circle divided in two. The left half symbolises $\delta^{13}C$ and the right half $\delta^{15}N$ according to the colour gradient shown in the legend. Individuals not analysed are depicted with a smaller grey point

4 DISCUSSION

4.1 ANIMAL HUSBANDRY MANAGEMENT STRATEGIES AND FOOD PRODUCTION IN EARLY MEDIEVAL IBERIA

Fauna from the same sites as those where the human populations came from was analysed for carbon and nitrogen stable isotope ratios for a double purpose. One of the aims was to characterise the feeding regime of early medieval livestock, as a means to approximate to husbandry strategies and agrarian practices. The other objective was to define the isotopic baseline of the ecosystems under study, which is essential for the most accurate interpretation of human isotopic signatures (see section 2.3.1). In this way, it was tried to get as many samples as possible from all the contexts studied, but this goal faced some obstacles. The main one was the fact that many of the sites included in this thesis only had funerary areas excavated. Cemeteries and religious buildings are rarely rich in fauna remains, because these are not usually the places were production, management and consumption of animal products are carried out. Therefore, in certain sites, such as Boadilla, Aldaieta or Sant Menna, getting fauna samples was really complicated and almost every fauna fragment available had to be taken, without having the opportunity to make a well-designed selection. Furthermore, at Finaga it was not possible to get any fauna sample at all. No samples from La Huelga were analysed either. However, it was because La Huelga was so close from El Soto/El Encadenado that, in order to make the most of the resources available, it was considered enough to have only one of the zooarchaeological assemblages analysed and the one from El Soto/El Encadenado was more abundant and varied. The other problem with fauna this research had to deal with was poor collagen preservation, which caused the loss of overall one fifth of the samples analysed, reaching up to half of the dataset in some cases. For these reasons, the consistency of the isotopic baselines for each context is uneven and it has to be acknowledged that in some cases an enlargement of the fauna assemblages analysed would benefit the accuracy of some of the interpretations.

All in all, 149 fauna samples from eight archaeological sites were analysed for this research (table 4.1). All of them belonged to domestic taxa. Herbivores, including sheep, goats, cattle and equids, was the best represented group in every site, not only because their remains are usually abundant, but also because they are the most useful group of animals for palaeodietary reconstruction. Since they only eat plants, they can be employed as a reference of how human diets would look like in each context if they did not incorporate any animal protein. Then, starting from them and taking fractionation into account, it is possible to estimate approximately the proportion of animal protein in the diet of the human populations living in the same environment. Omnivores were also sampled from all contexts. They comprised pigs and fowl, but both taxa were not present in all cases. Besides, at Aldaieta none of the omnivore samples met collagen quality criteria, so the only data about omnivore feeding patterns in the Basque Country comes from Dulantzi. Carnivores, namely dogs and cats, were the scarcest group of animals in the entire dataset. They were only sampled in three of the sites analysed, one from each of the regions under study, but the data they provided were essential to identify more accurately some specimens and to improve the understanding of the relationship between humans and animals in early medieval rural Iberia.

Table 4.1. Quantitative summary of specimens analysed of the complete fauna assemblage

Assemblage	*Spec sampled for $\delta^{13}C$ & $\delta^{15}N$*				*Spec well-preserved collagen*				*Spec bad-preserved collagen*
	Total	*Herbs*	*Omniv*	*Carniv*	*Total*	*Herbs*	*Omniv*	*Carniv*	
GOZ	26	18	8	0	23/26 = 88.5%	16	7	0	3/26 = 11.5%
BOA	20	12	7	1	20/20 = 100.0%	12	7	1	0/20 = 0.0%
SNC	14	10	4	0	8/14 = 57.1%	5	3	0	6/14 = 42.9%
ALD	15	12	2	1	9/15 = 60.0%	8	0	1	6/15 = 40.0%
SMD	18	11	7	0	18/18 = 100.0%	11	7	0	0/18 = 0.0%
CG	30	14	10	6	15/30 = 50.0%	6	5	4	15/30 = 50.0%
PMCV	16	11	5	0	15/16 = 93.8%	10	5	0	1/16 = 6.2%
RVSM	10	7	3	0	7/10 = 70.0%	4	3	0	3/10 = 30.0%
Total	149	95	46	8	115/149 = 77.2%	72	37	6	34/149 = 22.8%

The following sections will review the results of carbon and nitrogen stable isotope ratios of the entire assemblage of domestic animals analysed divided by feeding regimes, so as herbivores, omnivores and carnivores are discussed independently. Afterwards, a general overview on the contribution of these data to the knowledge about agrarian practices during Early Middle Ages in Iberia will be made.

4.1.1 HERBIVORES

The dataset of herbivores analysed for this research included cattle, ovicaprids and equids (table 4.2, table 4.3, figure 4.1, figure 4.2). In most cases sheep and goats were indistinguishable, so they were considered jointly, and equids were only present in the assemblages from Madrid-Toledo. Altogether the mean $\delta^{13}C$ of the 72 herbivores analysed was -20.3‰, pointing at the predominance of exclusive C_3 diets, and they had a standard deviation of 1.0‰ and a range of 4.3‰, which is quite a tight distribution for an assemblage of this size. With a mean of 6.7‰, a standard deviation of 1.8‰ and a range of 7.3‰, the dispersal of $\delta^{15}N$ was notably wider. These data suggest the differences in feeding patterns between taxa and sites relied mostly on the isotopic variability at the base of each ecosystem or the agrarian practices applied by local rural communities, rather than in the photosynthetic type of plants consumed. In this sense, one of the most interesting conclusions that can be drawn is that each of the three regions considered was characterised by a distinctive range of isotopic values.

Herbivores from Madrid-Toledo had the widest distribution of carbon stable isotope ratios. Their mean points at diets based on C_3 resources, but the presence of some specimens with $\delta^{13}C$ values above -19‰ indicates some of them ate considerable amounts of C_4 plants too. All the specimens with clear evidence of the consumption of millet fodder came from Gózquez. The enrichment of carbon stable isotope ratios did not affect the whole fauna assemblage from this village. However, it included cattle, ovicaprids and equids, so it cannot be said it was a phenomenon restricted to a specific taxon, but rather a particular feature of the livestock management strategies in this specific rural community. It is difficult to assess if herbivores from the other two assemblages from this region also had C_4 plants because there is no data to establish a precise cut-off point between exclusive C_3 eaters and herbivores with a mixed C_3-C_4 diet, so only specimens with very enriched $\delta^{13}C$ values can be assumed to have consumed any millets. According to their mean $\delta^{13}C$ values, cattle and ovicaprids from Boadilla would have been more liable to have had access occasionally to C_4 plants than those from El Soto/El Encadenado, which are the most depleted in the region. It is also worth noting that equids from Madrid-Toledo were overall the taxon with the lowest carbon stable isotope ratios. This was true both at Gózquez and Boadilla and it suggests these animals might have been managed differently or they might have been imported from regions with distinct isotopic signatures at the base of their ecosystems, since they are closer to the values of Basque sites than to the bulk of herbivores from Madrid-Toledo.

Table 4.2. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of the complete assemblage of herbivores grouped by region, site and taxa. Standard deviation is only reported if sample size is greater than two. Key: M-T = Madrid-Toledo, BC = Basque Country, CAT = Catalonia

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All	72	-20.3	1.0	-22.4	-18.1	4.3	6.7	1.8	2.6	9.9	7.3
M-T	33	-20.0	0.9	-22.2	-18.1	4.1	7.9	1.2	5.2	9.9	4.7
GOZ	16	-19.6	0.9	-21.3	-18.1	3.2	8.0	1.2	5.7	9.9	4.2
Bos taurus	6	-19.5	1.1	-20.8	-18.2	2.6	7.7	1.6	5.7	9.4	3.7
Ovis/Capra	5	-19.4	0.8	-20.3	-18.1	2.2	8.0	0.7	6.8	8.7	1.9
Equus sp	5	-19.8	0.9	-21.3	-19.0	2.3	8.4	1.1	6.9	9.9	3.0
BOA	12	-20.3	0.7	-22.2	-19.4	2.8	8.0	1.1	6.1	9.5	3.4
Bos taurus	3	-20.0	0.5	-20.3	-19.4	0.9	8.4	1.1	7.4	9.5	2.1
Ovis/Capra	5	-20.3	0.3	-20.6	-19.9	0.7	8.0	0.7	7.2	9.4	2.2
Equus sp	4	-20.7	1.2	-22.2	-19.6	2.6	7.8	1.5	6.1	9.4	3.3
SNC	5	-20.8	0.4	-21.2	-20.4	0.8	7.4	1.5	5.2	9.2	4.0
Bos taurus	3	-20.9	0.4	-21.2	-20.4	0.8	6.6	1.2	5.2	7.5	2.3
Ovis/Capra	2	-20.6	-	-20.7	-20.4	0.3	8.8	-	8.3	9.2	0.9
BC	19	-21.3	0.7	-22.4	-19.8	2.6	6.5	1.5	3.9	9.8	5.9
ALD	8	-21.7	0.5	-22.4	-21.0	1.4	6.6	1.2	4.8	8.1	3.3
Bos taurus	4	-22.1	0.2	-22.4	-21.9	0.5	5.8	0.8	4.8	6.7	1.9
Ovis/Capra	4	-21.3	0.3	-21.6	-21.0	0.6	7.5	1.0	6.1	8.1	2.0
SMD	11	-20.9	0.7	-22.1	-19.8	2.3	6.4	1.7	3.9	9.8	5.9
Bos taurus	6	-21.1	0.8	-22.1	-20.2	1.9	5.6	1.2	3.9	7.7	3.8
Ovis/Capra	5	-20.7	0.6	-21.2	-19.8	1.4	7.5	1.7	5.5	9.8	4.3
CAT	20	-19.8	0.6	-21.2	-18.7	2.5	4.8	1.3	2.6	7.5	5.0
CG	6	-19.8	0.5	-20.4	-18.8	1.6	5.4	1.3	4.0	7.2	3.2
Bos taurus	2	-19.8	-	-19.9	-19.6	0.3	5.2	-	4.2	6.1	1.9
Ovis/Capra	4	-19.8	0.7	-20.4	-18.8	1.6	5.6	1.4	4.0	7.2	3.2
PMCV	10	-19.8	0.5	-20.7	-18.9	1.8	4.6	1.3	2.6	7.6	5.0
Bos taurus	3	-19.6	0.9	-20.7	-18.9	1.8	4.9	0.3	4.7	5.2	0.5
Ovis/Capra	7	-19.9	0.2	-20.3	-19.6	0.7	4.3	1.6	2.6	7.6	5.0
RVSM	4	-20.0	1.0	-21.2	-18.7	2.5	4.6	1.1	3.5	6.1	2.6
Ovis/Capra	4	-20.0	1.0	-21.2	-18.7	2.5	4.6	1.1	3.5	6.1	2.6

Table 4.3. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of the complete assemblage of herbivores grouped by taxa and region. Key: M-T = Madrid-Toledo, BC = Basque Country, CAT = Catalonia

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
Bos taurus	27	-20.5	1.2	-22.4	-18.2	4.2	6.4	1.6	3.9	9.5	5.6
M-T	12	-20.0	1.0	-21.2	-18.2	3.0	7.6	1.5	5.2	9.5	4.3
BC	10	-21.5	0.8	-22.4	-20.2	2.2	5.6	1.0	3.9	7.7	3.8
Cat	5	-19.7	0.7	-20.7	-18.9	1.8	5.0	0.7	4.2	6.1	1.9
Ovis/Capra	36	-20.2	0.8	-21.6	-18.1	3.5	6.6	2.0	2.6	9.8	7.2
M-T	12	-19.9	0.7	-20.7	-18.1	2.6	8.1	0.8	6.8	9.4	2.6
BC	9	-21.0	0.5	-21.6	-19.8	1.8	7.5	1.3	5.5	9.8	4.3
Cat	15	-19.9	0.6	-21.2	-18.7	2.5	4.8	1.4	2.6	7.6	5.0
Equus sp	9	-20.2	1.1	-22.2	-19.0	3.2	8.1	1.2	6.1	9.9	3.8
M-T	9	-20.2	1.1	-22.2	-19.0	3.2	8.1	1.2	6.1	9.9	3.8

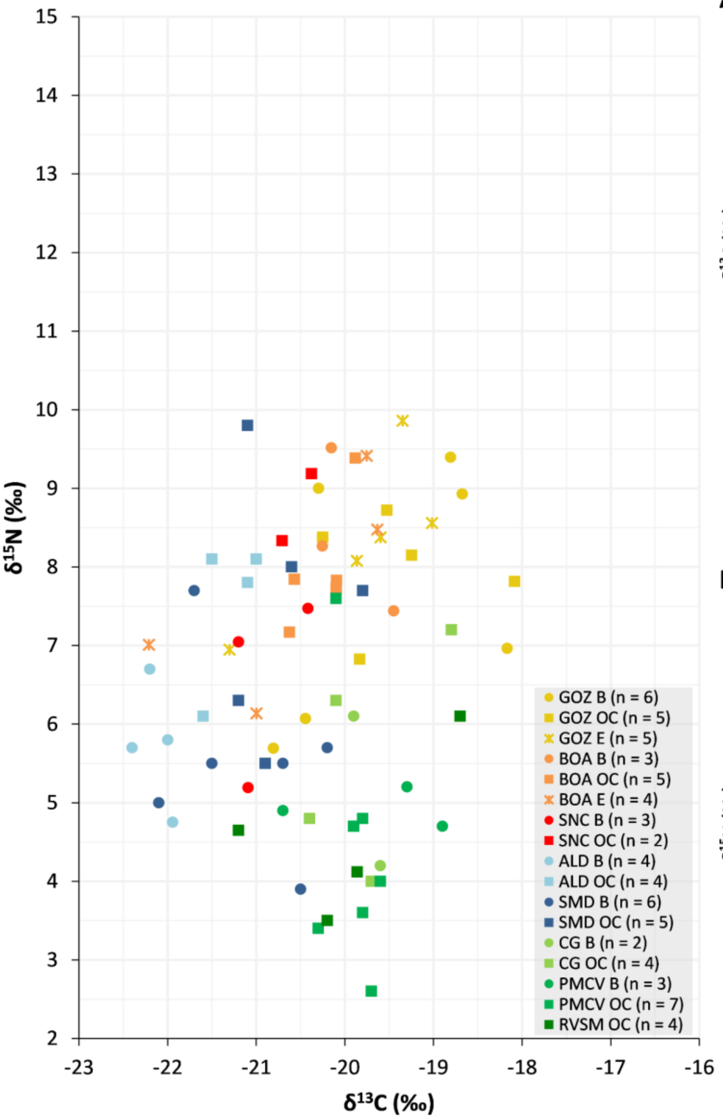


Figure 4.1. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of the complete assemblage of herbivores grouped by region, site and taxa

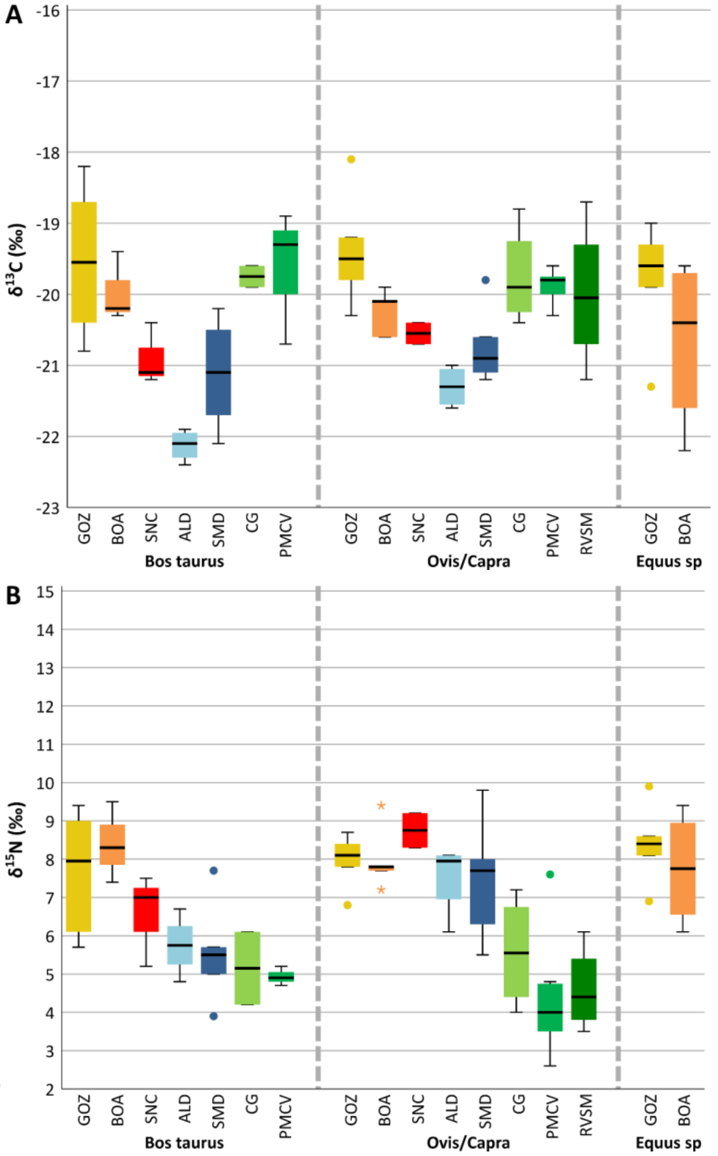


Figure 4.2. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of the complete assemblage of herbivores grouped by region, site and taxa

The other characteristic of the herbivores from Madrid-Toledo were enriched nitrogen isotope ratios. Cattle, ovicaprids and equids from this region had by far the highest mean $\delta^{15}N$ and all herbivore taxa had greater mean $\delta^{15}N$ values in the sites from Madrid-Toledo than in the other two zones studied. There was no clear association between taxa and nitrogen isotope ratios. For example, while equids was the species with the most positive mean $\delta^{15}N$ at Gózquez, at Boadilla it was cattle and at El Soto/El Encadenado ovicaprids. The cause of the enrichment of nitrogen isotope ratios at the base of the trophic chain in this region is not straightforward, because it is difficult to weight the influence of underlying geology and agrarian practices such as manuring. The centre of Iberia is currently considered a semiarid zone (Paniagua *et al.* 2019), but the palaeoclimatic indicators available do not picture a situation so extreme as to have affected isotopic values at the base of the trophic chain (López-Sáez *et al.* 2010). Salinity can also cause the enrichment of nitrogen isotope ratios of plants, which then is passed on consumers. It is known there are some salty water springs around Gózquez (see section 3.1.1.1.1). Still, it is possible to dismiss the influence of this factor on the assemblage from Gózquez, since the distribution of herbivore $\delta^{15}N$ values at Boadilla, where no salty water sources are recorded, was almost identical to the former. Having ruled out environmental factors, the most likely cause of the enrichment of herbivore nitrogen isotope ratios is manuring (Bogaard *et al.* 2007, Fraser *et al.* 2011). In preindustrial societies manuring was typically carried out with dung, which is enriched in ^{15}N (Sponheimer *et al.* 2003), so the application of animal waste does not only increase the availability of nitrogen, but it also enriches the nitrogen isotopic signature at the base of the trophic chain. As a consequence, animals eating on intensively manured plants show higher δ^{15}N values than expected in any given ecosystem, and this is precisely what is observed in the herbivores from the region of Madrid-Toledo. This is especially interesting because it suggests cattle, ovicaprids and equids were probably entering the fields after harvest to feed on crop leftovers, as this would have been the simplest way to accomplish this type of manuring. The social implications of this practice for the articulation of agrarian systems will be discussed below (see section 4.1.4).

The herbivores from the two Basque sites with fauna were characterised by the most depleted carbon stable isotope ratios and nitrogen isotope ratios intermediate to the herbivores from the other two regions. This means both cattle and ovicaprids had diets exclusively based on C_3 plants, such as wild grasses or fodder from wheat, barley, rye or oats. The distribution of δ^{13}C in this group was quite homogeneous, but herbivores from Aldaieta tended towards more depleted carbon stable isotope ratios than those from Dulantzi. Besides, in both cases cattle showed lower mean δ^{13}C values than ovicaprids, although the gap was notably greater at Aldaieta. The dissimilarities between taxa and sites were probably due to differences in the specific plants consumed, as there is also some variability in δ^{13}C values within C_3 plants. Still, landscape, and more specifically altitude, might have also had a relevant role in the variability of carbon stable isotope ratios of plants (Marshall *et al.* 2007). While Dulantzi was located in the middle of the plain known as *Llanada Alavesa*, Aldaieta was in its northern margin, with an easier access to mountain pastures. Summing up, there is no evidence of C_4 plant intake by any of the herbivores analysed from the Basque Country, which is extremely interesting taking into account the important role of millets in the diet of the human populations from the same settlements (see section 4.2).

The distributions of δ^{15}N were very similar in the two Basque sites analysed. The ranges of nitrogen isotope ratios of herbivores from Aldaieta and Dulantzi were halfway the equivalents from the regions of Madrid-Toledo and Catalonia, and they were compatible with the values expected for temperate climates. That is, in these cases there is no clear evidence of the influence of manuring. Nevertheless, it is noteworthy that both at Aldaieta and Dulantzi ovicaprids showed more enriched δ^{15}N values than cattle. Actually, the difference between the mean δ^{15}N of cattle and ovicaprids was 1.7‰ at Aldaieta and 1.9‰ at Dulantzi, which is around a third of a complete trophic level shift. Therefore, it is clear that none of the cattle from these sites had access to intensively manured plants, but it is possible that ovicaprids did. Indeed, the nitrogen isotope ratios of sheep and goats were equivalent to some of the herbivores from Madrid-Toledo. However, the data about the fauna from the Basque sites should be taken with caution. Due to preservation issues, most of the samples from these two fauna assemblages were teeth, which could have retained the effect of suckling even on adult specimens (Balasse 2014: 4125–4127). This could have biased both carbon and nitrogen stable isotope ratios towards more enriched values. In the case of δ^{13}C, where the effect is smaller, this would have resulted in carbon stable isotope ratios indicative of the consumption of C_4 plants, but actually none of the herbivores from Aldaieta or Dulantzi had such positive δ^{13}C values. As for δ^{15}N, the suckling effect may overestimate the role of manuring on herbivore diet.

The herbivore assemblage from Catalonia was formed by cattle and ovicaprid samples from all the three sites studied, but the number of samples successfully analysed at each one of them was quite small, especially at Can Gambús and Sant Menna. The distinctive features of herbivore feeding patterns in this region were moderately enriched carbon stable isotope ratios intermediate to those from Madrid-Toledo and the Basque Country and the most depleted nitrogen isotope ratios among all the samples analysed for this thesis. As a matter of fact, the mean $\delta^{13}C$ of the herbivores from Catalonia was the most enriched of the three regions covered in this thesis. However, this was due to the great width of the distribution of carbon stable isotope ratios of herbivores from Madrid-Toledo, which skewed the mean of this assemblage towards more negative values, but the bulk of cattle and ovicaprids from Catalonia were more enriched than those from the Basque Country and more depleted than the majority of those from Madrid-Toledo. Anyway, carbon stable isotope ratios of the herbivores from Catalan sites indicate their diet was largely based on C_3 resources. There were no meaningful differences between taxa or sites. That is, cattle and ovicaprids were randomly scattered all along the range without any identifiable pattern. Moreover, it is worth noting there were a few specimens with quite enriched $\delta^{13}C$ values which could have had small proportions of C_4 plants in their diet. They were a cattle from Castellar del Vallès, an ovicaprid from Can Gambús and another ovicaprid from Sant Menna. This makes clear there were no patterns in the distribution of carbon stable isotope ratios in this region.

When it comes to nitrogen isotope ratios, herbivores from Catalonia stood out for having the most depleted mean of the complete fauna assemblage in this thesis, but there was some internal variability too. Cattle and ovicaprids from Castellar del Vallès and Sant Menna tended towards lower $\delta^{15}N$ values than those from Can Gambús, the gap between their means being 0.8‰. This points at the existence of differences in the isotopic signatures at the base of the trophic chain, which could have been caused by distinct geologies, climatic conditions or other environmental factors (Amundson *et al.* 2003). All the three Catalan sites in this research were located in the western Vallès. However, Can Gambús was in the heart of the Catalan Coastal depression, while Castellar del Vallès and Sant Menna were at the foot of the northern Catalan Pre-Coastal mountain range and closer from each other. These differences in location would have implied the easier access of livestock from Castellar del Vallès and Sant Menna to mountain pastures and, therefore, could be the cause of the variations in nitrogen isotope ratios at the base of the trophic chain between these sites. Likewise, it has to be said that, where both taxa were analysed, $\delta^{15}N$ values of cattle and ovicaprids showed similar distributions, so probably there were no differences in their management. Moreover, this fact reinforces the idea that the origin of differences lay in environmental factors. Still, it is worth mentioning the contrast between the dispersion of cattle and ovicaprids at Castellar del Vallès, which suggests sheep and goats might have had access to a wider range of ecosystems. In any case, something that can be ruled out with confidence is the feeding of Catalan herbivores on intensively manured plants.

All in all, in general cattle, ovicaprids and equids showed similar feeding patterns within the same assemblage, but herbivore diet changed significantly from one site to another. In other words, although there would have been small differences, all herbivore taxa were managed similarly within the same settlement and within the same region differences were generally greater between sites than between taxa. These observations are further supported by statistics. The differences of mean carbon and nitrogen stable isotope ratios of herbivores between regions were statistically significant ($\delta^{13}C$ herbivores grouped by region, one-way ANOVA: $n = 72$, $F = 20.088$, $d.f.1 = 2$, $d.f.2 = 69$, $p < 0.001$, $\omega^2 = 0.347$; $\delta^{15}N$ herbivores grouped by region, one-way ANOVA: $n = 72$, $F = 119.463$, $d.f.1 = 2$, $d.f.2 = 69$, $p < 0.001$, $\omega^2 = 0.492$) and, according to effect sizes, differences between means were large for both variables. Besides, *post hoc* Tukey test revealed more information through pairwise comparison of the three regions. In the case of $\delta^{13}C$, the means of herbivores were statistically significant between Madrid-Toledo and the Basque Country ($p < 0.001$, mean difference = 1.239 ± 0.225) and between the Basque Country and Catalonia ($p < 0.001$, mean difference = 1.433 ± 0.250), but they were not between Madrid-Toledo and Catalonia ($p = 0.657$). This means the Basque Country was the region where herbivore $\delta^{13}C$ values were the most different. Regarding $\delta^{15}N$, there were statistically significant differences in herbivore means between all the possible pairs of regions (Madrid-Toledo vs Basque Country: $p = 0.001$, mean difference = 1.402 ± 0.372; Madrid-Toledo vs Catalonia: $p < 0.001$, mean difference = 3.087 ± 0.366;

Basque Country vs Catalonia: $p < 0.001$, mean difference = 1.686 ± 0.412). Thus, it can be concluded that each region had distinct ranges of nitrogen isotope ratios for herbivores.

The scenario becomes even more interesting if the focus is put on internal variability within regions. First, all herbivores from each zone of analysis were grouped by sites and compared with each other. Results revealed there were statistically significant differences in the distributions of carbon stable isotope ratios between sites in Madrid-Toledo ($\delta^{13}C$ herbivores Madrid-Toledo grouped by site, one-way ANOVA: n = 33, F = 5.497, d.f.1 = 2, d.f.2 = 30, p = 0.009, $\omega^2 = 0.214$) and the Basque Country ($\delta^{13}C$ herbivores Basque Country grouped by site ($n_{ALD} = 8$, $n_{SMD} = 11$), independent samples t-test: t = -2.741, d.f. = 17, p = 0.014, d = 1.275), but not in Catalonia (i). Besides, in Madrid-Toledo it was possible to identify that the difference was found in the comparison between herbivores from Gózquez and El Soto/El Encadenado (p = 0.018, mean difference = 1.185 ± 0.408), but there were no statistically significant differences between Gózquez and Boadilla (p = 0.053) or between Boadilla and El Soto/El Encadenado (p = 0.554). Conversely, no statistically significant differences were detected in the distributions of nitrogen isotope ratios in any of the three regions ($\delta^{15}N$ herbivores Madrid-Toledo grouped by site, one-way ANOVA: n = 33, F = 0.465, d.f.1 = 2, d.f.2 = 30, p = 0.633; $\delta^{15}N$ herbivores Basque Country grouped by site ($n_{ALD} = 8$, $n_{SMD} = 11$), independent samples t-test: t = 0.310, d.f. = 17, p = 0.761; $\delta^{15}N$ herbivores Catalonia grouped by site, Kruskal-Wallis H test: n = 20, H = 1.868, d.f. = 2, p = 0.393). Second, herbivores clustered by taxa were compared within each region. In this case, no statistically significant differences were detected in the distributions of carbon stable isotope ratios between cattle, ovicaprids and equids neither in Madrid-Toledo ($\delta^{13}C$ herbivores Madrid-Toledo grouped by taxa, one-way ANOVA: n = 33, F = 0.203, d.f.1 = 2, d.f.2 = 30, p = 0.818), nor in the Basque Country ($\delta^{13}C$ herbivores Basque Country grouped by taxa ($n_B = 10$, $n_{OC} = 9$), Mann-Whitney U test: U = 65.500, z = 1.675, p = 0.095), nor in Catalonia ($\delta^{13}C$ herbivores Catalonia grouped by taxa ($n_B = 5$, $n_{OC} = 15$), Mann-Whitney U test: U = 28.500, z = -0.788, p = 0.445). Likewise, the distributions of nitrogen isotope ratios of the three herbivore taxa did not present statistically significant differences either in Madrid-Toledo ($\delta^{15}N$ herbivores Madrid-Toledo grouped by taxa, one-way ANOVA: n = 33, F = 0.732, d.f.1 = 2, d.f.2 = 30, p = 0.489) and Catalonia ($\delta^{15}N$ herbivores Catalonia grouped by taxa ($n_B = 5$, $n_{OC} = 15$), Mann-Whitney U test: U = 26.500, z = -0.963, p = 0.349), but in the Basque Country they did ($\delta^{15}N$ herbivores Basque Country grouped by taxa ($n_B = 10$, $n_{OC} = 9$), Mann-Whitney U test: U = 79.500, z = 2.826, p = 0.003). These results underline the importance of location over taxon in the definition of herbivore isotopic signatures. Moreover, they demonstrate differences were greater between regions than within them and, when there were meaningful differences in a region, they lay in the distribution of carbon stable isotope ratios, not in the distribution of nitrogen isotope ratios. That is, differences between herbivores within regions were due to the consumption of diverse types of grasses or crops, while the intake of manured or unmanured plants tended to be homogeneous in most zones. Actually, the only context where significant differences were spotted within the same region was the Basque Country, where ovicaprids had systematically more enriched $\delta^{15}N$ values than cattle.

Considering all the above, it is difficult to define the typical feeding pattern of each herbivore taxon in early medieval Iberia, because isotopic signatures at the base of ecosystems varied from region to region and different animal husbandry management strategies were observed in each zone too. Equids was the herbivore species with the most distinctive diet. They were characterised by $\delta^{13}C$ values pointing at the exclusive consumption of C_3 plants and consistently enriched nitrogen isotope ratios. However, this unique pattern was certainly influenced by the fact that all the equids analysed came from Madrid-Toledo. In contrast, cattle and ovicaprid diets were more variable. Cattle only had clearly monotonous C_3 diets in the Basque Country. Instead, it is likely that in Catalonia at least some specimens incorporated small amounts of C_4 plants and in Madrid-Toledo the contribution of millets to the diet of cattle would have been more important. There were also differences in cattle diet based on the access to manured plants, which only happened in Madrid-Toledo, so cattle from the Basque Country and Catalonia were significantly more depleted in $\delta^{15}N$. Ovicaprids also had exclusive C_3 diets in the Basque Country, possibly small intake of millets in Catalonia and greater consumption of C_4 crops in Madrid-Toledo. Still, they were enriched in $\delta^{15}N$ both at Madrid-Toledo and the Basque Country, suggesting the access to manured plants for sheep and goats in both regions. Meanwhile, nitrogen isotope ratios of ovicaprids in Catalonia were consistently low. Altogether, when all cattle and ovicaprids were compared, no statistically significant differences were spotted in the distributions of carbon or nitrogen stable isotope ratios ($\delta^{13}C$ Bos taurus (n = 27) vs Ovis/Capra (n = 36), Mann-Whitney U test: U = 583.50, z = 1.355, p = 0.175; $\delta^{15}N$ Bos taurus (n = 27) vs Ovis/Capra (n = 36), Mann-Whitney U test: U = 527.000, z = 0.570, p = 0.569).

4.1.2 OMNIVORES

The main feature of the diet of omnivores in early medieval rural Iberian sites was heterogeneity (table 4.4, table 4.5, figure 4.3, figure 4.4). This was primarily due to two factors. On one side, the two omnivore taxa considered, namely pigs and fowl, are very different. The former is a mammal of medium size, while the latter a bird. Consequently, they have typically been managed differently. On the other side, the fact that both species can equally eat vegetal and animal products gives rise to diverse diets and, therefore, greater variability of isotopic signatures. Concerning the structure of the assemblage, it is worth mentioning that omnivores from the Basque country were only represented by pigs from Dulantzi. Instead, there were similar numbers of specimens successfully analysed in Madrid-Toledo and Catalonia, and both pigs and fowl were represented in all these sites except for Castellar del Vallès. Then, the mean $\delta^{13}C$ of the 37 omnivores with well-preserved collagen was -19.7‰ and they had a standard deviation of 1.0‰ and a range of 4.2‰. Similarly, the mean $\delta^{15}N$ of the whole assemblage was 7.5‰, with a standard deviation of 1.8‰ and a range of 7.3‰. However, because of the aforementioned reasons, the distributions of both carbon and nitrogen stable isotope ratios of pigs and fowl were statistically significantly different ($\delta^{13}C$ omnivores grouped by taxa (n_{Sus} = 25, n_{Avis} = 12), Mann-Whitney U test: U = 232.500, z = 2.680, p = 0.006; $\delta^{15}N$ omnivores grouped by taxa (n_{Sus} = 25, n_{Avis} = 12), Mann-Whitney U test: U = 231.500, z = 2.647, p = 0.007). This is why it is more sensible to report and discuss each taxon separately.

Pigs, which in total were represented by 25 specimens, presented a mean $\delta^{13}C$ of -20.0‰, with a standard deviation of 0.8‰ and a range of 3.6‰. In general, these values are compatible with diets largely based on C_3 resources and only occasionally a few individuals showed evidence of the consumption of small proportions of C_4 plants. In the same way, swine mean $\delta^{15}N$ was 7.0‰ and they had a standard deviation of 1.5‰ and a range of 5.1‰. Nevertheless, these figures are difficult to interpret by themselves and to estimate the importance of animal protein in the diet of pigs it is necessary to compare them to isotopic baselines drawn by herbivores (see section 4.1.1).

In the region of Madrid-Toledo all pigs were exclusively fed C_3 resources. This was the case even at Gózquez, where some herbivores were supplemented with C_4 fodder. Moreover, it is relevant because pigs would have been one of the most important sources of meat and other animal byproducts in the diet of local populations. Then, the fact that they were only fed with C_3 products reinforces the idea that the contribution of millets to human diet was through direct consumption. Regarding animal protein intake, $\delta^{15}N$ ratios of pigs both at Gózquez, Boadilla or El Soto/El Encadenado were close to local herbivores, which probably means they were reared similarly to cattle or ovicaprids. Hence, it is likely that pigs were free-ranged. Still, it should not be forgotten that $\delta^{15}N$ values of most herbivores from this region were possibly influenced by grazing on intensively manured fields. Therefore, swine nitrogen isotope ratios might underestimate the real weight of animal protein in their diet.

Table 4.4. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of the complete assemblage of omnivores grouped by region, site and taxa. Standard deviation is only reported if sample size is greater than two. Key: M-T = Madrid-Toledo, BC = Basque Country, CAT = Catalonia

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All	37	-19.7	1.0	-21.6	-17.4	4.2	7.5	1.8	3.9	11.2	7.3
M-T	17	-19.7	0.8	-21.6	-18.4	3.2	8.6	1.6	3.9	11.2	7.3
GOZ	7	-19.7	0.8	-21.0	-18.4	2.6	7.7	1.7	3.9	9.4	5.5
Sus scrofa d	5	-19.7	0.5	-20.4	-19.2	1.2	8.1	0.2	7.9	8.3	0.4
Avis	2	-19.7	-	-21.0	-18.4	2.6	6.7	-	3.9	9.4	5.5
BOA	7	-19.9	0.9	-21.6	-19.0	2.6	8.9	0.9	7.9	10.0	2.1
Sus scrofa d	4	-19.9	0.3	-20.3	-19.5	0.8	8.3	0.5	7.9	8.9	1.0
Avis	3	-19.9	1.5	-21.6	-19.0	2.6	9.8	0.2	9.6	10.0	0.4
SNC	3	-19.5	0.5	-19.9	-19.0	0.9	9.8	1.9	7.7	11.2	3.5
Sus scrofa d	1	-19.9	-	-	-	-	7.7	-	-	-	-
Avis	2	-19.3	-	-19.5	-19.0	0.5	10.9	-	10.6	11.2	0.6
BC	7	-20.7	0.7	-21.5	-19.3	2.2	5.8	1.1	4.6	7.1	2.5
SMD	7	-20.7	0.7	-21.5	-19.3	2.2	5.8	1.1	4.6	7.1	2.5
Sus scrofa d	7	-20.7	0.7	-21.5	-19.3	2.2	5.8	1.1	4.6	7.1	2.5
CAT	13	-19.2	1.1	-20.8	-17.4	3.4	7.1	1.7	4.3	9.4	5.1
CG	5	-18.3	0.7	-19.1	-17.4	1.7	8.5	0.7	7.8	9.2	1.4
Sus scrofa d	1	-18.8	-	-	-	-	9.2	-	-	-	-
Avis	4	-18.2	0.7	-19.1	-17.4	1.7	8.4	0.7	7.8	9.2	1.4
PMCV	5	-20.2	0.5	-20.8	-19.5	1.3	5.6	0.8	4.3	6.4	2.1
Sus scrofa d	5	-20.2	0.5	-20.8	-19.5	1.3	5.6	0.8	4.3	6.4	2.1
RVSM	3	-19.2	1.3	-20.6	-17.9	2.7	7.4	1.8	6.3	9.4	3.1
Sus scrofa d	2	-19.3	-	-20.6	-17.9	2.7	7.9	-	6.4	9.4	3.0
Avis	1	-19.2	-	-	-	-	6.3	-	-	-	-

Table 4.5. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of the complete assemblage of omnivores grouped by taxa and region. Key: M-T = Madrid-Toledo, BC = Basque Country, CAT = Catalonia

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
Sus scrofa d	25	-20.0	0.8	-21.5	-17.9	3.6	7.0	1.5	4.3	9.4	5.1
M-T	10	-19.8	0.4	-20.4	-19.2	1.2	8.1	0.3	7.7	8.9	1.2
BC	7	-20.7	0.7	-21.5	-19.3	2.2	5.8	1.1	4.6	7.1	2.5
Cat	8	-19.8	1.0	-20.8	-17.9	2.9	6.6	1.8	4.3	9.4	5.1
Avis	12	-19.1	1.2	-21.6	-17.4	4.2	8.7	2.0	3.9	11.2	7.3
M-T	7	-19.7	1.2	-21.6	-18.4	3.2	9.2	2.4	3.9	11.2	7.3
Cat	5	-18.4	0.8	-19.2	-17.4	1.8	8.0	1.1	6.3	9.2	2.9

In the Basque Country, only seven pigs from Dulantzi could be successfully analysed. They stood out for showing the most depleted carbon stable isotope ratios of the assemblage and low nitrogen isotope ratios too. This signifies they were also exclusive C_3 eaters and they were almost herbivores, since animal protein would have a had a very marginal role in their diet. Actually, $\delta^{15}N$ values of a few pigs from Dulantzi were even lower than some herbivores'. Then, it is reasonable to infer they were free-ranged.

In Catalonia pigs with well-preserved collagen were present in all the three sites included in this research, but only at Castellar del Vallès were they represented by a good number of specimens. Overall, according to their carbon stable isotope ratios, they were also largely fed on C_3 resources. However, it is likely that the specimen from Can Gambús and certainly the early medieval one from Sant Menna received small amounts of millets too. Nitrogen isotope ratios were the most variable in this region. At Castellar del Vallès, where the largest sample came from, pigs were more enriched in δ^{15}N than most herbivores, suggesting they received certain amount of animal protein. This means possibly they were partially fed with domestic waste and they were kept close from households at least sometimes. The only pig from Can Gambús also had a very high nitrogen isotope ratio, but it was a subadult, so it was likely due to the suckling effect. Instead, the only early medieval swine specimen from Sant Menna was similar to contemporary herbivores.

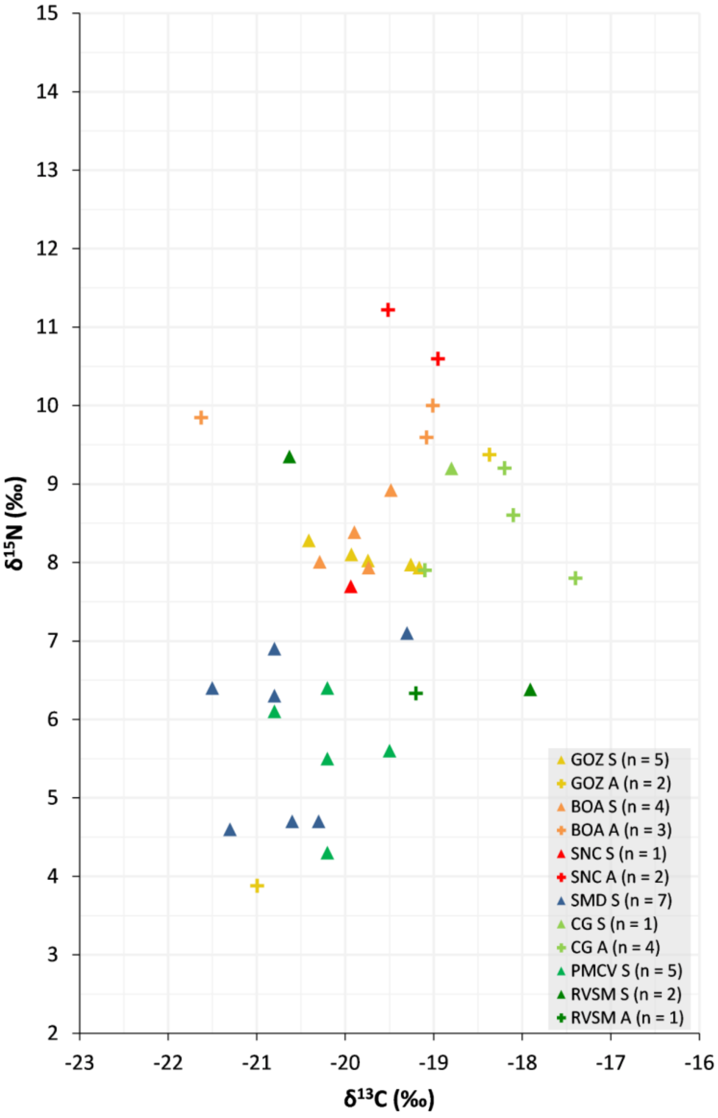


Figure 4.3. Scatterplot of (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of the complete assemblage of omnivores grouped by region, site and taxa

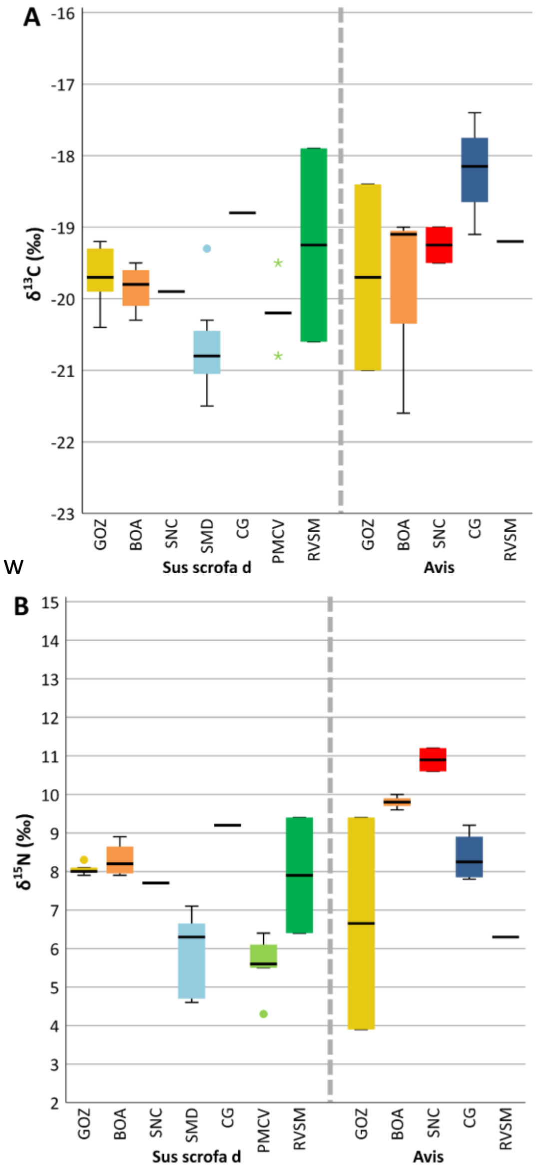


Figure 4.4. Boxplots representing (A) carbon stable isotope ratios (δ^{13}C) and (B) nitrogen isotope ratios (δ^{15}N) of the complete assemblage of omnivores grouped by region, site and taxa

Summing up, pigs were managed similarly in all the three regions. Their diets were predominantly based on C$_3$ products and they rarely showed evidence of notable consumption of animal protein. Thus, pigs would have preferentially been free-ranged, possibly feeding in forests or wooded meadows, which are known to have been predominant around some of the settlements studied (López-Sáez *et al.* 2010). The exception was Catalonia, where apparently pigs were occasionally supplemented with millets and domestic waste, suggesting they were at least partially reared in the proximity of households. These conclusions are supported by statistical analyses. In none of the regions were there statistically significant differences between the means of carbon stable isotope ratios of herbivores (i.e. cattle, ovicaprids, equids) and pigs (δ^{13}C Madrid-Toledo herbivores (n = 33) vs Sus scrofa d (n = 10), Welch t-test: t = -1.227, d.f. = 35.643, p = 0.228; $\delta^{13}C$ Basque Country herbivores (n = 11) vs Sus scrofa d (n = 7), independent samples t-test: t = -0.833, d.f. = 16, p = 0.417; $\delta^{13}C$ Catalonia herbivores (n = 20) vs Sus scrofa d (n = 8), independent samples t-test: t = -0.180, d.f. = 26, p = 0.859). Likewise, no statistically significant differences were detected either between the mean nitrogen isotope ratios of herbivores and pigs from Madrid-Toledo and the Basque Country ($\delta^{15}N$ Madrid-Toledo herbivores (n = 33) vs Sus scrofa d (n = 10), Welch t-test: t = -0.903, d.f. = 40.999, p = 0.372; $\delta^{15}N$ Basque Country herbivores (n = 11) vs Sus scrofa d (n = 7), independent samples t-test: t = -0.833, d.f. = 16, p = 0.417). Conversely, in Catalonia the difference between the mean $\delta^{15}N$ of herbivores and pigs was statistically significant ($\delta^{15}N$ Catalonia herbivores (n = 20) vs Sus scrofa d (n = 8), independent samples t-test: t = -2.968, d.f. = 26, p = 0.006, d = 1.241), which confirms the distinctive nature of swine management strategies in this region.

Fowls were characterised by the heterogeneity of their dietary patterns. In fact, they were the taxon with the largest ranges for both carbon and nitrogen stable isotope ratios. They were represented by twelve specimens, divided approximately proportionately between the sites from Madrid-Toledo and Catalonia, but no fowl from the Basque Country was sampled. Altogether they had a mean $\delta^{13}C$ of -19.1‰ with a standard deviation of 1.2‰ and a range of 4.2‰ and a mean $\delta^{15}N$ of 8.7‰ with a standard deviation of 2.0‰ and a range of 7.3‰. That is, they moved between the ranges of purely C_3 diets and C_3 diets with moderate contributions of C_4 plants, and their intake of animal protein would have been very variable. Fowl from Madrid-Toledo tended towards more depleted carbon stable isotope ratios and higher nitrogen isotope ratios, while those from Catalonia exhibited more enriched $\delta^{13}C$ and generally lower $\delta^{15}N$ values. However, these figures need to be confronted with those of local herbivores for accurate interpretation (see section 4.1.1). There were no statistically significant differences between the distributions of either carbon or nitrogen stable isotope ratios of herbivores (i.e. cattle, ovicaprids, equids) and fowl from Madrid-Toledo ($\delta^{13}C$ Madrid-Toledo herbivores (n = 33) vs Avis (n = 7), independent samples t-test: t = -0.928, d.f. = 38, p = 0.359; $\delta^{15}N$ Madrid-Toledo herbivores (n = 33) vs Avis (n = 7), Mann-Whitney U test: U = 146.000, z = 1.087, p = 0.293). Therefore, these animals were fed on predominantly C_3 products and only occasionally certain specimens would have received small proportions of C_4 plants. Regarding animal protein consumption, their $\delta^{15}N$ values were not substantially different from those of local herbivores, so they would have eaten mostly vegetal foodstuffs. Conversely, in Catalonia differences in the distribution of isotopic signatures between herbivores and fowls were statistically significant both for $\delta^{13}C$ and $\delta^{15}N$ ($\delta^{13}C$ Catalonia herbivores (n = 20) vs Avis (n = 5), Mann-Whitney U test: U = 94.000, z = 2.994, p = 0.001; $\delta^{15}N$ Catalonia herbivores (n = 20) vs Avis (n = 5), Mann-Whitney U test: U = 97.500, z = 3.232, $p < 0.001$). Considering most herbivores from Catalonia had diets largely based on C_3 plants, these data support the idea that most fowl in this region ate moderate amounts of millets. This is also evidence for the supplementing of poultry diet with considerable proportions of animal protein. Both features suggest in Catalonia fowl was fed at least partially with domestic waste and, consequently, it is reasonable to propose they were kept in courtyards in the proximity of households. With the results available it is more difficult to infer whether domestic birds in Madrid-Toledo were also managed similarly. Besides, it is worth noting the paradox that mean $\delta^{15}N$ of fowl was higher in Madrid-Toledo than in Catalonia, but further comparative analyses indicate animal protein consumption was actually greater in the latter, which underlines the importance of characterising the isotopic signatures at the base of local ecosystems as thoroughly as possible.

In conclusion, unlike herbivores, omnivores as a whole were characterised by great variability both between and within regions. Pigs from the same site had more homogeneous carbon and nitrogen stable isotope ratios, pointing at the possible existence of common strategies for swine management in each settlement, but in most cases fowl were extremely diverse even within the same assemblage. Hence, it looks like there were not well-defined strategies for their management, so perhaps their small size and dietary versatility favoured greater adaptability of poultry raising maybe even at the domestic unit level.

4.1.3 CARNIVORES

The small number of carnivores analysed was not enough to make well-grounded inferences on the dietary habits of these taxa, which were restricted to dogs and cats (table 4.6, figure 4.5, figure 4.6). Still, it was possible to make some interesting observations about the relationship between humans and these animals, which were normally not kept for food but for work and as pets. Usually the dietary patterns of domestic carnivores mimicry those of the human populations they live with (Guiry 2012), because dogs and cats often shared the domestic sphere with their keepers.

Table 4.6. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of the complete assemblage of carnivores grouped by region, site and taxa. Standard deviation is only reported if sample size is greater than two. Key: M-T = Madrid-Toledo, BC = Basque Country, CAT = Catalonia

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All	6	-19.1	1.0	-20.5	-18.0	2.5	8.4	1.4	6.5	10.1	3.6
M-T	1	-18.0	-	-	-	-	10.0	-	-	-	-
BOA	1	-18.0	-	-	-	-	10.0	-	-	-	-
Canis familiaris	1	-18.0	-	-	-	-	10.0	-	-	-	-
BC	1	-20.5	-	-	-	-	10.1	-	-	-	-
ALD	1	-20.5	-	-	-	-	10.1	-	-	-	-
Canis familiaris	1	-20.5	-	-	-	-	10.1	-	-	-	-
CAT	4	-19.0	0.8	-20.0	-18.3	1.7	7.6	0.8	6.5	8.3	1.8
CG	4	-19.0	0.8	-20.0	-18.3	1.7	7.6	0.8	6.5	8.3	1.8
Canis familiaris	2	-18.8	-	-19.2	-18.3	0.9	8.2	-	8.0	8.3	0.3
Felis catus	2	-19.2	-	-20.0	-18.3	1.7	7.1	-	6.5	7.7	1.2

The isotopic signature of dogs and cats tended to be close to the mean of local humans, especially concerning carbon stable isotope ratios. The only domestic carnivore analysed from Madrid-Toledo, a dog from Boadilla, was just 0.6‰ away from the mean $\delta^{13}C$ of the local human assemblage and it only differed 0.1‰ on $\delta^{15}N$. Then, it would have had a diet largely based on C_3 resources but with significant intake of C_4 plants and limited contribution of animal protein. The biggest dataset of domestic carnivores analysed, formed by two dogs and two cats, came from Can Gambús. Their isotopic signatures were quite tightly clustered. Carbon stable isotope ratios moved in the limit between exclusive C_3 diets and diets predominantly based on C_3 resources with small contributions of C_4 plants, and the offset between the mean $\delta^{13}C$ of domestic carnivores from Can Gambús and local humans buried in the settlement was just 0.2‰. Their nitrogen isotope ratios were 2.1‰ more depleted than local humans', but they were more enriched than local herbivores, pointing at the consumption of only small proportions of animal protein. The most interesting finding in this sense was to verify that omnivores from Can Gambús had higher $\delta^{15}N$ values than domestic carnivores, so they received greater proportions of animal protein, which supports the hypothesis that they were fed domestic waste and kept in courtyards at least partially (see section 4.1.2). Probably cats and dogs at Can Gambús were also given domestic waste, but it would have been differently composed. Besides, it has to be noted that one of the cats was notably more depleted in $\delta^{15}N$ than the other three specimens, but no clear dietary patterns were observed according to taxon. The exception to the proximity between the diets of domestic carnivores and local humans was the canid from Aldaieta. This specimen's carbon and nitrogen stable isotope ratios pointed at a purely C_3 diet with moderate consumption of animal protein. However, its isotopic signature was very different from any local human, which were characterised by the generalised intake of C_4 plants. Therefore, it can be concluded this was a wild specimen, a wolf, whose diet was very different from local humans'.

These results confirm domestic carnivores lived in close proximity to humans and probably a significant part of their diet was based on domestic waste. Otherwise, for example, the dog from Boadilla would have rarely had access to millets in nature. In addition, carbon and nitrogen stable isotope analyses were able to identify the canine from Aldaieta as a wolf, whose tooth was reused as pendant. This opens an unexplored window to the symbolic role of hunting and wild animals in early medieval Iberia (Grau-Sologestoa 2015: 143–149, Rao 2018), which at least at Aldaieta also involved bears (Azkarate 1999: 117, 309, 380, 381, 488).

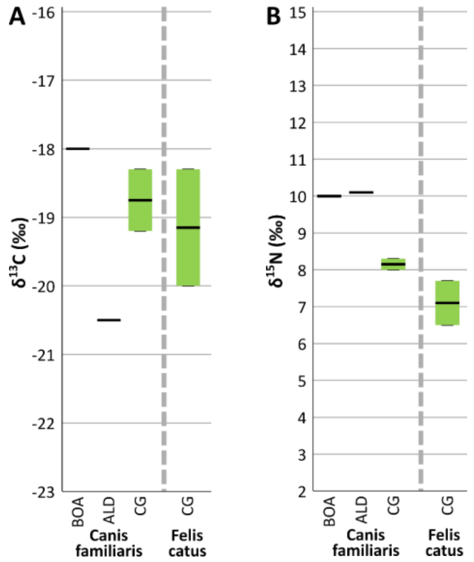


Figure 4.5. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of the complete assemblage of carnivores grouped by region, site and taxa

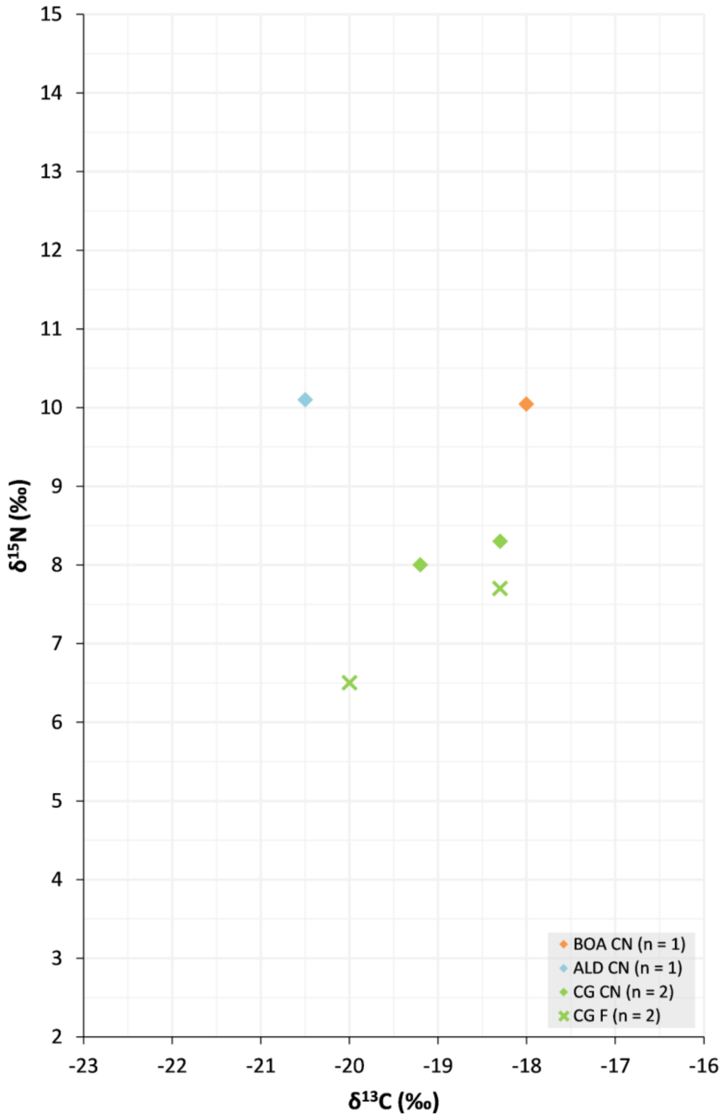


Figure 4.6. Scatterplot of ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of the complete assemblage of carnivores grouped by region, site and taxa

4.1.4 AGRARIAN PRACTICES

According to the isotopic data of the fauna from the eight assemblages analysed, it is possible to draw some conclusions about the livestock management strategies implemented by early medieval Iberian rural communities and indirectly also about some aspects of arable farming. The clearest outcome is the diversity of agrarian practices between regions, which seem to have been the smallest territorial unit with internal coherence when it comes to animal husbandry. There were some differences in livestock dietary patterns between sites from the same region too, but in general terms they followed similar trends, while there were remarkable differences from one region to another.

In Madrid-Toledo the main herbivore taxa, namely cattle and ovicaprids, had access to a wide range of resources. On one hand, they consumed both C_3 and C_4 plants. The former would have made up the bulk of their diet and the latter would have probably been supplied during the periods animals were kept closer from the settlement. On the other hand, many of the herbivores from Madrid-Toledo ate intensively manured plants, which were possibly obtained letting them in the fields once grain had been harvested. This combination of herbivore management strategies would have given rise to a complex system that integrated the exploitation of less anthropized resources, such as pastures, with arable farming, either for the production of millet fodder or the intensive manuring of fields. Equids, despite being also herbivores, represented an exception to this paradigm and they were probably managed differently, because they were not provided millets. This was the scenario in big settlements defined as villages, such as Gózquez and Boadilla. However, it is likely smaller farm type sites worked differently. In Madrid-Toledo only El Soto/El Encadenado fall under this definition. Here no animals were supplied C_4 fodder and it is unclear whether they had access to intensively manured plants, since their nitrogen isotope ratios were generally lower. Interestingly, all ovicaprids from this assemblage were more enriched in $\delta^{15}N$ than cattle, so if any taxa had access to manured plants, they would have been sheep and goats. Regarding omnivores, all pigs from the three fauna assemblages from Madrid-Toledo were very homogeneous in carbon and nitrogen stable isotope ratios. This means they were managed similarly in the whole region. They were free-ranged in open spaces, possibly in wooded meadows, and in no case did they have access to C_4 resources. Instead, fowl were very heterogeneous. They were mostly fed with C_3 products, although some specimens might have occasionally had millets too, and on average they consumed greater proportions of animal proteins than any other taxon, possibly because they were kept close to households to be fed with domestic waste. Finally, the only domestic carnivore from the region showed dietary patterns similar to local humans', confirming their proximity in everyday life.

Information about agrarian practices in the Basque Country is scarcer because there were not that many samples available. Still, it was possible to conclude unquestionably that livestock from Basque settlements had exclusive C_3 diets and, in spite of the great importance of C_4 plants in human diet in this region (see section 4.2), millets were not used as fodder in any case. There is no clear evidence of the consumption of intensively manured plants by Basque herbivores, but it has to be acknowledged that ovicaprids were systematically more enriched in $\delta^{15}N$ than cattle. Then, if any herbivorous taxa had access to them, it would have been sheep or goats. Pigs were also free-ranged, as indicated by the absence of any hint on the intake of animal protein from domestic waste. As for carnivores, only one specimen from this region was analysed and, based on the dissimilarity with the dietary patterns of local humans, it turned out to be a wild wolf. All in all, animal husbandry management strategies put in practice by early medieval rural communities in the Basque Country look like simpler than in other regions, possibly with all taxa being herded in little anthropized open spaces, such as pastures, wooded meadows or forests. Nevertheless, it is likely that agrarian systems in this region were more articulated than what is possible to observe through carbon and nitrogen stable isotope analyses and a larger and more balanced dataset would be needed to strengthen these conclusions.

In Catalonia animal feeding patterns did not differ substantially between sites either. This seems reasonable considering the three sites analysed were strictly contemporary and geographically very close. Herbivores, both cattle and ovicaprids, did not differ significantly between assemblages. Their diets were largely based on C_3 plants and only in some cases might they have received small proportions of C_4 crops as fodder. Likewise, in this region herbivores had the most depleted nitrogen isotope ratios, so it is very unlikely they had access to any manured plants. Pigs from Catalan assemblages had exclusive C_3 diets, as it was verified in the other two regions under study, but they were different in that they showed evidence of having been fed with domestic waste, as their $\delta^{15}N$ values were significantly higher than local herbivores'. This suggests that, unlike in Madrid-Toledo or the Basque Country, pigs were kept in the proximity of households at least during certain periods. This does not exclude they could also be free-ranged regularly, but it is relevant because it implies a different organisation of pig farming (Halley & Rosvold 2014). Besides, the identification of pigs regularly fed on domestic waste and stabled in settlements is not a common finding in medieval contexts either in Iberia (Fuller *et al.* 2010, Guede, Ortega, Zuluaga, Alonso-Olazabal, Murelaga, Solaun, *et al.* 2017, Jordana *et al.* 2019, López-Costas & Müldner 2016, Sirignano *et al.* 2014) or Europe (Baldoni *et al.* 2018, Buonincontri *et al.* 2016, Ervynck *et al.* 2007, Hammond & O'Connor 2013, Kaupová, Velemínský, Stránská, *et al.* 2018) until the last centuries of the period. Actually, the city of Valencia was the only early medieval context in Iberia where pigs showed so enriched nitrogen isotope ratios in comparison to local herbivores (Alexander *et al.* 2019) and it was difficult to find contemporary examples in Europe or the Mediterranean region (Frémondeau *et al.* 2017). Resuming the discussion on agrarian practices in Catalonia, fowl were as heterogeneous as in Madrid-Toledo, but in this region it was more frequent that they regularly got millets in their diet. Moreover, they also had considerable proportions of animal protein. Thus, it can be concluded that they were fed with domestic waste and possibly kept in courtyards close to households. Lastly, the similarity of dietary habits of domestic carnivores, i.e. dogs and cats, and humans in Catalonia was also confirmed. Summing up, Catalan agrarian systems would have been closer to what observed in the Basque Country than in Madrid-Toledo. This is especially true for the integration between animal husbandry and arable farming, since no contribution of livestock to manuring was recorded. Besides, the management strategy adopted for pigs is remarkable for its uniqueness in this chronological context.

Therefore, each of the three regions analysed was characterised by a specific set of agrarian practices. This would have certainly been the result of local rural communities adapting themselves to local environmental, social, political and economic conditions, which undoubtedly were different from settlement to settlement but, according to isotopic data, shared many common features within the same region. Nonetheless, despite differences, it is possible to recognise some common trends in agrarian practices at the supralocal scale. For example, cattle and ovicaprids were almost always managed similarly within the same assemblage, pigs were predominantly free-ranged, fowl was always the taxon with the most variable feeding patterns and domestic carnivores tended to be similar to local humans. In this way, the most relevant sources of variation were the supplementation of diet with millet fodder and the consumption of intensively manured plants in the case of herbivores, and the feeding of pigs with domestic waste. The latter was already discussed in the previous paragraph, but variation sources in herbivore diet deserve some attention.

Millet fodder was occasionally used to feed herbivores from Madrid-Toledo and, to a lesser extent, Catalonia. Such a finding is not common in early medieval contexts, but a few fauna assemblages where this herbivore feeding strategy was also followed have been recently published (Marinato 2016, Maxwell 2019, Sandias & Müldner 2015, Vidal-Ronchas *et al.* 2018), although in many cases they are formed by very few specimens. It is remarkable that all of them are located in southern Europe and the Middle East (i.e. Italy, Croatia, Jordan), which points at the existence of a regional pattern in the use of millets for livestock feeding. When it comes to Iberia, only a few isolated specimens with small proportions of C_4 plants in their diets have been identified at Zaballa (Sirignano *et al.* 2014), Egara (Jordana *et al.* 2019), Valencia (Alexander *et al.* 2019) and Monte da Cegonha (Saragoça *et al.* 2016), but the use of millets for feeding herbivores was definitively not a generalised trend either in the sites analysed for this thesis or among those published by other colleagues. Nevertheless, this is indirect evidence of the diversification of agrarian production by rural communities during Early Middle Ages, which in a context of political and economic instability and little capacity to plan ahead would have been aimed at optimising adaptation and minimising risks over agrarian production in order to grant food supply for the domestic unit throughout the year following peasant logics (Halstead & O'Shea 2004, Montanari 1979, Wickham 2005: 536–539).

Moreover, it should not be forgotten that millets were also used for human consumption, although their importance in diet varied from region to region (see section 4.2.1). Still, it is noteworthy that the Basque Country, the region where humans had greater proportions of C_4 plants in diet, was also the only territory where fauna assemblages showed no evidence of millet consumption at all. Conversely, in Madrid-Toledo and Catalonia, which were the regions where C_4 fodder intake by herbivores was the clearest, the importance of millets in human diet was quantitatively smaller. In other words, C_4 crops were cultivated in all three regions studied, but in each one they were used for different purposes. Similar differences were observed between contemporary Galicia and Asturias through ethnographic research (Moreno-Larrazabal *et al.* 2015). However, the reasons why each early medieval community decided to employ a specific resource for certain purposes are unknown.

The other relevant finding concerning agrarian practices was the identification of intensive manuring in some contexts. Mean nitrogen isotope ratios of herbivores from Gózquez and Boadilla were the highest of all the early medieval herbivore assemblages in this thesis (table 4.2) and also among the contemporary case studies in Iberia known through the literature. Besides, herbivores from El Soto/El Encadenado were only surpassed by those from A Lanzada (López-Costas & Müldner 2016), which was very likely influenced by salinity due to the proximity to the sea. Conversely, nitrogen isotope ratios of herbivores from the Basque Country and Catalonia were significantly more depleted in ^{15}N. The enrichment of herbivore $\delta^{15}N$ values in the assemblages from Madrid-Toledo is interpreted as the result of the consumption of intensively manured plants (Bogaard *et al.* 2007, Fraser *et al.* 2011). The most efficient way to attain such a manuring would have been to let animals in the fields after harvest to feed on crop leftovers. In this way, year after year herbivores would have contributed with their manure to the fertilisation of arable fields, increasing the nitrogen isotope ratios at the base of the local trophic chain. As a result, not only herbivores but also humans would have reached elevated nitrogen isotope ratios without the intake of significant amounts of animal protein or aquatic resources. This agrarian strategy, known as lifting of the fences or *derrota de las mieses* in Spanish, entails tight integration between arable farming and animal husbandry and it implies deep cohesion within the community, as it would have required negotiation and compromise between different domestic units. In a historical context like early medieval Iberia, where agrarian systems have traditionally been deemed simple and primitive (García Moreno 1986, Quirós 2014: 31–33, Vigil-Escalera & Quirós 2013: 375), finding evidence of such an articulated agrarian strategy as the lifting of the fences is a very significant hint of the complexity of productive systems in the region of Madrid-Toledo during Early Middle Ages; but it is equally interesting to verify that during the same period intensive manuring was not practiced in the Basque Country or Catalonia.

The identification of intensive manuring in early medieval Iberian contexts is further supported by the comparison with contemporary case studies from Europe and the rest of the Mediterranean basin. Considering all this huge area, less than ten herbivore assemblages out of the 105 recorded had equal or greater $\delta^{15}N$ values than those from Gózquez or Boadilla. Excluding those with only one or two specimens, most of them were located on the coast or in salt marsh areas in Belgium and the Netherlands (Ervynck *et al.* 2012, Müldner *et al.* 2014, McManus *et al.* 2013), so they were affected by salinity. The only exception was Raystown, in Ireland (Ryan *et al.* 2018). This was the only early medieval European herbivore assemblage from an inland location which exceeded the mean nitrogen isotope ratios of Gózquez and Boadilla and its enriched $\delta^{15}N$ values were also interpreted as the result of manuring, even though the practice of the lifting of the fences was not discussed. Then, the comparison at the supraregional level underlines the uniqueness of the identification of intensive manuring by early medieval rural communities in central Iberia, although new case studies could change this perspective, and it demonstrates the potential of carbon and nitrogen stable isotope analyses to bring to light aspects of agrarian practices not obviously related to human diet.

Table 4.7. Quantitative summary of individuals and samples analysed of the complete human assemblage

Assemblage	*Ind recorded in field*	*Ind available for study*	*Ind sampled for $\delta^{13}C$ & $\delta^{15}N$*	*Ind well-preserved collagen*	*Ind bad-preserved collagen*
GOZ cemetery	361	202/361 = 56.0%	36/202 = 17.8%	33/36 = 91.7% 33/202 = 16.3%	3/36 = 8.3%
GOZ settlement	11	10/11 = 90.9%	5/10 = 50.0%	5/5 = 100.0% 5/10 = 50.0%	0/5 = 0.0%
BOA	226	172/226 = 76.1%	87/172 = 50.6%	77/87 = 88.5% 77/172 = 44.8%	10/87 = 11.5%
SNC phase 1	9	7/9 = 77.8%	3/7 = 42.9%	3/3 = 100.0% 3/7 = 42.9%	0/3 = 0.0%
SNC phase 3	44	42/44 = 95.5%	15/42 = 35.7%	9/15 = 60.0% 9/42 = 21.4%	6/15 = 40.0%
LH phase 2	1	1/1 = 100.0%	1/1 = 100.0%	1/1 = 100.0% 1/1 = 100.0%	0/1 = 0.0%
LH phase 3	8	8/8 = 100.0%	6/8 = 75.0%	6/6 = 100.0% 6/8 = 75.0%	0/6 = 0.0%
ALD	132	117/132 = 88.6%	91/117 = 77.8%	70/91 = 76.9% 70/117 = 59.8%	21/91 = 23.1%
FIN	12	10/12 = 83.3%	9/10 = 90.0%	6/9 = 66.7% 6/10 = 60.0%	3/9 = 33.3%
SMD phase 3	3	3/3 = 100.0%	2/3 = 66.7%	2/2 = 100.0% 2/3 = 66.7%	0/2 = 0.0%
SMD phase 4	50	50/50 = 100.0%	16/50 = 32.0%	16/50 = 32.0% 16/50 = 32.0%	0/16 = 0.0%
CG cemetery	36	34/36 = 94.4%	33/34 = 97.1%	11/33 = 33.3% 11/34 = 32.4%	22/33 = 66.7%
CG settlement	8	8/8 = 100.0%	8/8 = 100.0%	5/8 = 62.5% 5/8 = 62.5%	3/8 = 37.5%
PMCV	33	32/32 = 100.0%	23/32 = 71.9%	21/23 = 91.3% 21/32 = 65.6%	2/23 = 8.7%
RVSM	89	76/89 = 85.4 %	65/76 = 85.5%	15/65 = 23.1% 15/76 = 19.7%	50/65 = 76.9%
Total	1023	772/1023 = 75.5%	400/772 = 51.8%	280/400 = 70.0% 280/772 = 36.3%	120/400 = 30.0%

4.2 DIET AND FOOD DISTRIBUTION IN EARLY MEDIEVAL RURAL IBERIA

This thesis gathers the results of palaeodietary reconstruction based on $\delta^{13}C$ and $\delta^{15}N$ of human populations from ten archaeological sites. However, three of them had two well distinguished phases (i.e. El Soto/El Encadenado, La Huelga, Dulantzi) and another two were formed by more than one area with funerary evidence (i.e. Gózquez, Can Gambús). Therefore, the total number of human assemblages analysed was fifteen (table 4.7). Seven were located in the region of Madrid-Toledo, four in the Basque Country and another four in Catalonia. The minimum number of individuals available for study in each assemblage ranged between 1 and (i.e. La Huelga phase 2) and 202 (i.e. Gózquez cemetery). In all 772 individuals were examined for age estimation and sex determination, and exactly 400 individuals (51.8%) were sampled for carbon and nitrogen stable isotope analyses. Among them, 280 individuals preserved good quality collagen and could be used for further interpretation. This meant 70.0% of all the individuals which underwent isotope analyses and 36.3% of the entire population studied. The number of individuals with well-preserved collagen in a single assemblage varied between 1 (i.e. La Huelga phase 2) to 77 (i.e. Boadilla). In this way, the success rate within individual assemblages was between 23.1% (i.e. Sant Menna) and 100.0% (i.e. Gózquez settlement, El Soto/El Encadenado phase 1, La Huelga phase 2, La Huelga phase 3, Dulantzi phase 3, Dulantzi phase 4). Likewise, the representativeness of the samples successfully analysed in comparison to the minimum number of individuals in each assemblage ranged between 16.3% (i.e. Gózquez cemetery) and 100.0% (i.e. La Huelga phase 2), but it has to be taken into account that these figures favour disproportionately smaller datasets.

Table 4.8. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of the complete human assemblage grouped by region and site. Standard deviation is only reported if sample size is greater than two. Key: M-T = Madrid-Toledo, BC = Basque Country, CAT = Catalonia

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All	280	-18.6	0.7	-21.4	-16.2	5.2	9.8	1.1	5.4	14.8	9.4
M-T	134	-18.6	0.6	-21.2	-16.2	5.0	10.2	1.2	6.4	14.8	8.4
GOZ cem	33	-18.7	0.7	-20.0	-16.2	3.8	9.9	1.1	8.4	13.9	5.5
GOZ settl	5	-18.8	0.3	-19.1	-18.5	0.6	10.6	0.7	10.1	11.5	1.4
BOA	77	-18.6	0.6	-21.2	-17.2	4.0	10.1	1.0	6.4	12.9	6.5
SNC ph1	3	-19.0	0.3	-19.3	-18.7	0.6	10.6	0.3	10.2	10.8	0.6
SNC ph3	9	-18.7	0.5	-19.5	-18.2	1.3	11.3	0.9	10.5	13.5	3.0
LH ph2	1	-18.8	-	-	-	-	11.0	-	-	-	-
LH ph3	6	-18.8	0.6	-19.8	-18.0	1.8	11.7	2.3	8.4	14.8	6.4
BC	94	-18.4	0.8	-21.4	-16.8	4.6	9.2	0.8	5.4	10.9	5.5
ALD	70	-18.3	0.7	-20.8	-16.8	4.0	9.1	0.6	7.5	10.3	2.8
FIN	6	-18.0	0.4	-18.4	-17.5	0.9	10.5	0.3	10.1	10.9	0.8
SMD ph3	2	-18.9	-	-19.1	-18.7	0.4	10.5	-	10.1	10.8	0.7
SMD ph4	16	-19.0	1.1	-21.4	-17.1	4.3	9.3	1.1	5.4	10.2	4.8
CAT	52	-18.9	0.7	-20.7	-17.3	3.4	9.5	1.0	7.7	12.9	5.2
CG cem	11	-19.2	0.7	-20.7	-18.3	2.4	9.7	0.6	8.6	10.6	2.0
CG settl	5	-19.3	0.5	-20.2	-18.8	1.4	9.4	0.6	8.5	10.0	1.5
PMCV	21	-18.7	0.6	-19.8	-17.3	2.5	9.3	1.1	8.2	12.9	4.7
RVSM	15	-18.6	0.6	-19.4	-17.6	1.8	9.7	1.1	7.7	12.9	5.2

Altogether, the human assemblage analysed for this thesis was formed by 280 individuals (table 4.8, figure 4.7, figure 4.8). Almost half of them came from Madrid-Toledo (134/280 = 47.8%), a third from the Basque Country (94/280 = 33.5%) and approximately a fifth from Catalonia (52/280 = 18.6%). The imbalance of the relative weight of each region in the dataset is due to the facts that two of the sites from Madrid-Toledo were notably bigger than the average in the other regions and collagen preservation in Catalonia was really bad in the majority of the assemblages. Considering all the three regions together, the mean carbon stable isotope ratio of humans was -18.6‰ and they had a standard deviation of 0.7‰ and a range of 5.2‰. Nitrogen isotope ratios were more widespread. Their mean was 9.8‰, standard deviation was 1.1‰ and range 9.4‰. In general terms, these figures indicate that the diet of early medieval Iberian rural communities was predominantly based on C_3 resources, in many cases with proportionately small input of C_4 plants. Besides, all the products consumed were terrestrial, as no clear evidence of the intake of aquatic resources, either marine or freshwater, was recorded in any of the assemblages. Nevertheless, in most cases the contribution of animal protein would have been small. These are the common features that characterised dietary patterns in all the case studies included in this research. It was somehow expectable to find some shared trends between the contexts analysed. On one hand, the ecosystems where they were located were not extremely different, so the range of products available in each region should have been similar, and, on the other, the specificity of carbon and nitrogen stable isotope analyses is not great either. Still, each of the three regions analysed had its own distinct set of food consumption patterns. These are especially notable when, instead of discussing directly δ^{13}C and δ^{15}N values, comparisons are based on the offsets between human carbon and nitrogen stable isotope ratios and the mean isotopic signatures of local herbivores (table 4.9, figure 4.9, figure 4.10). In this way it is possible to reduce the impact of the variations of isotopic baselines at the bottom of each ecosystem. However, it should be noted that not in all cases was it possible to analyse herbivores from the same contexts as humans. For this reason, herbivores from El Soto/El Encadenado were used as the reference for the human assemblages from La Huelga and for Finaga it was employed the mean of the herbivores from Aldaieta and Dulantzi, which were the closest contexts.

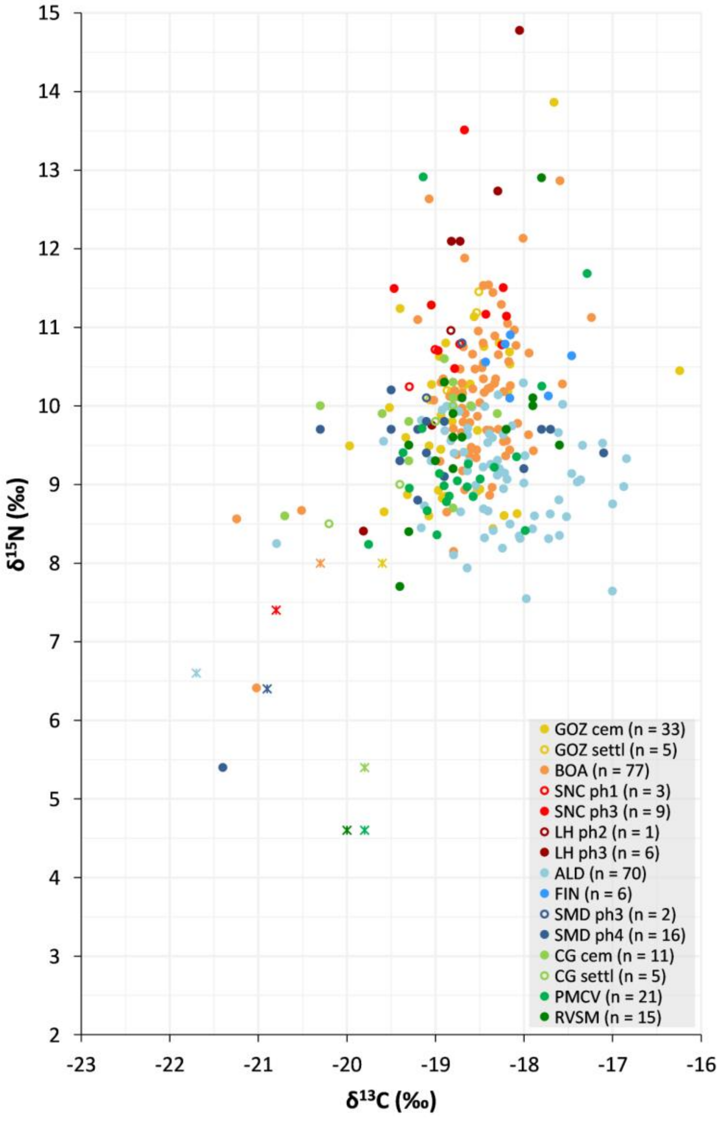


Figure 4.7. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of the complete assemblage of humans grouped by region and assemblage. Mean herbivore values are represented with stars of the same colour as humans

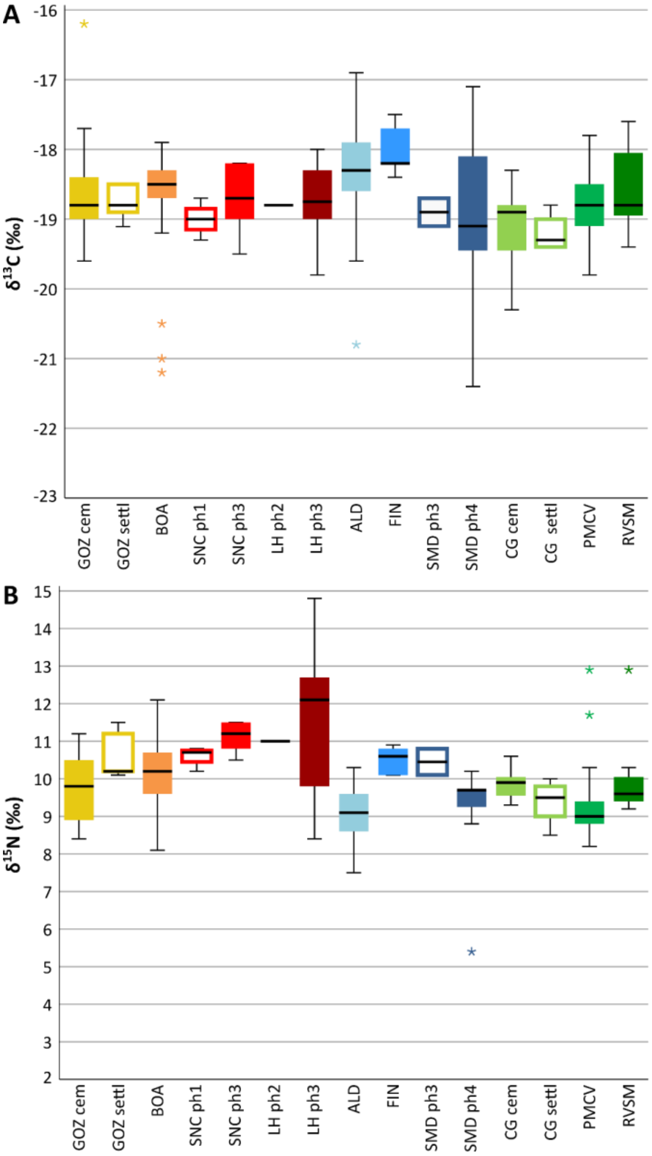


Figure 4.8. Boxplots representing (A) carbon stable isotope ratios (δ^{13}C) and (B) nitrogen isotope ratios (δ^{15}N) of the complete assemblage of humans grouped by region and assemblage

Differences between regions were meaningful using either criteria. The distributions of carbon stable isotope ratios between the three areas of study were statistically significantly different (δ^{13}C all humans grouped by region, Kruskal-Wallis H test: n = 280, H = 21.953, d.f. = 2, $p < 0.001$) and pairwise *post hoc* comparison confirmed the existence of statistically significant differences between all the combinations possible (Madrid-Toledo vs Basque Country: p = 0.015; Madrid-Toledo vs Catalonia: p = 0.030; Basque Country vs Catalonia: $p < 0.001$). Nitrogen isotope ratios also showed statistically significant differences between regions in their distributions (δ^{15}N all humans grouped by region, Kruskal-Wallis H test: n = 280, H = 56.600, d.f. = 2, $p < 0.001$). Nevertheless, pairwise *post hoc* comparison detected statistically significant differences between Madrid-Toledo and the Basque Country ($p < 0.001$) and between Madrid-Toledo and Catalonia ($p < 0.001$), but not between the Basque Country and Catalonia (p = 0.638). Likewise, when offsets between individual human carbon and nitrogen stable isotope ratios and mean local herbivore isotopic signatures were used, results were similar, but differences were even more noticeable. Differences in the distributions of δ^{13}C offsets between regions were statistically significant (δ^{13}C offsets all humans grouped by region, Kruskal-Wallis H test: n = 280, H = 147.071, d.f. = 2, $p < 0.001$) and pairwise *post hoc* comparison indicated differences were still statistically significant between all existing combinations (Madrid-Toledo vs Basque Country: $p < 0.001$; Madrid-Toledo vs Catalonia: p = 0.001; Basque Country vs Catalonia: $p < 0.001$). δ^{15}N offsets were also statistically significantly differently distributed between the three regions (δ^{15}N offsets all humans grouped by region, Kruskal-Wallis H test: n = 280, H = 110.059, d.f. = 2, $p < 0.001$) and, according to *post hoc* comparison, differences between any pair were statistically significant too (Madrid-Toledo vs Basque Country: p = 0.016; Madrid-Toledo vs Catalonia: $p < 0.001$; Basque Country vs Catalonia: $p < 0.001$). These results demonstrate differences in diet between the three regions investigated were substantially different. In addition, unlike what happened with herbivores (see section 4.1.1), in most cases there were also statistically significant differences between the assemblages from the same region. These internal differences will be discussed in the following paragraphs.

Table 4.9. Mean carbon (δ^{13}C) and nitrogen (δ^{15}N) stable isotope ratios of the complete human assemblage and the corresponding herbivore assemblages, and mean offsets between them grouped by region and assemblage. Key: M-T = Madrid-Toledo, BC = Basque Country, CAT = Catalonia. The figures in italics mark (i.e. La Huelga, Finaga) the contexts where there were no herbivores to analyse, so herbivore reference values were taken from neighbouring sites

	Humans			*Herbivores*			*Mean offsets*	
	n	*Mean δ^{13}C*	*Mean δ^{15}N*	*n*	*Mean δ^{13}C*	*Mean δ^{15}N*	*δ^{13}C*	*δ^{15}N*
All	280	-18.6	9.8	72	-20.3	6.7	**1.7**	**3.1**
M-T	134	-18.6	10.2	33	-20.0	7.9	**1.4**	**2.3**
GOZ cem	33	-18.7	9.9	16	-19.6	8.0	**0.9**	**1.9**
GOZ settl	5	-18.8	10.6	16	-19.6	8.0	**0.8**	**2.6**
BOA	77	-18.6	10.1	12	-20.3	8.0	**1.7**	**2.1**
SNC ph1	3	-19.0	10.6	5	-20.8	7.4	**1.8**	**3.2**
SNC ph3	9	-18.7	11.3	5	-20.8	7.4	**2.1**	**3.9**
LH ph2	1	-18.8	11.0	*5*	*-20.8*	*7.4*	**2.0**	**3.6**
LH ph3	6	-18.8	11.7	*5*	*-20.8*	*7.4*	**2.0**	**4.3**
BC	94	-18.4	9.2	19	-21.3	6.5	**2.9**	**2.7**
ALD	70	-18.3	9.1	8	-21.7	6.6	**3.4**	**2.5**
FIN	6	-18.0	10.5	*19*	*-21.3*	*6.5*	**3.3**	**4.0**
SMD ph3	2	-18.9	10.5	11	-20.9	6.4	**2.0**	**4.1**
SMD ph4	16	-19.0	9.3	11	-20.9	6.4	**1.9**	**2.9**
CAT	52	-18.9	9.5	20	-19.8	4.8	**0.9**	**4.7**
CG cem	11	-19.2	9.7	6	-19.8	5.4	**0.6**	**4.3**
CG settl	5	-19.3	9.4	6	-19.8	5.4	**0.5**	**4.0**
PMCV	21	-18.7	9.3	10	-19.8	4.6	**1.1**	**4.7**
RVSM	15	-18.6	9.7	4	-20.0	4.6	**1.4**	**5.1**

The six human assemblages in the region of Madrid-Toledo comprised 134 individuals. Their mean carbon stable isotope ratio was -18.6‰ with a standard deviation of 0.6‰ and a range of 5.0‰, and the mean offset between human and local herbivore δ^{13}C values was 1.4‰. Both absolute carbon stable isotope ratios and offsets regarding local herbivores of these human assemblages are intermediate to those from the Basque Country and Catalonia. They are indicative of diets largely based on C_3 resources with small but regular contributions from an enriched carbon source, that in this context was identified as C_4 plants. However, there were two distinct patterns in the consumption of plants, especially concerning millets. On one side, there was Gózquez, whose populations both from the cemetery and the settlement had mean $\delta^{13}C$ offsets below the 1‰ fractionation typically accepted for one trophic level shift. This was accompanied by the fact that Gózquez was the only site in the region where a significant proportion of herbivores were fed with millet fodder. Then, it can be concluded that at Gózquez the enrichment of $\delta^{13}C$ values due to C_4 plants was acquired mostly indirectly through the intake of animal products. On the other side, the human assemblages from Boadilla, El Soto/El Encadenado and La Huelga presented considerably larger offsets in comparison to local herbivores, in all cases exceeding the 1‰ fractionation accepted between trophic levels. This suggests in these settlements the enriched carbon isotopic signal from millets was incorporated by humans through direct consumption. This hypothesis is also sustained by local herbivore isotopic signatures, which did not show any evidence of the use of C_4 plants to feed herbivores at Boadilla even more clearly at El Soto/El Encadenado. These different manners of using millets were also supported by statistics. At first, no statistically significant differences were found in the distribution of $\delta^{13}C$ values between the six human assemblages from Madrid-Toledo ($\delta^{13}C$ all humans Madrid-Toledo grouped by assemblages, Kruskal-Wallis H test: $n = 134$, $H = 11.451$, d.f. = 6, $p = 0.075$). However, when offsets of $\delta^{13}C$ values between humans and local herbivores were considered, differences between distributions were statistically significant ($\delta^{13}C$ offsets all humans Madrid-Toledo grouped by assemblages, Kruskal-Wallis H test: $n = 134$, $H = 59.445$, d.f. = 6, $p < 0.001$) and pairwise *post hoc* comparison showed clearly that they lay in the contraposition between either of the two assemblages from Gózquez (i.e. GOZ cem, GOZ settl) and all the other datasets (GOZ cem vs BOA: $p < 0.001$, GOZ cem vs SNC ph3: $p < 0.001$, GOZ cem vs LH ph3: $p = 0.002$, GOZ settl vs BOA: $p = 0.030$, GOZ settl vs SNC ph3: $p = 0.005$, GOZ settl vs LH ph3: $p = 0.036$, the remaining fifteen combinations are not statistically significant). That is, there was a meaningful difference in the management and distribution of millets between Gózquez and the other case studies in the region of Madrid-Toledo. Interestingly, both human assemblages from Gózquez behaved similarly in this respect and the individuals from the cemetery of Boadilla, which presumably belonged to a big and articulated village type settlement alike Gózquez, were closer in their plant consumption patterns to the smaller farms of El Soto/El Encadenado and La Huelga.

Nitrogen isotope ratios from Madrid-Toledo showed a different regional distribution regarding animal protein intake. $\delta^{15}N$ of humans averaged 10.2‰, they had a standard deviation of 1.2‰ and a range of 8.4‰ and the mean offset between them and the corresponding herbivore assemblages was 2.3‰. This was the most enriched mean $\delta^{15}N$ and the largest standard deviation and range of the three regions included in this thesis, but at the same time it was the smallest $\delta^{15}N$ offset. This seeming paradox was caused by the fact that mean $\delta^{15}N$ values of herbivores from this region were the most enriched among all the fauna assemblages analysed here as a consequence of cattle, ovicaprids and equids grazing on intensively manured fields (see section 4.1.1). Then, although human mean absolute nitrogen isotope ratio may seem high, offset regarding local herbivores points at generally limited consumption of animal protein. However, there were some relevant differences between assemblages. Mean $\delta^{15}N$ offsets between humans and local herbivores differed notably between Gózquez and Boadilla, on one side, and El Soto/El Encadenado and La Huelga, on the other. Animal protein intake would have been really restricted at the former, where mean $\delta^{15}N$ offsets barely surpassed half of the 5‰ fractionation established as a standard for a trophic level shift, so the diet of these populations would have been predominantly based on plant products. Instead, at the latter two settlements mean $\delta^{15}N$ offsets exceeded 3‰ in all cases, so the proportion of animal protein in their diets would have been moderate or abundant. It is unlikely $\delta^{15}N$ enrichment of these human assemblages was caused by the preferential consumption of high trophic level animals because, despite fowl showing the highest nitrogen isotope ratios, the only pig successfully analysed was fed as a herbivore (see section 4.1.2) and the zooarchaeological study revealed most meat consumption came from ovicaprids (Morales & Llorente 2004). These differences are especially interesting because they can be associated to the type of settlement. In other words, diet in villages like Gózquez and Boadilla would have been notably scarcer in animal protein than in farms such as El Soto/El Encadenado or La Huelga. Statistical analyses corroborated this pattern. The distribution of $\delta^{15}N$ values between the six human assemblages from Madrid-Toledo were statistically significantly different ($\delta^{15}N$ all humans Madrid-Toledo grouped by assemblages, Kruskal-Wallis H test: n = 134, H = 22.412, d.f. = 6, p = 0.001). *Post hoc* comparison set out that statistically significant differences between pairs were always between the two groups defined above (GOZ cem vs SNC ph3: p = 0.001, BOA vs SNC ph3: p = 0.013, the remaining nineteen combinations are not statistically significant). Likewise, when $\delta^{15}N$ offsets between humans and their corresponding herbivores were compared, the results were equivalent ($\delta^{15}N$ offsets all humans Madrid-Toledo grouped by assemblages, Kruskal-Wallis H test: n = 134, H = 34.225, d.f. = 6, p < 0.001; pairwise *post hoc* comparison: GOZ cem vs SNC ph3: p < 0.001, GOZ cem vs LH ph3: p = 0.048, BOA vs SNC ph3: p = 0.001, the remaining eighteen combinations are not statistically significant). There is not an obvious explanation to understand this difference in animal protein consumption between villages and farms. Madrid-Toledo was the only region where such clear internal differences were identified, but this is probably related to the fact that it was the zone with the greatest number of individuals and assemblages analysed. In any case, the variability of dietary patterns observed within the region between rural communities that did not differ substantially in their materiality is a proof of the complexity of these local scale societies and the resilience to adapt themselves to diverse environmental and social conditions.

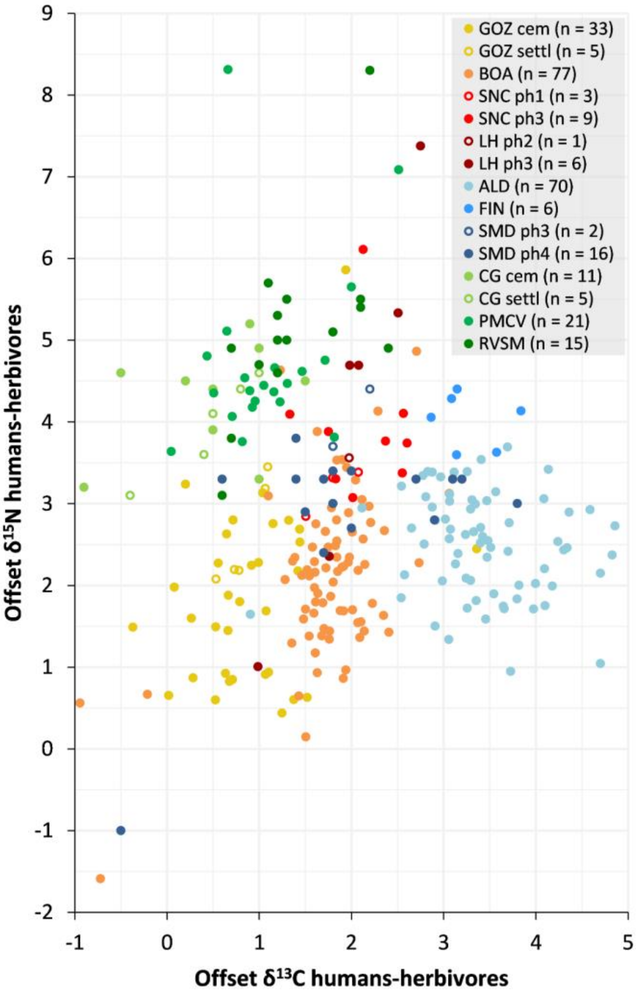


Figure 4.9. Scatterplot of the offsets between individual human carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) and the mean of their corresponding herbivore assemblages grouped by region and assemblage

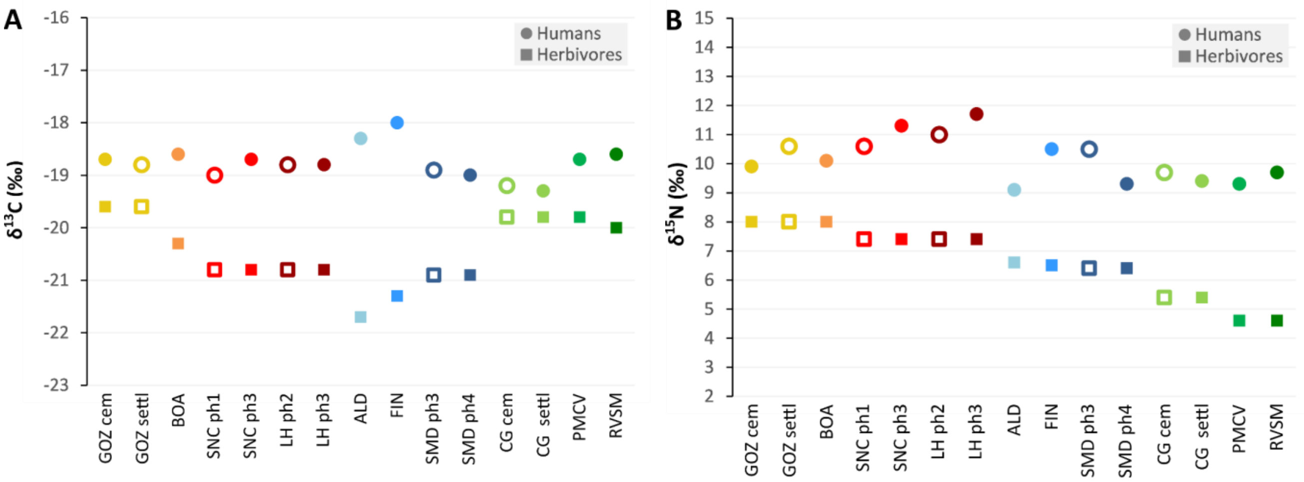


Figure 4.10. Comparison of mean (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of human and herbivores assemblages grouped by region and assemblage

The four assemblages analysed in the Basque Country showed quite different dietary patterns. They comprised 94 individuals. Their mean $\delta^{13}C$ was -18.4‰ with a standard deviation of 0.8‰ and a range of 4.6‰ and the mean offset between humans and local herbivores in the region was 2.9‰. These values were compatible with diets mostly based on C_3 resources with generalised smaller but regular contribution of C_4 plants. Otherwise it would not be possible to explain the enrichment of carbon stable isotope ratios observed in comparison to local herbivore assemblages, that in every assemblage amply exceeded the 1‰ fractionation normally accepted for one shift between trophic levels. Considering that in no case was there a clear increase in $\delta^{15}N$ associated to higher $\delta^{13}C$ values, marine resources do not seem a plausible source for this enrichment of carbon stable isotope ratios, so millet consumption is the most likely cause. Besides, isotopic analyses revealed not only that all fauna from Basque sites was had exclusive C_3 diets, but also that they presented the most depleted carbon stable isotope ratios measured in this thesis (see section 4.1). Therefore, the enrichment of $\delta^{13}C$ observed in the human assemblages from Basque sites must necessarily be due to direct consumption of C_4 plants by humans. There are two further remarks to be made on this topic. First, average millet intake in the Basque Country would have been the most abundant among the three regions under study, as the majority of the most enriched carbon stable isotope ratios were recorded there. However, although it is difficult to estimate quantitatively their importance in diet, they would have been eaten frequently enough to be clearly detectable on bone collagen. Second, it should not be forgotten that C_3 products were still the greatest component of diet also in this region and, in fact, there were individuals with exclusive C_3 diets in all the assemblages. In this sense, there were some relevant differences between the Basque case studies tackled. Statistical analyses brought forth the existence of statistically significant differences in the distribution of carbon stable isotope ratios between the four human assemblages from the Basque Country ($\delta^{13}C$ all humans Basque Country grouped by assemblages, Kruskal-Wallis H test: $n = 94$, $H = 11.979$, d.f. = 3, $p = 0.007$) and *post hoc* comparison revealed that the only pair where statistically significant differences remained was the one formed by Aldaieta and the phase 4 of Dulantzi ($p = 0.028$, the remaining five combinations are not statistically significant). Moreover, if this analysis was carried out with $\delta^{13}C$ offsets between humans and mean corresponding herbivores the results were essentially the same ($\delta^{13}C$ offsets all humans Basque Country grouped by assemblages, Kruskal-Wallis H test: $n = 94$, $H = 27.753$, d.f. = 3, $p < 0.001$; pairwise *post hoc* comparison: ALD vs SMD ph4: $p < 0.001$, the remaining five combinations are not statistically significant). This signifies there were notable differences in the consumption of plants between Aldaieta and the assemblage of phase 4 from Dulantzi. Although both datasets had some of the widest $\delta^{13}C$ ranges recorded, carbon stable isotope ratios at Aldaieta were clearly more clustered and they grouped around more enriched $\delta^{13}C$ values.

Instead, the individuals of phase 4 from Dulantzi were much more dispersed and their mean carbon stable isotope ratio was notably more depleted. That is, while at Aldaieta less than a tenth of the individuals had diets exclusively based on C_3 plants, in the phase 4 of Dulantzi this proportion raised up to half of the assemblage. The two individuals dated to the phase 3 of Dulantzi probably also had exclusive C_3 diets or they had very small proportions of C_4 plants. These data demonstrate that food consumption patterns at Aldaieta were clearly more homogeneous than among the individuals of phase 4 from Dulantzi, where there would have been significant internal differences. No obvious pattern was identified in the spatial distribution of individuals inside and around the church of Dulantzi in relation to $\delta^{13}C$ values (see section 3.2.3.4.3), so these differences in diet do not have an easy explanation in terms of social status or religious roles. The human assemblage from Finaga, which was also organised around a church, does not clear up this issue either. It was as homogeneous in carbon stable isotope ratios as the population from Aldaieta and its mean $\delta^{13}C$ and mean $\delta^{13}C$ offset regarding herbivores was also closer to Aldaieta than the phase 4 from Dulantzi. Then, exclusive consumption of C_3 plants cannot be directly associated to the rural communities that buried themselves around religious buildings.

Animal protein intake as understood from nitrogen isotope ratios also showed some differences between the Basque assemblages, but they did not draw the same patterns as the ones based on carbon stable isotope ratios. The regional mean $\delta^{15}N$ was 9.2‰, standard deviation 0.8‰ and range 5.5‰ and the mean $\delta^{15}N$ offset between humans and local herbivores was 2.7‰. The magnitude of this gap was between what recorded at Madrid-Toledo and Catalonia but closer to the former and just above half of what is normally considered a full trophic level shift. Then, in general terms animal protein intake at Basque settlements would have been moderate. Still, there were clear differences between individuals and assemblages. Aldaieta was the largest dataset and the one with the most depleted $\delta^{15}N$ values and the greatest spread on this variable. The assemblage of phase 4 from Dulantzi surpassed it in standard deviation and range, but only because it comprised an extreme outlier. Once it was excluded, its distribution was closer to Finaga. Anyhow, the human assemblage from Aldaieta included the whole spectrum between diets almost exclusively based on plants to moderate consumption of animal protein. Conversely, at Finaga and the phase 4 of Dulantzi absolute mean $\delta^{15}N$ values were more enriched and, ruling out the extreme outlier, dispersion was remarkably smaller, as both standard deviations and ranges were less than half than at Aldaieta. Thus, these populations would have had on average significantly greater proportions of animal protein in their diets, surpassing most individuals from Aldaieta and the villages in Madrid-Toledo. Actually, the individuals from Finaga had consistently the greatest nitrogen isotope ratios in the Basque Country, which could point at the occasional intake of marine resources. Nevertheless, without a strong isotopic baseline of local fauna, both terrestrial and marine, this hypothesis is difficult to prove. Most importantly, animal protein intake among the populations of Aldaieta and the phase 4 of Dulantzi would have been quite homogeneous. This is especially remarkable for the latter assemblage, where very clear differences were observed in carbon stable isotope ratios. That is, if in this context internal social stratification was somehow expressed through diet, it would have based on the types of plants eaten and not on the amount of animal protein consumed. The differences in $\delta^{15}N$ values between Basque human assemblages were also supported by statistics. The distributions of nitrogen isotope ratios of the four datasets together showed statistically significant differences between them ($\delta^{15}N$ all humans Basque Country grouped by assemblages, Kruskal-Wallis H test: $n = 94$, $H = 25.226$, d.f. = 3, $p < 0.001$). However, pairwise *post hoc* comparison concluded that differences were statistically significant between Aldaieta and Finaga ($p < 0.001$, the remaining five combinations are not statistically significant). Furthermore, taking $\delta^{15}N$ offsets between humans and local herbivores, differences between the distribution of assemblages were also statistically significant ($\delta^{15}N$ offsets all humans Basque Country grouped by assemblages, Kruskal-Wallis H test: $n = 94$, $H = 29.557$, d.f. = 3, $p < 0.001$) and pairwise *post hoc* comparison highlighted statistically significant differences not only between Aldaieta and Finaga ($p < 0.001$) but also between Aldaieta and the phase 4 of Dulantzi ($p = 0.022$, the remaining four combinations are not statistically significant), confirming the subregional animal protein intake pattern proposed above.

The diets of the four assemblages from Catalonia also showed some common particular features characteristic of this region. There were also some differences between them, but they were not as relevant as in the other areas of study. Considering altogether only 52 individuals were successfully analysed, Catalonia was the worse represented region in this thesis. Starting with carbon stable isotope ratios, their mean $\delta^{13}C$ was -18.9‰ with a standard deviation of 0.7‰ and a range of 3.4‰. These values were intermediate to those from Madrid-Toledo and the Basque Country. Yet the mean $\delta^{13}C$ offset between humans and local herbivores, which was 0.9‰, was the smallest of the three territories. According to these data, the diet of these populations was predominantly based on C_3 resources and only a few individuals in each dataset showed slight enrichment of carbon stable isotope ratios, which could be attributed to the influence of C_4 plants. Millets are known to have been used in these contexts for feeding livestock (see section 4.1), both herbivores and omnivores, so there is evidence that they were cultivated by these Catalan rural communities. Still, the importance of millets in human diet in this region would have never reached the proportions recorded in the Basque Country and possibly it was less relevant than in Madrid-Toledo too. Moreover, there were some differences between the assemblages studied. On one hand, there were the two datasets from Can Gambús, the individuals from the cemetery and those buried in the settlement, which had almost identical $\delta^{13}C$ parameters. Altogether, they were the assemblages with the most enriched $\delta^{13}C$ means and they also exhibited the smallest offsets between humans and local herbivores, falling well below the 1‰ usually accepted for one trophic level shift. In addition, the fauna assemblage from Can Gambús included some specimens with very enriched $\delta^{13}C$ values, especially omnivores, which the zooarchaeological study marked as the main source of meat in this village (Molina 2008a). Therefore, these data suggest that in these two assemblages the small enrichment of carbon stable isotope ratios observed in a few individuals was probably indirectly acquired through the consumption of animal products. On the other hand, there were the human assemblages of Castellar del Vallès and Sant Menna, which had more enriched mean $\delta^{13}C$ values and at the same time greater human to local herbivores mean $\delta^{13}C$ offsets exceeding the 1‰ fractionation between trophic levels. Then, it is likely that in these cases the enrichment of carbon stable isotope ratios was caused by the direct consumption of small amounts of C_4 plants by humans, rather than indirectly through meat or other animal byproducts. This hypothesis is reinforced by the fact that all the fauna specimens from Castellar del Vallès and the majority from Sant Menna had exclusively C_3 diets. Nevertheless, the differences in the distributions of carbon stable isotope ratios between these four Catalan human assemblages were not as clear as to be statistically significant ($\delta^{13}C$ all humans Catalonia grouped by assemblages, Kruskal-Wallis H test: $n = 52$, $H = 7.305$, d.f. = 3, $p = 0.063$). Instead, they were when datasets were compared using $\delta^{13}C$ offsets between humans and their corresponding herbivores ($\delta^{13}C$ offsets all humans Catalonia grouped by assemblages, Kruskal-Wallis H test: $n = 52$, $H = 7.247$, d.f. = 3, $p = 0.064$) and indeed the combinations that pairwise *post hoc* comparison underlined as statistically significant were the ones formed by the cemetery of Sant Menna and both the cemetery and the settlement of Can Gambús (CG cem vs RVSM: $p = 0.036$, CG settl vs RVSM: $p = 0.025$, the remaining four combinations are not statistically significant), confirming the contrast between these assemblages outlined above.

Nitrogen isotope ratios in the Catalan assemblages showed more homogeneous distribution and smaller differences. Their mean $\delta^{15}N$ was 9.5‰ with a standard deviation of 1.0‰ and a range of 5.2‰ and the mean $\delta^{15}N$ offset between humans and local herbivores was 4.7‰. Although the absolute mean nitrogen isotope ratio of the individuals from Catalonia was intermediate to the values recorded in Madrid-Toledo and the Basque Country, the gap between humans and the corresponding herbivores was by far the greatest and in all the four assemblages it was close to the 5‰ fractionation typically established for the transition between one trophic level and the next one. In theory this could be interpreted as the result of abundant animal protein consumption in such big proportions that the greatest part of the protein intake in these rural communities would have come from animal products. However, there are two lines of evidence that advise for a more nuanced explanation. First, Catalonia was the only region where pig diet included notable proportions of animal protein, that is, where they were fed as proper omnivores, since their nitrogen isotope ratios were significantly enriched in δ^{15}N in comparison to local herbivores (see section 4.1.2), and fowl were also provided animal protein, so as they were clearly distinguishable from cattle and ovicaprids. Besides, zooarchaeological analyses revealed that at Can Gambús swine and poultry were the two main species aimed at meat production (Molina 2008a) and at Castellar del Vallès a significant proportion of pigs and ovicaprids were slaughtered at young ages also for the obtention of meat (Molina 2008b, Molina 2008c). The consumption of both high trophic level animals, such as pigs and fowl fed on domestic waste, and young specimens, which probably retained the isotopic signal of suckling, would have contributed to the enrichment of nitrogen isotope ratios of humans. Second, the occasional intake of small amounts of marine products cannot be completely ruled out. The proximity of these settlements to the coast, in no case more than 23 km away from the sea, makes it a real possibility. Potentially fish and other marine resources could have been partially responsible of the big offsets between these human populations and their corresponding herbivore assemblages and they could also explain the enrichment of carbon stable isotope ratios of some individuals. Nevertheless, it is important to remember that, according to the data currently available, Mediterranean fish are not as enriched in δ^{15}N as those from the Atlantic Ocean and their nitrogen isotope ratios may actually be indistinguishable from terrestrial resources (García-Guixé *et al.* 2010). Therefore, it is likely that under these circumstances the occasional consumption of marine fish would have been difficult to detect. Still, it is a possibility that should not be completely disregarded and in the future could be verified through a better isotopic characterisation of the food resources available in the region. Considering all the above, the big δ^{15}N offsets between human and herbivore values in Catalan rural communities are possibly the consequence of the combination of the intake of great proportions of animal protein, the preferential consumption of animal products from omnivorous species or young specimens and perhaps the occasional contribution of marine resources. It is also worth noting that, unlike in Madrid-Toledo or the Basque Country, no relevant differences in the distribution of nitrogen isotope ratios between the Catalan assemblages (δ^{15}N all humans Catalonia grouped by assemblages, Kruskal-Wallis H test: $n = 52$, $H = 7.247$, d.f. = 3, $p = 0.064$) and, only when comparison was based on δ^{15}N offsets, a statistically significant difference arose (δ^{15}N offsets all humans Catalonia grouped by assemblages, Kruskal-Wallis H test: $n = 52$, $H = 11.408$, d.f. = 3, $p = 0.010$), that after *post hoc* comparison was reduced to the pair formed by the assemblage from the settlement of Can Gambús and Sant Menna (CG settl vs RVSM: $p = 0.016$, the remaining five combinations are not statistically significant). Thus, human diets in Catalonia were the most homogeneous on both variables among the three regions included in this research, pointing at the absence of strong internal differences in the distribution and consumption of food resources within rural communities in this territory.

All in all, the three regions analysed shared some common aspects of dietary patterns, each territory also showed specific features and there were subtle differences between assemblages from the same zone too. The diet of the rural communities from Madrid-Toledo was largely based on C_3 resources with small but regular contributions of C_4 plants, and animal protein intake was quite limited at villages and abundant in farms. The Basque human assemblages were distinguished by the most notable consumption of millets of the three regions, although diet would have been still mostly based on C_3 resources. Moreover, in these settlements animal protein intake would have been quite variable, ranging from moderate to abundant. Food consumption patterns in Catalonia were distinguished by homogeneity. Typical diets were mostly made up of C_3 resources and only a few individuals might have had small proportions of C_4 plants. Animal protein intake was possibly abundant and in addition it came preferentially from high trophic level animals and young specimens. Thereby, it could be concluded that the main features of dietary patterns were roughly configurated at the regional level, but they were locally adapted. This underlines the importance of villages and farms as the social space where agrarian practices and consumption patterns were defined, it confirms the deeply local character of these communities and it brings to light the ability of individual rural communities to adapt to the specificities of the environmental and social conditions where they lived.

Not only geographic location can be relevant for the definition of dietary patterns, but chronology might also have been an important factor. Although the time span covered by this research is not extremely wide, it is likely that between the 5th century and the middle of the 9th century there were also changes in the distribution and consumption of food resources. In more than half of the case studies included in this thesis two early medieval phases could be distinguished thanks to the general evolution of the settlement or the characteristics of funerary structures. These were El Soto/El Encadenado, La Huelga, Dulantzi, Can Gambús, Castellar del Vallès and Sant Menna. However, all of them were small populations and many were affected by collagen preservation issues, which caused that in most instances one phase or both were formed by a very small number of individuals, so it was not possible to analyse properly the diachronic evolution of diets. Nevertheless, in no case was it possible to appreciate any clear changes in carbon or nitrogen stable isotope ratios between phases. In the bigger sites, such as Gózquez, Boadilla or Aldaieta, the absence of dense webs of direct stratigraphic relationships and the scarcity of radiocarbon dates hindered the identification of internal phases. Actually, only at Boadilla was it possible to define three chronological phases based on grave goods, according to which the cemetery evolved concentrically from the older central nucleus outwards (see section 3.1.2.4.3). Three phases were defined and statistically significant differences in the distributions of both $\delta^{13}C$ and $\delta^{15}N$ were found between them. These pointed at the decrease in the intake of millets and the proportion of animal protein in diet from the middle of the 6th century onwards. It is not possible to make the same inferences at the cemetery of Gózquez, but also here more enriched carbon stable isotope ratios were associated to the oldest types of grave goods, which suggests that the trend identified at Boadilla could be more widespread. The problems to date early medieval contexts with greater precision are common to many other Iberian and European contexts and it is rare to find case studies with detailed diachronic analyses. Precisely for that reason it is striking that one of the few cases where it was possible to define internal phases showed the same trend. At the French cemetery of Norroy-le-Veneur the 74 individuals analysed were dated to either 6th or 7th centuries and a statistically significant difference was detected between their mean carbon stable isotope ratios, which were more higher in the older phase (Vytlačil *et al.* 2018). The enrichment is not enough to point at millet consumption, but the results are equally interesting because they suggest a change in plant consumption patterns approximately at the same moment as in Boadilla. These scarce data about the diachronic evolution of diets during Early Middle Ages are definitively not enough to draw a general overview, but they give an idea of the potential of this research line and they urge for higher-resolution chronological characterisation of these contexts.

4.2.1 MILLETS IN EARLY MEDIEVAL RURAL IBERIA

One of the most relevant findings of this research is the identification of millets as a significant component of the diet of early medieval Iberian rural communities, which contributed to a better understanding of their social, economic, cultural and political organisation. This was possible thanks to the particular isotopic signature of these crops (see section 2.4.1.2.1). Broomcorn millet (*Panicum miliaceum*) and foxtail millet (*Setaria italica*) were the only C_4 plants cultivated in Iberia up to the 8th century, when sugarcane was introduced by Muslims (Galloway 2005). These plants are native to Asia and they were brought to western

Europe during the Bronze Age (Lightfoot *et al.* 2013). They have a shorter growing period than most cereals. Then, they are usually sown in spring or early summer and they are reaped at the end of summer or the beginning of autumn (Moreno-Larrazabal *et al.* 2015). Thanks to that, it is possible to obtain more than a harvest in a year and, more importantly, they can be used as an alternative if wheat, barley, rye or oats are ruined. Therefore, millets offer the possibility to diversify agrarian production, rotate crops and minimise risks in the event of a catastrophe. Besides, they are very productive and they can bear extreme climate conditions with minimum work input.

Millets are also interesting from the nutritional point of view. They are rich in protein, vitamins and minerals and they do not contain gluten, so they are suitable for individuals affected by coeliac disease. In return, it is not possible to make bread with millet flour only. For this reason, most historical and ethnographic accounts say they were typically consumed as porridge, but there is indirect evidence of the popularity of flat breads during Early Middle Ages (Catalán *et al.* 2018, Curta 2015) and it is also possible that millets were mixed with other grains to produce bread.

Another of the reasons why the recognition of millets as a staple crop in the diet of early medieval Iberian rural communities is relevant is because of its invisibility on other records. Up to recently, based on documentary sources, millets were considered to have been marginal and little appreciated (Murphy 2016) and archaeological data did not provide evidence of them being widespread either (Peña-Chocarro *et al.* 2019). In the case of written sources, millets were undetectable probably as a consequence of the fact that they were rarely requested to pay rents (Portela 1976: 104–105, 271), as tributes tended to be used to collect more valuable crops for both self-consumption and commercialisation. Initially archaeobotanical records did not contribute to complete this picture. Millets are absent or scarce in many carpological assemblages, even in those where carbon and nitrogen stable isotope analyses highlight their presence (Vigil-Escalera *et al.* 2014), and it was only lately understood that this is probably related to preservation. Carbonisation, the most frequent preservation method in Iberian medieval sites, causes the destruction of millet grains under the same temperature and charring conditions that allow for the preservation of bigger seeds, such as wheat or barley (Märkle & Rösch 2008). Consequently, it is unlikely that both types of crops are preserved simultaneously in the same context. Nevertheless, certain archaeobotanical findings support the presence of millets in early medieval Iberian contexts. For example, millets were by far the most abundant taxa in the silos from Dulantzi dated to the 6th century, while after the 10th century wheat was clearly predominant (Alfaro *et al.* 2017: 263–264). The same process was observed in the nearby village of Zornoztegi, but interestingly not in Aistra (Quirós *et al.* 2020), and millets were also prevalent in the early medieval funerary cave of Riocueva, in Cantabria (Gutiérrez Cuenca *et al.* 2016). Likewise, in the village of Gózquez, where the carpological study did not identify any millet grain (Vigil-Escalera *et al.* 2014), the analysis of starch grains from hand mills revealed millets were the most abundant taxa over wheat and barley (Aceituno 2015, Vigil-Escalera 2020). These apparently contradictory findings underline the importance of the integration of multiple information records and analytical techniques (Ganzarolli *et al.* 2018) for a comprehensive understanding of early medieval agrarian practices and dietary patterns.

All in all, thanks to carbon and nitrogen stable isotope analyses it was possible to confirm that millets were present in the three Iberian regions investigated in this thesis, but they did not have the same importance in all of them. In some of the sites from Madrid-Toledo and Catalonia they were used to feed specific livestock taxa (see section 4.1.4). Focusing on human diet, variable millet consumption patterns were also detected. Basque human populations were clearly the ones that consumed the greatest proportions of millets and the most regularly. It was also interesting to observe that at Aldaieta and Finaga the ratio of C_3 and C_4 plants eaten were quite homogeneous within the same assemblage. Meanwhile, Dulantzi stood out for having the widest dispersion of carbon stable isotope ratios, meaning that the individuals buried in the cemetery of phase 4 had very diverse diets regarding plants, which ranged from exclusive C_3 regimes to proportions of C_4 plants equivalent to those recorded at Aldaieta. In the human assemblages from Madrid-Toledo millet intake would have been smaller, but regular enough to be detectable on bone collagen in most individuals. These datasets were also internally more homogeneous in the sense that most individuals within the same population had similar proportions of C_3 and C_4 plants. Catalan human populations had the smallest proportion of C_4 diets. Actually, it is likely that in some cases the isotopic signal of millets was incorporated into human bone collagen indirectly through the consumption of animals fed on C_4 fodder. In any case, less than half of each assemblage would have had significant proportions of millets in diet, so the majority ate predominantly C_3 resources.

The uncovering of the important role of millets in the diet of early medieval rural Iberian communities provides information on two topics. On one hand, it is a sign of the complexity of agrarian systems. The integration of millets into regular arable farming strategies would have meant an opportunity to obtain yields from the least productive fields, to implement crop rotation and to have an alternative resource in case wheat, barley, rye or oats failed. Besides, they would have added variety to human diet and flexibility to animal husbandry management, as they could also be used to feed livestock. That is, millets are perfectly suited to peasant logics, which in this context would have been driven by diversification as the best strategy to minimise the risks of almost self-sufficient agrarian economies (Halstead & O'Shea 2004, Montanari 1979, Wickham 2005: 536–539), and they highlight the autonomy of these rural communities to make decisions at least regarding the organisation and distribution of agrarian production. This is just another of the signs that early medieval agrarian systems were not archaic, inflexible and predominantly based on animal husbandry, as it has been traditionally proposed (García Moreno 1986, Quirós 2014: 31–33, Vigil-Escalera & Quirós 2013: 375); but arable farming and animal husbandry were well integrated, production was diversified and local communities adapted it to local environmental and social conditions in order to make the most of the resources available. In other words, far from being anchored in simple and primitive practices, early medieval communities set up complex and well-articulated agrarian systems that, being different from the Roman economic system aimed at markets, were the most efficient to meet their need in view of the new socioeconomic and political context that was established after the 5th century (Vigil-Escalera 2015).

On the other hand, the fact that not all the human assemblages analysed show the same distribution of millet consumption indicates that the access to this foodstuff was not homogeneous neither between different populations nor within them and it brings out the question of what the factors that determined it would have been. The individuals with carbon stable isotope ratios compatible with the intake of significant amounts of millets would have had access to a wider range of dietary resources, as individuals with diets exclusively based on C_4 plants were not identified in any case; suggesting they belonged to domestic units with autonomy to decide over their agrarian production. Then, in a context of such great instability as Early Middle Ages, millet consumption might have been a sign of autonomy, stability and good positioning with the community. The interpretation of the individuals with monotonous C_3 diets is more ambiguous. It is possible that some individuals avoided millets because they were poorly considered, so exclusive C_3 eaters would exhibit higher social status through their diet, as they would have been able to maintain a balanced diet without the need to resort to C_4 plants. However, it is also likely that the impossibility to access to millets was a sign low social status, exclusion from the community or the lack of autonomy to make autonomous decisions on agrarian production. Nevertheless, without further data, the social meaning of millets in early medieval Iberian rural communities is an extremely difficult topic to tackle and these are just hypotheses that will have to be verified in the future in light of new theoretical frameworks and analytical techniques.

Another of the difficulties for the interpretation of the role of millets in medieval diets is that its discovery is relatively recent. This is because C_4 plants were absent from northern Europe (see section 4.5), where palaeodietary reconstruction was first applied to historical contexts. Then, it was only during the last decade that the first early medieval populations with significant contribution from C_4 plants in diet were identified, all of them located in central (Austria: Herold 2008; Czech Republic: Halffman & Velemínský 2015, Kaupová 2016, Kaupová, Velemínský, Herrscher, *et al.* 2018, Kaupová, Velemínský, Stránská, *et al.* 2018, Plecerová *et al.* 2020, Smrčka *et al.* 2008; Hungary: Hakenbeck *et al.* 2017, Noche-Dowdy 2015; Russia: Higham *et al.* 2010) and southern Europe (Croatia: Lightfoot *et al.* 2012, Vidal-Ronchas *et al.* 2018; Greece: Bourbou *et al.* 2011, Bourbou *et al.* 2013; Italy: Amorim *et al.* 2018, Baldoni *et al.* 2016, Iacumin *et al.* 2014, Laffranchi *et al.* 2020, Marinato 2016, Maxwell 2019, Paladin *et al.* 2020, Riccomi *et al.* 2020, Scorrano *et al.* 2014). An excellent example of the distinction between northern European areas dominated by C_3 plants and the presence of C_4 plants from central Europe southwards are the populations from meridional Germany (Hakenbeck *et al.* 2010), where the consumption of millets was used as a proxy to identify migrants from central European zones. In Iberia too other human assemblages besides those analysed in this thesis show clear evidence of the intake of millets. The most obvious ones were the populations from Riocueva (Cantabria, E. Gutiérrez Cuenca & J. Á. Hierro, personal communication), San Juan de la Peña (Zaragoza, Martínez-Jarreta *et al.* 2017), Zaragoza Roman theatre (Zaragoza, Mundee 2010) and Tossal de les Basses (Alicante, Salazar-García *et al.* 2016) in Spain and Monte da Cegonha (Alentejo, Saragoça *et al.* 2016) in Portugal. Still, it is likely that C4 plants were also consumed in smaller proportion in other Iberian sites (Alaica *et al.* 2019, Fuller *et al.* 2010, Guede, Ortega, Zuluaga, Alonso-Olazabal, Murelaga, Solaun, *et al.* 2017, Jordana *et al.* 2019, Lubritto *et al.* 2017). Summing up, different lines of information suggest that in central and southern Europe millets were probably more relevant in early medieval agrarian systems and diets than was thought a decade ago and the new data obtained in this thesis and many other researches carried out during the last years are just the first step to understand the full significance of these crops.

4.2.2 ANIMAL PROTEIN CONSUMPTION IN EARLY MEDIEVAL RURAL IBERIA

Nitrogen isotope ratios allow the identification of the main protein sources in diet, as they can discriminate between foodstuffs of terrestrial, marine and freshwater origin, as well as the position of the individual in the food chain (see section 2.4.1.3). Thus, the most important conclusions of this thesis about this topic are that diets of early medieval rural communities were virtually exclusively terrestrial and that there was great variation in the proportions of vegetal and animal proteins in diets between human assemblages and regions (García-Collado 2020). Madrid-Toledo was the region with the biggest contrasts between nearby settlements. Animal protein intake ranged from very limited in villages, where diet would have been predominantly vegetarian, to abundant in farms. Livestock from both types of sites was fed similarly, so these differences cannot be attributed to the consumption of distinct trophic level specimens. In the Basque Country the proportion of animal protein in average diets would have been moderate. Theoretically at Finaga it would have been more abundant or these individuals might have gotten small contributions of marine resources, but the absence of fauna *in situ* to calibrate the local isotopic baseline makes this issue difficult to assess. Catalan human assemblages were the most homogeneous, as they all had diets with abundant proportions of animal protein. As it can be observed, there were differences in animal protein consumption concerning both abundance and distribution, but there is no clear association between the material features of settlements, the types of funerary structures or the characteristics of human populations and their protein intake patterns.

Traditionally greater consumption of animal products, which causes the enrichment of nitrogen isotope ratios, has been considered an indicator of higher social status (Montanari 1996, van der Veen 2003, Woolgar 2006) and several palaeodietary reconstructions of European early medieval populations attempted to prove this hypothesis based on the direct relationship between higher δ^{15}N values and the presence of lavish grave goods (Hannah *et al.* 2018, Knipper *et al.* 2015). However, in most cases this is not true (Czermak 2011, Hakenbeck *et al.* 2010, Knipper *et al.* 2013, Vidal-Ronchas *et al.* 2018) and the example of Berinsfield is paradoxical (Privat *et al.* 2002). Here individuals without grave goods showed the most enriched nitrogen isotope ratios because they obtained protein preferentially from omnivorous animals or freshwater fish, instead of getting it from herbivores as individuals with grave goods did. Then, access to animal protein has been observed to be determined by age, sex, religion or origin (Alt *et al.* 2014, Baldoni *et al.* 2016, Fuller *et al.* 2006, García-Collado *et al.* 2019, Herold 2008, Plecerová *et al.* 2020) or it could be randomly distributed. That is, as it happens with the contexts analysed in this thesis, by and large there does not seem to be an obvious connection between animal protein intake patterns and any other factor, but it looks like it is a contextual issue that has to be assessed thoroughly in each case.

This is probably related to the limitations of the analytical technique itself. Carbon and nitrogen stable isotope analyses on bone collagen provide information about the average of an individual's diet during a long period and they cannot distinguish qualities of the same product (O'Connell & Hedges 1999: 412). This means that with this methodology individuals eating the best meat cuts and those only having lard or any other byproducts, such as eggs, milk or dairy, are virtually indistinguishable. The same happens with short-term fluctuations in diet (Dyer 2006), for example, occasional feasting or food shortage, as well as with more or less elaborated preparations, which cannot be detected isotopically (Warinner & Tuross 2009). Considering the absence of striking differences in materiality within early medieval Iberia rural communities and the importance of ostentation to maintain social status, these could have been some of the strategies of distinction put into practice in these local scale societies. Therefore, the data obtained in this research do not give answer to all the questions initially posed about the role of animal protein in the definition of social structure in early medieval Iberian rural societies, but they highlight the heterogeneity and complexity of dietary patterns in these contexts and set the foundations for future comprehensive approaches which ideally would integrate different analytical techniques and all the written, archaeological, iconographic and ethnographic records available.

Regarding the consumption of aquatic resources, no individuals with clear evidence of the intake of significant proportions of marine or freshwater resources was found among all the individuals analysed. This does not rule out the possibility that fish or other aquatic organisms were occasionally eaten, but in general their importance in diet would not have been enough to be detectable on bone collagen. Only the human assemblage from Finaga and perhaps certain individuals from the Catalan sites could be showing slight enrichment of nitrogen isotope ratios caused by the intake of marine resources. The problem is that they do not exhibit the same increase of carbon stable isotope ratios, which should happen simultaneously. Therefore, evidence is faint and either way it would only point at the occasional consumption of marine products. Still, it has to be admitted that it seems no coincidence that all these settlements are those closest from the coast.

Nevertheless, it is no surprise that sites in proximity to the sea, rivers or lakes do not show any evidence of the consumption of marine or freshwater foodstuffs. This apparent contradiction has been observed in human populations of all periods (Richards *et al.* 2001). Overall for the Middle Ages no significant consumption of aquatic resources has been verified in European contexts before the 11th century, even in sites located in islands (Alaica *et al.* 2019, Barrett & Richards 2004, Bourbou *et al.* 2011, Fuller *et al.* 2010) or placed next to large rivers (Hakenbeck *et al.* 2010, Strott *et al.* 2008, Vytlačil *et al.* 2018). In fact, the few clear exceptions known are the Norwegian burial ground of Flakstad (Naumann *et al.* 2014), the Orcadian Viking phase of Westness (Barrett & Richards 2004) and the Galician early medieval population of A Lanzada (López-Costas & Müldner 2016), although probably the few individuals analysed from A Coruña (Galicia, Grandal-d'Anglade *et* *al.* 2015, Kaal *et al.* 2016) and Setubal Casa dos Mosaicos Romanos (Portugal, Toso & Alexander 2018) also had appreciable proportions of marine products in diet and the only site where it is likely that freshwater fish was regularly eaten was the cemetery of Roma San Pancrazio (Varano *et al.* 2020). It was not until High and Late Middle Ages fish became a staple product in European diets (Müldner & Richards 2007), possibly as a consequence of the fasting regulations imposed by Christianism (Quirós 2013, Serjeantson & Woolgar 2006). However, these rules seem to have had little effect during early medieval centuries and it is likely that fish and other aquatic resources were both unreachable and unappreciated for the rural communities studied here.

4.3 FOOD AND PERSONAL IDENTITIES

Historical and ethnographic evidence (Counihan & Kaplan 1998, Medina 2005, Mennell *et al.* 1992, Moffat & Prowse 2010, Woolgar 2010) demonstrates age and gender, some of the most basic elements of personal identities, are determinant in the access to food resources and the configuration of the diet of individuals. For this reason, it is deemed interesting to cross these variables with carbon and nitrogen stable isotope ratios in order to analyse, first, the evolution of dietary patterns throughout life and, second, the existence of any differences in the distribution of foodstuffs based on sex, which could be indicative of the status within domestic units or extended families. Still, given the limitations of many of the assemblages that form this thesis, it is not possible to tackle these issues in every case.

4.3.1 DIET AND AGE: CHANGES THROUGH LIFETIME

Analysing the evolution of diet through life is particularly interesting because it can provide information about human behaviours usually obscured in mainstream historical sources and narratives such as breastfeeding and weaning, the social consideration of children, the entry into adulthood or the treatment of elder individuals. The following pages present all the data available to tackle these topics in early medieval Iberian rural communities. However, it should be noted that in most of the human assemblages included in this thesis subadults were underrepresented in that they did not reflect the demographic structure they are presumed to have had as premodern agricultural populations. Moreover, after sampling and collagen quality check, some datasets were even more imbalanced in terms of age. In many cases subadults were poorly preserved and few anatomical elements suitable for analysis survived, so smaller proportions of subadults than in the original populations were sampled. This issue concerned especially Basque assemblages. In other instances, bad collagen preservation affected more severely certain age groups and, as a consequence, others were overrepresented in the final assemblage. This was the case in Catalonia, where three out of four datasets had greater proportions of subadults than in the whole population. Eventually, three out of fifteen assemblages only included one age group (i.e. only subadults or only adults) and in seven datasets one of the age groups was represented by less than five individuals. Besides, it was possible to assign specific age categories to most subadults. Conversely, the majority of adults could not have age estimated with precision, so changes in diet through adulthood are even more difficult to detect. Due to these biases, in most cases the inferences that can be done about the evolution of diet across age categories are limited.

Altogether, there were no meaningful differences between subadult and adult diets within or between assemblages (table 4.10, table 4.11, figure 4.11, figure 4.12). Subadults tended to show greater variability, while adults were generally more homogeneous, and only a few of the youngest individuals (i.e. infans 1A) stood out for their enriched carbon and nitrogen stable isotope ratios due to breastfeeding. In this way, it seems that overall in early medieval Iberian rural communities there were no restrictions in the access to food resources based on age. Actually, none of the assemblages where statistical analyses could be carried out resulted in statistically significant differences between subadults and adults in the distributions of $\delta^{13}C$ or $\delta^{15}N$.

Likewise, when specific age categories were compared, only Boadilla reported a statistically significant difference in the distribution of nitrogen isotope ratios.

Table 4.10. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of all subadults divided by age categories and grouped by region and assemblage. Standard deviation is only reported if sample size is greater than two. Key: M-T = Madrid-Toledo, BC = Basque Country, CAT = Catalonia

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All subadults	73	-18.6	0.7	-21.2	-17.3	3.9	9.9	1.4	7.5	14.8	7.3
Fetus	2	-17.9	-	-17.9	-17.8	0.1	10.2	0.2	10.0	10.3	0.3
Infans 1A	11	-18.2	0.7	-19.8	-17.3	2.5	11.5	2.0	8.4	14.8	6.4
Infans 1B	27	-18.9	0.7	-21.2	-17.6	3.6	9.5	0.9	7.7	11.5	3.8
Infans 2	16	-18.6	0.8	-20.8	-17.3	3.5	9.4	1.2	8.1	12.9	4.8
Juveniles	12	-18.6	0.4	-19.4	-18.0	1.4	9.9	1.1	7.5	11.5	4.0
M-T subadults	38	-18.6	0.6	-21.2	-17.6	3.6	10.3	1.4	8.1	14.8	6.7
Infans 1A	6	-18.3	0.8	-19.8	-17.6	2.2	11.9	2.5	8.4	14.8	6.4
Infans 1B	14	-18.9	0.8	-21.2	-18.1	3.1	9.8	1.1	8.1	11.5	3.4
Infans 2	6	-18.6	0.2	-18.9	-18.4	0.5	9.3	0.5	8.4	9.8	1.4
Juveniles	8	-18.6	0.3	-19.0	-18.2	0.8	10.5	0.5	9.9	11.5	1.6
GOZ cemetery	8	-18.6	0.6	-19.5	-17.7	1.8	10.2	1.7	8.4	13.9	5.5
Infans 1A	1	-17.7	-	-	-	-	13.9	-	-	-	-
Infans 1B	4	-18.7	0.6	-19.5	-18.1	1.4	9.9	0.9	8.6	10.8	2.2
Infans 2	2	-18.7	-	-18.9	-18.4	0.5	8.9	-	8.4	9.4	1.0
Juveniles	1	-19.0	-	-	-	-	10.3	-	-	-	-
GOZ settlement	5	-18.8	0.3	-19.1	-18.5	0.6	10.6	0.7	10.1	11.5	1.4
Infans 1A	1	-18.5	-	-	-	-	11.5	-	-	-	-
Infans 1B	2	-18.8	-	-19.1	-18.5	0.6	10.7	-	10.1	11.2	1.1
Juveniles	2	-18.9	-	-18.9	-18.8	0.1	10.2	-	10.2	10.2	0.0
BOA	18	-18.6	0.7	-21.2	-17.6	3.6	9.9	1.2	8.1	12.9	4.8
Infans 1A	2	-17.9	-	-18.1	-17.6	0.5	11.4	-	9.8	12.9	3.1
Infans 1B	6	-19.0	1.1	-21.2	-18.2	3.0	9.2	0.9	8.1	10.7	2.6
Infans 2	4	-18.6	0.2	-18.7	-18.4	0.3	9.5	0.3	9.2	9.8	0.6
Juveniles	2	-18.5	-	-18.7	-18.3	0.4	10.4	-	9.9	10.9	1.0
SNC phase 1	1	-19.3	-	-	-	-	10.2	-	-	-	-
Infans 1B	1	-19.3	-	-	-	-	10.2	-	-	-	-
SNC phase 3	4	-18.7	0.6	-19.5	-18.2	1.3	11.1	0.5	10.5	11.5	1.0
Infans 1B	1	-19.5	-	-	-	-	11.5	-	-	-	-
Juveniles	3	-18.4	0.3	-18.8	-18.2	0.6	10.9	0.5	10.5	11.5	1.0
LH phase 3	2	-18.9	-	-19.8	-18.0	1.8	11.6	-	8.4	14.8	6.4
Infans 1A	2	-18.9	-	-19.8	-18.0	1.8	11.6	-	8.4	14.8	6.4
BC subadults	14	-18.6	0.9	-20.8	-17.3	3.5	9.0	0.9	7.5	10.6	3.1
Infans 1B	4	-18.8	0.5	-19.4	-18.3	1.1	9.6	0.4	9.3	10.0	0.7
Infans 2	6	-18.4	1.3	-20.8	-17.3	3.5	9.1	1.0	8.1	10.6	2.5
Juveniles	3	-18.4	0.4	-18.7	-18.0	0.7	8.6	1.1	7.5	9.7	2.2
ALD	12	-18.6	0.8	-20.8	-17.3	3.5	8.9	0.9	7.5	10.0	2.5
Infans 1B	3	-18.6	0.3	-18.9	-18.3	0.6	9.7	0.4	9.3	10.0	0.7
Infans 2	5	-18.6	1.3	-20.8	-17.3	3.5	8.7	0.7	8.1	9.6	1.5
Juveniles	3	-18.4	0.4	-18.7	-18.0	0.7	8.6	1.1	7.5	9.7	2.2
FIN	1	-17.5	-	-	-	-	10.6	-	-	-	-
Infans 2	1	-17.5	-	-	-	-	10.6	-	-	-	-
SMD phase 4	1	-19.4	-	-	-	-	9.3	-	-	-	-
Infans 1B	1	-19.4	-	-	-	-	9.3	-	-	-	-

Table 4.10 (continuation)

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
CAT subadults	21	-18.7	0.7	-19.8	-17.3	2.5	9.8	1.3	7.7	12.9	5.2
Fetus	2	-17.9	-	-17.9	-17.8	0.1	10.2	0.2	10.0	10.3	0.3
Infans 1A	5	-18.1	0.7	-18.9	-17.3	1.6	11.0	1.2	10.1	12.9	2.8
Infans 1B	9	-19.0	0.6	-19.8	-17.6	2.2	9.0	0.8	7.7	10.0	2.3
Infans 2	4	-19.0	0.3	-19.3	-18.6	0.7	10.0	1.9	8.7	12.9	4.2
Juveniles	1	-19.4	-	-	-	-	9.0	-	-	-	-
CG cemetery	1	-18.8	-	-	-	-	8.7	-	-	-	-
Infans 2	1	-18.8	-	-	-	-	8.7	-	-	-	-
CG settlement	4	-19.1	0.3	-19.4	-18.8	0.6	9.6	0.4	9.0	10.0	1.0
Infans 1B	2	-18.9	-	-19.0	-18.8	0.2	9.9	-	9.8	10.0	0.2
Infans 2	1	-19.3	-	-	-	-	9.5	-	-	-	-
Juveniles	1	-19.4	-	-	-	-	9.0	-	-	-	-
PMCV	8	-18.7	0.8	-19.8	-17.3	2.5	9.9	1.6	8.2	12.9	4.7
Fetus	1	-17.8	-	-	-	-	10.3	-	-	-	-
Infans 1A	1	-17.3	-	-	-	-	11.7	-	-	-	-
Infans 1B	4	-19.2	0.5	-19.8	-18.6	1.2	8.8	0.5	8.2	9.4	1.2
Infans 2	2	-18.9	-	-19.1	-18.6	0.5	11.0	-	9.0	12.9	3.9
RVSM	8	-18.4	0.7	-19.4	-17.6	1.8	10.0	1.4	7.7	12.9	5.2
Fetus	1	-17.9	-	-	-	-	10.0	-	-	-	-
Infans 1A	4	-18.3	0.6	-18.9	-17.8	1.1	10.9	1.4	10.1	12.9	2.8
Infans 1B	3	-18.7	0.9	-19.4	-17.6	1.8	8.8	1.0	7.7	9.5	1.8

Table 4.11. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of all adults grouped by region and assemblage. Standard deviation is only reported if sample size is greater than two. Key: M-T = Madrid-Toledo, BC = Basque Country, CAT = Catalonia

	n	*$\delta^{13}C$ (‰)*					*$\delta^{15}N$ (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All adults	199	-18.6	0.7	-21.4	-16.2	5.2	9.7	1.0	5.4	13.5	8.1
M-T adults	89	-18.6	0.6	-21.0	-16.2	4.8	10.3	1.0	6.4	13.5	7.1
GOZ cemetery	24	-18.7	0.7	-20.0	-16.2	3.8	9.8	0.8	8.6	11.2	2.6
BOA	53	-18.6	0.5	-21.0	-17.2	3.8	10.2	1.0	6.4	12.6	6.2
SNC phase 1	2	-18.9	-	-19.0	-18.7	0.3	10.8	-	10.7	10.8	0.1
SNC phase 3	5	-18.7	0.4	-19.0	-18.2	0.8	11.6	1.1	10.7	13.5	2.8
LH phase 2	1	-18.8	-	-	-	-	11.0	-	-	-	-
LH phase 3	4	-18.7	0.3	-19.0	-18.3	0.7	11.7	1.3	9.8	12.7	2.9
BC adults	79	-18.4	0.8	-21.4	-16.8	4.6	9.3	0.8	5.4	10.9	5.5
ALD	57	-18.2	0.6	-19.6	-16.8	2.8	9.1	0.6	7.6	10.3	2.7
FIN	5	-18.1	0.3	-18.4	-17.7	0.7	10.5	0.4	10.1	10.9	0.8
SMD phase 3	2	-18.9	-	-19.1	-18.7	0.4	10.5	-	10.1	10.8	0.7
SMD phase 4	15	-18.9	1.1	-21.4	-17.1	4.3	9.3	1.1	5.4	10.2	4.8
CAT adults	31	-19.0	0.6	-20.7	-18.0	2.7	9.4	0.6	8.4	10.6	2.2
CG cemetery	10	-19.3	0.8	-20.7	-18.3	2.4	9.9	0.6	8.6	10.6	2.0
CG settlement	1	-20.2	-	-	-	-	8.5	-	-	-	-
PMCV	13	-18.7	0.4	-19.3	-18.0	1.3	9.0	0.4	8.4	9.7	1.3
RVSM	7	-18.8	0.4	-19.3	-18.2	1.1	9.4	0.5	8.4	9.9	1.5

In order to get a broader perspective, the distributions of carbon and nitrogen stable isotope ratios of all humans separated into subadults and adults were compared and no statistically significant differences were found ($\delta^{13}C$ all humans subadults (n = 73) vs adults (n = 199), Mann-Whitney U test: U = 7574.000, z = 0.541, p = 0.588; δ^{15}N all humans subadults (n = 73) vs adults (n = 199), Mann-Whitney U test: U = 7063.000, z = -0.348, p = 0.728). Instead, when data were broken down by specific age categories statistically significant differences arose in the distributions of δ^{13}C and δ^{15}N values and in both cases pairwise *post hoc* comparison indicated that statistically significant differences lay in infans 1A, which was the most distinct age group on the two variables (δ^{13}C all humans grouped by age categories, Kruskal-Wallis H test: n = 267, H = 15.840, d.f. = 5, p = 0.007, pairwise *post hoc* comparison: infans 1A vs infans 1B: p = 0.016, the remaining fourteen combinations are not statistically significant; δ^{15}N all humans grouped by age categories, Kruskal-Wallis H test: n = 267, H = 17.510, d.f. = 5, p = 0.004, pairwise *post hoc* comparison: infans 1A vs infans 1B: p = 0.017, infans 1A vs infans 2: p = 0.003, infans 1A vs adults sp: p = 0.025, the remaining twelve combinations are not statistically significant).

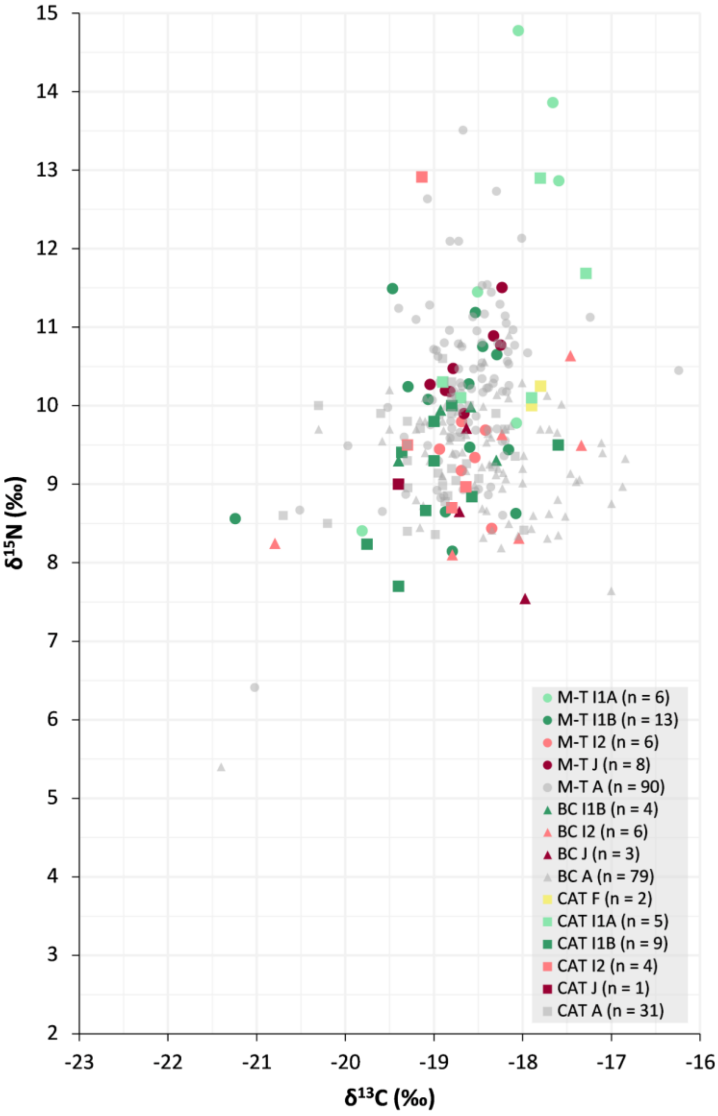


Figure 4.11. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of all individuals whose age could be estimated grouped by region

Similar statistical analyses were conducted considering each region separately with the aim of understanding if geographic location was a relevant factor in the distribution of dietary resources by age. In none of the three territories under study were there differences in the distribution of carbon or nitrogen stable isotope ratios when subadults and adults were compared directly (δ^{13}C all humans Madrid-Toledo subadults (n = 38) vs adults (n = 89), Mann-Whitney U test: U = 1631.000, z = -0.317, p = 0.751; δ^{15}N all humans Madrid-Toledo subadults (n = 38) vs adults (n = 89), Mann-Whitney U test: U = 1830.000, z = 0.733, p = 0.464; δ^{13}C all humans Basque Country subadults (n = 14) vs adults (n = 79), Mann-Whitney U test: U = 616.500, z = 0.683, p = 0.494; δ^{15}N all humans Basque Country subadults (n = 14) vs adults (n = 79), Mann-Whitney U test: U = 641.500, z = 0.952, p = 0.341; $\delta^{13}C$ all humans Catalonia subadults (n = 21) vs adults (n = 31), Mann-Whitney U test: U = 280.500, z = 0.843, p = 0.399; $\delta^{15}N$ all humans Catalonia subadults (n = 21) vs adults (n = 31), Mann-Whitney U test: U = 266.500, z = -1.102, p = 0.271).

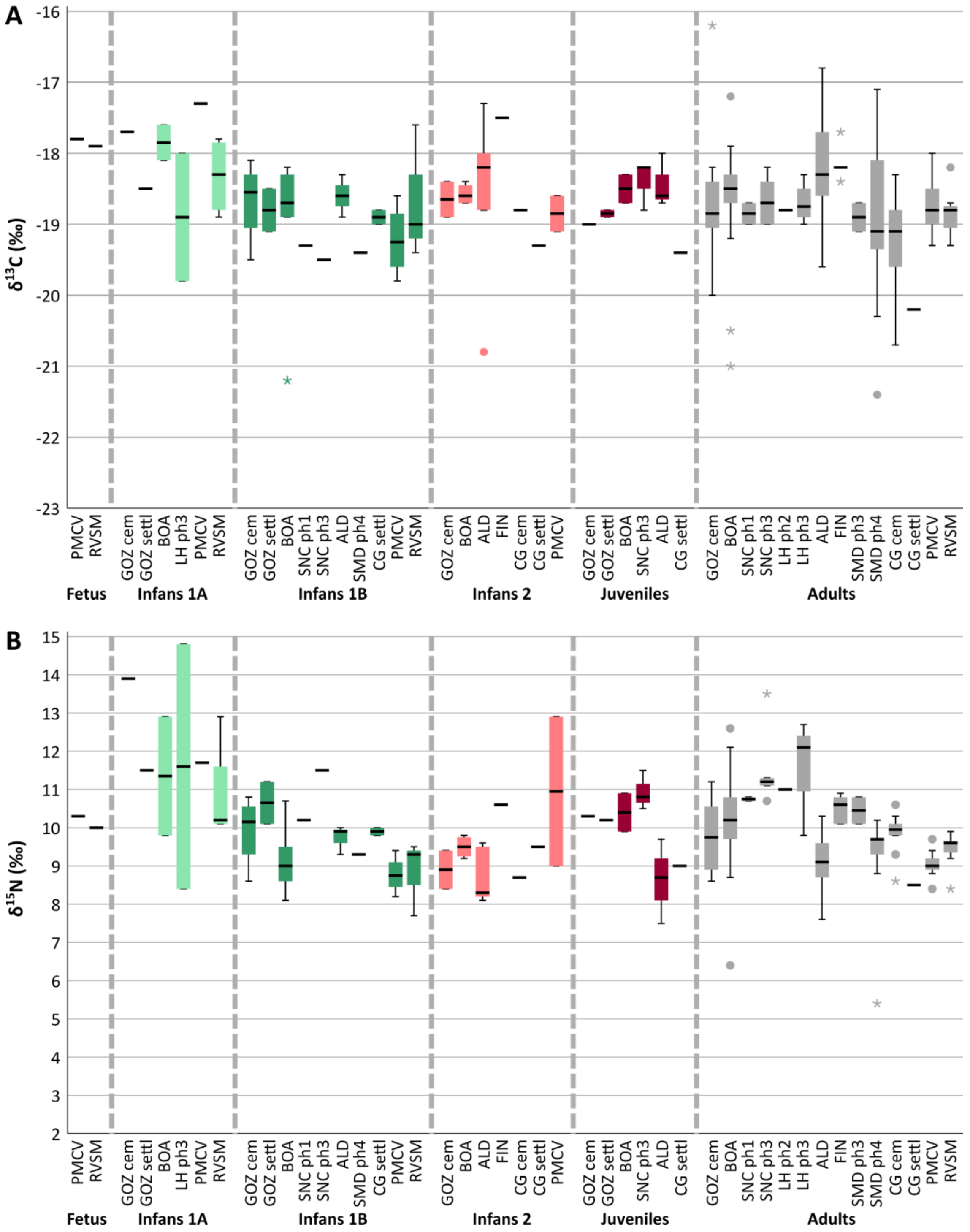


Figure 4.12. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of all individuals whose age could be estimated grouped by assemblage

Nevertheless, when specific age categories were used, results differed notably between regions. In Madrid-Toledo no statistically significant differences were found in the distribution of $\delta^{13}C$ values between specific age categories ($\delta^{13}C$ all humans Madrid-Toledo grouped by age categories, Kruskal-Wallis H test: n = 123, H =

5.996, d.f. = 4, p = 0.199), but there were in the distribution of $\delta^{15}N$ values ($\delta^{15}N$ all humans Madrid-Toledo grouped by age categories, Kruskal-Wallis H test: n = 123, H = 12.660, d.f. = 4, p = 0.013). In addition, *post hoc* comparison indicated that the only pair where differences were statistically significant was the one formed by infans 1A and infans 2 (p = 0.024, the remaining fourteen combinations are not statistically significant), which were the age groups with the most enriched and the most depleted nitrogen isotope ratios respectively. In the Basque Country no differences in any of the two variables were identified ($\delta^{13}C$ all humans Basque Country grouped by age categories, Kruskal-Wallis H test: n = 92, H = 2.568, d.f. = 3, p = 0.463; $\delta^{15}N$ all humans Basque Country grouped by age categories, Kruskal-Wallis H test: n = 92, H = 3.262, d.f. = 3, p = 0.353). Still, it is likely these results are biased. No individuals younger than 3 years of age at death (i.e. infans 1A) were included in the Basque dataset, while that was the age group with the most particular isotopic signatures in the other two regions. Meanwhile, in Catalonia differences between age groups were statistically significant for the distributions of both carbon and nitrogen stable isotope ratios ($\delta^{13}C$ all humans Catalonia grouped by age categories, Kruskal-Wallis H test: n = 52, H = 12.321, d.f. = 5, p = 0.031; $\delta^{15}N$ all humans Catalonia grouped by age categories, Kruskal-Wallis H test: n = 52, H = 15.170, d.f. = 5, p = 0.010). However, *post hoc* comparison of the distribution of $\delta^{13}C$ values did not spot any pair whose differences were statistically significant. Conversely, statistically significant differences in the distribution of $\delta^{15}N$ values were detected between the pairs formed by infans 1A and infans 1B (p = 0.014) and infans 1A and adults sp (p = 0.028, the remaining thirteen combinations are not statistically significant), highlighting the uniqueness of the dietary patterns of the youngest individuals also in Catalonia.

All these data reinforce the hypothesis that there were no substantial differences between the diets of subadults and adults, and infans 1A was the most distinct age group. This was certainly due to the effect of breastfeeding on carbon and nitrogen stable isotope ratios. Breastfeeding babies are one trophic level above their mothers due to the fractionation that takes place between them (Beaumont *et al.* 2018, Dupras 2010, Reynard & Tuross 2015), so they present $\delta^{13}C$ and $\delta^{15}N$ values notably more enriched than the adults from the same population. Five individuals out of the eleven infans 1A identified fit this pattern. Their ages at death ranged between 3 months and 2 years, with most of them between 1 and 2 years of age. Still, it is possible that some of them were partially weaned before death, as the offset between their isotopic signatures and the mean of local adult females is smaller than the enrichment corresponding to one full trophic level shift. The remaining six infans 1A, aged between birth and 3 years, showed no evidence of breastfeeding at all. This could be because they were completely weaned before death or because they were never breastfed. Yet, it is important to keep in mind that the isotopic signal of breastfeeding does not disappear from bone collagen immediately, but it takes several weeks or months to be fade away. For this reason, bone collagen is not the most suitable tissue to study breastfeeding and weaning patterns (Beaumont *et al.* 2018). All in all, there is evidence pointing simultaneously at breastfeeding beyond the first year of life and very early weaning or no breastfeeding to any extent. Nonetheless, with the few data available it is not possible to draw firm conclusions about diet during the first years of life in early medieval Iberian rural communities.

All subadults older than 3 years of age tended to be similar to local adults regarding carbon stable isotope ratios, although they were generally more heterogeneous. On the contrary, infans 1B and infans 2 were frequently more depleted in nitrogen isotope ratios than their corresponding adults. This points at the smaller intake of animal protein by subadults after weaning. In this way, $\delta^{15}N$ values and, thus, animal protein intake did not reach the level of equivalent adults up to the age group of juveniles, suggesting that after age 15 approximately individuals started to be socially considered as adults (Lewis *et al.* 2016). Boadilla was the assemblage where this evolution could be more clearly observed (see section 3.1.2.4.3), as it was the dataset with the largest representation of subadults. Infans 1A presented the most enriched nitrogen isotope ratios, but $\delta^{15}N$ values experienced a strong drop at the age of infans 1B. Nitrogen isotope ratios of infans 2 were slightly more enriched than the former and they were comparable to adults in the case of juveniles. At the same time, after infans 1A, carbon stable isotope ratios remained stable along all age categories. Changes in adult diet were even more difficult to tackle due to the problems to estimate adult age accurately. Actually, none of the human assemblages analysed offered the possibility to explore this variable. Summing up, differences in diet between subadults and adults were very subtle and they would have lain mostly in the proportions of animal protein. Then, it is likely that the proportion of plants consumed did not vary greatly based on age but, according to the scarce data available, the access to animal products might have been somehow limited before adolescence.

No specific research has been devoted to the changes in diet throughout life in early medieval Iberia, but several studies have identified individuals with particular dietary patterns associated to age. In various cases, such as Dulantzi phase 5 (Lubritto *et al.* 2017), Tauste (Guede, Ortega, Zuluaga, Alonso-Olazabal, Murelaga, Pina, *et al.* 2017), Egara (Jordana *et al.* 2019), Ibiza S'Hort des Llimoners (Fuller *et al.* 2010) or Monte da Cegonha (Saragoça *et al.* 2016), young subadults who were being breastfed at or around the time of death were detected thanks to the enrichment they showed in nitrogen isotope ratios. Their ages ranged between 6 months and 3 years, pointing at quite late weaning. Still, it has to be considered this was not usually an abrupt event, but a gradual process which could take several months to be completed, and bone collagen does not offer enough resolution to analyse it in detail. No applications to early medieval Iberian contexts of carbon and nitrogen stable isotope analyses on incremental dentine samples, which is the most appropriate method for tackling breastfeeding and weaning, have been published yet, but in the near future it will certainly be a very valuable source of new information about children feeding patterns. Moreover, in the cases of Dulantzi phase 5 and Ibiza S'Hort des Llimoners a strong depletion of nitrogen isotope ratios was verified in older subadults, which can be related to the decrease of animal protein intake during late childhood observed in Boadilla. Similar patterns have also been observed in contemporary sites all over Europe. B. T. Fuller *et al.* (2006) and Ch. Bourbou *et al.* (2013) carried out specific studies on breastfeeding and weaning in the UK and Greece respectively and both of them included early medieval samples. Both concluded that weaning was not completed up to around the age of 4, which is even later than what observed in Iberian populations. Other papers too provided isolated data about individuals being breastfed at the time of death (Alt *et al.* 2014, Amorim *et al.* 2018, Geber 2010, Hakenbeck *et al.* 2010, Hemer *et al.* 2016, Marinato 2016, Privat *et al.* 2002). Besides, the British population of Melbourn (Hannah *et al.* 2018) presented an evolution of nitrogen isotope ratios along age very similar to the pattern observed in Boadilla, with a notable decrease of $\delta^{15}N$ values during late childhood that did not reach the level of adults up to adolescence. All these parallels confirm that the absence of stark differences in diet between age groups within the same population was the rule in early medieval contexts, so probably age was not a determining factor in the distribution of food resources or at least differences were not detectable isotopically.

4.3.2 DIET AND SEX: SEXUAL DIVISION OF FOOD?

More than half of the adult individuals successfully analysed for carbon and nitrogen stable isotope ratios had sex determined and were useful to discuss the sexual division of food. However, they were not evenly distributed and the results are not equally representative for all the assemblages and regions. The best represented region was the Basque Country, where it was possible to determine sex of eight out of ten adults. Poor preservation affected sex determination of the adult assemblages from Madrid-Toledo and Catalonia in different ways. In the former it meant that only one third of adults had sex determined. In the latter it caused that only a small number of adults from each assemblage had good quality collagen. Therefore, although sex of up to two thirds of the adults could be determined, it is likely that these twenty individuals do not reflect faithfully the variability of adult diet in the region. Besides, there were great differences between the sex ratios of the final assemblages from each region. In Catalonia it was the most balanced and in Madrid-Toledo it was very imbalanced in favour of females, while in the Basque Country it was strongly skewed towards males. These considerations are important because the underlying demographic structure of the groups to be compared will determine the results to a certain extent. It should also be recalled that subadults were not subjected to macroscopic sex determination because they do not show enough sexual dimorphism in the skeleton. Then, it is assumed that, if there were any differences in the feeding patterns of male and female children and adolescents, they will go unnoticed. The only exception was Aldaieta, where sex was determined through DNA analyses, so a small number of subadults got it determined. Still, they were not enough to draw any meaningful conclusions on the topic.

Table 4.12. Summary statistics of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios of all adults whose sex could be determined grouped by region and assemblage. Standard deviation is only reported if sample size is greater than two. Key: M-T = Madrid-Toledo, BC = Basque Country, CAT = Catalonia

	n	*δ13C (‰)*					*δ15N (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All adults	199	-18.6	0.7	-21.4	-16.2	5.2	9.7	1.0	5.4	13.5	8.1
Male adults	59	-18.4	0.8	-21.4	-16.8	4.6	9.4	0.9	5.4	12.1	6.7
Female adults	54	-18.6	0.6	-20.5	-17.0	3.5	9.9	1.0	8.4	12.7	4.3
M-T adults	89	-18.6	0.6	-21.0	-16.2	4.8	10.3	1.0	6.4	13.5	7.1
Male adults	10	-18.6	0.4	-19.6	-18.2	1.4	10.0	1.1	8.7	12.1	3.4
Female adults	20	-18.7	0.6	-20.5	-188.0	2.5	10.8	1.0	8.6	12.7	4.1
GOZ cemetery	24	-18.7	0.7	-20.0	-16.2	3.8	9.8	0.8	8.6	11.2	2.6
Male adults	6	-18.7	0.5	-19.6	-18.2	1.4	9.8	1.0	8.7	11.1	2.4
Female adults	6	-18.5	0.5	-19.4	-18.2	1.2	10.3	0.9	8.6	11.2	2.6
BOA	53	-18.6	0.5	-21.0	-17.2	3.8	10.2	1.0	6.4	12.6	6.2
Male adults	3	-18.5	0.3	-18.8	-18.3	0.5	9.6	0.7	8.9	10.3	1.4
Female adults	7	-18.8	0.8	-20.5	-18.0	2.5	10.7	1.1	8.7	12.1	3.4
SNC phase 1	2	-18.9	-	-19.0	-18.7	0.3	10.8	-	10.7	10.8	0.1
Female adults	1	-19.0	-	-	-	-	10.7	-	-	-	-
SNC phase 3	5	-18.7	0.4	-19.0	-18.2	0.8	11.6	1.1	10.7	13.5	2.8
Female adults	2	-18.6	-	-19.0	-18.2	0.8	11.2	-	11.1	11.3	0.2
LH phase 2	1	-18.8	-	-	-	-	11.0	-	-	-	-
Female adults	1	-18.8	-	-	-	-	11.0	-	-	-	-
LH phase 3	4	-18.7	0.3	-19.0	-18.3	0.7	11.7	1.3	9.8	12.7	2.9
Male adults	1	-18.7	-	-	-	-	12.1	-	-	-	-
Female adults	3	-18.7	0.4	-19.0	-18.3	0.7	11.5	1.5	9.8	12.7	2.9
BC adults	79	-18.4	0.8	-21.4	-16.8	4.6	9.3	0.8	5.4	10.9	5.5
Male adults	39	-18.3	0.9	-21.4	-16.8	4.6	9.2	0.9	5.4	10.8	5.4
Female adults	24	-18.3	0.7	-19.2	-17.0	2.2	9.4	0.7	8.4	10.9	2.5
ALD	57	-18.2	0.6	-19.6	-16.8	2.8	9.1	0.6	7.6	10.3	2.7
Male adults	28	-18.0	0.6	-19.6	-16.8	2.8	9.2	0.6	7.6	10.3	2.7
Female adults	17	-18.4	0.6	-19.2	-17.0	2.2	9.1	0.6	8.4	10.1	1.7
FIN	5	-18.1	0.3	-18.4	-17.7	0.7	10.5	0.4	10.1	10.9	0.8
Male adults	1	-18.2	-	-	-	-	10.8	-	-	-	-
Female adults	3	-18.0	0.3	-18.2	-17.7	0.5	10.4	0.5	10.1	10.9	0.8
SMD phase 3	2	-18.9	-	-19.1	-18.7	0.4	10.5	-	10.1	10.8	0.7
Female adults	1	-19.1	-	-	-	-	10.1	-	-	-	-

Table 4.12 (continuation)

	n	*δ^{13}C (‰)*					*δ^{15}N (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
SMD phase 4	15	-18.9	1.1	-21.4	-17.1	4.3	9.3	1.1	5.4	10.2	4.8
Male adults	10	-19.1	1.1	-21.4	-17.8	3.6	9.2	1.4	5.4	10.2	4.8
Female adults	3	-18.0	1.1	-19.2	-17.1	2.1	9.6	0.2	9.4	9.7	0.3
CAT adults	31	-19.0	0.6	-20.7	-18.0	2.7	9.4	0.6	8.4	10.6	2.2
Male adults	10	-18.8	0.5	-19.6	-18.1	1.5	9.5	0.5	8.8	10.3	1.5
Female adults	10	-18.9	0.4	-19.3	-18.0	1.3	9.3	0.5	8.4	10.0	1.6
CG cemetery	10	-19.3	0.8	-20.7	-18.3	2.4	9.9	0.6	8.6	10.6	2.0
Male adults	3	-18.9	0.7	-19.6	-18.3	1.3	10.0	0.2	9.9	10.3	0.4
Female adults	3	-19.1	0.4	-19.3	-18.6	0.7	9.7	0.4	9.3	10.0	0.7
CG settlement	1	-20.2	-	-	-	-	8.5	-	-	-	-
PMCV	13	-18.7	0.4	-19.3	-18.0	1.3	9.0	0.4	8.4	9.7	1.3
Male adults	5	-18.7	0.5	-19.3	-18.1	1.2	9.1	0.2	8.8	9.4	0.6
Female adults	4	-18.7	0.5	-19.2	-18.0	1.2	9.1	0.5	8.4	9.7	1.3
RVSM	7	-18.8	0.4	-19.3	-18.2	1.1	9.4	0.5	8.4	9.9	1.5
Male adults	2	-18.8	-	-18.8	-18.8	0.0	9.8	-	9.6	9.9	0.3
Female adults	3	-19.1	0.3	-19.3	-18.8	0.5	9.0	0.6	8.4	9.5	1.1

Considering all the above, only adult individuals were used to explore the differences in diet between sexes (table 4.12, figure 4.13, figure 4.14). However, assemblages with less than nine individuals of known sex or with less than three individuals in any of the two sex categories were excluded from individualised analysis, as they were not deemed representative. As a result, only five out of the fifteen human assemblages studied, namely the cemetery of Gózquez, Boadilla, Aldaieta, the phase 4 of Dulantzi and Castellar del Vallès, were useful to compare variations in diet between adult males and females. None of them presented statistically significant differences in the distribution of carbon stable isotope ratios, except for Aldaieta (see section 3.2.1.4.3). In this case adult males showed notably more enriched carbon stable isotope ratios than females, pointing at greater intake of C_4 plants by the former. Moreover, the identification of the sex of a few subadults through DNA analyses revealed that, regardless sex, subadults were closer in δ^{13}C to female adults, which suggests that in this context millets might have been preferentially consumed by adult males before any other demographic group. Still, at Aldaieta there was also a statistically significant association between the presence of grave goods in burials and enriched carbon stable isotope ratios. In other words, artefacts were found more frequently in the burials of male adults than next to subadults or adult females. Hence, it is difficult to decide if it was sex or social status as expressed through grave goods that determined the access to greater proportions of millets. Nevertheless, taking into account that statistically significant differences in the distribution of δ^{13}C values based on sex were only found in this case, while the enrichment of carbon stable isotope ratios of individuals with grave goods was extendible to the whole Basque Country and also Madrid-Toledo (see section 4.4.1), it is more likely that social status as defined by grave goods had a greater weight in the access to C_4 plants rather than sex. As for nitrogen isotope ratios, no statistically significant differences were detected in any of the assemblages considered representative. Yet, it is worth mentioning that at Aldaieta and the phase 4 of Dulantzi adult females were notably more homogeneous than adult males. Conversely, at Castellar del Vallès adult males were substantially more uniform in δ^{15}N values than adult females. That is, there might have been some differences in the allotment of animal products, but there was not a general pattern that can be extrapolated to most cases. All in all, apart for the exception of Aldaieta discussed above, no meaningful differences based on sex were observed in the distribution of food resources within early medieval rural Iberian communities, neither concerning the proportions of cereals consumed nor the intake of animal protein.

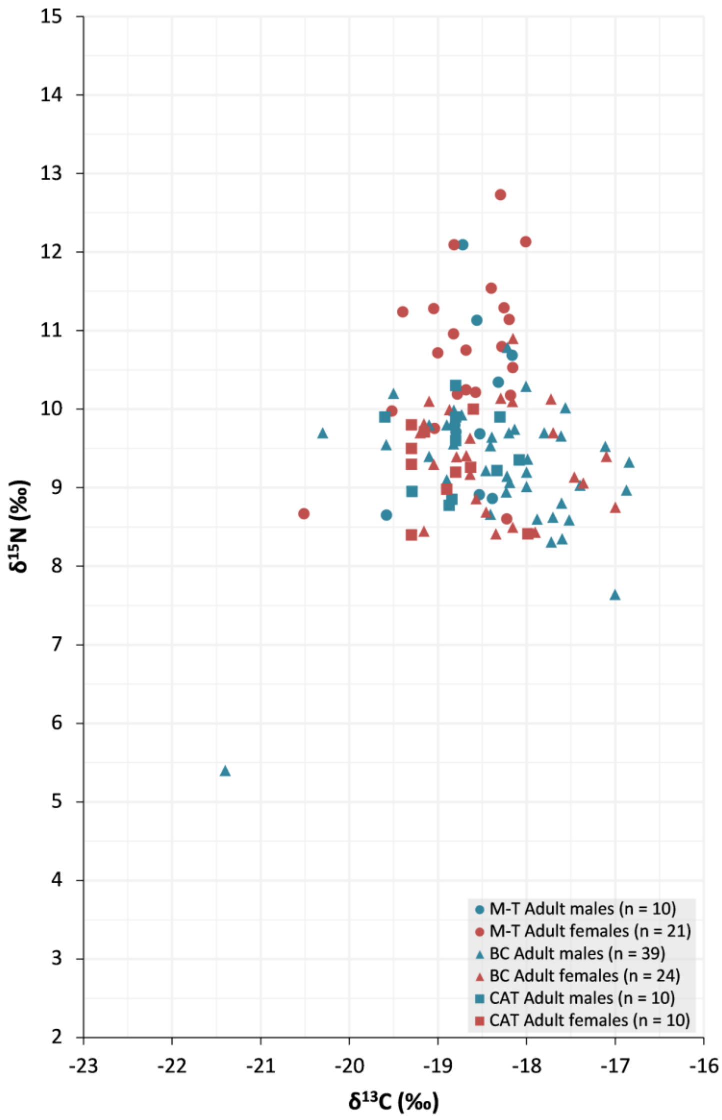


Figure 4.13. Scatterplot of carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of all adults whose sex could be determined grouped by region

When differences in diet between sexes were considered from a wider perspective, the results were similar. Taking the all the individuals analysed together, there were no statistically significant differences in the distribution of carbon stable isotope ratios between adult males and females (δ^{13}C all humans adult males (n = 59) vs adult females (n = 54), Mann-Whitney U test: U = 1313.500, z = -1.610, p = 0.107). No statistically significant differences were found either when individuals were grouped by regions (δ^{13}C all humans Madrid-Toledo adult males (n = 10) vs adult females (n = 20), Mann-Whitney U test: U = 102.500, z = 0.912, p = 0.914; δ^{13}C all humans Basque Country adult males (n = 39) vs adult females (n = 24), Mann-Whitney U test: U = 398.000, z = -0.992, p = 0.321; δ^{13}C all humans Catalonia adult males (n = 10) vs adult females (n = 10), Mann-Whitney U test: U = 39.500, z = 0.420, p = 0.436). This indicates that in general terms there were no systematic differences in the distribution of crops based on sex. Besides, it reinforces the hypothesis that the statistically significant differences observed in Aldaieta had more to do with social status than with sex. Instead, there were statistically significant differences between the distributions of nitrogen isotope ratios of adult males and females (δ^{15}N all humans adult males (n = 59) vs adult females (n = 54), Mann-Whitney U test: U = 1953.000, z = 2.071, p = 0.038). However, when δ^{15}N values were compared separately by regions these differences disappeared (δ^{15}N all humans Madrid-Toledo adult males (n = 10) vs adult females (n = 20), independent samples t-test: t = -1.879, d.f. = 28, p = 0.071; δ^{15}N all humans Basque Country adult males (n = 39) vs adult females (n = 24), Mann-Whitney U test: U = 496.500, z = 0.404, p = 0.686; δ^{15}N all humans Catalonia adult males (n = 10) vs adult females (n = 10), independent samples t-test: t = 0.978, d.f. = 18, p = 0.341). Thus, the difference arisen when looking at the whole assemblage was probably meaningless and just an artefact of the imbalanced arrangement of individuals by regions and demographic categories. That is to say that large scale analyses confirmed what observed at the local level, that in these contexts sex was not a crucial factor in the configuration of diet.

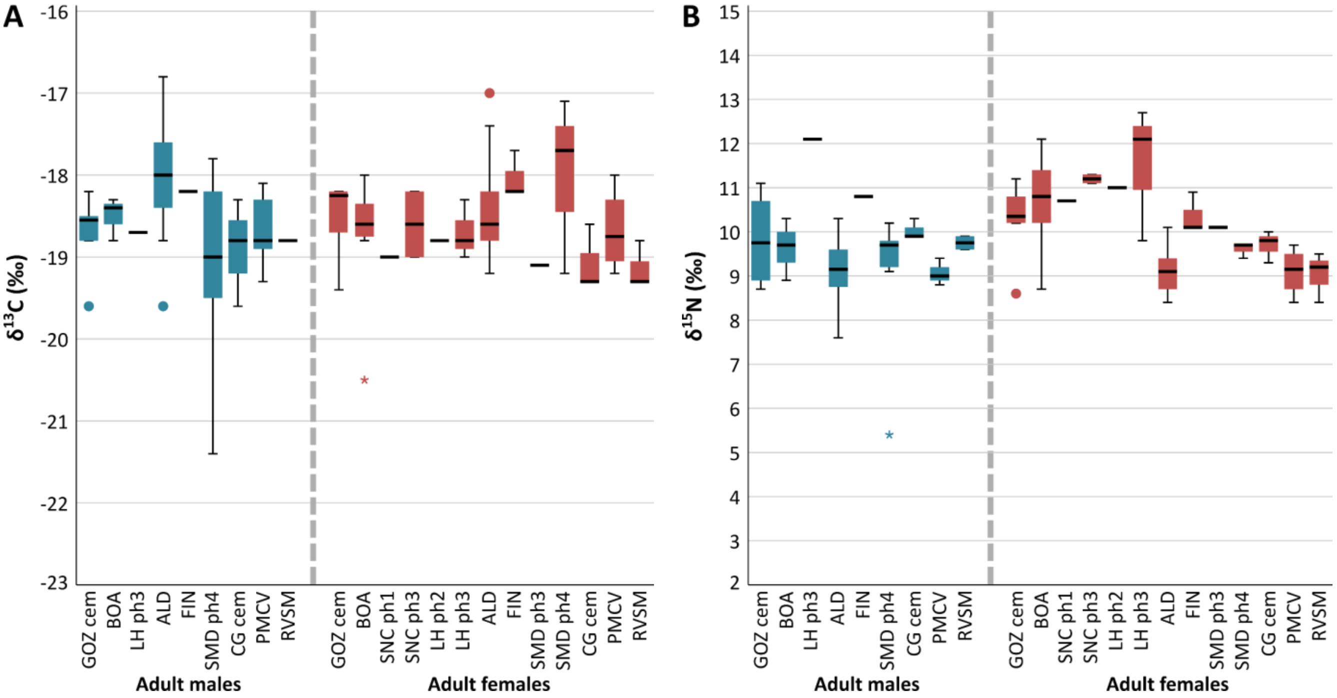


Figure 4.14. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of all adults whose sex could be determined grouped by assemblage

The absence of relevant differences in adult diet between sexes was not a particular feature of the populations analysed for this thesis. Among all the Iberian early medieval case studies hitherto published, only two reported significant differences between adult males and females. They were the human assemblages from Ibiza Joan Planells (Alaica *et al.* 2019) and Tauste (Guede, Ortega, Zuluaga, Alonso-Olazabal, Murelaga, Pina, *et al.* 2017). In both cases adult males showed more enriched nitrogen isotope ratios, pointing at the consumption of greater proportions of animal protein in comparison to adult females. This is interesting because the only meaningful differences found among the sites analysed in this research lay in the variability of carbon stable isotope ratios. At the European level differences in diet based on sex are not identified in every case either, but they are expressed in diverse ways. In most cases it is through nitrogen isotope ratios and adult males show more enriched values (Alt *et al.* 2014, Baldoni *et al.* 2016, Fuller *et al.* 2006, Herold 2008, Plecerová *et al.* 2020). That is, when there are clear differences between sexes in animal protein intake, it is normally adult males that show the most abundant consumption levels. There were also a few instances where differences between male and female adult diets resided in carbon stable isotope ratios (Hakenbeck *et al.* 2010, Knipper *et al.* 2013). In both cases it was assumed $\delta^{13}C$ values of adult males represented the isotopic signature of local ecosystems and differences in comparison to adult females were due to the fact that women were migrants from areas with distinct isotopic baselines. In other contexts differences between sexes were not materialised in the actual carbon and nitrogen stable isotope ratios, but in their variability (Kaupová, Velemínský, Herrscher, *et al.* 2018, Privat *et al.* 2002), and in every example adult females tended towards more homogeneous $\delta^{13}C$ and $\delta^{15}N$ values than adult males, suggesting it was more common that the latter had access to a wider range of resources. In any case, it has to be stressed that in early medieval contexts by far the most common scenario is the absence of any significant differences between the diets of adult males and females, so it can be concluded that sex was probably not a determining factor in the access to food resources.

4.4 FOOD FOR DISTINCTION: DIET AS A MARKER OF SOCIAL INEQUALITY

One of the aims of this thesis was to verify if diet, as understood from carbon and nitrogen stable isotope ratios, could be used as an indicator to approach the social organisation of early medieval Iberian rural societies. The use of consumption patterns as a proxy of social status has already been proposed by other researchers from written sources, archaeological records and palaeodietary reconstruction too. Feasting and display of access to exclusive foodstuffs were some of the distinctive features of early medieval elites (Wickham 2011: 12), as often reflected in early medieval chronicles and sagas. Food consumption patterns can also identify privileged households through the distribution of fauna remains looking at the concentration of skeletal elements corresponding to the most appreciated cuts of meat, for example (Grau-Sologestoa 2015, Valenti & Salvadori 2007). Likewise, carbon and nitrogen stable isotope analyses have been used in various contexts to try to spot socially distinguished individuals starting from the premise that certain products might have been preferentially consumed by elites. Depending on the context, these could be meat and animal protein in general, identifiable through $\delta^{15}N$ (Knipper *et al.* 2015), but also marine fish or millets, which can be detected thanks to $\delta^{13}C$ (Lightfoot *et al.* 2015, Linderholm *et al.* 2008).

Actually, one of the keys to unravel the relationship between social status and diet is to identify the products that showed off social status in each setting and it is important to be aware this is a contextual matter. For instance, while wheat bread might have been a privilege in a specific historical moment, the access to millets and the consequent possibility to face adversities thanks to a diversified agricultural production might have denoted a more relevant position under other circumstances. For this reason, it is considered essential to get rid of any preconception and, instead, to use the archaeological evidence available to tackle this issue. In the Iberian early medieval rural contexts analysed in this thesis there are two main kinds of indicators which can be confronted with carbon and nitrogen stable isotope ratios in order to explore the connection between diet and social inequality, even if not all of them are applicable in every context.

The first one are grave goods. Clothing items, jewellery, containers, tools, weapons and other objects were common findings in some of the funerary contexts analysed in this research, especially in the regions of Madrid-Toledo and the Basque Country. Over the years the presence of these artefacts has been read in different ways, from purely ethnic interpretations (Härke 2011) to the straightforward equivalence between the wealth of grave goods and the social position of individuals (Halsall 2011), up to the most widely accepted paradigm nowadays, which proposes that grave goods are part of a display rigged up by the descendants of the deceased, so grave goods might have more to do with the legacy the heirs wanted to show than with the real role of the dead individual in the community during life (Pohl & Reimitz 1998). Then, grave goods can be confronted with carbon and nitrogen stable isotope ratios as a means to verify if the factors that defined the composition of diet and the access to certain food resources were also relevant in the configuration of the funerary ritual, but it should not be expected to find a clear correlation between them.

The second window to the understanding of social inequality in early medieval Iberian rural communities from the intersection of diet and the funerary record was the location of burials. The position of an individual’s grave is usually not a matter of chance. It can be determined by personal identity, family bonds or social status of the deceased, so analysing this variable can potentially inform about all these topics. The problem is to disentangle these factors and to clear up which was the most influential in each context. Among the case studies addressed in this work, there are two useful criteria to tackle this topic. On one hand, three of the cemeteries analysed (i.e. Finaga, Dulantzi, Sant Menna) were arranged around churches. The proximity to the building is a well-known indicator of social status, since the closeness to the relics, usually guarded in the apse, was thought to facilitate salvation, and the spatial organisation around or inside the church often reflected social hierarchy (O'Sullivan 2013: 271–273). On the other hand, there is the issue of social exclusion. At least in two of the sites studied here (i.e. Gózquez, Can Gambús) individuals buried outside the community cemetery were found. They were scattered between domestic and productive areas and most of them were deposited in reused structures, such as silos and wells, without any funerary treatment. This means a clear segregation from the community materialised not only through the physical separation of these individuals, but also through the denial of a proper funerary ritual. Several interpretations about the reasons for the marginalisation of these individuals have been proposed. Initially these deviant burials were hypothesised to have belonged to slaves, that is, it was suggested that segregation would have been based on legal status (Roig & Coll 2011). Later, age, origin and disease have been suggested in different fora as the causes of exclusion, but up to the moment there is not a convincing interpretation. There is some agreement on the fact that individuals disposed of without any funerary gesture were not considered full members of the peasant community (Vigil-Escalera 2013a, Vigil-Escalera 2016), although the specific reasons for their discrimination are unclear. Still, it is likely that not all these non-normative burials come up to the same reasons, so evidence needs to be examined case by case. All in all, exploring the relationship between diet and the location of burials, either regarding the church or in terms of social exclusion, is deemed interesting in order to check if there might have been any key in food consumption patterns between the individuals placed in diverse contexts which could explain the origin of these differences in treatment at death.

4.4.1 DIET, GRAVE GOODS AND SOCIAL STATUS

The proportion of individuals with grave goods was very variable from site to site. In the region of Madrid-Toledo the populations from the two community cemeteries analysed, namely Gózquez and Boadilla, which were used simultaneously from the end of the 5th century or the beginning of the 6th century to the mid-8th century, were the contexts where most grave goods were found. Between one fifth and one quarter of all the individuals recorded (Gózquez cemetery: 24.1%, Boadilla: 22.1%) were accompanied by artefacts. The majority were clothing items and jewellery, while containers and tools and weapons only meant a small proportion of the objects. The smaller sites of El Soto/El Encadenado and La Huelga, also in the region of Madrid-Toledo, were different in this aspect of the funerary ritual. Both were formed by two separate chronological phases. El Soto/El Encadenado had a first small cemetery dated to the first half of the 5th century where the majority of individuals (66.7%) were buried with grave goods. In this case, following the fashion of post-imperial necropolises (Vigil-Escalera 2015: 155–162), containers were the prevalent type of artefact, clothing items and jewellery were incidental and tools and weapons absent. Instead, the first phase of La Huelga was assigned to the 7th century, so it was contemporary to Gózquez and Boadilla, but it was made up of a single individual without any grave goods. The two later phases of El Soto/El Encadenado and La Huelga had several features in common. They started along the 8th century and were in use possibly until the middle of the 9th century. Thus, they were both formed mostly by Islamic burials and, accordingly, none of them had any grave goods.

As for the Basque Country, grave goods were found in all the three sites studied. The main occupation phases of either Aldaieta, Finaga or Dulantzi were dated to between the mid-6th century and the end of the 7th century or the 8th century. They were characterised by great percentages of individuals with grave goods (Aldaieta: 45.5%, Finaga: 50.0%, Dulantzi phase 4: 40.0%). Altogether clothing items and jewellery, containers, and tools and weapons were recovered in similar proportions, but the latter category stood out because in no other region were tools and weapons so abundant. Moreover, it must be noted that the phase 2 of Finaga started slightly earlier, along the 5th century, and some of the grave goods, more specifically the plain late Hispanic red slip ware bowl, match the features of the aforementioned post-imperial cemeteries. This is also true for some of the artefacts found in Aldaieta, such as hobnails or the Simancas type knife. Therefore, it could be proposed that the cemeteries of Aldaieta and Finaga were actually the result of the overlap of two phases with changing funerary rituals, the earliest one comparable to postimperial necropolises and the second one characterised by the abundance of grave goods, especially tools and weapons. Nevertheless, at the moment it is not possible to separate these two hypothetical stages, in Aldaieta due to the scarcity of radiocarbon dates and in Finaga because of the large errors of the measurements available. Finally, it has to be said that the assemblage of phase 3 from Dulantzi was not taken into account for this section of the discussion because the only individual in primary position did not carry any grave goods and the two other individuals came from secondary deposits, so it was not possible to know how they were originally buried.

Catalonia was the region with the smaller proportion of individuals with grave goods. Actually, the finding of any artefacts within graves was really incidental (Can Gambús cemetery: 2.7%, Castellar del Vallés: 0.0%, Sant Menna: 2.2%). The few exceptions recorded can be quickly summarised. At Can Gambús one of the individuals from the cemetery was accompanied by a pottery container and a bead, two of the individuals from Castellar del Vallès had one egg each placed next to their skeletons and at Sant Menna one individual held a bead and another one an unidentified object made of bone. Then, the use of grave goods in the predominant funerary ritual in Catalonia seems to have been different from the other two regions discussed here (Roig 2015: 357–360, 367–369).

Table 4.13. Summary statistics of carbon (δ^{13}C) and nitrogen (δ^{15}N) stable isotope ratios of the human assemblages useful for the discussion of the relationship between diet and grave goods: the cemetery of Gózquez, Boadilla, Aldaieta and the phase 4 from Dulantzi. Key: select = selection, M-T = Madrid-Toledo, BC = Basque Country

	n	*δ^{13}C (‰)*					*δ^{15}N (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
All humans select	196	-18.5	0.7	-21.4	-16.2	5.2	9.6	1.0	5.4	13.9	8.5
Grave g absence	111	-18.7	0.5	-21.4	-16.2	5.2	9.6	1.1	5.4	13.9	8.5
Grave g presence	85	-18.3	0.4	-20.8	-16.8	4.0	9.6	0.9	7.5	12.1	4.6
M-T select	110	-18.6	0.6	-21.2	-16.2	5.0	10.0	1.0	6.4	13.9	7.5
Grave g absence	75	-18.7	0.7	-21.2	-16.2	5.0	10.0	1.1	6.4	13.9	7.5
Grave g presence	35	-18.4	0.4	-19.0	-17.2	1.8	10.2	0.9	8.4	12.1	3.7
GOZ cemetery	33	-18.7	0.7	-20.0	-16.2	3.8	9.9	1.1	8.4	13.9	5.5
Grave g absence	23	-18.8	0.8	-20.0	-16.2	3.8	9.9	1.2	8.6	13.9	5.3
Grave g presence	10	-18.6	0.3	-19.0	-18.2	0.8	9.7	0.9	8.4	10.8	2.4
BOA	77	-18.6	0.6	-21.2	-17.2	4.0	10.1	1.0	6.4	12.9	6.5
Grave g absence	52	-18.7	0.6	-21.2	-17.6	3.6	10.0	1.0	6.4	12.9	6.5
Grave g presence	25	-18.3	0.4	-18.9	-17.2	1.7	10.4	0.8	9.0	12.1	3.1
BC select	86	-18.4	0.8	-21.4	-16.8	4.6	9.1	0.7	5.4	10.3	4.9
Grave g absence	36	-18.6	0.8	-21.4	-17.4	4.0	9.0	0.9	5.4	10.3	4.9
Grave g presence	50	-18.2	0.7	-20.8	-16.8	4.0	9.2	0.6	7.5	10.2	2.7
ALD	70	-18.3	0.7	-20.8	-16.8	4.0	9.1	0.6	7.5	10.3	2.8
Grave g absence	28	-18.4	0.6	-19.6	-17.4	2.2	9.0	0.6	7.9	10.3	2.4
Grave g presence	42	-18.2	0.7	-20.8	-16.8	4.0	9.1	0.6	7.5	10.1	2.6
SMD phase 4	16	-19.0	1.1	-21.4	-17.1	4.3	9.3	1.1	5.4	10.2	4.8
Grave g absence	8	-19.4	1.1	-21.4	-17.7	3.7	8.9	1.4	5.4	9.7	4.3
Grave g presence	8	-18.5	0.9	-19.5	-17.1	2.4	9.7	0.3	9.2	10.2	1.0

Focusing specifically on the relationship between diet and grave goods, ultimately the dataset selected to explore this issue was restricted to four assemblages: the cemetery of Gózquez, Boadilla, Aldaieta and the assemblage of phase 4 from Dulantzi (table 4.13, figure 4.15, figure 4.16). This selection included the contexts where artefacts had a relevant role in the funerary ritual and where a sufficient number of individuals with and without them could be satisfactorily measured. Thereby the assemblage from the settlement of Gózquez, both phases of El Soto/El Encadenado and La Huelga, individuals of phase 3 from Dulantzi and all the three Catalan sites were left aside of this discussion because they were not consistent enough for this purpose.

No clear patterns or differences in the distribution of either carbon or nitrogen stable isotope ratios of individuals with and without grave goods were observable in any of the four assemblages considered. Still, it was noticeable that in all the cases individuals with grave goods showed more enriched $\delta^{13}C$ mean values than individuals without them. This indicates individuals buried with artefacts were more likely to have mixed C_3-C_4 diets and to eat greater proportions of millets than those without. In addition, although there was a lot of variability, it was rare to find individuals with grave goods with exclusively C_3 diets. Actually, this situation only came across at Dulantzi, which was also the assemblage with the greatest contrast between the mean $\delta^{13}C$ of individuals with and without artefacts. In this way, the difference between the distributions of carbon stable isotope ratios of individuals with and without grave goods were statistically significant in Boadilla and Aldaieta, but not in the cemetery of Gózquez and in the population of phase 4 of Dulantzi. However, when assemblages were paired by regions (Madrid-Toledo: Gózquez cemetery & Boadilla, Basque Country: Aldaieta & Dulantzi phase 4), the comparison of the distribution of $\delta^{13}C$ turned out statistically significant both in Madrid-Toledo ($\delta^{13}C$ Madrid-Toledo individuals without grave goods ($n = 75$) vs individuals with grave goods ($n = 35$), Mann-Whitney U test: $U = 1785.500$, $z = 3.046$, $p = 0.002$) and the Basque Country ($\delta^{13}C$ Basque Country individuals without grave goods ($n = 36$) vs individuals with grave goods ($n = 50$), Mann-Whitney U test: $U = 1205.000$, $z = 2.674$, $p = 0.007$). The coincidence of results across regions is meaningful, even more taking into account the differences in the variability of $\delta^{13}C$ between them, since in Madrid-Toledo individuals were substantially more clustered than in the Basque Country, where they were notably more scattered. Besides, the outcome of the comparison of individuals with and without grave goods was the same considering all the four assemblages together ($\delta^{13}C$ All humans select individuals without grave goods ($n = 111$) vs individuals with grave goods ($n = 85$), Mann-Whitney U test: $U = 6471.000$, $z = 4.465$, $p < 0.000$).

These data point at the importance of plants, and more specifically millets, in the definition of social status as expressed through grave goods in early medieval Iberian peasant communities. Combining all the data available, the hypothesis that, in the contexts where grave goods were a relevant feature of the funerary ritual, individuals buried with artefacts were more likely to have greater proportions of millets in their diets is reinforced. In other words, the consumption of C_4 plants made individuals more feasible to receive any grave goods in their burial. This can be read in two ways. The most immediate interpretation would be to associate the consumption of millets with social status. The relationship between these two concepts is not straightforward, but it suggests that the factors which regulated the consumption of millets were similar to the ones which configurated the funerary ritual in terms of grave goods. That is, whatever led heirs to invest in artefacts to be laid in the burial of their deceased relative, it was also relevant for the access to C_4 crops of that individual during its life. Unfortunately, with the osteoarchaeological, isotopic and contextual information currently available, it is not possible to determine if the factors which favoured the consumption of C_4 plants and propitiated the use of grave goods were age, sex, ancestry, geographic origin, religion, legal status, occupation, property or others. An alternative interpretation for the difference in the distribution of carbon stable isotope ratios between individuals with and without artefacts can be proposed based on chronology. It is known that grave goods were not used in the same way throughout the entire duration of these cemeteries, but from the 7th century on their use changed and decreased (Vigil-Escalera 2013b: 261–262). Therefore, grave goods could be understood as a chronological indicator marking the earliest burials, while individuals without any objects would preferentially correspond to the later phases of cemeteries. According to this hypothesis, millet consumption would have been prevalent approximately during the first century and a half of use of these graveyards, and it would have declined afterwards. Actually, this pattern was verified at Boadilla, the only one of the four assemblages discussed in this section where a widespread internal phasing could be established. It is likely that the two interpretations proposed in this paragraph were somehow complementary, but solving this issue is difficult without a program of high-resolution radiocarbon dating of these contexts. Although it is not possible to be more specific, the association between the consumption of millets and the use of grave goods found here is deemed relevant not only for what it means for the knowledge of early medieval peasant diet itself, but also because it looks like a pattern applicable to quite distant regions both in geographic and political terms. Then, it is worth asking if Catalan sites, where grave goods were scarce, would have also fitted in the same logics.

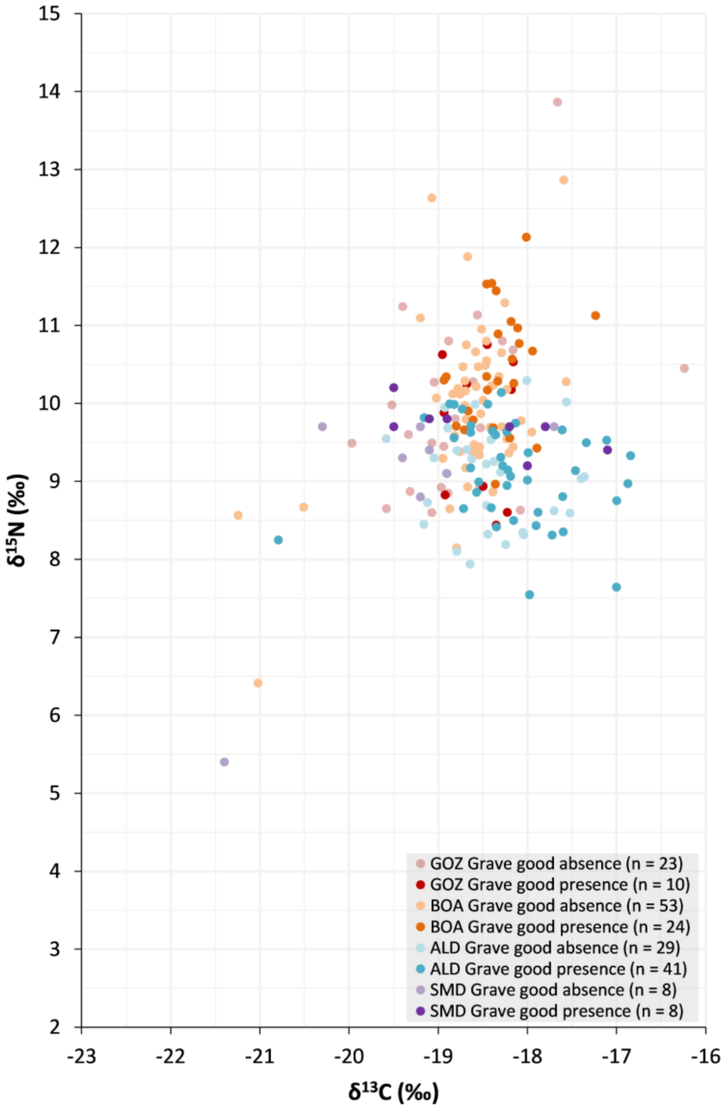


Figure 4.15. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from the cemetery of Gózquez, Boadilla, Aldaieta and the phase 4 of Dulantzi divided by presence or absence of grave goods

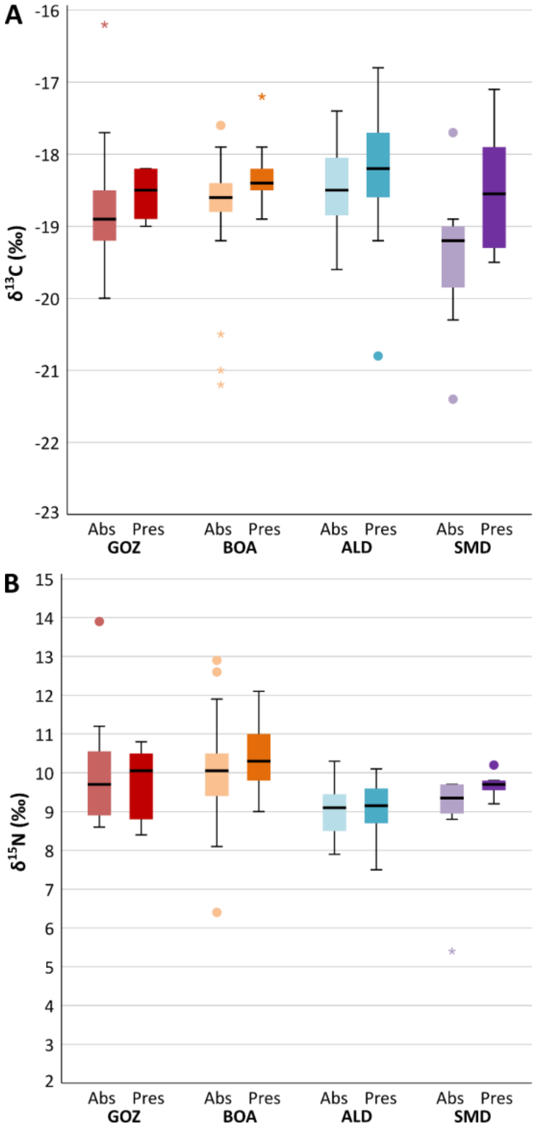


Figure 4.16. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from the cemetery of Gózquez Boadilla, Aldaieta and the phase 4 of Dulantzi divided by presence or absence of grave goods. Key: Abs = Grave good absence, Pres = Grave good presence

Contrary to the differences observed for carbon stable isotope ratios, the standard pattern in the distribution of nitrogen isotope ratios between individuals with and without grave goods was uniformity. The gaps between the mean $\delta^{15}N$ of both categories in the four assemblages considered were as small as for $\delta^{13}C$. The exception was the population of phase 4 from Dulantzi, where the mean $\delta^{15}N$ of individuals with artefacts was notably more enriched than those without, but the greater magnitude of the difference was due to an extreme outlier among individuals without artefacts. Nonetheless, what is really important is that individuals with and without grave goods were randomly distributed along the whole range of $\delta^{15}N$. Actually, the only assemblage where differences were statistically significant was Boadilla, where individuals buried with artefacts also tended towards more enriched nitrogen isotope ratios, pointing at the consumption of greater proportions of animal protein by them. Still, when individuals of the two assemblages from Madrid-Toledo were compared no statistically significant difference arose between individuals with and without grave goods ($\delta^{15}N$ Madrid-Toledo individuals without grave goods ($n = 75$) vs individuals with grave goods ($n = 35$), Mann-Whitney U test: $U = 1601.500$, $z = 1.857$, $p = 0.063$), and the result was the same for the Basque Country ($\delta^{15}N$ Basque Country individuals without grave goods ($n = 36$) vs individuals with grave goods ($n = 50$), Mann-Whitney U test: $U = 1033.000$, $z = 1.166$, $p = 0.243$), as well as for the four populations considered altogether ($\delta^{15}N$ All humans select individuals without grave goods ($n = 111$) vs individuals with grave goods ($n = 85$), Mann-Whitney U test: $U = 4712.000$, $z = -0.014$, $p = 0.989$). This means there were no general patterns in the consumption of animal protein between individuals with and without grave goods. Conversely, individuals buried in both ways had all kinds of diets in terms of intake of meat and other animal byproducts.

Hence, enriched $\delta^{15}N$ as an indicator of greater animal protein consumption, which has typically been considered a sign of high social status (Knipper *et al.* 2015), was found irrelevant in relation to the use of grave goods as part of the funerary ritual in Madrid-Toledo and the Basque Country between 6th and 8th centuries. Instead, millet intake turned out to be a key element in the relationship between diet and social status as expressed through the laying of artefacts in burials. This would be against the most common interpretation of the relationship between crops and social status, which would be based on the traditional idea that C_3 grains, such as wheat or barley, would have been more appreciated than C_4 plants (Moreno-Larrazabal *et al.* 2015, Murphy 2016). In contrast, according to the data presented, in the contexts discussed above millets seem to have been a well valued resource, regularly consumed by the same individuals displaying social status during the funerary ritual through all kinds of artefacts. Then, the identification of significant amounts of millets in the diet of an individual could be understood as an indicator of the access to a greater range of resources, which in peasant communities would have been a sign autonomy (Montanari 1979), and this is one of the meanings that grave goods might have had in these contexts.

Unfortunately, there are not many comparable case studies from Iberia published in order to verify these hypotheses under other settings. In fact, so far only five Iberian populations dated to between 5th and 8th centuries which used grave goods as a relevant component of the funerary ritual have been analysed for carbon and nitrogen stable isotope ratios. First, there is the assemblage from Plaza de la Almoina in Valencia (Alexander *et al.* 2019), which was an urban context, so it would have been very different from the rural settlements studied for this thesis. Then, there are the sites of S'Hort des Llimoners (Fuller *et al.* 2010) and Joan Planells (Alaica *et al.* 2019), both of them located in the city of Ibiza and, therefore, outside mainland Iberia and in an insular environment. La Ontavia (Salazar-García *et al.* 2013), placed in the southern Inner Plateau, would be the closest to the cases in the region of Madrid-Toledo included in this research, but the chronology of the cemetery is wider and grave goods are limited to a few rings. Lastly, there are the individuals found in the cave of Riocueva in Cantabria (Gutiérrez Cuenca & Hierro 2019 and personal communication), but it is difficult to confront this case with the rural populations tackled in this research because of the singularity of early medieval funerary contexts in caves. Indeed, it is striking that hitherto none of the great early medieval rural cemeteries in Iberia (Barroso 2018) has been the object of any isotopic study. Regardless, among the five cases known, which account for 143 individuals, no meaningful differences were detected in the distribution of either δ^{13}C or δ^{15}N between individuals with and without grave goods. This would suggest the relationship between diet and social status as materialised during the funerary ritual worked differently in the rural areas of Madrid-Toledo and the Basque Country in comparison with urban centres or the eastern region of Iberia and the Balearic islands. However, it is likely that a more systematic analysis of this kind of contexts would yield different and more nuanced results.

Conversely, in Europe many rural early medieval cemeteries with great proportions of individuals with grave goods have been the object of palaeodietary reconstruction. Actually, comparing the dietary patterns of individuals with and without artefacts was one of the driving forces of the first applications of isotopic techniques to medieval populations. Still, interestingly, after more than 75 cases studies published all around Europe, no general patterns can be detected and the connection between the laying of objects next to burials and diet has to be assessed case by case. In most instances there were no meaningful associations between carbon or nitrogen stable isotope ratios and grave goods. This is true for France (Mion 2019), Germany (Hakenbeck *et al.* 2010, Knipper *et al.* 2013, Schutkowski *et al.* 1999), Hungary (Hakenbeck *et al.* 2017, Noche-Dowdy 2015), Italy (Amorim *et al.* 2018, Iacumin *et al.* 2014, Marinato 2016, Maxwell 2019, Paladin *et al.* 2020, Salamon *et al.* 2008, Tafuri *et al.* 2018) and the UK (Beavan-Athfield & Mays 2009, Hannah *et al.* 2018, Lucy *et al.* 2009, Müldner & Richards 2007, O'Connell & Lawler 2009, Sakai 2017), which are the contemporary states with a greater number of assemblages analysed.

In the few cases where significant differences were found between the use of grave goods and isotopic signatures, they lay in the distribution of nitrogen isotope ratios and they have typically been interpreted as a correlation between the presence of artefacts in burials and their richness and the consumption of greater proportions of terrestrial animal protein. This was so in the cemeteries of Morken (Germany, Knipper *et al.* 2015), Polhill (UK, Hannah *et al.* 2018), Szólad (Hungary, Alt *et al.* 2014), where individuals with the more abundant and lavish grave goods had significantly more enriched δ^{15}N values than the individuals without any artefact. Instead, these populations were homogeneous in the distribution of δ^{13}C, so the differences in nitrogen isotope ratios were explained as the result of the privileged access to meat and other animal byproducts by the individuals buried with grave goods. The example of Berinsfield (UK, Privat *et al.* 2002) was already discussed above but it is also relevant here. In this assemblage individuals without grave good had the highest δ^{15}N values as the result of the intake of freshwater resources, while those buried with artefacts showed the lowest δ^{15}N values, since their main protein source would have been preferentially terrestrial herbivorous animals. Thus, in this context freshwater resources would have been a marker of lower social status. Only in one case carbon stable isotope ratios were correlated with grave goods. It was the cemetery of Norroy-le-Veneur (France, Vytlačil *et al.* 2018), where individuals accompanied by artefacts had notably more enriched carbon stable isotope ratios than the rest of the population. In addition, individuals with grave goods were more tightly clustered in this variable. Yet, absolute δ^{13}C values in this assemblage do not support the presence of C$_4$ crops in the diet of the population from Norroy-le-Veneur, but they point at a distinguished composition of the vegetable intake of the individuals buried with artefacts. This is the example found in the literature closest to the association between the use of grave goods in the funerary ritual and plant consumption patterns observed in early medieval rural Iberia.

4.4.2 DIET, THE LOCATION OF BURIALS AND SOCIAL EXCLUSION

The location of burials can be an alternative approach to assess social status in relation to diet. This is especially useful in the contexts where grave goods are absent, but it is also interesting to observe the interaction of these two factors in the cases where they happen to coincide. Considering the characteristics of the contexts included in this research, the proximity to the church and the exclusion from the community cemetery are the two criteria related with location that will be explored.

The placement of burials inside or outside churches was not coincidental, but it was probably regulated by the intersection of personal identity, social status and the role of the individual within the religious community. In this way, individuals of higher social status or with a more relevant position in the management of the church, such as members of the clergy, monks or nuns, would have had more chances to be buried inside the church and closer to the altar, where relics were usually guarded, making these areas more highly regarded (O'Sullivan 2013). However, other factors may also be important. For example, in some contexts fetuses and children who died shortly after birth were assigned a preferential area inside or very close to the church (Perez 2016). This has been typically thought to have been aimed at giving them special protection because they were not baptised.

Only three out of the ten sites analysed in this thesis had a contemporary church. They were Finaga and Dulantzi in the Basque Country and Sant Menna in Catalonia, which means no religious building was found in the region of Madrid-Toledo. According to the data available, all of them were founded between the 5th century and the middle of the 6th century and they were quite different from each other. The temple of Finaga was built during the 5th century using a previous 4th century mausoleum, but it is not possible to be more precise about the moment it was transformed into church. It was a small and simple construction of just 20 m^2 formed by a single nave and a square apse. The churches of Dulantzi and Sant Menna were bigger and had a more complex architecture. The building uncovered at Dulantzi had 315 m^2, which included three naves separated by columns, a squared apse, two distinguished rooms north and south of the apse and a separate baptistery. Instead, the church of Sant Menna consisted in a single nave, a square apse and a separate room which could have been a baptistery and was later transformed into a tower, with a total extension of 80 m^2.

The distribution of burials relative to the churches was also variable. No graves were found inside the church of Finaga. They were arranged around it, concentrating in the area closer to the apse, although this picture may be biased because this was also the area more intensively excavated and less affected by posterior structures. Conversely, in Dulantzi and Sant Menna burials were made both inside and outside the church, but with different balance. At Dulantzi most graves were inside the temple, more specifically in the naves and the room south of the apse, and the burials outside were restricted to the space immediately contiguous to the walls, in such a way that no funerary structure was found beyond 2.5 meters. In contrast, at Sant Menna most graves were outside the building. Burials inside the church were only made during the first century and a half of use of the temple, so after the 7th century all graves were placed outside. Besides, the vast majority of the individuals inside the church were subadults, namely fetuses and infans 1A. In the case of Sant Menna, the outer cemetery spread out around the whole perimeter of the building up to 20 meters from it.

Focusing on the relationship between diet and the location of burials relative to religious buildings, no significant differences were found in any of the three cases considered in the distributions of carbon and nitrogen stable isotope ratios between the individuals inside and outside the churches or located in different areas of the respective cemeteries. The human assemblage from Finaga was not only small, but also extremely homogeneous, so it was difficult to find any internal differences and both the individuals in direct contact with the apse and those in the second row had comparable isotopic signatures. The greater sample size from Dulantzi allowed for a more nuanced analysis. This population was characterised by the great range of $\delta^{13}C$ values, but individuals inside and outside the temple showed comparable variability, which means the proportions of C_3 and C_4 plants consumed were not associated with the location of an individual's grave. In other words, the factors which regulated the access to specific crops were unrelated with the features which determined the positioning of burials. At Sant Menna the number of individuals valid for palaeodietary reconstruction was also small and only two individuals from inside the church could be successfully analysed, both of them younger than age 2 at the time of death. Then, it was very difficult to compare the diets of individuals from inner and outer burial spaces. Still, restricting the sample to subadults, the distributions of carbon and nitrogen stable isotope ratios from both areas were virtually indistinguishable, and no differences were observed either within the whole population according to the distance to the building. All in all, it seems that at least in the sites analysed here the proximity to the church was not associated with diet or, in case there were differences in food consumption patterns between individuals buried inside, outside, closer or further from the temples, they were undetectable isotopically. This is not to say that social status had nothing to do with the location of graves in the cemeteries associated to churches; but it means that, as it was verified in Dulantzi, carbon and nitrogen stable isotope ratios are not useful to approach the relationship between the arrangement of burials and individual social status in these early medieval rural communities.

A number of contemporary populations buried around and inside churches have been the object of palaeodietary reconstruction both in Iberia (Guede, Ortega, Zuluaga, Alonso-Olazabal, Murelaga, Solaun, *et al.* 2017, Jordana *et al.* 2019, Saragoça *et al.* 2016), Europe (Bourbou *et al.* 2011, Kline 2015, Lightfoot *et al.* 2012, Maxwell 2019, Mion 2019) and the Middle East (Gregoricka & Sheridan 2013, Sandias & Müldner 2015), but the variable of the location of graves has not been thoroughly explored. Yet, there is an interesting precedent in Asturias (MacKinnon *et al.* 2019), where the relationship between social status and diet throughout the Middle and Modern Ages was systematically analysed in eight contexts. The research was grounded on the idea that graves inside churches would have belonged to individuals of higher social status than those outside and these individuals would have had higher $\delta^{15}N$ values, because they would have eaten greater proportions of animal protein in comparison to those buried outside. Interestingly, no meaningful differences were spotted in the distribution of nitrogen isotope ratios between both groups. Instead, a statistically significant difference between individuals inside and outside churches was found on $\delta^{13}C$, according to which those buried indoors tended towards more enriched carbon stable isotope ratios. Therefore, higher social status individuals buried inside churches would have had easier access to C_4 plants than those placed outside temples, underlining the role of millets in the definition of social status during the Early Middle Ages, as it was already suggested by the relationship between diet and grave goods (see section 4.4.1). Summing up, although most of the cases gathered in this study about Asturias are posterior to the populations chosen for this thesis and the dataset is quite heterogeneous, the conclusions are relevant because they do not only demonstrate the potential of spatial analysis in palaeodietary reconstruction, but they also confirm the role of C_4 plants as a distinctive foodstuff during the Middle Ages.

There is another connection between the location of burials and diet that can be explored in order to try to understand the social organisation of early medieval Iberian rural communities, and it revolves around the individuals found in non-normative funerary contexts outside community cemeteries. During the last two decades the proliferation in Spain of archaeological interventions on large areas has resulted in the identification of a growing corpus of rural settlement dated to between 6th and 8th centuries where, in addition to the conventional community cemetery, there were a small number of individuals disposed of without any proper funerary treatment in reused structures, such as silos or wells, scattered around residential or productive boroughs (Roig 2015: 369–389, Vigil-Escalera 2013a). These should not to be confused with isolated burials where there is some evidence of funerary ritual, for instance, the neat laying of the corpse, although sometimes it may be difficult to distinguish both phenomena due to taphonomic processes or the reduced size of some interventions.

Among the sites which make up this thesis, three of them yielded some type of deviant funerary context. They were Gózquez, in the region of Madrid-Toledo, and Can Gambús and Sant Menna, in Catalonia. At Gózquez the majority of the population was buried in the community cemetery, but eleven individuals were found in three silos in the eastern neighbourhood of the village. One of the silos was occupied by a single individual and the other two held five individuals each. All of them were in unnatural positions, indicating they were thrown with little care into the storage pits. At Can Gambús too most individuals were buried in the community cemetery. Besides, there were five structures with human remains in primary position scattered around the settlement. One of them was an isolated burial in a simple pit grave where the individual was given the same treatment as those in the main graveyard. The other ones were a well with two individuals and three silos, two of them with two individuals each and the last one with a single individual. In all the cases except one they were in abnormal positions, result of having being thrown from the edge of the silos or the well. The case of Sant Menna is different. Here only the church and the space immediately around it were excavated, so there is little evidence about domestic and productive structures. The conventional cemetery developed around the temple, which coexisted with a few silos. One of these storage pits, surrounded by earlier, contemporary and later graves, was reused to hold the burial of an individual. However, instead of being thrown into it, it was bent into fetal position to make it fit into the silo, a quite unusual arrangement in medieval contexts that was not observed in any other adult burials in the site. It is worth noting the absence of this type of funerary evidence in the Basque Country, where large archaeological interventions in early medieval sites are still rare. Actually, it is not possible to dismiss the existence of non-normative human deposits in the sites where significant portions of settlement areas were not excavated. Therefore, it cannot be ruled out that the cemeteries of Boadilla, Aldaieta, Finaga or Dulantzi also coincided with some kind of deviant burials. Thus, it is likely that the real importance of this phenomenon is underrepresented.

Table 4.14. Summary statistics of carbon (δ^{13}C) and nitrogen (δ^{15}N) stable isotope ratios of the human assemblages useful for the discussion of social exclusion: Gózquez and Can Gambús

	n	*δ^{13}C (‰)*					*δ^{15}N (‰)*				
		Mean	*SD*	*Min*	*Max*	*Range*	*Mean*	*SD*	*Min*	*Max*	*Range*
GOZ	38	-18.7	0.6	-20.0	-16.2	3.8	10.0	1.1	8.4	13.9	5.5
Cemetery	33	-18.7	0.7	-20.0	-16.2	3.8	9.9	1.1	8.4	13.9	5.5
Settlement	5	-18.8	0.3	-19.1	-18.5	0.6	10.6	0.7	10.1	11.5	1.4
CG	16	-19.3	0.7	-20.7	-18.3	2.4	9.6	0.6	8.5	10.6	2.1
Cemetery	11	-19.2	0.7	-20.7	-18.3	2.4	9.7	0.6	8.6	10.6	2.0
Settlement	5	-19.3	0.5	-20.2	-18.8	1.4	9.4	0.4	0.6	8.5	1.5

The small number of individuals recovered in settlements relative to those in the corresponding cemeteries complicated the comparison of dietary patterns between both groups. In addition, Catalan sites were affected by very poor collagen preservation. This meant the only individual in a silo from Sant Menna could not be successfully analysed. Then, the entire site had to be cut off from this discussion. Moreover, just one third of the individuals sampled in the cemetery of Can Gambús had well preserved collagen. Nevertheless, carbon and nitrogen stable isotope ratios of a good number of individuals from both the cemetery and the settlement of Gózquez and Can Gambús could be compared (table 4.14, figure 4.17, figure 4.18) and no meaningful differences were found between them. Actually, the differences were bigger between sites than between assemblages. The gap between the mean δ^{13}C of individuals buried in the cemetery and those in the settlement was just 0.1‰ both at Gózquez and Can Gambús, and 0.7‰ and 0.3‰ respectively for δ^{15}N. The greater difference between the two assemblages from Gózquez on nitrogen isotope ratios was due to the fact that all the individuals from the settlement analysed were subadults, which also tended towards more enriched δ^{15}N values in the graveyard. In fact, the mean δ^{15}N of the subadults from the cemetery of Gózquez was exactly the same as the individuals buried in the settlement. Most of the individuals from the settlement of Can Gambús valid for palaeodietary reconstruction were also subadults. Unfortunately, it was not possible to compare them directly with the subadults from the cemetery because only one individual of this age category could be successfully analysed in that assemblage.

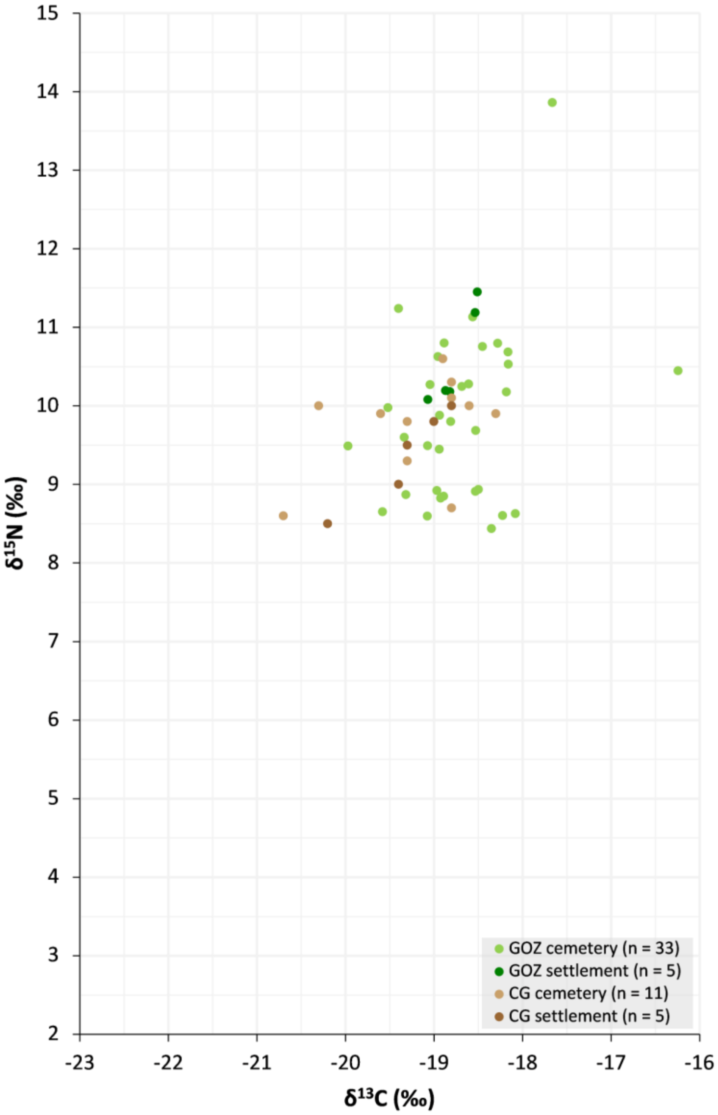


Figure 4.17. Scatterplot of carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of humans from Gózquez and Can Gambús divided by the location of burials

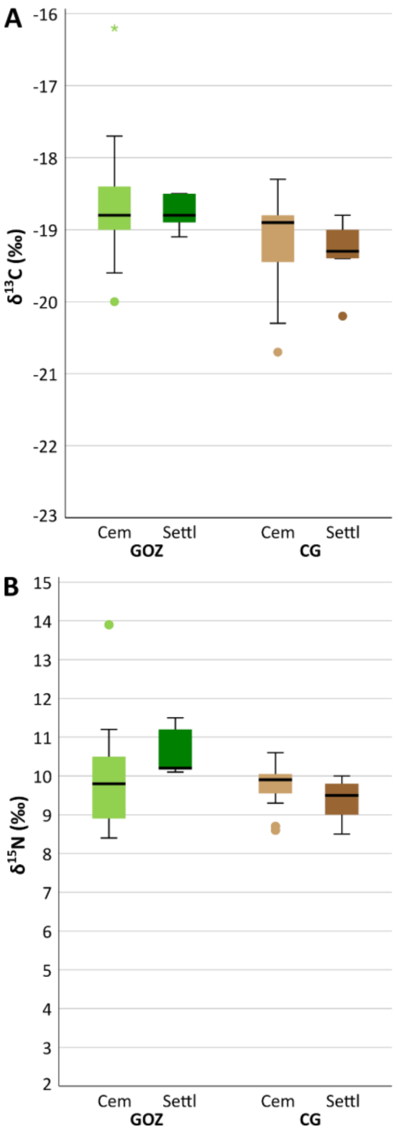


Figure 4.18. Boxplots representing (A) carbon stable isotope ratios ($\delta^{13}C$) and (B) nitrogen isotope ratios ($\delta^{15}N$) of humans from Gózquez and Can Gambús divided by the location of burials. Key: Cem = Cemetery, Settl = Settlement

According to these data, differences in diet were smaller between the individuals buried in the same site than between those who had a similar treatment at death. That is, the dietary patterns of individuals in non-normative funerary contexts were not substantially different from the populations buried in community cemeteries, at least in their main components. It is possible that there were variations in the abundance, the quality or the preparation of products, but the access to equivalent proportions of diverse types of crops or animal protein by most of the individuals from the same site, regardless the funerary treatment they received, points at quite a homogeneous diet across all the individuals within a village. Therefore, even if it is clear that the individuals scattered around residential and productive areas were marginalised at the time of death, palaeodietary reconstruction suggests they were not excluded at such an important element of daily life as eating. This may be interpreted as evidence of the fact that they were integrated into the same domestic units as the individuals buried in the cemetery.

None of these data clear up indisputably the identity of the individuals in these deviant contexts. The initial hypothesis that they were slaves or some kind of dependent workers with a different legal status (Roig & Coll 2011) is not confirmed, but it cannot be rejected either, since there is no grounds to assume that slaves would have had a clearly distinct diet. Age seems to have played a significant role in the identity of the individuals excluded from the community cemetery, as both at Gózquez and Can Gambús subadults were proportionately considerably more abundant in the settlements than in the cemeteries. Still, this may be an artefact of the sites selected for study (Roig 2015: 374). All things considered, it is clear that the individuals thrown into silos and wells were not considered full members of the social and political community represented in the cemetery and exclusion was highlighted by the denial of a decorous funerary treatment (Vigil-Escalera 2013a, Vigil-Escalera 2016). In this setting, carbon and nitrogen stable isotope analyses are unable to determine the specific causes of this segregation, but they have demonstrated that the food consumption patterns of the individuals marginalised in death were quite similar to the rest of the inhabitants in the same village, nuancing their otherness and adding complexity to the social organisation of these otherwise homogeneous rural communities.

This thesis is the first study that tackles the diet of these atypical funerary contexts in early medieval Iberia, so there is no previous data to compare the results. No similar contemporary contexts have been published in Europe either and, although other forms of social exclusion at death are known (Reynolds 2009), it is not really a frequent topic in the literature about diet during Early Middle Ages. The closest example is the case of Flakstad, in Norway (Naumann *et al.* 2014). The site, dated to between 9th and 11th centuries, was formed by three individual and three multiple graves. The latter were remarkable because in every case they were formed by one regular individual and the other one or two individuals were headless. The interpretation given by the authors was that the intact individuals in the multiple burials were high status personalities accompanied by beheaded slaves offered to them as grave goods. The individuals in the single graves would represent the common population. Then, dietary patterns between the three groups were compared and they concluded there were no relevant differences between the decapitated slaves and the individuals in single graves. Both groups had diets rich in marine resources, easily accessible products in northern Scandinavia. Instead, individuals with head in collective burials relied heavily on terrestrial protein. Despite the geographic and chronological distance between Flakstad and Gózquez or Can Gambús, this parallel is interesting because it brings to light that differences lay in the comparison between really high status individuals and the rest of the population, but dietary patterns of common individuals and slaves were indistinguishable. Similarly, there are several cases in south-eastern Germany where two types of funerary contexts which occurred simultaneously between 7th and 9th centuries were compared (Czermak 2011, Strott *et al.* 2008). These sites were made up of a conventional cemetery normally organised in rows, where the common population is assumed to have been buried, and the so-called separate burials, clusters of distinguished graves often enclosed by ditches and interpreted as privileged burial grounds for the elites. Carbon and nitrogen stable isotope ratios were measured on individuals from both types of cemeteries in five similar sites. Still, data yielded opposing results. It was determined that at Etting-Sandfeld, Grossmehring and Unteriegling-Loibachanger the individuals from separate burials had significantly higher $\delta^{15}N$ values than those in conventional cemeteries, pointing at the consumption of greater proportions of animal protein by the former. Conversely, at Kelheim-Kanal I and Bruckmühl no differences in the distributions of nitrogen isotope ratios were detected between individuals in the regular graveyard and the separate cemetery. These examples, which were synchronous and close both geographic and culturally, expose the heterogeneity and complexity of early medieval rural communities and warn against the use of simplistic interpretations such as the correlation between enriched $\delta^{15}N$, great animal protein consumption and high social status.

4.5 EARLY MEDIEVAL PEASANT DIET IN IBERIA IN CONTEXT

The aim of this section is to contextualise the new information about the diet of early medieval Iberian rural communities obtained in this research in light of the data available from relatable sites in chronological and geographic terms based on publications and grey literature. On one hand, the fauna and human assemblages analysed as part of this thesis were compared with the case studies known for Iberia and the Balearic islands dated to the first millennium AD in order to understand the diachronic evolution of dietary patterns in the long term in three regions tackled here and those surrounding them. On the other, the diet of the Iberian early medieval communities were put alongside all the contemporary populations with palaeodietary reconstructions that could be found in Europe and the whole Mediterranean basin, including the Middle East and northern Africa. This search was restricted to early medieval contexts, that is, to the period between 5th and 10th centuries approximately. For these purposes, publications, theses and unpublished reports were consulted. Accessibility and language were the two major constraints. A few works whose references were known could not be looked up because they were unpublished or hosted in archives that could not be reached. Likewise, this review was limited to the researches presented in the languages understood by the author, namely Spanish, English, French, Italian and German. It is also worth noting that the data collected for these comparative surveys were not subjected to the same collagen quality criteria as the individuals analysed expressly for this thesis, but the standards proposed by each author were maintained, so it has to be acknowledged that individuals assessed differently are considered together. Besides, when assemblages were compared with each other, their size was disregarded. As a consequence, smaller datasets will be overrepresented and *vice versa*.

Figure 4.19 and figure 4.20 represent the spatial distribution of all human populations (table 7.13) and fauna assemblages (table 7.14) with carbon and nitrogen stable isotope analyses known in Iberia dated to between 1st and 10th centuries broken down by large geographic areas and chronological phases. The territory was divided into five areas, namely north-western, north-eastern, central, eastern and southern Iberia. These partitions were designed with the aim of creating the most consistent groups based on the existing datasets, but they do not necessarily respond to geographically or historically meaningful areas. Actually, it is likely that in the future, when new case studies are added, they will have to be redefined. Regarding chronology, three main phases were established: Roman age, between 1st and 5th centuries; first half of Early Middle Ages, between 5th and 8th centuries, and second half of Early Middle Ages, between 8th and 10th centuries. However, some datasets did not fit in only one of them so intermediate categories were used when necessary. Altogether 47 human and 30 fauna assemblages were recorded, accounting for a total of 861 human individuals and 306 fauna specimens.

Some interesting observations were noticeable at first glance. The spatial distribution of case studies across Iberia is very uneven. There are large spaces, especially in the Inner Plateau, the Baetic depression and the Portuguese Atlantic façade, with hardly any site analysed. Instead, many cases concentrated in quite restricted zones, such as the area around Madrid, the Basque Country and the surroundings of Barcelona. These clusters coincided with the regions analysed in this thesis, as the fifteen human assemblages and the eight fauna datasets that form it are quantitatively the greatest contribution to the study of diet during the first millennium AD in Iberia. Thus, north-western Iberia is clearly the zone with the greatest concentration of Roman and early medieval populations with palaeodietary reconstructions, followed by the north-eastern and central areas of the peninsula. Conversely, case studies in eastern and southern Iberia are scarcer and scattered. Sites with carbon and nitrogen stable isotope analyses were not homogeneously distributed in chronological terms either. The Roman period was the worst represented. This was possibly related to the fact that for a great part of the period individuals were cremated, so skeletal remains are more difficult to identify and recover and bone collagen is rarely preserved (Mays *et al.* 2013). The first half of Early Middle Ages was the phase with the greatest set of case studies. The second half of Early Middle Ages was illustrated by a smaller number of human and fauna assemblages, still it was quite well-represented.

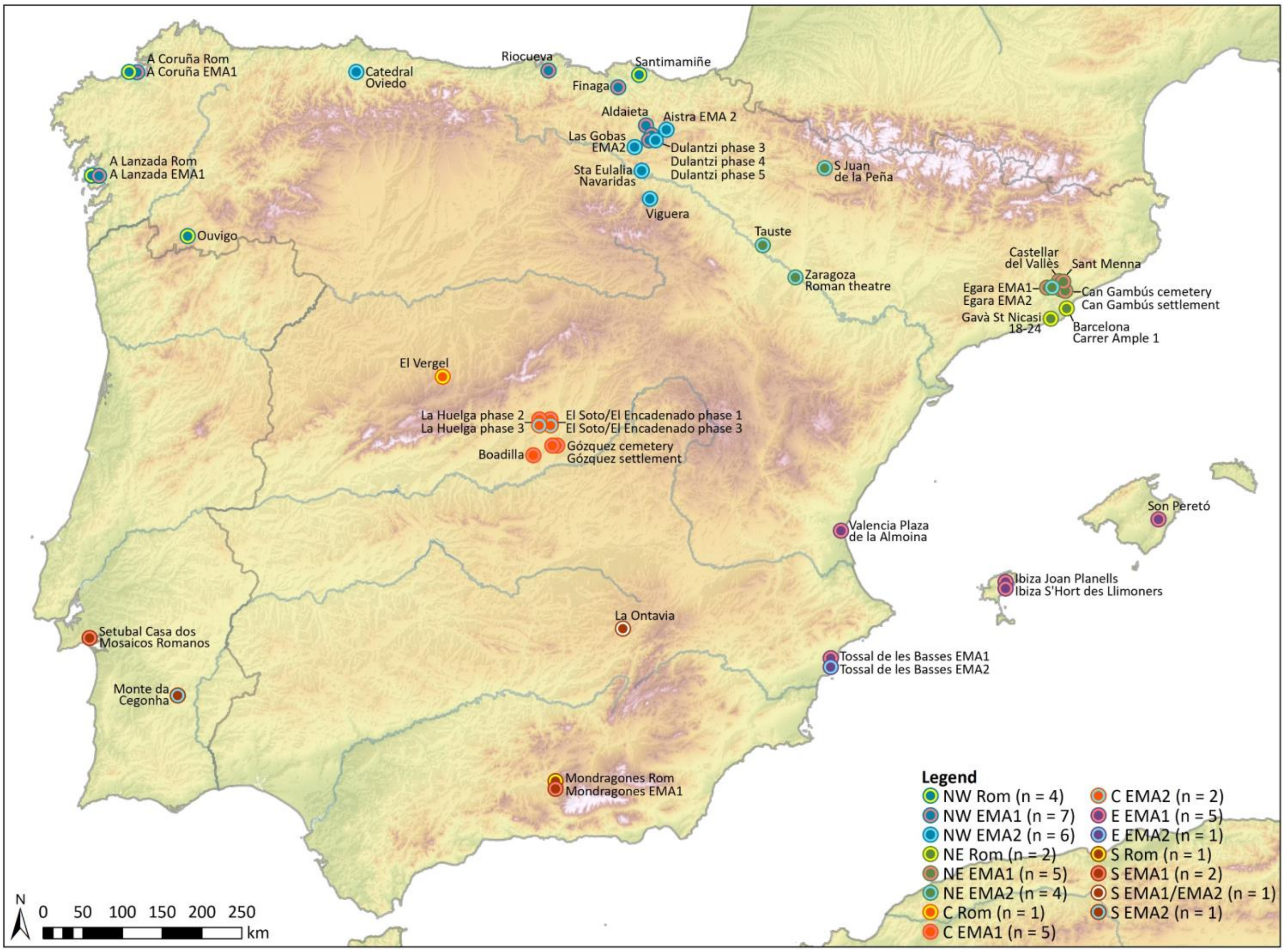


Figure 4.19. Geographic distribution of all the human assemblages in Iberia dated to between 1st and 10th c. where carbon and nitrogen stable isotope analyses have been performed grouped by large geographic areas. References and more detailed data can be consulted in table 7.13. Key: NW = north-western Iberia, NE = north-eastern Iberia, C = central Iberia, E = eastern Iberia, S = southern Iberia, Rom = Roman age (1st-5th c.), EMA1 = first half of Early Middle Ages (5th-8th c.), EMA2 = second half of Early Middle Ages (8th-10th c.)

Despite internal diversity, which has to be discussed on a case to case basis, food consumption patterns in Roman and early medieval Iberia were quite homogeneous. Figure 4.21A, figure 4.22 and figure 4.23 represent the dispersion of mean carbon and nitrogen stable isotope ratios of human and fauna assemblages grouped by large geographic areas considering only adults and domestic herbivores respectively. Datasets were narrowed down to these categories in order to avoid the variability that subadults and omnivores, carnivores or wildlife could introduce. As a result, a few assemblages formed only by these groups were excluded from graphs. Diets were predominantly terrestrial and they were largely based on C_3 resources with different contributions of C_4 plants. North-western fauna and human assemblages were the most heterogeneous on both $\delta^{13}C$ and $\delta^{15}N$ not only because it was the zone with the greatest number of case studies, but also because some diets in this area included significant proportions of millets and marine resources. Variability in the other areas was significantly smaller, although there were outliers in all the human assemblages.

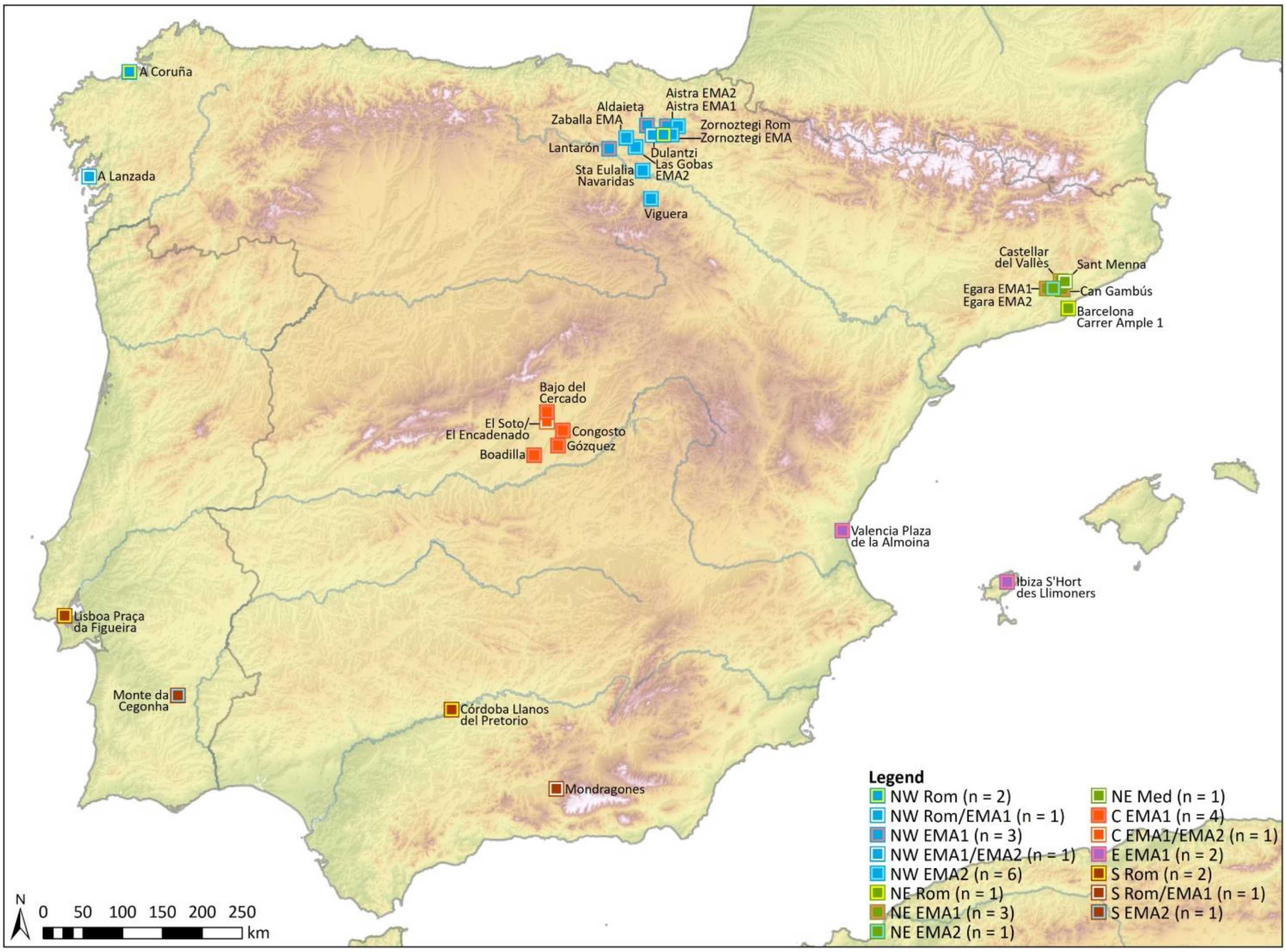


Figure 4.20. Geographic distribution of all the fauna assemblages in Iberia dated to between 1st and 10th c. where carbon and nitrogen stable isotope analyses have been performed grouped by large geographic areas. References and more detailed data can be consulted in table 7.14. Key: NW = north-western Iberia, NE = north-eastern Iberia, C = central Iberia, E = eastern Iberia, S = southern Iberia, Rom = Roman age (1st-5th c.), EMA1 = first half of Early Middle Ages (5th-8th c.), EMA2 = second half of Early Middle Ages (8th-10th c.), Med = Middle Ages (5th-15th c.)

As indicated by carbon stable isotope ratios, domestic herbivores were mainly fed on C_3 plants in all areas and just in a few cases was there evidence of certain specimens supplemented with C_4 plants, but apparently the use of millets as fodder did not respond to a regional trend. Mean nitrogen isotope ratios of domestic herbivores were considerably more variable, since probably they were reflecting the differences in local isotopic baselines between different zones. The assemblages from central Iberia stood out for their enriched δ^{15}N values, which points at intensive manuring through the access of livestock to harvested fields (see section 4.1.4). Such high nitrogen isotope ratios were not verified in any of the other zones, supporting the idea that this was possibly a specificity of early medieval agrarian practices in the territories closer to Toledo.

Human diets were very homogeneous across regions, especially concerning carbon stable isotope ratios. Most adult assemblages were tightly clustered around the limit between exclusively C_3 diets and C_3 diets with small but regular intake of C_4 plants. Still, around a third of north-western datasets, as well as one from central Iberia and another one from the south, showed very enriched δ^{13}C mean values. The cases of A Lanzada Rom, A Lanzada EMA1 and Setúbal Casa dos Mosaicos Romanos were interpreted as the result of the regular intake of marine products, as their nitrogen isotope ratios were enriched too. The fact that both sites are located right on the Atlantic coast is most likely not a coincidence, but there are not enough data from the Atlantic shoreline to confirm if this was a generalised trend in this area. The remaining cases with enriched δ^{13}C mean values were explained by the consumption of great proportions of millets. Then, it can be suggested that the north-west was the Iberian region where C_4 plants had the most relevant role in human diet during Roman and early medieval periods, a hypothesis that was already formulated based on the results of the early medieval Basque sites analysed for this thesis (see section 4.2.1). In general terms, animal protein intake, as understood from mean nitrogen isotope ratios, ranged between moderate in central and southern Iberian populations and abundant in north-western, north-eastern and eastern zones. Nevertheless, this joint assessment obscures variability within regions, which in some instances was quite important (see section 4.2.2). Therefore, in this specific case comparison between large geographic areas may not be appropriate.

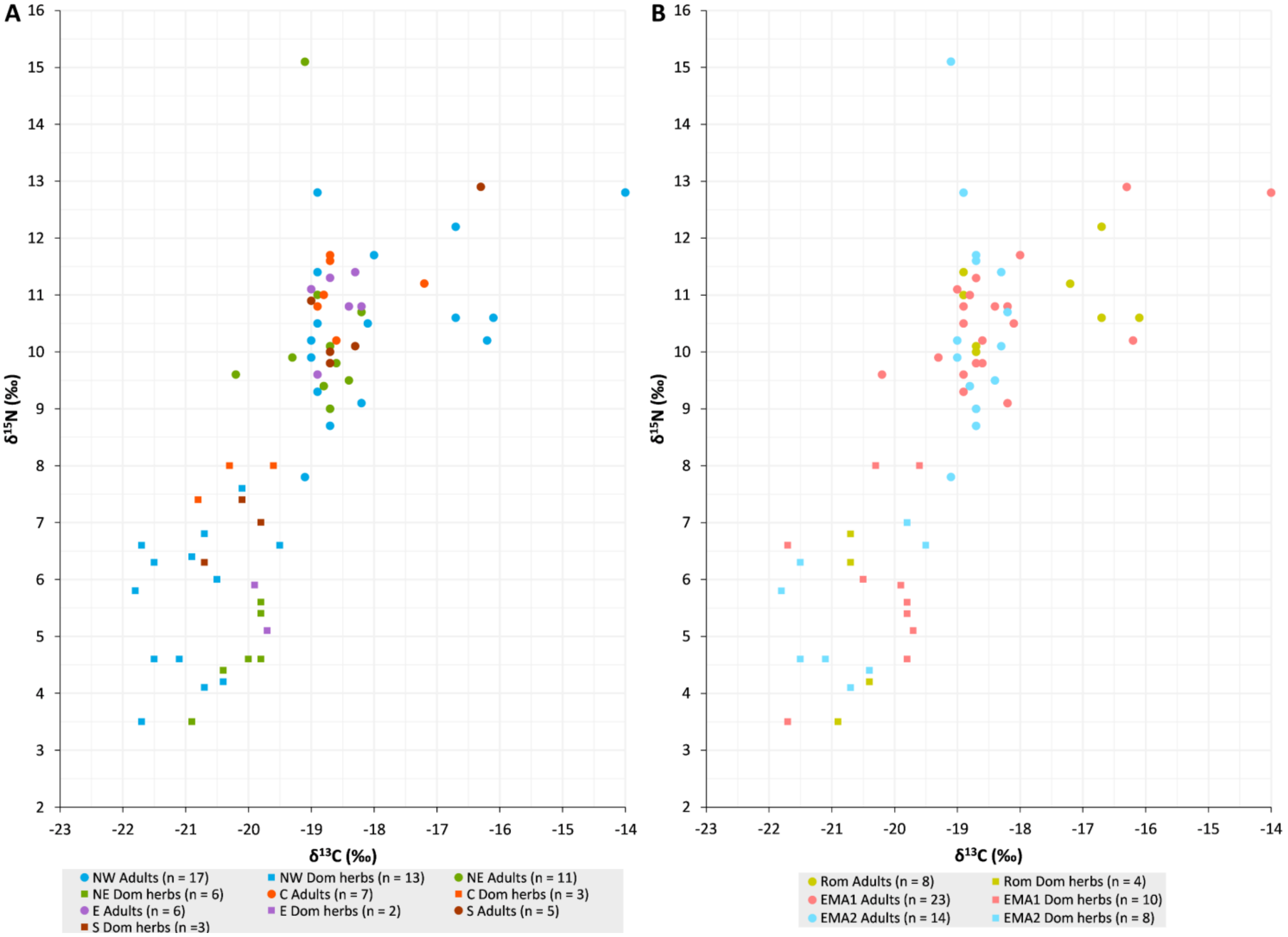


Figure 4.21. Scatterplot of mean carbon (δ^{13}C) and nitrogen stable isotope ratios (δ^{15}N) of adults and domestic herbivores of all human and fauna assemblages in Iberia dated to between 1st and 10th c. grouped by (A) large geographic areas and (B) chronological phases. References and more detailed data can be consulted in table 7.13 and table 7.14. Key: NW = north-western Iberia, NE = north-eastern Iberia, C = central Iberia, E = eastern Iberia, S = southern Iberia, Rom = Roman age (1st-5th c.), EMA1 = first half of Early Middle Ages (5th-8th c.), EMA2 = second half of Early Middle Ages (8th-10th c.)

The data available can also be used to analyse diet in Iberia from the Roman period to Early Middle Ages from a diachronic perspective. As it can be observed in figure 4.21B, figure 4.24 and figure 4.25, there were no clear differences between the three phases defined, but a more detailed examination reveals some interesting findings. Contrary to what happened in the comparison between regions, domestic herbivores showed greater variability on carbon stable isotope ratios than on nitrogen isotope ratios. This was due to the specimens dated to the first half of Early Middle Ages, which had the most enriched mean δ^{13}C values. That is, between 5th and

8th centuries domestic herbivores were fed with C_4 plants more frequently than during previous or later phases. Actually, all Roman domestic herbivores had exclusive C_3 feeding regimes. Instead, during the second half of Early Middle Ages there were a few assemblages where certain specimens might have been fed with small proportions of millets, but they would have meant an exception and the difference with the former phase was clear. In contrast, the distribution of nitrogen isotope ratios was more homogeneous between phases. This was not because all contemporary domestic herbivore assemblages had the same mean $\delta^{15}N$ values, but because variability was equally distributed among the three periods, which proves differences lay in geographic location as the key factor in the definition of local nitrogen isotopic baselines.

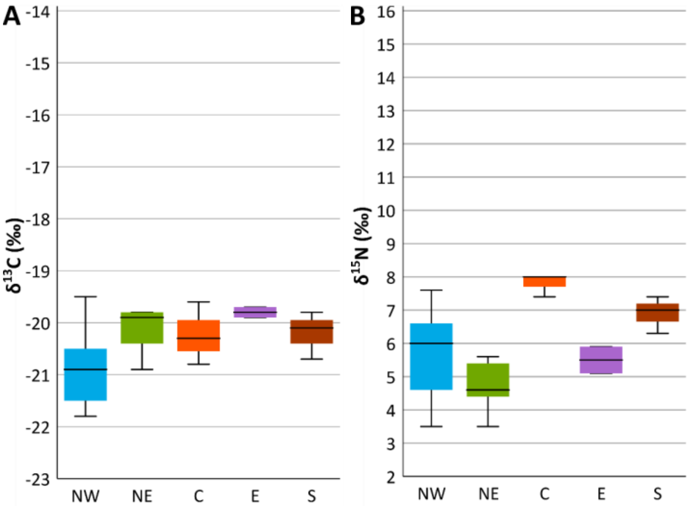


Figure 4.22. Boxplots representing mean (A) carbon ($\delta^{13}C$) and (B) nitrogen stable isotope ratios ($\delta^{15}N$) of domestic herbivores of all fauna assemblages in Iberia dated to between 1st and 10th c. grouped by large geographic areas. References ad more detailed data can be consulted in table 7.14. Key: NW = north-western Iberia, NE = north-easter Iberia, C = central Iberia, E = eastern Iberia, S = southern Iberia

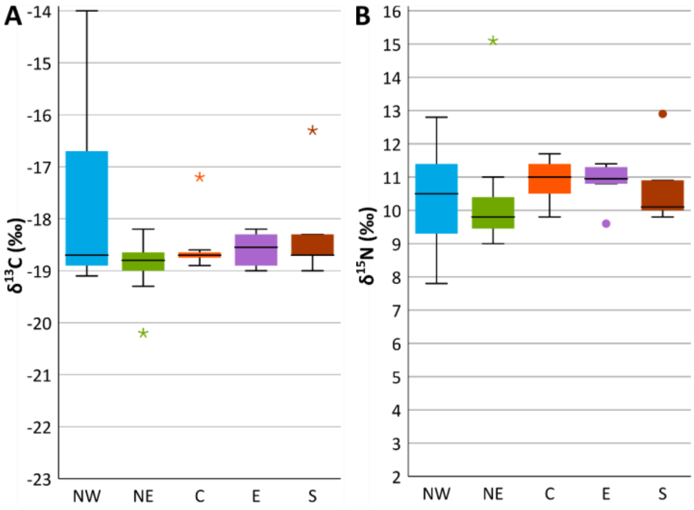


Figure 4.23. Boxplots representing mean (A) carbon ($\delta^{13}C$) and (B) nitrogen stable isotope ratios ($\delta^{15}N$) of adults of all human assemblages in Iberia dated to between 1st and 10th c. grouped by large geographic areas. References ad more detailed data can be consulted in table 7.13. Key: NW = north-western Iberia, NE = north-easter Iberia, C = central Iberia, E = eastern Iberia, S = southern Iberia

Human diets were also quite stable over time, but some weak trends were noticeable. Mean carbon stable isotope ratios experienced a homogenisation throughout the three phases, while mean nitrogen isotope ratios increased in variability progressively. The wide spread of mean $\delta^{13}C$ values during the Roman age was due to the coincidence of assemblages consuming products with very diverse carbon stable isotope ratios. Diets were mainly based on C_3 resources, but C_4 plant intake was also significant in some populations and at least the case of A Coruña Rom pointed clearly at the consumption of marine resources. During the first half of Early Middle Ages the same three carbon sources, namely C_3 plants, C_4 plants and marine products, were still present in Iberian diets. Most populations were clustered around the mean $\delta^{13}C$ values in the boundary between entirely C_3 and mixed C_3-C_4 diets, so this would have been the predominant dietary regime. However, there was a small number of human assemblages that stood out for their enriched mean carbon stable isotope ratios. In the cases of A Lanzada EMA1 and Setúbal Casa dos Mosaicos Romanos it was interpreted as the result of the consumption of great proportions of marine protein, because their mean $\delta^{15}N$ values were also very high. Nevertheless, carbon stable isotope ratios of the adults from A Lanzada EMA1 were so enriched that it is likely they also got considerable proportions of millets in diet. The other adult assemblage of this period with very high mean $\delta^{13}C$ was Riocueva, where individuals probably had greater proportions of C_4 plants than any other of the contemporary populations in the region. During the second half of Early Middle Ages the process of homogenisation of carbon stable isotope ratios was accentuated. All the datasets were in the same range as the majority of the individuals from the previous phase, which confirms the consolidation of diets largely made up of C_3 resources with small but regular intake of C_4 plants. The absence of adult assemblages with extremely enriched mean $\delta^{13}C$ values indicates diets with great contribution of millets or marine products disappeared after the 8th century. Yet, the lack of evidence about the consumption of marine resources during the second half of Early Middle Ages could be biased by the unavailability of human populations subjected to palaeodietary reconstruction dated to this phase in the Atlantic coast.

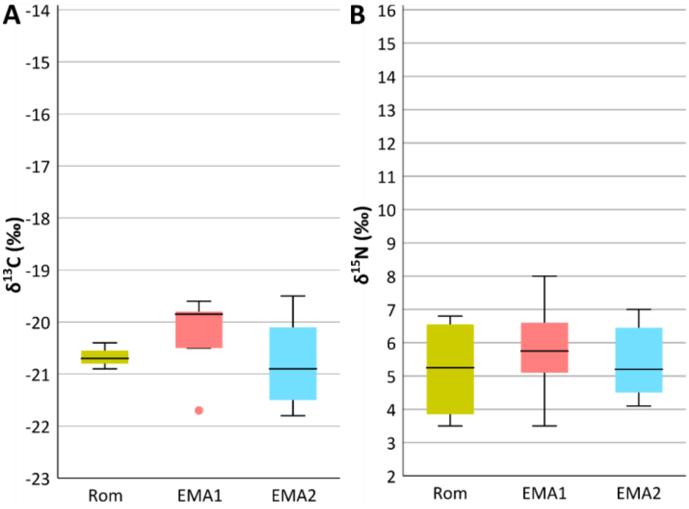


Figure 4.24. Boxplots representing mean (A) carbon ($\delta^{13}C$) and (B) nitrogen stable isotope ratios ($\delta^{15}N$) of domestic herbivores of all fauna assemblages in Iberia dated to between 1st and 10th c. grouped by chronological phases. References ad more detailed data can be consulted in table 7.14. Key: Rom = Roman age (1st-5th c.), EMA1 = first half of Early Middle Ages (5th-8th c.), EMA2 = second half of Early Middle Ages (8th-10th c.)

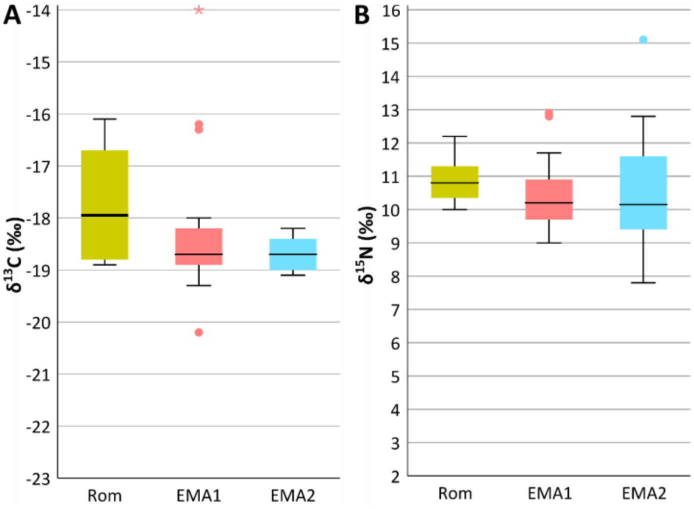


Figure 4.25. Boxplots representing mean (A) carbon ($\delta^{13}C$) and (B) nitrogen stable isotope ratios ($\delta^{15}N$) of adults of all human assemblages in Iberia dated to between 1st and 10th c. grouped by chronological phases. References ad more detailed data can be consulted in table 7.13. Key: Rom = Roman age (1st-5th c.), EMA1 = first half of Early Middle Ages (5th-8th c.), EMA2 = second half of Early Middle Ages (8th-10th c.)

Nitrogen isotope ratios underwent the opposite process. Mean $\delta^{15}N$ values of Roman adults were quite homogeneous and they clustered in the upper half of the range for all the assemblages recorded, pointing at the consumption of great proportions of animal protein and marine resources, as already revealed by carbon stable isotope ratios. During the first half of Early Middle Ages adult mean nitrogen isotope ratios tended towards lower values, which suggests there was a general reduction in animal protein intake and marine resources too lost importance. Simultaneously the range of mean $\delta^{15}N$ values increased significantly both upwards and downwards. This meant that between 5th and 8th centuries animal protein consumption became more variable and populations with very restricted intake of animal products coexisted with others where these resources were readily available. The case studies analysed for this thesis are good examples of this contrasting situation (see section 4.2.2), which can also be extended to other contemporary Iberian case studies. During the second half of Early Middle Ages this trend became more apparent. Mean nitrogen isotope ratios of most adult assemblages were around the same values as in the previous phase, but there were a few cases with even more extreme figures. Thus, it is confirmed that Iberian early medieval communities had very different animal protein consumption levels, although the keys to understand this variability are still unclear.

Unfortunately, none of the Iberian case studies allowed to observe the evolution of diet along the three phases, but in the few instances where a site covered more than one period no big differences were noticed between them. For example, A Lanzada showed evidence of the consumption of marine resources both during the Roman age and the first half of Early Middle Ages. Likewise, early medieval populations such as Dulantzi El Soto/El Encadenado or Egara, which encompassed both phases, did not exhibit significant differences in terms of the type of crops consumed or animal protein intake either. This suggests that, despite the dietary trends dictated by the changing social and political conditions in each phase, location was still the main factor determining the availability of food resources and the configuration of local diets.

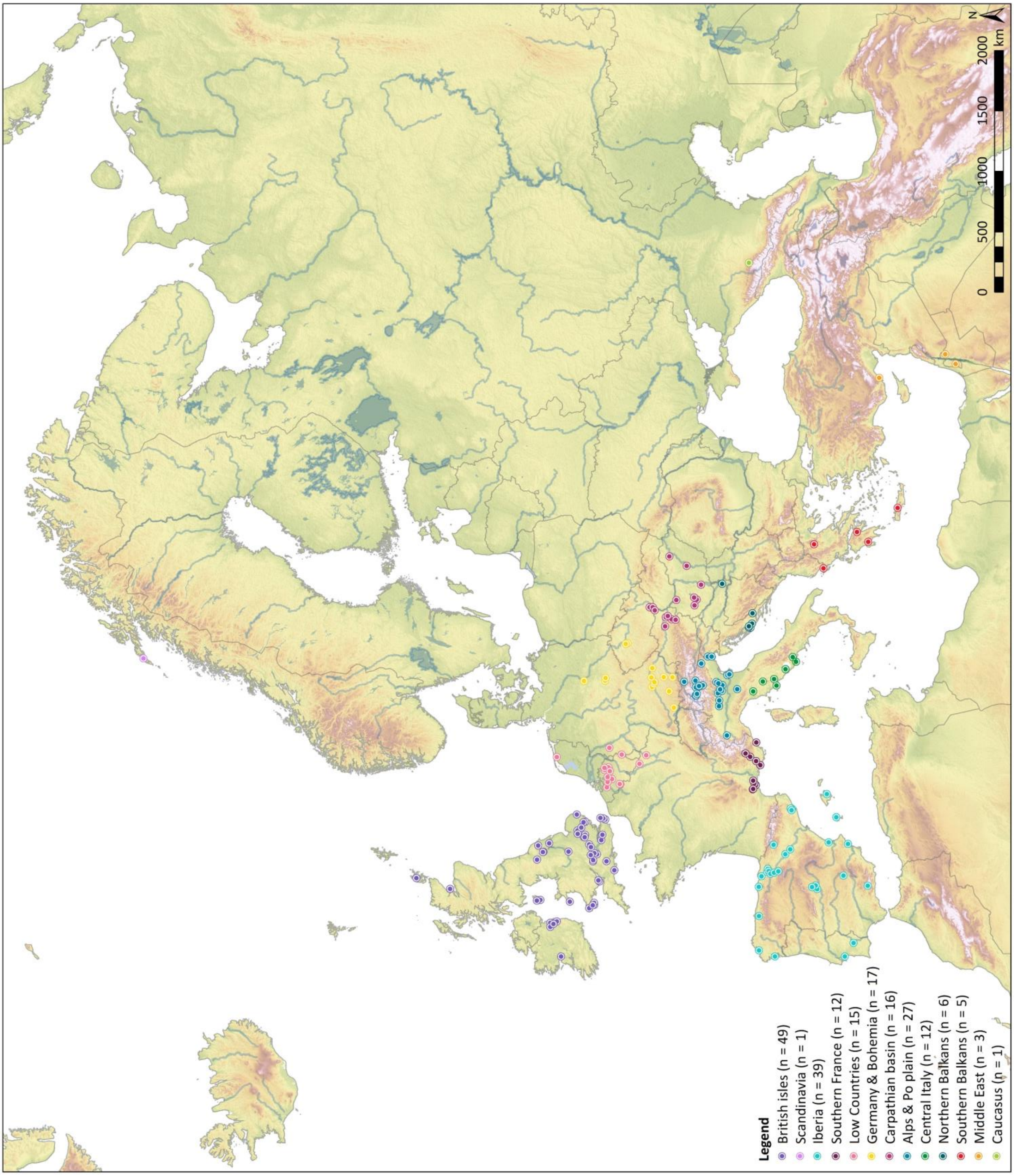


Figure 4.26. Geographic distribution of all the human assemblages in Europe, the Middle East and northern Africa dated to between 5th and 10th c. where carbon and nitrogen stable isotope analyses have been performed grouped by large geographic areas. References and more detailed data can be consulted in table 7.15

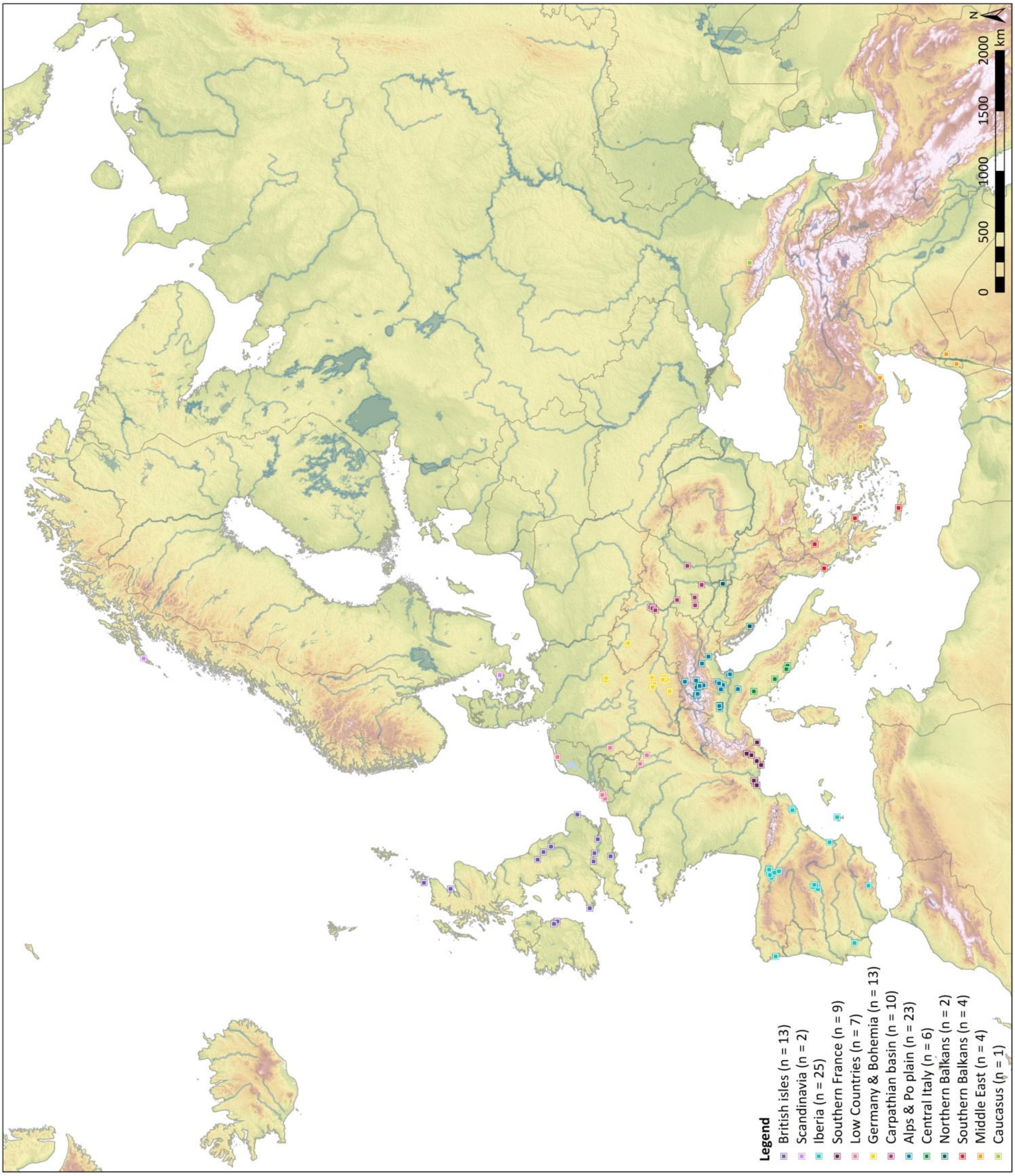


Figure 4.27. Geographic distribution of all the fauna assemblages in Europe, the Middle East and northern Africa dated to between 5th and 10th c. where carbon and nitrogen stable isotope analyses have been performed grouped by large geographic areas. References and more detailed data can be consulted in table 7.16

The diet of early medieval Iberian rural communities was also compared to contemporary case studies from Europe and the Mediterranean basin. The aim was to contextualise animal feeding strategies and human dietary patterns recorded in the sites studied for this thesis from a wider perspective in order to bring to light similarities, differences or supraregional trends which could contribute to the understanding of early medieval rural settlements in Iberia. In addition, it is also interesting to analyse the distribution of case studies across the continent and to identify which were the predominant food consumption patterns in each territory on a large scale. For this purpose, all human (table 7.15) and fauna assemblages (table 7.16) in Europe, the Middle East and northern Africa dated to between 5th and 10th centuries which had carbon and nitrogen stable isotope analyses were recorded. Overall, they comprised 211 human populations and 119 fauna datasets, which meant 4392 human individuals and 1552 animal specimens.

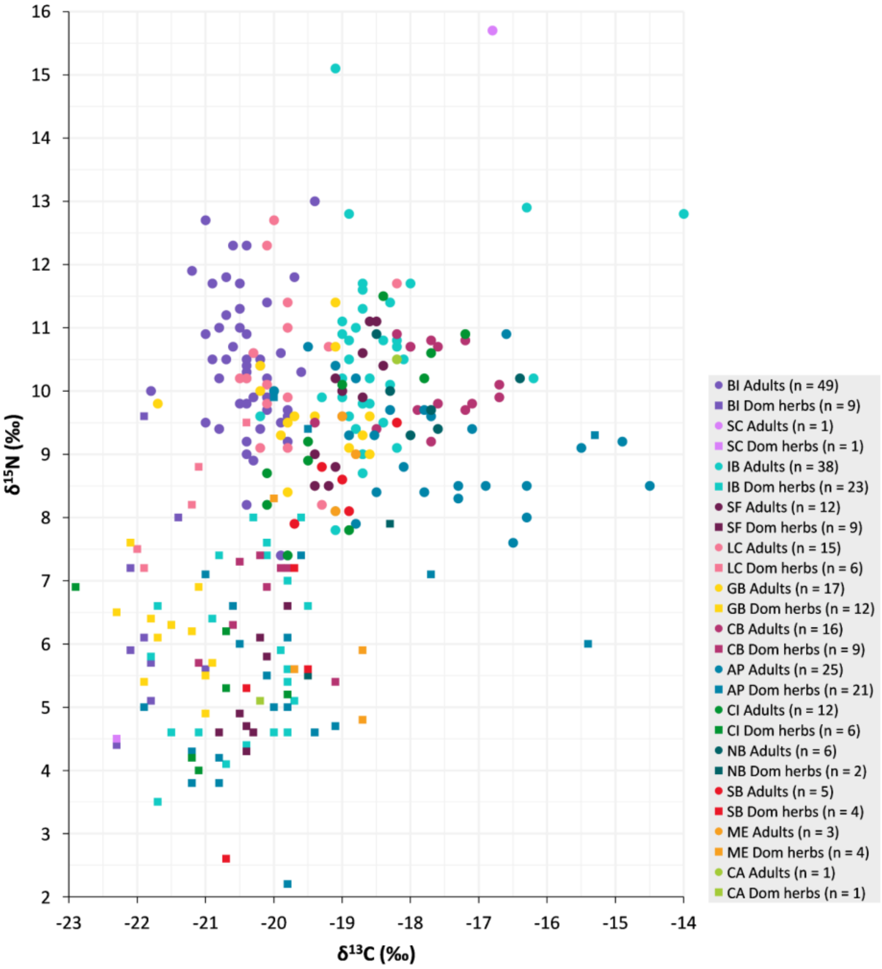


Figure 4.28. Scatterplot of mean carbon ($\delta^{13}C$) and nitrogen stable isotope ratios ($\delta^{15}N$) of adults and domestic herbivores of all human and fauna assemblages in Europe, the Middle East and northern Africa dated to between 5th and 10th c. grouped by large geographic areas. References and more detailed data can be consulted in table 7.15 and table 7.16. Key: BI = British isles, SC = Scandinavia, IB = Iberia, SF = southern France, LC = Low Countries, GB = Germany & Bohemia, CB = Carpathian basin, AP = Alps & Po plain, CI = central Italy, NB = northern Balkans, SB = southern Balkans, ME = Middle East, CA = Caucasus

Their spatial distribution is represented in figure 4.26 and figure 4.27 , according to which the first observations to be made is that the dispersal of case studies was as uneven as in Iberia. There are certain areas, especially in western Europe, with high density of human and fauna assemblages with palaeodietary reconstructions, but also very broad areas without any data. In fact, it has to be said that, thanks to the contribution of this thesis and although there is still a lot of work to be done, Iberia is currently one of the European territories where early medieval diets are known more thoroughly. Other zones particularly well covered are the British islands, the Alps and the surrounding areas to the north and south, as well as the Carpathian basin. Low Countries, southern France, central Italy, the Balkans and the Middle East are also represented by a reasonable number of case studies, while researches in Scandinavia and the Caucasus are just incidental. Conversely, most Scandinavia and central Europe, all eastern Europe and northern Africa do not count with carbon and nitrogen stable isotope analyses on any early medieval contexts. It is also noteworthy the absence of any studies in most of France and vast zones of Germany. This means there is no information at all about the dietary patterns of the populations who inhabited these regions between 5th and 10th centuries, which is an important bias considering the key role they had in the development of Early Middle Ages. Taking this imbalanced distribution into account, all the human and fauna assemblages known were grouped in large geographic areas with the aim of facilitating comparison between them. Still, the zones defined do not necessarily correspond to historical regions and considerable internal variability is expected within them.

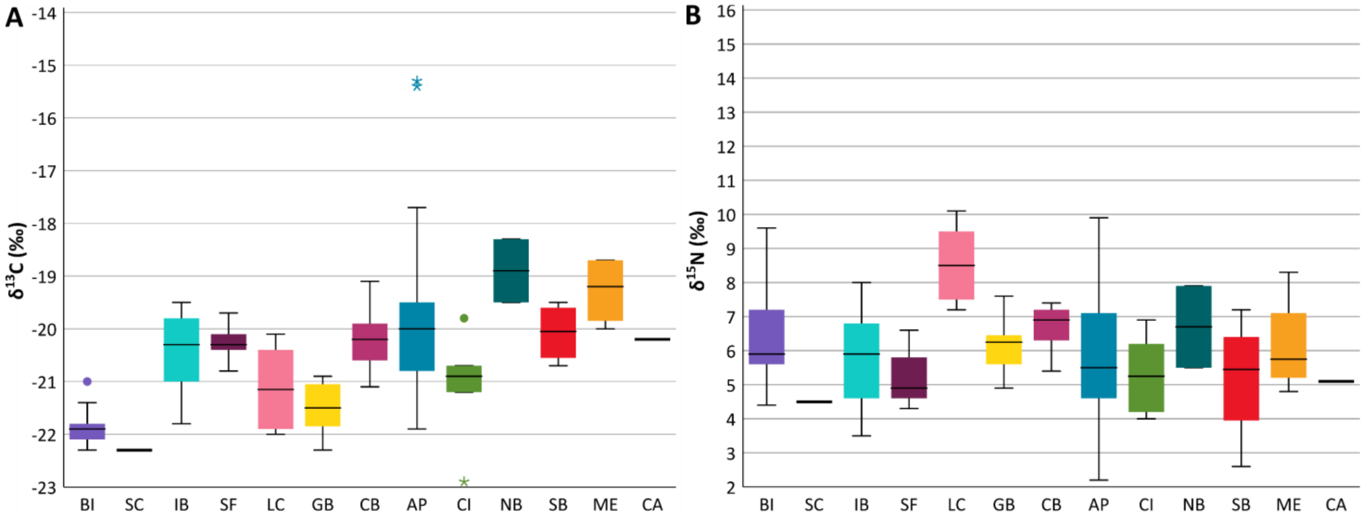


Figure 4.29. Boxplots representing mean (A) carbon ($\delta^{13}C$) and (B) nitrogen stable isotope ratios ($\delta^{15}N$) of domestic herbivores of all fauna assemblages in Europe, the Middle East and northern Africa dated to between 5th and 10th c. grouped by large geographic areas. References and more detailed data can be consulted in table 7.15 and table 7.16. Key: BI = British isles, SC = Scandinavia, IB = Iberia, SF = southern France, LC = Low Countries, GB = Germany & Bohemia, CB = Carpathian basin, AP = Alps & Po plain, CI = central Italy, NB = northern Balkans, SB = southern Balkans, ME = Middle East, CA = Caucasus

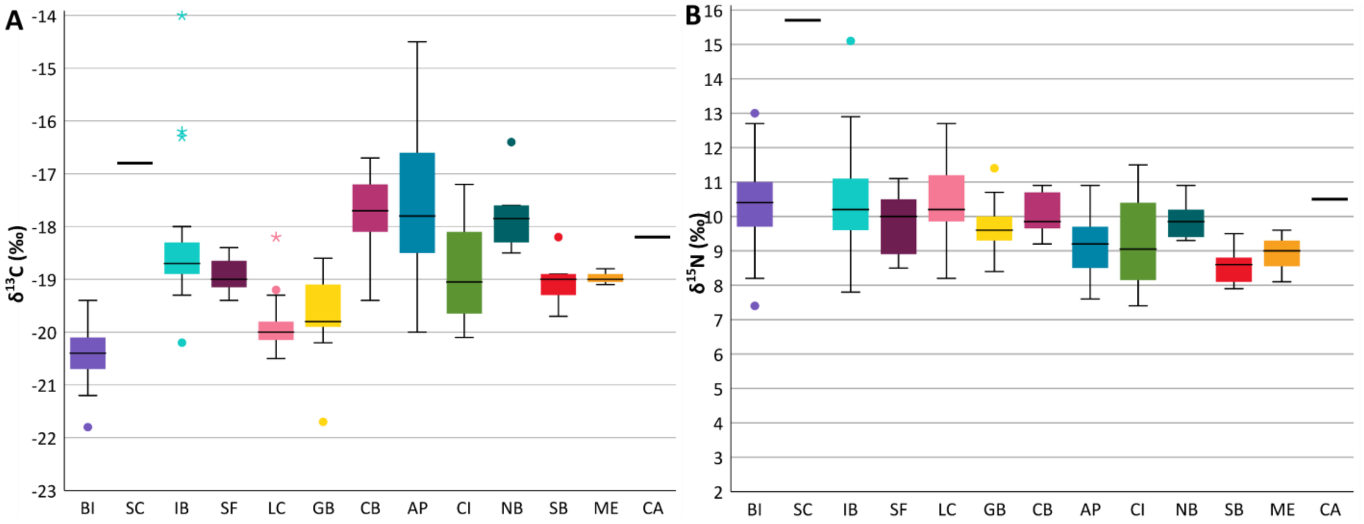


Figure 4.30. Boxplots representing mean (A) carbon ($\delta^{13}C$) and (B) nitrogen stable isotope ratios ($\delta^{15}N$) of adults of all human assemblages in Europe, the Middle East and northern Africa dated to between 5th and 10th c. grouped by large geographic areas. References and more detailed data can be consulted in table 7.15 and table 7.16. Key: BI = British isles, SC = Scandinavia, IB = Iberia, SF = southern France, LC = Low Countries, GB = Germany & Bohemia, CB = Carpathian basin, AP = Alps & Po plain, CI = central Italy, NB = northern Balkans, SB = southern Balkans, ME = Middle East, CA = Caucasus

Mean carbon and nitrogen stable isotope ratios of adults and domestic herbivores of all human and fauna assemblages recorded were plotted in figure 4.28, figure 4.29 and figure 4.30. Human subadults and omnivore and carnivore domestic animals, as well as all wild taxa, were excluded from these graphs because they are likely to show particular dietary patterns and hinder comparison. To begin with, it was interesting to observe that domestic herbivores presented equal variability on the distribution of both $\delta^{13}C$ and $\delta^{15}N$. Then, it is likely that they were reflecting mainly the differences between local isotopic baselines, although agrarian practices and case to case livestock feeding strategies would have certainly influenced their isotopic signatures too. Instead, adults were notably more heterogeneous on carbon stable isotope ratios than on nitrogen isotope ratios, indicating that during Early Middle Ages differences in human diet across Europe and the Mediterranean basin lay chiefly in the proportions of C_3 and C_4 resources consumed, rather than in animal protein intake.

Carbon stable isotope ratios of domestic herbivores pointed to predominantly C_3 dietary regimes and only some of the assemblages from the Alps and the Po plain, the northern Balkans and the Middle East presented clear evidence of the use of millets to feed livestock. Besides, in Iberia, southern France and the southern Balkans C_4 plants were possibly also employed as fodder, but it would have been less frequent. As it can be observed, all these regions were in southern Europe or around the Mediterranean sea, while the territories with exclusive C_3 diets for domestic herbivores were mostly in northern Europe. This suggests there was a geographic pattern in the use of C_4 plants as a supplement in animal diets. The main exception to this model were the domestic herbivores from central Italy, which were in the heart of the Mediterranean sea, but apparently were only fed with C_3 resources. The presence of the city of Rome in this region is probably important to grasp this anomaly, but more systematic studies about food supply of early medieval cities as opposed to rural areas are needed in order to understand this issue fully. Mean nitrogen isotope ratios of the majority of domestic herbivore assemblages fluctuate around the same values, reflecting the variability of local isotopic baseline. The specimens from the Low Countries stood out for their enriched $\delta^{15}N$ values, as many of them fed on salt marshes, which causes the increase of nitrogen isotope ratios of local plants. Some of the datasets from the British isles, Iberia, Germany and Bohemia, the Carpathian basin, the Alps and the Po plains, northern and southern Balkans and the Middle East also included a few cases with high mean $\delta^{15}N$ values, that could be due to the consumption of intensively manured plants or extreme aridity, but it was not a regular trait of domestic herbivore diets as it was in the Low Countries.

Human early medieval diets shared some common features across Europe and the Mediterranean basin. The great majority of the populations recorded had purely terrestrial diets and, as it happened in Iberia, only a few specific assemblages showed clear evidence of the consumption of aquatic products. Moreover, most diets were largely based on C_3 resources, while the intake of C_4 plants varied greatly from nothing to really significant proportions in certain instances. Likewise, in most cases animal protein played a relevant role in diet, but its importance in each human assemblage has to be evaluated individually in relation to local fauna. Carbon stable isotope ratios of adult humans displayed great variability between the different regions of Europe and the Mediterranean basin. The populations from the Alps and the Po plain were especially remarkable in this sense for their large range of mean $\delta^{13}C$ values, which indicates diets in this area were extremely diverse in terms of the type of plants consumed. Iberia, the Carpathian basin and central Italy also exhibited great variability of carbon stable isotope ratios. The regions defined can be loosely classified into three groups based on their mean $\delta^{13}C$ values. On one end, there are the British isles, the Lower Countries and Germany and Bohemia, where diets were exclusively based on C_3 resources. On the other end, populations from the Carpathian basin, the Alps and the Po plain and northern Balkans had the greatest proportions of millets in their diets. In between, predominant dietary patterns of adults from Iberia, southern France, central Italy, southern Balkans and the Middle East were made up mainly by C_3 resources with small but regular contributions of C_4 plants. Scandinavia and the Caucasus were excluded from this classification, as they were only represented by one assemblage each. Summing up, a pattern geographic pattern, similar to the one observed for domestic herbivores, can be appreciated in the spatial distribution of millets as part of human diet during Early Middle Ages. The populations with the greatest intake of C_4 plants clustered around the northern Adriatic sea and all the other assemblages where millets were also present were located in southern Europe and around the

Mediterranean sea. Instead, all the northern European human adult datasets had exclusive C_3 diets. The only exception may be some of the Bohemian sites, which had slightly enriched carbon stable isotope ratios. They were grouped together with German case studies for geographic proximity, but they might have been closer in dietary patterns to the populations from the Carpathian basin. Some researches have attributed the taste for millets in southern and central Europe during Early Middle Ages to the influence of migrations (Hakenbeck *et al.* 2010, Lightfoot *et al.* 2012), which was probably an important factor. However, the suitability of C_4 crops to the climatic and ecological conditions of southern Europe and the Mediterranean basin should not be disregarded either. Actually, one of the greatest handicaps to evaluate properly this issue is that the role of millets during the Roman age is greatly unknown (Murphy 2016), so it is difficult to assess if their relevance from the 5th century onwards was really an innovation or the continuation of a long term process.

Nitrogen isotope ratios of human adults showed less heterogeneity between regions, but internal variability within the same geographic area was very important. For this reason, it is difficult to make any generalisation about animal protein intake during Early Middle Ages at such large scale. Mean nitrogen isotope ratios ranged in all the regions, except Scandinavia, around the same values; but the really meaningful indicator is the offset between mean $\delta^{15}N$ values of human adults and local domestic herbivores. It was not possible to calculate it in all cases, because many populations lacked reference values to characterise the local isotopic baseline. Yet, with the data available it can be said that the Lower Countries, the Alps and Po plain and the Middle East were the regions with the smallest mean proportion of animal protein in diet. They were followed by the populations from the British isles, Iberia, Germany and Bohemia, the Carpathian basin, central Italy and northern and southern Balkans, which on average would have had access to greater proportions of animal products than the former group. The human adults with the diets most abundant in animal protein were southern France and the Caucasus, although the latter was only represented by one assemblage so it is risky to make any firm conclusion from it. Besides, there was a single population from Scandinavia which exhibited the largest offset between human adults and local domestic herbivores, and it was interpreted as the result of diets based on marine resources. In this way, it is apparent that, unlike carbon stable isotope ratios, there was not a clear geographic pattern in the distribution of nitrogen isotope ratios.

All in all, this large scale review of contemporary case studies across Europe and the Mediterranean basin contributes to contextualise and to better understand livestock feeding strategies and dietary patterns of early medieval Iberian rural communities. Iberian populations were close to other southern European regions in the predominance of terrestrial diets largely based on C_3 resources with smaller inputs of C_4 plants and very variable contributions of animal protein. Then, it is clear that Iberia participated in the same dynamics as other European and Mediterranean territories, although in this case the of role migrants in the emergence of millets as a staple food is uncertain and for the rural communities which were the focus of this thesis it was interpreted in terms of peasant agrarian logics (see sections 4.1.4 and 4.2.1) and internal differences in social status (see section 4.4.1). Anyway, despite the big interest of the wide overview drawn in this section, it has to be said that the greatest potential of palaeodietary reconstruction through carbon and nitrogen stable isotope ratios lies in the detailed analysis of human and fauna assemblages, which allows to account for variability due to the individual, environmental and historical factors relevant in each context, and only through the availability of a high density of contemporary case studies with well-defined isotopic baselines in every region will it be possible to elaborate a well-grounded social archaeology of food in early medieval Iberia.

5 CONCLUSIONS

5.1 MAIN RESULTS

This thesis accomplished the mains aims and objectives posed in the introduction. Ten sites dated to between 5th and 9th centuries and distributed between Madrid-Toledo, the Basque Country and Catalonia were investigated from the points of view of funerary archaeology, demography and palaeodiet. They included fifteen human assemblages that meant the recording of 690 funerary structures comprising 1023 individuals, of which 772 were preserved and available for osteoarchaeological study and 280 were successfully analysed for carbon and nitrogen stable isotope ratios. Likewise, eight fauna datasets provided a total of 115 samples with well-preserved collagen. Thus, this is the largest palaeodietary reconstruction hitherto carried out for early medieval Iberia and it offers new data about previously unexplored geographic areas and the most neglected centuries of the Middle Ages in terms of the application of biomolecular techniques. All in all, this research was able to produce a standardised record combining several proxies which covered three distant regions within Iberia in quite a narrow chronological framework. This allowed to establish well-grounded comparisons between very heterogeneous archaeological interventions, enabling to look at diet from multiple complementary perspectives. Besides, together with an articulated interpretative proposal, this thesis makes available a great volume of normalised and methodologically up to date data that hopefully in the near future will boost new questions, debates and historical narratives about the role of diet as a mirror but also an active element in the construction of early medieval identities.

The fauna assemblages analysed revealed extremely interesting new data about animal management strategies and agrarian practices in these rural societies (see section 4.1). Only domestic taxa were studied. All of them, regardless their typical eating habits, were fed predominantly on terrestrial C_3 resources. Specimens of the same species and region tended towards similar feeding patterns, suggesting that the availability of resources determined by the environment was key in the configuration of animal diets and confirming the utility of local fauna as a proxy to draw the isotopic baseline of local ecosystems. Herbivores showed distinct carbon and nitrogen stable isotope ratios depending on the region they came from, but in general there were no significant differences between cattle, ovicaprids and equids. In Madrid-Toledo, along with C_3 plants, some specimens were also given small amounts of millet fodder. However, the most relevant finding in this aspect was the identification of very enriched nitrogen isotope ratios in most herbivores, which pointed at the consumption of intensively manured plants. This was probably accomplished letting them graze in the fields after being harvested and it is sign of strong internal cohesion within the rural communities of this region. No evidence of this type of agrarian practices was recognised in any of the other two regions analysed. Basque herbivores stood out for having completely C_3 diets, although the humans from the same sites had the diets richest in C_4 plants. Instead, herbivores from Catalonia were close to those from Madrid-Toledo in the occasional intake of millets, but their nitrogen isotope ratios were incompatible with pasturing in manured fields. Interestingly, omnivores presented completely different regional patterns. While pigs from Madrid-Toledo and the Basque Country were free-ranged, as indicated by the closeness of their $\delta^{13}C$ and $\delta^{15}N$ values to corresponding local herbivores; swine from Catalonia had notably enriched nitrogen isotope ratios, revealing they were at least partially fed with domestic waste and probably kept in courtyards near households. In no case were C_4 plants used to feed pigs. Conversely, both in Madrid-Toledo and Catalonia they were extensively employed to feed fowl, which had the most variable carbon and nitrogen stable isotope ratios. Moreover, they frequently had enriched $\delta^{15}N$ values too, indicating their diets also included domestic refuse. Considering all this evidence, livestock management strategies reflect the choices of early medieval rural societies in order to organise their production, as well as their ability to adapt to local environmental and social conditions. In this way, they portray a set of complex agrarian practices with a clear integration between agriculture and animal husbandry far from the simple and primitive scenario drawn by traditional historiography.

Human dietary patterns also shared many common features across Iberia and they can be grouped by regions, but in this case there was greater variability between assemblages from the same zone (see section 4.2). The predominant diet was exclusively terrestrial, largely based on C_3 resources, in instances with small contribution of C_4 plants and variable proportions of animal protein. All the human most assemblages from Madrid-Toledo were similar in their carbon stable isotope ratios, which indicated their diets were mainly formed by C_3 plants, but the majority of individuals also a had small proportions of millets regularly enough to be observable on bone collagen. Only in the case of Gózquez was it possible that the enrichment of $\delta^{13}C$ values observed was acquired indirectly through the consumption of animals fed on C_4 plants. Nitrogen isotope ratios and, therefore, animal protein intake, was clearly different between the villages of Gózquez and Boadilla and the farms of El Soto/El Encadenado and La Huelga. In the former it was quite restricted, so as diet would have been predominantly based on plant products. In contrast, in the latter it ranged between moderate and abundant. The reasons behind these stark differences in the intake of animal products are not straightforward and further work is needed to refine this interpretation and get a full explanation.

The principal characteristic of human diets in the Basque Country was the great consumption of C_4 plants in comparison with other contexts. For the majority of individuals C_3 resources would have still been prevalent, but most individuals also had significant amounts of millets and the proportion of Basque individuals with exclusively C_3 diets was really small in comparison to the other regions. The importance of millets in Basque human assemblages was especially clear since all the fauna from Basque sites were wholly fed on C_3 resources, so the enrichment of humans' carbon stable isotope ratios came necessarily from direct consumption of millets. Nevertheless, there were some relevant differences between sites in C_4 plant intake regarding variability. The populations from Aldaieta and in particular Finaga were quite homogeneous in $\delta^{13}C$ values and all the individuals would have relatively similar dietary patterns. Conversely, the human assemblage of phase 4 from Dulantzi presented the greatest variability of carbon stable isotope ratios, exposing the coexistence of individuals with very different diets in this context. Respecting nitrogen isotope ratios, the bigger populations of Aldaieta and the phase 4 of Dulantzi had moderate intake of animal protein. Meanwhile the individuals buried at Finaga showed consistently more enriched $\delta^{15}N$ values that could be interpreted as the result of the consumption of greater proportions of animal protein, perhaps from omnivorous taxa or young specimens, or the occasional input of marine resources, which would not have been strange considering that site was less than 15 km from the coast.

Human diet in Catalan settlements was close to what observed in the population from Madrid-Toledo in regards to carbon stable isotope ratios. Diets in early medieval rural Catalonia were mostly based on C_3 resources and only a few individuals from each dataset exhibited $\delta^{13}C$ values compatible with the intake of small proportions of C_4 plants. Actually, because some of the Catalan herbivores analysed were also occasionally fed with millets, it is difficult to establish if the enrichment of carbon stable isotope ratios observed was due to direct consumption of C_4 plants by humans or it was caused by eating products from those millet-eating animals. As for nitrogen isotope ratios, all Catalan populations had large offsets between their mean $\delta^{15}N$ values and local herbivores', which points at large protein intake. However, it would be advisable to improve the isotopic characterisation of local livestock, as it is also possible that the preferential consumption of omnivores or young specimens could overestimate the real importance of animal protein in the diet of these human assemblages. In addition, these populations could have also received small inputs from marine resources, but this hypothesis is yet to be proved. Unlike in the other regions, in Catalonia there were no meaningful differences between human assemblages, which may be due to the short distance between them.

As it can be noticed, aquatic resources, either marine or freshwater, were virtually imperceptible in all the contexts analysed. It cannot be completely ruled out that they were eaten sporadically, but their consumption would have been below the detection threshold of carbon and nitrogen stable isotope ratios on bone collagen. Summing up, it would be very difficult to define a typical diet for early medieval rural populations in Iberia. Dietary patterns in these contexts were characterised by diversity dictated by the local availability of products and probably social, political and cultural constraints, which are more challenging to decipher. Still, at the same time, most human assemblages were internally quite homogeneous in their carbon and nitrogen stable isotope ratios. For these reasons, it has to be concluded that in the current state of research it is not possible to use diet as a direct indicator of historical categories defined by other sources, such as peasants or slaves.

Nonetheless, internal variability of human diets within early medieval Iberian rural populations based on age, sex or social status as understood from the presence of grave goods next to burials or the location of graves was worth exploring. In general, no significant associations were found between age and food consumption patterns (see section 4.3.1). Subadults and adults from the same populations tended to present similar carbon and nitrogen stable isotope ratios and only infans 1A, the youngest individuals, showed distinct isotopic signatures as a consequence of breastfeeding and weaning. Yet, it has to be said that at Boadilla, which was the human assemblages with the greatest number of samples successfully analysed, a pattern in the evolution of nitrogen isotope ratios associated to age was recognised. According to these data, once weaned, individuals under the age of 8 would have had the smallest intake of animal protein and subadults would not have attained animal protein consumption levels equivalent to adults until the age of 14 approximately. Instead, carbon stable isotope ratios stayed steady along all age categories, reinforcing the hypothesis that the differences in $\delta^{15}N$ values were the consequence of the deliberate decision of excluding the young subadults from the access to animal products. Unless in the future the number of subadults analysed is not increased in all the assemblages, it will not be possible to verify if this was a generalised trend or a particularity of the population from Boadilla. Comparison of dietary patterns between adult males and adult females did not reveal any meaningful differences in the access to food resources based on sex, neither for carbon nor for nitrogen stable isotope ratios (see section 4.3.2). Only in the case of Aldaieta was there a statistically significant difference between adult males and adult females, the former showing systematically more enriched $\delta^{13}C$ values. Nevertheless, further analyses suggested that this difference had more to do with social status as expressed through grave goods, which were preferentially carried by adult males, than with sex itself. Therefore, based on the few data available, it is unlikely that in early medieval Iberian rural societies there were systematic differences between sexes in the distribution of dietary resources.

The role of diet as an indicator of social status was assessed through the presence of grave goods in burials and the location of graves within or outside the community cemetery or in relation to churches. The use of grave goods as part of the funerary ritual in Madrid-Toledo and the Basque Country was associated to carbon stable isotope ratios (see section 4.4.1). Individuals buried with any artefact tended towards more enriched $\delta^{13}C$ values and, therefore, they were more likely to include certain amount of millets in their diets. Actually, it was rare to find individuals with grave goods and exclusive C_3 diets. This indicates crop consumption patterns and specifically C_4 plants played an important role in the definition of social status. On the contrary, there was no association between the laying of grave goods in burials and nitrogen isotope ratios, which, as long as they provide information about the consumption of meat and other animal byproducts, have traditionally been considered an indicator of social status. Still, individuals with and without grave goods showed very variable proportions of animal protein intake and no pattern was discernible in these regards. Location of burials was not directly associated with diet either (see section 4.4.2). In Finaga, Dulantzi and Sant Menna individuals with different diets were randomly distributed inside and around churches and in no case was it possible to identify clusters of individuals with specific dietary patterns around the most meaningful zones, such as the apse. Likewise, there were no significant differences either in $\delta^{13}C$ or $\delta^{15}N$ between the individuals buried in the community cemeteries of Gózquez and Can Gambús and those thrown into reused productive structures scattered around the settlement. In fact, in both cases human assemblages from the same site were almost indistinguishable, which suggests that, regardless the place where they ended up being buried, their diets were probably based on the same range of resources. In conclusion, the relationship between diet and social status was complex and it did not work in the most obvious ways. Nevertheless, with the data available, it is possible to bring out the great potential of food consumption patterns to characterise internal differences and to surface connections that cannot be beheld otherwise, so it is worth keeping on investigating in this direction.

5.2 LIMITATIONS

Despite the interesting results obtained, several factors hindered the development of this research. They had to do with the methodological boundaries of the analytical techniques applied, preservation issues, interpretative limits, and time and budget constraints. Regarding methodological limits, carbon and nitrogen stable isotope ratios provide unprecedented information about diet from skeletal remains at the individual level, but they also have some important issues that prevented from getting more accurate results. On one hand, there is the fact that carbon and nitrogen stable isotope ratios obtained on bone collagen reflect the average of the isotopic composition of diet during a long period. As a consequence, it is impossible to catch short term variations in diet, such as famine or feasting, and any foodstuff eaten occasionally would go unnoticed. The same happens with the products of different quality from the same organism or with variations in preparation. That is, meat, lard and milk from the same animals have virtually the same isotopic signatures, and stews and roasts elaborated with the same ingredients too, although they would denote very unalike use of resources and should be interpreted differently in social terms. However, currently it is not possible to catch these nuances with carbon and nitrogen stable isotope ratios alone. On the other hand, one of the biggest limitations of this analytical technique is caused by the uncertainty around offsets between trophic levels. The lack of precise knowledge about fractionation rates of carbon and nitrogen stable isotope ratios between organisms and all the factor that can influence them, affects the accuracy of palaeodietary reconstructions. For example, currently it is difficult to estimate quantitatively the proportion of animal protein in an individual's diet or the relative importance of C_3 and C_4 plants, which hampers the potential of any interpretation.

The scarcity of analogous case studies of early medieval rural contexts in Iberia was also one of the great challenges of this thesis. Most of the palaeodietary reconstructions of medieval populations that have been published up to now focus on the Late Middle Ages and in many instances they are made up of a very small number of individuals. In addition, there is the problem of the insufficiency of knowledge about Roman diet, so it is not easy to assess the continuity or novelty of the food consumption patterns identified in the populations analysed here. Moreover, although in Europe there is a larger volume of data concerning early medieval populations, it is often tough to establish connections between distant regions, as there may be many historical and cultural factors that could bias comparisons. The scantness of references is especially problematic in the contexts where there is no fauna available to draw local isotopic baselines. Actually, this was one of the obstacles that this thesis had to face, especially for the interpretation of dietary patterns in the Basque sites, which did not include wide domestic or productive areas to retrieve large and varied fauna assemblages. In these cases, if there was a consistent set of previous studies in the region, it would be possible to interpret human dietary patterns even without the need to analyse fauna samples. Still, it has to be said that the carelessness towards the characterisation of local fauna from early medieval contexts is a constant in all European and Mediterranean regions (see section 4.5) and one of the future tasks in order to improve the resolution of palaeodietary reconstruction.

Preservation and time and budget constraints also meant important limitations for this thesis. Taphonomic processes affected human and fauna assemblages in two different ways. In some contexts they caused the fragmentation of bone and teeth and the erosion of cortical surface, and in the worst cases they led to the complete disappearance of all skeletal elements. For this reason, a quarter of the individuals identified in the field could not be recovered. Besides, in many instances the results of the osteoarchaeological study were very limited because the skeletal remains that arrived to the laboratory were extremely poorly preserved macroscopically. In other contexts it was the molecular structure of bone collagen that was damaged, so the carbon and nitrogen stable isotope ratios measured were not valid for palaeodietary reconstruction. This problem was particularly severe in the human and fauna assemblages from Catalonia and it strongly conditioned the results from this region, as almost two thirds of the human samples and a third of the fauna samples selected did not have well-preserved collagen. Finally, limitations in time and budget generated that human populations could not be entirely analysed and, more importantly, that in the assemblages with particularly bad preservation at the molecular level sampling could not be repeated in order to increase the size of datasets.

5.3 FUTURE RESEARCH

This research brought out many new questions about dietary patterns of early medieval rural Iberian communities and it opens a number of new paths to explore the social role of food in this period. During the development of this research many data that finally were not incorporated in this thesis were collected. They concerned mainly metric variability of the populations analysed and palaeopathology. More precisely, oral pathologies (Hillson 2005) and metabolic bone diseases (Brickley & Ives 2008) were systematically recorded for all the individuals. It was considered that these two groups of pathologies could contribute to palaeodietary reconstruction, as in both cases they are closely related to diet. However, the volume of data generated was so large that it would have been impossible to process and discuss it on time to meet the deadlines of this thesis. For this reason, it was decided to leave these data aside temporarily, but it would be extremely interesting to recover them in the near future in order to explore the relationship between diet, health and disease in early medieval rural Iberian communities. Oral pathologies can provide information about the types of food consumed complementary to carbon and nitrogen stable isotope analyses and metabolic bone diseases are an excellent proxy of nutritional deficiencies. Taking into account most of the work to develop this topic is already done, this will be one of the priority research lines after the completion of this thesis.

Focusing on carbon and nitrogen stable isotope analyses, in the future it will be necessary to keep on working on the characterisation of local isotopic baselines, as they are essential for the accurate interpretation of human diets. For this purpose, it will be fundamental to increase the number of fauna samples analysed from each context, reaching the minimum threshold of 0.3 animals per each human analysed (López-Costas & Alexander 2019: 3661) and including enough specimens of every taxon in order to be able to fully account for variability within species. It would also be desirable to include in sampling marine and freshwater fish, since there is a severe lack of isotopic data about early medieval aquatic resources. Moreover, it would be very exciting to have the opportunity to incorporate plant remains into the datasets to elaborate isotopic baselines (Hamerow *et al.* 2019). Direct isotopic analysis of charred seeds can contribute to the characterisation of local carbon and nitrogen isotopic signatures more accurately than fauna remains. Besides, they can supply new data about agrarian practices, such as manuring or water use, which can only be glimpsed at from documentary sources or other archaeological records. Unfortunately, in many of the sites analysed for this thesis all useful fauna fragments were already analysed and no plant remains were recovered, so it may be necessary to explore other nearby contemporary settlements.

Another research line to keep on working in the future is the application of other biomolecular methods to gain new insights about diet in early medieval Iberian rural contexts. Considering what it is already known about these populations, carbon stable isotope analyses on dental enamel and carbon and nitrogen stable isotope analyses on incremental dentine sections would be specially interesting. The former would be useful to assess with greater precision the contribution of C_4 plants to human diets, as dental enamel reflects the isotopic composition of the whole diet rather than favouring the protein fraction as bone collagen does (Ambrose & Norr 1993). This would be the most straightforward approach to elucidate the dietary patterns of all those individuals around the limit between exclusive C_3 and mixed C_3-C_4 diets. The latter allows to investigate the evolution of an individual's diet along childhood and adolescence thanks to the fact that dentine grows in overlapping layers and it does not remodel (Beaumont & Montgomery 2015). Therefore, this microsampling technique means an opportunity to get inside the feeding patterns of both the children who died during the first years of life and those who survived up to adulthood. Analyses on bone collagen suggested drew forth some very young subadults who were never breastfed and others weaned beyond 2 years of age. Then, it looks like very different behaviours in relation to infant feeding coexisted and it would be very helpful to have more detailed and abundant data to discuss this topic, as it is not only relevant to understand the attitudes of each societies towards children but it also had an impact on the health of mothers and the adults those children became in.

Lastly, it would be great if the knowledge generated as part of this thesis could be used as a platform to explore other contexts and chronologies. On one hand, there are other types of early medieval settlements that would be interesting to investigate. No early medieval urban populations from the centre of Iberia, the Basque Country or Catalonia have been studied from the point of view of diet in, but carbon and nitrogen stable isotope analyses can make significant contributions to the understanding of food supply networks and internal social differences within early medieval cities. In addition, the comparison of livestock management strategies and dietary patterns between nearby rural and urban communities can also help in the characterisation of the articulation of territories at the regional scale. For these reasons, the palaeodietary reconstruction of urban populations close in time and space to the ones analysed on this thesis would be an excellent continuation for this research. On the other hand, there is a real need to improve what is known so far about diets in Iberia during the Roman age. Despite the obstacle that means the prevalence of cremation during the first centuries of the period, there are many human skeletal assemblages dated to the Late Roman period that could be analysed to cover this gap, but hitherto less than a hundred of human individuals and a few more than fifty fauna specimens have been successfully analysed (see section 4.5). The characterisation of rural and urban dietary patterns during the Roman age is essential for the interpretation of early medieval contexts, as otherwise it is impossible to assess if the trends observed from the 5th century on constitute an innovation or the continuation of previous processes. Hence, the study of Roman Iberian human populations and fauna assemblages should also be a priority in the future of palaeodietary reconstruction through carbon and nitrogen stable isotope analyses.

6 REFERENCES

Aceituno, F.J. 2015. *Informe análisis de almidones arqueológicos sitio Gózquez de Arriba, provincia de Madrid*. Antioquía.

Acsádi, G. & Nemeskéri, J. 1970. *History of human life span and mortality*. Budapest: Akadémiai Kiadó.

Alaica, A.K., Schalburg-Clayton, J., Dalton, A., Kranioti, E.F., Graziani, G. & Pickard, C. 2019. Variability along the frontier: stable carbon and nitrogen isotope ratio analysis of human remains from the Late Roman–Early Byzantine cemetery site of Joan Planells, Ibiza, Spain. *Archaeological and Anthropological Sciences* 11: 3783–3796.

Alarcón, A. 2006. *Estudio arqueofaunístico del yacimiento arqueológico de 'La Huelga'*, in J. Morín de Pablos (ed.) *La investigación arqueológica de la época visigoda en la Comunidad de Madrid. Volumen III La cultura material (Zona Arqueológica 8)*: 965–981. Alcalá de Henares: Museo Arqueológico Regional.

Albarella, U. & Davis, S.J.M. 1994. *The Saxon and Medieval animal bones excavated 1985-1989 from West Cotton, Northamptonshire (Ancient Monuments Laboratory Report 17/94)*. London: English Heritage.

Albarella, U., Davis, S.J.M., Detry, C. & Rowley-Conwy, P. 2005. Pigs of the 'Far West': the biometry of Sus from archaeological sites in Portugal. *Anthropozoologica* 40: 27–54.

Alexander, M.M. 2016. *The application of stable isotopes to explore diets in late medieval Spain*, in J.A. Quirós (ed.) *Demografía, paleopatologías y desigualdad social en el noroeste peninsular en época medieval (Documentos de Arqueología Medieval 10)*: 245–261. Bilbao: Universidad del País Vasco.

Alexander, M.M., Gutiérrez, A., Millard, A.R., Richards, M.P. & Gerrard, C.M. 2019. Economic and socio-cultural consequences of changing political rule on human and faunal diets in medieval Valencia (c. fifth–fifteenth century AD) as evidenced by stable isotopes. *Archaeological and Anthropological Sciences* 11: 3875–3893.

Alfaro, E. 2015. *La formación de la red parroquial en Álava y Treviño. Evidencias desde la arqueología (siglos XI-XIII)*. Vitoria-Gasteiz: Universidad del País Vasco.

Alfaro, E., Loza, M. & Niso, J. 2019. *Dos tumbas de privilegio en la basílica funeraria y bautismal del siglo VI de San Martín de Dulantzi (Álava)*, in J. López Vilar (ed.) *Actas del IV Congrés Tarraco Biennal. VII Reunió d'Arqueologia cristiana Hispànica. Tarragona, 21-24 noviembre 2018*: 147–154. Tarragona: Tarraco Biennal.

Alfaro, E., Loza, M., Niso, J. & Solaun, J.L. 2017. Iglesias, rentas y sistemas de almacenamiento en el País Vasco durante los siglos X y XI d. C.: el testimonio arqueológico de San Martín de Dulantzi (Alegría-Dulantzi, Álava). *Archivo Español de Arqueología* 90: 247.

Alt, K.W., Knipper, C., Peters, D., Müller, W., Maurer, A.F., Kollig, I., Nicklisch, N., Müller, C., Karimnia, S., Brandt, G., Roth, C., Rosner, M., Mende, B., Schöne, B.R., Vida, T. & von Freeden, U. 2014. Lombards on the move. An integrative study of the migration period cemetery at Szólád, Hungary. *PLoS ONE* 9: e110793.

Althoff, G. 1996. *Manger oblige: repas, banquets et fêtes*, in J.-L. Flandrin & M. Montanari (ed.) *Histoire de l'alimentation*: 305–318. Paris: Fayard.

Alzualde, A. 2005. *Caracterización genética de la población humana de Aldaieta (s. VI-VII dC, Pais Vasco): significado biológico y comportamiento biosocial*. Leioa: Universidad del País Vasco/Euskal Herriko Unibertsitatea.

Alzualde, A., Izagirre, N., Alonso, S., Alonso, A., Albarrán, C., Azkarate, A. & de la Rúa, C. 2006. Insights into the 'isolation' of the Basques: mtDNA lineages from the historical site of Aldaieta (6th-7th centuries AD).

American Journal of Physical Anthropology 130: 394–404.

Alzualde, A., Izagirre, N., Alonso, S., Alonso, A. & de la Rúa, C. 2005. Temporal mithocondrial DNA variations in the Basque Country: Influence of the post-Neolithic events. *Annals of Human Genetics* 69: 665–679.

Alzualde, A., Izagirre, N., Santos, A., Rivera, N.A., Alonso, A., Azkarate, A. & de la Rúa, C. 2007. Influences of the European Kingdoms of Late Antiquity on the Basque Country. *Current Anthropology* 48.1: 155–163.

Ambrose, S.H. 1990. Preparation and characterization of bone and tooth collagen for isotopic analysis. *Journal of Archaeological Science* 17: 431–451.

Ambrose, S.H. 1991. Effects of diet, climate and physiology on nitrogen isotope abundances in terrestrial foodwebs. *Journal of Archaeological Science* 18: 293–317.

Ambrose, S.H. 1993. *Isotopic analysis of paleodiets: methodological and interpretative considerations*, in M.K. Sandford (ed.) *Investigations of ancient human tissue. Chemical analyses in anthroplogy*: 59–130. Langthorne: Gordon and Breach.

Ambrose, S.H. 2001. *Controlled diet and climate experiments on nitrogen isotope ratios of rats*, in S.H. Ambrose & M.A. Katzenberg (ed.) *Biogeochemical approaches to paleodietary analysis*: 243–259. New York: Kluwer Academic Publishers.

Ambrose, S.H. & Norr, L. 1993. *Experimental evidence for the relationship of the carbon isotope ratios of whole diet and dietary protein to those of bone collagen and carbonate*, in J.B. Lambert & G. Grupe (ed.) *Prehistoric Human Bone. Archaeology at the Molecular Level*: 1–37. Berlin: Springer.

Amorim, C.E.G., Vai, S., Posth, C., Modi, A., Koncz, I., Hakenbeck, S.E., La Rocca, C., Mende, B., Bobo, D., Pohl, W., Luisella, P.B., Bedini, E., Francalacci, P., Giostra, C., Vida, T., Winger, D., von Freeden, U., Ghirotto, S., Lari, M., Barbujani, G., Krause, J., David, C., Geary, P.J. & Veeramah, K.R. 2018. Understanding 6th-century barbarian social organization and migration through paleogenomics. *Nature Communications* 9: e3547.

Amundson, R., Austin, A.T., Schuur, E.A.G., Yoo, K., Matzek, V., Kendall, C., Uebersax, A., Brenner, D. & Baisden, W.T. 2003. Global patterns of the isotopic composition of soil and plant nitrogen. *Global Biogeochemical Cycles* 17: 31.

Araus, J.L. & Buxó, R. 1993. Changes in carbon isotope discrimination in grain cereals from the North-Western Mediterranean basin during the past seven millennia. *Australian Journal of Plant Physiology* 20: 117–128.

Argote, N., Botella, M.C. & Etxeberria, F. 2013. Necrópolis medievales del País Vasco: estado actual de la investigación antropológica. *Sautuola* XVIII: 275–289.

Ariño, E. 2013. El hábitat rural en la Península Ibérica entre finales del siglo IV y principios del VIII: un ensayo interpretativo. *Antiquité Tardive* 21: 93–123.

Arnold, C.J., Wysocki, M.P. & Richards, M.P. 1998. Excavation of ‘Ty Newydd’, Ynys Enlli (Bardsey Island, Gwynedd. *Archaeologia Cambrensis* 147: 96–132.

Artigues, P.L., Bravo, P. & Hinojo, E. 2007. Excavacions arqueològiques a Can Gambús 2, Sabadell (Vallès Occidental). *Tribuna d’Arqueologia* 2006: 111–140.

Artigues, P.L., Codina, D., Moncunill, N. & Velaza, J. 2007. Un colgante ibérico hallado en Can Gambús (Sabadell). *Palaeohispánica* 7: 239–250.

Azkarate, A. 1989. Necrópolis de Aldaieta (Nanclares de Gamboa, Álava): I campaña de urgencia. *Arkeoikuska* 1987: 82.

Azkarate, A. 1990a. Necrópolis de Aldaieta (Nanclares de Gamboa, Álava). *Arkeoikuska* 1988: 31.

Azkarate, A. 1990b. Algunas consideraciones sobre la Arqueología de época Germánica en Euskal Herria. *Munibe* 42: 345–355.

Azkarate, A. 1991a. Necrópolis de Aldaieta (Nanclares de Gamboa, Álava): II campaña de excavaciones. *Arkeoikuska* 1989: 32–33.

Azkarate, A. 1991b. Necrópolis tardoantigua de Aldaieta (Nanclares de Gamboa): III campaña de excavaciones. *Arkeoikuska* 1990: 26–30.

Azkarate, A. 1991c. Eremitismo de época visigótica. Testimonios arqueológicos. *Codex Aquilarensis* 5: 141–179.

Azkarate, A. 1992. Necrópolis tardoantigua de Aldaieta (Nanclares de Gamboa, Álava): IV campaña de excavaciones. *Arkeoikuska* 1991: 44–51.

Azkarate, A. 1993a. Necrópolis tardoantigua de Aldaieta (Nanclares de Gamboa, Álava): V campaña de excavaciones. *Arkeoikuska* 1992: 57–65.

Azkarate, A. 1993b. Francos, aquitanos y vascones. Testimonios arqueológicos al sur de los Pirineos. *Archivo Español de Arqueología* 66: 149–176.

Azkarate, A. 1994. Asentamiento tardoantiguo de Aldaieta-Espikulatxe (Nanclares de Gamboa-Landa): VI campaña de excavaciones. *Arkeoikuska* 1993: 62–75.

Azkarate, A. 1995. Asentamiento tardoantiguo de Aldaieta-Espikulatxe (Nanclares de Gamboa). *Arkeoikuska* 1994: 58–76.

Azkarate, A. 1996. *Entre francos y visigodos. La tardoantigüedad en Álava*, in A. Rivera (ed.) *Alava, nuestra historia*: 73–86. Bilbao: El Correo Español. El Pueblo Vasco.

Azkarate, A. 1997. Necrópolis de San Pelayo (Alegría-Dulantzi). *Arkeoikuska* 1996: 165–170.

Azkarate, A. 1999. *Necrópolis tardoantigua de Aldaieta (Nanclares de Gamboa, Álava). Volumen I. Memoria de la excavación e inventario de los hallazgos*. Vitoria-Gasteiz: Diputación Foral de Álava.

Azkarate, A. 2002. *De la Tardoantigüedad al Medievo cristiano. Una mirada a los estudios arqueológicos sobre el mundo funerario*, in D. Vaquerizo (ed.) *Espacios y usos funerarios en el Occidente romano: Actas del Congreso Internacional celebrado en la Facultad de Filosofía y Letras de la Universidad de Córdoba (5-9 junio, 2001)*, 2: 115–140. Córdoba: Universidad de Córdoba, Seminario de Arqueología.

Azkarate, A. 2003. La arqueología y los intereses historiográficos. De los postulados vascocantabristas a las necrópolis tardoantiguas de influencia nordpirenaica. *Bidebarrieta. Revista de Humanidades y Ciencias Sociales de Bilbao* 12: 27–60.

Azkarate, A. 2004. ¿Reihengräberfelder al sur de los Pirineos occidentales? *Antigüedad y Cristianismo: Monografías históricas sobre la Antigüedad Tardía* XXI: 389–413.

Azkarate, A. 2005. Sobre los orígenes cronológicos de los cementerios cispirenaicos de época tardoantigua. *Munibe* 57: 405–417.

Azkarate, A. 2011. *Repensando los márgenes circumpirenaicos-occidentales durante los siglos VI y VII d.C.*, in E. Baquedano (ed.) *711. Arqueología e Historia entre dos mundos (Zona arqueológica 15.1)*: 241–253. Alcalá de Henares: Museo Arqueológico Regional.

Azkarate, A. 2018. Reflexiones sobre arqueología, lingüística e iglesias rupestres de época tardoantigua. *Anuario del Seminario de Filología Vasca 'Julio de Urquijo'. International Journal of Basque Linguistics and Philology* LII: 61–78.

Azkarate, A. & García Camino, I. 1996. *Estelas e inscripciones medievales del País Vasco (Siglos VI-XI) I. País Vasco occidental*. Bilbao: Gobierno Vasco, Departamento de Cultura; Universidad del País Vasco, Servicio Editorial.

Azkarate, A. & García Camino, I. 2012. *El espacio circumpirenaico occidental durante los siglos VI al X d.C. según el registro arqueológico: algunos interrogantes*, in L. Caballero, P. Mateos, & C. García de Castro (ed.) *Asturias entre visigodos y mozárabes (Anejos de AEspA LXIII)*: 331–351. Madrid: CSIC, Instituto de Historia.

Azkarate, A. & García Camino, I. 2013. *Vasconia, tierra intermedia. Ritos funerarios de frontera*. Bilbao, Vitoria: Diputación Foral de Bizkaia, Diputación Foral de Álava.

Azkarate, A., Nuñez, J. & Solaun, J.L. 2003. *Materiales y contextos cerámicos de los siglos VI al X en el País Vasco*, in L. Caballero, M. Retuerce, & P. Mateos (ed.) *Cerámicas tardorromanas y altomedievales en la Península Ibérica: ruptura y continuidad (Anejos del Archivo Español de Arqueología XXVIII)*: 321–370. Madrid: CSIC, Instituto de Historia (Anejos del Archivo Espa?ol de Arqueolog?a).

Azkarate, A. & Solaun, J.L. 2016. *La cerámica altomedieval en el País Vasco (siglos V-X d.c.): producciones, modelos productivos y patrones de consumo*, in A. Vigil-Escalera & J.A. Quirós (ed.) *La cerámica de la Alta Edad Media en el cuadrante noroeste de la Península Ibérica (siglos V-X). Sistemas de producción, mecanismos de distribución y patrones de consumo (Documentos de Arqueología Medieval 9)*: 193–228. Bilbao: Universidad del País Vasco.

Balasse, M. 2014. *Isotopic studies of husbandry practices*, in C. Smith (ed.) *Encyclopedia of Global Archaeology*: 4120–4127. New York: Springer New York.

Balasse, M. & Ambrose, S.H. 2005. Distinguishing sheep and goats using dental morphology and stable carbon isotopes in C4 grassland environments. *Journal of Archaeological Science* 32: 691–702.

Balasse, M. & Tresset, A. 2002. Early weaning of neolithic domestic cattle (Bercy, France) revealed by intratooth variation in nitrogen isotope ratios. *Journal of Archaeological Science* 29: 853–859.

Baldoni, M., Nardi, A., Müldner, G.H., Lelli, R., Gnes, M., Ferraresi, F., Meloni, V., Cerino, P., Greco, S., Manenti, G., Angle, M., Rickards, O. & Martínez-Labarga, C. 2016. Archaeo-biological reconstruction of the Italian medieval population of Colonna (8th-10th centuries CE). *Journal of Archaeological Science: Reports* 10: 483–494.

Baldoni, M., Scorrano, G., Gismondi, A., D'Agostino, A., Alexander, M.M., Gaspari, L., Vallelonga, F., Canini, A., Rickards, O. & Martínez-Labarga, C. 2018. Who were the miners of Allumiere? A multidisciplinary approach to reconstruct the osteobiography of an Italian worker community. *PLoS ONE* 13: e0205362.

Barandiarán, I., Martín-Bueno, M. & Rodríguez Salís, J. 1999. *Santa Elena de Irun: excavación arqueológica de 1971 y 1972*. San Sebastián: Arkeolan.

Barbiera, I. 2008. Il mistero delle donne scomparse. Sex-ratio e società nel medioevo italiano. *Archeologia Medievale* XXXV: 491–501.

Barbiera, I. 2012. Si masculi superassent foeminas. Sex ratio et mortalité au Moyen Âge. *Mélanges de l'École Française de Rome - Moyen Âge* 124: 547–565.

Barbiera, I. 2018. *Sex ratio nell'Italia medievale: acceso conteso alle risorse?*, in S. Joye & R. Le Jan (ed.) *Genre et compétition dans les sociétés occidentales du Haut Moyen Âge, IVe-XIe siècle*: 43–63. Turnhout: Brepols.

Barbiera, I., Castiglioni, M. & dalla Zuanna, G. 2017. *Missing women in the Italian Middle Ages? Data and interpretation*, in S.R. Huebner & G. Nathan (ed.) *Mediterranean families in Antiquity: households, extended families, and domestic space*: 283–309. Chichester: Wiley Blackwell.

Barone, R. 1976. *Anatomie comparée des mammifères domestiques*. (ed.)V. Frères. Paris.

Barrett, J.H., Orton, D.C., Johnstone, C., Harland, J., Van Neer, W., Ervynck, A., Roberts, C., Locker, A., Amundsen, C., Enghoff, I.B., Hamilton-Dyer, S., Heinrich, D., Hufthammer, A.K., Jones, A.K.G., Jonsson, L., Makowiecki, D., Pope, P., O'Connell, T.C., de Roo, T. & Richards, M.P. 2011. Interpreting the expansion of sea fishing in Medieval Europe using stable isotope analysis of archaeological cod bones. *Journal of Archaeological Science* 38: 1516–1524.

Barrett, J.H. & Richards, M.P. 2004. Identity, gender, religion and economy: new isotope and radiocarbon evidence for marine resource intensification in early historic Orkney, Scotland, UK. *European Journal of Archaeology* 7: 249–271.

Barrett, J.H. & Richards, M.P. 2012. *Feeding the livestock: the stable isotope evidence*, in J.H. Barrett (ed.) *Being an Islander: production and identity at Quoygrew, Orkney, AD 900-1600*: 199–205. Cambridge: McDonald Institute for Archaeological Research.

Barroso, R. 2018. *Etnicidad vs aculturación. Las necrópolis castellanas de los siglos V-VI d.C. y el asentamiento visigodo en la Península Ibérica. Una mirada desde la meseta sur*. Oxford: Archaeopress.

Beaumont, J. 2020. The whole tooth and nothing but the tooth: or why temporal resolution of bone collagen may be unreliable. *Archaeometry* 63: 626–645.

Beaumont, J., Craig-Atkins, E., Buckberry, J.L., Haydock, H., Horne, P., Howcroft, R., Mackenzie, K. & Montgomery, J. 2018. Comparing apples and oranges: why infant bone collagen may not reflect dietary intake in the same way as dentine collagen. *American Journal of Physical Anthropology*.

Beaumont, J., Gledhill, A. & Montgomery, J. 2014. Isotope analysis of incremental human dentine: towards higher temporal resolution. *Bulletin of the International Association of Paleodontology* 8: 212–223.

Beaumont, J. & Montgomery, J. 2015. Oral histories: a simple method of assigning chronological age to isotopic values from human dentine collagen. *Annals of Human Biology* 42: 407–414.

Beavan-Athfield, N. & Mays, S.A. 2009. *Amino-acid and stable-isotope analysis: investigation of bone protein survival and dietary implications*, in C. Scull (ed.) *Early medieval (late 5th-early 8th centuries AD) cemeteries at Boss Hall and Buttermarket, Ipswich, Suffolk*: 222–226. Leeds: The Society for Medieval Archaeology.

Beguiristain, M.A., Etxeberria, F. & Herrasti, L. 2001. Tres tumbas de la etapa Hispano-Goda en Gomacín, Puente la Reina (Navarra). *Cuadernos de Arqueología de la Universidad de Navarra* 9: 223–277.

Bello, S. & Andrews, P. 2006. *The intrinsic pattern of preservation of human skeleton and its influence on the interprettation of funerary behaviours*, in R.L. Gowland & C.J. Knüsel (ed.) *Social archaeology of funerary remains*: 1–13. Oxford: Oxbow Books.

Belmonte, C. 2006. *Una hipòtesi de funcionament de la sagrera de Sant Menna: resultats de l'excavació* *arqueològica realitzada al solar ubicat entre el carrer de Sabadell, 3 i la plaça de Dalt, 10-14 de Sentmenat (Vallès Occidental)*, in *III Congrés d'Arqueologia Medieval i Moderna a Catalunya. Sabadell, del 18 al 21 de maig de 2006*: 707–716. Sabadell: ACRAM.

BENDER, M.M. 1968. Mass spectrometric studies of carbon 13 variations in corn and other grasses. *Radiocarbon* 10: 468–472.

BENSON, A.A. & CALVIN, M. 1950. Carbon dioxide fixation by green plants. *Annual Review of Plant Physiology* 1: 25–42.

BENTLEY, R.A. 2006. Strontium isotopes from the Earth to the archaeological akeleton: a review. *Journal of Archaeological Method and Theory* 13: 135–187.

BIRRELL, J. 2006. *Procuring, preparing, and serving venison in Late Medieval England*, in C.M. Woolgar, D. Serjeantson, & T. Waldron (ed.) *Food in Medieval England. Diet and nutrition*: 176–188. Oxford: Oxford University Press.

BLACK, S. & SCHEUER, L. 1996. Age changes in the clavicle: from the early neonatal period to skeletal maturity. *International Journal of Osteoarchaeology* 6: 425–434.

BOCHERENS, H. & DRUCKER, D.G. 2003. Trophic level isotopic enrichement of carbon and nitrogen in bone collagen: case studies from recent and ancient terrestrial ecosystems. *International Journal of Osteoarchaeology* 13: 46–53.

BOCHERENS, H., FIZET, M., MARIOTTI, A., LANGE-BADRE, B., VANDERMEERSCH, B., BOREL, J.P. & BELLON, G. 1991. Isotopic biogeochemistry (13C,15N) of fossil vertebrate collagen: application to the study of a past food web including Neandertal man. *Journal of Human Evolution* 20: 481–492.

BOCQUET-APPEL, J.-P. & MASSET, C. 1977. Estimateurs en paléodémographie. *L'Homme* 17: 65–90.

BOCQUET-APPEL, J.-P. & MASSET, C. 1982. *Farewell to paleodemography Journal of Human Evolution*.

BOESSNECK, J. 1969. *Osteological differences between sheep (Ovis aries L.) and goat (Capra hircus L.)*, in D.R. Brothwell & E. Higgs (ed.) *Science in Archaeology*: 331–358. New York: Praeger Publications.

BOGAARD, A., HEATON, T.H.E., POULTON, P.R. & MERBACH, I. 2007. The impact of manuring on isotope ratios in cereals: archaeological implications for reconstruction of diet and crop management practices. *Journal of Archaeological Science* 34: 335–343.

BÖHME, H.W. 2002. Der Friedhof von Aldaieta in Kantabrien. Zeugnis für ein fränkisches Schlachtfeld des 6. Jahrhunderts? *Acta Praehistorica et Archaeologica* 34: 135–150.

BONAFINI, M., PELLEGRINI, M., DITCHFIELD, P. & POLLARD, A.M. 2013. Investigation of the 'canopy effect' in the isotope ecology of temperate woodlands. *Journal of Archaeological Science* 40: 3926–3935.

BOURBOU, C., FULLER, B.T., GARVIE-LOK, S.J. & RICHARDS, M.P. 2011. Reconstructing the diets of Greek Byzantine populations (6th-15th centuries AD) using carbon and nitrogen stable isotope ratios. *American Journal of Physical Anthropology* 146: 569–581.

BOURBOU, C., FULLER, B.T., GARVIE-LOK, S.J. & RICHARDS, M.P. 2013. Nursing mothers and feeding bottles: reconstructing breastfeeding and weaning patterns in Greek Byzantine populations (6th–15th centuries AD) using carbon and nitrogen stable isotope ratios. *Journal of Archaeological Science* 40: 3903–3913.

BOUTTON, T.W. 1991. *Stable carbon isotope ratios of natural materials: II. Atmospheric, terrestrial, marine, and freshwater environments*, in D.C. Coleman & B. Fry (ed.) *Carbon isotope techniques*: 173–185. San Diego: Academic Press.

BRAUN, H.I. (ed.) 1994. *The Collected Works of John W. Tukey. Volume VIII. Multiple comparisons*. New York: Chapman & Hall.

BRICKLEY, M.B. 2018. Cribra orbitalia and porotic hyperostosis: a biological approach to diagnosis. *American Journal of Physical Anthropology* 167: 896–902.

BRICKLEY, M.B. & IVES, R. 2008. *The bioarchaeology of metabolic bone disease*. Boston: Elsevier.

BRICKLEY, M.B. & MCKINLEY, J.I. 2004. *Guidelines to the standards for recording human remains (IFA Paper No. 7)*. Reading: BABAO.

BRONK RAMSEY, C. & LEE, S. 2013. Recent and planned developments of the program OxCal. *Radiocarbon* 55: 720–730.

BROOKS, S. & SUCHEY, J.M. 1990. Skeletal age determination based on the os pubis: a comparison of the Acsádi-Nemeskéri and Suchey-Brooks methods. *Human Evolution* 5: 227–238.

Brown, T., Nelson, D.E., Vogel, J.S. & Southon, J.R. 1988. Improved collagen extraction by modified Longin method. *Radiocarbon* 30: 171–177.

Brownlee, E.C. 2020. The dead and their possessions: the declining agency of the cadaver in Early Medieval Europe. *European Journal of Archaeology* 23: 406–427.

Brozou, A., Lynnerup, N., Mannino, M.A., Millard, A.R. & Gröcke, D.R. 2019. Investigating dietary patterns and organisational structure by using stable isotope analysis: a pilot study of the Danish medieval leprosy hospital at Næstved. *Anthropologischer Anzeiger* 76: 167–178.

Buckberry, J.L. & Chamberlain, A.T. 2002. Age estimation from the auricular surface of the illium. A revised method. *American Journal of Physical Anthropology* 119: 231–239.

Buckberry, J.L., Montgomery, J., Towers, J., Müldner, G.H., Holst, M., Evans, J.A., Gledhill, A., Neale, N. & Lee-Thorp, J.A. 2014. Finding Vikings in the Danelaw. *Oxford Journal of Archaeology* 33: 413–434.

Budd, P., Montgomery, J., Barreiro, B. & Thomas, R.G. 2000. Differential diagenesis of strontium in archaeological human dental tissues. *Applied Geochemistry* 15: 687–694.

Buikstra, J.E. & Ubelaker, D.H. (ed.) 1994. *Standards for data collection from human skeletal remains (Proceedings of a Seminar at The Field Museum of Natural History, organized by Jonathan Haas) (Arkansas Archaeological Survey Research Series No. 44)*. Fayeteville: Arkansas Archaeological Survey.

Buonincontri, M.P., Pecci, A., Di Pasquale, G., Ricci, P. & Lubritto, C. 2016. Multiproxy approach to the study of Medieval food habits in Tuscany (central Italy). *Archaeological and Anthropological Sciences*.

Caldas, I.M., Carneiro, J.L., Teixeira, A., Matos, E., Afonso, A. & Magalhaes, T. 2012. Chronological course of third molar eruption in a Portuguese population. *International Journal of Legal Medicine* 126: 107–112.

Calvo, M.J. & Catalán, R. 2007. *La Alameda del Señorío de Illescas (Toledo). Manzanas R-30, R-23 y R-24. Inventario de material*.

Cardoso, H.F.V., Spake, L. & Humphrey, L.T. 2017. Age estimation of immature human skeletal remains from the dimensions of the girdle bones in the postnatal period. *American Journal of Physical Anthropology* 163: 772–783.

Catalán, R. 2013. *Acerca de la 'fíbula de Tiermes'. Una nueva propuesta acerca de su cronología y procedencia a partir del estudio de las fíbulas 'trilaminares' en el territorio de la Meseta*, in J.C. Sastre, R. Catalán, & P. Fuentes (ed.) *Arqueología en el valle del Duero. Del Neolítico a la Antigüedad Tardía: nuevas perspectivas (Actas de las primeras jornadas de jóvenes investigadores en el valle del Duero. Zamora, 16, 17 y 18 de noviembre de 2011)*: 217–226. Madrid: La Ergástula.

Catalán, R. 2014. *De Cabriana Aldaieta: armamento y mundo funerario en el valle de Duero y su entorno (siglos V-VIII)*, in J. Honrado, M.Á. Brezmes, A. Tejeiro, & Ó. Rodríguez Monterrubio (ed.) *Investigaciones arqueológicas en el valle del Duero. Del Neolítico a la Antigüedad tardía. Actas de las Segundas Jornadas de Jóvenes Investigadores del Valle del Duero. León, 25 a 27 de octubre de 2012*: 427–439. Valencia: Glyphos Publicaciones.

Catalán, R. 2015. *Elementos de armamento y mundo funerario en Hispania (siglos V-VIII). Reflexiones teóricas y ejemplos destacados*, in J.A. Quirós & S. Castellanos (ed.) *Identidad y etnicidad en Hispania. Propuestas teóricas y cultura material en los siglos V-VIII (Documentos de Arqueología Medieval 8)*: 291–312. Bilbao: Universidad del País Vasco.

Catalán, R., Calvo, M.J. & Vega, E. 2018. *Estudio preliminar de la cerámica de época visigoda de Alameda del Señorío (Illescas, Toledo). Morfotipos, cronología e interpretación cronocultural de un conjunto cerámica en una aldea altomedieval*, in I. Martín Viso, P. Fuentes, J.C. Sastre, & R. Catalán (ed.) *Cerámicas altomedievales en Hispania y su entorno (siglos V-VIII d.C.)*: 489–513. Valladolid: Glyphos Publicaciones.

Catalán, R. & Rojas, J.M. 2009. *La necrópolis de Boadilla: aspectos funerarios y contexto cronocultural de un asentamiento de época visigoda*, in J. Pinar & T. Juárez (ed.) *Contextos funeraris a la Mediterrània nord-occidental (segles V-VIII) (Gausac 34-35)*: 223–236. Sant Cugat del Vallès: AREDAT.

Cau, M.Á., Riera, M., Salas, M. & Van Strydonck, M. 2014. Radiocarbon dating of the necropolis of the Early Christian site of Son Peretó (Mallorca, Balearic Islands). *Radiocarbon* 56: 399–410.

Caut, S., Angulo, E. & Courchamp, F. 2009. Variation in discrimination factors (Δ15N and Δ13C): the effect of diet isotopic values and applications for diet reconstruction. *Journal of Applied Ecology* 46: 443–453.

Cepeda, J.J. 2019. *Dos iglesias tardoantiguas en el norte de Hispania: San Martín de Finaga (Bizkaia) y Buradón*

(Álava), in J. López Vilar (ed.) *Actas del IV Congrés Tarraco Biennal. VII Reunió d'Arqueologia cristiana Hispànica. Tarragona, 21-24 noviembre 2018*: 243–250. Tarragona: Tarraco Biennal.

Cepeda, J.J. & Cortés, C. 2018. Necrópolis romana de Tribisburu. *Arkeoikuska* 2017: 242–244.

Cepeda, J.J. & Unzueta, M. 2015. Necrópolis de San Martín de Finaga. *Arkeoikuska* 2014: 168–172.

Chamberlain, A.T. 2006. *Demography in Archaeology*. Cambridge: Cambridge University Press.

Chisholm, B.S., Nelson, D.E. & Schwarcz, H.P. 1982. Stable-carbon isotope ratios as a measure of marine versus terrestrial protein in ancient diets. *Science* 216: 1131–1132.

Cohen, A. & Serjeantson, D. 1996. *A manual for the identification of bird bones from archaeological sites*. London: Archetype Publications Ltd.

Cohen, J. 1988. *Statistical power analysis for the behavioral sciences*. Hillsdale: Lawrence Erlbaum Associates.

Cole, G. & Waldron, T. 2019. Cribra orbitalia: dissecting an ill-defined phenomenon. *International Journal of Osteoarchaeology*.

Coll, J.M. 1999. *Rectoria vella església de St. Menna*. Barcelona: Generalitat de Catalunya.

Coll, J.M. 2003. *Can Palau (Sentmenat, Vallès Occidental). Un habitacle rural de l'antiguitat tardana (segle VI)*, in *Actes del II Congrés d'Arqueologia Medieval i Moderna de Catalunya (Sant Cugat del Vallès, del 18 al 21 de abril de 2002)*: 476–480. Sant Cugat del Vallès: ACRAM.

Coll, J.M. 2005. *Memòria de la intervenció arqueològica a l'esglèsia vella de Sant Menna (Sentmenat, Vallès occidental). Juliol 2002*. Sabadell: Arrago S.L.

Coll, J.M. 2011. *Els vidres d'época visigoda a Catalunya: primeres dades*, in *Actes del IV Congrés d'Arqueologia medieval i moderna de Catalunya (Tarragona, del 10 al 13 de juny de 2010)*: 201–209. Tarragona: ACRAM.

Coll, J.M., Molina, J.A. & Roig, J. 1997. L'església vella de Sant Menna (Sentmenat, Vallès Occidental): fase I. (ed.)M. Genera *Annals de l'Institut d'Estudis Gironins* XXXVIII. Barcelona: Generalitat de Catalunya: 1331–1345.

Coll, J.M., Molina, J.A. & Roig, J. 2003. *La rectoria medieval i moderna de l'església vella de Sant Menna (Sentmenat, Vallès Occidental)*, in *Actes del II Congrés d'Arqueologia Medieval i Moderna de Catalunya (Sant Cugat del Vallès, del 18 al 21 de abril de 2002)*: 437–442. Sant Cugat del Vallès: ACRAM.

Coll, J.M. & Roig, J. 2003. *Cerámicas reducidas de cocina de la Antigüedad Tardía en la Catalunya oriental (siglos V-VII)*, in C. Bakirtzes (ed.) *Actes du VIIe congrès international sur la ceràmique médiévale en Méditerranée (Thessalonque 1999)*: 735–738. Athens: Caisse des Recettes Archéologiques.

Coll, J.M. & Roig, J. 2005. Un assentament del neolític i un viatge de l'antiguitat tardana als Horts de Can Torras (Castellas del Vallès, Vallès Occidental). *Recerca* 4: 45–58.

Coll, J.M. & Roig, J. 2006. Un intervenció arqueològica als Horts de Can Torras (Castellar del Vallès): un assentament del neolític i un vilatge de l'antiguitat tardana. *Tribuna d'Arqueologia* 2003–2004: 113–127.

Coll, J.M. & Roig, J. 2008. *Memòria de la intervenció arqueològica als Horts de Can Torras (Castellar del Vallès, Vallès occidental), març-abril 2003*. Sabadell: Arrago S.L.

Coll, J.M. & Roig, J. 2011. *La fi de les vil·les romanes baiximperials a la depressió prelitoral (segles IV-V): contextos estratigràfics i registre material per datar-los*, in *Actes del IV Congrés d'Arqueologia medieval i moderna de Catalunya (Tarragona, del 10 al 13 de juny de 2010)*: 161–172. Tarragona: ACRAM.

Collins, M.J., Hiller, J., Smith, C.I., Roberts, J.P., Prigodich, R.V., Wess, T.J. & Millard, A.R. 2002. The survival of organic matter in bone: a review. *Archaeometry* 44: 383–394.

Colonese, A.C., Lucquin, A., Guedes, E.P., Thomas, R., Best, J., Fothergill, B.T., Sykes, N., Foster, A., Miller, H., Poole, K., Maltby, M., Von Tersch, M. & Craig, O.E. 2017. The identification of poultry processing in archaeological ceramic vessels using in-situ isotope references for organic residue analysis. *Journal of Archaeological Science* 78: 179–192.

Coltrain, J.B., Hayes, M.G. & O'Rourke, D.H. 2004. Sealing, whaling and caribou: the skeletal isotope chemistry of Eastern Arctic foragers. *Journal of Archaeological Science* 31: 39–57.

Contreras, M. 2006. *Evolución del ritual funerario entre los ss. VI y VIII d.C. en el asentamiento de Gózquez de Arriba (San Martín de la Vega, Madrid)*, in J. López Quiroga, J. Morín de Pablos, & A.M. Martínez Tejera (ed.) *Gallia e Hispania en el contexto de la presencia 'germánica' (ss. V-VII). Balance y perspectivas (BAR International Series 1534)*: 273–288. Oxford: Archaeopress.

Contreras, M. 2011. *La necrópolis medieval de Gózquez de Arriba (San Martín de la Vega). Memoria final*.

Madrid: Comunidad de Madrid.

CONTRERAS, M. & FERNÁNDEZ UGALDE, A. 2006. *El espacio funerario en el poblado de época visigoda de Gózquez de Arriba*, in J. Morín de Pablos (ed.) *La investigación arqueológica de la época visigoda en la Comunidad de Madrid (Zona Arqueológica 8)*, II: 517–536. Alcalá de Henares: Museo Arqueológico Regional.

COPLEN, T.B. 2011. Guidelines and recommended terms for expression of stable-isotope-ratio and gas-ratio measurements results. *Rapid Communications in Mass Spectrometry* 25: 2538–2560.

COUNIHAN, C.M. & KAPLAN, S.L. (ed.) 1998. *Food and gender. Identity and power*. London: Routledge.

CRAIG, H. 1957. Isotopic standards for carbon and oxygen and correction factors for mass-spectrometric analysis of carbon dioxide. *Geochimica et Cosmochimica Acta* 12: 133–149.

CRAIG, O.E., BONDIOLI, L., FATTORE, L., HIGHAM, T.F.G. & HEDGES, R.E.M. 2013. Evaluating marine diets through radiocarbon dating and stable isotope analysis of victims of the AD79 eruption of Vesuvius. *American Journal of Physical Anthropology* 152: 345–352.

CRAMÉR, H. 1946. *Mathematical methods of statistics*. Princeton: Princeton University Press.

CURTA, F. 2015. *Social identity on the platter. Clay pans in 6th-7th century ceramic assemblages*, in J. López, M. Kazanski, & V. Ivanisevic (ed.) *Identity and otherness among the barbarians in Late Antiquity and Early Medieval Europe. The problematic relationship between texts and archaeology*. Madrid.

CURTIS-SUMMERS, S., JANET, M. & CARVER, M. 2014. Stable isotope evidence for dietary contrast between Pictish and Medieval populations at Portmahomack, Scotland. *Medieval Archaeology* 58: 21–43.

CZERMAK, A. 2011. *Soziale Stratifizierung im frühen Mittelalter. Aussage- und Nachweismöglichkeiten anhand von biologischen Indikatoren*. München: Ludwig Maximilians Universität.

D'ORTENZIO, L., BRICKLEY, M.B., SCHWARCZ, H.P. & PROWSE, T.L. 2015. You are not what you eat during physiological stress: isotopic evaluation of human hair. *American Journal of Physical Anthropology* 157: 374–388.

DAVIS, S.J.M. 1992. *A rapid method for recording information about mammal bones from archaeological sites (Ancient Monuments Laboratory Report 19/92)*. London: English Heritage.

DE JUAN, J., VIGIL-ESCALERA, A., CÁCERES, Y. & SCHIBILLE, N. 2019. Changes in the supply of eastern Mediterranean glasses to Visigothic Spain. *Journal of Archaeological Science* 107: 23–31.

DE LA RÚA, C., ALONSO, S. & IZAGIRRE, N. 2005. Tradición e innovación de la Antropología Física en el País Vasco. *Munibe* 57: 315–326.

DE LUCA, A., BOISSEAU, N., TEA, I., LOUVET, I., ROBINS, R.J., FORHAN, A., CHARLES, M.-A. & HANKARD, R. 2012. δ15N and δ13C in hair from newborn infants and their mothers: a cohort study. *Pediatric Research* 71: 598–604.

DE MIGUEL, M.P., FONTECHA, L., IZAGIRRE, N. & DE LA RÚA, C. 2016. *Paleopatología, ADN y diferenciación social en la maqbara de Pamplona: límites y posibilidades*, in J.A. Quirós (ed.) *Demografía, paleopatologías y desigualdad social en el noroeste peninsular en época medieval (Documentos de Arqueología Medieval 10)*: 163–181. Bilbao: Universidad del País Vasco.

DEINES, P. 1980. *The isotopic composition of reduced organic carbon*, in P. Fritz & J.C. Fontes (ed.) *Handbook of environmental isotope geochemistry. 1 The terrestrial environment, A*: 329–406. Amsterdam: Elsevier.

DENIRO, M.J. 1985. Postmortem preservation and alteration of in vivo bone collagen isotope ratios in relation to palaeodietary reconstruction. *Nature* 317: 806–809.

DENIRO, M.J. & EPSTEIN, S. 1978. Influence of diet on the distribution of carbon isotopes in animals. *Geochimica et Cosmochimica Acta* 42: 495–506.

DENIRO, M.J. & EPSTEIN, S. 1981. Influence of diet on the distribution of nitrogen isotopes in animals. *Geochimica et Cosmochimica Acta* 45: 341–351.

DIARTE-BLASCO, P. 2016. New thinking in old landscapes: discoveries, research and approaches for Late Antque and Early Medieval Iberia. *Medieval Settlement Research* 31: 1–14.

DÍAZ-DEL-RÍO, P., WATERMAN, A.J., THOMAS, J.T., PEATE, D.W., TYKOT, R.H., MARTÍNEZ-NAVARRETE, M.I. & VICENT, J.M. 2017. Diet and mobility patterns in the Late Prehistory of central Iberia (4000–1400 cal BC): the evidence of radiogenic (87Sr/86Sr) and stable (δ18O, δ13C) isotope ratios. *Archaeological and Anthropological Sciences*.

DITTMANN, K. & GRUPE, G. 2000. Biochemical and palaeopathological investigations on weaning and infant mortality in the early Middle Ages. *Anthropologischer Anzeiger* 58: 345–355.

DOBBERSTEIN, R.C., COLLINS, M.J., CRAIG, O.E., TAYLOR, G.M., PENKMAN, K.E.H. & RITZ-TIMME, S. 2009. Archaeological collagen: why worry about collagen diagenesis? *Archaeological and Anthropological Sciences* 1: 31–42.

Domínguez Fernández, E.G. & López Lancha, R. 2010. *El yacimiento hispanovisigodo de 'Cárcavas' en Illescas (Toledo). Avance de los resultados de la primera fase de la intervención arqueológica preventiva, en un asentamiento de amplia dispersión*, in A. García (ed.) *Espacios urbanos en el Occidente Mediterráneo (s. VI-VIII)*: 183–190. Toledo: Toletum Visigodo.

Domínguez, R.M., Rincón, J. & Vigil-Escalera, A. 2004. *Memoria de las excavaciones arqueológicas en el yacimiento 'La Huelga'. Afectado por el soterramiento de línea eléctrica de 400 kV (Barajas, Madrid)*.

Doppler, T., Gerling, C., Heyd, V., Knipper, C., Kuhn, T., Lehmann, M.F., Pike, A.W.G. & Schibler, J. 2017. Landscape opening and herding strategies: carbon isotope analyses of herbivore bone collagen from the Neolithic and Bronze Age lakeshore site of Zurich-Mozartstrasse, Switzerland. *Quaternary International* 436: 18–28.

Douglas, M. 2001. *Implicit meanings. Selected essays in anthropology (2nd edition) Journal of Chemical Information and Modeling*. Vol. 53. London: Routledge.

Drucker, D.G., Bridault, A., Hobson, K.A., Szuma, E. & Bocherens, H. 2008. Can carbon-13 in large herbivores reflect the canopy effect in temperate and boreal ecosystems? Evidence from modern and ancient ungulates. *Palaeogeography, Palaeoclimatology, Palaeoecology* 266: 69–82.

Duday, H. 2006. *Archaeothanatology or the archaeology of death*, in R.L. Gowland & C.J. Knüsel (ed.) *Social archaeology of funerary remains*: 31–56. Oxford: Oxbow Books.

Dufour, É., Bocherens, H. & Mariotti, A. 1999. Palaeodietary implications of isotopic variability in Eurasian lacustrine fish. *Journal of Archaeological Science* 26: 617–627.

Dunn, O.J. 1964. A note on multiple comparisons using rank sums. *Technometrics* 7: 241–252.

Dupras, T.L. 2010. *The use of stable isotope analysis to determine infant and young child feeding patterns*, in T. Moffat & T.L. Prowse (ed.) *Human diet and nutrition in biocultural perspective. Past meets present*: 89–108. New York: Berghahn Books.

Dyer, C.C. 2006. *Seasonal patterns in food consumption in the Later Middle Ages*, in C.M. Woolgar, D. Serjeantson, & T. Waldron (ed.) *Food in Medieval England. Diet and nutrition*: 201–214. Oxford: Oxford University Press.

Ervynck, A., Deckers, P., Lentacker, A., Tys, D. & Van Neer, W. 2012. *'Leffinge-Oude Werf': the first archaeozoological collection from a terp settlement in coastal Flanders*, in D.C.M. Raemaekers, E. Esser, R.C.G.M. Lauwerier, & J.T. Zeiler (ed.) *A bouquet of archaeozoological studies. Essays in honour of Wietske Prummel*: 149–160. Groningen: University of Groninger Library.

Ervynck, A., Lentacker, A., Müldner, G.H., Richards, M.P. & Dobney, K. 2007. *An investigation into the transition from forest dwelling pigs to farm animals in medieval Flanders, Belgium*, in U. Albarella, K. Dobney, A. Ervynck, & P. Rowley-Conwy (ed.) *Pigs and humans. 10,000 years of interaction*: 171–193. Oxford: Oxford University Press.

Estaca-Gómez, V., Malalana-Ureña, A., Yravedra, J., Matás, G.J. & Morín de Pablos, J. 2019. Economic implications of livestock management strategies in the center of the Iberian Peninsula, Tagus Basin, and Mancha Alta region between the VIII and XI centuries AD. *Archaeological and Anthropological Sciences* 11: 1289–1305.

Fagernäs, Z., García-Collado, M.I., Hendy, J., Hofman, C.A., Speller, C., Velsko, I.M. & Warinner, C. 2020. A unified protocol for simultaneous extraction of DNA and proteins from archaeological dental calculus. *Journal of Archaeological Science* 118: 105135.

Falys, C.G. & Lewis, M.E. 2011. Proposing a way forward: a review of standardisation in the use of age categories and ageing techniques in osteological analysis (2004-2009). *International Journal of Osteoarchaeology* 21: 704–716.

Faro, J.A., García-Barberena, M. & Unzu, M. 2008. Pamplona y el Islam. Nuevos testimonios arqueológicos. *Trabajos de Arqueología Navarra* 20: 229–284.

Farquhar, G.D., Ehleringer, J.R. & Hubick, K.T. 1989. Carbon isotope discrimination and photosynthesis. *Annual Review of Plant Physiology and Plant Molecular Biology* 40: 503–537.

Fazekas, I.G. & Kósa, F. 1978. *Forensic fetal osteology*. Budapest: Akadémiai Kiadó.

Fernandes, R., Nadeau, M.J. & Grootes, P.M. 2012. Macronutrient-based model for dietary carbon routing in bone collagen and bioapatite. *Archaeological and Anthropological Sciences* 4: 291–301.

Fernández-Crespo, T. 2011a. *Estudio arqueo-antropológico de las inhumaciones tardorromanas, tardoantiguas y altomedievales de la necrópolis de San Martín de Dulantzi (Álava)*. Vitoria-Gasteiz: Centro de Patrimonio Cultural Vasco.

Fernández-Crespo, T. 2011b. *Caracterización antropológica de los individuos plenomedievales de la necrópolis de San Martín (Alegría-Dulantzi, Álava)*. Vitoria-Gasteiz.

Fernández-Martínez, P., Maurer, A.-F., Jiménez-Morillo, N.T., Botella, M., López, B. & Barrocas, C. 2020. Bone stable isotope data of the Late Roman population (4th-7th centuries CE) from Mondragones (Granada): a dietary reconstruction in a Roman villa context of south-eastern Spain. *Journal of Archaeological Science: Reports* 33: 102566.

Fernández de Ortega, I. 2007. *Hidrogeología de las sierras de Badaia y Arkamo (u.h. calizas de Subijana, País Vasco): investigación mediante aplicación conjunta de diversas técnicas con especial incidencia en la dinámica intrapozo*. Leioa: Universidad del País Vasco/Euskal Herriko Unibertsitatea.

Fernández Domínguez, E., Gamba, C., Arroyo-Pardo, E., Vigil-Escalera, A., Vírseda, L. & Barrio, P.A. 2009. *Resultados del análisis de ADN mitocondrial de 30 muestras de 3 necrópolis altomedievales de la C.A.M.*, in *Actas de las Cuartas Jornadas de Patrimonio Arqueológico de la Comunidad de Madrid*: 301–305. Madrid: Comunidad de Madrid. Dirección General de Patrimonio Histórico.

Fernández Mier, M. 2015. *La articulación social de la Alta Edad Media asturiana*, in J.A. Quirós & S. Castellanos (ed.) *Identidad y etnicidad en Hispania. Propuestas teóricas y cultura material en los siglos V-VIII (Documentos de Arqueología Medieval 8)*: 181–200. Bilbao: Universidad del País Vasco.

Ferrio, J.P., Alonso, N., Voltas, J. & Araus, J.L. 2006. Grain weight changes over time in ancient cereal crops: Potential roles of climate and genetic improvement. *Journal of Cereal Science* 44: 323–332.

Field, A. 2018. *Discovering statistics using IBM SPSS Statistics*. Los Ángeles: Sage Edge.

Filloy, I. 1995. Carretera A-3112 (entre Dallo y Alegría). *Arkeoikuska* 1994: 333.

Fisher, R.A. 1922. On the interpretation of χ2 from continguency tables, and the calculation of p. *Journal of the Royal Statistical Society* 85: 87–94.

Fogel, M.L., Tuross, N. & Owsley, D.W. 1989. Nitrogen isotope tracers of human lactation in modern and archaeological populations. *Carniege Institution of Washington Yearbook* 88: 111–117.

Fontanals-Coll, M., Subirà, M.E., Díaz-Zorita, M., Duboscq, S. & Gibaja, J.F. 2015. Investigating palaeodietary and social differences between two differentiated sectors of a Neolithic community, La Bòbila Madurell-Can Gambús (north-east Iberian Peninsula). *Journal of Archaeological Science: Reports* 3: 160–170.

Fontecha, L., Hervella, M., López, S., de Miguel, M.P., Alonso, S., Izagirre, N. & de la Rúa, C. 2012. *Variabilidad genética de la población adulta de la maqbara de Pamplona (Navarra, s. VIII)*, in D. Turbón, L. Fañanás, C. Rissech, & A. Rosa (ed.) *Biodiversidad humana y evolución*: 417–420. Barcelona: Sociedad Española de Antropología Física.

France, R.L. 1995a. Differentiation between littoral and pelagic food webs in lakes using stable carbon isotopes. *Limnology and Oceanography* 40: 1310–1313.

France, R.L. 1995b. Stable nitrogen isotopes in fish: literature synthesis on the influence of ecotonal coupling. *Estuarine, Coastal and Shelf Science* 41: 737–742.

France, R.L. & Peters, R.H. 1997. Ecosystem differences in the trophic enrichment of 13C in aquatic food webs. *Canadian Journal of Fisheries and Aquatic Sciences* 54: 1255–1258.

Fraser, R.A., Bogaard, A., Charles, M., Styring, A.K., Wallace, M., Jones, G., Ditchfield, P. & Heaton, T.H.E. 2013. Assessing natural variation and the effects of charring, burial and pre-treatment on the stable carbon and nitrogen isotope values of archaeobotanical cereals and pulses. *Journal of Archaeological Science* 40: 4754–4766.

Fraser, R.A., Bogaard, A., Heaton, T.H.E., Charles, M., Jones, G., Christensen, B.T., Halstead, P., Merbach, I., Poulton, P.R., Sparkes, D. & Styring, A.K. 2011. Manuring and stable nitrogen isotope ratios in cereals and pulses: towards a new archaeobotanical approach to the inference of land use and dietary practices. *Journal of Archaeological Science* 38: 2790–2804.

Frémondeau, D., De Cupere, B., Evin, A. & Van Neer, W. 2017. Diversity in pig husbandry from the Classical-Hellenistic to the Byzantine periods: an integrated dental analysis of Düzen Tepe and Sagalassos assemblages

(Turkey). *Journal of Archaeological Science: Reports* 11: 38–52.

Froehle, A.W., Kellner, C.M. & Schoeninger, M.J. 2010. Effect of diet and protein source on carbon stable isotope ratios in collagen: Follow up to Warinner and Tuross (2009). *Journal of Archaeological Science* 37: 2662–2670.

Fry, B. 2006. *Stable isotope ecology Stable Isotope Ecology*. New York: Springer.

Fry, B. & Sherr, E.B. 1988. *δ13C measurements as indicators of carbon flow in marine and freshwater ecosystems*, in P.W. Rundel, J.R. Ehleriinger, & K.A. Nagy (ed.) *Stable isotopes in ecological research*: 196–229. New York: Springer.

Fuller, B.T., De Cupere, B., Marinova, E., Van Neer, W., Waelkens, M. & Richards, M.P. 2012. Isotopic reconstruction of human diet and animal husbandry practices during the Classical-Hellenistic, imperial, and Byzantine periods at Sagalassos, Turkey. *American Journal of Physical Anthropology* 149: 157–171.

Fuller, B.T., Fuller, J.L., Harris, D.A. & Hedges, R.E.M. 2006. Detection of breastfeeding and weaning in modern human infants with carbon and nitrogen stable isotope ratios. *American Journal of Physical Anthropology* 129: 279–293.

Fuller, B.T., Fuller, J.L., Sage, N.E., Harris, D.A., O’Connell, T.C. & Hedges, R.E.M. 2004. Nitrogen balance and δ15N: why you’re not what you eat during pregnancy. *Rapid Communications in Mass Spectrometry* 18: 2889–2896.

Fuller, B.T., Fuller, J.L., Sage, N.E., Harris, D.A., O’Connell, T.C. & Hedges, R.E.M. 2005. Nitrogen balance and δ15N: why you’re not what you eat during nutritional stress. *Rapid Communications in Mass Spectrometry* 19: 2497–2506.

Fuller, B.T., Márquez-Grant, N. & Richards, M.P. 2010. Investigation of diachronic dietary patterns on the islands of Ibiza and Formentera, Spain: evidence from carbon and nitrogen isotope ratio analysis. *American Journal of Physical Anthropology* 143: 512–522.

Fuller, B.T., Molleson, T.I., Harris, D.A., Gilmour, L.T. & Hedges, R.E.M. 2006. Isotopic evidence for breastfeeding and possible adult dietary differences from Late/Sub-Roman Britain. *American Journal of Physical Anthropology* 129: 45–54.

Fuller, B.T., Richards, M.P. & Mays, S.A. 2003. Stable carbon and nitrogen isotope variations in tooth dentine serial sections from Wharram Percy. *Journal of Archaeological Science* 30: 1673–1684.

Galloway, J.H. 2005. *The sugar cane industry. An historical geography from its origins to 1914*. Cambridge: Cambridge University Press.

Ganzarolli, G., Alexander, M.M., Chavarría, A. & Craig, O.E. 2018. Direct evidence from lipid residue analysis for the routine consumption of millet in Early Medieval Italy. *Journal of Archaeological Science* 96: 124–130.

García-Collado, M.I. 2016. *Food consumption patterns and social inequality in an early medieval rural community in the centre of the Iberian Peninsula*, in J.A. Quirós (ed.) *Social complexity in early medieval rural communities. The north-western Iberian archaeological record*: 59–78. Oxford: Archaeopress.

García-Collado, M.I. 2019a. *Intervención arqueológica y puesta en valor de la necrópolis de Santa Eulalia (Navaridas, Rioja Alavesa). Informe osteoarqueológico y análisis de isótopos estabes de carbono y nitrógeno de la población humana*. Vitoria-Gasteiz: Qark Arqueología S.L.

García-Collado, M.I. 2019b. *Informe osteoarqueológico de la población enterrada en el castillo de Viguera (La Rioja)*. Vitoria-Gasteiz.

García-Collado, M.I. 2020. *El consumo de carne en las comunidades rurales altomedievales de la peninsula ibérica desde una perspectiva isotópica*, in B. del Bo & I. Santos (ed.) *Carne e macellai tra Italia e Spagna nel Medioevo*: 36–50. Milano: FrancoAngeli.

García-Collado, M.I., Ricci, P., Catalán, R., Altieri, S., Lubritto, C. & Quirós, J.A. 2019. Palaeodietary reconstruction as an alternative approach to poorly preserved early medieval human bone assemblages: the case of Boadilla (Toledo, Spain). *Archaeological and Anthropological Sciences* 11: 3765–3782.

García-Guixé, E., Subirà, M.E., Marlasca, R. & Richards, M.P. 2010. δ13C and δ15N in ancient and recent fish bones from the Mediterranean Sea. *Journal of Nordic Archaeological Science* 17: 83–92.

García-Rubio, A. 2007. *Anejo: Informe antropológico (Encadenado/El Soto, Barajas)*, in A. Vigil-Escalera & L. Vírseda (ed.) *Memoria: Excavación arqueológica en el yacimiento ‘Encadenado/El Soto’. Campaña 2005 (Barajas, Madrid)*: 163–192. Madrid: ÁREA Sociedad Cooperativa Madrileña.

García Camino, I. 1996. Bilbao: de la prehistoria a la fundación de la villa. *Bidebarrieta. Revista de Humanidades y Ciencias Sociales de Bilbao* 1: 67–97.

García Camino, I. 2001. La aportación de la arqueología al estudio del tránsito entre la antigüedad y el medievo en Bizkaia. *Arqueología y territorio medieval* 8: 97–112.

García Camino, I. 2002. *Arqueología y poblamiento en Bizkaia, siglos VI-XII. La configuración de la sociedad feudal*. Bilbao: Diputación Foral de Bizkaia.

García Camino, I. 2004. Arqueología medieval en Bizkaia: hipótesis y perspectivas de investigación. *Kobie. Serie Anejos* 6: 537–558.

García Camino, I. 2011. *Arqueología de la Alta Edad Media en el País Vasco Cantábrico*, in J.A. Quirós (ed.) *Vasconia en la Alta Edad Media 450-1000. Poderes y comunidades rurales en el Norte Peninsular (Documentos de Arqueología Medieval 2)*: 145–161. Bilbao: Univers.

García Camino, I. 2016. Espacios de frontera y arqueología entre la antigüedad y la Alta Edad Media. El caso de Vasconia. *Anejos de Nailos* 3: 191–219.

García Camino, I. & Unzueta, M. 1995. Necrópolis de San Martín de Finaga (Basauri). *Arkeoikuska* 1994: 339–344.

García Camino, I. & Unzueta, M. 1996. Necrópolis de San Martín de Finaga (Basauri). *Arkeoikuska* 1995: 435–439.

García Moreno, L.A. 1986. El campesino hispanovisigodo entre bajos rendimientos y catástrofes naturales. Su incidencia demográfica. *Antigüedad y Cristianismo: Monografías históricas sobre la Antigüedad Tardía* III: 171–187.

Garvie-Lok, S.J. 2001. *Loaves and Fishes: a stable isotope reconstruction of diet in Medieval Greece*. Calgary: University of Calgary.

Geber, J. 2010. *Osteological report*, in J. Lehane & F. Delaney (ed.) *Archaeological Excavation Report E3770. Owenbristy, Co. Galway. Cashel and burial ground (Eachtra Journal 8)*: 131–348. Cork: Eachtra Archaeological Projects.

Gesch, D.B., Verdin, K.L. & Greenlee, S.K. 1999. New land surface digital elevation model covers the Earth. *Eos* 80: 69–70.

Giorgi, F., Bartoli, F., Iacumin, P. & Mallegni, F. 2005. Oligoelements and isotopic geochemistry: a multidisciplinary approach to the reconstruction of the paleodiet. *Human Evolution* 20: 55–82.

Gómez de la Torre-Verdejo, A. 2017. *El vidrio en la submeseta sur en época visigoda, siglos VI y VII. Tipología, producción y uso en ámbitos urbano y rural*. Alcalá de Henares: Universidad de Alcalá de Henares.

Goude, G. & Fontugne, M. 2016. Carbon and nitrogen isotopic variability in bone collagen during the Neolithic period: influence of environmental factors and diet. *Journal of Archaeological Science* 70: 117–131.

Gowland, R.L. 2007. *Age, ageism and osteological bias: the evidence from late Roman Britain*, in M. Harlow & R. Laurence (ed.) *Age and ageing in the Roman empire*: 153–169. Portsmouth: Journal of Roman Archaeology (Supplementary Series Number 65).

Gowland, R.L. & Halcrow, S.E. (ed.) 2020. *The mother-infant nexus in anthropology. Small beginnings, significant outcomes*. Cham: Springer.

Grandal-d'Anglade, A. & Bello, J.M. 2018. Nuevos elementos sobre la vida y la muerte en Brigantium a finales del Imperio Romano. La tumba de la Casa Martelo (A Coruña). *Férvedes* 9: 187–196.

Grandal-d'Anglade, A., Serrulla, F., Tomás, V., Pérez Rama, M., Gómez, M. & Ramil, E. 2015. Vida y muerte de dos mujeres de Brigantium (NW de Iberia) mediante isótopos estables y antropología forense. *Cadernos do Laboratorio Xeolóxico de Laxe* 38: 45–66.

Grant, A. 1982. *The use of tooth wear as a guide to the age of domestic ungulates*, in B. Wilson, S. Grigson, & S. Payne (ed.) *Ageing and sexing of animal bones from archaeological sites*: 91–108. Oxford: British Archaeological Reports.

Grassi, F., Quirós, J.A., Alonso, A., Ortega, L.Á. & Fornacelli, C. 2017. State formation in early medieval Castile: craft production and social complexity. *Antiquity* 91.

Grau-Sologestoa, I. 2013a. *El registro faunístico de los asentamientos rurales altomedievales*, in J.A. Quirós (ed.) *El poblamiento rural de época visigoda en Hispania. Arqueología del campesinado en el interior peninsular (Documentos de Arqueología Medieval 6)*: 329–344. Bilbao: Universidad del País Vasco.

Grau-Sologestoa, I. 2013b. Zooarqueología de las aldeas y villas en el País Vasco: actividad ganadera y usos animales en la Edad Media (siglos V-XV). *Debates de Arqueología Medieval* 3: 99–116.

Grau-Sologestoa, I. 2014. Waste management at early medieval rural sites in northern Spain: Taphonomic issues for interpreting faunal remains. *Quaternary International* 330: 97–108.

Grau-Sologestoa, I. 2015a. *The zooarchaeology of medieval Alava in its Iberian context (BAR International Series 2769)*. Oxford: Archaeopress.

Grau-Sologestoa, I. 2015b. Livestock management in Spain from Roman to post-medieval times: a biometrical analysis of cattle, sheep/goat and pig. *Journal of Archaeological Science* 54: 123–134.

Grau-Sologestoa, I. 2016. *Faunal remains and social inequality in the Basque Country during the Early Middle Ages*, in J.A. Quirós (ed.) *Social complexity in early medieval rural communities. The north-western Iberian archaeological record*: 47–58. Oxford: Archaeopress.

Grau-Sologestoa, I. 2017. *La ganadería en el País Vasco entre los siglos VI y X: evidencia zooarqueológica*, in S. Villar & M. García García (ed.) *Ganadería y arqueología medieval*: 59–71. Granada: Alhulia.

Gregoricka, L.A. & Sheridan, S.G. 2013. Ascetic or affluent? Byzantine diet at the monastic community of St. Stephen’s, Jerusalem from stable carbon and nitrogen isotopes. *Journal of Anthropological Archaeology* 32: 63–73.

Guede, I., Ortega, L.Á., Zuluaga, M.C., Alonso-Olazabal, A., Murelaga, X., Pina, M., Gutiérrez, F.J. & Iacumin, P. 2017. Isotope analyses to explore diet and mobility in a medieval Muslim population at Tauste (NE Spain). *PLoS ONE* 12: e0176572.

Guede, I., Ortega, L.Á., Zuluaga, M.C., Alonso-Olazabal, A., Murelaga, X. & Quirós, J.A. 2013. Evaluación de la diagénesis en huesos arqueológicos y caracterización de la relación 87Sr/86Sr local en la evaluación de migraciones humanas. *Geogaceta* 54: 71–74.

Guede, I., Ortega, L.Á., Zuluaga, M.C., Alonso-Olazabal, A., Murelaga, X., Solaun, J.L., Sánchez Pinto, I. & Azkarate, A. 2017. Isotopic evidence for the reconstruction of diet and mobility during village formation in the Early Middle Ages: Las Gobas (Burgos, northern Spain). *Archaeological and Anthropological Sciences*.

Guede, I., Zuluaga, M.C., Ortega, L.Á., Alonso-Olazabal, A., Murelaga, X., García Camino, I. & Iacumin, P. 2020. Social structuration in medieval rural society based on stable isotope analysis of dietary habits and mobility patterns: San Juan de Momoitio (Biscay, north Iberian Peninsula). *Journal of Archaeological Science: Reports* 31: 102300.

Guiry, E.J. 2012. Dogs as analogs in stable isotope-based human paleodietary reconstructions: a review and considerations for future use. *Journal of Archaeological Method and Theory* 19: 351–376.

Gustafson, G. & Koch, G. 1974. Age estimation up to 16 years of age based on dental development. *Odontologisk revy* 25: 297–306.

Gutiérrez Cuenca, E. & Hierro, J.Á. 2019. *Riocueva, una cueva sepulcral de época visigoda (siglos VII-VIII) en la zona costera de Cantabria*, in A. García Álvarez-Busto, C. García de Castro, & S. Ríos (ed.) *130 aniversario del origen del Reino de Asturias. Congreso internacional. Del fin de la Antigüedad Tardía a la Alta Edad Media en la península ibérica (650-900) (Anejos de Nailos 5)*: 515–529. Oviedo: Asociación de Profesionales Independientes de la Arqueología de Asturias.

Gutiérrez Cuenca, E., Hierro, J.Á., López-Doriga, I. & Martín Seijo, M. 2016. Fires in the dark. Wood and charcoal analysis of the early medieval funerary deposits in the cave of Riocueva (Cantabria, Spain). *Estudos do Quaternário* 16: 73–85.

Gutiérrez Lloret, S. 2013. *De Teodomiro a Tudmīr. Los primeros tiempos desde la arqueología (s. VII-IX)*, in *De Mahoma a Carlomagno. Los primeros tiempos (siglos VII-IX) XXXIX Semana de Estudios Medievales. Estella, 17-20 julio 2012*: 229–283. Pamplona: Gobierno de Navarra.

Gutiérrez Lloret, S. 2015. *Early Al-Andalus: an archaeological approach to the process of islamization in the Iberian peninsula (7th to 10th centuries)*, in S. Gelichi & R. Hodges (ed.) *New directions in early medieval European archaeology: Spain and Italy compared. Essays for Riccardo Francovich (HAMA 24)*: 43–85. Turnhout.

Haavikko, K. 1970. The formation and the alveolar and clinical eruption of the permanent teeth: an orthopantomographic study. *Proceedings of the Finnish Dental Society* 66: 101–170.

Hakenbeck, S.E., Evans, J.A., Chapman, H. & Fóthi, E. 2017. Practising pastoralism in an agricultural environment: an isotopic analysis of the impact of the Hunnic incursions on Pannonian populations. *PLoS ONE* 12: e0173079.

HAKENBECK, S.E., MCMANUS, E., GEISLER, H., GRUPE, G. & O'CONNELL, T.C. 2010. Diet and mobility in Early Medieval Bavaria: a study of carbon and nitrogen stable isotopes. *American Journal of Physical Anthropology* 143: 235–249.

HALFFMAN, C.M. & VELEMÍNSKÝ, P. 2015. Stable isotope evidence for diet in early medieval Great Moravia (Czech Republic). *Journal of Archaeological Science: Reports* 2: 1–8.

HALLEY, D.J. & ROSVOLD, J. 2014. Stable isotope analysis and variation in medieval domestic pig husbandry practices in northwest Europe: absence of evidence for a purely herbivorous diet. *Journal of Archaeological Science* 49: 1–5.

HALSALL, G. 2011. Ethnicity and early medieval cemeteries. *Arqueología y territorio medieval* 18: 15–27.

HALSTEAD, P., COLLINS, P. & ISAAKIDOU, V. 2002. Sorting the sheep from the goats: morphological distinctions between the mandibles and mandibular teeth of adult Ovis and Capra. *Journal of Archaeological Science* 29: 545–553.

HALSTEAD, P. & O'SHEA, J. 2004. *Introduction: cultural responses to risk and uncertainty*, in P. Halstead & J. O'Shea (ed.) *Bad year economics: cultural responses to risk and uncertainty*: 1–7. Cambridge: Cambridge University Press.

HAMEROW, H., BOGAARD, A., CHARLES, M., RAMSEY, C., THOMAS, R., FORSTER, E., HOLMES, M., MCKERRACHER, M., NEIL, S. & STROUD, E. 2019. Feeding Anglo-Saxon England: the bioarchaeology of an agricultural revolution. *Antiquity* 93: 1–4.

HAMMOND, C. & O'CONNOR, T. 2013. Pig diet in medieval York: carbon and nitrogen stable isotopes. *Archaeological and Anthropological Sciences* 5: 123–127.

HANNAH, E.L., MCLAUGHLIN, T.R., KEAVENEY, E.M. & HAKENBECK, S.E. 2018. Anglo-Saxon diet in the Conversion period: a comparative isotopic study using carbon and nitrogen. *Journal of Archaeological Science: Reports* 19: 24–34.

HÄRKE, H. 2011. Anglo-Saxon immigration and ethnogenesis. *Medieval Archaeology* 55: 1–28.

HARTNETT, K.M. 2010. Analysis of age-at-death estimation using data from a new, modern autopsy sample - Part I: pubic bone. *Journal of Forensic Sciences* 55: 1145–1151.

HASTORF, C.A. 2017. *The Social Archaeology of Food. Thinking about eating from Prehistory to the present*. Cambridge: Cambridge University Press.

HEATON, T.H.E. 1987. The 15N/14N ratios of plants in South Africa and Namibia: relationship to climate and coastal/saline environments. *Oecologia* 74: 236–246.

HEATON, T.H.E. 1999. Spatial, species, and temporal variations in the 13C/12C ratios of C3 plants: implications for palaeodiet studies. *Journal of Archaeological Science* 26: 637–649.

HEATON, T.H.E., VOGEL, J.C., VON LA CHEVALLERIE, G. & COLLETT, G. 1986. Climatic influence on the isotopic composition of bone nitrogen. *Nature* 322: 822–823.

HEDGES, R.E.M. 2002. Bone diagenesis: an overview of processes. *Archaeometry* 44: 319–328.

HEDGES, R.E.M. 2009. *Studying human diet*, in C. Gosden, B. Cunliffe, & R.A. Joyse (ed.) *The Oxford Handbook of Archaeology*: 484–512. Oxford: Oxford University Press.

HEDGES, R.E.M., CLEMENT, J.G., THOMAS, D.L. & O'CONNELL, T.C. 2007. Collagen turnover in the adult femoral mid-shaft: modeled from anthropogenic radiocarbon tracer measurements. *American Journal of Physical Anthropology* 133: 808–816.

HEDGES, R.E.M. & REYNARD, L.M. 2007. Nitrogen isotopes and the trophic level of humans in archaeology. *Journal of Archaeological Science* 34: 1240–1251.

HEDGES, R.E.M., STEVENS, R.E. & KOCH, P.L. 2006. *Isotopes in bones and teeth*, in M.J. Leng (ed.) *Isotopes in palaeoenvironmental research. Volume 10. Developments in paleoenviromental research*: 117–145. Dordrecht: Springer.

HEMER, K.A., LAMB, A.L., CHENERY, C.A. & EVANS, J.A. 2016. A multi-isotope investigation of diet and subsistence amongst island and mainland populations from early medieval western Britain. *American Journal of Physical Anthropology*.

HERNÁNDEZ-BELOQUI, B., BURJACHS, F. & IRIARTE-CHIAPUSSO, M.J. 2013. *Antropización en el paisaje vegetal de época* *visigoda en el centro peninsular a través del registro paleopaninológico*, in J.A. Quirós (ed.) *El poblamiento rural de época visigoda en Hispania. Arqueología del campesinado en el interior peninsular (Documentos de Arqueología Medieval 6)*: 345–356. Bilbao: Universidad del País Vasco.

Hernández-Beloqui, B., Iriarte-Chiapusso, M.J., Echazarreta-Gallego, A. & Ayerdi, M. 2015. The Late Holocene in the western Pyrenees: a critical review of the current situation of palaeopalynological research. *Quaternary International* 364: 78–85.

Hernando, R. & Iguácel, P. 1994. La Arboleda: enterramiento de época hispano-visigoda; Illescas (Toledo). *Espacio, tiempo y forma. Serie II, historia antigua* 7: 237–248.

Herold, M. 2008. *Sex differences in mortality in Lower Austria and Vienna in the Early Medieval period: an investigation and evaluation of possible contributing factors*. Wien: Universität Wien.

Hervella, M., Izagirre, N., Alonso, S. & de la Rúa, C. 2009. *Tópicos y nuevas interpretaciones en la Antropología Física a la luz del análisis del ADN antiguo*, in A. Llanos (ed.) *Actas del Congreso Internacional Medio siglo de arqueología en el Cantábrico oriental y su entorno*: 953–962. Vitoria-Gasteiz: Diputación Foral de Álava, Instituto Alavés de Arqueología.

Hierro, J.Á. 2018. *Los objetos de época visigoda de la cueva de Los Goros, sesenta años después*, in E. Gutiérrez Cuenca, J.Á. Hierro, & R. Bolado (ed.) *Septem! Homenaje a Alberto Gómez Castanedo*: 177–191. Santander: Acanto.

Higham, T.F.G., Warren, R., Belinskij, A., Härke, H. & Wood, R. 2010. Radiocarbon dating, stable isotope analysis, and diet-derived offsets in 14C ages from the Klin-Yar site, Russian North Caucasus. *Radiocarbon* 52: 653–670.

Higuero, A. 2015. Sesgos de género en la interpretación de los restos óseos humanos. *Journal of Feminist, Gender and Women Studies* 2: 49–55.

Hillson, S.W. 2005. *Teeth*. Cambridge: Cambridge University Press.

Hobson, K.A. 1999. Tracing origins and migration of wildlife using stable isotopes: a review. *Oecologia* 120: 314–326.

Hobson, K.A., Alisauskas, R.T. & Clark, R.G. 1993. Stable nitrogen isotope enrichment in avian tissues due to fasting and nutritional stress: implications for isotopic analyses of diet. *The Condor* 95: 388.

Hoefs, J. 2018. *Stable isotope geochemistry*. Cham: Springer.

Hoppa, R.D. & Vaupel, J.W. 2002. *The Rostock manifesto for paleodemography: the way from stage to age*, in R.D. Hoppa & J.W. Vaupel (ed.) *Paleodemography: age distributions from skeletal samples*: 1–8. Cambridge: Cambridge University Press.

Howland, M.R., Corr, L.T., Young, S.M.M., Jones, V., Jim, S., van der Merwe, N.J., Mitchell, A.D. & Evershed, R.P. 2003. Expression of the dietary isotope signal in the compound-specific d13C values of pig bone lipids and amino acids. *International Journal of Osteoarchaeology* 13: 54–65.

Iacumin, P., Galli, E., Cavalli, F. & Cecere, L. 2014. C4-consumers in southern Europe: the case of Friuli V.G. (NE-Italy) during Early and Central Middle Ages. *American Journal of Physical Anthropology* 154: 561–574.

Ibáñez, A. & Moraza, A. 2005. Evolución cronotipológica de las inhumaciones medievales en el Cantábrico Oriental: el caso de Santa María la Real de Zarautz (Gipuzkoa). *Munibe* 57: 419–434.

Inserra, F., Pecci, A., Cau, M.Á. & Roig, J. 2015a. *Food habits and ceramic use in Late Antique Catalonia: residue analysis on cooking wares from the archaeological site of Can Gambús-1 (Sabadell, Catalonia, Spain)*, in *1st International Conference on Metrology for Archaeology. Proceedings*: 176–179. Benevento: University of Sannio, University of Salerno.

Inserra, F., Pecci, A., Cau, M.Á. & Roig, J. 2015b. Organic residues analysis of Late Antique pottery from Plaça Major-Horts de Can Torras (Castellar del Vallés, Catalonia, Spain). *Periodico di Mineralogia* 84: 123–138.

Inskip, S.A., Taylor, G.M., Zakrzewski, S.R., Mays, S.A., Pike, A.W.G., Llewellyn, G., Williams, C.M., Lee, O.Y.C., Wu, H.H.T., Minnikin, D.E., Besra, G.S. & Stewart, G.R. 2015. Osteological, biomolecular and geochemical examination of an Early Anglo-Saxon case of lepromatous leprosy. *PLoS ONE* 10: e0124282.

Iriarte, A. 1998. La necrópolis de San Pelayo (Alegría-Dulantzi, Álava) y la cuestión de la fecha de inicio de las necrópolis de tipo merovingio en Álava. *Cuadernos de Arqueología de la Universidad de Navarra* 6: 139–163.

Iscan, M.Y., Loth, S.R. & Wright, R.K. 1984. Age estimation from the rib by phase analysis: white males. *Journal of Forensic Sciences* 29: 1094–1104.

Iscan, M.Y., Loth, S.R. & Wright, R.K. 1985. Age estimation from the rib by phase analysis: white females. *Journal of Forensic Sciences* 30: 853–863.

Izagirre, N., Alonso, S. & de la Rúa, C. 2005. Descifrando los mensajes del pasado: análisis del ADN antiguo. *Munibe* 57 (Homena: 327–335.

Izagirre, N., Alzualde, A., Alonso, S., Paz, L., Alonso, A. & de la Rúa, C. 2005. Rare haplotypes in mtDNA: Applications in the analysis of biosocial aspects of past human populations. *Human Biology* 77.4: 443–456.

Izagirre, N., Alzualde, A., Hervella, M., Alonso, S., Alonso, A., Azkarate, A. & de la Rúa, C. 2009. *Interpretación antropológica de la población humana de Aldaieta (s. VI-VII, Álava)*, in A. Llanos (ed.) *Actas del Congreso Internacional Medio siglo de arqueología en el Cantábrico oriental y su entorno*: 911–924. Vitoria-Gasteiz: Diputación Foral de Álava, Instituto Alavés de Arqueología.

Izagirre, N., Alzualde, A., Santos, A., Rivera, N.A. & Alonso, A. 2006. *Aportación del ADNa a la reconstrucción histórica. La necrópolis de Aldaieta (Nanclares de Gamboa, Álava) (s. VI-VIII)*, in A. Martinez-Almagro (ed.) *Diversidad biológica y salud humana (XVI Congreso de la Sociedad Española de Antropología Física. Alcalá de Henares, 6-9 julio 2009)*: 165–174. Murcia: Universidad Católica San Antonio.

Izagirre, N., de Bizcarra, N., Alzualde, A. & de la Rúa, C. 2001. Estimación del sexo a nivel molecular en restos esqueléticos humanos. *Munibe* 53: 143–150.

Jans, M.M.., Nielsen-Marsh, C.M., Smith, C.I., Collins, M.J. & Kars, H. 2004. Characterisation of microbial attack on archaeological bone. *Journal of Archaeological Science* 31: 87–95.

Jay, M. 2009. Breastfeeding and weaning behaviour in archaeological populations: evidence from the isotopic analysis of skeletal materials. *Childhood in the Past* 2: 163–179.

Jim, S., Ambrose, S.H. & Evershed, R.P. 2004. Stable carbon isotopic evidence for differences in the dietary origin of bone cholesterol, collagen and apatite: implications for their use in palaeodietary reconstruction. *Geochimica et Cosmochimica Acta* 68: 61–72.

Jim, S., Jones, V., Ambrose, S.H. & Evershed, R.P. 2006. Quantifying dietary macronutrient sources of carbon for bone collagen biosynthesis using natural abundance stable carbon isotope analysis. *British Journal of Nutrition* 95: 1055–1062.

Jiménez-Brobeil, S.A., Laffranchi, Z., Maroto, R.M., López Sánchez, F.A. & Delgado, A. 2016. How royals feasted in the court of Pedro I of Castile: a contribution of stable isotope study to medieval history. *Journal of Archaeological Science: Reports* 10: 424–430.

Jiménez-Brobeil, S.A., Maroto, R.M., Laffranchi, Z., Roca, M.G., Granados, A. & Delgado, A. 2020. Exploring diet in an isolated medieval rural community of Northern Iberia: the case study of San Baudelio de Berlanga (Soria, Spain). *Journal of Archaeological Science: Reports* 30: 102218.

Jordana, X., Malgosa, A., Casté, B. & Tornero, C. 2019. Lost in transition: the dietary shifts from Late Antiquity to the Early Middle Ages in the North Eastern Iberian Peninsula. *Archaeological and Anthropological Sciences* 11: 3751–3763.

Jørkov, M.L.S., Heinemeier, J. & Lynnerup, N. 2007. Evaluating bone collagen extraction methods for stable isotope analysis in dietary studies. *Journal of Archaeological Science* 34: 1824–1829.

Jørkov, M.L.S., Heinemeier, J. & Lynnerup, N. 2009. The petrous bone - A new sampling site for identifying early dietary patterns in stable isotopic studies. *American Journal of Physical Anthropology* 138: 199–209.

Kaal, J., López-Costas, O. & Martínez Cortizas, A. 2016. Diagenetic effects on pyrolysis fingerprints of extracted collagen in archaeological human bones from NW Spain, as determined by pyrolysis-GC-MS. *Journal of Archaeological Science* 65: 1–10.

Katzenberg, M.A. 2008. *Stable isotope analysis: a tool for studying past diet, demography, and life history*, in M.A. Katzenberg & S.R. Saunders (ed.) *Biological Anthropology of the Human Skeleton*: 413–441. Hoboken: Wiley & Sons.

Katzenberg, M.A. & Lovell, N.C. 1999. Stable isotope variation in pathological bone. *International Journal of Osteoarchaeology* 9: 316–324.

Kaupová, S. 2016. *Bioarchaeology of the medieval population of central Europe: relationships among health status, social context and nutrition*. Prague: Charles University.

Kaupová, S., Velemínský, P., Herrscher, E., Sládek, V., Macháček, J., Poláček, L. & Brůžek, J. 2018. Diet in transitory society: isotopic analysis of medieval population of Central Europe (ninth-eleventh century AD, Czech Republic). *Archaeological and Anthropological Sciences* 10: 923–942.

Kaupová, S., Velemínský, P., Stránská, P., Bravermanová, M., Frolíková-Kaliszová, D. & Frolík, J. 2018. Dukes elites, and commoners: dietary reconstruction of the early medieval population of Bohemia (9th-11th century AD, Czech Republic). *Archaeological and Anthropological Sciences*.

Kline, S.A. 2015. *From valley to coast: an isotopic study of diet in southern Albania across three millennia*. Chico: California State University.

Knipper, C., Held, P., Fecher, M., Nicklisch, N., Meyer, C., Schreiber, H., Zich, B., Metzner-Nebelsick, C., Hubensack, V., Hansen, L., Nieveler, E. & Alt, K.W. 2015. Superior in life-superior in death. Dietary distinction of central European Prehistoric and Medieval elites. *Current Anthropology* 56: 579–589.

Knipper, C., Peters, D., Meyer, C., Maurer, A.F., Muhl, A., Schöne, B.R. & Alt, K.W. 2013. Dietary reconstruction in Migration Period Central Germany: a carbon and nitrogen isotope study. *Archaeological and Anthropological Sciences* 5: 17–35.

Knudson, K.J., O'Donnabhain, B., Carver, C., Cleland, R. & Price, T.D. 2012. Migration and Viking Dublin: Paleomobility and paleodiet through isotopic analyses. *Journal of Archaeological Science* 39: 308–320.

Kratochvil, Z. 1969. Species criteria on the distal section of the tibia in Ovis ammon F. aries L. and Capra aegagrus F. hircus L. *Acta Veterinaria (Brno)* 38: 483–490.

Kruskal, W.H. & Wallis, W.A. 1952. Use of ranks in one-criterion variance analysis. *Journal of the American Statistical Association* 47: 583–621.

Kwok, C.S., Garvie-Lok, S.J. & Katzenberg, M.A. 2018. Exploring variation in infant feeding practices in Byzantine Greece using stable isotope analysis of dentin serial sections. *International Journal of Osteoarchaeology*.

Labarta, A. 2017. *Anillos de la Península Ibérica, 711-1611*. Valencia: Ángeles Carrillo Baez.

Laffranchi, Z., Mazzucchi, A., Thompson, S., Delgado-Huertas, A., Granados-Torres, A. & Milella, M. 2020. Funerary reuse of a Roman amphitheatre: palaeodietary and osteological study of Early Middle Ages burials (8th and 9th centuries AD) discovered in the Arena of Verona (Northeastern Italy). *International Journal of Osteoarchaeology*.

Lanz, J. 2016. Antzinateko baskoiak: izen eta izanaren arteko eztabaidak (XVI.-XXI. mendeak). *Sancho el sabio: Revista de cultura e investigación vasca* 39: 33–65.

Larrañaga, K. 1993. El pasaje del pseudo-Fredegario sobre el dux Francio de Cantabria y otros indicios de naturaleza textual y onomástica sobre presencia franca tardoantigua al sur de los Pirineos. *Archivo Español de Arqueología* 66: 177–206.

Larrea, J.J. 2009. Construir un reino en la periferia de Al-Andalus: Pamplona y el Pirineo occidental en los siglos VIII y X. *Territorio, Sociedad y Poder* Anejo nº 2: 279–308.

Larrea, J.J. 2011. *Territorio y sociedad en la Vasconia de los siglos VIII a X*, in J.A. Quirós (ed.) *Vasconia en la Alta Edad Media 450-1000. Poderes y comunidades rurales en el Norte Peninsular (Documentos de Arqueología Medieval 2)*: 19–28. Vitoria-Gasteiz: Universidad del País Vasco.

Larrea, J.J. 2016. Las iglesias de los vascones: una problemática antigua y un registro arqueológico nuevo (siglos VI y VII). *Anejos de Nailos* 3: 221–248.

Larrea, J.J. & Pozo, M. 2015. Vasconia en la Tardoantigüedad: de la antropología a una historia en pedazos. *Revista Internacional de Estudios Vascos* 60: 42–77.

Larrea, J.J. & Pozo, M. 2019. La Tarraconense occidental, de la reforma de Diocleciano a la reforma gregoriana. Entre la noción ideal y la lógica espacial. *Mélanfes de la Casa de Velázquez* 49: 133–163.

Lee-Thorp, J.A. 2008. On isotopes and old bones. *Archaeometry* 50: 925–950.

Levene, H. 1960. *Robust tests for equality of variances*, in I. Olkin, S.G. Ghurye, W. Hoeffding, W.G. Madow, & H.B. Mann (ed.) *Contributions to probability and statistics. Essays in honor of Harold Hotelling*: 278–292. Redwood City: Stanford University Press.

Lewis, M.E. 2007. *Bioarchaeology of children: the perspectives from biological and forensic anthropology*. Cambridge: Cambridge University Press.

Lewis, M.E., Shapland, F. & Watts, R. 2016. On the threshold of adulthood: a new approach for the use of maturation indicators to assess puberty in adolescents from medieval England. *American Journal of Human Biology* 28: 48–56.

Lidén, K. & Angerbjörn, A. 1999. Dietary change and stable isotopes: a model of growth and dormancy in cave bears. *Proceedings of the Royal Society B: Biological Sciences* 266: 1779–1783.

LIGHTFOOT, E., LIU, X. & JONES, M.K. 2013. Why move starchy cereals? A review of the isotopic evidence for prehistoric millet consumption across Eurasia. *World Archaeology* 45: 574–623.

LIGHTFOOT, E., O'CONNELL, T.C., STEVENS, R.E., HAMILTON, J., HEY, G. & HEDGES, R.E.M. 2009. An investigation into diet at the site of Yarnton, Oxfordshire, using stable Carbon and Nitrogen isotopes. *Oxford Journal of Archaeology* 28: 301–322.

LIGHTFOOT, E., PRZELOMSKA, N., CRAVEN, M., O'CONNELL, T.C., HE, L., HUNT, H. V. & JONES, M.K. 2016. Intraspecific carbon and nitrogen isotopic variability in foxtail millet (Setaria italica). *Rapid Communications in Mass Spectrometry* 30: 1475–1487.

LIGHTFOOT, E., ŠLAUS, M. & O'CONNELL, T.C. 2012. Changing cultures, changing cuisines: cultural transitions and dietary change in Iron Age, Roman, and Early Medieval Croatia. *American Journal of Physical Anthropology* 148: 543–556.

LIGHTFOOT, E., ŠLAUS, M., ŠIKANJIĆ, P.R. & O'CONNELL, T.C. 2015. Metals and millets: Bronze and Iron Age diet in inland and coastal Croatia seen through stable isotope analysis. *Archaeological and Anthropological Sciences* 7: 375–386.

LINDERHOLM, A., HEDENSTIERNA, C., SVENSK, O. & LIDÉN, K. 2008. Diet and status in Birka: stable isotopes and grave goods compared. *Antiquity* 82: 446–461.

LLANOS, A., APELLÁNIZ, J.M., AGORRETA, J.A. & FARIÑA, J. 1975. El castro del castillo de Henayo (Alegría - Álava). Memoria de excavaciones de 1969-1970. *Estudios de Arqueología Alavesa* 8: 87–212.

LONGIN, R. 1971. New method of collagen extraction for radiocarbon dating. *Nature* 230: 241–242.

LÓPEZ-COSTAS, O. 2012. *Antropología de los restos óseos humanos de Galicia: Estudio de la población romana y medieval gallega*. Granada: Universidad de Granada.

LÓPEZ-COSTAS, O. & ALEXANDER, M.M. 2019. Paleodiet in the Iberian Peninsula: exploring the connections between diet, culture, disease and environment using isotopic and osteoarchaeological evidence. *Archaeological and Anthropological Sciences* 11: 3653–3664.

LÓPEZ-COSTAS, O. & MÜLDNER, G.H. 2016. Fringes of the empire: diet and cultural change at the Roman to post-Roman transition in NW Iberia. *American Journal of Physical Anthropology* 161: 141–154.

LÓPEZ-SÁEZ, J.A., ALBA, F., PÉREZ-DÍAZ, S. & MANZANO, S. 2010. Paisaje Holoceno de una gran urbe: la ciudad de Madrid. *Polen* 20: 7–24.

LÓPEZ QUINTANA, J.C., GUENAGA, A., ETXEBERRIA, F., HERRASTI, L., MARTÍNEZ DE PANCORBO, M., PALENCIA, L., VALVERDE, L. & CARDOSO, S. 2015. Nuevos datos sobre la secuencia de uso sepulcral de la cueva de Santimamiñe (Kortetzubi, Bizkaia). *ARPI Arqueología y Prehistoria del Interior Peninsular* 03 (Extra): 180–196.

LOVEJOY, C.O., MEINDL, R.S., PRYZBECK, T.R. & MENSFORTH, R.P. 1985. Chronological metamorphosis of the auricular surface of the ilium: a new method for the determination of adult skeletal age at death. *American Journal of Physical Anthropology* 68: 15–28.

LOZA, M. 2016. San Martín de Dulantzi. Calles Gastezbidea y Baratzaldea. *Arkeoikuska* 2015: 22.

LOZA, M. & NISO, J. 2012. Yacimiento de San Martín de Dulantzi (Alegría-Dulantzi, Álava). *Arkeoikuska* 2011: 35–57.

LOZA, M. & NISO, J. 2015. San Martín de Dulantzi. *Arkeoikuska* 2014: 21–27.

LOZA, M. & NISO, J. 2016. La basílica tardoantigua de San Martín de Dulantzi (Alegría-Dulantzi, Álava). *Pyrenae* 47: 95–129.

LUBRITTO, C., GARCÍA-COLLADO, M.I., RICCI, P., ALTIERI, S., SIRIGNANO, C. & QUIRÓS, J.A. 2017. New dietary evidence on medieval rural communities of the Basque Country (Spain) and its surroundings from carbon and nitrogen stable isotope analyses: social insights, diachronic changes and geographic comparison. *International Journal of Osteoarchaeology* 27: 984–1002.

LUCY, S., NEWMAN, R., DODWELL, N., HILLS, C., DEKKER, M., O'CONNELL, T.C., RIDDLER, I. & WALTON ROGERS, P. 2009. The burial of a princess? The later seventh-century cemetery at Westfield Farm, Ely. *The Antiquaries Journal* 89: 81–141.

LUCY, S.J., TIPPER, J. & DICKENS, A. 2009. *The Anglo-Saxon settlement and cemetery at Bloodmoor Hill, Carlton Colville, Suffolk (East Anglian Archaeology 131)*. Cambridge: Cambridge Archaeological Unit.

MACKINNON, A.T., PASSALACQUA, N. V. & BARTELINK, E.J. 2019. Exploring diet and status in the Medieval and

Modern periods of Asturias, Spain, using stable isotopes from bone collagen. *Archaeological and Anthropological Sciences* 11: 3837–3855.

Makarewicz, C.A. & Sealy, J.C. 2015. Dietary reconstruction, mobility, and the analysis of ancient skeletal tissues: expanding the prospects of stable isotope research in archaeology. *Journal of Archaeological Science* 56: 146–158.

Malainey, M.E. 2011. *A consumer's guide to archaeological science. Analytical techniques*. New York: Springer.

Mann, H.B. & Whitney, D.R. 1947. On a test of whether one of two random variables is stochastically larger than the other. *The Annals of Mathematical Statistics* 18: 50–60.

Maresh, M.M. 1970. *Measurements from roentgenograms*, in R.W. McCammon (ed.) *Human growth and development*: 157–200. Springfield: C.C. Thomas.

Marinato, M. 2016. *Analisi isotopiche e bioarcheologia come fonti per lo studio del popolamento tra tardo antico e alto medioevo in Italia settentrionale. Dati a confronto per le province di Bergamo, Moderna e Verona*. Padova: Università degli studi di Padova.

Märkle, T. & Rösch, M. 2008. Experiments on the effects of carbonization on some cultivated plant seeds. *Vegetation History and Archaeobotany* 17: S257–S263.

Marshall, J.D., Brooks, J.R. & Lajtha, K. 2007. *Sources of variation in the stable isotopic composition of plants*, in R. Michener & K. Lajtha (ed.) *Stable isotopes in ecology and environmental science (Second edition)*: 22–60. Malden: Blackwell Publishing.

Martín, A., Miret, J., Bosch, J., Blanch, R.M., Aliaga, S., Enrich, R., Colomer, S., Albizuri, S., Folch, J., Martínez, J. & Casas, T. 1988. Les excavacions al paratge de la Bòbila Madurell i de Can Feu (Sant Quirze del Vallès, Vallès Occidental). *Tribuna d'Arqueologia* 1987–1988: 77–92.

Martín Viso, I. 2006. *La configuración de un espacio de frontera: propuestas sobre la Vasconia tardoantigua*, in U. Espinosa & S. Castellanos (ed.) *Comunidades locales y dinámicas de poder en el norte de la Península Ibérica durante la Antigüedad Tardía*: 101–139. Logroño: Universidad de La Rioja.

Martín Viso, I. 2014. *El espacio del más acá: las geografías funerarias entre la Alta y la Plena Edad Media*, in E. López Ojeda (ed.) *De la tierra al cielo. Ubi sunt qui ante nos in hoc mundo fuere? XXIV Semana de Estudios Medievales. Nájera, del 29 de julio al 2 de agosto de 2013*: 75–140. Logroño: Instituto de Estudios Riojanos.

Martínez-Jarreta, B., Sosa, C., Laliena, C., Budowle, B. & Hedges, R.E.M. 2017. Stable isotope and radiocarbon dating of the remains of the Medieval Royal House of Aragon (Spain) shed light on their diets, life histories and identities. *Archaeometry*.

Martínez Sánchez, R.M., Rubio, M., Moreno-García, M., Maldonado, A., Granados, A. & Delgado, A. 2020. Who let the dogs in? Lap dogs, canid sacrifices and funerary practices in the Roman cemetery of Llanos del Pretorio (Cordoba, Spain). *Archaeological and Anthropological Sciences* 12: 87.

Maxwell, A.B. 2019. *Exploring variations in diet and migration from Late Antiquity to the Early Medieval period in the Veneto, Italy: a biochemical analysis by Ashley B . Maxwell A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor o*. Tampa: University of South Florida.

Mays, S., Elders, J., Humphrey, L., White, W. & Marshall, P. (ed.) 2013. *Science and the Dead. A guideline for the destructive sampling of archaeological human remains for scientific analysis*. Swindon: English Heritage, Advisory Panel on the Archaeology of Burials in England.

Mays, S.A. & Beavan-Athfield, N. 2012. An investigation of diet in early Anglo-Saxon England using carbon and nitrogen stable isotope analysis of human bone collagen. *Journal of Archaeological Science* 39: 867–874.

McCormick, M. 2015. Tracking mass death during the fall of Rome's empire (I). *Journal of Roman Archaeology* 28: 325–357.

McCormick, M. 2016. Tracking mass death during the fall of Rome's empire (II): a first inventory. *Journal of Roman Archaeology* 29: 1008–1046.

McGlynn, G. 2007. *Using 13C-, 15N-, and 18O stable isotope analysis of human bone tissue to identify transhumance, high altitude habitation and reconstruct palaeodiet for the early medieval Alpine population at Volders, Austria*. München: Ludwig Maximilians Universität.

McManus, E., Montgomery, J., Evans, J.A., Lamb, A.L., Brettel, R. & Jelsma, J. 2013. 'To the land or to the sea': Diet and mobility in Early Medieval Frisia. *Journal of Island & Coastal Archaeology* 8: 255–277.

Medina, F.X. 2005. *Cows, pigs and... witches! On meat, diet and food in the Mediterranean area*, in A. Hubert

& R. Avila (ed.) *Man and meat*: 155–164. Mexico: Universidad de Guadalajara.

MEIER-AUGENSTEIN, W. 2018. *Stable isotope forensics. An introduction to the forensic application of stable isotope analysi. Second edition*. Chichester: Wiley.

MENNELL, S., MURCOTT, A. & VAN OTTERLOO, A. 1992a. Introduction: Significance and theoretical orientations. *Current Sociology* 40: 1–19.

MENNELL, S., MURCOTT, A. & VAN OTTERLOO, A. 1992b. Patterns of food consumption. *Current Sociology* 40: 54–60.

MESTRE, A.M. 1995. *Primeres conclusions sobre els individus inhumats a la necròpoli de l'Església Vella de Sant Menna (Sentmenat, Vallès Occidental), s. V-VI*, in J. Roig, J.M. Coll, & J.A. Molina (ed.) *L'església vella de Sant Menna. Sentmenat: del segle V al XX. 1500 anys d'evolució històrica*: 140–147. Sentmenat: Ajuntament de Sentmenat.

MINAGAWA, M. & WADA, E. 1984. Stepwise enrichment of 15N along food chains: Further evidence and the relation between δ15N and animal age. *Geochimica et Cosmochimica Acta* 48: 1135–1140.

MION, L. 2019. *Aux origines de l'alimentation méditerranéenne: Analyses isotopiques de vestiges bioarchéologiques de l'Antiquité au début du Moyen Âge dans le Sud-Est de la France*. Aix-en-Provence: Aix Marseille Université.

MOFFAT, T. & PROWSE, T.L. 2010a. *Introduction. A biocultural approach to human diet and nutrition*, in T. Moffat & T.L. Prowse (ed.) *Human diet and nutrition in biocultural perspective. Past meets present*: 1–10. New York: Berghahn Books.

MOFFAT, T. & PROWSE, T.L. (ed.) 2010b. *Human diet and nutrition in biocultural perspective. Past meets present*. New York: Berghahn Books.

MOLINA, D. & ROIG, J. 2008. *Informe tècnic de la intervenció arqueològica a la Plaça Major de Castellar del Vallès (Vallès Occ.), març-maig de 2008*. Sabadell: Arrago S.L.

MOLINA, J.A. 2005. *Estudi arqueozoològic*, in *Memòria de la intervenció arqueològica a l'església vella de Sant Menna (Sentmenat, Vallès occidental). Juliol 2002*: 161–199. Sabadell: Arrago S.L.

MOLINA, J.A. 2008a. *Memòria de la intervenció arqueològica a Can Gambús 1 (Sabadell, Vallès Occ.). Abril 2003-desembre 2004 i agost 2006. Volum 22. Annex 26. Estudi de les restes arqueozoològiques dels nivells tardoantics (s. VI-VII) de Can Gambús 1 (Sabadell, Vallès Occ.)*. Sabadell: Arrago S.L.

MOLINA, J.A. 2008b. *Memòria de la intervenció arqueològica al jaciment de la Plaça Major de Castellar del Vallès (Vallès Occ.), abril-desembre 2005. Volum II. Annex 12 - Primer avenç de l'estudi arqueozzològic de la intervenció arqueològica a la Plaça Major de Castellar del*. Sabadell: Arrago S.L.

MOLINA, J.A. 2008c. *Memòria de la intervenció arqueològica als Horts Can Torras (Castellar del Vallès, Vallès Occ.). Març-abril 2003. Annex 7. Estudi de les restes arqueozoològiques Horts Can Torras*. Sabadell: Arrago S.L.

MOLLESON, T.I., COX, M., WALDRON, A.H. & WHITTAKER, D. 1993. *The Spitalfields project. Vol. 2: The anthropology. The middling sort (CBA Research Report 86)*. York: Council for British Archaeology.

MONTANARI, M. 1979. *L'alimentazione contadina nell'Alto Medioevo*. Napoli: Liguori Editore.

MONTANARI, M. 1996. *Romains, barbares, chrétiens: à l'aube de la culture alimentare européenne*, in J.-L. Flandrin & M. Montanari (ed.) *Histoire de l'alimentation*: 279–282. Paris: Fayard.

MOORE, F.E. 2017. *Diet and subsistence in the Anglo-Saxon Trent Valley: a stable isotope investigation of Broughton Lodge Anglo-Saxon cemetery , Nottinghamshire*. Nottingham: University of Nottingham.

MORALES, A. & LLORENTE, L. 2004a. *Anejo 1. Informe preliminar sobre la fauna de 'El Encadenado' (Barajas, Madrid) (LAZ-UAM 2004/6)*, in M.M. Presas, J.L. Herce, & A. Vigil-Escalera (ed.) *Memoria de las excavaciones arqueológicas en el yacimiento 'El Encadenado'. Afectado por el soterramiento de línea eléctrica de 400 kV (Barajas, Madrid)*: 138–167. Madrid: ÁREA Sociedad Cooperativa Madrileña.

MORALES, A. & LLORENTE, L. 2004b. *Anejo 2. Informe arqueozoológico (La Huelga, Barajas) (Infrome técnico LAZ-UAM 2004/5)*, in R.M. Domínguez Alonso, J. Rincón, & A. Vigil-Escalera (ed.) *Memoria de las excavaciones arqueológicas en el yacimiento 'La Huelga'. Afectado por el soterramiento de línea eléctrica de 400 kV (Barajas, Madrid)*: 97–119. Madrid: ÁREA Sociedad Cooperativa Madrileña.

MORALES, A. & ORTIZ, N. 2000. *Las aves del yacimiento visigodo de Gózquez (San Martín de la Vega, Madrid). Informe técnico LAZ-UAM 2000/5*. Madrid: Laboratorio de Arqueozoología UAM.

MORALES, A. & PINO, B. 2000. *Gózquez (S. Martín de la Vega, Madrid): Estudio preliminar de la fauna, en especial de los mamíferos. Informe 2000/4*. Madrid: Laboratorio de Arqueozoología UAM.

MOREDA, F.J., VILAR, S., SERRANO, R., CARRAL, R., SERRULLA, F., GRANDAL-D'ANGLADE, A. & GÓMEZ, M. 2010. La necrópolis bajoimperial del yacimiento 'El Vergel' (San Pedro del Arroyo, Ávila). *Oppidum* 6–7: 141–184.

MORENO-LARRAZABAL, A., TEIRA-BRIÓN, A., SOPELANA-SALCEDO, I., ARRANZ-OTAEGUI, A. & ZAPATA, L. 2015. Ethnobotany of millet cultivation in the north of the Iberian Peninsula. *Vegetation History and Archaeobotany* 24: 541–554.

MÜLDNER, G.H. 2009. *Investigating medieval diet and society by stable isotope analysis*, in R. Gilchrist & A. Reynolds (ed.) *Reflections: 50 Years of Medieval Archaeology, 1957-2007 (Society for Medieval Archaeology Monographs 30)*: 327–346. Leeds: Maney Publishing.

MÜLDNER, G.H., BRITTON, K. & ERVYNCK, A. 2014. Inferring animal husbandry strategies in coastal zones through stable isotope analysis: new evidence from the Flemish coastal plain (Belgium, 1st-15th century AD). *Journal of Archaeological Science* 41: 322–332.

MÜLDNER, G.H. & RICHARDS, M.P. 2007. Stable isotope evidence for 1500 years of human diet at the city of York, UK. *American Journal of Physical Anthropology* 133: 682–697.

MUNDEE, M. 2010. *Exploring diet and society in Medieval Spain: new approaches using stable isotope analysis*. Durham: University of Durham.

MURPHY, C. 2016. Finding millet in the Roman world. *Archaeological and Anthropological Sciences* 8: 65–78.

NAUMANN, E., KRZEWIŃSKA, M., GÖTHERSTRÖM, A. & ERIKSSON, G. 2014. Slaves as burial gifts in Viking Age Norway? Evidence from stable isotope and ancient DNA analyses. *Journal of Archaeological Science* 41: 533–540.

NAVARRO, F.J. 2009. *Navarra, la Gallia y Aquitania en la Antigüedad Tardía*, in J. Andreu (ed.) *Los vascones de las fuentes antiguas: en torno a una etnia de la Antigüedad Peninsular*: 291–299. Barcelona: Universitat de Barcelona.

NAVASCUES, J. de 1976. Rectificaciones al cementerio franco de Pamplona. *Príncipe de Viana* 142–143: 119–128.

NAWROCKI, S.P. 2010. *The nature and sources of error in the estimation of age at death from the skeleton*, in K.E. Latham & M. Finnegan (ed.) *Age estimation of the human skeleton*: 79–101. Sprinfield: Charles C. Thomas Publisher.

NISO, J. 2014. *San Martín de Dulantzi. Intervención arqueológica en las calles Nuestra Señora de Ayala y San Martín (Alegría-Dulantzi) (2009-2010)*. Vitoria-Gasteiz: Iterbide S.C.

NOCHE-DOWDY, L.D. 2015. *Multi-isotope analysis to reconstruct dietary and migration patterns of an Avar population from Sajópetri, Hungary, AD 568-895*. Tampa: University of South Florida.

NUÑEZ, J., SÁENZ DE URTURI, F. & MARTÍNEZ TORRECILLA, J.M. 2004. Yacimiento de Mariturri (Vitoria-Gasteiz). III campaña. *Arkeoikuska* 2003: 194–202.

O'CONNELL, T.C. & HEDGES, R.E.M. 1999. Investigations into the effect of diet on modern human hair isotopic values. *American Journal of Physical Anthropology* 108: 409–425.

O'CONNELL, T.C., KNEALE, C.J., TASEVSKA, N. & KUHNLE, G.G.C. 2012. The diet-body offset in human nitrogen isotopic values: a controlled dietary study. *American Journal of Physical Anthropology* 149: 426–434.

O'CONNELL, T.C. & LAWLER, A. 2009. *Stable isotope analysis of human and faunal remains*, in S. Lucy, J. Tipper, & A. Dickens (ed.) *The Anglo-Saxon settlement and cemetery at Bloodmoor Hill, Carlton Colville, Suffolk (East Anglian Archaeology 131)*: 317–321. Cambridge: Cambridge Archaeological Unit.

O'LEARY, M.H. 1981. Carbon isotope fractionation in plants. *Phytochemistry* 20: 553–567.

O'LEARY, M.H. 1988. Carbon isotopes in photosynthesis fractionation techniques may reveal new aspects of carbon dynamics in plants. *BioScience* 38: 328–336.

O'SULLIVAN, D. 2013. *Burial of the Christian dead in the Later Middle Ages*, in L. Nilsson & S. Tarlow (ed.) *The Oxford Handbook of the Archaeology of Death and Burial*: 259–280. Oxford: Oxford University Press.

OLSEN, K.C., WHITE, C.D., LONGSTAFFE, F.J., VON HEYKING, K., MCGLYNN, G., GRUPE, G. & RÜHLI, F.J. 2014. Intraskeletal isotopic compositions (δ13C, δ15N) of bone collagen: nonpathological and pathological variation. *American Journal of Physical Anthropology* 153: 598–604.

ORTEGA, L.Á., GUEDE, I., ARANGUREN, I., ZULUAGA, M.C., ALONSO, A., MURELAGA, X., NISO, J., LOZA, M. & QUIRÓS, J.A. 2012. Estudio isotópico del Sr en restos óseos del cementerio altomedieval de Dulantzi (Alegría-Dulantzi, Álava). *Macla* 16: 42–43.

Ortega, L.Á., Guede, I., Zuluaga, M.C., Alonso, A., Murelaga, X., Niso, J., Loza, M. & Quirós, J.A. 2013. Strontium isotopes of human remains from the San Martín de Dulantzi graveyard (Alegría-Dulantzi, Álava) to infer population mobility in the Early Middle Ages. *Quaternary International* 303: 54–63.

Paladin, A., Moghaddam, N., Stawinoga, A.E., Siebke, I., Depellegrin, V., Tecchiati, U., Lösch, S. & Zink, A.R. 2020. Early medieval Italian Alps: reconstructing diet and mobility in the valleys. *Archaeological and Anthropological Sciences* 12: 82.

Pancorbo, A. 2003. *Entorn església vella de Sant Menna (entre la plaça de l'església i c/Roca Farina)*. Barcelona: Arqueociència S.C.S.L.

Paniagua, L.L., García-Martín, A., Moral, F.J. & Rebollo, F.J. 2019. Aridity in the Iberian Peninsula (1960–2017): distribution, tendencies, and changes. *Theoretical and Applied Climatology* 138: 811–830.

Parker Pearson, M. 2003. *Food, identity and culture: An introduction and overview*, in M. Parker Pearson (ed.) *Food, culture and identity in the Neolithic and Early Bronze Age (BAR International Series 1117)*: 1–30. Oxford: Archaeopress.

Passalacqua, N. V. 2010. The utility of the Samworth and Gowland age-at-death 'look-up' tables in forensic anthropology. *Journal of Forensic Sciences* 55: 482–487.

Passariello, I., Simone, P., Tandoh, J., Marzaioli, F., Capano, M., de Cesare, N. & Terrasi, F. 2012. Characterization of different chemical procedures for 14C dating of buried, cremated, and modern bone samples at CIRCE. *Radiocarbon* 54: 867–877.

Payne, S. 1969. *A metrical distinction between sheep and goat metacarpals*, in P.J. Ucko & G.W. Dimbleby (ed.) *The domestication and exploitation of plants and animals*: 295–305. London: Duckworth.

Payne, S. 1973. Kill-off patterns in sheep and goats: the mandible from Asvan Kale. *Anatolian Studies* 23: 281–303.

Payne, S. 1985. Morphological distinction between the mandibular teeth of young sheep, Ovis, and goats, Capra. *Journal of Archaeological Science* 12: 139–147.

Payne, S. & Bull, G. 1988. Components of variation in measurements of pig bones and teeth, and the use of measurements to distinguish wild from domestic pig remains. *Archaeozoologia* II: 27–66.

Paz, J.Á. 2008. *Las producciones de terra sigillata hispánica intermedia y tad*, in D. Bernal & A. Ribera (ed.) *Cerámicas hispanorromanas: un estado de la cuestión*: 497–540. Cádiz: Universidad de Cádiz.

Pearson, K. 1900. On the criterion that a given system of deviations from the probable in the case of a correlated system of variables is such that it can be reasonably supposed to have arisen from random sampling. *Philosophical Magazine* 50: 157–175.

Peña-Chocarro, L., Pérez-Jordà, G., Alonso, N., Antolín, F., Teira-Brión, A., Tereso, J.P.V., Montes, E.M. & López Reyes, D. 2019. Roman and medieval crops in the Iberian Peninsula: a first overview of seeds and fruits from archaeological sites. *Quaternary International* 499: 49–66.

Pérez-Díaz, S., Luelmo, R., López-Sáez, J.A. & Peña-Chocarro, L. 2019. *Vegetación y paleoeconomía durante la Edad Media*, in J.A. López-Sáez, S. Pérez-Díaz, E. García-Gómez, & F. Alba-Sánchez (ed.) *Historia de la vegetación y los paisajes de Toledo*: 359–369. Toledo: Editorial Cuarto Centenario.

Perez, É. 2016. *Des sépultures particulières? Les enfants dans les espaces funéraires au Moyen Âge*, in M. Lauwers & A. Zemour (ed.) *Qu'est-ce qu'une sépulture? Humanités et systèmes funéraires de la préhistoire à nos jours. XXXVIè rencontres internationales d'archéologe et d'histoire d'Antibes*: 467–478. Antibes: Éditions APDCA.

Pérez Villa, A. 2014. *Prácticas funerarias de la Edad del Bronce en la cuenca medio-alta del Tajo*. Madrid: Universidad Nacional de Educación a Distancia.

Pescucci, L., Battistini, A., de Angelis, F. & Catalano, P. 2013. Vivere al centro di Roma nel'VIII secolo d.C. Indicazioni antropologiche. *Bolletino di Archaeologia On Line* IV: 113–138.

Peterson, B.J. & Fry, B. 1987. Stable isotopes in ecosystem studies. *Annual Review of Ecology and Systematics* 18: 293–320.

Phenice, T.W. 1969. A newly developed visual method of sexing the Os Pubis. *American Journal of Physical Anthropology* 30: 297–301.

Picazo, J. V., Pérez Lambán, F., Peña, J.L., Sampietro, M.M., Longares, L.A., Justes, J. & Ortega, J.M. 2016. Los

Pedregales (Lupiñén-Ortilla, Huesca): contribución al conocimiento del poblamiento altomedieval en la Hoya de Huesca. *Archivo Español de Arqueología*.

Pinar, J. 2009. *El hallazgo de Guereñu-Ozabal. Nuevos datos sobre el mundo funerario del territorio alavés en la Antigüedad Tardía*, in A. Llanos (ed.) *Actas del Congreso Internacional Medio siglo de arqueología en el Cantábrico oriental y su entorno*: 925–952. Vitoria-Gasteiz: Instituto Alavés de Arqueología.

Plata, A., Solaun, J.L. & Grupo de Investigación en Arqueología de la Arquitectura 2009. Plan de castillos de la CAV. *Arkeoikuska* 2008: 23–42.

Plazaola, J. 2000. Entre francos y visigodos. *Revista Internacional de Estudios Vascos* 45.2: 541–567.

Plecerová, A., Kaupová Drtikolová, S., Šmerda, J., Stloukal, M. & Velemínský, P. 2020. Dietary reconstruction of the Moravian Lombard population (Kyjov, 5th-6th centuries AD, Czech Republic) through stable isotope analysis (δ13C, δ15N). *Journal of Archaeological Science: Reports* 29: 102062.

Pociña, C.A. 1995. *Estudi de les ceràmiques fines d'importació de l'Església Vella de Sant Menna (Sentmenat)*, in J. Roig, J.M. Coll, & J.A. Molina (ed.) *L'església vella de Sant Menna. Sentmenat: del segle V al XX. 1500 anys d'evolució històrica*: 134–139. Sentmenat: Ajuntament de Sentmenat.

Pohl, W. & Reimitz, H. (ed.) 1998. *Strategies of distinction. The construction of ethnic communities, 300-800 (The transformations of the Roman World, v. 2)*. Leiden: Brill.

Polet, C. & Katzenberg, M.A. 2002. Comportements alimentaires de trois populations médiévales belges: apports de la biogéochimie isotopique. *Revue Belge de Philologie et d'Histoire* 80: 1371–1390.

Pollard, M. & Heron, C. 2008. *Archaeological chemistry*. Cambridge: Cambridge University Press.

Portela, E. 1976. *La región del obispado de Tuy en los siglos XII a XV. Una sociedad en la expansión y en la crisis*. Santiago de Compostela: El Eco Franciscano.

Post, D.M. 2002. Using stable isotopes to estimate trophic position: models, methods, and assumptions. *Ecology* 83: 703–718.

Pozo, M. 2016. *Vasconia y los vascones de la crisis del Imperio romano a la llegada del Islam (siglos V-VIII). Evolución sociopolítica y génesis de la gens effera*. Vitoria-Gasteiz: Universidad del País Vasco/Euskal Herriko Unibertsitatea.

Presas, M.M., Herce, J.L. & Vigil-Escalera, A. 2004. *Memoria de las excavaciones arqueológicas en el yacimiento 'El Encadenado'. Afectado por el soterramiento de línea eléctrica de 400 kV (Barajas, Madrid)*. Madrid: ÁREA Sociedad Cooperativa.

Preston, T. & Owens, N.J.P. 1983. Interfacing an Automatic Elemental Analyser with an Isotope Ratio Mass Spectrometer: the Potential for Fully Automated Total Nitrogen and Nitrogen-15 Analysis. *Analyst* 108: 971–977.

Preston, T. & Owens, N.J.P. 1985. Preliminary 13C measurements using a Gas Chromatograph interfaced to an Isotope Ratio Mass Spectrometer. *Biomedical Mass Spectrometry* 12: 510–513.

Privat, K.L., O'Connell, T.C. & Richards, M.P. 2002. Stable isotope analysis of human and faunal remains from the Anglo-Saxon cemetery at Berinsfield, Oxfordshire: dietary and social implications. *Journal of Archaeological Science* 29: 779–790.

Pyankov, V.I., Ziegler, H., Akhani, H., Deigele, C. & Lüttge, U. 2010. European plants with C4 photosynthesis: Geographical and taxonomic distribution and relations to climate parameters. *Botanical Journal of the Linnean Society* 163: 283–304.

Quintelier, K., Ervynck, A., Müldner, G.H., Van Neer, W., Richards, M.P. & Fuller, B.T. 2014. Isotopic examination of links between diet, social differentiation, and DISH at the post-medieval Carmelite Friary of Aalst, Belgium. *American Journal of Physical Anthropology* 153: 203–213.

Quirós, J.A. 2003. *La Llanada oriental entre la tardoantigüedad y el año mil: las transformaciones en la estructura del hábitat y del poblamiento rural*, in E. Pastor (ed.) *La Llanada oriental a través de la Historia: claves desde el presente para comprender nuestro pasado*: 43–51. Vitoria-Gasteiz: Diputación Foral de Álava.

Quirós, J.A. 2009. *Arqueología del campesinado altomedieval: las aldeas y las granjas del País Vasco*, in J.A. Quirós (ed.) *The Archaeology of Early Medieval villages in Europe (Documentos de Arqueología Medieval 1)*: 385–403. Vitoria-Gasteiz: Universidad del País Vasco.

Quirós, J.A. 2010. *Arqueología de las aldeas en el noroeste peninsular. Comunidades campesinas y poderes territoriales en los siglos V-X*, in J.I. de la Iglesia (ed.) *Monasterios, espacio y sociedad en la España cristiana* *medieval (XX Semana de Estudios Medievales. Nájera, del 3 al 7 de agosto de 2009)*: 225–256. Logroño: Instituto de Estudios Riojanos.

QUIRÓS, J.A. 2011a. *Los paisajes altomedievales en el País Vasco, 500-900. De la desarticulación territorial a la emergencia de los condados*, in J.A. Quirós (ed.) *Vasconia en la Alta Edad Media 450-1000. Poderes y comunidades rurales en el Norte Peninsular (Documentos de Arqueología Medieval 2)*: 29–54. Vitoria-Gasteiz: Universidad del País Vasco.

QUIRÓS, J.A. 2011b. Las iglesias altomedievales en el País Vasco. Del monumento al paisaje. *Studia Historica. Historia Medieval* 29: 175–205.

QUIRÓS, J.A. 2011c. Early medieval landscapes in north-west Spain: Local powers and communities, fifth-tenth centuries. *Early Medieval Europe* 19: 285–311.

QUIRÓS, J.A. 2011d. *La arquitectura doméstica de los yacimientos rurales en torno al año 711*, in E. Baquedano (ed.) *711. Arqueología e Historia entre dos mundos (Zona arqueológica 15.2)*: 65–84. Alcalá de Henares: Museo Arqueológico Regional.

QUIRÓS, J.A. 2013a. *Archaeology of power and hierarchies in early medieval villages in Northern of Spain*, in J. Klapste (ed.) *Hierarchies in rural settlements. Ruralia IX*: 199–212. Turnhout: Brepols.

QUIRÓS, J.A. (ed.) 2013b. *El poblamiento rural de época visigoda en Hispania. Arqueología del campesinado en el interior peninsular (Documentos de Arqueología Medieval 6)*. Bilbao: Universidad del País Vasco.

QUIRÓS, J.A. 2013c. Los comportamientos alimentarios del campesinado medieval en el País Vasco y su entorno (siglos VIII-XIV). *Historia Agraria* 59: 13–41.

QUIRÓS, J.A. 2014. Oltre la frammentazione postprocessualista. Archeologia agraria nel nordovest della Spagna. *Archeologia Medievale* XLI: 23–37.

QUIRÓS, J.A., AZKARATE, A., BOHIGAS, R., GARCÍA CAMINO, I., PALOMINO, Á.L. & TEJADO, J.M. 2009. *Arqueología de la Alta Edad Media en el Cantábrico Oriental*, in A. Llanos (ed.) *Actas del Congreso Internacional Medio siglo de arqueología en el Cantábrico oriental y su entorno*: 449–500. Vitoria-Gasteiz: Instituto Alavés de Arqueología.

QUIRÓS, J.A., LOZA, M. & NISO, J. 2013. Identidades y ajuares en las necrópolis altomedievales. Estudios isotópicos del cementerio de San Martín de Dulantzi, Álava (siglos VI-X). *Archivo Español de Arqueología* 86: 215–232.

QUIRÓS, J.A., RICCI, P. & LUBRITTO, C. 2012. Paleodieta e società rurali altomedievali dei Paesi Baschi alla luce dei marcatori isotopici di C e N. *Archeologia Medievale* XXXIX: 87–92.

QUIRÓS, J.A. & SANTOS, I. 2015. *Founding and owning churches in early medieval Álava (north Spain): the creation, transmission, and monumentalization of memory*, in J.C. Sánchez-Pardo & M.G. Shapland (ed.) *Churches and social power in early medieval Europe. Intergrating archaelogical and historical approaches*: 35–68. Turnhout: Brepols.

QUIRÓS, J.A., TERESO, J.P. & SEABRA, L. 2020. Social history of agriculture at medieval rural sites in the northern of the Iberia Peninsula: Aistra and Zornoztegi (Alava, Spain).

QUIRÓS, J.A. & VIGIL-ESCALERA, A. 2006. Networks of peasant villages between Toledo and Uelegia Alabense, northwestern Spain (5th-10th centuries). *Archeologia Medievale* 33: 79–128.

QUIRÓS, J.A. & VIGIL-ESCALERA, A. 2011. *Dove sono i visgoti? Cimiteri e villaggi nella Spagna centrale nei secoli VI e VII*, in M. Ebanista & C. Rotili (ed.) *Archeologia e storia delle migrazioni: Europa, Italia, Mediterraneo fra tarda età romana e alto medioevo. Atti del Convegno Internazionale di studi Cimitile-Santa Maria Capua Vetere, 17-18 giugno 2010 (Giornate sulla tarda antichità e il medioevo, 3)*: 259–281. Cimitile: Tavolario Edizioni.

RAO, R. 2018. *Il tempo dei lupi. Storia e luoghi di un animale favoloso*. Milano: UTET.

REIMER, P.J., BARD, E., BAYLISS, A., BECK, J.W., BALCKWELL, P.G., BRONK RAMSEY, C., BUCK, C.E., CHENG, H., EDWARDS, R.L., FRIEDRICH, M., GROOTES, P.M., GUILDERSON, T.P., HAFLIDASON, H., HAJDAS, I., HATTÉ, C., HEATON, T.J., HOFFMANN, D.L., HOGG, A.G., HUGHEN, K.A., KAISER, K.F., KROMER, B., MANNING, S.W., NIU, M., REIMER, R.W., RICHARDS, D.A., SCOTT, E.M., SOUTHON, J.R., STAFF, R.A., TURNEY, C.S.M. & VAN DER PLICHT, J. 2013. IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 Years cal BP. *Radiocarbon* 55: 1869–1887.

REITSEMA, L.J., VERCELLOTTI, G. & BOANO, R. 2016. Subadult dietary variation at Trino Vercellese, Italy, and its relationship to adult diet and mortality. *American Journal of Physical Anthropology*.

RENFREW, C. & BAHN, P. 2016. *Archaeology. Theories, methods, and practice*. London: Thames & Hudson.

Reynard, L.M. & Tuross, N. 2015. The known, the unknown and the unknowable: weaning times from archaeological bones using nitrogen isotope ratios. *Journal of Archaeological Science* 53: 618–625.

Reynolds, A. 2009. *Anglo-saxon deviant burial customs*. Oxford: Oxford University Press.

Ricci, P., Mongelli, V., Vitiello, A., Campana, S., Sirignano, C., Rubino, M., Fornaciari, G. & Lubritto, C. 2012. The privileged burial of the Pava Pieve (Siena, 8th century AD). *Rapid Communications in Mass Spectrometry* 26: 2393–2398.

Riccomi, G., Minozzi, S., Zech, J., Cantini, F., Giuffra, V. & Roberts, P. 2020. Stable isotopic reconstruction of dietary changes across Late Antiquity and the Middle Ages in Tuscany. *Journal of Archaeological Science: Reports* 33: 102546.

Richards, M.P., Hedges, R.E.M., Molleson, T.I. & Vogel, J.C. 1998. Stable isotope analysis reveals variations in human diet at the Poundbury Camp cemetery site. *Journal of Archaeological Science* 25: 1247–1252.

Richards, M.P., Hedges, R.E.M., Walton, I., Stoddart, S. & Malone, C. 2001. Neolithic diet at the Brochtorff Circle, Malta. *European Journal of Archaeology* 4: 253–262.

Richards, M.P. & Montgomery, J. 2012. *Isotope analysis and paleopathology: a short review and future developments*, in J.E. Buikstra & C.A. Roberts (ed.) *The Global History of Palaeopathology: pioneers and prospects*: 718–731. Oxford: Oxford University Press.

Riera-Mora, S. & Esteban-Amat, A. 1994. Vegetation history and human activity during the last 6000 years on the central Catalan coast (northeastern Iberian Peninsula). *Vegetation History and Archaeobotany* 3: 7–23.

Riera, A. 2017. A carnibus se abstineat, nam dura est conditio nutrire hostem contra quem dimices. La alimentación en algunas reglas monásticas hispanas de los siglos VI y VII. *Hortus Artium Medieavalium* 23: 440–453.

Rissech, C. & Black, S. 2007. Scapular development from the neonatal period to skeletal maturity: a preliminary study. *International Journal of Osteoarchaeology* 17: 451–464.

Rissech, C., Pujol, A., Christie, N., Lloveras, L., Richards, M.P. & Fuller, B.T. 2016. Isotopic reconstruction of human diet at the Roman site (1st-4th c. AD) of Carrer Ample 1, Barcelona, Spain. *Journal of Archaeological Science: Reports* 9: 366–374.

Rissech, C., Roberts, C.A., Tomás-Batlle, X., Tomás-Gimeno, X., Fuller, B.T., Fernandez, P.L. & Botella, M.C. 2013. A Roman skeleton with possible treponematosis in the north-east of the Iberian Peninsula: a morphological and radiological study. *International Journal of Osteoarchaeology* 23: 651–663.

Riutort, J., Cau, M.Á. & Roig, J. 2018. Archaeometric characterization of regional late antique cooking wares from the area of Vallès (Catalonia, Spain): the case of two rural sites. *Journal of Archaeological Science: Reports* 21: 1091–1102.

Riutort, J., Fantuzzi, L. & Cau Ontiveros, M. 2020. Cooking and common wares in the Late Antique rural site of Plaça Major de Castellar del Vallès (Catalonia, Spain): archaeometric characterization. *Archaeological and Anthropological Sciences* 12: 106.

Roberts, P., Fernandes, R., Craig, O.E., Larsen, T., Lucquin, A., Swift, J. & Zech, J. 2017. Calling all archaeologists: guidelines for terminology, methodology, data handling, and reporting when undertaking and reviewing stable isotope applications in archaeology. *Rapid Communications in Mass Spectrometry*.

Rodríguez Cifuentes, M. & de Juana, L.Á. 2006. *La Huelga y El Malecón: dos asentamientos altomedievales entre la tradición y el cambio*, in J. Morín de Pablos (ed.) *La investigación arqueológica de la época visigoda en la Comunidad de Madrid. Volumen II La ciudad y el campo (Zona Arqueológica 8)*: 418–431. Alcalá de Henares: Museo Arqueológico Regional.

Rodríguez Cifuentes, M. & Domingo, L.A. 2006. *Las Charcas, un asentamiento rural visigodo en la vega del Jarama*, in J. Morín de Pablos (ed.) *La investigación arqueológica de la época visigoda en la Comunidad de Madrid. Volumen II La ciudad y el campo (Zona Arqueológica 8)*: 432–445. Alcalá de Henares: Museo Arqueológico Regional.

Rodríguez Monterrubio, Ó. 2015. *Alameda del Señorío (Illescas, Toledo). Análisis arqueozoológico fauna seleccionada*. Madrid: Unpublished report.

Roig, J. 2006. *Informe tècnic de la intervenció arqueològica al Parc Infantil de la Plaça Major de Castellar del Vallès (Vallès Occ.), 2006*. Sabadell: Arrago S.L.

Roig, J. 2009. *Asentamientos rurales y poblados tardoantiguos y altomedievales en Cataluña (siglos VI al X)*, in

J.A. Quirós (ed.) *The Archaeology of Early Medieval villages in Europe (Documentos de Arqueología Medieval 1)*: 207–251. Bilbao: Universidad del País Vasco.

Roig, J. 2011a. *Formas de poblamiento rural en torno al 711: documentación arqueológica del área catalana*, in E. Baquedano (ed.) *711. Arqueología e Historia entre dos mundos (Zona arqueológica 15.2)*: 119–144. Alcalá de Henares: Museo Arqueológico Regional.

Roig, J. 2011b. *Vilatges i assentaments pagesos de l'Antiguitat Tardana als territoria de Barcino i Egara (Depressió Litoral i Prelitorial): caracterització del poblamentrural entre els segles V-VIII*, in *Actes del IV Congrés d'Arqueologia medieval i moderna de Catalunya (Tarragona, del 10 al 13 de juny de 2010)*: 227–250. Tarragona: ACRAM.

Roig, J. 2013. *Silos, poblados e iglesias: almacenaje y rentas en época visigoda y altomedieval en Cataluña (ss. VI-XI)*, in A. Vigil-Escalera, G. Bianchi, & J.A. Quirós (ed.) *Horrea, barns and silos. Storage and incomes in Early Medieval Europe (Documentos de Arqueología Medieval 5)*: 145–170. Bilbao: Universidad del País Vasco.

Roig, J. 2015. *Necrópolis de época visigoda, ajuares funerarios y depósitos humanos anómalos de los s. V-VIII en la Tarraconense oriental (Cataluña): ¿indicadores de 'etnicidad' y/o nivel económico? e indicios arqueológicos de desigualdad y exclusión social inhumaciones*, in J.A. Quirós & S. Castellanos (ed.) *Identidad y etnicidad en Hispania. Propuestas teóricas y cultura material en los siglos V-VIII (Documentos de Arqueología Medieval 8)*: 333–393. Bilbao: Universidad del País Vasco.

Roig, J. 2018. *El sepulcro en fosa en silo de la Plaça Major de Castellar del Vallès (Castellar del Vallès, Barcelona)*, in J.F. Gibaja, M. Mozota, M.E. Subirà, A. Martín, & J. Roig (ed.) *Mirando a la muerte. Las prácticas funerarias durante el Neolítico en el noreste peninsular*: 60–72. Castellón de la Plana: e-DitARX.

Roig, J. 2019. *Prácticas funerarias de época visigoda y altomedieval (siglos VI al X): el ejemplo arqueológico del noreste peninsular (Cataluña)*, in A. García Álvarez-Busto, C. García de Castro, & S. Ríos (ed.) *130 aniversario del origen del Reino de Asturias. Congreso internacional. Del fin de la Antigüedad Tardía a la Alta Edad Media en la península ibérica (650-900) (Anejos de Nailos 5)*: 431–481. Oviedo: Asociación de Profesionales Independientes de la Arqueología de Asturias.

Roig, J. & Coll, J.M. 2007a. El paratge arqueològic de Can Gambús 1 (Sabadell, Vallès Occidental). *Tribuna d'Arqueologia* 2006: 85–109.

Roig, J. & Coll, J.M. 2007b. La intervenció arqueològica al jaciment de l' aparcament subterrani de la plaça Major de Castellar del Vallès. Primeres dades i resultats preliminars. *Recerca* 5: 117–142.

Roig, J. & Coll, J.M. 2008a. *Memòria de la intervenció arqueològica a Can Gambús 1 (Sabadell, Vallès Occ.). Abril 2003-desembre 2004 i agost 2006*. Sabadell: Arrago S.L.

Roig, J. & Coll, J.M. 2008b. *Memòria de la intervenció arqueològica al jaciment de la Plaça Major de Castellar del Vallès (Vallès Occidental), abril-desembre 2005*. Sabadell: Arrago S.L.

Roig, J. & Coll, J.M. 2010a. El jaciment de la Plaça Major de Castellar del Vallès: de l'assentament del Neolític al vilatge de l'Antiguitat Tardana. 5.000 anys d'evolució històrica. *Recerca* 7: 77–108.

Roig, J. & Coll, J.M. 2010b. El jaciment de la Plaça Major de Castellar del Vallès: de l'assentament del Neolític, el canal de l'edat del ferro i el vilatge de l'Antiguitat Tardana. *Tribuna d'Arqueologia* 2008–2009: 187–220.

Roig, J. & Coll, J.M. 2011a. *Esquelets humans en sitges, pous i abocadors als assentaments rurals i vilatges de l'Antiguitat Tardana de Catalunya (segles V-VIII): evidènces arqueòlogiques de la presència d'esclaus i serfs*, in *Actes del IV Congrés d'Arqueologia medieval i moderna de Catalunya (Tarragona, del 10 al 13 de juny de 2010)*: 75–82. Tarragona: ACRAM.

Roig, J. & Coll, J.M. 2011b. *El registre ceràmic dels assentaments i vilatges de l'Antiguitat Tardana de la depressió litoral i prelitoral (s. VI-VIII): caracterització de les produccions i estudi morfol`gic*, in *Actes del IV Congrés d'Arqueologia medieval i moderna de Catalunya (Tarragona, del 10 al 13 de juny de 2010)*: 211–226. Tarragona: ACRAM.

Roig, J. & Coll, J.M. 2012a. *El món funerari dels territoria de Barcino i Egara entre l'Antiguitat Tardana i l'època altmedieval (segles V al XII): caracterizació de les necròpolis i cronotipologia de les sepultures*, in N. Molist & G. Ripoll (ed.) *Arqueologia funèraria al nord-est peninsular (segles VI-XII) (Monografies d'Olèrdola 3.2)*: 373–401. Olèrdola: Museu d'Arqueologia de Catalunya.

Roig, J. & Coll, J.M. 2012b. *El registro cerámico de una aldea modelo de la Antigüedad Tardía en Cataluña (siglos VI-VIII): Can Gambùs-1 (Sabadell, Barcelona)*, in S. Gelichi (ed.) *Atti del IX Congresso Internazionale* *sulla ceramica medievale nel Mediterraneo. Venezia, Scuola Grande dei Carmini, Auditorium Santa Margherita. 23-27 novembre 2009*: 195–198. Firenze: All'Insegna del Giglio.

ROIG, J. & COLL, J.M. 2015. L'assentament del neolític dels Horts de Can Torras i la Plaça Major de Castellar del Vallès: les sitges, les sepultures i el material arqueològic. *Recerca* 8: 114–149.

ROIG, J. & COLL, J.M. 2018. *El enterramiento múltiple en silo de Horts de Can Torras (Castellar del Vallès, Barcelona)*, in J.F. Gibaja, M. Mozota, M.E. Subirà, A. Martín, & J. Roig (ed.) *Mirando a la muerte. Las prácticas funerarias durante el Neolítico en el noreste peninsular*: 74–89. Castellón de la Plana: e-DitARX.

ROIG, J., COLL, J.M., GIBAJA, J.F., CHAMBON, P., VILLAR, V., RUIZ, J., TERRADAS, X. & SUBIRÀ, M.E. 2010. La necrópolis de Can Gambús-1 (Sabadell, Barcelona). Nuevos conocimientos sobre las prácticas funerarias durante el Neolítico medio en el Noreste de la Península Ibérica. *Trabajos de Prehistoria* 67: 59–84.

ROIG, J., COLL, J.M. & MOLINA, J.A. 1995. *L'església vella de Sant Menna. Sentmenat: del segle V al XX. 1500 anys d'evolució històrica*. Sentmenat: Ajuntament de Sentmenat.

RUIZ, J. & SUBIRÀ, M.E. 2010. *Estudi antropològic de dos sepulcres de fossa al Vallès: E-54, UE 229 de Can Marcet a Sant Cugat del Vallès i E-41 UE 284 de la Plaça Major de Castellar del Vallès*. Bellaterra: MINOA Arqueologia i Serveis S.L.

RUIZ, J., VILLAR, V. & SUBIRÀ, M.E. 2007. *La població visigoda de Can Gambús (Sabadell)*, in *III Congrés d'Arqueologia Medieval i Moderna a Catalunya. Sabadell, del 18 al 21 de maig de 2006*: 799–806. Sabadell: ACRAM.

RYAN, S.E., REYNARD, L.M., CROWLEY, Q.G., SNOECK, C. & TUROSS, N. 2018. Early medieval reliance on the land and the local: an integrated multi-isotope study (87Sr/86Sr, δ18O, δ13C, δ15N) of diet and migration in Co. Meath, Ireland. *Journal of Archaeological Science* 98: 59–71.

SAKAI, Y. 2017. *Transition from the Late Roman period to the Early Anglo-Saxon period in the Upper Thames Valley based on stable isotopes*. Oxford: University of Oxford.

SALAMON, M., COPPA, A., MCCORMICK, M., RUBINI, M., VARGIU, R. & TUROSS, N. 2008. The consilience of historical and isotopic approaches in reconstucting the medieval Mideterranean diet. *Journal of Archaeological Science* 35: 1667–1672.

SALAZAR-GARCÍA, D.C., BENÍTEZ DE LUGO, L., ÁLVAREZ GARCÍA, H.J. & BENITO, M. 2013. Estudio diacrónico de la dieta de los pobladores de Terrinches (Ciudad Real) a partir del análisis de isótopos estables sobre restos óseos humanos. *Revista Española de Antropología Física* 34: 6–14.

SALAZAR-GARCÍA, D.C., ROMERO, A., GARCÍA-BORJA, P., SUBIRÀ, M.E. & RICHARDS, M.P. 2016. A combined dietary approach using isotope and dental buccal-microwear analysis of human remains from the Neolithic, Roman and Medieval periods from the archaeological site of Tossal de les Basses (Alicante, Spain). *Journal of Archaeological Science: Reports* 6: 610–619.

SALESSE, K., KAUPOVÁ, S., BRŮŽEK, J., KUŽELKA, V. & VELEMÍNSKÝ, P. 2019. An isotopic case study of individuals with syphilis from the pathological-anatomical reference collection of the national museum in Prague (Czech Republic, 19th century A.D.). *International Journal of Paleopathology* 25: 46–55.

SAMPEDRO, C. 1999. *Análisis de los restos antropológicos procedentes del yacimiento 050 de San Martín de la Vega (Madrid)*. Madrid: ÁREA Sociedad Cooperativa.

SAMPEDRO, C. 2004. *Análisis de los restos antropológicos procedentes del yacimiento de 'La Huelga' (Barajas, Madrid)*, in R.M. Domínguez Alonso, J. Rincón, & A. Vigil-Escalera (ed.) *Memoria de las excavaciones arqueológicas en el yacimiento 'La Huelga'. Afectado por el soterramiento de línea eléctrica de 400 kV (Barajas, Madrid)*: 82–96. Madrid: ÁREA Sociedad Cooperativa Madrileña.

SAMPEDRO, C. 2011. *Anexo I. Estudio antropológico (Gózquez, San Martín de la Vega)*, in M. Contreras (ed.) *La necrópolis medieval de Gózquez de Arriba (San Martín de la Vega). Memoria Final*: 651–737. Madrid: Dirección General de Patrimonio de la Comunidad de Madrid.

SAMWORTH, R. & GOWLAND, R.L. 2007. Estimation of adult skeletal age-at-death: statistical assumptions and applications. *International Journal of Osteoarchaeology* 17: 174–188.

SÁNCHEZ RINCÓN, R., LOZA, M. & NISO, J. 2014. Las monedas de San Martín de Dulantzi (Alegría-Dulantzi, Álava, País Vasco). Luces y sombras, siglos I-XIV. *Munibe* 65: 197–213.

SANDIAS, M. & MÜLDNER, G.H. 2015. Diet and herding strategies in a changing environment: stable isotope analysis of Bronze Age and Late Antique skeletal remains from Ya'amūn, Jordan. *Journal of Archaeological*

Science 63. Elsevier Ltd: 24–32.

Saragoça, P., Maurer, A.F., Šoberl, L., Lopes, M. da C., Alfenim, R., Leandro, I., Umbelino, C., Fernandes, T., Valente, M.J., Ribeiro, S., Santos, J.F., Janeiro, A.I. & Dias Barrocas, C. 2016. Stable isotope and multi-analytical investigation of Monte da Cegonha: a Late Antiquity population in southern Portugal. *Journal of Archaeological Science: Reports*.

Saunders, S.R., Hoppa, R.D. & Southern, R. 1993. Diaphyseal growth in a nineteenth century skeletal sample of subadults from St Thomas' church, Belleville, Ontario. *International Journal of Osteoarchaeology* 3: 265–281.

Schaefer, M.C., Black, S. & Scheuer, L. 2009. *Juvenile osteology. A laboratory and field manual*. London: Elsevier.

Scheuer, L. & Black, S. 2000. *Developmental juvenile osteology*. London: Elsevier.

Scheuer, L. & MacLaughlin-Black, S. 1994. Age estimation from the pars basilaris of the fetal and juvenile occipital bone. *International Journal of Osteoarchaeology* 4: 377–380.

Scheuer, L., Musgrave, J.H. & Evans, S.P. 1980. The estimation of late fetal and perinatal age from limb bone length by linear and logarithmic regression. *Annals of Human Biology* 7: 257–265.

Schmid, E. 1972. *Atlas of animal bones for prehistorians, archaeologists and Quaternary geologists*. Amsterdam: Elsevier.

Schoeller, D.A. 1999. Isotope fractionation: why aren't we what we eat? *Journal of Archaeological Science* 26: 667–673.

Schoeninger, M.J. 2010. *Diet reconstruction and ecology using stable isotope ratios*, in C.S. Larsen (ed.) *A Companion to Biological Anthropology*: 445–464. Chichester: Wiley-Blackwell.

Schoeninger, M.J. & DeNiro, M.J. 1984. Nitrogen and carbon isotopic composition of bone collagen from marine and terrestrial animals. *Geochimica et Cosmochimica Acta* 48: 625–639.

Schoeninger, M.J., DeNiro, M.J. & Tauber, H. 1983. Stable nitrogen isotope ratios of bone collagen reflect marine and terrestrial components of Prehistoric human diet. *Science* 220: 1381–1383.

Schutkowski, H., Herrmann, B., Wiedemann, F., Bocherens, H. & Grupe, G. 1999. Diet, status and decomposition at Weingarten: trace element and isotope analysis on Early Mediaeval skeletal material. *Journal of Archaeological Science* 26: 675–685.

Schwarcz, H.P. 2001. *Some biochemical aspects of carbon isotopic studies*, in S.H. Ambrose & M.A. Katzenberg (ed.) *Biogeochemical approaches to paleodietary analysis*: 189–209. New York: Kluwer Academic Publishers.

Schwarcz, H.P., Dupras, T.L. & Fairgrieve, S.I. 1999. 15N enrichment in the Sahara: in search of a global relationship. *Journal of Archaeological Science* 26: 629–636.

Schwarcz, H.P. & Schoeninger, M.J. 1991. Stable isotope analyses in human nutritional ecology. *Yearbook of Physical Anthropology* 34: 283–321.

Schwarcz, H.P. & Schoeninger, M.J. 2011. *Stable isotopes of carbon and nitrogen as tracers for paleo-diet reconstruction*, in M. Baskaran (ed.) *Handbook of environmental isotope geochemistry*: 725–742. Heidelberg: Springer.

Scorrano, G., Brilli, M., Martínez-Labarga, C., Giustini, F., Pacciani, E., Chilleri, F., Scaldaferri, F., Gasbarrini, A., Gasbarrini, G. & Rickards, O. 2014. Palaeodiet reconstruction in a woman with probable celiac disease: a stable isotope analysis of bone remains from the archaeological site of Cosa (Italy). *American Journal of Physical Anthropology* 154: 349–356.

Séguy, I. & Buchet, L. (ed.) 2013. *Handbook of palaeodemography*. Heidelberg: Springer.

Serjeantson, D. & Woolgar, C.M. 2006. *Fish consumption in Medieval England*, in C.M. Woolgar, D. Serjeantson, & T. Waldron (ed.) *Food in Medieval England. Diet and nutrition*: 102–130. Oxford: Oxford University Press.

Serrano, E., Torra, M., Catalán, R. & Vigil-Escalera, A. 2016. *La cerámica de los siglos VIII-IX en Madrid, Toledo y Guadalajara*, in A. Vigil-Escalera & J.A. Quirós (ed.) *La cerámica de la Alta Edad Media en el cuadrante noroeste de la Península Ibérica (siglos V-X). Sistemas de producción, mecanismos de distribución y patrones de consumo (Documentos de Arqueología Medieval 9)*: 279–313. Bilbao: Universidad del País Vasco.

Shapiro, S.S. & Wilk, M.B. 1965. An analysis of variance test for normality. *Biometrika* 52: 591–611.

Silver, A. 1969. *The ageing of domestic animals*, in Donald R. Brothwell & S. Higgs (ed.) *Science in Archaeology*: 283–302. London: Thames & Hudson.

SIRIGNANO, C., GRAU-SOLOGESTOA, I., RICCI, P., GARCÍA-COLLADO, M.I., ALTIERI, S., QUIRÓS, J.A. & LUBRITTO, C. 2014. Animal husbandry during Early and High Middle Ages in the Basque Country (Spain). *Quaternary International* 346: 138–148.

SLACK, C.R. & HATCH, M.D. 1967. Comparative studies on the activity of carboxylases and other enzymes in relation to the new pathway of photosynthetic carbon dioxide fixation in tropical grasses. *The Biochemical journal* 103: 660–665.

SLOVAK, N.M. & PAYTAN, A. 2011. *Applications of Sr isotopes in archaeology*, in M. Baskaran (ed.) *Handbook of environmental isotope geochemistry*: 743–768. Heidelberg: Springer.

SMITH, B.H. 1991. *Standards of human tooth formation and dental age assessment*, in M.A. Kelley & C.S. Larsen (ed.) *Advances in Dental Anthropology*: 143–168. New York: Wiley-Liss.

SMITH, B.N. & EPSTEIN, S. 1971. Two categories of 13C/12C ratios for higher plants. *Plant physiology* 47: 380–384.

SMRČKA, V., VELEMÍNSKÝ, P., BŮZEK, F. & ZOCOVÁ, J. 2008. *Stable C, N isotopes in human skeletal material from the Great Moravian burial site at Mikulčice-Kostelisko*, in P. Velemínský & L. Poláček (ed.) *Studien zum Burgwall von Mikulčice*: 169–175. Brno: Archäeologisches Institut der Akademie der Wissenschaften der Tschechischen Republik.

SPONHEIMER, M., ROBINSON, T., AYLIFFE, L., ROEDER, B., HAMMER, J., PASSEY, B., WEST, A., CERLING, T., DEARING, D. & EHLERINGER, J. 2003. Nitrogen isotopes in mammalian herbivores: hair δ15N values fron controlled feeding study. *International Journal of Osteoarchaeology* 13: 80–87.

STROTT, N., CZERMAK, A. & GRUPE, G. 2008. Are biological correlates to social stratification depicted in skeletal finds? Investigation of early medieval separate burial grounds in Bavaria. *Documenta Archaeobiologiae* 5: 67–86.

STUDENT 1908. The probable error of a mean. *Biometrika* 6: 1–25.

SUBIRÀ, M.E., GARCÍA-GUIXÉ, E. & BERROCAL, I. 2004. *Informe de les restes humanes recuperades a l'estructura 11 d'Horts de Can Torras (Castellar del Vallès, Vallès occidental)*. Barcelona: Universitat Autònoma de Barcelona.

SZPAK, P., METCALFE, J.Z. & MACDONALD, R.A. 2017. Best practices for calibrating and reporting stable isotope measurements in archaeology. *Journal of Archaeological Science: Reports* 13: 609–616.

SZPAK, P., MILLAIRE, J.F., WHITE, C.D. & LONGSTAFFE, F.J. 2012. Influence of seabird guano and camelid dung fertilization on the nitrogen isotopic composition of field-grown maize (Zea mays). *Journal of Archaeological Science* 39: 3721–3740.

SZPAK, P., WHITE, C.D., LONGSTAFFE, F.J., MILLAIRE, J.F. & VÁSQUEZ SÁNCHEZ, V.F. 2013. Carbon and nitrogen isotopic survey of Northern Peruvian plants: baselines for paleodietary and paleoecological studies. *PLoS ONE* 8: e53763.

TAFURI, M.A., GOUDE, G. & MANZI, G. 2018. Isotopic evidence of diet variation at the transition between classical and post-classical times in Central Italy. *Journal of Archaeological Science: Reports* 21: 496–503.

TEJERIZO, C. 2013. *La arquitectura doméstica en las aldeas meseteñas altomedievales*, in J.A. Quirós (ed.) *El poblamiento rural de época visigoda en Hispania. Arqueología del campesinado en el interior peninsular (Documentos de Arqueología Medieval 6)*: 289–328. Bilbao: Universidad del País Vasco.

TEJERIZO, C. 2014. Estructuras de fondo rehundido altomedievales en la Península Ibérica. *Munibe* 65: 215–238.

TIESZEN, L.L., BOUTTON, T.W., TESDAHL, K.G. & SLADE, N.A. 1983. Fractionation and turnover of stable carbon isotopes in animal tissues: Implications for d13C analysis of diet. *Oecologia* 57: 32–37.

TIESZEN, L.L. & FAGRE, T. 1993. *Effect of diet quality and composition on the isotopic composition of respiratory CO2, bone collagen, bioapatite, and soft tissues*, in J.B. Lambert & G. Grupe (ed.) *Prehistoric human bone. Archaeology at the molecular level*: 121–155. Berlin: Springer.

TOSO, A.M. & ALEXANDER, M.M. 2018. *Paleodietary reconstruction*, in C. Tavares da Silva (ed.) *Caetobriga. O sítio arqueológico da Casa dos Mosaicos (Setúbal Arqueológica 17)*: 203–206. Setúbal: Museu de Arqueologia e Etnografia do Distrito de Setúbal.

TOSO, A.M., GASPAR, S., BANHA DA SILVA, R., GARCIA, S.J. & ALEXANDER, M.M. 2019. High status diet and health in Medieval Lisbon: a combined isotopic and osteological analysis of the Islamic population from São Jorge Castle, Portugal. *Archaeological and Anthropological Sciences* 11: 3699–3716.

TSUTAYA, T. & YONEDA, M. 2013. Quantitative reconstruction of weaning ages in archaeological human populations using bone collagen nitrogen isotope ratios and approximate Bayesian computation. *PLoS ONE* 8: e72327.

TSUTAYA, T. & YONEDA, M. 2015. Reconstruction of breastfeeding and weaning practices using stable isotope and trace element analyses: a review. *American Journal of Physical Anthropology* 156: 2–21.

UBELAKER, D.H. 1989. *Human skeletal remains. Excavation, analysis, interpretation*. Washington: Taraxacum.

UTRERO, M.Á. 2006. *Iglesias tardoantiguas y altomedievales de la Península Ibérica. Análisis arqueológico y sistemas de abovedamiento (Anejos de Arqueología Española XL)*. Madrid: Instituto de Historia CSIC.

VALENTI, M. & SALVADORI, F. 2007. *Animal bones: synchronous and diachronic distribution as patterns of socially determined meat consumption in the early and high Middle Ages in central and northern Italy*, in A. Pluskowski (ed.) *Breaking and shaping beastly bodies. Animals as material culture in the Middle Ages*: 171–188. Oxford: Oxbow Books.

VALENTIN, J. 2002. Basic anatomical and physiological data for use in radiological protection: reference values. *Annals of the ICRP* 32. Oxford: Pergamon Press: 1–277.

VALENZUELA-LAMAS, S., JIMÉNEZ-MANCHÓN, S., EVANS, J.A., LÓPEZ, D., JORNET, R. & ALBARELLA, U. 2016. Analysis of seasonal mobility of sheep in Iron Age Catalonia (north-eastern Spain) based on strontium and oxygen isotope analysis from tooth enamel: First results. *Journal of Archaeological Science: Reports* 6: 828–836.

VAN DER MERWE, N.J. & MEDINA, E. 1991. The canopy effect, carbon isotope ratios and foodwebs in Amazonia. *Journal of Archaeological Science* 18: 249–259.

VAN DER MERWE, N.J. & VOGEL, J.C. 1978. 13C content of human collagen as a measure of prehistoric diet in Woodland North America. *Nature* 276: 815–816.

VAN DER VEEN, M. 2003. When is food a luxury? *World Archaeology* 34: 405–427.

VAN KLINKEN, G.J. 1999. Bone collagen quality indicators for palaeodietary and radiocarbon measurements. *Journal of Archaeological Science* 26: 687–695.

VAN KLINKEN, G.J., RICHARDS, M.P. & HEDGES, R.E.M. 2001. *An overview of causes for stable isotopic variations in past European human populations: environmental, ecophysiological, and cultural effects*, in S.H. Ambrose & M.A. Katzenberg (ed.) *Biogeochemical approaches to paleodietary analysis*: 39–63. New York: Kluwer Academic Publishers.

VAN KLINKEN, G.J., VAN DER PLICHT, H. & HEDGES, R.E.M. 1994. Bond 13C/12C ratios reflect (palaeo-)climatic variations. *Geophysical Research Letters* 21: 445–448.

VAN STRYDONCK, M., ERVYNCK, A., VANDENBRUAENE, M. & BOUDIN, M. 2009. Anthropology and 14C analysis of skeletal remains from relic shrines: an unexpected source of information for medieval archaeology. *Radiocarbon* 51: 569–577.

VANDERKLIFT, M.A. & PONSARD, S. 2003. Sources of variation in consumer-diet δ15N enrichment: a meta-analysis. *Oecologia* 136: 169–182.

VANPOOL, T.L. & LEONARD, R.D. 2011. *Quantitative analysis in archaeology*. Chichester: Wiley-Blackwell.

VARANO, S., DE ANGELIS, F., BATTISTINI, A., BRANCAZI, L., PANTANO, W., RICCI, P., ROMBONI, M., CATALANO, P., GAZZANIGA, V., LUBRITTO, C., SANTANGELI VALENZANI, R., MARTÍNEZ-LABARGA, C. & RICKARDS, O. 2020. The edge of the Empire: diet characterization of medieval Rome through stable isotope analysis. *Archaeological and Anthropological Sciences* 12: 196.

VARÓN, F.R. 2012. Asentamiento de Aldaia. *Arkeoikuska* 2011: 75–78.

VARÓN, F.R. 2018. Determinación del trazado de Iter XXXIV a su paso por Álava (Berantevilla, Armiñón, Iruña de Oca, Vitoria, Elburgo, Alegría, San Millán, Salvatierra, Asparrena). *Arkeoikuska* 2017.

VARÓN, F.R., AZCUNE, I. & ORTEGA, A. 2011. Valoración arqueológica del asentamiento de Aldaia, Arroiabe (Arrazua-Ubarrundia, Álava). *Estudios de Arqueología Alavesa* 27: 49–78.

VELÁZQUEZ, I., LOZA, M. & NISO, J. 2017. Una posible cristianización del mito de Teseo representada en una cochlear hallada en la iglesia de San Martín de Dulantzi (Alegría-Dulantzi, Álava). *Euphrosyne* 45: 539–561.

VIDAL-RONCHAS, R., RAJIĆ ŠIKANJIĆ, P., PREMUŽIĆ, Z., RAPAN PAPEŠA, A. & LIGHTFOOT, E. 2018. Diet, sex, and social status in the Late Avar period: stable isotope investigations at Nuštar cemetery, Croatia. *Archaeological and Anthropological Sciences*, 1–11.

VIGIL-ESCALERA, A. *Memoria de las excavaciones arqueológicas en el yacimiento de época visigoda de Gózquez de Arriba (San Martín de la Vega, Madrid). 1997-1999*. Madrid: ÁREA Sociedad Cooperativa.

Vigil-Escalera, A. 2000. Cabañas de época visigoda: evidencias arqueológicas del sur de Madrid. Tipología, elementos de datación y discusión. *Archivo Español de Arqueología* 73: 223–252.

Vigil-Escalera, A. 2003a. Arquitectura de tierra, piedra y madera en Madrid (ss. V-IX d.C.). Variables materiales, consideraciones sociales. *Arqueología de la Arquitectura* 2: 287–291.

Vigil-Escalera, A. 2003b. *Cerámicas tardorromanas y altomedievales de Madrid*, in L. Caballero, P. Mateos, & M. Retuerce (ed.) *Cerámicas tardorromanas y altomedievales en la Península Ibérica: ruptura y continuidad (Anejos del Archivo Español de Arqueología XXVIII)*: 371–387. Mérida: Instituto de Arqueología de Mérida.

Vigil-Escalera, A. 2003c. *Los poblados de época visigoda del sur de Madrid: algunos aspectos económicos y sociales*, in *I Congreso del Instituto de Estudios Históricos del Sur de Madrid 'Jiménez de Gregorio' (Pinto, 2003)*: 51–68. Alcorcón: I.E.H.S.M. 'Jiménez de Gregorio'.

Vigil-Escalera, A. 2004. Noticia preliminar acerca del hallazgo de una necrópolis altomedieval de rito islámico en la Comunidad de Madrid. El yacimiento de La Huelga (Barajas, Madrid). *Bolskan* 21: 57–61.

Vigil-Escalera, A. 2005. *Nuevas perspectivas sobre la arqueología madrileña de época visigoda*, in A. Castillo & F. Sáez Lara (ed.) *Actas de las Primeras Jornadas de Patrimonio Arqueológico en la Comunidad de Madrid. 24- 26 de noviembre de 2004*: 169–181. Madrid: Dirección General de Patrimonio Histórico.

Vigil-Escalera, A. 2006a. *El modelo de poblamiento rural en la Meseta y algunas cuestiones de visibilidad arqueológica*, in J. López Quiroga & A.M. Martínez Tejera (ed.) *Gallia e Hispania en el contexto de la presencia 'germánica' (ss. V-VII). Balance y perspectivas (BAR International Series 1534)*: 89–108. Oxford: Archaeopress.

Vigil-Escalera, A. 2006b. *Primeros pasos hacia el análisis de la organización interna de los asentamientos rurales de época visigoda*, in J. Morín de Pablos (ed.) *La investigación arqueológica de la época visigoda en la Comunidad de Madrid (Zona Arqueológica 8)*, II: 367–376. Alcalá de Henares: Museo Arqueológico Regional.

Vigil-Escalera, A. 2007a. Granjas y aldeas altomedievales al Norte de Toledo (450-800 d.C.). *Archivo Español de Arqueología* 80: 239–284.

Vigil-Escalera, A. 2007b. *Algunas observaciones sobre las cerámicas 'de época visigoda' (ss. V-IX) de la región de Madrid*, in A. Malpica & J.C. Carvajal (ed.) *Estudios de cerámica tardorromana y altomedieval*: 359–382. Granada: Alhulia.

Vigil-Escalera, A. 2009a. *Las aldeas altomedievales madrileñas y su proceso formativo*, in J.A. Quirós (ed.) *The Archaeology of Early Medieval villages in Europe (Documentos de Arqueología Medieval 1)*: 315–339. Bilbao: Universidad del País Vasco.

Vigil-Escalera, A. 2009b. Sepulturas, huertos y radiocarbono (siglos VIII-XIII d.C.). El proceso de islamización en el medio rural del centro peninsular y otras cuestiones. *Studia Historica. Historia Medieval* 27: 97–118.

Vigil-Escalera, A. 2010. *Formas de parcelario en las aldeas altomedievales del sur de Madrid. Una aproximación arqueológica preliminar*, in H. Kirchner (ed.) *Por una Arqueología Agraria. Perspectivas de investigación sobre los espacios de cultivo en las sociedades medievales hispánicas (BAR International Series 2062)*: 1–9. Oxford: Archaeopress.

Vigil-Escalera, A. 2011. El pequeño mundo en ruinas de la arqueología contractual española. *Arkeogazte* 1: 17–20.

Vigil-Escalera, A. 2012. Apuntes sobre la arquitectura de los hogares y hornos domésticos altomedievales del centro de la Península Ibérica (siglos V-VIII d.C.). *Arqueología de la Arquitectura* 9: 165–180.

Vigil-Escalera, A. 2013a. *Prácticas y ritos funerarios*, in J.A. Quirós (ed.) *El poblamiento rural de época visigoda en Hispania. Arqueología del campesinado en el interior peninsular (Documentos de Arqueología Medieval 6)*: 259–288. Bilbao: Universidad del País Vasco.

Vigil-Escalera, A. 2013b. *Gózquez (San Martín de la Vega, Madrid)*, in J.A. Quirós (ed.) *El poblamiento rural de época visigoda en Hispania. Arqueología del campesinado en el interior peninsular (Documentos de Arqueología Medieval 6)*: 155–177. Bilbao: Universidad del País Vasco.

Vigil-Escalera, A. 2013c. Comunidad política aldeana y exclusión. Una revisión de las formas de inhumación altomedievales. *Reti Medievali Rivista* 14: 1–42.

Vigil-Escalera, A. 2013d. *El Soto/El Encadenado (Barajas, Madrid)*, in J.A. Quirós (ed.) *El poblamiento rural de época visigoda en Hispania. Arqueología del campesinado en el interior peninsular (Documentos de*

Arqueología Medieval 6): 216–231. Bilbao: Universidad del País Vasco.

Vigil-Escalera, A. 2013e. *La Huelga (Barajas, Madrid)*, in J.A. Quirós (ed.) *El poblamiento rural de época visigoda en Hispania. Arqueología del campesinado en el interior peninsular (Documentos de Arqueología Medieval 6)*: 232–243. Bilbao: Universidad del País Vasco.

Vigil-Escalera, A. 2015a. *La identidad de la comunidad local y las afiliaciones individuales en necrópolis de la Alta Edad Media (400-900 AD)*, in J.A. Quirós & S. Castellanos (ed.) *Identidad y etnicidad en Hispania. Propuestas teóricas y cultura material en los siglos V-VIII (Documentos de Arqueología Medieval 8)*: 249–274. Bilbao: Universidad del País Vasco.

Vigil-Escalera, A. 2015b. *El espacio doméstico en el ámbito rural del centro de la península ibérica entre los siglos V y IX d.C.*, in M.E. Díez Jorge & J. Navarro (ed.) *La casa medieval en la península ibérica*: 519–539. Madrid: Sílex.

Vigil-Escalera, A. 2015c. *M-02 El Soto (Barajas, Madrid)*, in *Los primeros paisajes altomedievales en el interior de Hispania. Registros campesinos del siglo quinto d.C. (Documentos de Arqueología Medieval 7)*: 170–172. Bilbao: Universidad del País Vasco.

Vigil-Escalera, A. 2015d. *Contextos arqueológicos de El Soto (Barajas, Madrid)*, in *Los primeros paisajes altomedievales en el interior de Hispania. Registros campesinos del siglo quinto d.C. (Documentos de Arqueología Medieval 7)*: 131–133. Bilbao: Universidad del País Vasco.

Vigil-Escalera, A. 2015e. *Los primeros paisajes altomedievales en el interior de Hispania. Registros campesinos del siglo quinto d.C. (Documentos de Arqueología Medieval 7)*. Bilbao: Universidad del País Vasco.

Vigil-Escalera, A. 2016. *Invisible social inequalities in early medieval communities: the bare bones of household slavery*, in J.A. Quirós (ed.) *Social complexity in early medieval rural communities. The north-western Iberian archaeological record*: 113–123. Oxford: Archaeopress.

Vigil-Escalera, A. 2019. *Hábitats de época visigoda en la région de Madrid*, in *Du Royaume Goth au Midi Merovingien. Actes des 34e Journées d'Archéologie Mérovigienne de Toulouse, 6, 7, et 8 Novembre 2013*. Toulouse: Association française d'archéologie mérovingienne.

Vigil-Escalera, A. 2020. *Cinturones, molinos y cosechas de vino: elementos extrañados de sus contextos*, in C. Doménech, I. Grau, & S. Gutiérrez Lloret (ed.) *El sitio de las cosas*. Alicante: Universidad de Alicante.

Vigil-Escalera, A., Moreno-García, M., Peña-Chocarro, L., Morales, A., Llorente, L., Sabato, D. & Ucchesu, M. 2014. Productive strategies and consumption patterns in the Early Medieval village of Gózquez (Madrid, Spain). *Quaternary International* 346: 7–19.

Vigil-Escalera, A. & Quirós, J.A. 2012. *Arqueología de los paisajes rurales altomedievales en el Noroeste Peninsular*, in L. Caballero, P. Mateos, & T. Cordero (ed.) *Visigodos y Omeyas: el territorio (Anejos de Archivo Español de Arqueología LXI)*: 79–95. Mérida: Instituto de Arqueología de Mérida.

Vigil-Escalera, A. & Quirós, J.A. 2013. *Un ensayo de interpretación del registro arqueológico*, in J.A. Quirós (ed.) *El poblamiento rural de época visigoda en Hispania. Arqueología del campesinado en el interior peninsular (Documentos de Arqueología Medieval 6)*: 357–399. Bilbao: Universidad del País Vasco.

Vigil-Escalera, A. & Vírseda, L. 2007. *Memoria: Excavación arqueológica en el yacimiento 'Encadenado/El Soto'. Campaña 2005 (Barajas, Madrid)*. Madrid: ÁREA Sociedad Cooperativa.

Vika, E. & Theodoropoulou, T. 2012. Re-investigating fish consumption in Greek antiquity: results from δ13C and δ15N analysis from fish bone collagen. *Journal of Archaeological Science* 39: 1618–1627.

Virginia, R.A. & Delwiche, C.C. 1982. Natural 15N abundance of presumed N2-fixing and non-N2-fixing plants from selected ecosystems. *Oecologia* 54: 317–325.

von den Driesch, A. 1976. *A guide to the measurement of animal bones from archaelogical sites*. Cambridge: Peabody Museum Press, Harvard University.

Vytlačil, Z., Kaupová, S., Lefebvre, A., Velemínský, P. & Brůžek, J. 2018. A time of change: dietary reconstruction of the Merovingian cemetery of Norroy-le-Veneur, France. *Anthropologischer Anzeiger* 75: 325–338.

Wada, E., Kadonaga, T. & Matsuo, S. 1975. 15N abundance in nitrogen of naturally occurring substances and global assessment of denitrification from isotopic viewpoint. *Geochemical Journal* 9: 139–148.

Warinner, C. & Tuross, N. 2009. Alkaline cooking and stable isotope tissue-diet spacing in swine: archaeological implications. *Journal of Archaeological Science* 36: 1690–1697.

Waters-Rist, A.L. & Katzenberg, M.A. 2010. The effect of growth on stable nitrogen isotope ratios in subadult bone collagen. *International Journal of Osteoarchaeology* 20: 172–191.

Welch, B.L. 1947. The generalization of 'Student's' problem when several different population variances are involved. *Biometrika* 34: 28–35.

White, T.D. & Folkens, P.A. 2005. *The human bone manual*. London: Elsevier.

Wickham, C. 2005. *Framing Early Middle Ages: Europe and the Mediterranean, 400-800*. Oxford: Oxford University Press.

Wickham, C. 2011. *The changing composition of early élites*, in F. Bougard, H.W. Goetz, & R. Le Jan (ed.) *Théorie et pratiques des élites au Haut Moyen Âge. Conception, perception et réalisation sociale*: 5–18. Turnhout: Brepols.

Woolgar, C.M. 2006. *Meat and dairy products in late medieval England*, in C.M. Woolgar, D. Serjeantson, & T. Waldron (ed.) *Food in Medieval England. Diet and nutrition*: 88–101. Oxford: Oxford University Press.

Woolgar, C.M. 2010. Food and the Middle Ages. *Journal of Medieval History* 36: 1–19.

Young, R.W. 1957. Postnatal growth of the frontal and parietal bones in white males. *American Journal of Physical Anthropology* 15: 367–386.

7 APPENDICES

7.1 FUNERARY ARCHAEOLOGY

Table 7.1. Formal characteristics, location and chronology of the burials. Chronology refers to the deposit, which does not necessarily match the date of the individual (e.g. SMD 181-1-2810). Key: Grave type: SP = simple pit, SPp = piled simple pit, N = niche, SL = slabs, WL = walls, WLs = stuccoed walls, TE = tegulae, BMf = building material fragments, MX = mixed materials, SC = sarcophagus, NFS = non-funerary structure, U = undetermined; Location: N = north, S = south, E = east, W = west, ch = church; Chronology: * = radiocarbon date available (see table 7.3); Availab anthr m = Availability of anthropological material for study: 0 = no, 1 = yes; Position: 1S = primary deposit, supine position, 1P = primary deposit, prone position, 1L = primary deposit, lateral position, 1F = primary deposit, fetal position, 1T = primary deposit, thrown body, 2R = secondary deposit, reduction, 2O = secondary deposit, ossuary, 2Fi = secondary deposit in filling, 2Tu = secondary deposit in tumulus, 2U = secondary deposit, undetermined, U = undetermined deposit; Orientation: N = north, S = south, E = east, W = west, N/A = not applicable.

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
GOZ 001-1-4602	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 002-1-4606	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 003-1-1003	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 004-1-1008	SL	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 005-1-1011	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 006-1-1014	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 007-1-4004	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 008-1-4007	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 009-1-4011	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 010-1-4014	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 011-1-4017	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 012-1-4020	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 013-1-4023	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 014-1-4026	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 015-1-4029	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 015-2-4029	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 015-3-4029	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 015-4-4029	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 016-1-4032	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 017-1-4042	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 018-1-4038	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 019-1-4041	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 020-1-4045	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 021-1-4048	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 022-1-4052	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 023-1-4055	SP	Cemetery	6th-mid-8th c.	1	1S	W-E

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
GOZ 024-1-4058	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 025-1-4061	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 026-1-4064	SL	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 027-1-4067	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 028-1-4070	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 029-1-4073	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 030-1-4076	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 031-1-4082	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 032-1-4085	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 033-1-4088	SL	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 033-2-4088	SL	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 034-1-4091	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 035-1-4094	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 036-1-4099	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 037-1-4102	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 038-1-4105	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 039-1-4108	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 040-1-4111	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 041-1-4114	SL	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 042-1-4117	SL	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 043-1-4120	BMf	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 044-1-4126	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 045-1-4129	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 046-1-4152	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 047-01-4154	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 047-02-4154	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 047-03-4154	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 047-04-4154	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 047-05-4154	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 047-06-4154	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 047-07-4154	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 047-08-4154	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 047-09-4154	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 047-10-4154	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 048-1-4168	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 048-2-4157	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 049-1-4169	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 050-1-4164	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 051-1-4167	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 052-1-4175	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 052-2-4175	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 053-1-4179	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 054-1-4224	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 055-1-4188	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 055-2-4188	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 055-3-4188	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 056-1-4191	BMf	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 057-1-4195	N	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 058-1-4198	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 058-2-4198	SP	Cemetery	6th-mid-8th c.	1	1S	W-E

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
GOZ 059-1-4201	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 060-1-4205	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 060-2-4205	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 061-1-4226	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 062-1-4211	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 063-1-4215	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 063-2-4215	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 064-1-4218	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 065-1-4231	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 065-2-4231	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 065-3-4231	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 066-1-4236	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 066-2-4236	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 067-1-4241	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 067-2-4238	SP	Cemetery	6th-mid-8th c.	1	2Tu	N/A
GOZ 068-1-4244	BMf	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 069-1-4253	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 069-2-4050	SP	Cemetery	6th-mid-8th c.	1	2Tu	N/A
GOZ 070-1-4256	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 070-2-4256	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 071-1-4259	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 071-2-4259	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 072-1-4262	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 073-1-4267	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 073-2-4264	SP	Cemetery	6th-mid-8th c.	1	2Tu	N/A
GOZ 074-1-4269	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 075-1-4276	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 075-2-4276	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 075-3-4275	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 075-4-4275	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 076-1-4247	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 077-1-4286	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 077-2-4286	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 078-1-4292	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 078-2-4291	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 078-3-4291	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 078-4-4291	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 079-1-4296	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 080-1-4300	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 081-1-4305	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 082-1-4307	BMf	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 083-1-4314	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 084-1-4318	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 084-2-4318	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 085-1-4336	N	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 086-1-4324	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 087-1-4330	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 087-2-4329	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 088-1-4333	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 089-1-4373	SP	Cemetery	6th-mid-8th c.	0	1S	W-E

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
GOZ 089-2-4372	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 090-1-4375	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 090-2-4346	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 091-1-4432	N	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 091-2-4349	N	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 091-3-4350	N	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 091-4-4350	N	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 092-1-4354	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 092-2-4354	SP	Cemetery	6th-mid-8th c.	0	2R	N/A
GOZ 093-1-4357	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 094-1-4363	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 094-2-4362	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 095-1-4364	BMf	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 096-1-4370	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 096-2-4369	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 097-1-4377	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 097-2-4378	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 098-1-4390	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 098-2-4380	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 099-1-4393	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 100-1-4398	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 100-2-4399	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 100-3-4396	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 100-4-4396	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 101-1-4438	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 102-1-4403	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 102-2-4402	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 103-1-4442	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 103-2-4441	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 103-3-4408	SP	Cemetery	6th-mid-8th c.	1	2Tu	N/A
GOZ 103-4-4408	SP	Cemetery	6th-mid-8th c.	1	2Tu	N/A
GOZ 104-1-4414	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 105-1-4417	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 106-1-4422	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 107-1-4425	SP	Cemetery	6th-mid-8th c.	1	U	N/A
GOZ 108-1-4429	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 108-2-4428	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 109-1-4454	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 110-1-4448	N	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 110-2-4451	N	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 111-1-4461	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 112-1-4467	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 112-2-4468	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 113-1-4473	SL	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 114-1-4477	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 115-1-4483	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 116-1-4566	N	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 116-2-4565	N	Cemetery	6th-mid-8th c.	0	2R	N/A
GOZ 117-1-4490	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 117-2-4489	SP	Cemetery	6th-mid-8th c.	1	2R	N/A

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
GOZ 118-1-4493	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 118-2-4492	SP	Cemetery	6th-mid-8th c.	0	2R	N/A
GOZ 119-1-4498	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 119-2-4497	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 120-1-4501	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 121-1-4504	SP	Cemetery	6th-mid-8th c.	1	U	N/A
GOZ 122-1-4508	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 123-1-4512	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 124-1-4610	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 124-2-4610	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 124-3-4610	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 124-4-4515	SP	Cemetery	6th-mid-8th c.	1	2Tu	N/A
GOZ 125-1-4519	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 126-1-5089	N	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 127-1-4526	BMf	Cemetery	6th-mid-8th c.	1	U	N/A
GOZ 128-1-4530	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 129-1-4538	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 130-1-4542	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 131-1-4579	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 131-2-4550	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 131-3-4546	SP	Cemetery	6th-mid-8th c.	1	2Tu	N/A
GOZ 131-4-4546	SP	Cemetery	6th-mid-8th c.	1	2Tu	N/A
GOZ 132-1-4557	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 132-2-4552	SP	Cemetery	6th-mid-8th c.	1	2Tu	N/A
GOZ 133-1-4607	SL	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 134-1-4565	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 134-2-4565	SP	Cemetery	6th-mid-8th c.	0	2R	N/A
GOZ 135-1-4568	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 135-2-4568	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 136-1-4719	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 136-2-4646	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 136-3-4645	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 136-4-4645	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 136-5-4645	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 136-6-4644	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 136-7-4572	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 137-1-4577	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 138-1-4583	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 139-1-4589	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 140-1-4593	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 141-1-4597	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 141-2-4598	SP	Cemetery	6th-mid-8th c.	0	2R	N/A
GOZ 142-1-4601	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 143-1-4604	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 144-1-4607	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 144-2-4608	SP	Cemetery	6th-mid-8th c.	0	2R	N/A
GOZ 145-1-4613	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 146-1-4618	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 146-2-4642	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 147-1-4639	SP	Cemetery	6th-mid-8th c.	0	1S	W-E

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
GOZ 148-1-4681	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 149-1-4632	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 149-2-4632	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 149-3-4632	SP	Cemetery	6th-mid-8th c.	1	2Fi	W-E
GOZ 150-1-4638	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 150-2-4638	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 150-3-4637	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 151-1-4651	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 151-2-4650	SP	Cemetery	6th-mid-8th c.	0	2R	N/A
GOZ 152-1-4655	N	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 153-1-4658	SP	Cemetery	6th-mid-8th c.	1	U	N/A
GOZ 154-1-4665	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 154-2-4664	SP	Cemetery	6th-mid-8th c.	0	2R	N/A
GOZ 155-1-4667	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 156-1-4726	N	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 157-1-4674	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 158-1-4728	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 158-2-4729	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 158-3-4678	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 159-1-4687	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 160-1-4691	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 161-1-4692	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 162-1-4763	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 162-2-4764	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 162-3-4762	SP	Cemetery	6th-mid-8th c.	0	2R	N/A
GOZ 162-4-4698	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 162-5-4696	SP	Cemetery	6th-mid-8th c.	0	2Tu	N/A
GOZ 163-1-4751	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 164-1-4704	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 165-1-4710	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 166-1-4713	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 167-1-4716	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 168-1-4722	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 169-1-4733	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 170-1-4736	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 171-1-4739	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 171-2-4740	SP	Cemetery	6th-mid-8th c.	0	2R	N/A
GOZ 172-1-4741	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 173-1-4747	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 174-1-4750	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 175-1-4755	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 176-1-4756	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 177-1-4761	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 178-1-4767	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 179-1-4771	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 180-1-4901	N	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 181-1-4784	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 182-1-4788	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 183-1-4798	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 183-2-4797	SP	Cemetery	6th-mid-8th c.	1	2R	N/A

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
GOZ 184-1-4799	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 185-1-4803	SP	Cemetery	6th-mid-8th c.	1	U	N/A
GOZ 186-1-4809	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 187-1-4811	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 188-1-4817	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 188-2-4816	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 189-1-4823	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 189-2-4818	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 190-1-4828	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 191-1-4831	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 191-2-4832	SP	Cemetery	6th-mid-8th c.	0	2R	N/A
GOZ 192-1-4836	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 193-1-4839	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 194-1-4845	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 195-1-4848	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 195-2-4848	SP	Cemetery	6th-mid-8th c.	0	2R	N/A
GOZ 196-1-4852	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 197-1-4855	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 198-1-4860	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 199-1-4865	SL	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 200-1-4872	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 200-2-4872	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 201-1-4875	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 201-2-4874	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 202-1-4879	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 203-1-4881	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 203-2-4882	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 204-1-4884	SP	Cemetery	6th-mid-8th c.	1	U	N/A
GOZ 205-1-4963	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 206-1-4891	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 207-1-4896	SP	Cemetery	6th-mid-8th c.	1	U	N/A
GOZ 208-1-4897	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 209-1-4907	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 210-1-4911	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 211-1-4917	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 211-2-4917	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 212-1-4923	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 213-1-4925	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 214-1-4927	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 215-1-4933	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 216-1-5043	N	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 216-2-5043	N	Cemetery	6th-mid-8th c.	0	2R	N/A
GOZ 217-1-4940	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 218-1-4944	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 219-1-4948	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 220-1-4952	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 221-1-4960	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 221-2-4962	SP	Cemetery	6th-mid-8th c.	1	2Tu	N/A
GOZ 222-1-4966	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 223-1-4969	SP	Cemetery	6th-mid-8th c.	0	U	N/A

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
GOZ 224-1-4976	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 225-1-4967	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 225-2-4965	SP	Cemetery	6th-mid-8th c.	0	2R	N/A
GOZ 225-3-5082	SP	Cemetery	6th-mid-8th c.	0	2R	N/A
GOZ 226-1-4986	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 226-2-4985	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 226-3-4985	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 227-1-4989	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 228-1-4993	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 229-1-4996	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 230-1-5003	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 230-2-5002	SP	Cemetery	6th-mid-8th c.	1	2Fi	N/A
GOZ 231-1-5006	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 232-1-5012	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 232-2-5011	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 233-1-5017	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 234-1-5022	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 235-1-5068	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 236-1-5028	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 236-2-5070	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 236-3-5027	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 237-1-5032	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 238-1-5035	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 239-1-5039	SP	Cemetery	6th-mid-8th c.	1	U	N/A
GOZ 240-1-5041	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 241-1-5046	SP	Cemetery	6th-mid-8th c.	1	U	N/A
GOZ 242-1-5049	SP	Cemetery	6th-mid-8th c.	0	U	N/A
GOZ 243-1-5085	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 243-2-5055	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 244-1-5060	SP	Cemetery	6th-mid-8th c.	0	1S	W-E
GOZ 244-2-5057	SP	Cemetery	6th-mid-8th c.	1	2R	N/A
GOZ 245-1-5062	SP	Cemetery	6th-mid-8th c.	1	U	N/A
GOZ 246-1-5076	SP	Cemetery	6th-mid-8th c.	1	1S	W-E
GOZ 246-2-5075	SP	Cemetery	6th-mid-8th c.	0	2R	N/A
GOZ 247-1-5080	SP	Cemetery	6th-mid-8th c.	1	U	N/A
GOZ 5831-1-6150	NFS	Settlement	Mid-7th-mid-8th c.*	1	1T	N/A
GOZ 5831-2-6150	NFS	Settlement	Mid-7th-mid-8th c.*	1	1T	N/A
GOZ 5831-3-6150	NFS	Settlement	Mid-7th-mid-8th c.*	1	1T	N/A
GOZ 5831-4-6150	NFS	Settlement	Mid-7th-mid-8th c.*	1	1T	N/A
GOZ 5831-5-6150	NFS	Settlement	Mid-7th-mid-8th c.*	1	1T	N/A
GOZ 6640-1-6644	NFS	Settlement	Mid-6th-start 7th c.	0	1T	N/A
GOZ 6640-2-6644	NFS	Settlement	Mid-6th-start 7th c.*	1	1T	N/A
GOZ 6640-3-6644	NFS	Settlement	Mid-6th-start 7th c.*	1	1T	N/A
GOZ 6640-4-6644	NFS	Settlement	Mid-6th-start 7th c.*	1	1T	N/A
GOZ 6640-5-6644	NFS	Settlement	Mid-6th-start 7th c.*	1	1T	N/A
GOZ 6890-1-6891	NFS	Settlement	Start 7th-mid-8th c.	1	1T	N/A
BOA 001-1	SP	Cemetery	End 5th-mid-8th c.	1	2U	N/A
BOA 002-1	WL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 002-2	WL	Cemetery	End 5th-mid-8th c.	1	2U	N/A
BOA 003-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
BOA 004-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 005-1	WL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 006-1	SP	Cemetery	End 5th-mid-8th c.	0	1S	W-E
BOA 007-1	SL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 008-1	WL	Cemetery	End 5th-mid-8th c.	0	1S	W-E
BOA 009-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 010-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 011-1	WL	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 012-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 013-1	MX	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 014-1	BMf	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 015-1	BMf	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 016-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 017-1	MX	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 017-2	MX	Cemetery	End 5th-mid-8th c.	1	2U	N/A
BOA 018-1	SL	Cemetery	End 5th-mid-8th c.	1	2O	N/A
BOA 019-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 020-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 021-1	BMf	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 022-1	WL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 023-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 024-1	SL	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 025-1	SP	Cemetery	End 5th-mid-8th c.	0	1S	W-E
BOA 026-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 027-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 028-1	BMf	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 029-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 030-1	WL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 031-1	MX	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 032-1	MX	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 033-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 034-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 035-1	WL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 036-1	SL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 037-1	SL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 037-2	SL	Cemetery	End 5th-mid-8th c.	0	2R	W-E
BOA 038-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 039-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 040-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 041-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 042-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 043-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 044-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 045-1	WL	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 047-1	BMf	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 048-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 049-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 050-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 051-1	WL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 051-2	WL	Cemetery	End 5th-mid-8th c.	1	2R	N/A

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
BOA 052-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 053-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 054-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 054-2	SP	Cemetery	End 5th-mid-8th c.	1	2R	N/A
BOA 055-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 055-2	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 058-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 059-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 060-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 061-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 062-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 063-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 064-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 065-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 066-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 067-1	WL	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 068-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 068-2	SP	Cemetery	End 5th-mid-8th c.	1	2U	N/A
BOA 069-1	SL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 069-2	SL	Cemetery	End 5th-mid-8th c.	1	2R	N/A
BOA 070-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 071-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 072-1	WL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 072-2	WL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 072-3	WL	Cemetery	End 5th-mid-8th c.	1	2R	N/A
BOA 073-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 074-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 075-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 076-1	SL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 076-2	SL	Cemetery	End 5th-mid-8th c.	1	2U	N/A
BOA 077-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 078-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 079-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 080-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 081-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 082-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 083-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 084-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 085-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 085-2	SP	Cemetery	End 5th-mid-8th c.	1	2R	N/A
BOA 086-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 086-2	SP	Cemetery	End 5th-mid-8th c.	1	2U	N/A
BOA 087-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 088-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 089-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 089-2	SP	Cemetery	End 5th-mid-8th c.	1	2R	N/A
BOA 090-1	SL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 091-1	WL	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 092-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 093-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
BOA 094-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 095-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 096-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 097-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 098-1	SL	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 099-1	SL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 100-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 101-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 102-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 103-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 103-2	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 103-3	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 103-4	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 104-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 105-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 105-2	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 105-3	SP	Cemetery	End 5th-mid-8th c.	1	2R	N/A
BOA 105-4	SP	Cemetery	End 5th-mid-8th c.	1	2R	N/A
BOA 106-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 107-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 107-2	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 107-3	SP	Cemetery	End 5th-mid-8th c.	1	2R	N/A
BOA 107-4	SP	Cemetery	End 5th-mid-8th c.	1	2R	N/A
BOA 108-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 109-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 109-2	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 110-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 111-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 112-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 113-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 113-2	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 114-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 115-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 115-2	SP	Cemetery	End 5th-mid-8th c.	1	2R	N/A
BOA 115-3	SP	Cemetery	End 5th-mid-8th c.	1	2R	N/A
BOA 115-4	SP	Cemetery	End 5th-mid-8th c.	1	2R	N/A
BOA 116-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 117-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 118-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 119-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 120-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 120-2	SP	Cemetery	End 5th-mid-8th c.	1	2U	N/A
BOA 121-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 122-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 123-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 124-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 125-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 125-2	SP	Cemetery	End 5th-mid-8th c.	1	2U	N/A
BOA 126-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 127-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
BOA 128-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 128-2	SP	Cemetery	End 5th-mid-8th c.	1	2R	N/A
BOA 129-1	SL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 130-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 131-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 132-1	SL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 133-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 134-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 135-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 136-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 137-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 138-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 139-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 140-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 141-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 142-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 143-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 144-1	SP	Cemetery	End 5th-mid-8th c.	0	U	W-E
BOA 145-1	SL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 145-2	SL	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 145-3	SL	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 145-4	SL	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 145-5	SL	Cemetery	End 5th-mid-8th c.	1	2R	N/A
BOA 145-6	SL	Cemetery	End 5th-mid-8th c.	1	2R	N/A
BOA 146-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 147-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 147-2	SP	Cemetery	End 5th-mid-8th c.	0	2R	N/A
BOA 148-1	SL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 149-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 150-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 151-1	SL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 151-2	SL	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 151-3	SL	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 152-1	SL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 152-2	SL	Cemetery	End 5th-mid-8th c.	1	2R	N/A
BOA 153-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 154-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 155-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 156-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 157-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 157-2	SP	Cemetery	End 5th-mid-8th c.	1	2U	N/A
BOA 159-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 160-1	SL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 160-2	SL	Cemetery	End 5th-mid-8th c.	1	2R	N/A
BOA 160-3	SL	Cemetery	End 5th-mid-8th c.	1	2U	N/A
BOA 161-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 162-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 163-1	WL	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 164-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 165-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
BOA 166A-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 166B-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 169-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 171A-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 171B-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 173-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 174-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 175-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 176-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 177-1	SP	Cemetery	End 5th-mid-8th c.	1	U	N/A
BOA 178-1	SP	Cemetery	End 5th-mid-8th c.	1	2R	N/A
BOA 179-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 179-2	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 180-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 181-1	SP	Cemetery	End 5th-mid-8th c.	0	U	N/A
BOA 182-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 183-1	WL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 184-1	SP	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 185-1	SP	Cemetery	End 5th-mid-8th c.	0	1S	W-E
BOA 186-1	SP	Cemetery	End 5th-mid-8th c.	0	1S	W-E
BOA 187-1	SL	Cemetery	End 5th-mid-8th c.	1	1S	W-E
BOA 187-2	SL	Cemetery	End 5th-mid-8th c.	1	2R	N/A
SNC 30100-1-30102	SP	Cemetery S	Start 8th-mid-9th c.	1	1S	W-E
SNC 30105-1-30108	SL	Cemetery S	Start 8th-mid-9th c.*	1	1L	W-E
SNC 30110-1-30111	SL	Cemetery S	Start 8th-mid-9th c.	1	2U	N/A
SNC 30110-2-30111	SL	Cemetery S	Start 8th-mid-9th c.	1	2U	N/A
SNC 30110-3-30111	SL	Cemetery S	Start 8th-mid-9th c.	1	2U	N/A
SNC 30110-4-30112	SL	Cemetery S	Start 8th-mid-9th c.	1	2Fi	N/A
SNC 30115-1-30117	SP	Cemetery S	Start 8th-mid-9th c.	1	1L	W-E
SNC 30130-1-30134	N	Cemetery S	Start 8th-mid-9th c.	1	1L	W-E
SNC 30140-1-30143	SP	Cemetery S	Start 8th-mid-9th c.	1	1L	W-E
SNC 30150-1-30152	SP	Cemetery S	Start 8th-mid-9th c.	1	1L	W-E
SNC 30150-2-30152	SP	Cemetery S	Start 8th-mid-9th c.	1	2U	N/A
SNC 30155-1-30156	SP	Cemetery S	Start 8th-mid-9th c.	0	U	N/A
SNC 30170-1-30186	N	Cemetery S	Start 8th-mid-9th c.	1	1L	W-E
SNC 30180-1-30182	N	Cemetery S	Start 8th-mid-9th c.*	1	1L	W-E
SNC 30240-1-30242	N	Cemetery S	Start 8th-mid-9th c.	1	1L	W-E
SNC 30270-1-30272	SP	Cemetery S	Start 8th-mid-9th c.	1	1L	W-E
SNC 30280-1-30283	N	Cemetery S	Start 8th-mid-9th c.*	1	1L	W-E
SNC 30290-1-30292	SP	Cemetery S	Start 8th-mid-9th c.	0	U	N/A
SNC 30295-1-30297	SP	Cemetery S	Start 8th-mid-9th c.	1	1L	W-E
SNC 30320-1-30322	SP	Cemetery S	Start 8th-mid-9th c.	1	1L	W-E
SNC 30444-1-30446	N	Cemetery S	Start 8th-mid-9th c.	1	1L	W-E
SNC 30620-1-30622	SP	Cemetery S	Start 8th-mid-9th c.	1	U	N/A
SNC 30740-1-30742	SP	Cemetery S	Start 8th-mid-9th c.*	1	1L	W-E
SNC 30745-1-30747	SP	Cemetery S	Start 8th-mid-9th c.	1	U	W-E
SNC 30750-1-30752	N	Cemetery S	Start 8th-mid-9th c.	1	U	W-E
SNC 30790-1-30793	N	Cemetery S	Start 8th-mid-9th c.	1	1L	W-E
SNC 30795-1-30798	N	Cemetery S	Start 8th-mid-9th c.	1	1L	W-E
SNC 30800-1-30803	SP	Cemetery S	Start 8th-mid-9th c.*	1	1S	N-S

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
SNC 30800-2-30802	SP	Cemetery S	Start 8th-mid-9th c.*	1	2R	N/A
SNC 30800-3-30801	SP	Cemetery S	Start 8th-mid-9th c.	1	2U	N/A
SNC 30805-1-30808	U	Cemetery S	Start 8th-mid-9th c.	1	U	N/A
SNC 30810-1-30813	SP	Cemetery S	Start 8th-mid-9th c.*	1	1S	W-E
SNC 30810-2-30813	SP	Cemetery S	Start 8th-mid-9th c.*	1	1S	W-E
SNC 30810-3-30812	SP	Cemetery S	Start 8th-mid-9th c.*	1	2R	N/A
SNC 30810-4-30812	SP	Cemetery S	Start 8th-mid-9th c.*	1	2R	N/A
SNC 30810-5-30812	SP	Cemetery S	Start 8th-mid-9th c.*	1	2R	N/A
SNC 30810-6-30812	SP	Cemetery S	Start 8th-mid-9th c.*	1	2R	N/A
SNC 30830-1-30832	SP	Cemetery S	Start 8th-mid-9th c.	1	1L	W-E
SNC 30835-1-30837	SP	Cemetery S	Start 8th-mid-9th c.	1	1S	W-E
SNC 30840-1-30842	N	Cemetery S	Start 8th-mid-9th c.	1	1L	W-E
SNC 30850-1-30858	SP	Cemetery S	Start 8th-mid-9th c.	1	1L	W-E
SNC 30865-1-30869	N	Cemetery S	Start 8th-mid-9th c.	1	1L	W-E
SNC 30880-1-30884	N	Cemetery S	Start 8th-mid-9th c.	1	1L	W-E
SNC 30890-1-30892	SP	Cemetery S	Start 8th-mid-9th c.	1	U	N/A
SNC 33000-1-33003	SP	Cemetery N	First half 5th c.	1	1S	N-S
SNC 33005-1-33004	SP	Cemetery N	First half 5th c.	1	1S	S-N
SNC 33010-1-33013	SP	Cemetery N	First half 5th c.	1	1S	N-S
SNC 33020-1-33021	SP	Cemetery N	First half 5th c.	0	U	N/A
SNC 33030-1-33032	SP	Cemetery N	First half 5th c.	1	1S	S-N
SNC 33040-1-33043	SP	Cemetery N	First half 5th c.	1	U	N/A
SNC 33050-1-33053	SP	Cemetery N	First half 5th c.	0	U	N/A
SNC 33060-1-33064	SP	Cemetery N	First half 5th c.	1	1S	S-N
SNC 33070-1-33072	SP	Cemetery N	First half 5th c.	1	1S	S-N
LH 1-1-7023	SP	Sector 1	7th c.*	1	1S	W-E
LH 2-1-7112	SP	Sector 2 N	End 8th-9th c.	1	1L	SW-NE
LH 3-1-7132	N	Sector 2 N	End 8th-9th c.*	1	1L	SW-NE
LH 4-1-7162	SP	Sector 2 S	End 8th-9th c.	1	1L	W-E
LH 5-1-7182	SP	Sector 2 S	End 8th-9th c.	1	1L	W-E
LH 6-1-7192	SP	Sector 2 S	End 8th-9th c.	1	1L	W-E
LH 7-1-7198	SP	Sector 2 N	End 8th-9th c.	1	1L	SW-NE
LH 8-1-7202	SP	Sector 2 N	End 8th-9th c.	1	1L	SW-NE
LH 9-1-7172	SP	Sector 2 S	End 8th-9th c.	1	1L	W-E
ALD A001-1	SP	Sector A	Mid-6th-start 8th c.	0	1S	W-E
ALD A002-1	SP	Sector A	Mid-6th-start 8th c.	0	1S	W-E
ALD A003-1	SP	Sector A	Mid-6th-start 8th c.	0	1S	E-W
ALD A004-1	SP	Sector A	Mid-6th-start 8th c.	0	U	N-S
ALD A005-1	SP	Sector A	Mid-6th-start 8th c.	0	1S	E-W
ALD A006-1	SP	Sector A	Mid-6th-start 8th c.	0	U	E-W
ALD A007-1	SP	Sector A	Mid-6th-start 8th c.	0	1S	W-E
ALD A008-1	SP	Sector A	Mid-6th-start 8th c.	1	1S	S-N
ALD A009-1	SP	Sector A	Mid-6th-start 8th c.	1	1S	W-E
ALD A010-1	SP	Sector A	Mid-6th-start 8th c.	1	U	W-E
ALD A011-1	SP	Sector A	Mid-6th-start 8th c.	1	1S	S-N
ALD ASUP-01	U	Sector A	Mid-6th-start 8th c.	0	2U	N/A
ALD ASUP-02	U	Sector A	Mid-6th-start 8th c.	0	2U	N/A
ALD ASUP-03	U	Sector A	Mid-6th-start 8th c.	0	2U	N/A
ALD ASUP-04	U	Sector A	Mid-6th-start 8th c.	0	2U	N/A
ALD ASUP-05	U	Sector A	Mid-6th-start 8th c.	0	2U	N/A

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
ALD ASUP-06	U	Sector A	Mid-6th-start 8th c.	1	2U	N/A
ALD ASUP-07	U	Sector A	Mid-6th-start 8th c.	1	2U	N/A
ALD ASUP-08	U	Sector A	Mid-6th-start 8th c.	1	2U	N/A
ALD ASUP-09	U	Sector A	Mid-6th-start 8th c.	1	2U	N/A
ALD ASUP-10	U	Sector A	Mid-6th-start 8th c.	1	2U	N/A
ALD B001-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B002-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B003-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B004-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B005-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	NW-SE
ALD B006/B008-1	SP	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B006/B008-2	SP	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B006/B008-3	SP	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B006/B008-4	SP	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B006/B008-5	SP	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B009/B010-1(B009)	SL	Sector B	Mid-6th-start 8th c.	0	2U	N/A
ALD B009/B010-2(B010)	SL	Sector B	Mid-6th-start 8th c.	0	2U	N/A
ALD B011-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B012-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B013-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B014-1	SP	Sector B	Mid-6th-start 8th c.*	1	1S	W-E
ALD B015-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B016-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B016-2	SP	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B017-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B018-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B019-1	SP	Sector B	Mid-6th-start 8th c.	1	1F	W-E
ALD B020-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	E-W
ALD B021-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B021-2	SP	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B022-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B023-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B024-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B025-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B026/B027-1(B026)	SP	Sector B	Mid-6th-start 8th c.	1	1S	N-S
ALD B026/B027-2(B027)	SP	Sector B	Mid-6th-start 8th c.	1	1S	N-S
ALD B028-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	N-S
ALD B029/B043-01(B029)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B029/B043-02(B030)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B029/B043-03(B031)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B029/B043-04(B032)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B029/B043-05(B033)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B029/B043-06(B034)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B029/B043-07(B035)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B029/B043-08(B036)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B029/B043-09(B037)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B029/B043-10(B038)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B029/B043-11(B039)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B029/B043-12(B040)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B029/B043-13(B041)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
ALD B029/B043-14(B042)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B029/B043-15(B043)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B044-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	N-S
ALD B045/B047-1(B045)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B045/B047-2(B046)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B045/B047-3(B047)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B048/B054-1(B048)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B048/B054-2(B049)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B048/B054-3(B050)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B048/B054-4(B051)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B048/B054-5(B052)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B048/B054-6(B053)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B048/B054-7	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B048/B054-8(B054)	SPp	Sector B	Mid-6th-start 8th c.	0	1S	SW-NE
ALD B055/B063-01(B055)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	NW-SE
ALD B055/B063-02(B056)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	SW-NE
ALD B055/B063-03(B057)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	NE-SW
ALD B055/B063-04(B058)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B055/B063-05(B059)	SPp	Sector B	Mid-6th-start 8th c.	1	1L	SW-NE
ALD B055/B063-06(B060)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	SW-NE
ALD B055/B063-07(B061)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	SW-NE
ALD B055/B063-08(B062)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	SW-NE
ALD B055/B063-09(B063)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	SW-NE
ALD B055/B063-10	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B064/B076-01(B064)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B064/B076-02(B065)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B064/B076-03(B066)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B064/B076-04(B067)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B064/B076-05(B068)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B064/B076-06(B069)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B064/B076-07(B070)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B064/B076-08(B071)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B064/B076-09(B072)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B064/B076-10(B073)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B064/B076-11(B074)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B064/B076-12(B075)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B064/B076-13(B076)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B077/B087-01(B077)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B077/B087-02(B078)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B077/B087-03(B079)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B077/B087-04(B080)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B077/B087-05(B081)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B077/B087-06(B082)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B077/B087-07(B083)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B077/B087-08(B084)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B077/B087-09(B085)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B077/B087-10(B086)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B077/B087-11(B087)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B088/B098-01(B088)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B088/B098-02(B089)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
ALD B088/B098-03(B090)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B088/B098-04(B091)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B088/B098-05(B092)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B088/B098-06(B093)	SPp	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B088/B098-07(B094)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	N-S
ALD B088/B098-08(B095)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B088/B098-09(B096)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B088/B098-10(B097)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B088/B098-11(B098)	SPp	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B099/B101-1(B099)	SP	Sector B	Mid-6th-start 8th c.	1	1S	E-W
ALD B099/B101-2(B100)	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B099/B101-3(B101)	SP	Sector B	Mid-6th-start 8th c.	1	2U	N/A
ALD B102/B103-1(B102)	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B102/B103-2(B103)	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
ALD B104-1	SP	Sector B	Mid-6th-start 8th c.	1	1L	N-S
ALD B105-1	SP	Sector B	Mid-6th-start 8th c.	1	1S	W-E
FIN 02-1-44	SP	Outside ch	5th-8th c.*	1	1S	W-E
FIN 03-1-50	SP	Outside ch	5th-8th c.*	1	1S	W-E
FIN 03-2-61	SP	Outside ch	5th-8th c.	1	U	N/A
FIN 06-1-53	SP	Outside ch	5th-8th c.*	1	1S	W-E
FIN 07-1-57	SP	Outside ch	5th-8th c.*	1	1S	W-E
FIN 08-1-56	SP	Outside ch	5th-8th c.*	1	1S	W-E
FIN 09-1-60	SP	Outside ch	5th-8th c.*	1	1S	N-S
FIN 13-1-30	SP	Outside ch	5th-8th c.	1	1S	N-S
FIN 14-1-73	SP	Outside ch	5th-8th c.	1	1S	W-E
FIN 15-1-74	SP	Outside ch	5th-8th c.	1	1S	N-S
FIN 16-1	SP	Outside ch	5th-8th c.	0	1S	W-E
FIN 17-1	SP	Outside ch	5th-8th c.	0	1S	W-E
SMD 2811-1-2810(181)	WLs	Inside ch	Mid-6th-end 7th c.*	1	2O	N/A
SMD 2841-1-2840(184)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 2871-1-2870(187)	SP	Outside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 2901-1-2900(190)	SP	Outside ch	Mid-6th-end 7th c.*	1	1S	W-E
SMD 2901-2-2900	SP	Outside ch	Mid-6th-end 7th c.	1	2U	N/A
SMD 2961-1-2960(196)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 2961-2-2970(197)	SP	Inside ch	Mid-6th-end 7th c.*	1	1S	W-E
SMD 2981-1-2990(199)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 2981-2-3120(212)	SP	Inside ch	Mid-6th-end 7th c.*	1	1S	W-E
SMD 2981-3-3030(203)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 2981-4-2980(198)	SP	Inside ch	Mid-6th-end 7th c.*	1	1S	W-E
SMD 3021-1-3020(202)	SP	Outside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 3041-1-3040(204)	SP	Inside ch	Mid-6th-end 7th c.*	1	1S	W-E
SMD 3061-1-3060(206)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 3071-1-3070(207)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 3071-2-3070	SP	Inside ch	Mid-6th-end 7th c.	1	2U	N/A
SMD 3081-1-3080(208)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 3091-1-3090(209)	SP	Outside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 3101-1-3100(210)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 3111-1-3110(211)	SP	Outside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 3151-1-3150(215)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	E-W
SMD 3151-2-3150	SP	Inside ch	Mid-6th-end 7th c.	1	2R	N/A

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
SMD 3151-3-3150	SP	Inside ch	Mid-6th-end 7th c.	1	2R	N/A
SMD 3161-1-3160(216)	SP	Outside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 3161-2-3160	SP	Outside ch	Mid-6th-end 7th c.	1	2U	N/A
SMD 3161-3-3160	SP	Outside ch	Mid-6th-end 7th c.	1	2U	N/A
SMD 3161-4-3160	SP	Outside ch	Mid-6th-end 7th c.	1	2U	N/A
SMD 3181-1-3180(218)	SP	Cemetery	5th-mid-6th c.	1	1S	W-E
SMD 3361-1-3360(236)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 3371-1-3370(237)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 3371-2-3370	SP	Inside ch	Mid-6th-end 7th c.	1	2U	W-E
SMD 3381-1-3380(238)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 3381-2-3380	SP	Inside ch	Mid-6th-end 7th c.	1	2U	N/A
SMD 3381-3-3380	SP	Inside ch	Mid-6th-end 7th c.	1	2U	N/A
SMD 3391-1-3390(239)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 3391-2-3390	SP	Inside ch	Mid-6th-end 7th c.	1	2U	W-E
SMD 3401-1-3390(240)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 3401-2-3390	SP	Inside ch	Mid-6th-end 7th c.	1	2U	N/A
SMD 3411-1-3410(241)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 3411-2-3410	SP	Inside ch	Mid-6th-end 7th c.	1	2U	N/A
SMD 3421-1-3420(242)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 3431-1-3430(243)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 3431-2-3430	SP	Inside ch	Mid-6th-end 7th c.	1	2U	N/A
SMD 3451-1-3450(245)	SP	Inside ch	Mid-6th-end 7th c.	1	2R	N/A
SMD 3451-2-3450	SP	Inside ch	Mid-6th-end 7th c.	1	2U	N/A
SMD 3461-1-3460(246)	SC	Inside ch	Mid-6th-end 7th c.*	1	2U	N/A
SMD 3461-2-3460	SC	Inside ch	Mid-6th-end 7th c.*	1	2U	N/A
SMD 3551-1-3550(255)	SP	Outside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 3601-1-3600(260)	SP	Outside ch	Mid-6th-end 7th c.	1	1P	W-E
SMD 3601-2-3600	SP	Outside ch	Mid-6th-end 7th c.	1	2U	N/A
SMD 3601-3-3600	SP	Outside ch	Mid-6th-end 7th c.	1	2U	N/A
SMD 3611-1-3610(261)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	W-E
SMD 3621-1-3620(262)	SP	Inside ch	Mid-6th-end 7th c.	1	1S	W-E
CG 053-1-0420	NFS	Settlement	7th-8th c.	1	1T	N/A
CG 053-2-0421	NFS	Settlement	7th-8th c.	1	1T	N/A
CG 080-1-0393	NFS	Settlement	7th-8th c.	1	1S	E-W
CG 094-1-1231	NFS	Settlement	7th-8th c.	1	1T	N/A
CG 094-2-1230	NFS	Settlement	7th-8th c.*	1	1T	N/A
CG 192-1-0353	SP	Settlement	Mid-6th-8th c.	1	1S	N-S
CG 220-1-0433	SP	Cemetery W	Mid-6th-8th c.	1	1S	SW-NE
CG 254-1-0623	SP	Cemetery E	6th c.	1	1S	SW-NE
CG 255-1-0626	SP	Cemetery E	6th c.	0	U	N/A
CG 279-1-0669	SP	Cemetery E	6th c.	0	U	N/A
CG 295-1-0704	SP	Cemetery W	Mid-6th-8th c.	1	1S	W-E
CG 296-1-0701	SP	Cemetery W	Mid-6th-8th c.	1	1S	E-W
CG 370-1-0916	SP	Cemetery W	Mid-6th-8th c.	1	1S	SW-NE
CG 371-1-0794	SP	Cemetery W	Mid-6th-8th c.	1	1S	SW-NE
CG 372-1-0797	SP	Cemetery W	Mid-6th-8th c.	1	1S	W-E
CG 373-1-0823	SP	Cemetery W	Mid-6th-8th c.	1	1S	E-W
CG 374-1-1695	NFS	Settlement	7th-8th c.	1	1T	N/A
CG 374-2-1473	NFS	Settlement	7th-8th c.	1	1T	N/A
CG 380-1-0826	SP	Cemetery W	Mid-6th-8th c.	1	1S	W-E

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
CG 381-1-0840	SP	Cemetery W	Mid-6th-8th c.	1	1S	W-E
CG 382-1-0837	SP	Cemetery W	Mid-6th-8th c.	1	1S	W-E
CG 385-1-0853	TE	Cemetery W	Mid-6th-8th c.	1	1S	W-E
CG 387-1-0746	SP	Cemetery W	Mid-6th-8th c.	1	1S	E-W
CG 391-1-0925	SP	Cemetery W	Mid-6th-8th c.*	1	1S	W-E
CG 392-1-0856	SP	Cemetery W	Mid-6th-8th c.	1	1S	W-E
CG 392-2-0855	SP	Cemetery W	Mid-6th-8th c.	1	2R	N/A
CG 393-1-0875	SP	Cemetery W	Mid-6th-8th c.	1	1S	W-E
CG 393-2-0874	SP	Cemetery W	Mid-6th-8th c.	1	1L	W-E
CG 395-1-0879	SP	Cemetery W	Mid-6th-8th c.	1	1S	E-W
CG 411-1-0901	SP	Cemetery W	Mid-6th-8th c.	1	1S	SW-NE
CG 443-1-0953	SP	Cemetery E	6th c.	1	1S	N/A
CG 444-1-0957	TE	Cemetery E	6th c.	1	U	N/A
CG 445-1-0960	TE	Cemetery E	6th c.	1	1S	W-E
CG 446-1-0964	TE	Cemetery E	6th c.	1	U	N/A
CG 447-1-0968	TE	Cemetery E	6th c.	1	U	SW-NE
CG 453-1-1315	SP	Cemetery W	Mid-6th-8th c.	1	1S	SW-NE
CG 477-1-1434	SP	Cemetery W	Mid-6th-8th c.	1	1S	W-E
CG 511-1-1437	SP	Cemetery W	Mid-6th-8th c.	1	1S	SW-NE
CG 512-1-1440	SP	Cemetery W	Mid-6th-8th c.	1	1S	E-W
CG 519-1-1480	TE	Cemetery W	Mid-6th-8th c.	1	1S	W-E
CG 597-1-1656	SP	Cemetery W	Mid-6th-8th c.	1	1S	SW-NE
CG 598-1-1646	TE	Cemetery W	Mid-6th-8th c.	1	1S	W-E
CG 599-1-1643	SP	Cemetery W	Mid-6th-8th c.	1	U	W-E
CG 692-1-1794	SP	Cemetery W	Mid-6th-8th c.	1	1S	S-N
PMCV 14-1-109	SL	Cemetery centre	7th-8th c.	1	1S	N-S
PMCV 15-1-130	MX	Cemetery centre	7th-8th c.*	1	1S	NW-SE
PMCV 15-2-126	MX	Cemetery centre	7th-8th c.	1	2Tu	N/A
PMCV 15-3-126	MX	Cemetery centre	7th-8th c.	1	2Tu	N/A
PMCV 16-1-103	MX	Cemetery centre	7th-8th c.	1	1S	NW-SE
PMCV 16-2-102	MX	Cemetery centre	7th-8th c.	1	1S	NW-SE
PMCV 17-1-477	SP	Cemetery centre	7th-8th c.	0	U	N/A
PMCV 18-1-114	TE	Cemetery S	6th c.	1	1S	N-S
PMCV 19-1-139	TE	Cemetery S	6th c.	1	1S	N-S
PMCV 19-2-141	TE	Cemetery S	6th c.	1	2R	N/A
PMCV 20-1-122	TE	Cemetery S	6th c.	1	1S	N-S
PMCV 21-1-160	TE	Cemetery S	6th c.	1	1S	N-S
PMCV 22-1-118	TE	Cemetery S	6th c.	1	1S	N-S
PMCV 22-2-116	TE	Cemetery S	6th c.	1	2R	N/A
PMCV 23-1-134	TE	Cemetery S	6th c.	1	1S	N-S
PMCV 43-1-350	SL	Cemetery centre	7th-8th c.	1	1S	NW-SE
PMCV 43-2-350	SL	Cemetery centre	7th-8th c.	1	2U	N/A
PMCV 44-1-469/470	TE	Cemetery N	End 6th-8th c.	1	1S	N-S
PMCV 45-1-412	TE	Cemetery N	End 6th-8th c.	1	1S	NW-SE
PMCV 46-1-444	TE	Cemetery N	End 6th-8th c.	1	1S	NW-SE
PMCV 46-2-445	TE	Cemetery N	End 6th-8th c.	1	1S	NW-SE
PMCV 46-3-444/445	TE	Cemetery N	End 6th-8th c.	1	U	N/A
PMCV 46-4-446	TE	Cemetery N	End 6th-8th c.	1	2R	N/A
PMCV 47-1-357	TE	Cemetery N	End 6th-8th c.	1	U	N/A
PMCV 48-1-353	SL	Cemetery N	End 6th-8th c.	1	U	N/A

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
PMCV 49-1-451	TE	Cemetery N	End 6th-8th c.	1	1S	NW-SE
PMCV 49-2-419	TE	Cemetery N	End 6th-8th c.	1	2Tu	N/A
PMCV 50-1-458/472	MX	Cemetery N	End 6th-8th c.	1	1S	NW-SE
PMCV 50-2-474	MX	Cemetery N	End 6th-8th c.	1	2R	N/A
PMCV 51-1-454	TE	Cemetery N	End 6th-8th c.	1	1S	NW-SE
PMCV 55-1-399	SP	Cemetery centre	End 6th-8th c.	1	2U	N/A
PMCV 55-2-399	SP	Cemetery centre	End 6th-8th c.	1	2U	N/A
PMCV 57-1-420/449	TE	Cemetery N	End 6th-8th c.	1	2R	N/A
RVSM 002-1-027(003)	TE	Outside ch	Mid-5th-6th c.	1	1S	W-E
RVSM 003-1-056(004a)	WL	Outside ch	7th-8th c.	1	1S	W-E
RVSM 003-2-056(004b)	WL	Outside ch	7th-8th c.	1	2Fi	N/A
RVSM 004-1-057(005)	TE	Outside ch	Mid-5th-6th c.	1	1S	W-E
RVSM 007-1-060(010)	SL	Outside ch	Mid-5th-6th c.	1	1S	W-E
RVSM 009-1-062(012)	WL	Outside ch	7th-8th c.	1	1S	W-E
RVSM 010-1-078(013)	WL	Outside ch	7th-8th c.	1	1S	W-E
RVSM 011-1-079(016a)	TE	Outside ch	Mid-5th-6th c.	1	1S	W-E
RVSM 011-2-079(016b)	TE	Outside ch	Mid-5th-6th c.	1	2Fi	N/A
RVSM 011-3-079(016c)	TE	Outside ch	Mid-5th-6th c.	1	2Fi	N/A
RVSM 014-1-086(014a)	SP	Outside ch	7th-8th c.	1	1S	W-E
RVSM 014-2-086(014b)	SP	Outside ch	7th-8th c.	1	2Fi	N/A
RVSM 015-1-087(015)	SP	Outside ch	7th-8th c.	0	1S	W-E
RVSM 018-1-092(021)	WL	Outside ch	7th-8th c.	1	1S	W-E
RVSM 020-1-096(023)	WL	Outside ch	7th-8th c.	1	1S	W-E
RVSM 020-2-096(037)	WL	Outside ch	7th-8th c.	1	2R	N/A
RVSM 022-1-100(025)	SL	Outside ch	7th-8th c.	1	1S	W-E
RVSM 023-1-107(026)	SP	Inside ch	Mid-5th-6th c.	1	1F	W-E
RVSM 024-1-118(027a)	SP	Inside ch	Mid-5th-6th c.	1	1S	W-E
RVSM 024-2-118(027b)	SP	Inside ch	Mid-5th-6th c.	1	2U	N/A
RVSM 025-1-117(032)	TE	Outside ch	Mid-5th-6th c.	1	1S	W-E
RVSM 027-1-103(030)	SP	Inside ch	Mid-5th-6th c.	0	1S	W-E
RVSM 028-1-104(031a)	WL	Inside ch	Mid-5th-6th c.	0	2U	N/A
RVSM 028-2-104(031b)	WL	Inside ch	Mid-5th-6th c.	0	2U	N/A
RVSM 028-3-104(031c)	WL	Inside ch	Mid-5th-6th c.	0	2U	N/A
RVSM 028-4-104(031d)	WL	Inside ch	Mid-5th-6th c.	0	2U	N/A
RVSM 028-5-104(031e)	WL	Inside ch	Mid-5th-6th c.	0	2U	N/A
RVSM 029-1-095(033)	BMf	Outside ch	7th-8th c.	1	1S	W-E
RVSM 031-1-128(036)	SP	Inside ch	Mid-5th-6th c.	1	1S	W-E
RVSM 031-2-128(035)	SP	Inside ch	Mid-5th-6th c.	1	2R	N/A
RVSM 032-1-130(038b)	SP	Outside ch	7th-8th c.	1	1S	W-E
RVSM 032-2-129(038a1)	SP	Outside ch	7th-8th c.	1	2R	N/A
RVSM 032-3-129(038a2)	SP	Outside ch	7th-8th c.	1	2R	N/A
RVSM 032-4-129(038a3)	SP	Outside ch	7th-8th c.	1	2R	N/A
RVSM 033-1-132(039)	NFS	Outside ch	Mid-5th-6th c.	1	1F	N-S
RVSM 034-1-143(040)	TE	Inside ch	Mid-5th-6th c.	1	1S	W-E
RVSM 034-2-145(145a)	TE	Inside ch	Mid-5th-6th c.	1	2U	N/A
RVSM 034-3-145(145b)	TE	Inside ch	Mid-5th-6th c.	1	2U	N/A
RVSM 035-1-146(041)	SP	Outside ch	7th-8th c.	1	1S	W-E
RVSM 038-1-156(047)	SP	Inside ch	Mid-5th-6th c.	1	1S	W-E
RVSM 038-2-155(046a)	SP	Inside ch	Mid-5th-6th c.	1	2R	N/A
RVSM 038-3-155(046b)	SP	Inside ch	Mid-5th-6th c.	1	2R	N/A

Individual	*Grave type*	*Location*	*Chronology*	*Availab anthr m*	*Position*	*Orientation*
RVSM 042-1-158(050)	SP	Inside ch	Mid-5th-6th c.	1	1F	W-E
RVSM 047-1-169(055)	SP	Inside ch	Mid-5th-6th c.	0	U	N/A
RVSM 048-1-170(056)	WL	Outside ch	7th-8th c.	1	1S	W-E
RVSM 049-1-171(057)	TE	Outside ch	Mid-5th-6th c.	1	1S	W-E
RVSM 050-1-151(058)	SP	Outside ch	7th-8th c.	0	1S	W-E
RVSM 051-1-152(059b)	SP	Outside ch	7th-8th c.	1	1S	W-E
RVSM 051-2-152(059a)	SP	Outside ch	7th-8th c.	0	2R	N/A
RVSM 052-1-173(060a)	WL	Outside ch	Mid-5th-6th c.	1	2U	N/A
RVSM 052-2-173(060b)	WL	Outside ch	Mid-5th-6th c.	1	2U	N/A
RVSM 053-1-174(061)	BMf	Outside ch	Mid-5th-6th c.	1	1S	W-E
RVSM 054-1-176(062)	SP	Outside ch	7th-8th c.	1	1S	W-E
RVSM 055-1-177(063)	SP	Outside ch	7th-8th c.	1	1S	W-E
RVSM 055-2-177(087a)	SP	Outside ch	7th-8th c.	1	1S	W-E
RVSM 055-3-177(087b)	SP	Outside ch	7th-8th c.	1	2Fi	N/A
RVSM 056-1-178(064a)	SP	Outside ch	7th-8th c.	1	1S	W-E
RVSM 056-2-178(064b)	SP	Outside ch	7th-8th c.	1	2Fi	N/A
RVSM 056-3-178(064c)	SP	Outside ch	7th-8th c.	1	2Fi	N/A
RVSM 060-1-184(068)	WL	Outside ch	7th-8th c.	1	2Fi	N/A
RVSM 062-1-194(070)	SP	Outside ch	7th-8th c.	1	1S	W-E
RVSM 063-1-198	SL	Inside ch	Mid-5th-6th c.	0	U	N/A
RVSM 064-1-200(074)	SP	Inside ch	Mid-5th-6th c.	1	1S	W-E
RVSM 064-2-199(073)	SP	Inside ch	Mid-5th-6th c.	1	2R	N/A
RVSM 113-1-384(126)	SP	Outside ch	7th-8th c.	1	1S	W-E
RVSM 114-1-385(127)	SP	Outside ch	7th-8th c.	1	1S	W-E
RVSM 115-1-386(128)	TE	Outside ch	Mid-5th-6th c.	1	1S	W-E
RVSM 116-1-387(129b)	TE	Outside ch	Mid-5th-6th c.	1	1S	W-E
RVSM 116-2-387(129a)	TE	Outside ch	Mid-5th-6th c.	1	2R	N/A
RVSM 117-1-393(130)	SP	Outside ch	7th-8th c.	1	1S	W-E
RVSM 118-1-394(131)	SP	Outside ch	7th-8th c.	1	1S	W-E
RVSM 120-1-396(133)	SL	Outside ch	7th-8th c.	1	1S	W-E
RVSM 121-1-398(134a)	WL	Outside ch	7th-8th c.	1	1S	W-E
RVSM 121-2-398(134b)	WL	Outside ch	7th-8th c.	1	2Fi	N/A
RVSM 124-1-401(137)	SP	Outside ch	7th-8th c.	1	1S	W-E
RVSM 125-1-402(138)	WL	Outside ch	Mid-5th-6th c.	1	1S	W-E
RVSM 127-1-412(140)	SL	Outside ch	7th-8th c.	1	1S	W-E
RVSM 128-1-413(141)	WL	Outside ch	7th-8th c.	1	1S	W-E
RVSM 129-1-415(142a)	WL	Outside ch	7th-8th c.	1	1S	W-E
RVSM 129-2-415(142b)	WL	Outside ch	7th-8th c.	1	2Fi	N/A
RVSM 129-3-415(142c)	WL	Outside ch	7th-8th c.	1	2Fi	N/A
RVSM 130-1-416(143)	WL	Outside ch	7th-8th c.	1	1S	W-E
RVSM 139-1-434(151)	WL	Outside ch	7th-8th c.	0	1S	W-E
RVSM 141-1-436(152)	SP	Outside ch	7th-8th c.	1	1S	W-E
RVSM 142-1-437(153)	SP	Outside ch	7th-8th c.	1	1S	W-E
RVSM 146-1-454(157)	WL	Outside ch	7th-8th c.	1	1S	W-E
RVSM 154-1-490(174)	WL	Outside ch	7th-8th c.	0	1S	W-E
RVSM 154-2-462(165b)	WL	Outside ch	7th-8th c.	1	1S	W-E
RVSM 154-3-462(165a)	WL	Outside ch	7th-8th c.	1	1S	W-E

Table 7.2. Coffin items and grave goods in the burials. Only the items which could be certainly associated to an individual are recorded. Key: 0 = absence, 1 = presence (only the absence or presence of items of each category is shown, the number of items of each category is not reported here).

						GG Clothing & jewellery							GG Containers				GG Tools & weapons									GG Other		
Individual	*Coffin items*	*Grave goods*	*GG C&J*	*GG Cnt*	*GG T&W*	*Fibulae*	*Belt plates*	*Earrings*	*Necklace items*	*Bracelets*	*Rings*	*Other*	*Pottery*	*Glass*	*Metal*	*Wood*	*Long sword*	*Short sword*	*Spear*	*Axe*	*Knife*	*Farm tools*	*Personal hygiene*	*Flint tools*	*Other*	*Fauna*	*Religious items*	*Other*
GOZ 001-1-4602	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 002-1-4606	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 003-1-1003	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 004-1-1008	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 005-1-1011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 006-1-1014	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 007-1-4004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 008-1-4007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 009-1-4011	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 010-1-4014	1	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
GOZ 011-1-4017	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 012-1-4020	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 013-1-4023	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 014-1-4026	1	1	1	0	0	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 015-1-4029	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 015-2-4029	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 015-3-4029	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 015-4-4029	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 016-1-4032	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 017-1-4042	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 018-1-4038	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 019-1-4041	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 020-1-4045	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 021-1-4048	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 022-1-4052	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Individual	GOZ 023-1-4055	GOZ 024-1-4058	GOZ 025-1-4061	GOZ 026-1-4064	GOZ 027-1-4067	GOZ 028-1-4070	GOZ 029-1-4073	GOZ 030-1-4076	GOZ 031-1-4082	GOZ 032-1-4085	GOZ 033-1-4088	GOZ 033-2-4088	GOZ 034-1-4091	GOZ 035-1-4094	GOZ 036-1-4099	GOZ 037-1-4102	GOZ 038-1-4105	GOZ 039-1-4108	GOZ 040-1-4111	GOZ 041-1-4114	GOZ 042-1-4117	GOZ 043-1-4120	GOZ 044-1-4126	GOZ 045-1-4129	GOZ 046-1-4152	GOZ 047-01-4154	GOZ 047-02-4154
GG Other	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	*Wood*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Clothing & jewellery	*Other*	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
	Rings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Earrings	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Belt plates	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
	Fibulae	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
	GG T&W	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	GG Cnt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG C&J	0	0	0	0	1	1	0	1	1	1	1	0	0	0	0	0	1	1	1	0	0	0	0	1	1	1	0
	Grave goods	0	0	0	0	1	1	0	1	1	1	1	0	1	0	0	0	1	1	1	0	0	0	0	1	1	1	0
	Coffin items	0	1	0	0	1	1	0	1	1	1	0	0	1	0	1	1	1	1	1	0	1	0	0	1	1	1	0

						GG Clothing & jewellery							GG Containers				GG Tools & weapons									GG Other		
Individual	Coffin items	Grave goods	GG C&J	GG Cnt	GG T&W	Fibulae	Belt plates	Earrings	Necklace items	Bracelets	Rings	Other	Pottery	Glass	Metal	Wood	Long sword	Short sword	Spear	Axe	Knife	Farm tools	Personal hygiene	Flint tools	Other	Fauna	Religious items	Other
GOZ 047-03-4154	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 047-04-4154	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 047-05-4154	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 047-06-4154	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 047-07-4154	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 047-08-4154	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 047-09-4154	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 047-10-4154	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 048-1-4168	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 048-2-4157	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 049-1-4169	1	1	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 050-1-4164	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 051-1-4167	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 052-1-4175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 052-2-4175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 053-1-4179	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
GOZ 054-1-4224	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 055-1-4188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 055-2-4188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 055-3-4188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 056-1-4191	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 057-1-4195	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 058-1-4198	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 058-2-4198	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 059-1-4201	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 060-1-4205	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 060-2-4205	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Individual	GOZ 061-1-4226	GOZ 062-1-4211	GOZ 063-1-4215	GOZ 063-2-4215	GOZ 064-1-4218	GOZ 065-1-4231	GOZ 065-2-4231	GOZ 065-3-4231	GOZ 066-1-4236	GOZ 066-2-4236	GOZ 067-1-4241	GOZ 067-2-4238	GOZ 068-1-4244	GOZ 069-1-4253	GOZ 069-2-4050	GOZ 070-1-4256	GOZ 070-2-4256	GOZ 071-1-4259	GOZ 071-2-4259	GOZ 072-1-4262	GOZ 073-1-4267	GOZ 073-2-4264	GOZ 074-1-4269	GOZ 075-1-4276	GOZ 075-2-4276	GOZ 075-3-4275	GOZ 075-4-4275
GG Other	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	*Wood*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Clothing & jewellery	*Other*	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Earrings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Belt plates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fibulae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG T&W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG Cnt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG C&J	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Grave goods	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coffin items	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

						GG Clothing & jewellery							GG Containers				GG Tools & weapons									GG Other		
Individual	Coffin items	Grave goods	GG C&J	GG Cnt	GG T&W	Fibulae	Belt plates	Earrings	Necklace items	Bracelets	Rings	Other	Pottery	Glass	Metal	Wood	Long sword	Short sword	Spear	Axe	Knife	Farm tools	Personal hygiene	Flint tools	Other	Fauna	Religious items	Other
GOZ 076-1-4247	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 077-1-4286	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 077-2-4286	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 078-1-4292	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 078-2-4291	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 078-3-4291	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 078-4-4291	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 079-1-4296	0	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
GOZ 080-1-4300	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 081-1-4305	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 082-1-4307	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 083-1-4314	1	1	1	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 084-1-4318	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 084-2-4318	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 085-1-4336	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 086-1-4324	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 087-1-4330	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 087-2-4329	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 088-1-4333	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 089-1-4373	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 089-2-4372	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 090-1-4375	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 090-2-4346	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 091-1-4432	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 091-2-4349	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 091-3-4350	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
GOZ 091-4-4350	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

						GG Clothing & jewellery							GG Containers				GG Tools & weapons									GG Other		
Individual	*Coffin items*	*Grave goods*	*GG C&J*	*GG Cnt*	*GG T&W*	*Fibulae*	*Belt plates*	*Earrings*	*Necklace items*	*Bracelets*	*Rings*	*Other*	*Pottery*	*Glass*	*Metal*	*Wood*	*Long sword*	*Short sword*	*Spear*	*Axe*	*Knife*	*Farm tools*	*Personal hygiene*	*Flint tools*	*Other*	*Fauna*	*Religious items*	*Other*
GOZ 092-1-4354	1	1	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 092-2-4354	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 093-1-4357	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 094-1-4363	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 094-2-4362	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 095-1-4364	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 096-1-4370	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 096-2-4369	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 097-1-4377	1	1	1	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
GOZ 097-2-4378	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 098-1-4390	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 098-2-4380	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 099-1-4393	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 100-1-4398	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 100-2-4399	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 100-3-4396	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 100-4-4396	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 101-1-4438	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 102-1-4403	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 102-2-4402	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 103-1-4442	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 103-2-4441	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 103-3-4408	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 103-4-4408	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 104-1-4414	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 105-1-4417	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 106-1-4422	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

						GG Clothing & jewellery							GG Containers				GG Tools & weapons									GG Other		
Individual	*Coffin items*	*Grave goods*	*GG C&J*	*GG Cnt*	*GG T&W*	*Fibulae*	*Belt plates*	*Earrings*	*Necklace items*	*Bracelets*	*Rings*	*Other*	*Pottery*	*Glass*	*Metal*	*Wood*	*Long sword*	*Short sword*	*Spear*	*Axe*	*Knife*	*Farm tools*	*Personal hygiene*	*Flint tools*	*Other*	*Fauna*	*Religious items*	*Other*
GOZ 107-1-4425	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 108-1-4429	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 108-2-4428	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 109-1-4454	1	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
GOZ 110-1-4448	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 110-2-4451	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 111-1-4461	1	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
GOZ 112-1-4467	1	1	1	0	0	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 112-2-4468	1	1	1	0	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
GOZ 113-1-4473	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 114-1-4477	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 115-1-4483	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 116-1-4566	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 116-2-4565	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 117-1-4490	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 117-2-4489	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 118-1-4493	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 118-2-4492	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 119-1-4498	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 119-2-4497	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 120-1-4501	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 121-1-4504	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 122-1-4508	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 123-1-4512	1	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
GOZ 124-1-4610	1	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
GOZ 124-2-4610	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 124-3-4610	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Individual	GOZ 124-4-4515	GOZ 125-1-4519	GOZ 126-1-5089	GOZ 127-1-4526	GOZ 128-1-4530	GOZ 129-1-4538	GOZ 130-1-4542	GOZ 131-1-4579	GOZ 131-2-4550	GOZ 131-3-4546	GOZ 131-4-4546	GOZ 132-1-4557	GOZ 132-2-4552	GOZ 133-1-4607	GOZ 134-1-4565	GOZ 134-2-4565	GOZ 135-1-4568	GOZ 135-2-4568	GOZ 136-1-4719	GOZ 136-2-4646	GOZ 136-3-4645	GOZ 136-4-4645	GOZ 136-5-4645	GOZ 136-6-4644	GOZ 136-7-4572	GOZ 137-1-4577	GOZ 138-1-4583
GG Other	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	*Wood*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Clothing & jewellery	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rings	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Earrings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
	Belt plates	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
	Fibulae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	GG T&W	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG Cnt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG C&J	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	1	0	1
	Grave goods	0	0	1	0	0	0	0	0	1	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	1	0	1
	Coffin items	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0	1	0	0

						GG Clothing & jewellery							GG Containers				GG Tools & weapons									GG Other		
Individual	Coffin items	Grave goods	GG C&J	GG Cnt	GG T&W	Fibulae	Belt plates	Earrings	Necklace items	Bracelets	Rings	Other	Pottery	Glass	Metal	Wood	Long sword	Short sword	Spear	Axe	Knife	Farm tools	Personal hygiene	Flint tools	Other	Fauna	Religious items	Other
GOZ 139-1-4589	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 140-1-4593	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 141-1-4597	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 141-2-4598	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 142-1-4601	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 143-1-4604	0	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
GOZ 144-1-4607	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 144-2-4608	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 145-1-4613	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 146-1-4618	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 146-2-4642	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 147-1-4639	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 148-1-4681	0	1	1	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
GOZ 149-1-4632	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 149-2-4632	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 149-3-4632	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 150-1-4638	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 150-2-4638	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 150-3-4637	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 151-1-4651	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 151-2-4650	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 152-1-4655	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 153-1-4658	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 154-1-4665	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 154-2-4664	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 155-1-4667	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOZ 156-1-4726	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

GG Other			GG Tools & weapons									GG Containers				GG Clothing & jewellery												
Other	Religious items	Fauna	Other	Flint tools	Personal hygiene	Farm tools	Knife	Axe	Spear	Short sword	Long sword	Wood	Metal	Glass	Pottery	Other	Rings	Bracelets	Necklace items	Earrings	Belt plates	Fibulae	GG T&W	GG Cnt	GG C&J	Grave goods	Coffin items	Individual
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	GOZ 176-1-4756
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	GOZ 175-1-4755
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	GOZ 174-1-4750
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	1	1	1	GOZ 173-1-4747
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	GOZ 172-1-4741
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	GOZ 171-2-4740
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	GOZ 171-1-4739
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	1	1	GOZ 170-1-4736
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	1	GOZ 169-1-4733
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	GOZ 168-1-4722
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	GOZ 167-1-4716
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	GOZ 166-1-4713
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	GOZ 165-1-4710
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	GOZ 164-1-4704
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	GOZ 163-1-4751
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	GOZ 162-5-4696
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	GOZ 162-4-4698
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	GOZ 162-3-4762
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	GOZ 162-2-4764
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	1	0	GOZ 162-1-4763
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	GOZ 161-1-4692
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	GOZ 160-1-4691
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	GOZ 159-1-4687
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	GOZ 158-3-4678
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	GOZ 158-2-4729
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	GOZ 158-1-4728
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	1	1	GOZ 157-1-4674

	Individual	GOZ 177-1-4761	GOZ 178-1-4767	GOZ 179-1-4771	GOZ 180-1-4901	GOZ 181-1-4784	GOZ 182-1-4788	GOZ 183-1-4798	GOZ 183-2-4797	GOZ 184-1-4799	GOZ 185-1-4803	GOZ 186-1-4809	GOZ 187-1-4811	GOZ 188-1-4817	GOZ 188-2-4816	GOZ 189-1-4823	GOZ 189-2-4818	GOZ 190-1-4828	GOZ 191-1-4831	GOZ 191-2-4832	GOZ 192-1-4836	GOZ 193-1-4839	GOZ 194-1-4845	GOZ 195-1-4848	GOZ 195-2-4848	GOZ 196-1-4852	GOZ 197-1-4855	GOZ 198-1-4860
GG Other	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	*Wood*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Clothing & jewellery	*Other*	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Earrings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Belt plates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
	Fibulae	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	GG T&W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG Cnt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG C&J	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
	Grave goods	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
	Coffin items	0	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	0	0	0	1	1

	Individual	GOZ 199-1-4865	GOZ 200-1-4872	GOZ 200-2-4872	GOZ 201-1-4875	GOZ 201-2-4874	GOZ 202-1-4879	GOZ 203-1-4881	GOZ 203-2-4882	GOZ 204-1-4884	GOZ 205-1-4963	GOZ 206-1-4891	GOZ 207-1-4896	GOZ 208-1-4897	GOZ 209-1-4907	GOZ 210-1-4911	GOZ 211-1-4917	GOZ 211-2-4917	GOZ 212-1-4923	GOZ 213-1-4925	GOZ 214-1-4927	GOZ 215-1-4933	GOZ 216-1-5043	GOZ 216-2-5043	GOZ 217-1-4940	GOZ 218-1-4944	GOZ 219-1-4948	GOZ 220-1-4952
GG Other	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	*Wood*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Clothing & jewellery	*Other*	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	Rings	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Earrings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
	Belt plates	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0
	Fibulae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG T&W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG Cnt	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG C&J	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1	0
	Grave goods	0	0	0	1	0	0	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1	0
	Coffin items	0	0	0	0	0	1	1	0	1	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0

	Individual	GOZ 221-1-4960	GOZ 221-2-4962	GOZ 222-1-4966	GOZ 223-1-4969	GOZ 224-1-4976	GOZ 225-1-4967	GOZ 225-2-4965	GOZ 225-3-5082	GOZ 226-1-4986	GOZ 226-2-4985	GOZ 226-3-4985	GOZ 227-1-4989	GOZ 228-1-4993	GOZ 229-1-4996	GOZ 230-1-5003	GOZ 230-2-5002	GOZ 231-1-5006	GOZ 232-1-5012	GOZ 232-2-5011	GOZ 233-1-5017	GOZ 234-1-5022	GOZ 235-1-5068	GOZ 236-1-5028	GOZ 236-2-5070	GOZ 236-3-5027	GOZ 237-1-5032	GOZ 238-1-5035
GG Other	Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	Wood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
GG Clothing & jewellery	Other	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
	Rings	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bracelets	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Earrings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Belt plates	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fibulae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG T&W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG Cnt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	GG C&J	0	0	1	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
	Grave goods	0	0	1	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
	Coffin items	0	0	1	1	1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1

	Individual	GOZ 239-1-5039	GOZ 240-1-5041	GOZ 241-1-5046	GOZ 242-1-5049	GOZ 243-1-5085	GOZ 243-2-5055	GOZ 244-1-5060	GOZ 244-2-5057	GOZ 245-1-5062	GOZ 246-1-5076	GOZ 246-2-5075	GOZ 247-1-5080	GOZ 5831-1-6150	GOZ 5831-2-6150	GOZ 5831-3-6150	GOZ 5831-4-6150	GOZ 5831-5-6150	GOZ 6640-1-6644	GOZ 6640-2-6644	GOZ 6640-3-6644	GOZ 6640-4-6644	GOZ 6640-5-6644	GOZ 6890-1-6891	BOA 001-1	BOA 002-1	BOA 002-2	BOA 003-1
GG Other	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	*Wood*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Clothing & jewellery	*Other*	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Rings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Earrings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Belt plates	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Fibulae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	GG T&W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	GG Cnt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG C&J	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Grave goods	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Coffin items	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1

	Individual	BOA 004-1	BOA 005-1	BOA 006-1	BOA 007-1	BOA 008-1	BOA 009-1	BOA 010-1	BOA 011-1	BOA 012-1	BOA 013-1	BOA 014-1	BOA 015-1	BOA 016-1	BOA 017-1	BOA 017-2	BOA 018-1	BOA 019-1	BOA 020-1	BOA 021-1	BOA 022-1	BOA 023-1	BOA 024-1	BOA 025-1	BOA 026-1	BOA 027-1	BOA 028-1	BOA 029-1
GG Other	*Other*	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	*Other*	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	*Wood*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Clothing & jewellery	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
	Earrings	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Belt plates	0	0	1	1	1	0	0	0	0	0	1	0	1	0	0	1	0	0	1	0	0	0	0	1	0	0	1
	Fibulae	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	GG T&W	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	GG Cnt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG C&J	0	0	1	1	1	1	0	0	1	0	1	1	1	0	0	1	0	0	1	0	0	0	0	1	0	0	1
	Grave goods	0	0	1	1	1	1	0	0	1	0	1	1	1	0	0	1	0	0	1	0	0	0	0	1	0	0	1
	Coffin items	0	0	0	1	1	1	0	0	0	1	1	0	0	1	0	1	1	1	1	1	0	0	1	1	0	0	0

	Individual	BOA 030-1	BOA 031-1	BOA 032-1	BOA 033-1	BOA 034-1	BOA 035-1	BOA 036-1	BOA 037-1	BOA 037-2	BOA 038-1	BOA 039-1	BOA 040-1	BOA 041-1	BOA 042-1	BOA 043-1	BOA 044-1	BOA 045-1	BOA 047-1	BOA 048-1	BOA 049-1	BOA 050-1	BOA 051-1	BOA 051-2	BOA 052-1	BOA 053-1	BOA 054-1	BOA 054-2
GG Other	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	*Wood*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Clothing & jewellery	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rings	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Earrings	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Belt plates	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Fibulae	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG T&W	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG Cnt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG C&J	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Grave goods	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Coffin items	1	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	0	1	0	1	0	1	0	0	1	1	0

GG Other	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
GG Tools & weapons	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	*Wood*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Clothing & jewellery	*Other*	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rings	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Earrings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Belt plates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fibulae	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG T&W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG Cnt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG C&J	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
	Grave goods	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0
	Coffin items	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Individual	BOA 055-1	BOA 055-2	BOA 058-1	BOA 059-1	BOA 060-1	BOA 061-1	BOA 062-1	BOA 063-1	BOA 064-1	BOA 065-1	BOA 066-1	BOA 067-1	BOA 068-1	BOA 068-2	BOA 069-1	BOA 069-2	BOA 070-1	BOA 071-1	BOA 072-1	BOA 072-2	BOA 072-3	BOA 073-1	BOA 074-1	BOA 075-1	BOA 076-1	BOA 076-2	BOA 077-1

	Individual	BOA 078-1	BOA 079-1	BOA 080-1	BOA 081-1	BOA 082-1	BOA 083-1	BOA 084-1	BOA 085-1	BOA 085-2	BOA 086-1	BOA 086-2	BOA 087-1	BOA 088-1	BOA 089-1	BOA 089-2	BOA 090-1	BOA 091-1	BOA 092-1	BOA 093-1	BOA 094-1	BOA 095-1	BOA 096-1	BOA 097-1	BOA 098-1	BOA 099-1	BOA 100-1	BOA 101-1
GG Other	Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	Wood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Clothing & jewellery	Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Earrings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Belt plates	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fibulae	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	GG T&W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	GG Cnt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG C&J	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
	Grave goods	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0
	Coffin items	1	0	0	1	1	0	0	1	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0	1	0	0	0

	Individual	BOA 102-1	BOA 103-1	BOA 103-2	BOA 103-3	BOA 103-4	BOA 104-1	BOA 105-1	BOA 105-2	BOA 105-3	BOA 105-4	BOA 106-1	BOA 107-1	BOA 107-2	BOA 107-3	BOA 107-4	BOA 108-1	BOA 109-1	BOA 109-2	BOA 110-1	BOA 111-1	BOA 112-1	BOA 113-1	BOA 113-2	BOA 114-1	BOA 115-1	BOA 115-2	BOA 115-3
GG Other	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	*Wood*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Clothing & jewellery	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Earrings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Belt plates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Fibulae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG T&W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG Cnt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG C&J	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Grave goods	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Coffin items	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0

	Individual	BOA 115-4	BOA 116-1	BOA 117-1	BOA 118-1	BOA 119-1	BOA 120-1	BOA 120-2	BOA 121-1	BOA 122-1	BOA 123-1	BOA 124-1	BOA 125-1	BOA 125-2	BOA 126-1	BOA 127-1	BOA 128-1	BOA 128-2	BOA 129-1	BOA 130-1	BOA 131-1	BOA 132-1	BOA 133-1	BOA 134-1	BOA 135-1	BOA 136-1	BOA 137-1	BOA 138-1
GG Other	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	*Wood*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Clothing & jewellery	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Earrings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Belt plates	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
	Fibulae	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG T&W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	GG Cnt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG C&J	0	0	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0
	Grave goods	0	0	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	1	1	1	0	1	1	0	0
	Coffin items	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	1

	Individual	BOA 139-1	BOA 140-1	BOA 141-1	BOA 142-1	BOA 143-1	BOA 144-1	BOA 145-1	BOA 145-2	BOA 145-3	BOA 145-4	BOA 145-5	BOA 145-6	BOA 146-1	BOA 147-1	BOA 147-2	BOA 148-1	BOA 149-1	BOA 150-1	BOA 151-1	BOA 151-2	BOA 151-3	BOA 152-1	BOA 152-2	BOA 153-1	BOA 154-1	BOA 155-1	BOA 156-1
GG Other	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	*Wood*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Clothing & jewellery	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rings	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Earrings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Belt plates	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fibulae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG T&W	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	GG Cnt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG C&J	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Grave goods	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	Coffin items	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Individual	BOA 157-1	BOA 157-2	BOA 159-1	BOA 160-1	BOA 160-2	BOA 160-3	BOA 161-1	BOA 162-1	BOA 163-1	BOA 164-1	BOA 165-1	BOA 166A-1	BOA 166B-1	BOA 169-1	BOA 171A-1	BOA 171B-1	BOA 173-1	BOA 174-1	BOA 175-1	BOA 176-1	BOA 177-1	BOA 178-1	BOA 179-1	BOA 179-2	BOA 180-1	BOA 181-1	BOA 182-1
GG Other	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	*Wood*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
GG Clothing & jewellery	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Earrings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Belt plates	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
	Fibulae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	GG T&W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG Cnt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	GG C&J	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1
	Grave goods	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1
	Coffin items	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0

	Individual	BOA 183-1	BOA 184-1	BOA 185-1	BOA 186-1	BOA 187-1	BOA 187-2	SNC 30100-1-30102	SNC 30105-1-30108	SNC 30110-1-30111	SNC 30110-2-30111	SNC 30110-3-30111	SNC 30110-4-30112	SNC 30115-1-30117	SNC 30130-1-30134	SNC 30140-1-30143	SNC 30150-1-30152	SNC 30150-2-30152	SNC 30155-1-30156	SNC 30170-1-30186	SNC 30180-1-30182	SNC 30240-1-30242	SNC 30270-1-30272	SNC 30280-1-30283	SNC 30290-1-30292	SNC 30295-1-30297	SNC 30320-1-30322	SNC 30444-1-30446
GG Other	Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	Wood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Clothing & jewellery	Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rings	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Earrings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Belt plates	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fibulae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG T&W	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG Cnt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG C&J	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Grave goods	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coffin items	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Individual	SNC 30620-1-30622	SNC 30740-1-30742	SNC 30745-1-30747	SNC 30750-1-30752	SNC 30790-1-30793	SNC 30795-1-30798	SNC 30800-1-30803	SNC 30800-2-30802	SNC 30800-3-30801	SNC 30805-1-30808	SNC 30810-1-30813	SNC 30810-2-30813	SNC 30810-3-30812	SNC 30810-4-30812	SNC 30810-5-30812	SNC 30810-6-30812	SNC 30830-1-30832	SNC 30835-1-30837	SNC 30840-1-30842	SNC 30850-1-30858	SNC 30865-1-30869	SNC 30880-1-30884	SNC 30890-1-30892	SNC 33000-1-33003	SNC 33005-1-33004	SNC 33010-1-33013	SNC 33020-1-33021
GG Other	Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	Wood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
GG Clothing & jewellery	Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Earrings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Belt plates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fibulae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG T&W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG Cnt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
	GG C&J	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Grave goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
	Coffin items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1

						GG Clothing & jewellery							GG Containers				GG Tools & weapons									GG Other		
Individual	*Coffin items*	*Grave goods*	*GG C&J*	*GG Cnt*	*GG T&W*	*Fibulae*	*Belt plates*	*Earrings*	*Necklace items*	*Bracelets*	*Rings*	*Other*	*Pottery*	*Glass*	*Metal*	*Wood*	*Long sword*	*Short sword*	*Spear*	*Axe*	*Knife*	*Farm tools*	*Personal hygiene*	*Flint tools*	*Other*	*Fauna*	*Religious items*	*Other*
SNC 33030-1-33032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SNC 33040-1-33043	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SNC 33050-1-33053	1	1	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SNC 33060-1-33064	1	1	1	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SNC 33070-1-33072	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LH 1-1-7023	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LH 2-1-7112	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LH 3-1-7132	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LH 4-1-7162	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LH 5-1-7182	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LH 6-1-7192	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LH 7-1-7198	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LH 8-1-7202	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LH 9-1-7172	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD A001-1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
ALD A002-1	1	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
ALD A003-1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD A004-1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
ALD A005-1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
ALD A006-1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
ALD A007-1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
ALD A008-1	1	1	1	1	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0
ALD A009-1	1	1	1	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	1	1	1	0	0
ALD A010-1	1	1	1	1	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
ALD A011-1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0
ALD ASUP-01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD ASUP-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

						GG Clothing & jewellery							GG Containers				GG Tools & weapons									GG Other		
Individual	*Coffin items*	*Grave goods*	*GG C&J*	*GG Cnt*	*GG T&W*	*Fibulae*	*Belt plates*	*Earrings*	*Necklace items*	*Bracelets*	*Rings*	*Other*	*Pottery*	*Glass*	*Metal*	*Wood*	*Long sword*	*Short sword*	*Spear*	*Axe*	*Knife*	*Farm tools*	*Personal hygiene*	*Flint tools*	*Other*	*Fauna*	*Religious items*	*Other*
ALD ASUP-03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD ASUP-04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD ASUP-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD ASUP-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD ASUP-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD ASUP-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD ASUP-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD ASUP-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B001-1	1	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
ALD B002-1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B003-1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
ALD B004-1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
ALD B005-1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B006/B008-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B006/B008-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B006/B008-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B006/B008-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B006/B008-5	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
ALD B009/B010-1(B009)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B009/B010-2(B010)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B011-1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
ALD B012-1	1	1	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
ALD B013-1	1	1	0	1	1	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0
ALD B014-1	1	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B015-1	1	1	1	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
ALD B016-1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
ALD B016-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

						GG Clothing & jewellery							GG Containers				GG Tools & weapons									GG Other		
Individual	*Coffin items*	*Grave goods*	*GG C&J*	*GG Cnt*	*GG T&W*	*Fibulae*	*Belt plates*	*Earrings*	*Necklace items*	*Bracelets*	*Rings*	*Other*	*Pottery*	*Glass*	*Metal*	*Wood*	*Long sword*	*Short sword*	*Spear*	*Axe*	*Knife*	*Farm tools*	*Personal hygiene*	*Flint tools*	*Other*	*Fauna*	*Religious items*	*Other*
ALD B017-1	1	1	1	1	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0
ALD B018-1	1	1	1	1	1	0	1	0	0	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0
ALD B019-1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B020-1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B021-1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
ALD B021-2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
ALD B022-1	1	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0
ALD B023-1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
ALD B024-1	1	1	1	1	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0
ALD B025-1	1	1	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0
ALD B026/B027-1(B026)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B026/B027-2(B027)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B028-1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B029/B043-01(B029)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B029/B043-02(B030)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B029/B043-03(B031)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B029/B043-04(B032)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B029/B043-05(B033)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B029/B043-06(B034)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B029/B043-07(B035)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B029/B043-08(B036)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B029/B043-09(B037)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B029/B043-10(B038)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B029/B043-11(B039)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B029/B043-12(B040)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B029/B043-13(B041)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B029/B043-14(B042)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

					GG Clothing & jewellery							GG Containers				GG Tools & weapons									GG Other		
Individual	*Coffin items*	*Grave goods*	*GG C&J*	*GG Cnt*	*GG T&W*	*Fibulae*	*Belt plates*	*Earrings*	*Necklace items*	*Bracelets*	*Rings*	*Other*	*Pottery*	*Glass*	*Metal*	*Wood*	*Long sword*	*Short sword*	*Spear*	*Axe*	*Knife*	*Farm tools*	*Personal hygiene*	*Flint tools*	*Other*	*Fauna*	*Religious items*	*Other*
ALD B029/B043-15(B043)	1	1	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
ALD B044-1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
ALD B045/B047-1(B045)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B045/B047-2(B046)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B045/B047-3(B047)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B048/B054-1(B048)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B048/B054-2(B049)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B048/B054-3(B050)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B048/B054-4(B051)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B048/B054-5(B052)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B048/B054-6(B053)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B048/B054-7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B048/B054-8(B054)	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B055/B063-01(B055)	1	1	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
ALD B055/B063-02(B056)	1	1	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
ALD B055/B063-03(B057)	1	1	1	1	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0
ALD B055/B063-04(B058)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B055/B063-05(B059)	1	1	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
ALD B055/B063-06(B060)	1	1	1	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
ALD B055/B063-07(B061)	1	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
ALD B055/B063-08(B062)	1	1	1	1	1	0	0	0	1	0	0	1	0	1	1	0	0	1	1	1	1	0	0	0	0	0	0	0
ALD B055/B063-09(B063)	1	1	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
ALD B055/B063-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B064/B076-01(B064)	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
ALD B064/B076-02(B065)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B064/B076-03(B066)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B064/B076-04(B067)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Individual	ALD B064/B076-05(B068)	ALD B064/B076-06(B069)	ALD B064/B076-07(B070)	ALD B064/B076-08(B071)	ALD B064/B076-09(B072)	ALD B064/B076-10(B073)	ALD B064/B076-11(B074)	ALD B064/B076-12(B075)	ALD B064/B076-13(B076)	ALD B077/B087-01(B077)	ALD B077/B087-02(B078)	ALD B077/B087-03(B079)	ALD B077/B087-04(B080)	ALD B077/B087-05(B081)	ALD B077/B087-06(B082)	ALD B077/B087-07(B083)	ALD B077/B087-08(B084)	ALD B077/B087-09(B085)	ALD B077/B087-10(B086)	ALD B077/B087-11(B087)	ALD B088/B098-01(B088)	ALD B088/B098-02(B089)	ALD B088/B098-03(B090)	ALD B088/B098-04(B091)	ALD B088/B098-05(B092)	ALD B088/B098-06(B093)	ALD B088/B098-07(B094)
GG Other	Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	Other	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1	0	0
	Axe	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0
	Spear	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	1
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	Wood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Clothing & jewellery	Other	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	1	1	1	0	1	0	1	0	1
	Rings	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1
	Earrings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Belt plates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Fibulae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG T&W	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	1
	GG Cnt	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
	GG C&J	0	0	1	1	0	0	0	1	1	1	1	0	0	0	0	0	1	0	1	1	1	0	1	1	1	0	1
	Grave goods	0	0	1	1	0	0	0	1	1	1	1	0	0	0	0	0	1	0	1	1	1	1	1	1	1	0	1
	Coffin items	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0

						GG Clothing & jewellery							GG Containers				GG Tools & weapons									GG Other		
Individual	*Coffin items*	*Grave goods*	*GG C&J*	*GG Cnt*	*GG T&W*	*Fibulae*	*Belt plates*	*Earrings*	*Necklace items*	*Bracelets*	*Rings*	*Other*	*Pottery*	*Glass*	*Metal*	*Wood*	*Long sword*	*Short sword*	*Spear*	*Axe*	*Knife*	*Farm tools*	*Personal hygiene*	*Flint tools*	*Other*	*Fauna*	*Religious items*	*Other*
ALD B088/B098-08(B095)	1	1	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0
ALD B088/B098-09(B096)	1	1	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
ALD B088/B098-10(B097)	1	1	1	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	1	0	0	1	0	0	0	0
ALD B088/B098-11(B098)	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B099/B101-1(B099)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B099/B101-2(B100)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B099/B101-3(B101)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B102/B103-1(B102)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B102/B103-2(B103)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B104-1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALD B105-1	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FIN 02-1-44	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FIN 03-1-50	1	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
FIN 03-2-61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FIN 06-1-53	1	1	1	1	1	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
FIN 07-1-57	1	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FIN 08-1-56	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FIN 09-1-60	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FIN 13-1-30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FIN 14-1-73	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
FIN 15-1-74	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FIN 16-1	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FIN 17-1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SMD 2811-1-2810(181)	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
SMD 2841-1-2840(184)	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
SMD 2871-1-2870(187)	0	1	1	1	1	0	0	0	0	0	1	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
SMD 2901-1-2900(190)	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Individual	SMD 2901-2-2900	SMD 2961-1-2960(196)	SMD 2961-2-2970(197)	SMD 2981-1-2990(199)	SMD 2981-2-3120(212)	SMD 2981-3-3030(203)	SMD 2981-4-2980(198)	SMD 3021-1-3020(202)	SMD 3041-1-3040(204)	SMD 3061-1-3060(206)	SMD 3071-1-3070(207)	SMD 3071-2-3070	SMD 3081-1-3080(208)	SMD 3091-1-3090(209)	SMD 3101-1-3100(210)	SMD 3111-1-3110(211)	SMD 3151-1-3150(215)	SMD 3151-2-3150	SMD 3151-3-3150	SMD 3161-1-3160(216)	SMD 3161-2-3160	SMD 3161-3-3160	SMD 3161-4-3160	SMD 3181-1-3180(218)	SMD 3361-1-3360(236)	SMD 3371-1-3370(237)	SMD 3371-2-3370
GG Other	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	*Wood*	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Glass	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
GG Clothing & jewellery	*Other*	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rings	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Earrings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Belt plates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Fibulae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG T&W	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	GG Cnt	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
	GG C&J	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
	Grave goods	0	0	1	1	1	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	0
	Coffin items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

						GG Clothing & jewellery							GG Containers				GG Tools & weapons									GG Other		
Individual	*Coffin items*	*Grave goods*	*GG C&J*	*GG Cnt*	*GG T&W*	*Fibulae*	*Belt plates*	*Earrings*	*Necklace items*	*Bracelets*	*Rings*	*Other*	*Pottery*	*Glass*	*Metal*	*Wood*	*Long sword*	*Short sword*	*Spear*	*Axe*	*Knife*	*Farm tools*	*Personal hygiene*	*Flint tools*	*Other*	*Fauna*	*Religious items*	*Other*
SMD 3381-1-3380(238)	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
SMD 3381-2-3380	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SMD 3381-3-3380	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SMD 3391-1-3390(239)	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
SMD 3391-2-3390	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SMD 3401-1-3390(240)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SMD 3401-2-3390	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SMD 3411-1-3410(241)	0	1	1	1	1	0	0	0	0	0	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
SMD 3411-2-3410	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SMD 3421-1-3420(242)	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
SMD 3431-1-3430(243)	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
SMD 3431-2-3430	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SMD 3451-1-3450(245)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SMD 3451-2-3450	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SMD 3461-1-3460(246)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SMD 3461-2-3460	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SMD 3551-1-3550(255)	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SMD 3601-1-3600(260)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SMD 3601-2-3600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SMD 3601-3-3600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SMD 3611-1-3610(261)	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
SMD 3621-1-3620(262)	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
CG 053-1-0420	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 053-2-0421	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 080-1-0393	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 094-1-1231	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 094-2-1230	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

						GG Clothing & jewellery							GG Containers				GG Tools & weapons									GG Other		
Individual	Coffin items	Grave goods	GG C&J	GG Cnt	GG T&W	Fibulae	Belt plates	Earrings	Necklace items	Bracelets	Rings	Other	Pottery	Glass	Metal	Wood	Long sword	Short sword	Spear	Axe	Knife	Farm tools	Personal hygiene	Flint tools	Other	Fauna	Religious items	Other
CG 192-1-0353	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 220-1-0433	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 254-1-0623	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 255-1-0626	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 279-1-0669	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 295-1-0704	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 296-1-0701	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 370-1-0916	0	1	1	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 371-1-0794	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 372-1-0797	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 373-1-0823	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 374-1-1695	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 374-2-1473	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 380-1-0826	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 381-1-0840	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 382-1-0837	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 385-1-0853	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 387-1-0746	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 391-1-0925	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 392-1-0856	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 392-2-0855	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 393-1-0875	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 393-2-0874	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 395-1-0879	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 411-1-0901	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 443-1-0953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 444-1-0957	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

						GG Clothing & jewellery							*GG Containers*				*GG Tools & weapons*									*GG Other*		
Individual	*Coffin items*	*Grave goods*	*GG C&J*	*GG Cnt*	*GG T&W*	*Fibulae*	*Belt plates*	*Earrings*	*Necklace items*	*Bracelets*	*Rings*	*Other*	*Pottery*	*Glass*	*Metal*	*Wood*	*Long sword*	*Short sword*	*Spear*	*Axe*	*Knife*	*Farm tools*	*Personal hygiene*	*Flint tools*	*Other*	*Fauna*	*Religious items*	*Other*
CG 445-1-0960	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 446-1-0964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 447-1-0968	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 453-1-1315	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 477-1-1434	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 511-1-1437	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 512-1-1440	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 519-1-1480	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 597-1-1656	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 598-1-1646	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 599-1-1643	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CG 692-1-1794	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 14-1-109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 15-1-130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 15-2-126	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 15-3-126	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 16-1-103	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 16-2-102	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 17-1-477	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 18-1-114	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
PMCV 19-1-139	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 19-2-141	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
PMCV 20-1-122	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 21-1-160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 22-1-118	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 22-2-116	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 23-1-134	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

						GG Clothing & jewellery							GG Containers				GG Tools & weapons									GG Other		
Individual	Coffin items	Grave goods	GG C&J	GG Cnt	GG T&W	Fibulae	Belt plates	Earrings	Necklace items	Bracelets	Rings	Other	Pottery	Glass	Metal	Wood	Long sword	Short sword	Spear	Axe	Knife	Farm tools	Personal hygiene	Flint tools	Other	Fauna	Religious items	Other
PMCV 43-1-350	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 43-2-350	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 44-1-469/470	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 45-1-412	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 46-1-444	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 46-2-445	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 46-3-444/445	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 46-4-446	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 47-1-357	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 48-1-353	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 49-1-451	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 49-2-419	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 50-1-458/472	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 50-2-474	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 51-1-454	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 55-1-399	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 55-2-399	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PMCV 57-1-420/449	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 002-1-027(003)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 003-1-056(004a)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 003-2-056(004b)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 004-1-057(005)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 007-1-060(010)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 009-1-062(012)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 010-1-078(013)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 011-1-079(016a)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 011-2-079(016b)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

					GG Clothing & jewellery							GG Containers				GG Tools & weapons									GG Other		
Individual	Coffin items	Grave goods	GG C&J	GG Cnt	GG T&W	Fibulae	Belt plates	Earrings	Necklace items	Bracelets	Rings	Other	Pottery	Glass	Metal	Wood	Long sword	Short sword	Spear	Axe	Knife	Farm tools	Personal hygiene	Flint tools	Other	Fauna	Religious items	Other
RVSM 011-3-079(016c)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 014-1-086(014a)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 014-2-086(014b)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 015-1-087(015)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 018-1-092(021)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 020-1-096(023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 020-2-096(037)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 022-1-100(025)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 023-1-107(026)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 024-1-118(027a)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 024-2-118(027b)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 025-1-117(032)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 027-1-103(030)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 028-1-104(031a)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 028-2-104(031b)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 028-3-104(031c)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 028-4-104(031d)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 028-5-104(031e)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 029-1-095(033)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 031-1-128(036)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 031-2-128(035)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 032-1-130(038b)	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
RVSM 032-2-129(038a1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 032-3-129(038a2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 032-4-129(038a3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 033-1-132(039)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RVSM 034-1-143(040)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Individual	RVSM 034-2-145(145a)	RVSM 034-3-145(145b)	RVSM 035-1-146(041)	RVSM 038-1-156(047)	RVSM 038-2-155(046a)	RVSM 038-3-155(046b)	RVSM 042-1-158(050)	RVSM 047-1-169(055)	RVSM 048-1-170(056)	RVSM 049-1-171(057)	RVSM 050-1-151(058)	RVSM 051-1-152(059b)	RVSM 051-2-152(059a)	RVSM 052-1-173(060a)	RVSM 052-2-173(060b)	RVSM 053-1-174(061)	RVSM 054-1-176(062)	RVSM 055-1-177(063)	RVSM 055-2-177(087a)	RVSM 055-3-177(087b)	RVSM 056-1-178(064a)	RVSM 056-2-178(064b)	RVSM 056-3-178(064c)	RVSM 060-1-184(068)	RVSM 062-1-194(070)	RVSM 063-1-198	RVSM 064-1-200(074)
GG Other	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	*Wood*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Clothing & jewellery	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Earrings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Belt plates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fibulae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG T&W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG Cnt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG C&J	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Grave goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Coffin items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Individual	RVSM 064-2-199(073)	RVSM 113-1-384(126)	RVSM 114-1-385(127)	RVSM 115-1-386(128)	RVSM 116-1-387(129b)	RVSM 116-2-387(129a)	RVSM 117-1-393(130)	RVSM 118-1-394(131)	RVSM 120-1-396(133)	RVSM 121-1-398(134a)	RVSM 121-2-398(134b)	RVSM 124-1-401(137)	RVSM 125-1-402(138)	RVSM 127-1-412(140)	RVSM 128-1-413(141)	RVSM 129-1-415(142a)	RVSM 129-2-415(142b)	RVSM 129-3-415(142c)	RVSM 130-1-416(143)	RVSM 139-1-434(151)	RVSM 141-1-436(152)	RVSM 142-1-437(153)	RVSM 146-1-454(157)	RVSM 154-1-490(174)	RVSM 154-2-462(165b)	RVSM 154-3-462(165a)
GG Other	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Religious items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fauna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Tools & weapons	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flint tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Personal hygiene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Farm tools	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Knife	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Axe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Short sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Long sword	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Containers	*Wood*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pottery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GG Clothing & jewellery	*Other*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bracelets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Necklace items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Earrings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Belt plates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fibulae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG T&W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG Cnt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GG C&J	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Grave goods	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coffin items	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 7.3. Radiocarbon dates available for the individuals studied. The radiocarbon date of the individual does not necessarily match the deposit (e.g. SMD 181-1-2810). For a few dates it is not possible to determine with confidence which individual was sampled. Then, the range of individuals the date could come from is indicated in the column *Individual* with a slash sign in the second figure (e.g. SNC 308810-1/2-30813 indicates the radiocarbon date may come from individual 308810-1-30813 or 308810-2-30813). All the radiocarbon dates were calibrated by the author with the software OxCal 4.2 (Bronk Ramsey & Lee 2013) using the curve IntCal13 (Reimer *et al.* 2013). The calibrated dates are reported as the interval with the greatest likelihood under two sigmas. Some of the calibrated dates presented here do not agree with those published, because they were calibrated with other procedures.

Individual	*Chronology deposit*	*^{14}C date BP*	*^{14}C date cal 2σ*	*Reference*
GOZ 5831-1/5-6150	Mid-7th-mid-8th c.	1229 ± 36 BP	687-885 (95.4%)	Vigil-Escalera nd: 85
		1210 ± 50 BP	679-901 (90.4%)	Vigil-Escalera nd: 86
GOZ 6640-2/5-6644	Mid-6th-start 7th c.	1399 ± 37 BP	580-675 (95.4%)	Vigil-Escalera nd: 85
		1390 ± 60 BP	545-723 (89.7%)	Vigil-Escalera nd: 85
SNC 30105-1-30108	Start 8th-mid-9th c.	1371 ± 21 BP	634-680 (95.4%)	Vigil-Escalera 2009: 113
		1238 ± 22 BP	687-780 (65.3%)	Vigil-Escalera 2009: 113
SNC 30180-1-30182	Start 8th-mid-9th c.	1305 ± 27 BP	660-725 (66.2%)	Vigil-Escalera 2009: 113
SNC 30280-1-30283	Start 8th-mid-9th c.	1162 ± 29 BP	773-904 (74.2%)	Vigil-Escalera 2009: 113
SNC 30740-1-30742	Start 8th-mid-9th c.	987 ± 21 BP	994-1050 (66.0%)	Vigil-Escalera 2009: 113
		753 ± 19 BP	1244-1284 (92.7%)	Vigil-Escalera 2009: 113
SNC 30800-1-30803	Start 8th-mid-9th c.	1287 ± 31 BP	665-771 (95.4%)	Vigil-Escalera 2009: 113
SNC 30800-2-30802	Start 8th-mid-9th c.	1321 ± 23 BP	665-715 (77.6%)	Vigil-Escalera 2009: 113
SNC 30810-1/2-30813	Start 8th-mid-9th c.	1320 ± 33 BP	651-726 (71.7%)	Vigil-Escalera 2009: 113
SNC 30810-3/6-30812	Start 8th-mid-9th c.	1157 ± 27 BP	775-905 (68.7%)	Vigil-Escalera 2009: 113
		1148 ±22 BP	856-971 (76.8%)	Vigil-Escalera 2009: 113
LH 1-1-7023	7th c.	1397 ± 22 BP	606-664 (95.4%)	Vigil-Escalera 2009: 103
LH 3-1-7132	End 8th-mid-9th c.	1212 ± 20 BP	767-885 (89.8%)	Vigil-Escalera 2009: 103
ALD Unknown	6th-7th c.	1365 ± 30 BP	611-690 (82.7%)	Azkarate 1990: 353
ALD B014-1	6th-7th c.	1345 ± 35 BP	636-723 (82.7%)	Azkarate *et al.* 2003: 359
FIN 02-1-44	5th-8th c.	1645 ± 60 BP	252-545 (95.4%)	García Camino 2002: 71
FIN 03-1-50	5th-8th c.	1340 ± 70 BP	547-779 (87.3%)	Cepeda & Unzueta 2015: 170
FIN 06-1-53	5th-8th c.	1520 ± 50 BP	424-632 (95.4%)	Cepeda & Unzueta 2015: 170
FIN 07-1-57	5th-8th c.	1550 ± 50 BP	405-605 (95.4%)	Cepeda & Unzueta 2015: 170
FIN 08-1-56	5th-8th c.	1620 ± 50 BP	331-557 (94.7%)	Cepeda & Unzueta 2015: 170
FIN 09-1-60	5th-8th c.	1620 ± 50 BP	331-557 (94.7%)	Cepeda & Unzueta 2015: 170
SMD 2811-1-2810(181)	Mid-6th-end 7th c.	1626 ± 37 BP	345-538 (95.4%)	Quirós *et al.* 2013: 220
SMD 2901-1-2900(190)	Mid-6th-end 7th c.	1365 ± 32 BP	610-692 (93.0%)	Quirós *et al.* 2013: 220
SMD 2961-2-2970(197)	Mid-6th-end 7th c.	1490 ± 30 BP	535-644 (92.2%)	Quirós *et al.* 2013: 220
SMD 2981-2-3120(212)	Mid-6th-end 7th c.	1520 ± 30 BP	505-609 (65.5%)	Quirós *et al.* 2013: 220
SMD 2981-4-2980(198)	Mid-6th-end 7th c.	1441 ± 41 BP	547-660 (95.4%)	Quirós *et al.* 2013: 220
SMD 3041-1-3040(204)	Mid-6th-end 7th c.	1417 ± 35 BP	573-665 (95.4%)	Quirós *et al.* 2013: 220
SMD 3181-1-3180(218)	5th-mid-6th c.	1580 ± 30 BP	410-546 (95.4%)	Quirós *et al.* 2013: 220
SMD 3461-1-3460(246)	Mid-6th-end 7th c.	1670 ± 30 BP	258-428 (95.4%)	Alfaro *et al.* 2019: 152
SMD 3461-2-3460	Mid-6th-end 7th c.	1440 ± 30 BP	566-655 (95.4%)	Alfaro *et al.* 2019: 153
CG 094-2-1230	7th-8th c.	1320 ± 35 BP	650-729 (71.1%)	Roig 2015: 349
CG 391-1-0925	Mid-6th-8th c.	1345 ± 35 BP	636-723 (82.7%)	Roig 2015: 349
PMCV 15-1-130	7th-8th c.	1315 ± 30 BP	655-724 (70.4%)	Roig 2015: 351
RVSM 024-1-118(027a)	Mid-5th-6th c.	1295 ± 40 BP	650-778 (93.5%)	Roig 2015: 343

7.2 HUMAN OSTEOARCHAEOLOGY

Table 7.4. Age and sex of the individuals studied. Only the individuals which preserved any skeletal remain and were available for study are included. Key: y = years, m = months, wiu = weeks in uterus.

Individual	*Age*		*Sex*
GOZ 002-1-4606	Adult sp		Undetermined
GOZ 003-1-1003	Adult sp		Undetermined
GOZ 004-1-1008	Adult sp		Undetermined
GOZ 010-1-4014	Adult sp		Undetermined
GOZ 012-1-4020	Adult sp		Undetermined
GOZ 013-1-4023	Infans 1A	1 y 4 m - 2 y 8 m	Undetermined
GOZ 014-1-4026	Juvenile	13 - 16 y	Undetermined
GOZ 015-1-4029	Adult sp		Probable female
GOZ 015-2-4029	Adult sp		Undetermined
GOZ 015-3-4029	Infans 1B	3 - 6 y	Undetermined
GOZ 015-4-4029	Fetus		Undetermined
GOZ 018-1-4038	Adult sp		Undetermined
GOZ 019-1-4041	Adult sp		Undetermined
GOZ 021-1-4048	Young adult	20 - 24 y	Probable female
GOZ 023-1-4055	Infans 2	6 - 12 y	Undetermined
GOZ 024-1-4058	Infans 1B	3 - 4 y	Undetermined
GOZ 025-1-4061	Infans 2	8 y 6 m - 13 y 6 m	Undetermined
GOZ 029-1-4073	Adult sp		Undetermined
GOZ 031-1-4082	Adult sp		Undetermined
GOZ 033-2-4088	Adult sp		Undetermined
GOZ 039-1-4108	Adult sp		Undetermined
GOZ 040-1-4111	Undetermined		Undetermined
GOZ 047-01-4154	Adult sp		Undetermined
GOZ 047-02-4154	Adult sp		Undetermined
GOZ 047-03-4154	Adult sp		Undetermined
GOZ 047-04-4154	Adult sp		Undetermined
GOZ 047-05-4154	Infans 2	8 - 11 y	Undetermined
GOZ 047-06-4154	Infans 1B	5 - 9 y	Undetermined
GOZ 047-07-4154	Infans 1B	2 - 4 y	Undetermined
GOZ 047-08-4154	Infans 1A	1 y 6 m - 2 y	Undetermined
GOZ 047-09-4154	Infans 1A	6 m	Undetermined
GOZ 047-10-4154	Infans 1A	Birth - 1.5 m	Undetermined
GOZ 052-1-4175	Adult sp		Probable female
GOZ 052-2-4175	Adult sp		Undetermined
GOZ 053-1-4179	Infans 2	7 y 6 m - 12 y 6 m	Undetermined
GOZ 054-1-4224	Adult sp		Probable female
GOZ 055-1-4188	Adult sp		Undetermined
GOZ 055-2-4188	Adult sp		Undetermined
GOZ 055-3-4188	Infans 1B	3 - 5 y	Undetermined
GOZ 057-1-4195	Adult sp		Undetermined
GOZ 058-1-4198	Infans 2	9 y 6 m - 14 y 6 m	Undetermined
GOZ 058-2-4198	Adult sp		Undetermined
GOZ 059-1-4201	Adult sp		Undetermined
GOZ 060-1-4205	Adult sp		Undetermined

Individual	*Age*		*Sex*
GOZ 060-2-4205	Adult sp		Probable male
GOZ 061-1-4226	Adult sp		Male
GOZ 063-1-4215	Adult sp		Undetermined
GOZ 063-2-4215	Subadult sp		Undetermined
GOZ 065-1-4231	Adult sp		Ambiguous
GOZ 065-2-4231	Adult sp		Undetermined
GOZ 065-3-4231	Infans 1B	2 - 4 y	Undetermined
GOZ 066-1-4236	Adult sp		Undetermined
GOZ 066-2-4236	Adult sp		Undetermined
GOZ 067-1-4241	Adult sp		Undetermined
GOZ 067-2-4238	Adult sp		Undetermined
GOZ 069-1-4253	Adult sp		Undetermined
GOZ 069-2-4050	Adult sp		Undetermined
GOZ 070-1-4256	Adult sp		Female
GOZ 070-2-4256	Adult sp		Undetermined
GOZ 071-1-4259	Adult sp		Probable male
GOZ 071-2-4259	Adult sp		Undetermined
GOZ 073-1-4267	Adult sp		Undetermined
GOZ 073-2-4264	Adult sp		Undetermined
GOZ 075-1-4276	Adult sp		Undetermined
GOZ 075-2-4276	Infans 1B	6 - 7 y	Undetermined
GOZ 075-3-4275	Adult sp		Undetermined
GOZ 075-4-4275	Adult sp		Probable male
GOZ 077-1-4286	Undetermined		Undetermined
GOZ 077-2-4286	Undetermined		Undetermined
GOZ 078-1-4292	Adult sp		Undetermined
GOZ 078-2-4291	Adult sp		Undetermined
GOZ 078-3-4291	Adult sp		Undetermined
GOZ 078-4-4291	Adult sp		Undetermined
GOZ 080-1-4300	Adult sp		Undetermined
GOZ 081-1-4305	Adult sp		Undetermined
GOZ 083-1-4314	Adult sp		Female
GOZ 084-1-4318	Adult sp		Probable female
GOZ 084-2-4318	Infans 1B	4 - 6 y	Undetermined
GOZ 085-1-4336	Adult sp		Female
GOZ 086-1-4324	Adult sp		Undetermined
GOZ 087-1-4330	Adult sp		Probable male
GOZ 087-2-4329	Adult sp		Undetermined
GOZ 088-1-4333	Adult sp		Undetermined
GOZ 089-2-4372	Adult sp		Undetermined
GOZ 090-2-4346	Adult sp		Undetermined
GOZ 091-1-4432	Adult sp		Undetermined
GOZ 091-2-4349	Adult sp		Undetermined
GOZ 091-3-4350	Adult sp		Undetermined
GOZ 091-4-4350	Adult sp		Undetermined
GOZ 092-1-4354	Adult sp		Undetermined
GOZ 094-1-4363	Adult sp		Undetermined
GOZ 094-2-4362	Adult sp		Undetermined

Individual	*Age*		*Sex*
GOZ 096-1-4370	Adult sp		Undetermined
GOZ 096-2-4369	Adult sp		Undetermined
GOZ 097-1-4377	Adult sp		Undetermined
GOZ 097-2-4378	Young adult	25 - 36 y	Male
GOZ 098-2-4380	Adult sp		Undetermined
GOZ 100-1-4398	Young adult	25 - 38 y	Ambiguous
GOZ 100-2-4399	Adult sp		Male
GOZ 100-3-4396	Adult sp		Probable female
GOZ 100-4-4396	Juvenile	15 - 16 y	Undetermined
GOZ 101-1-4438	Adult sp		Ambiguous
GOZ 102-1-4403	Infans 1B	3 - 5 y	Undetermined
GOZ 102-2-4402	Adult sp		Probable male
GOZ 103-1-4442	Adult sp		Undetermined
GOZ 103-2-4441	Infans 1B	3 y 6 m - 5 y	Undetermined
GOZ 103-3-4408	Adult sp		Undetermined
GOZ 103-4-4408	Adult sp		Undetermined
GOZ 104-1-4414	Adult sp		Undetermined
GOZ 106-1-4422	Adult sp		Undetermined
GOZ 107-1-4425	Infans 1B	6 - 7 y	Undetermined
GOZ 108-1-4429	Young adult	22 - 38 y	Probable female
GOZ 108-2-4428	Adult sp		Undetermined
GOZ 109-1-4454	Adult sp		Undetermined
GOZ 110-1-4448	Young adult	22 - 38 y	Female
GOZ 111-1-4461	Adult sp		Undetermined
GOZ 112-1-4467	Adult sp		Female
GOZ 112-2-4468	Infans 2	11 - 13 y	Undetermined
GOZ 115-1-4483	Adult sp		Probable male
GOZ 117-1-4490	Adult sp		Undetermined
GOZ 117-2-4489	Adult sp		Undetermined
GOZ 119-1-4498	Subadult sp		Undetermined
GOZ 119-2-4497	Adult sp		Undetermined
GOZ 121-1-4504	Adult sp		Undetermined
GOZ 124-4-4515	Adult sp		Female
GOZ 127-1-4526	Adult sp		Undetermined
GOZ 129-1-4538	Adult sp		Undetermined
GOZ 131-2-4550	Adult sp		Undetermined
GOZ 131-3-4546	Adult sp		Undetermined
GOZ 131-4-4546	Adult sp		Undetermined
GOZ 132-2-4552	Juvenile	12 - 18 y	Undetermined
GOZ 134-1-4565	Infans 1B	3 y 6 m - 6 y 6 m	Undetermined
GOZ 135-1-4568	Adult sp		Female
GOZ 135-2-4568	Fetus	38 - 40 wiu	Undetermined
GOZ 136-2-4646	Adult sp		Undetermined
GOZ 136-6-4644	Adult sp		Probable female
GOZ 136-7-4572	Adult sp		Undetermined
GOZ 138-1-4583	Adult sp		Undetermined
GOZ 141-1-4597	Undetermined		Undetermined
GOZ 142-1-4601	Adult sp		Undetermined

Individual	*Age*		*Sex*
GOZ 146-1-4618	Adult sp		Undetermined
GOZ 146-2-4642	Adult sp		Undetermined
GOZ 149-1-4632	Infans 1B	5 - 9 y	Undetermined
GOZ 149-2-4632	Infans 1B	3 - 5 y	Undetermined
GOZ 149-3-4632	Adult sp		Undetermined
GOZ 150-1-4638	Adult sp		Probable female
GOZ 150-2-4638	Adult sp		Probable male
GOZ 151-1-4651	Adult sp		Undetermined
GOZ 153-1-4658	Subadult sp	2 - 10 y	Undetermined
GOZ 155-1-4667	Adult sp		Undetermined
GOZ 156-1-4726	Adult sp		Undetermined
GOZ 158-1-4728	Adult sp		Undetermined
GOZ 158-2-4729	Adult sp		Undetermined
GOZ 158-3-4678	Adult sp		Undetermined
GOZ 159-1-4687	Adult sp		Probable female
GOZ 162-4-4698	Infans 1B	3 - 5 y	Undetermined
GOZ 168-1-4722	Adult sp		Undetermined
GOZ 173-1-4747	Adult sp		Undetermined
GOZ 178-1-4767	Adult sp		Undetermined
GOZ 183-1-4798	Adult sp		Undetermined
GOZ 183-2-4797	Adult sp		Undetermined
GOZ 185-1-4803	Infans 1B	2 - 4 y	Undetermined
GOZ 188-1-4817	Adult sp		Probable female
GOZ 188-2-4816	Adult sp		Undetermined
GOZ 189-1-4823	Adult sp		Undetermined
GOZ 189-2-4818	Adult sp		Undetermined
GOZ 191-1-4831	Adult sp		Undetermined
GOZ 192-1-4836	Adult sp		Undetermined
GOZ 200-1-4872	Undetermined		Undetermined
GOZ 200-2-4872	Undetermined		Undetermined
GOZ 201-2-4874	Adult sp		Undetermined
GOZ 202-1-4879	Adult sp		Undetermined
GOZ 203-2-4882	Undetermined		Undetermined
GOZ 204-1-4884	Adult sp		Undetermined
GOZ 206-1-4891	Adult sp		Undetermined
GOZ 207-1-4896	Subadult sp		Undetermined
GOZ 209-1-4907	Infans 1B	4 y - 7 y 6 m	Undetermined
GOZ 216-1-5043	Adult sp		Undetermined
GOZ 219-1-4948	Adult sp		Undetermined
GOZ 220-1-4952	Adult sp		Male
GOZ 221-2-4962	Adult sp		Undetermined
GOZ 224-1-4976	Adult sp		Undetermined
GOZ 226-1-4986	Adult sp		Undetermined
GOZ 226-2-4985	Infans 1A	1 y - 1 y 6 m	Undetermined
GOZ 226-3-4985	Infans 1B	4 - 5 y	Undetermined
GOZ 230-1-5003	Adult sp		Probable female
GOZ 230-2-5002	Juvenile	14 - 20 y	Undetermined
GOZ 231-1-5006	Adult sp		Undetermined

Individual	*Age*		*Sex*
GOZ 232-1-5012	Adult sp		Probable male
GOZ 232-2-5011	Undetermined		Undetermined
GOZ 233-1-5017	Adult sp		Female
GOZ 236-1-5028	Adult sp		Undetermined
GOZ 236-2-5070	Infans 2	7 y 6 m - 12 y 6 m	Undetermined
GOZ 236-3-5027	Undetermined		Undetermined
GOZ 238-1-5035	Adult sp		Probable male
GOZ 239-1-5039	Adult sp		Undetermined
GOZ 241-1-5046	Adult sp		Undetermined
GOZ 243-2-5055	Adult sp		Undetermined
GOZ 244-2-5057	Adult sp		Undetermined
GOZ 245-1-5062	Undetermined		Undetermined
GOZ 246-1-5076	Adult sp		Undetermined
GOZ 247-1-5080	Adult sp		Undetermined
GOZ 5831-1-6150	Infans 1B	5 - 9 y	Undetermined
GOZ 5831-2-6150	Infans 1B	6 - 7 y	Undetermined
GOZ 5831-3-6150	Subadult sp		Undetermined
GOZ 5831-4-6150	Subadult sp		Undetermined
GOZ 5831-5-6150	Infans 2	6 - 10 y	Undetermined
GOZ 6640-2-6644	Juvenile	13 - 18 y	Undetermined
GOZ 6640-3-6644	Infans 1B	5 - 7 y	Undetermined
GOZ 6640-4-6644	Juvenile	18 - 20 y	Undetermined
GOZ 6640-5-6644	Infans 2	8 y 6 m - 13 y 6 m	Undetermined
GOZ 6890-1-6891	Infans 1A	2 y - 2 y 8 m	Undetermined
BOA 001-1	Adult sp		Undetermined
BOA 002-1	Adult sp		Undetermined
BOA 002-2	Undetermined		Undetermined
BOA 003-1	Adult sp		Undetermined
BOA 004-1	Adult sp		Undetermined
BOA 005-1	Adult sp		Undetermined
BOA 007-1	Adult sp		Undetermined
BOA 009-1	Adult sp		Undetermined
BOA 012-1	Adult sp		Probable female
BOA 013-1	Adult sp		Undetermined
BOA 014-1	Adult sp		Undetermined
BOA 015-1	Adult sp		Undetermined
BOA 016-1	Adult sp		Undetermined
BOA 017-1	Adult sp		Undetermined
BOA 017-2	Juvenile	12 - 18 y	Undetermined
BOA 018-1	Adult sp		Female
BOA 019-1	Adult sp		Undetermined
BOA 020-1	Adult sp		Undetermined
BOA 021-1	Adult sp		Undetermined
BOA 022-1	Adult sp		Undetermined
BOA 023-1	Juvenile	14 - 16 y	Undetermined
BOA 024-1	Adult sp		Female
BOA 026-1	Adult sp		Undetermined
BOA 029-1	Undetermined		Undetermined

Individual	*Age*		*Sex*
BOA 030-1	Adult sp		Undetermined
BOA 034-1	Adult sp		Undetermined
BOA 035-1	Adult sp		Undetermined
BOA 036-1	Adult sp		Undetermined
BOA 037-1	Adult sp		Undetermined
BOA 039-1	Adult sp		Undetermined
BOA 040-1	Adult sp		Undetermined
BOA 041-1	Undetermined		Undetermined
BOA 042-1	Subadult sp		Undetermined
BOA 043-1	Adult sp		Undetermined
BOA 044-1	Adult sp		Undetermined
BOA 047-1	Adult sp		Probable female
BOA 048-1	Adult sp		Undetermined
BOA 049-1	Adult sp		Undetermined
BOA 050-1	Adult sp		Undetermined
BOA 051-1	Infans 2	11 y - 13 y 6 m	Undetermined
BOA 051-2	Juvenile	12 - 18 y	Undetermined
BOA 052-1	Subadult sp		Undetermined
BOA 053-1	Adult sp		Undetermined
BOA 054-1	Adult sp		Undetermined
BOA 054-2	Adult sp		Undetermined
BOA 055-1	Infans 2	9 y 6 m - 14 y 6 m	Undetermined
BOA 055-2	Undetermined	> 11 y	Undetermined
BOA 058-1	Adult sp		Undetermined
BOA 059-1	Undetermined		Undetermined
BOA 060-1	Adult sp		Undetermined
BOA 061-1	Undetermined		Undetermined
BOA 062-1	Adult sp		Undetermined
BOA 065-1	Adult sp		Undetermined
BOA 066-1	Adult sp		Undetermined
BOA 068-1	Adult sp		Probable female
BOA 068-2	Infans 2	11 - 13 y	Undetermined
BOA 069-1	Infans 1B	3 y 6 m - 6 y 6 m	Undetermined
BOA 069-2	Infans 2	12 y - 13 y 6 m	Undetermined
BOA 070-1	Subadult sp		Undetermined
BOA 071-1	Juvenile	14 - 16 y	Undetermined
BOA 072-1	Infans 1B	3 - 5 y	Undetermined
BOA 072-2	Juvenile	12 - 16 y	Undetermined
BOA 072-3	Infans 1A	2 - 3 y	Undetermined
BOA 073-1	Subadult sp	2 y - 12 y 6 m	Undetermined
BOA 074-1	Undetermined		Undetermined
BOA 075-1	Infans 1B	3 - 5 y	Undetermined
BOA 076-1	Adult sp		Undetermined
BOA 076-2	Subadult sp	< 20 y	Undetermined
BOA 077-1	Infans 2	6 - 10 y	Undetermined
BOA 078-1	Undetermined		Undetermined
BOA 080-1	Adult sp		Undetermined
BOA 081-1	Adult sp		Undetermined

Individual	*Age*		*Sex*
BOA 082-1	Adult sp		Undetermined
BOA 084-1	Subadult sp	< 16 y	Undetermined
BOA 085-1	Adult sp		Undetermined
BOA 085-2	Infans 1B	4 - 5 y	Undetermined
BOA 086-1	Adult sp		Probable female
BOA 086-2	Infans 1A	7 m - 1 y 6 m	Undetermined
BOA 089-1	Adult sp		Probable female
BOA 089-2	Infans 1B	5 - 9 y	Undetermined
BOA 090-1	Adult sp		Undetermined
BOA 091-1	Adult sp		Undetermined
BOA 093-1	Adult sp		Undetermined
BOA 094-1	Adult sp		Probable female
BOA 095-1	Adult sp		Undetermined
BOA 096-1	Subadult sp		Undetermined
BOA 097-1	Undetermined		Undetermined
BOA 098-1	Infans 1B	3 - 5 y	Undetermined
BOA 099-1	Adult sp		Undetermined
BOA 100-1	Subadult sp	1 - 16 y	Undetermined
BOA 101-1	Undetermined		Undetermined
BOA 102-1	Undetermined		Undetermined
BOA 103-1	Adult sp		Undetermined
BOA 103-2	Adult sp		Undetermined
BOA 103-3	Infans 1B	6 - 7 y	Undetermined
BOA 103-4	Adult sp		Undetermined
BOA 104-1	Adult sp		Undetermined
BOA 105-1	Adult sp		Undetermined
BOA 105-2	Adult sp		Undetermined
BOA 105-3	Infans 1A	1 - 2 y	Undetermined
BOA 105-4	Adult sp		Probable female
BOA 106-1	Adult sp		Undetermined
BOA 107-1	Adult sp		Undetermined
BOA 107-2	Adult sp		Undetermined
BOA 107-3	Adult sp		Undetermined
BOA 107-4	Infans 1B	3 - 5 y	Undetermined
BOA 108-1	Undetermined		Undetermined
BOA 109-1	Adult sp		Undetermined
BOA 112-1	Adult sp		Female
BOA 113-1	Adult sp		Undetermined
BOA 113-2	Infans 2	6 - 12 y	Undetermined
BOA 114-1	Adult sp		Undetermined
BOA 115-1	Adult sp		Undetermined
BOA 115-2	Adult sp		Undetermined
BOA 115-3	Adult sp		Undetermined
BOA 115-4	Infans 1A	1 y 6 m - 2 y	Undetermined
BOA 116-1	Undetermined		Undetermined
BOA 119-1	Subadult sp	< 16 y	Undetermined
BOA 120-1	Subadult sp	6 - 10 y	Undetermined
BOA 120-2	Subadult sp	< 12 y 6 m	Undetermined

Individual	*Age*		*Sex*
BOA 121-1	Infans 2	6 - 11 y	Undetermined
BOA 122-1	Infans 1B	3 - 4 y	Undetermined
BOA 124-1	Adult sp		Undetermined
BOA 125-1	Adult sp		Undetermined
BOA 125-2	Infans 1B	3 - 5 y	Undetermined
BOA 126-1	Adult sp		Undetermined
BOA 128-1	Adult sp		Undetermined
BOA 128-2	Adult sp		Undetermined
BOA 129-1	Adult sp		Undetermined
BOA 131-1	Adult sp		Female
BOA 132-1	Adult sp		Undetermined
BOA 133-1	Adult sp		Undetermined
BOA 135-1	Adult sp		Undetermined
BOA 138-1	Adult sp		Undetermined
BOA 139-1	Adult sp		Undetermined
BOA 142-1	Adult sp		Undetermined
BOA 143-1	Adult sp		Undetermined
BOA 145-1	Adult sp		Undetermined
BOA 145-2	Infans 2	6 - 12 y	Undetermined
BOA 145-3	Adult sp		Undetermined
BOA 145-4	Adult sp		Undetermined
BOA 145-5	Adult sp		Undetermined
BOA 145-6	Adult sp		Undetermined
BOA 146-1	Adult sp		Undetermined
BOA 147-1	Adult sp		Undetermined
BOA 148-1	Adult sp		Undetermined
BOA 149-1	Adult sp		Undetermined
BOA 150-1	Adult sp		Undetermined
BOA 151-1	Infans 1B	5 - 9 y	Undetermined
BOA 151-2	Juvenile	12 - 18 y	Undetermined
BOA 151-3	Undetermined		Undetermined
BOA 152-1	Adult sp		Undetermined
BOA 152-2	Adult sp		Undetermined
BOA 157-1	Middle-old adult	34 - 58 y	Female
BOA 157-2	Subadult sp	< 16 y	Undetermined
BOA 160-1	Young adult	21 - 36 y	Male
BOA 160-2	Adult sp		Undetermined
BOA 160-3	Infans 1B	2 - 4 y	Undetermined
BOA 162-1	Adult sp		Undetermined
BOA 163-1	Adult sp		Undetermined
BOA 166A-1	Adult sp		Probable male
BOA 169-1	Adult sp		Undetermined
BOA 174-1	Young-middle adult	27 - 47 y	Probable male
BOA 177-1	Adult sp		Undetermined
BOA 178-1	Adult sp		Undetermined
BOA 179-1	Adult sp		Undetermined
BOA 179-2	Undetermined		Undetermined
BOA 182-1	Adult sp		Undetermined

Individual	*Age*		*Sex*
BOA 183-1	Adult sp		Undetermined
BOA 184-1	Adult sp		Undetermined
BOA 187-1	Adult sp		Undetermined
BOA 187-2	Adult sp		Undetermined
SNC 30100-1-30102	Infans 1B	3 y 6 m - 6 y 6 m	Undetermined
SNC 30105-1-30108	Adult sp		Probable female
SNC 30110-1-30111	Infans 1B	3 - 5 y	Undetermined
SNC 30110-2-30111	Infans 2	8 y 6 m - 13 y 6 m	Undetermined
SNC 30110-3-30111	Infans 1B	2 - 4 y	Undetermined
SNC 30110-4-30112	Adult sp		Undetermined
SNC 30115-1-30117	Fetus	20 - 40 wiu	Undetermined
SNC 30130-1-30134	Adult sp		Probable male
SNC 30140-1-30143	Adult sp		Undetermined
SNC 30150-1-30152	Juvenile	12 - 18 y	Undetermined
SNC 30150-2-30152	Undetermined		Undetermined
SNC 30170-1-30186	Juvenile	14 - 16 y	Undetermined
SNC 30180-1-30182	Adult sp		Undetermined
SNC 30240-1-30242	Adult sp		Undetermined
SNC 30270-1-30272	Adult sp		Undetermined
SNC 30280-1-30283	Juvenile	14 - 18 y	Undetermined
SNC 30295-1-30297	Infans 1A	9 m - 1 y	Undetermined
SNC 30320-1-30322	Infans 1B	2 - 4 y	Undetermined
SNC 30444-1-30446	Adult sp		Probable female
SNC 30620-1-30622	Subadult sp		Undetermined
SNC 30740-1-30742	Adult sp		Probable female
SNC 30745-1-30747	Infans 1A	32 wiu - 2 m	Undetermined
SNC 30750-1-30752	Infans 1B	5 - 9 y	Undetermined
SNC 30790-1-30793	Adult sp		Undetermined
SNC 30795-1-30798	Adult sp		Undetermined
SNC 30800-1-30803	Adult sp		Undetermined
SNC 30800-2-30802	Adult sp		Ambiguous
SNC 30800-3-30801	Fetus	32 - 36 wiu	Undetermined
SNC 30805-1-30808	Adult sp		Undetermined
SNC 30810-1-30813	Adult sp		Probable female
SNC 30810-2-30813	Infans 2	7 - 8 y	Undetermined
SNC 30810-3-30812	Adult sp		Undetermined
SNC 30810-4-30812	Juvenile	12 - 18 y	Undetermined
SNC 30810-5-30812	Juvenile	< 18 y	Undetermined
SNC 30810-6-30812	Adult sp		Probable female
SNC 30830-1-30832	Adult sp		Probable male
SNC 30835-1-30837	Middle-old adult	33 - 57 y	Female
SNC 30840-1-30842	Adult sp		Probable female
SNC 30850-1-30858	Adult sp		Ambiguous
SNC 30865-1-30869	Adult sp		Undetermined
SNC 30880-1-30884	Adult sp		Probable female
SNC 30890-1-30892	Fetus	40 wiu	Undetermined
SNC 33000-1-33003	Adult sp		Undetermined
SNC 33005-1-33004	Adult sp		Undetermined

Individual	*Age*		*Sex*
SNC 33010-1-33013	Infans 1A	3 - 9 m	Undetermined
SNC 33030-1-33032	Adult sp		Probable female
SNC 33040-1-33043	Infans 1B	3 y 6 m - 6 y 6 m	Undetermined
SNC 33060-1-33064	Infans 1B	5 - 9 y	Undetermined
SNC 33070-1-33072	Infans 1B	2 - 4 y	Undetermined
LH 1-1-7023	Middle-old adult	33 - 57 y	Female
LH 2-1-7112	Infans 1A	1 y 6 m - 3 y	Undetermined
LH 3-1-7132	Adult sp		Probable female
LH 4-1-7162	Infans 1A	1 - 2 y	Undetermined
LH 5-1-7182	Infans 1B	3 y 6 m - 6 y 6 m	Undetermined
LH 6-1-7192	Infans 1A		Undetermined
LH 7-1-7198	Adult sp		Probable female
LH 8-1-7202	Adult sp		Male
LH 9-1-7172	Adult sp		Probable female
ALD A008-1	Juvenile	14 - 18 y	Undetermined
ALD A009-1	Adult sp		Male
ALD A010-1	Adult sp		Undetermined
ALD A011-1	Adult sp	14 - 25 y	Undetermined
ALD ASUP-06	Adult sp		Undetermined
ALD ASUP-07	Adult sp		Undetermined
ALD ASUP-08	Adult sp		Undetermined
ALD ASUP-09	Adult sp		Undetermined
ALD ASUP-10	Subadult sp	1 y 4 m - 12 y	Undetermined
ALD B001-1	Infans 2	11 - 13 y	Undetermined
ALD B002-1	Adult sp		Male
ALD B003-1	Adult sp		Female
ALD B004-1	Infans 2	6 - 12 y	Undetermined
ALD B005-1	Adult sp		Male
ALD B006/B008-1	Adult sp		Undetermined
ALD B006/B008-2	Adult sp		Undetermined
ALD B006/B008-3	Adult sp		Undetermined
ALD B006/B008-4	Adult sp		Undetermined
ALD B006/B008-5	Infans 1B	2 - 4 y	Undetermined
ALD B011-1	Adult sp		Male
ALD B012-1	Adult sp		Male
ALD B013-1	Young adult	21 - 36 y	Male
ALD B014-1	Adult sp		Female
ALD B015-1	Adult sp		Female
ALD B016-1	Adult sp		Female
ALD B016-2	Adult sp		Undetermined
ALD B017-1	Juvenile	13 - 20 y	Male
ALD B018-1	Adult sp		Male
ALD B019-1	Adult sp		Male
ALD B020-1	Adult sp		Female
ALD B021-1	Adult sp		Female
ALD B021-2	Infans 1A	1 y 4 m - 2 y 8 m	Undetermined
ALD B022-1	Adult sp		Male
ALD B023-1	Adult sp		Probable female

Individual	*Age*		*Sex*
ALD B024-1	Adult sp		Female
ALD B025-1	Young adult		Male
ALD B026/B027-1(B026)	Adult sp		Female
ALD B026/B027-2(B027)	Adult sp		Undetermined
ALD B028-1	Adult sp		Male
ALD B029/B043-01(B029)	Adult sp		Male
ALD B029/B043-02(B030)	Adult sp		Male
ALD B029/B043-03(B031)	Adult sp		Female
ALD B029/B043-04(B032)	Adult sp		Undetermined
ALD B029/B043-05(B033)	Adult sp		Undetermined
ALD B029/B043-06(B034)	Adult sp		Undetermined
ALD B029/B043-07(B035)	Adult sp		Undetermined
ALD B029/B043-08(B036)	Adult sp		Undetermined
ALD B029/B043-09(B037)	Adult sp		Undetermined
ALD B029/B043-10(B038)	Adult sp		Undetermined
ALD B029/B043-11(B039)	Infans 1B	3 - 5 y	Undetermined
ALD B029/B043-12(B040)	Infans 1B	4 - 8 y	Undetermined
ALD B029/B043-13(B041)	Infans 2	10 - 12 y	Undetermined
ALD B029/B043-14(B042)	Juvenile	12 - 18 y	Undetermined
ALD B029/B043-15(B043)	Adult sp		Ambiguous
ALD B044-1	Adult sp		Male
ALD B045/B047-1(B045)	Adult sp		Male
ALD B045/B047-2(B046)	Adult sp		Female
ALD B045/B047-3(B047)	Adult sp		Undetermined
ALD B048/B054-1(B048)	Adult sp		Female
ALD B048/B054-2(B049)	Adult sp		Probable male
ALD B048/B054-3(B050)	Adult sp		Undetermined
ALD B048/B054-4(B051)	Adult sp		Undetermined
ALD B048/B054-5(B052)	Adult sp		Undetermined
ALD B048/B054-6(B053)	Infans 1B	3 y - 6 y 6 m	Undetermined
ALD B048/B054-7	Subadult sp	2 - 10 y	Undetermined
ALD B055/B063-01(B055)	Juvenile	12 - 18 y	Male
ALD B055/B063-02(B056)	Adult sp		Male
ALD B055/B063-03(B057)	Adult sp		Undetermined
ALD B055/B063-04(B058)	Infans 2	7 y 6 m - 12 y 6 m	Undetermined
ALD B055/B063-05(B059)	Adult sp		Male
ALD B055/B063-06(B060)	Adult sp		Female
ALD B055/B063-07(B061)	Adult sp		Male
ALD B055/B063-08(B062)	Adult sp		Male
ALD B055/B063-09(B063)	Adult sp		Male
ALD B055/B063-10	Infans 1B	3 y 6 m - 6 y 6 m	Undetermined
ALD B064/B076-01(B064)	Adult sp		Male
ALD B064/B076-02(B065)	Adult sp		Female
ALD B064/B076-03(B066)	Infans 1B	3 - 5 y	Undetermined
ALD B064/B076-04(B067)	Adult sp		Male
ALD B064/B076-05(B068)	Adult sp		Male
ALD B064/B076-06(B069)	Adult sp		Male
ALD B064/B076-07(B070)	Adult sp		Undetermined

Individual	*Age*		*Sex*
ALD B064/B076-08(B071)	Infans 1B	3 - 5 y	Female
ALD B064/B076-09(B072)	Subadult sp		Undetermined
ALD B064/B076-10(B073)	Adult sp		Female
ALD B064/B076-11(B074)	Adult sp		Male
ALD B064/B076-12(B075)	Adult sp		Female
ALD B064/B076-13(B076)	Adult sp		Male
ALD B077/B087-01(B077)	Adult sp		Male
ALD B077/B087-02(B078)	Adult sp		Male
ALD B077/B087-03(B079)	Adult sp		Probable female
ALD B077/B087-04(B080)	Juvenile	12 - 18 y	Female
ALD B077/B087-05(B081)	Infans 1B	4 - 8 y	Undetermined
ALD B077/B087-06(B082)	Adult sp		Male
ALD B077/B087-07(B083)	Infans 2	6 - 10 y	Undetermined
ALD B077/B087-08(B084)	Infans 2	9 y 6 m - 15 y	Male
ALD B077/B087-09(B085)	Adult sp		Female
ALD B077/B087-10(B086)	Adult sp		Male
ALD B077/B087-11(B087)	Adult sp		Male
ALD B088/B098-01(B088)	Adult sp		Undetermined
ALD B088/B098-02(B089)	Adult sp		Male
ALD B088/B098-03(B090)	Adult sp		Male
ALD B088/B098-04(B091)	Adult sp		Male
ALD B088/B098-05(B092)	Adult sp		Male
ALD B088/B098-06(B093)	Adult sp		Female
ALD B088/B098-07(B094)	Adult sp		Male
ALD B088/B098-08(B095)	Adult sp		Probable female
ALD B088/B098-09(B096)	Adult sp		Male
ALD B088/B098-10(B097)	Adult sp		Male
ALD B088/B098-11(B098)	Adult sp		Female
ALD B099/B101-1(B099)	Adult sp		Female
ALD B099/B101-2(B100)	Adult sp		Male
ALD B099/B101-3(B101)	Undetermined		Undetermined
ALD B102/B103-1(B102)	Subadult sp		Undetermined
ALD B102/B103-2(B103)	Adult sp		Undetermined
ALD B104-1	Adult sp		Male
ALD B105-1	Adult sp		Undetermined
FIN 02-1-44	Adult sp		Probable female
FIN 03-1-50	Adult sp		Undetermined
FIN 03-2-61	Infans 1B	3 – 5 y	Undetermined
FIN 06-1-53	Adult sp		Undetermined
FIN 07-1-57	Adult sp		Female
FIN 08-1-56	Adult sp		Male
FIN 09-1-60	Adult sp		Probable female
FIN 13-1-30	Adult sp		Undetermined
FIN 14-1-73	Infans 2	9 y 6 m - 14 y 6 m	Undetermined
FIN 15-1-74	Adult sp		Undetermined
SMD 2811-1-2810(181)	Young adult	25 - 38 y	Female
SMD 2841-1-2840(184)	Middle-old adult	38 - 66 y	Male
SMD 2871-1-2870(187)	Adult sp		Probable male

Individual	*Age*		*Sex*
SMD 2901-1-2900(190)	Adult sp		Female
SMD 2901-2-2900	Infans 1A	Birth - 2 m	Undetermined
SMD 2961-1-2960(196)	Adult sp		Female
SMD 2961-2-2970(197)	Adult sp		Probable male
SMD 2981-1-2990(199)	Young adult	22 - 25 y	Male
SMD 2981-2-3120(212)	Middle-old adult	36 - 58 y	Male
SMD 2981-3-3030(203)	Middle-old adult	40 - 64 y	Male
SMD 2981-4-2980(198)	Middle-old adult	33 - 54 y	Male
SMD 3021-1-3020(202)	Adult sp		Undetermined
SMD 3041-1-3040(204)	Adult sp		Male
SMD 3061-1-3060(206)	Old adult	43 - 74 y	Probable male
SMD 3071-1-3070(207)	Infans 1	< 5 y	Undetermined
SMD 3071-2-3070	Infans 1	< 5 y	Undetermined
SMD 3081-1-3080(208)	Old adult	46 - 80 y	Male
SMD 3091-1-3090(209)	Old adult	43 - 74 y	Ambiguous
SMD 3101-1-3100(210)	Adult sp		Female
SMD 3111-1-3110(211)	Adult sp		Female
SMD 3151-1-3150(215)	Middle-old adult	39 - 63 y	Probable male
SMD 3151-2-3150	Adult sp		Ambiguous
SMD 3151-3-3150	Adult sp		Probable female
SMD 3161-1-3160(216)	Adult sp		Female
SMD 3161-2-3160	Adult sp		Undetermined
SMD 3161-3-3160	Subadult sp		Undetermined
SMD 3161-4-3160	Fetus	34 wiu	Undetermined
SMD 3181-1-3180(218)	Undetermined		Undetermined
SMD 3361-1-3360(236)	Adult sp		Probable female
SMD 3371-1-3370(237)	Infans 1B	3 y 6 m - 5 y	Undetermined
SMD 3371-2-3370	Adult sp		Undetermined
SMD 3381-1-3380(238)	Juvenile	15 - 16 y	Undetermined
SMD 3381-2-3380	Middle-old adult	38 - 66 y	Undetermined
SMD 3381-3-3380	Subadult sp		Undetermined
SMD 3391-1-3390(239)	Adult sp		Probable male
SMD 3391-2-3390	Infans 1A	1 y - 1 y 6 m	Undetermined
SMD 3401-1-3390(240)	Old adult	43 - 74 y	Female
SMD 3401-2-3390	Adult sp		Undetermined
SMD 3411-1-3410(241)	Old adult	43 - 69 y	Male
SMD 3411-2-3410	Adult sp		Probable female
SMD 3421-1-3420(242)	Adult sp		Probable male
SMD 3431-1-3430(243)	Adult sp		Probable male
SMD 3431-2-3430	Adult sp		Undetermined
SMD 3451-1-3450(245)	Middle-old adult	34 - 58 y	Probable male
SMD 3451-2-3450	Adult sp		Undetermined
SMD 3461-1-3460(246)	Adult sp		Undetermined
SMD 3461-2-3460	Infans 1B	3 - 5 y	Undetermined
SMD 3551-1-3550(255)	Adult sp		Undetermined
SMD 3601-1-3600(260)	Adult sp		Probable female
SMD 3601-2-3600	Adult sp		Undetermined
SMD 3601-3-3600	Infans 1A	2 y 6 m - 3 y	Undetermined

Individual	*Age*		*Sex*
SMD 3611-1-3610(261)	Adult sp		Undetermined
SMD 3621-1-3620(262)	Young-middle adult	28 - 46 y	Probable male
CG 053-1-0420	Infans 2	12 - 14 y	Undetermined
CG 053-2-0421	Infans 1B	4 - 8 y	Undetermined
CG 080-1-0393	Infans 1B	3 y	Undetermined
CG 094-1-1231	Young-middle adult	28 - 46 y	Male
CG 094-2-1230	Adult sp		Probable female
CG 192-1-0353	Adult sp		Undetermined
CG 220-1-0433	Adult sp		Probable male
CG 254-1-0623	Adult sp		Ambiguous
CG 295-1-0704	Adult sp		Undetermined
CG 296-1-0701	Adult sp		Undetermined
CG 370-1-0916	Adult sp		Probable male
CG 371-1-0794	Adult sp		Undetermined
CG 372-1-0797	Infans 2	9 y 6 m - 14 y 6 m	Undetermined
CG 373-1-0823	Adult sp		Ambiguous
CG 374-1-1695	Adult sp		Probable male
CG 374-2-1473	Juvenile	15 - 20 y	Undetermined
CG 380-1-0826	Adult sp		Male
CG 381-1-0840	Adult sp		Probable female
CG 382-1-0837	Adult sp		Probable male
CG 385-1-0853	Adult sp		Female
CG 387-1-0746	Adult sp		Undetermined
CG 391-1-0925	Adult sp		Female
CG 392-1-0856	Adult sp		Female
CG 392-2-0855	Adult sp		Probable male
CG 393-1-0875	Adult sp		Probable male
CG 393-2-0874	Juvenile	17 - 20 y	Undetermined
CG 395-1-0879	Adult sp		Probable male
CG 411-1-0901	Adult sp		Male
CG 443-1-0953	Adult sp		Undetermined
CG 444-1-0957	Adult sp		Undetermined
CG 445-1-0960	Adult sp		Probable female
CG 446-1-0964	Infans 2	6 - 10 y	Undetermined
CG 447-1-0968	Adult sp		Undetermined
CG 453-1-1315	Infans 2	8 y 6 m - 13 y 6 m	Undetermined
CG 477-1-1434	Adult sp		Female
CG 511-1-1437	Adult sp		Probable female
CG 512-1-1440	Infans 2	7 y 6 m - 12 y 6 m	Undetermined
CG 519-1-1480	Adult sp		Male
CG 597-1-1656	Adult sp		Probable female
CG 598-1-1646	Infans 2	7 y 6 m - 12 y 6 m	Undetermined
CG 599-1-1643	Infans 1B	2 - 4 y	Undetermined
CG 692-1-1794	Adult sp		Undetermined
PMCV 14-1-109	Adult sp		Undetermined
PMCV 15-1-130	Middle-old adult	33 - 57 y	Female
PMCV 15-2-126	Adult sp		Probable male
PMCV 15-3-126	Adult sp		Undetermined

Individual	*Age*		*Sex*
PMCV 16-1-103	Infans 1A	3 - 9 m	Undetermined
PMCV 16-2-102	Fetus	38 - 40 wiu	Undetermined
PMCV 18-1-114	Infans 1B	2 - 4 y	Undetermined
PMCV 19-1-139	Middle-old adult	33 - 54 y	Male
PMCV 19-2-141	Young adult	22 - 25 y	Probable male
PMCV 20-1-122	Infans 1B	3 - 4 y	Undetermined
PMCV 21-1-160	Middle-old adult	39 - 63 y	Female
PMCV 22-1-118	Infans 1B	5 y - 6 y 6 m	Undetermined
PMCV 22-2-116	Adult sp		Probable male
PMCV 23-1-134	Adult sp		Male
PMCV 43-1-350	Young adult	22 - 36 y	Female
PMCV 43-2-350	Adult sp		Undetermined
PMCV 44-1-469/470	Young adult	17 - 27 y	Male
PMCV 45-1-412	Adult sp		Male
PMCV 46-1-444	Adult sp		Undetermined
PMCV 46-2-445	Adult sp		Undetermined
PMCV 46-3-444/445	Adult sp		Undetermined
PMCV 46-4-446	Adult sp		Probable female
PMCV 47-1-357	Undetermined		Undetermined
PMCV 48-1-353	Adult sp		Undetermined
PMCV 49-1-451	Infans 1B	5 - 9 y	Undetermined
PMCV 49-2-419	Adult sp		Undetermined
PMCV 50-1-458/472	Infans 2	11 y - 14 y 6 m	Undetermined
PMCV 50-2-474	Adult sp		Undetermined
PMCV 51-1-454	Infans 2	7 y 6 m - 12 y 6 m	Undetermined
PMCV 55-1-399	Adult sp		Undetermined
PMCV 55-2-399	Adult sp		Undetermined
PMCV 57-1-420/449	Adult sp		Undetermined
RVSM 002-1-027(003)	Young adult	21 - 36 y	Male
RVSM 003-1-056(004a)	Old adult	48 - 83 y	Female
RVSM 003-2-056(004b)	Fetus	34 - 36 wiu	Undetermined
RVSM 004-1-057(005)	Adult sp		Undetermined
RVSM 007-1-060(010)	Infans 1A	1 y - 1 y 6 m	Undetermined
RVSM 009-1-062(012)	Old adult	46 - 80 y	Undetermined
RVSM 010-1-078(013)	Young-middle adult	25 - 40 y	Female
RVSM 011-1-079(016a)	Middle-old adult	33 - 57 y	Probable male
RVSM 011-2-079(016b)	Adult sp		Undetermined
RVSM 011-3-079(016c)	Subadult sp		Undetermined
RVSM 014-1-086(014a)	Infans 1A	1 - 2 y	Undetermined
RVSM 014-2-086(014b)	Adult sp		Undetermined
RVSM 018-1-092(021)	Middle-old adult	41 - 67 y	Male
RVSM 020-1-096(023)	Middle-old adult	34 - 83 y	Male
RVSM 020-2-096(037)	Infans 1A	3 - 9 m	Undetermined
RVSM 022-1-100(025)	Young-middle adult	27 - 44 y	Male
RVSM 023-1-107(026)	Fetus	34 - 36 wiu	Undetermined
RVSM 024-1-118(027a)	Young adult	22 - 38 y	Female
RVSM 024-2-118(027b)	Fetus	36 - 38 wiu	Undetermined
RVSM 025-1-117(032)	Adult sp		Undetermined

Individual	*Age*		*Sex*
RVSM 029-1-095(033)	Infans 1B	2 - 4 y	Undetermined
RVSM 031-1-128(036)	Infans 1A	1 - 2 y	Undetermined
RVSM 031-2-128(035)	Infans 1A	1 - 2 y	Undetermined
RVSM 032-1-130(038b)	Young adult	22 - 35 y	Male
RVSM 032-2-129(038a1)	Adult sp		Undetermined
RVSM 032-3-129(038a2)	Adult sp		Undetermined
RVSM 032-4-129(038a3)	Infans 1A	Birth - 1 y	Undetermined
RVSM 033-1-132(039)	Old adult	45 - 72 y	Male
RVSM 034-1-143(040)	Adult sp		Undetermined
RVSM 034-2-145(145a)	Infans 1A	1 y - 1 y 6 m	Undetermined
RVSM 034-3-145(145b)	Infans 1A	Birth - 3 m	Undetermined
RVSM 035-1-146(041)	Adult sp		Undetermined
RVSM 038-1-156(047)	Infans 1A	3 - 6 m	Undetermined
RVSM 038-2-155(046a)	Fetus	36 - 40 wiu	Undetermined
RVSM 038-3-155(046b)	Infans 1A	Birth - 3 m	Undetermined
RVSM 042-1-158(050)	Fetus	26 - 30 wiu	Undetermined
RVSM 048-1-170(056)	Young adult	22 - 30 y	Probable male
RVSM 049-1-171(057)	Adult sp		Undetermined
RVSM 051-1-152(059b)	Adult sp		Probable female
RVSM 052-1-173(060a)	Adult sp		Undetermined
RVSM 052-2-173(060b)	Subadult sp		Undetermined
RVSM 053-1-174(061)	Young-middle adult	27 - 47 y	Probable female
RVSM 054-1-176(062)	Adult sp		Probable male
RVSM 055-1-177(063)	Adult sp		Undetermined
RVSM 055-2-177(087a)	Adult sp		Undetermined
RVSM 055-3-177(087b)	Subadult sp		Undetermined
RVSM 056-1-178(064a)	Adult sp		Probable female
RVSM 056-2-178(064b)	Infans 1A	1 y 4 m - 2 y 8 m	Undetermined
RVSM 056-3-178(064c)	Infans 2		Undetermined
RVSM 060-1-184(068)	Infans 2	10 - 14 y	Undetermined
RVSM 062-1-194(070)	Adult sp		Probable female
RVSM 064-1-200(074)	Infans 1A	3 - 6 m	Undetermined
RVSM 064-2-199(073)	Infans 1A	2 - 3 y	Undetermined
RVSM 113-1-384(126)	Old adult	43 - 74 y	Female
RVSM 114-1-385(127)	Adult sp		Female
RVSM 115-1-386(128)	Young adult	19 - 31 y	Probable male
RVSM 116-1-387(129b)	Young-middle adult	25 - 40 y	Probable female
RVSM 116-2-387(129a)	Middle-old adult	33 - 57 y	Male
RVSM 117-1-393(130)	Infans 1B	5 - 7 y	Undetermined
RVSM 118-1-394(131)	Old adult	42 - 70 y	Undetermined
RVSM 120-1-396(133)	Adult sp		Undetermined
RVSM 121-1-398(134a)	Young adult	17 - 29 y	Female
RVSM 121-2-398(134b)	Infans 1B	6 - 7 y	Undetermined
RVSM 124-1-401(137)	Juvenile	12 - 18 y	Undetermined
RVSM 125-1-402(138)	Adult sp		Undetermined
RVSM 127-1-412(140)	Adult sp		Undetermined
RVSM 128-1-413(141)	Old adult	43 - 69 y	Female
RVSM 129-1-415(142a)	Infans 1B	4 - 7 y	Undetermined

Individual	*Age*		*Sex*
RVSM 129-2-415(142b)	Infans 1	< 7 y	Undetermined
RVSM 129-3-415(142c)	Adult sp		Undetermined
RVSM 130-1-416(143)	Old adult	42 - 70 y	Female
RVSM 141-1-436(152)	Young-middle adult	25 - 40 y	Female
RVSM 142-1-437(153)	Young-middle adult	29 - 46 y	Probable male
RVSM 146-1-454(157)	Middle-old adult	37 - 60 y	Male
RVSM 154-2-462(165b)	Old adult	53 - 86 y	Female
RVSM 154-3-462(165a)	Infans 1B	5 - 9 y	Undetermined

Table 7.5. Indicators used for subadult age estimation. Key: Age, dental dev & eruption = Age, dental development & eruption; Age, epiph f = Age, epiphyseal fusion; y = years, m = months, wiu = weeks in uterus, - = not observable.

Individual	*Age, final estimation*		*Age, dental dev & eruption*	*Age, epiph f*	*Age, linear growth*
GOZ 013-1-4023	Infans 1A	1 y 4 m - 2 y 8 m	1 y 4 m - 2 y 8 m	-	-
GOZ 014-1-4026	Juvenile	13 - 16 y	< 20 y	13 - 16 y	-
GOZ 015-3-4029	Infans 1B	3 - 6 y	-	< 16 y	3 - 6 y
GOZ 015-4-4029	Fetus		-	-	-
GOZ 023-1-4055	Infans 2	6 - 12 y	6 - 12 y	< 16 y	-
GOZ 024-1-4058	Infans 1B	3 - 4 y	-	-	-
GOZ 025-1-4061	Infans 2	8 y 6 m - 13 y 6 m	8 y 6 m - 13 y 6 m	-	-
GOZ 047-05-4154	Infans 2	8 - 11 y	-	< 18 y	8 - 11 y
GOZ 047-06-4154	Infans 1B	5 - 9 y	5 - 9 y	1 - 18 y	-
GOZ 047-07-4154	Infans 1B	2 - 4 y	2 - 4 y	> 1 y	-
GOZ 047-08-4154	Infans 1A	1 y 6 m - 2 y	-	< 18 y	1 y 6 m - 2 y
GOZ 047-09-4154	Infans 1A	6 m	-	< 18 y	6 m
GOZ 047-10-4154	Infans 1A	Birth - 1.5 m	-	< 18 y	Birth - 1.5 m
GOZ 053-1-4179	Infans 2	7 y 6 m - 12 y 6 m	7 y 6 m - 12 y 6 m	-	-
GOZ 055-3-4188	Infans 1B	3 - 5 y	-	3 - 5 y	-
GOZ 058-1-4198	Infans 2	9 y 6 m - 14 y 6 m	9 y 6 m - 14 y 6 m	< 1 y	-
GOZ 063-2-4215	Subadult sp		-	-	-
GOZ 065-3-4231	Infans 1B	2 - 4 y	2 - 4 y	-	-
GOZ 075-2-4276	Infans 1B	6 - 7 y	-	< 16 y	6 - 7 y
GOZ 084-2-4318	Infans 1B	4 - 6 y	-	-	4 - 6 y
GOZ 100-4-4396	Juvenile	15 - 16 y	-	< 16 y	-
GOZ 102-1-4403	Infans 1B	3 - 5 y	3 - 5 y	> 1 y	-
GOZ 103-2-4441	Infans 1B	3 y 6 m - 5 y	3 y 6 m - 6 y 6 m	< 5 y	-
GOZ 107-1-4425	Infans 1B	6 - 7 y	6 - 10 y	> 2 y	6 - 7 y
GOZ 112-2-4468	Infans 2	11 - 13 y	6 - 12 y	12 - 16 y	-
GOZ 119-1-4498	Subadult sp		-	-	-
GOZ 132-2-4552	Juvenile	12 - 18 y	12 - 18 y	-	-
GOZ 134-1-4565	Infans 1B	3 y 6 m - 6 y 6 m	3 y 6 m - 6 y 6 m	-	-
GOZ 135-2-4568	Fetus	38 - 40 wiu	-	-	38 - 40 wiu
GOZ 149-1-4632	Infans 1B	5 - 9 y	5 - 9 y	-	-
GOZ 149-2-4632	Infans 1B	3 - 5 y	3 - 5 y	-	-
GOZ 153-1-4658	Subadult sp	2 - 10 y	2 - 10 y	-	-
GOZ 162-4-4698	Infans 1B	3 - 5 y	3 - 5 y	-	-
GOZ 185-1-4803	Infans 1B	2 - 4 y	2 - 4 y	-	-
GOZ 207-1-4896	Subadult sp		-	-	-

Individual	*Age, final estimation*		*Age, dental dev & eruption*	*Age, epiph f*	*Age, linear growth*
GOZ 209-1-4907	Infans 1B	4 y - 7 y 6 m	-	2 - 16 y	4 y - 7 y 6 m
GOZ 226-2-4985	Infans 1A	1 y - 1 y 6 m	1 - 2 y	1 - 11 y	1 y - 1 y 6 m
GOZ 226-3-4985	Infans 1B	4 - 5 y	4 - 8 y	3 - 6 y	4 - 5 y
GOZ 230-2-5002	Juvenile	14 - 20 y	-	14 - 20 y	-
GOZ 236-2-5070	Infans 2	7 y 6 m - 12 y 6 m	7 y 6 m - 12 y 6 m	-	-
GOZ 5831-1-6150	Infans 1B	5 - 9 y	5 - 9 y	2 - 20 y	-
GOZ 5831-2-6150	Infans 1B	6 - 7 y	6 - 10 y	5 - 7 y	-
GOZ 5831-3-6150	Subadult sp		-	-	-
GOZ 5831-4-6150	Subadult sp		-	-	-
GOZ 5831-5-6150	Infans 2	6 - 10 y	6 - 10 y	> 2 y	-
GOZ 6640-2-6644	Juvenile	13 - 18 y	-	13 - 18 y	-
GOZ 6640-3-6644	Infans 1B	5 - 7 y	5 - 9 y	3 - 7 y	-
GOZ 6640-4-6644	Juvenile	18 - 20 y	> 13 y	18 - 20 y	16 - 17 y
GOZ 6640-5-6644	Infans 2	8 y 6 m - 13 y 6 m	8 y 6 m - 13 y 6 m	5 - 18 y	-
GOZ 6890-1-6891	Infans 1A	2 y - 2 y 8 m	1 y 8 m - 2 y 8 m	> 2 y	-
BOA 017-2	Juvenile	12 - 18 y	12 - 18 y	-	-
BOA 023-1	Juvenile	14 - 16 y	-	14 - 16 y	-
BOA 042-1	Subadult sp		-	-	-
BOA 051-1	Infans 2	11 y - 13 y 6 m	11 y - 13 y 6 m	< 16 y	-
BOA 051-2	Juvenile	12 - 18 y	12 - 18 y	-	-
BOA 052-1	Subadult sp		-	-	-
BOA 055-1	Infans 2	9 y 6 m - 14 y 6 m	9 y 6 m - 14 y 6 m	-	-
BOA 068-2	Infans 2	11 - 13 y	-	< 20 y	11 - 13 y
BOA 069-1	Infans 1B	3 y 6 m - 6 y 6 m	3 y 6 m - 6 y 6 m	-	-
BOA 069-2	Infans 2	12 y - 13 y 6 m	8 y 6 m - 13 y 6 m	12 - 18 y	-
BOA 070-1	Subadult sp		-	-	-
BOA 071-1	Juvenile	14 - 16 y	> 6 y	14 - 16 y	-
BOA 072-1	Infans 1B	3 - 5 y	3 - 5 y	< 18 y	-
BOA 072-2	Juvenile	12 - 16 y	12 - 18 y	11 - 16 y	-
BOA 072-3	Infans 1A	2 - 3 y	-	2 - 3 y	11 m - 3 y 2 m
BOA 073-1	Subadult sp	2 y - 12 y 6 m	2 y - 12 y 6 m	2 - 18 y	-
BOA 075-1	Infans 1B	3 - 5 y	3 - 5 y	2 - 5 y	-
BOA 076-2	Subadult sp	< 20 y	-	< 20 y	-
BOA 077-1	Infans 2	6 - 10 y	6 - 10 y	< 18 y	-
BOA 084-1	Subadult sp	< 16 y	-	< 16 y	-
BOA 085-2	Infans 1B	4 - 5 y	-	3 - 11 y	4 - 5 y
BOA 086-2	Infans 1A	7 m - 1 y 6 m	-	< 20 y	7 m - 1 y 6 m
BOA 089-2	Infans 1B	5 - 9 y	5 - 9 y	< 18 y	-
BOA 096-1	Subadult sp		-	-	-
BOA 098-1	Infans 1B	3 - 5 y	3 - 5 y	< 18 y	-
BOA 100-1	Subadult sp	1 - 16 y	-	1 - 16 y	-
BOA 103-3	Infans 1B	6 - 7 y	-	< 16 y	-
BOA 105-3	Infans 1A	1 - 2 y	-	< 18 y	1 - 2 y
BOA 107-4	Infans 1B	3 - 5 y	3 - 5 y	-	-
BOA 113-2	Infans 2	6 - 12 y	6 - 12 y	< 16 y	-
BOA 115-4	Infans 1A	1 y 6 m - 2 y	-	-	1 y 6 m - 2 y
BOA 119-1	Subadult sp	< 16 y	-	< 16 y	-

Individual	*Age, final estimation*		*Age, dental dev & eruption*	*Age, epiph f*	*Age, linear growth*
BOA 120-1	Subadult sp	6 - 10 y	6 - 10 y	2 - 3 y	-
BOA 120-2	Subadult sp	< 12 y 6 m	< 12 y 6 m	-	-
BOA 121-1	Infans 2	6 - 11 y	6 - 12 y	< 11 y	-
BOA 122-1	Infans 1B	3 - 4 y	2 - 4 y	1 - 7 y	3 y 5 m - 4 y 3 m
BOA 125-2	Infans 1B	3 - 5 y	3 - 5 y	-	-
BOA 145-2	Infans 2	6 - 12 y	6 - 12 y	-	-
BOA 151-1	Infans 1B	5 - 9 y	5 - 9 y	-	-
BOA 151-2	Juvenile	12 - 18 y	12 - 18 y	-	-
BOA 157-2	Subadult sp	< 16 y	-	< 16 y	-
BOA 160-3	Infans 1B	2 - 4 y	-	2 - 4 y	-
SNC 30100-1-30102	Infans 1B	3 y 6 m - 6 y 6 m	3 y 6 m - 6 y 6 m	-	-
SNC 30110-1-30111	Infans 1B	3 - 5 y	3 - 5 y	-	-
SNC 30110-2-30111	Infans 2	8 y 6 m - 13 y 6 m	8 y 6 m - 13 y 6 m	-	-
SNC 30110-3-30111	Infans 1B	2 - 4 y	2 - 4 y	-	-
SNC 30115-1-30117	Fetus	20 - 40 wiu	20 - 40 wiu	-	-
SNC 30150-1-30152	Juvenile	12 - 18 y	12 - 18 y	-	-
SNC 30170-1-30186	Juvenile	14 - 16 y	> 13 y	14 - 16 y	-
SNC 30280-1-30283	Juvenile	14 - 18 y	12 - 18 y	> 14 y	-
SNC 30295-1-30297	Infans 1A	9 m - 1 y	6 m - 1 y	< 2 y	1 y 1 m - 2 y 3 m
SNC 30320-1-30322	Infans 1B	2 - 4 y	2 - 4 y	< 16 y	-
SNC 30620-1-30622	Subadult sp		-	-	-
SNC 30745-1-30747	Infans 1A	32 wiu - 2 m	32 wiu - 2 m	-	-
SNC 30750-1-30752	Infans 1B	5 - 9 y	5 - 9 y	-	-
SNC 30800-3-30801	Fetus	32 - 36 wiu	-	-	32 - 36 wiu
SNC 30810-2-30813	Infans 2	7 - 8 y	-	3 - 18 y	7 - 8 y
SNC 30810-4-30812	Juvenile	12 - 18 y	> 12 y	< 18 y	-
SNC 30810-5-30812	Juvenile	< 18 y	-	< 18 y	-
SNC 30890-1-30892	Fetus	40 wiu	-	-	40 wiu
SNC 33010-1-33013	Infans 1A	3 - 9 m	3 - 9 m	-	-
SNC 33040-1-33043	Infans 1B	3 y 6 m - 6 y 6 m	3 y 6 m - 6 y 6 m	-	-
SNC 33060-1-33064	Infans 1B	5 - 9 y	5 - 9 y	-	-
SNC 33070-1-33072	Infans 1B	2 - 4 y	2 - 4 y	> 1 y	-
LH 2-1-7112	Infans 1A	1 y 6 m - 3 y	2 - 4 y	2 - 3 y	1 y - 1 y 6 m
LH 4-1-7162	Infans 1A	1 - 2 y	1 - 2 y	-	-
LH 5-1-7182	Infans 1B	3 y 6 m - 6 y 6 m	3 y 6 m - 6 y 6 m	-	-
LH 6-1-7192	Infans 1A		-	-	-
ALD A008-1	Juvenile	14 - 18 y	12 - 18 y	14 - 20 y	-
ALD ASUP-10	Subadult sp	1 y 4 m - 12 y	1 y 4 m - 12 y	-	-
ALD B001-1	Infans 2	11 - 13 y	9 y 6 m - 14 y 6 m	> 12 y	-
ALD B004-1	Infans 2	6 - 12 y	6 - 12 y	> 2 y	-
ALD B006/B008-5	Infans 1B	2 - 4 y	2 - 4 y	-	-
ALD B017-1	Juvenile	13 - 20 y	> 13 y	15 - 20 y	-
ALD B021-2	Infans 1A	1 y 4 m - 2 y 8 m	1 y 4 m - 2 y 8 m	-	-
ALD B029/B043-11(B039)	Infans 1B	3 - 5 y	3 - 5 y	< 5 y	-
ALD B029/B043-12(B040)	Infans 1B	4 - 8 y	4 - 8 y	-	-
ALD B029/B043-13(B041)	Infans 2	10 - 12 y	-	< 18 y	10 - 12 y
ALD B029/B043-14(B042)	Juvenile	12 - 18 y	12 - 18 y	-	-

Individual	*Age, final estimation*		*Age, dental dev & eruption*	*Age, epiph f*	*Age, linear growth*
ALD B048/B054-6(B053)	Infans 1B	3 y - 6 y 6 m	3 y - 6 y 6 m	-	-
ALD B048/B054-7	Subadult sp	2 - 10 y	2 - 10 y	-	-
ALD B055/B063-01(B055)	Juvenile	12 - 18 y	12 - 18 y	-	-
ALD B055/B063-04(B058)	Infans 2	7 y 6 m - 12 y 6 m	7 y 6 m - 12 y 6 m	-	-
ALD B055/B063-10	Infans 1B	3 y 6 m - 6 y 6 m	3 y 6 m - 6 y 6 m	-	-
ALD B064/B076-03(B066)	Infans 1B	3 - 5 y	3 - 5 y	-	-
ALD B064/B076-08(B071)	Infans 1B	3 - 5 y	3 - 5 y	-	-
ALD B064/B076-09(B072)	Subadult sp		-	-	-
ALD B077/B087-04(B080)	Juvenile	12 - 18 y	12 - 18 y	-	-
ALD B077/B087-05(B081)	Infans 1B	4 - 8 y	4 - 8 y	> 1 y	-
ALD B077/B087-07(B083)	Infans 2	6 - 10 y	6 - 10 y	5 - 12 y	-
ALD B077/B087-08(B084)	Infans 2	9 y 6 m - 15 y	9 y 6 m - 14 y 6 m	15 - 18 y	12 y 4 m - 15 y
ALD B102/B103-1(B102)	Subadult sp		-	-	-
FIN 03-2-61	Infans 1B	3 - 5 y	3 - 5 y	-	-
FIN 14-1-73	Infans 2	9 y 6 m - 14 y 6 m	9 y 6 m - 14 y 6 m		
SMD 2901-2-2900	Infans 1A	Birth - 2 m	32 wiu - 2 m	< 1 y	> 40 wiu
SMD 3071-1-3070(207)	Infans 1	< 5 y	-	< 5 y	-
SMD 3071-2-3070	Infans 1	< 5 y	-	< 14 y	< 5 y
SMD 3161-3-3160	Subadult sp		-	-	-
SMD 3161-4-3160	Fetus	34 wiu	-	-	34 wiu
SMD 3371-1-3370(237)	Infans 1B	3 y 6 m - 5 y	3 y 6 m - 6 y 6 m	4 - 5 y	3 y 6 m - 4 y 6 m
SMD 3381-1-3380(238)	Juvenile	15 - 16 y	12 - 18 y	15 - 16 y	12 - 16 y
SMD 3381-3-3380	Subadult sp		-	< 20 y	-
SMD 3391-2-3390	Infans 1A	1 y - 1 y 6 m	-	< 16 y	1 y - 1 y 6 m
SMD 3461-2-3460	Infans 1B	3 - 5 y	3 - 5 y	-	-
SMD 3601-3-3600	Infans 1A	2 y 6 m - 3 y	-	< 20 y	2 y 6 m - 3 y
CG 053-1-0420	Infans 2	12 - 14 y	12 - 18 y	> 12 y	-
CG 053-2-0421	Infans 1B	4 - 8 y	4 - 8 y	> 2 y	-
CG 080-1-0393	Infans 1B	3 y	3 - 5 y	2 - 3 y	-
CG 372-1-0797	Infans 2	9 y 6 m - 14 y 6 m	9 y 6 m - 14 y 6 m	-	-
CG 374-2-1473	Juvenile	15 - 20 y	15 - 20 y	14 - 19 y	-
CG 393-2-0874	Juvenile	17 - 20 y	15 - 20 y	17 - 30 y	-
CG 446-1-0964	Infans 2	6 - 10 y	6 - 10 y	-	-
CG 453-1-1315	Infans 2	8 y 6 m - 13 y 6 m	8 y 6 m - 13 y 6 m	-	-
CG 512-1-1440	Infans 2	7 y 6 m - 12 y 6 m	7 y 6 m - 12 y 6 m	-	-
CG 598-1-1646	Infans 2	7 y 6 m - 12 y 6 m	7 y 6 m - 12 y 6 m	-	-
CG 599-1-1643	Infans 1B	2 - 4 y	2 - 4 y	-	-
PMCV 16-1-103	Infans 1A	3 - 9 m	3 - 9 m	< 1 y	-
PMCV 16-2-102	Fetus	38 - 40 wiu	-	< 1 y	38 - 40 wiu
PMCV 18-1-114	Infans 1B	2 - 4 y	3 - 5 y	2 - 3 y	2 - 6 y
PMCV 20-1-122	Infans 1B	3 - 4 y	3 - 4 y	1 - 18 y	-
PMCV 22-1-118	Infans 1B	5 y - 6 y 6 m	3 y 6 m - 6 y 6 m	3 - 7 y	5 - 7 y
PMCV 49-1-451	Infans 1B	5 - 9 y	-	1 - 16 y	-
PMCV 50-1-458/472	Infans 2	11 y - 14 y 6 m	9 y 6 m - 14 y 6 m	11 - 16 y	-
PMCV 51-1-454	Infans 2	7 y 6 m - 12 y 6 m	7 y 6 m - 12 y 6 m	< 16 y	-
RVSM 003-2-056(004b)	Fetus	34 - 36 wiu	-	< 14 y	34 - 36 wiu
RVSM 007-1-060(010)	Infans 1A	1 y - 1 y 6 m	-	< 16 y	1 y - 1 y 6 m

Individual	*Age, final estimation*		*Age, dental dev & eruption*	*Age, epiph f*	*Age, linear growth*
RVSM 011-3-079(016c)	Subadult sp		-	-	-
RVSM 014-1-086(014a)	Infans 1A	1 - 2 y	1 y 8 m - 2 y 8 m	< 5 y	11 m - 1 y 9 m
RVSM 020-2-096(037)	Infans 1A	3 - 9 m	3 - 9 m	< 2 y	-
RVSM 023-1-107(026)	Fetus	34 - 36 wiu	-	< 18 y	34 - 36 wiu
RVSM 024-2-118(027b)	Fetus	36 - 38 wiu	-	< 18 y	36 - 38 wiu
RVSM 029-1-095(033)	Infans 1B	2 - 4 y	2 - 4 y	2 - 4 y	2 - 5 y
RVSM 031-1-128(036)	Infans 1A	1 - 2 y	1 - 2 y	1 - 5 y	1 y 1 m - 1 y 6 m
RVSM 031-2-128(035)	Infans 1A	1 - 2 y	1 - 2 y	> 2 y	-
RVSM 032-4-129(038a3)	Infans 1A	Birth - 1 y	-	< 18 y	Birth - 1 y
RVSM 034-2-145(145a)	Infans 1A	1 y - 1 y 6 m	-	< 2 y	1 y - 1 y 6 m
RVSM 034-3-145(145b)	Infans 1A	Birth - 3 m	-	< 4 y	Birth - 3 m
RVSM 038-1-156(047)	Infans 1A	3 - 6 m	3 - 9 m	1 - 2 y	1.5 - 6 m
RVSM 038-2-155(046a)	Fetus	36 - 40 wiu	-	< 18 y	-
RVSM 038-3-155(046b)	Infans 1A	Birth - 3 m	-	< 18 y	Birth - 6 m
RVSM 042-1-158(050)	Fetus	26 - 30 wiu	-	< 5 y	26 - 30 wiu
RVSM 052-2-173(060b)	Subadult sp		-	-	-
RVSM 055-3-177(087b)	Subadult sp		-	< 18 y	-
RVSM 056-2-178(064b)	Infans 1A	1 y 4 m - 2 y 8 m	1 y 4 m - 2 y 8 m	-	-
RVSM 056-3-178(064c)	Infans 2		-	< 16 y	-
RVSM 060-1-184(068)	Infans 2	10 - 14 y	> 5 y	5 - 10 y	-
RVSM 064-1-200(074)	Infans 1A	3 - 6 m	3 - 9 m	< 1 y	-
RVSM 064-2-199(073)	Infans 1A	2 - 3 y	1 y 4 m - 4 y	< 5 y	2 - 3 y
RVSM 117-1-393(130)	Infans 1B	5 - 7 y	5 - 9 y	1 - 4 y	-
RVSM 121-2-398(134b)	Infans 1B	6 - 7 y	-	< 7 y	7 - 8 y
RVSM 124-1-401(137)	Juvenile	12 - 18 y	12 - 18 y	< 2 y	-
RVSM 129-1-415(142a)	Infans 1B	4 - 7 y	6 - 8 y	4 - 6 y	4 - 5 y
RVSM 129-2-415(142b)	Infans 1	< 7 y	-	< 7 y	-
RVSM 154-3-462(165a)	Infans 1B	5 - 9 y	6 - 10 y	3 - 6 y	5 - 9 y

Table 7.6. Indicators used for adult age estimation and sex determination. Key: Age, final estimation: y = years; Sex, final determination: ^{DNA} = determined by DNA analysis (Alzualde *et al.* 2007); Late fusing ep = Late fusing epiphyses: 1 = open, 2 = partial fusion, 3 = complete fusion; Skelet deg = Skeletal degeneration: numbers indicate the phases as defined for each method (pubic symphysis: Brooks & Suchey 1990, auricular surface: Lovejoy et al. 1985, sternal end of the fourth rib: Iscan et al. 1984, Iscan et al. 1985); Sex determination indicators: 1 = female, 2 = probable female, 3 = ambiguous, 4 = probable male, 5 = male; - = not observable.

				Age estimation indicators								*Sex determination indicators*										
				Late fusing ep					*Skelet deg*													
Individual	*Age, final estimation*		*Sex, final determination*	*Iliac crest*	*Ischial tuberosity*	*Jugular growth p*	*Clavicle, sternal*	*Sacrum, S1-S2*	*Pubic symphysis*	*Auricular surface*	*Rib 4, sternal*	*Ventral arc*	*Subpubic concavity*	*Ischiopubic ramus*	*Subpubic angle*	*Greater sciatic notch*	*Preauricular sulcus*	*Nuchal crest*	*Mastoid process*	*Supraorbital margin*	*Glabella*	*Mental eminence*
GOZ 002-1-4606	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 003-1-1003	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 004-1-1008	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 010-1-4014	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 012-1-4020	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 015-1-4029	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	3	2	1
GOZ 015-2-4029	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 018-1-4038	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 019-1-4041	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 021-1-4048	Young adult	20 - 24	Probable female	3	-	-	3	-	-	-	3	-	-	-	-	2	-	-	-	-	-	-
GOZ 029-1-4073	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 031-1-4082	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 033-2-4088	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 039-1-4108	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 047-01-4154	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 047-02-4154	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 047-03-4154	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 047-04-4154	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 052-1-4175	Adult sp		Probable female	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
GOZ 052-2-4175	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 054-1-4224	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
GOZ 055-1-4188	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 055-2-4188	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 057-1-4195	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

			Age estimation indicators								Sex determination indicators										
			Late fusing ep					Skelet deg													
Individual	Age, final estimation	Sex, final determination	Iliac crest	Ischial tuberosity	Jugular growth pl	Clavicle, sternal	Sacrum, S1-S2	Pubic symphysis	Auricular surface	Rib 4, sternal	Ventral arc	Subpubic concavity	Ischiopubic ramus	Subpubic angle	Greater sciatic notch	Preauricular sulcus	Nuchal crest	Mastoid process	Supraorbital margin	Glabella	Mental eminence
GOZ 058-2-4198	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 059-1-4201	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 060-1-4205	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 060-2-4205	Adult sp	Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	3	-	-
GOZ 061-1-4226	Adult sp	Male	-	3	-	-	-	-	-	-	-	-	-	-	5	-	-	-	3	-	-
GOZ 063-1-4215	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
GOZ 065-1-4231	Adult sp	Ambiguous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	2
GOZ 065-2-4231	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 066-1-4236	Adult sp	Undetermined	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-
GOZ 066-2-4236	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 067-1-4241	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 067-2-4238	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 069-1-4253	Adult sp	Undetermined	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 069-2-4050	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 070-1-4256	Adult sp	Female	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	1	2	1	-
GOZ 070-2-4256	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 071-1-4259	Adult sp	Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	4
GOZ 071-2-4259	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 073-1-4267	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 073-2-4264	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 075-1-4276	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 075-3-4275	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 075-4-4275	Adult sp	Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-
GOZ 078-1-4292	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 078-2-4291	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 078-3-4291	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 078-4-4291	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

				Age estimation indicators								Sex determination indicators										
				Late fusing ep					Skelet deg													
Individual	Age, final estimation		Sex, final determination	Iliac crest	Ischial tuberosity	Jugular growth pl	Clavicle, sternal	Sacrum, S1-S2	Pubic symphysis	Auricular surface	Rib 4, sternal	Ventral arc	Subpubic concavity	Ischiopubic ramus	Subpubic angle	Greater sciatic notch	Preauricular sulcus	Nuchal crest	Mastoid process	Supraorbital margin	Glabella	Mental eminence
GOZ 080-1-4300	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-
GOZ 081-1-4305	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 083-1-4314	Adult sp		Female	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1	-
GOZ 084-1-4318	Adult sp		Probable female	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
GOZ 085-1-4336	Adult sp		Female	-	3	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-
GOZ 086-1-4324	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 087-1-4330	Adult sp		Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-
GOZ 087-2-4329	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 088-1-4333	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 089-2-4372	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 090-2-4346	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 091-1-4432	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 091-2-4349	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 091-3-4350	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 091-4-4350	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 092-1-4354	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 094-1-4363	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 094-2-4362	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 096-1-4370	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 096-2-4369	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 097-1-4377	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 097-2-4378	Young adult	25 - 36 y	Male	3	3	-	3	3	2	-	-	5	5	5	5	3	-	3	4	4	4	4
GOZ 098-2-4380	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 100-1-4398	Young adult	25 - 38 y	Ambiguous	3	3	-	-	3	-	2	-	-	-	-	-	1	2	-	-	-	-	-
GOZ 100-2-4399	Adult sp		Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
GOZ 100-3-4396	Adult sp		Probable female	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 101-1-4438	Adult sp		Undetermined	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4

Individual	Age, final estimation		Sex, final determination	Age estimation indicators								Sex determination indicators										
				Late fusing ep					Skelet deg													
				Iliac crest	*Ischial tuberosity*	*Jugular growth pl*	*Clavicle, sternal*	*Sacrum, S1-S2*	*Pubic symphysis*	*Auricular surface*	*Rib 4, sternal*	*Ventral arc*	*Subpubic concavity*	*Ischiopubic ramus*	*Subpubic angle*	*Greater sciatic notch*	*Preauricular sulcus*	*Nuchal crest*	*Mastoid process*	*Supraorbital margin*	*Glabella*	*Mental eminence*
GOZ 102-2-4402	Adult sp		Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	2	4	-
GOZ 103-1-4442	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 103-3-4408	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 103-4-4408	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 104-1-4414	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 106-1-4422	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 108-1-4429	Young adult	22 - 38 y	Probable female	-	-	-	-	-	-	2	-	-	-	-	-	1	4	-	-	-	-	-
GOZ 108-2-4428	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 109-1-4454	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 110-1-4448	Young adult	22 - 38 y	Female	3	3	-	-	-	-	2	-	-	-	-	1	1	5	1	2	-	-	-
GOZ 111-1-4461	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 112-1-4467	Adult sp		Female	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	2	1	2
GOZ 115-1-4483	Adult sp		Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-
GOZ 117-1-4490	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 117-2-4489	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 119-2-4497	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 121-1-4504	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 124-4-4515	Adult sp		Female	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
GOZ 127-1-4526	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 129-1-4538	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 131-2-4550	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 131-3-4546	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 131-4-4546	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 135-1-4568	Adult sp		Female	3	3	-	-	-	-	-	-	-	-	-	-	1	2	3	2	2	1	-
GOZ 136-2-4646	Adult sp		Undetermined	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 136-6-4644	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
GOZ 136-7-4572	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

			Age estimation indicators								Sex determination indicators										
			Late fusing ep					Skelet deg													
Individual	Age, final estimation	Sex, final determination	Iliac crest	Ischial tuberosity	Jugular growth pl	Clavicle, sternal	Sacrum, S1-S2	Pubic symphysis	Auricular surface	Rib 4, sternal	Ventral arc	Subpubic concavity	Ischiopubic ramus	Subpubic angle	Greater sciatic notch	Preauricular sulcus	Nuchal crest	Mastoid process	Supraorbital margin	Glabella	Mental eminence
GOZ 138-1-4583	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
GOZ 142-1-4601	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 146-1-4618	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 146-2-4642	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 149-3-4632	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 150-1-4638	Adult sp	Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
GOZ 150-2-4638	Adult sp	Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	3	-
GOZ 151-1-4651	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 155-1-4667	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 156-1-4726	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 158-1-4728	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 158-2-4729	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 158-3-4678	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 159-1-4687	Adult sp	Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	-
GOZ 168-1-4722	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 173-1-4747	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 178-1-4767	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 183-1-4798	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 183-2-4797	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 188-1-4817	Adult sp	Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
GOZ 188-2-4816	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 189-1-4823	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 189-2-4818	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 191-1-4831	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 192-1-4836	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 201-2-4874	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
GOZ 202-1-4879	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

			Age estimation indicators								Sex determination indicators										
			Late fusing ep					Skelet deg													
Individual	Age, final estimation	Sex, final determination	Iliac crest	Ischial tuberosity	Jugular growth pl	Clavicle, sternal	Sacrum, S1-S2	Pubic symphysis	Auricular surface	Rib 4, sternal	Ventral arc	Subpubic concavity	Ischiopubic ramus	Subpubic angle	Greater sciatic notch	Preauricular sulcus	Nuchal crest	Mastoid process	Supraorbital margin	Glabella	Mental eminence
GOZ 204-1-4884	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 206-1-4891	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 216-1-5043	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 219-1-4948	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 220-1-4952	Adult sp	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	4	-	-	-
GOZ 221-2-4962	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 224-1-4976	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 226-1-4986	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 230-1-5003	Adult sp	Probable female	-	-	-	-	-	-	-	-	-	-	-	-	2	5	2	-	-	-	2
GOZ 231-1-5006	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 232-1-5012	Adult sp	Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	-
GOZ 233-1-5017	Adult sp	Female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-
GOZ 236-1-5028	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 238-1-5035	Adult sp	Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	-
GOZ 239-1-5039	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 241-1-5046	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 243-2-5055	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 244-2-5057	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 246-1-5076	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOZ 247-1-5080	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 001-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 002-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 003-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 004-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 005-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 007-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 009-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Individual	Age, final estimation	Sex, final determination	Age estimation indicators								Sex determination indicators										
			Late fusing ep					Skelet deg													
			Iliac crest	Ischial tuberosity	Jugular growth pl	Clavicle, sternal	Sacrum, S1-S2	Pubic symphysis	Auricular surface	Rib 4, sternal	Ventral arc	Subpubic concavity	Ischiopubic ramus	Subpubic angle	Greater sciatic notch	Preauricular sulcus	Nuchal crest	Mastoid process	Supraorbital margin	Glabella	Mental eminence
BOA 012-1	Adult sp	Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
BOA 013-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 014-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 015-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 016-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 017-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 018-1	Adult sp	Female	3	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-
BOA 019-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 020-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 021-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 022-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 024-1	Adult sp	Female	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-
BOA 026-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 030-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 034-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 035-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 036-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 037-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 039-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 040-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 043-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 044-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 047-1	Adult sp	Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
BOA 048-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 049-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 050-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 053-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

			Age estimation indicators								Sex determination indicators										
			Late fusing ep					Skelet deg													
Individual	Age, final estimation	Sex, final determination	Iliac crest	Ischial tuberosity	Jugular growth pl	Clavicle, sternal	Sacrum, S1-S2	Pubic symphysis	Auricular surface	Rib 4, sternal	Ventral arc	Subpubic concavity	Ischiopubic ramus	Subpubic angle	Greater sciatic notch	Preauricular sulcus	Nuchal crest	Mastoid process	Supraorbital margin	Glabella	Mental eminence
BOA 054-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 054-2	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 058-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 060-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 062-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 065-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 066-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 068-1	Adult sp	Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
BOA 076-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 080-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 081-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 082-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 085-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 086-1	Adult sp	Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
BOA 089-1	Adult sp	Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
BOA 090-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 091-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 093-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 094-1	Adult sp	Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2
BOA 095-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 099-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 103-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 103-2	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 103-4	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 104-1	Adult sp	Undetermined	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 105-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 105-2	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Individual	Age, final estimation	Sex, final determination	*Age estimation indicators*								*Sex determination indicators*										
			Late fusing ep					*Skelet deg*													
			Iliac crest	*Ischial tuberosity*	*Jugular growth pl*	*Clavicle, sternal*	*Sacrum, S1-S2*	*Pubic symphysis*	*Auricular surface*	*Rib 4, sternal*	*Ventral arc*	*Subpubic concavity*	*Ischiopubic ramus*	*Subpubic angle*	*Greater sciatic notch*	*Preauricular sulcus*	*Nuchal crest*	*Mastoid process*	*Supraorbital margin*	*Glabella*	*Mental eminence*
BOA 105-4	Adult sp	Probable female	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
BOA 106-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 107-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 107-2	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 107-3	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 109-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 112-1	Adult sp	Female	3	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	-	1	1
BOA 113-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 114-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 115-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 115-2	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 115-3	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 124-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 125-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 126-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 128-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 128-2	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 129-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 131-1	Adult sp	Female	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
BOA 132-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 133-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
BOA 135-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 138-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 139-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 142-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 143-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 145-1	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Individual	Age, final estimation		Sex, final determination	Age estimation indicators								Sex determination indicators										
				Late fusing ep					Skelet deg													
				Iliac crest	Ischial tuberosity	Jugular growth pl	Clavicle, sternal	Sacrum, S1-S2	Pubic symphysis	Auricular surface	Rib 4, sternal	Ventral arc	Subpubic concavity	Ischiopubic ramus	Subpubic angle	Greater sciatic notch	Preauricular sulcus	Nuchal crest	Mastoid process	Supraorbital margin	Glabella	Mental eminence
BOA 145-3	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 145-4	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 145-5	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 145-6	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 146-1	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 147-1	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 148-1	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 149-1	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 150-1	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 152-1	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 152-2	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 157-1	Middle-old adult	34 - 58 y	Female	-	-	-	-	-	4	-	-	1	-	1	1	-	-	-	-	-	-	-
BOA 160-1	Young adult	21 - 36 y	Male	3	-	-	-	-	2	-	-	5	-	5	5	-	-	-	-	-	-	-
BOA 160-2	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 162-1	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 163-1	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 166A-1	Adult sp		Probable male	3	-	-	-	-	-	-	-	-	-	-	-	4	5	-	-	-	-	4
BOA 169-1	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 174-1	Young-middle adult	27 - 47 y	Probable male	3	-	-	-	-	-	3	-	-	-	-	-	4	-	-	-	-	-	-
BOA 177-1	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 178-1	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 179-1	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 182-1	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 183-1	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 184-1	Adult sp		Undetermined	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 187-1	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOA 187-2	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

				Age estimation indicators								*Sex determination indicators*										
				Late fusing ep					*Skelet deg*													
Individual	*Age, final estimation*		*Sex, final determination*	*Iliac crest*	*Ischial tuberosity*	*Jugular growth pl*	*Clavicle, sternal*	*Sacrum, S1-S2*	*Pubic symphysis*	*Auricular surface*	*Rib 4, sternal*	*Ventral arc*	*Subpubic concavity*	*Ischiopubic ramus*	*Subpubic angle*	*Greater sciatic notch*	*Preauricular sulcus*	*Nuchal crest*	*Mastoid process*	*Supraorbital margin*	*Glabella*	*Mental eminence*
SNC 30105-1-30108	Adult sp		Probable female	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
SNC 30110-4-30112	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SNC 30130-1-30134	Adult sp		Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	3	4	3
SNC 30140-1-30143	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SNC 30180-1-30182	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SNC 30240-1-30242	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SNC 30270-1-30272	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SNC 30444-1-30446	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-
SNC 30740-1-30742	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
SNC 30790-1-30793	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SNC 30795-1-30798	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SNC 30800-1-30803	Adult sp		Undetermined	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SNC 30800-2-30802	Adult sp		Ambiguous	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-
SNC 30805-1-30808	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SNC 30810-1-30813	Adult sp		Probable female	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
SNC 30810-3-30812	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SNC 30810-6-30812	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
SNC 30830-1-30832	Adult sp		Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	4	-
SNC 30835-1-30837	Middle-old adult	33 - 57 y	Female	3	-	-	3	-	-	4	-	-	-	-	-	1	1	1	1	2	-	3
SNC 30840-1-30842	Adult sp		Probable female	3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	2	2	2	1
SNC 30850-1-30858	Adult sp		Ambiguous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	3	3	-
SNC 30865-1-30869	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SNC 30880-1-30884	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	-	2
SNC 33000-1-33003	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SNC 33005-1-33004	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SNC 33030-1-33032	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
LH 1-1-7023	Middle-old adult	33 - 57 y	Female	3	3	-	3	-	-	4	-	-	-	-	-	1	1	-	2	1	-	2

				Age estimation indicators								Sex determination indicators										
				Late fusing ep					Skelet deg													
Individual	Age, final estimation		Sex, final determination	Iliac crest	Ischial tuberosity	Jugular growth pl	Clavicle, sternal	Sacrum, S1-S2	Pubic symphysis	Auricular surface	Rib 4, sternal	Ventral arc	Subpubic concavity	Ischiopubic ramus	Subpubic angle	Greater sciatic notch	Preauricular sulcus	Nuchal crest	Mastoid process	Supraorbital margin	Glabella	Mental eminence
LH 3-1-7132	Adult sp		Probable female	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
LH 7-1-7198	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
LH 8-1-7202	Adult sp		Male	3	-	-	-	-	-	-	-	-	-	-	-	-	-	4	5	3	5	-
LH 9-1-7172	Adult sp		Probable female	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
ALD A009-1	Adult sp		Male	-	-	-	-	-	-	-	-	-	-	-	-	5	-	4	-	-	-	-
ALD A010-1	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD A011-1	Adult sp	14 - 25 y	Undetermined	-	3	-	-	2	-	-	-	-	-	-	-	3	-	-	-	-	-	-
ALD ASUP-06	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD ASUP-07	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD ASUP-08	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD ASUP-09	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B002-1	Adult sp		Male^{DNA}	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	4	-	4	-
ALD B003-1	Adult sp		Female^{DNA}	3	-	-	3	3	-	-	-	-	-	-	-	1	-	2	3	1	1	2
ALD B005-1	Adult sp		Male	3	-	-	-	-	-	-	-	-	-	-	-	4	-	3	4	-	-	4
ALD B006/B008-1	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B006/B008-2	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B006/B008-3	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B006/B008-4	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B011-1	Adult sp		Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	-	-
ALD B012-1	Adult sp		Male	-	-	-	-	-	-	-	-	-	-	-	-	3	-	4	4	5	5	4
ALD B013-1	Young adult	21 - 36 y	Male	3	3	-	3	-	2	-	-	5	-	5	5	2	4	3	3	3	4	2
ALD B014-1	Adult sp		Female	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	2	2	1
ALD B015-1	Adult sp		Female	3	3	-	3	-	-	-	-	-	-	-	-	1	4	1	2	1	2	1
ALD B016-1	Adult sp		Female	-	-	-	3	-	-	-	-	-	-	-	-	1	-	1	1	1	1	2
ALD B016-2	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B018-1	Adult sp		Male	-	3	-	-	-	-	-	-	-	-	-	-	3	5	4	-	4	5	3
ALD B019-1	Adult sp		Male	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	3	4	-	-

			Age estimation indicators								Sex determination indicators										
			Late fusing ep					Skelet deg													
Individual	Age, final estimation	Sex, final determination	Iliac crest	Ischial tuberosity	Jugular growth pl	Clavicle, sternal	Sacrum, S1-S2	Pubic symphysis	Auricular surface	Rib 4, sternal	Ventral arc	Subpubic concavity	Ischiopubic ramus	Subpubic angle	Greater sciatic notch	Preauricular sulcus	Nuchal crest	Mastoid process	Supraorbital margin	Glabella	Mental eminence
ALD B020-1	Adult sp	Female	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	2	-	-	-
ALD B021-1	Adult sp	Female	-	-	-	3	-	-	-	-	-	-	-	-	2	-	1	-	-	-	2
ALD B022-1	Adult sp	Male	-	3	-	-	-	-	-	-	-	-	-	-	-	-	5	5	5	-	5
ALD B023-1	Adult sp	Probable female	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-	-
ALD B024-1	Adult sp	Female	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	3
ALD B025-1	Young adult	Male	-	3	-	-	-	-	-	-	-	-	-	-	3	-	-	4	2	-	-
ALD B026/B027-1(B026)	Adult sp	Female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
ALD B026/B027-2(B027)	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
ALD B028-1	Adult sp	Male	-	-	-	-	-	-	-	-	-	-	-	-	3	-	3	1	3	3	2
ALD B029/B043-	Adult sp	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B029/B043-	Adult sp	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B029/B043-	Adult sp	Female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B029/B043-	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B029/B043-	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B029/B043-	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B029/B043-	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B029/B043-	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B029/B043-	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B029/B043-	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B029/B043-	Adult sp	Ambiguous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	-	2
ALD B044-1	Adult sp	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B045/B047-1(B045)	Adult sp	Male	-	3	-	-	-	-	-	-	-	-	-	-	4	5	-	1	3	-	4
ALD B045/B047-2(B046)	Adult sp	Female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-
ALD B045/B047-3(B047)	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B048/B054-1(B048)	Adult sp	Female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
ALD B048/B054-2(B049)	Adult sp	Probable male	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-
ALD B048/B054-3(B050)	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

			Age estimation indicators								Sex determination indicators										
			Late fusing ep					Skelet deg													
Individual	Age, final estimation	Sex, final determination	Iliac crest	Ischial tuberosity	Jugular growth pl	Clavicle, sternal	Sacrum, S1-S2	Pubic symphysis	Auricular surface	Rib 4, sternal	Ventral arc	Subpubic concavity	Ischiopubic ramus	Subpubic angle	Greater sciatic notch	Preauricular sulcus	Nuchal crest	Mastoid process	Supraorbital margin	Glabella	Mental eminence
ALD B048/B054-4(B051)	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B048/B054-5(B052)	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B055/B063-	Adult sp	Male	3	3	-	3	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-
ALD B055/B063-	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
ALD B055/B063-	Adult sp	Male	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	3	-	-	-
ALD B055/B063-	Adult sp	Female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
ALD B055/B063-	Adult sp	Male	-	3	-	-	-	-	-	-	-	-	-	-	2	5	-	2	2	2	3
ALD B055/B063-	Adult sp	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B055/B063-	Adult sp	Male	-	3	-	-	-	-	-	-	5	-	5	5	5	-	5	4	4	5	4
ALD B064/B076-	Adult sp	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B064/B076-	Adult sp	Female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B064/B076-	Adult sp	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
ALD B064/B076-	Adult sp	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B064/B076-	Adult sp	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
ALD B064/B076-	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B064/B076-	Adult sp	Female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B064/B076-	Adult sp	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
ALD B064/B076-	Adult sp	Female	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
ALD B064/B076-	Adult sp	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	3	3	-	-
ALD B077/B087-	Adult sp	Male	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	4	-	-	-
ALD B077/B087-	Adult sp	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-
ALD B077/B087-	Adult sp	Probable female	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
ALD B077/B087-	Adult sp	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	4	-
ALD B077/B087-	Adult sp	Female	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	2	1	2	3
ALD B077/B087-	Adult sp	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	4	4
ALD B077/B087-	Adult sp	Male	-	-	-	-	-	-	-	-	-	-	-	-	4	-	5	3	4	3	4
ALD B088/B098-	Adult sp	Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

				Age estimation indicators								Sex determination indicators										
				Late fusing ep					Skelet deg													
Individual	Age, final estimation		Sex, final determination	Iliac crest	Ischial tuberosity	Jugular growth pl	Clavicle, sternal	Sacrum, S1-S2	Pubic symphysis	Auricular surface	Rib 4, sternal	Ventral arc	Subpubic concavity	Ischiopubic ramus	Subpubic angle	Greater sciatic notch	Preauricular sulcus	Nuchal crest	Mastoid process	Supraorbital margin	Glabella	Mental eminence
ALD B088/B098-	Adult sp		Male	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
ALD B088/B098-	Adult sp		Male	-	3	-	-	-	-	-	-	-	-	-	-	3	-	-	4	-	-	-
ALD B088/B098-	Adult sp		Male	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	5	5	5	-
ALD B088/B098-	Adult sp		Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	3	-	5
ALD B088/B098-	Adult sp		Female	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	1	2	-	-
ALD B088/B098-	Adult sp		Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	5
ALD B088/B098-	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-
ALD B088/B098-	Adult sp		Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	4	5	5	5
ALD B088/B098-	Adult sp		Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
ALD B088/B098-	Adult sp		Female	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
ALD B099/B101-1(B099)	Adult sp		Female	-	3	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-	-
ALD B099/B101-2(B100)	Adult sp		Male	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B102/B103-2(B103)	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALD B104-1	Adult sp		Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-
ALD B105-1	Adult sp		Undetermined	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FIN 02-1-44	Adult sp		Probable female	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
FIN 03-1-50	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FIN 06-1-53	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FIN 07-1-57	Adult sp		Female	3	3	-	3	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-
FIN 08-1-56	Adult sp		Male	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	4	-	5
FIN 09-1-60	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-
FIN 13-1-30	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FIN 15-1-74	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMD 2811-1-2810(181)	Young adult	25 - 38 y	Female	3	3	-	3	3	-	2	-	-	-	-	-	1	2	2	2	2	1	2
SMD 2841-1-2840(184)	Middle-old adult	38 - 66 y	Male	3	3	-	-	-	-	5	-	-	-	-	-	5	5	-	-	-	-	-
SMD 2871-1-2870(187)	Adult sp		Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	4	-
SMD 2901-1-2900(190)	Adult sp		Female	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-

				Age estimation indicators								Sex determination indicators										
				Late fusing ep					Skelet deg													
Individual	Age, final estimation		Sex, final determination	Iliac crest	Ischial tuberosity	Jugular growth pl	Clavicle, sternal	Sacrum, S1-S2	Pubic symphysis	Auricular surface	Rib 4, sternal	Ventral arc	Subpubic concavity	Ischiopubic ramus	Subpubic angle	Greater sciatic notch	Preauricular sulcus	Nuchal crest	Mastoid process	Supraorbital margin	Glabella	Mental eminence
SMD 2961-1-2960(196)	Adult sp		Female	-	-	-	3	-	-	-	-	-	-	-	-	-	-	1	1	2	-	2
SMD 2961-2-2970(197)	Adult sp		Probable male	-	3	-	3	-	-	-	-	-	-	-	-	-	-	3	4	4	4	4
SMD 2981-1-2990(199)	Young adult	22 - 25 y	Male	3	3	-	-	1	-	2	-	-	-	-	-	4	5	-	-	-	-	-
SMD 2981-2-3120(212)	Middle-old adult	36 - 58 y	Male	3	3	-	-	3	4	5	-	5	5	5	5	3	5	-	-	-	-	-
SMD 2981-3-3030(203)	Middle-old adult	40 - 64 y	Male	-	3	-	-	-	5	5	-	2	5	5	4	4	5	-	-	5	5	-
SMD 2981-4-2980(198)	Middle-old adult	33 - 54 y	Male	3	3	-	-	3	4	4	-	5	5	5	5	4	5	-	-	-	-	-
SMD 3021-1-3020(202)	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMD 3041-1-3040(204)	Adult sp		Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	5	-
SMD 3061-1-3060(206)	Old adult	43 - 74 y	Probable male	3	3	-	3	-	-	6	-	-	-	-	-	4	5	4	3	2	4	2
SMD 3081-1-3080(208)	Old adult	46 - 80 y	Male	3	-	-	-	-	-	7	-	-	-	-	-	5	5	-	-	-	-	-
SMD 3091-1-3090(209)	Old adult	43 - 74 y	Ambiguous	-	-	-	3	-	-	6	-	-	-	-	-	5	5	1	-	-	-	1
SMD 3101-1-3100(210)	Adult sp		Female	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2
SMD 3111-1-3110(211)	Adult sp		Female	-	-	-	3	-	-	-	-	-	-	-	-	-	-	2	-	-	-	1
SMD 3151-1-3150(215)	Middle-old adult	39 - 63 y	Probable male	3	3	-	-	3	4	7	-	5	5	5	4	3	5	-	-	-	-	2
SMD 3151-2-3150	Adult sp		Ambiguous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2	-	-	-
SMD 3151-3-3150	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-
SMD 3161-1-3160(216)	Adult sp		Female	-	3	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	-	1
SMD 3161-2-3160	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMD 3161-3-3160	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	1	1
SMD 3371-2-3370	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMD 3381-2-3380	Middle-old adult	38 - 66 y	Undetermined	-	-	-	-	-	-	5	-	-	-	-	-	3	-	-	-	-	-	-
SMD 3391-1-3390(239)	Adult sp		Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	4	-
SMD 3401-1-3390(240)	Old adult	43 - 74 y	Female	-	-	-	3	3	-	6	-	1	-	-	1	3	-	2	2	-	-	3
SMD 3401-2-3390	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
SMD 3411-1-3410(241)	Old adult	43 - 69 y	Male	3	-	-	3	3	5	6	-	5	5	5	5	4	5	-	3	3	2	3
SMD 3411-2-3410	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	1	-
SMD 3421-1-3420(242)	Adult sp		Probable male	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-

				Age estimation indicators								Sex determination indicators										
				Late fusing ep					Skelet deg													
Individual	Age, final estimation		Sex, final determination	Iliac crest	Ischial tuberosity	Jugular growth pl	Clavicle, sternal	Sacrum, S1-S2	Pubic symphysis	Auricular surface	Rib 4, sternal	Ventral arc	Subpubic concavity	Ischiopubic ramus	Subpubic angle	Greater sciatic notch	Preauricular sulcus	Nuchal crest	Mastoid process	Supraorbital margin	Glabella	Mental eminence
SMD 3431-1-3430(243)	Adult sp		Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
SMD 3431-2-3430	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMD 3451-1-3450(245)	Middle-old adult	34 - 58 y	Probable male	3	3	-	3	3	4	-	-	5	-	4	5	5	5	3	3	3	-	2
SMD 3451-2-3450	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMD 3461-1-3460(246)	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMD 3551-1-3550(255)	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMD 3601-1-3600(260)	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2	1	-
SMD 3601-2-3600	Adult sp		Undetermined	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMD 3611-1-3610(261)	Adult sp		Undetermined	3	-	-	3	-	-	-	-	-	-	-	-	1	-	3	4	4	4	4
SMD 3621-1-3620(262)	Young-middle adult	28 - 46 y	Probable male	3	-	-	-	-	3	-	-	5	-	5	5	5	-	-	-	-	-	-
CG 094-1-1231	Young-middle adult	28 - 46 y	Male	3	3	-	-	-	3	-	-	5	-	4	4	5	5	1	3	4	4	-
CG 094-2-1230	Adult sp		Probable female	3	-	-	-	-	-	-	-	-	-	-	-	2	-	1	3	3	3	2
CG 192-1-0353	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CG 220-1-0433	Adult sp		Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	3
CG 254-1-0623	Adult sp		Ambiguous	-	-	-	-	-	-	-	-	-	-	-	-	3	-	4	-	-	3	2
CG 295-1-0704	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CG 296-1-0701	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CG 370-1-0916	Adult sp		Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-
CG 371-1-0794	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CG 373-1-0823	Adult sp		Ambiguous	-	3	-	-	-	-	-	-	-	-	-	-	2	-	-	-	5	-	-
CG 374-1-1695	Adult sp		Probable male	-	3	-	-	-	-	-	-	-	-	-	-	5	-	-	3	4	3	4
CG 380-1-0826	Adult sp		Male	-	-	-	-	-	-	-	-	-	-	-	-	5	-	5	3	2	5	-
CG 381-1-0840	Adult sp		Probable female	-	3	-	-	-	-	-	-	-	-	-	-	1	-	1	-	3	3	1
CG 382-1-0837	Adult sp		Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-
CG 385-1-0853	Adult sp		Female	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
CG 387-1-0746	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CG 391-1-0925	Adult sp		Female	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	1	1	1

				Age estimation indicators								Sex determination indicators										
				Late fusing ep					Skelet deg													
Individual	Age, final estimation		Sex, final determination	Iliac crest	Ischial tuberosity	Jugular growth pl	Clavicle, sternal	Sacrum, S1-S2	Pubic symphysis	Auricular surface	Rib 4, sternal	Ventral arc	Subpubic concavity	Ischiopubic ramus	Subpubic angle	Greater sciatic notch	Preauricular sulcus	Nuchal crest	Mastoid process	Supraorbital margin	Glabella	Mental eminence
CG 392-1-0856	Adult sp		Female	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	2	1	-
CG 392-2-0855	Adult sp		Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	4	-
CG 393-1-0875	Adult sp		Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-
CG 395-1-0879	Adult sp		Probable male	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	4	5	4	-
CG 411-1-0901	Adult sp		Male	-	3	-	-	-	-	-	-	-	-	-	-	5	-	-	4	4	-	4
CG 443-1-0953	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CG 444-1-0957	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CG 445-1-0960	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	2
CG 447-1-0968	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CG 477-1-1434	Adult sp		Female	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
CG 511-1-1437	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CG 519-1-1480	Adult sp		Male	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	4	-	-	-
CG 597-1-1656	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
CG 692-1-1794	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PMCV 14-1-109	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PMCV 15-1-130	Middle-old adult	33 - 57 y	Female	3	3	-	3	-	-	4	-	1	-	-	-	1	2	1	1	2	-	2
PMCV 15-2-126	Adult sp		Probable male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-
PMCV 15-3-126	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	2	1	-
PMCV 19-1-139	Middle-old adult	33 - 54 y	Male	3	3	-	-	-	4	4	-	5	-	5	5	5	5	2	4	3	-	2
PMCV 19-2-141	Young adult	22 - 25 y	Probable male	3	3	1	1	1	-	2	-	-	-	-	-	4	5	1	5	2	2	1
PMCV 21-1-160	Middle-old adult	39 - 63 y	Female	3	3	3	-	-	4	7	-	1	1	2	1	2	5	1	4	-	-	1
PMCV 22-2-116	Adult sp		Probable male	-	3	-	-	-	-	-	-	-	-	-	-	5	5	2	1	4	5	4
PMCV 23-1-134	Adult sp		Male	3	3	-	-	-	-	-	-	-	-	-	-	5	5	-	-	-	-	5
PMCV 43-1-350	Young adult	22 - 36 y	Female	3	3	-	3	-	1	4	-	-	-	1	1	1	1	1	2	1	1	1
PMCV 43-2-350	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PMCV 44-1-469/470	Young adult	17 - 27 y	Male	-	3	-	3	-	1	-	-	-	-	-	-	5	-	-	5	-	4	-
PMCV 45-1-412	Adult sp		Male	1	-	-	-	-	-	-	-	-	-	-	-	4	5	-	5	4	4	4

				Age estimation indicators								Sex determination indicators										
				Late fusing ep					Skelet deg													
Individual	Age, final estimation		Sex, final determination	Iliac crest	Ischial tuberosity	Jugular growth pl	Clavicle, sternal	Sacrum, S1-S2	Pubic symphysis	Auricular surface	Rib 4, sternal	Ventral arc	Subpubic concavity	Ischiopubic ramus	Subpubic angle	Greater sciatic notch	Preauricular sulcus	Nuchal crest	Mastoid process	Supraorbital margin	Glabella	Mental eminence
PMCV 46-1-444	Adult sp		Undetermined	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PMCV 46-2-445	Adult sp		Undetermined	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-
PMCV 46-3-444/445	Adult sp		Undetermined	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-
PMCV 46-4-446	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
PMCV 48-1-353	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PMCV 49-2-419	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PMCV 50-2-474	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PMCV 55-1-399	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PMCV 55-2-399	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PMCV 57-1-420/449	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 002-1-027(003)	Young adult	21 - 36 y	Male	-	3	1	-	-	2	-	-	5	-	-	4	-	-	3	5	-	-	-
RVSM 003-1-056(004a)	Old adult	48 - 83 y	Female	-	3	-	-	-	-	8	-	-	-	-	-	2	5	1	2	2	2	-
RVSM 004-1-057(005)	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 009-1-062(012)	Old adult	46 - 80 y	Undetermined	-	-	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 010-1-078(013)	Young-middle adult	25 - 40 y	Female	3	3	-	3	2	3	2	-	1	1	1	1	1	1	1	1	2	1	2
RVSM 011-1-079(016a)	Middle-old adult	33 - 57 y	Probable male	3	3	-	3	3	-	4	-	-	-	-	-	4	5	5	5	-	-	-
RVSM 011-2-079(016b)	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 014-2-086(014b)	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 018-1-092(021)	Middle-old adult	41 - 67 y	Male	3	-	-	-	3	6	4	-	5	5	5	5	-	5	2	-	-	-	-
RVSM 020-1-096(023)	Middle-old adult	34 - 83 y	Male	-	-	-	3	-	4	8	-	-	-	5	4	4	5	-	-	-	-	-
RVSM 022-1-100(025)	Young-middle adult	27 - 44 y	Male	3	3	-	-	-	2	4	-	5	-	5	5	5	5	-	-	-	-	-
RVSM 024-1-118(027a)	Young adult	22 - 38 y	Female	3	3	-	-	3	-	2	-	2	1	1	1	1	1	-	-	-	-	-
RVSM 025-1-117(032)	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 032-1-130(038b)	Young adult	22 - 35 y	Male	3	3	-	3	-	2	2	-	5	5	5	5	4	5	-	-	-	-	4
RVSM 032-2-129(038a1)	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 032-3-129(038a2)	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 033-1-132(039)	Old adult	45 - 72 y	Male	3	3	-	3	3	6	5	-	5	5	5	5	4	5	-	-	4	4	-

Individual	Age, final estimation		Sex, final determination	Age estimation indicators								Sex determination indicators										
				Late fusing ep					Skelet deg													
				Iliac crest	Ischial tuberosity	Jugular growth pl	Clavicle, sternal	Sacrum, S1-S2	Pubic symphysis	Auricular surface	Rib 4, sternal	Ventral arc	Subpubic concavity	Ischiopubic ramus	Subpubic angle	Greater sciatic notch	Preauricular sulcus	Nuchal crest	Mastoid process	Supraorbital margin	Glabella	Mental eminence
RVSM 034-1-143(040)	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 035-1-146(041)	Adult sp		Undetermined	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 048-1-170(056)	Young adult	22 - 30 y	Probable male	3	3	-	2	-	1	3	-	5	5	5	4	3	5	2	4	2	3	2
RVSM 049-1-171(057)	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 051-1-152(059b)	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
RVSM 052-1-173(060a)	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 053-1-174(061)	Young-middle adult	27 - 47 y	Probable female	-	-	-	-	-	-	3	-	-	-	-	-	2	4	-	-	-	-	-
RVSM 054-1-176(062)	Adult sp		Probable male	-	-	-	3	-	-	-	-	-	-	-	-	-	-	3	4	3	2	1
RVSM 055-1-177(063)	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 055-2-177(087a)	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 056-1-178(064a)	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
RVSM 062-1-194(070)	Adult sp		Probable female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
RVSM 113-1-384(126)	Old adult	43 - 74 y	Female	3	-	-	-	-	-	6	-	-	-	-	-	-	2	1	-	1	1	1
RVSM 114-1-385(127)	Adult sp		Female	-	-	-	3	-	-	-	-	-	-	-	-	-	-	2	2	-	-	1
RVSM 115-1-386(128)	Young adult	19 - 31 y	Probable male	3	3	-	-	-	1	2	-	-	-	-	5	3	5	-	4	2	-	4
RVSM 116-1-387(129b)	Young-middle adult	25 - 40 y	Probable female	3	3	-	-	2	3	2	-	-	-	-	-	3	2	2	1	-	-	1
RVSM 116-2-387(129a)	Middle-old adult	33 - 57 y	Male	-	-	-	-	-	-	4	-	-	-	-	-	5	5	-	-	-	-	-
RVSM 118-1-394(131)	Old adult	42 - 70 y	Undetermined	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 120-1-396(133)	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 121-1-398(134a)	Young adult	17 - 29 y	Female	3	3	-	3	-	-	1	-	-	-	-	-	1	5	1	1	2	1	2
RVSM 125-1-402(138)	Adult sp		Undetermined	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 127-1-412(140)	Adult sp		Undetermined	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 128-1-413(141)	Old adult	43 - 69 y	Female	3	3	-	3	3	5	6	-	1	-	1	2	2	2	-	1	1	1	1
RVSM 129-3-415(142c)	Adult sp		Undetermined	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RVSM 130-1-416(143)	Old adult	42 - 70 y	Female	-	3	-	3	-	5	-	-	1	-	1	2	1	-	1	1	-	-	2
RVSM 141-1-436(152)	Young-middle adult	25 - 40 y	Female	-	-	-	3	3	2	3	-	1	-	1	1	2	2	1	1	-	-	1
RVSM 142-1-437(153)	Young-middle adult	29 - 46 y	Probable male	3	3	-	3	-	2	5	-	5	5	5	4	5	4	1	3	4	3	4

				Age estimation indicators								Sex determination indicators										
				Late fusing ep					Skelet deg													
Individual	Age, final estimation		Sex, final determination	Iliac crest	Ischial tuberosity	Jugular growth pl	Clavicle, sternal	Sacrum, S1-S2	Pubic symphysis	Auricular surface	Rib 4, sternal	Ventral arc	Subpubic concavity	Ischiopubic ramus	Subpubic angle	Greater sciatic notch	Preauricular sulcus	Nuchal crest	Mastoid process	Supraorbital margin	Glabella	Mental eminence
RVSM 146-1-454(157)	Middle-old adult	37 - 60 y	Male	3	3	3	3	3	5	4	-	5	-	4	5	5	5	2	3	2	3	4
RVSM 154-2-462(165b)	Old adult	53 - 86 y	Female	3	3	-	3	3	6	7	-	1	1	1	1	-	2	2	1	2	1	2

Table 7.7. Skeletal preservation of the individuals studied. Key: Compl = Completeness: 25 = 0-25% of the skeleton preserved, 50 = 25-50% of the skeleton preserved, 75 = 50-75% of the skeleton preserved, 100 = 75-100 of the skeleton preserved; Frag = Fragmentation: 0 = 0% of the anatomical elements preserved fragmented, 25 = 1-25% of the anatomical elements preserved fragmented, 50 = 25-50% of the anatomical elements preserved fragmented, 75 = 50-75% of the anatomical elements preserved fragmented, 100 = 75-100% of the anatomical elements preserved fragmented; Surf p = Surface preservation: 0 = fresh appearance, 1 = slight surface erosion, 2 = more extensive surface erosion with deeper penetration, 3 = most surface eroded and some details of the surface masked, 4 = all surface eroded and uneven distribution of depth or degree of alterations, 5 = heavy erosion on all surface and some modifications of profile, 6 = heavy erosion on all surface and substantial modification of profile.

Individual	*Compl*	*Frag*	*Surf p*
GOZ 002-1-4606	25	100	6
GOZ 003-1-1003	25	100	6
GOZ 004-1-1008	25	100	6
GOZ 010-1-4014	25	50	5
GOZ 012-1-4020	25	100	4
GOZ 013-1-4023	25	100	2
GOZ 014-1-4026	25	50	2
GOZ 015-1-4029	25	100	4
GOZ 015-2-4029	25	100	5
GOZ 015-3-4029	25	100	3
GOZ 015-4-4029	25	100	2
GOZ 018-1-4038	25	100	4
GOZ 019-1-4041	25	100	6
GOZ 021-1-4048	50	100	4
GOZ 023-1-4055	25	100	4
GOZ 024-1-4058	25	100	4
GOZ 025-1-4061	25	100	2
GOZ 029-1-4073	25	100	3
GOZ 031-1-4082	25	100	6
GOZ 033-2-4088	25	100	6
GOZ 039-1-4108	25	100	6
GOZ 040-1-4111	25	100	6
GOZ 047-01-4154	25	100	3
GOZ 047-02-4154	25	100	3
GOZ 047-03-4154	25	100	3
GOZ 047-04-4154	25	100	3
GOZ 047-05-4154	25	0	3
GOZ 047-06-4154	25	25	3
GOZ 047-07-4154	25	100	3
GOZ 047-08-4154	25	50	3
GOZ 047-09-4154	25	50	3
GOZ 047-10-4154	25	50	3
GOZ 052-1-4175	25	100	5
GOZ 052-2-4175	25	100	6
GOZ 053-1-4179	25	100	4
GOZ 054-1-4224	50	100	4
GOZ 055-1-4188	25	100	5
GOZ 055-2-4188	25	100	4
GOZ 055-3-4188	25	100	5
GOZ 057-1-4195	25	100	3
GOZ 058-1-4198	25	100	3
GOZ 058-2-4198	25	100	5
GOZ 059-1-4201	25	100	6
GOZ 060-1-4205	25	100	6
GOZ 060-2-4205	25	100	6
GOZ 061-1-4226	50	100	4
GOZ 063-1-4215	25	100	6
GOZ 063-2-4215	25	100	6
GOZ 065-1-4231	25	100	6
GOZ 065-2-4231	25	100	6
GOZ 065-3-4231	25	100	2
GOZ 066-1-4236	50	100	5
GOZ 066-2-4236	25	10	5
GOZ 067-1-4241	25	100	6
GOZ 067-2-4238	25	100	6
GOZ 069-1-4253	25	100	6
GOZ 069-2-4050	25	100	6
GOZ 070-1-4256	25	100	6
GOZ 070-2-4256	25	100	5
GOZ 071-1-4259	75	100	5
GOZ 071-2-4259	25	100	5
GOZ 073-1-4267	25	100	6
GOZ 073-2-4264	25	100	6
GOZ 075-1-4276	25	100	5
GOZ 075-2-4276	25	100	5
GOZ 075-3-4275	25	100	6
GOZ 075-4-4275	25	100	6
GOZ 077-1-4286	25	100	6
GOZ 077-2-4286	25	100	6
GOZ 078-1-4292	25	100	6
GOZ 078-2-4291	25	100	6
GOZ 078-3-4291	25	100	6
GOZ 078-4-4291	25	100	5
GOZ 080-1-4300	25	100	6
GOZ 081-1-4305	25	100	5
GOZ 083-1-4314	50	100	5
GOZ 084-1-4318	50	100	5
GOZ 084-2-4318	25	100	5
GOZ 085-1-4336	25	100	4
GOZ 086-1-4324	50	100	5

Individual	*Compl*	*Frag*	*Surf p*
GOZ 087-1-4330	25	100	6
GOZ 087-2-4329	25	100	5
GOZ 088-1-4333	25	100	5
GOZ 089-2-4372	25	100	5
GOZ 090-2-4346	25	100	6
GOZ 091-1-4432	25	100	5
GOZ 091-2-4349	25	100	5
GOZ 091-3-4350	25	100	6
GOZ 091-4-4350	25	100	5
GOZ 092-1-4354	25	100	6
GOZ 094-1-4363	75	100	5
GOZ 094-2-4362	25	100	4
GOZ 096-1-4370	25	100	6
GOZ 096-2-4369	25	100	5
GOZ 097-1-4377	25	100	6
GOZ 097-2-4378	75	100	3
GOZ 098-2-4380	25	100	6
GOZ 100-1-4398	25	100	4
GOZ 100-2-4399	25	25	0
GOZ 100-3-4396	25	25	0
GOZ 100-4-4396	25	0	4
GOZ 101-1-4438	50	100	5
GOZ 102-1-4403	25	100	3
GOZ 102-2-4402	50	100	4
GOZ 103-1-4442	25	25	0
GOZ 103-2-4441	25	100	3
GOZ 103-3-4408	25	100	6
GOZ 103-4-4408	25	100	6
GOZ 104-1-4414	25	100	6
GOZ 106-1-4422	25	100	6
GOZ 107-1-4425	50	100	4
GOZ 108-1-4429	50	100	5
GOZ 108-2-4428	25	100	5
GOZ 109-1-4454	25	100	6
GOZ 110-1-4448	100	75	3
GOZ 111-1-4461	25	100	6
GOZ 112-1-4467	50	100	5
GOZ 112-2-4468	25	50	5
GOZ 115-1-4483	25	100	4
GOZ 117-1-4490	25	100	6
GOZ 117-2-4489	25	100	6
GOZ 119-1-4498	25	100	5
GOZ 119-2-4497	25	25	0
GOZ 121-1-4504	25	100	6
GOZ 124-4-4515	25	100	5
GOZ 127-1-4526	25	100	4
GOZ 129-1-4538	25	100	6
GOZ 131-2-4550	25	100	4
GOZ 131-3-4546	25	100	5
GOZ 131-4-4546	25	100	6
GOZ 132-2-4552	25	100	6
GOZ 134-1-4565	25	100	4
GOZ 135-1-4568	75	100	4
GOZ 135-2-4568	25	100	4
GOZ 136-2-4646	25	0	3
GOZ 136-6-4644	25	100	3
GOZ 136-7-4572	25	100	4
GOZ 138-1-4583	25	100	5
GOZ 141-1-4597	25	100	6
GOZ 142-1-4601	25	100	4
GOZ 146-1-4618	25	100	6
GOZ 146-2-4642	25	100	4
GOZ 149-1-4632	25	100	6
GOZ 149-2-4632	25	100	3
GOZ 149-3-4632	25	0	3
GOZ 150-1-4638	25	100	5
GOZ 150-2-4638	25	100	6
GOZ 151-1-4651	25	100	4
GOZ 153-1-4658	25	25	4
GOZ 155-1-4667	25	100	4
GOZ 156-1-4726	25	100	4
GOZ 158-1-4728	25	100	5
GOZ 158-2-4729	25	100	6
GOZ 158-3-4678	25	100	5
GOZ 159-1-4687	25	100	4
GOZ 162-4-4698	25	100	6
GOZ 168-1-4722	25	100	6
GOZ 173-1-4747	25	100	5
GOZ 178-1-4767	25	100	5
GOZ 183-1-4798	25	100	5
GOZ 183-2-4797	25	100	5
GOZ 185-1-4803	25	50	4
GOZ 188-1-4817	25	100	6
GOZ 188-2-4816	25	100	6
GOZ 189-1-4823	25	50	5
GOZ 189-2-4818	25	50	5
GOZ 191-1-4831	25	100	4
GOZ 192-1-4836	25	100	6
GOZ 200-1-4872	25	100	6
GOZ 200-2-4872	25	100	4
GOZ 201-2-4874	25	100	6
GOZ 202-1-4879	25	100	6
GOZ 203-2-4882	25	100	4
GOZ 204-1-4884	25	100	5
GOZ 206-1-4891	25	100	6
GOZ 207-1-4896	25	100	5

Individual	*Compl*	*Frag*	*Surf p*
GOZ 209-1-4907	75	100	5
GOZ 216-1-5043	25	100	5
GOZ 219-1-4948	25	100	5
GOZ 220-1-4952	50	100	6
GOZ 221-2-4962	25	100	4
GOZ 224-1-4976	25	100	6
GOZ 226-1-4986	50	100	5
GOZ 226-2-4985	25	100	5
GOZ 226-3-4985	25	100	5
GOZ 230-1-5003	75	100	4
GOZ 230-2-5002	25	100	4
GOZ 231-1-5006	25	100	5
GOZ 232-1-5012	50	100	5
GOZ 232-2-5011	25	100	5
GOZ 233-1-5017	50	100	5
GOZ 236-1-5028	25	100	5
GOZ 236-2-5070	25	100	5
GOZ 236-3-5027	25	100	6
GOZ 238-1-5035	25	100	4
GOZ 239-1-5039	25	100	5
GOZ 241-1-5046	25	100	5
GOZ 243-2-5055	50	100	5
GOZ 244-2-5057	25	100	4
GOZ 245-1-5062	25	100	6
GOZ 246-1-5076	25	75	4
GOZ 247-1-5080	25	100	5
GOZ 5831-1-6150	25	75	3
GOZ 5831-2-6150	25	0	1
GOZ 5831-3-6150	25	100	3
GOZ 5831-4-6150	25	100	4
GOZ 5831-5-6150	25	100	4
GOZ 6640-2-6644	25	75	3
GOZ 6640-3-6644	25	25	4
GOZ 6640-4-6644	50	50	4
GOZ 6640-5-6644	25	25	4
GOZ 6890-1-6891	25	100	4
BOA 001-1	25	100	4
BOA 002-1	25	100	6
BOA 002-2	25	100	2
BOA 003-1	25	100	5
BOA 004-1	25	100	5
BOA 005-1	25	100	5
BOA 007-1	25	100	5
BOA 009-1	25	100	5
BOA 012-1	25	100	5
BOA 013-1	25	100	5
BOA 014-1	25	100	4
BOA 015-1	25	100	6
BOA 016-1	25	100	5
BOA 017-1	25	100	4
BOA 017-2	25	100	4
BOA 018-1	25	100	3
BOA 019-1	25	100	5
BOA 020-1	25	100	5
BOA 021-1	25	100	5
BOA 022-1	25	100	6
BOA 023-1	25	100	4
BOA 024-1	25	100	5
BOA 026-1	25	100	6
BOA 029-1	25	100	6
BOA 030-1	25	100	4
BOA 034-1	25	100	5
BOA 035-1	25	100	4
BOA 036-1	25	100	4
BOA 037-1	25	100	4
BOA 039-1	25	100	5
BOA 040-1	25	100	4
BOA 041-1	25	100	4
BOA 042-1	25	100	4
BOA 043-1	25	100	5
BOA 044-1	25	100	4
BOA 047-1	25	100	4
BOA 048-1	25	100	5
BOA 049-1	25	100	5
BOA 050-1	25	100	4
BOA 051-1	25	100	6
BOA 051-2	25	100	5
BOA 052-1	25	100	4
BOA 053-1	25	100	4
BOA 054-1	25	25	4
BOA 054-2	25	100	2
BOA 055-1	25	100	5
BOA 055-2	25	100	5
BOA 058-1	25	100	4
BOA 059-1	25	100	4
BOA 060-1	25	100	3
BOA 061-1	25	100	6
BOA 062-1	25	100	6
BOA 065-1	25	100	5
BOA 066-1	25	100	4
BOA 068-1	25	100	4
BOA 068-2	25	100	4
BOA 069-1	25	100	4
BOA 069-2	25	100	4
BOA 070-1	25	100	3
BOA 071-1	25	100	3

Individual	*Compl*	*Frag*	*Surf p*
BOA 072-1	25	100	3
BOA 072-2	75	100	3
BOA 072-3	50	100	3
BOA 073-1	50	100	4
BOA 074-1	25	100	5
BOA 075-1	50	100	4
BOA 076-1	25	100	2
BOA 076-2	25	100	2
BOA 077-1	25	100	4
BOA 078-1	25	100	6
BOA 080-1	25	100	5
BOA 081-1	25	100	4
BOA 082-1	25	100	5
BOA 084-1	25	100	3
BOA 085-1	50	100	3
BOA 085-2	25	100	3
BOA 086-1	25	100	4
BOA 086-2	25	100	3
BOA 089-1	50	100	4
BOA 089-2	25	100	4
BOA 090-1	25	100	5
BOA 091-1	25	100	4
BOA 093-1	25	100	4
BOA 094-1	25	100	4
BOA 095-1	25	100	5
BOA 096-1	25	100	5
BOA 097-1	25	100	5
BOA 098-1	25	100	4
BOA 099-1	25	100	4
BOA 100-1	25	100	3
BOA 101-1	25	100	5
BOA 102-1	25	100	5
BOA 103-1	25	100	3
BOA 103-2	25	100	3
BOA 103-3	25	50	2
BOA 103-4	25	100	4
BOA 104-1	25	100	4
BOA 105-1	25	100	2
BOA 105-2	25	100	2
BOA 105-3	25	100	3
BOA 105-4	25	75	3
BOA 106-1	25	100	4
BOA 107-1	25	100	4
BOA 107-2	25	100	3
BOA 107-3	25	100	5
BOA 107-4	25	100	4
BOA 108-1	25	100	6
BOA 109-1	25	100	4
BOA 112-1	50	100	3
BOA 113-1	25	100	4
BOA 113-2	25	0	2
BOA 114-1	25	100	4
BOA 115-1	25	100	3
BOA 115-2	25	100	5
BOA 115-3	25	100	4
BOA 115-4	25	100	4
BOA 116-1	25	100	5
BOA 119-1	25	100	4
BOA 120-1	25	100	3
BOA 120-2	25	50	2
BOA 121-1	50	75	2
BOA 122-1	25	100	3
BOA 124-1	25	100	5
BOA 125-1	25	100	5
BOA 125-2	25	100	3
BOA 126-1	25	100	4
BOA 128-1	25	100	3
BOA 128-2	25	100	3
BOA 129-1	25	100	5
BOA 131-1	25	100	5
BOA 132-1	25	100	4
BOA 133-1	25	100	4
BOA 135-1	25	100	5
BOA 138-1	25	100	5
BOA 139-1	25	100	5
BOA 142-1	25	100	6
BOA 143-1	25	100	6
BOA 145-1	25	100	4
BOA 145-2	25	100	5
BOA 145-3	25	100	5
BOA 145-4	25	100	6
BOA 145-5	50	100	4
BOA 145-6	25	100	6
BOA 146-1	25	50	3
BOA 147-1	25	100	4
BOA 148-1	25	100	4
BOA 149-1	25	100	5
BOA 150-1	25	100	4
BOA 151-1	25	100	2
BOA 151-2	25	100	3
BOA 151-3	25	100	2
BOA 152-1	25	100	4
BOA 152-2	25	100	4
BOA 157-1	25	100	2
BOA 157-2	25	100	3
BOA 160-1	50	100	4

Individual	*Compl*	*Frag*	*Surf p*
BOA 160-2	25	100	4
BOA 160-3	25	100	4
BOA 162-1	25	100	4
BOA 163-1	25	100	4
BOA 166A-1	50	100	3
BOA 169-1	25	100	4
BOA 174-1	25	100	4
BOA 177-1	25	100	3
BOA 178-1	25	100	4
BOA 179-1	25	100	4
BOA 179-2	25	100	4
BOA 182-1	25	100	5
BOA 183-1	25	100	5
BOA 184-1	25	100	5
BOA 187-1	25	100	3
BOA 187-2	25	100	5
SNC 30100-1-30102	50	100	3
SNC 30105-1-30108	50	100	3
SNC 30110-1-30111	25	100	3
SNC 30110-2-30111	25	100	3
SNC 30110-3-30111	25	100	3
SNC 30110-4-30112	25	100	2
SNC 30115-1-30117	25	100	4
SNC 30130-1-30134	75	100	2
SNC 30140-1-30143	25	100	4
SNC 30150-1-30152	50	100	4
SNC 30150-2-30152	25	100	2
SNC 30170-1-30186	75	100	2
SNC 30180-1-30182	25	25	0
SNC 30240-1-30242	50	100	4
SNC 30270-1-30272	50	100	4
SNC 30280-1-30283	25	100	3
SNC 30295-1-30297	50	100	3
SNC 30320-1-30322	75	100	3
SNC 30444-1-30446	50	100	3
SNC 30620-1-30622	25	100	4
SNC 30740-1-30742	50	100	3
SNC 30745-1-30747	25	100	3
SNC 30750-1-30752	25	100	2
SNC 30790-1-30793	25	100	3
SNC 30795-1-30798	25	100	4
SNC 30800-1-30803	50	100	2
SNC 30800-2-30802	50	100	2
SNC 30800-3-30801	25	100	2
SNC 30805-1-30808	25	100	4
SNC 30810-1-30813	75	100	4
SNC 30810-2-30813	50	100	4
SNC 30810-3-30812	25	100	3
SNC 30810-4-30812	25	100	3
SNC 30810-5-30812	25	100	3
SNC 30810-6-30812	25	100	3
SNC 30830-1-30832	50	100	3
SNC 30835-1-30837	100	75	2
SNC 30840-1-30842	100	75	2
SNC 30850-1-30858	50	100	4
SNC 30865-1-30869	50	100	4
SNC 30880-1-30884	75	100	3
SNC 30890-1-30892	25	100	4
SNC 33000-1-33003	25	100	4
SNC 33005-1-33004	25	100	3
SNC 33010-1-33013	50	100	3
SNC 33030-1-33032	25	100	4
SNC 33040-1-33043	25	100	4
SNC 33060-1-33064	50	100	4
SNC 33070-1-33072	25	100	3
LH 1-1-7023	75	75	2
LH 2-1-7112	75	100	2
LH 3-1-7132	50	100	3
LH 4-1-7162	25	100	4
LH 5-1-7182	25	100	3
LH 6-1-7192	25	100	4
LH 7-1-7198	50	100	3
LH 8-1-7202	100	100	2
LH 9-1-7172	75	100	3
ALD A008-1	50	100	4
ALD A009-1	50	100	5
ALD A010-1	50	100	5
ALD A011-1	25	100	5
ALD ASUP-06	25	100	5
ALD ASUP-07	25	100	5
ALD ASUP-08	25	100	5
ALD ASUP-09	25	100	5
ALD ASUP-10	25	100	5
ALD B001-1	25	100	5
ALD B002-1	50	100	5
ALD B003-1	75	100	5
ALD B004-1	25	100	6
ALD B005-1	50	100	5
ALD B006/B008-1	25	100	4
ALD B006/B008-2	25	100	4
ALD B006/B008-3	25	100	4
ALD B006/B008-4	25	100	4
ALD B006/B008-5	25	0	2
ALD B011-1	25	100	4
ALD B012-1	100	100	4
ALD B013-1	100	75	4

Individual	*Compl*	*Frag*	*Surf p*
ALD B014-1	75	100	4
ALD B015-1	100	100	4
ALD B016-1	75	100	5
ALD B016-2	25	100	3
ALD B017-1	100	100	4
ALD B018-1	75	100	4
ALD B019-1	75	100	4
ALD B020-1	75	100	5
ALD B021-1	50	100	5
ALD B021-2	25	100	5
ALD B022-1	75	100	5
ALD B023-1	50	100	4
ALD B024-1	50	100	5
ALD B025-1	75	100	5
ALD B026/B027-1(B026)	25	100	5
ALD B026/B027-2(B027)	25	100	5
ALD B028-1	75	100	5
ALD B029/B043-01(B029)	25	25	4
ALD B029/B043-02(B030)	25	0	4
ALD B029/B043-03(B031)	25	100	4
ALD B029/B043-04(B032)	25	100	4
ALD B029/B043-05(B033)	25	100	4
ALD B029/B043-06(B034)	25	100	4
ALD B029/B043-07(B035)	25	0	4
ALD B029/B043-08(B036)	25	100	4
ALD B029/B043-09(B037)	25	100	4
ALD B029/B043-10(B038)	25	100	4
ALD B029/B043-11(B039)	25	100	4
ALD B029/B043-12(B040)	25	100	4
ALD B029/B043-13(B041)	25	100	5
ALD B029/B043-14(B042)	25	100	4
ALD B029/B043-15(B043)	50	100	5
ALD B044-1	50	100	6
ALD B045/B047-1(B045)	75	100	5
ALD B045/B047-2(B046)	50	100	5
ALD B045/B047-3(B047)	25	100	6
ALD B048/B054-1(B048)	25	100	5
ALD B048/B054-2(B049)	25	100	5
ALD B048/B054-3(B050)	25	100	4
ALD B048/B054-4(B051)	25	100	4
ALD B048/B054-5(B052)	25	100	4
ALD B048/B054-6(B053)	25	0	3
ALD B048/B054-7	25	50	4
ALD B055/B063-01(B055)	50	100	6
ALD B055/B063-02(B056)	75	100	5
ALD B055/B063-03(B057)	50	100	6
ALD B055/B063-04(B058)	25	100	5
ALD B055/B063-05(B059)	50	100	5
ALD B055/B063-06(B060)	25	100	6
ALD B055/B063-07(B061)	75	100	5
ALD B055/B063-08(B062)	25	100	6
ALD B055/B063-09(B063)	100	100	4
ALD B055/B063-10	25	0	3
ALD B064/B076-01(B064)	25	100	6
ALD B064/B076-02(B065)	25	100	6
ALD B064/B076-03(B066)	25	50	3
ALD B064/B076-04(B067)	25	100	5
ALD B064/B076-05(B068)	25	100	5
ALD B064/B076-06(B069)	50	100	5
ALD B064/B076-07(B070)	25	100	6
ALD B064/B076-08(B071)	25	0	3
ALD B064/B076-09(B072)	25	100	5
ALD B064/B076-10(B073)	25	100	5
ALD B064/B076-11(B074)	25	100	5
ALD B064/B076-12(B075)	25	100	5
ALD B064/B076-13(B076)	50	100	5
ALD B077/B087-01(B077)	75	100	4
ALD B077/B087-02(B078)	50	100	6
ALD B077/B087-03(B079)	25	100	4
ALD B077/B087-04(B080)	25	0	3
ALD B077/B087-05(B081)	25	100	4
ALD B077/B087-06(B082)	25	100	4
ALD B077/B087-07(B083)	25	100	4
ALD B077/B087-08(B084)	75	100	5
ALD B077/B087-09(B085)	75	100	4
ALD B077/B087-10(B086)	50	75	4
ALD B077/B087-11(B087)	100	100	4
ALD B088/B098-01(B088)	25	100	5
ALD B088/B098-02(B089)	25	100	6
ALD B088/B098-03(B090)	50	100	6
ALD B088/B098-04(B091)	75	100	5
ALD B088/B098-05(B092)	75	100	4
ALD B088/B098-06(B093)	50	100	5
ALD B088/B098-07(B094)	75	100	4
ALD B088/B098-08(B095)	75	100	6
ALD B088/B098-09(B096)	50	100	6
ALD B088/B098-10(B097)	50	100	5
ALD B088/B098-11(B098)	75	100	4
ALD B099/B101-1(B099)	50	100	4
ALD B099/B101-2(B100)	50	100	4
ALD B099/B101-3(B101)	25	100	4
ALD B102/B103-1(B102)	25	100	5
ALD B102/B103-2(B103)	25	100	5
ALD B104-1	25	25	0
ALD B105-1	50	100	4
FIN 02-1-44	25	100	4

Individual	*Compl*	*Frag*	*Surf p*
FIN 03-1-50	25	100	4
FIN 03-2-61	25	100	4
FIN 06-1-53	25	100	4
FIN 07-1-57	50	100	3
FIN 08-1-56	50	100	4
FIN 09-1-60	25	100	4
FIN 13-1-30	25	100	4
FIN 14-1-73	25	100	4
FIN 15-1-74	25	100	5
SMD 2811-1-2810(181)	100	75	1
SMD 2841-1-2840(184)	50	100	4
SMD 2871-1-2870(187)	25	100	3
SMD 2901-1-2900(190)	25	100	4
SMD 2901-2-2900	25	25	1
SMD 2961-1-2960(196)	50	100	1
SMD 2961-2-2970(197)	50	100	2
SMD 2981-1-2990(199)	50	100	5
SMD 2981-2-3120(212)	50	100	2
SMD 2981-3-3030(203)	50	100	3
SMD 2981-4-2980(198)	50	75	1
SMD 3021-1-3020(202)	50	100	0
SMD 3041-1-3040(204)	25	25	0
SMD 3061-1-3060(206)	100	100	2
SMD 3071-1-3070(207)	25	100	1
SMD 3071-2-3070	25	100	2
SMD 3081-1-3080(208)	50	100	5
SMD 3091-1-3090(209)	50	100	3
SMD 3101-1-3100(210)	50	100	4
SMD 3111-1-3110(211)	50	100	2
SMD 3151-1-3150(215)	50	100	2
SMD 3151-2-3150	25	100	4
SMD 3151-3-3150	25	100	2
SMD 3161-1-3160(216)	50	100	3
SMD 3161-2-3160	25	100	1
SMD 3161-3-3160	25	100	1
SMD 3161-4-3160	25	100	2
SMD 3181-1-3180(218)	25	100	5
SMD 3361-1-3360(236)	50	100	5
SMD 3371-1-3370(237)	100	50	2
SMD 3371-2-3370	25	100	2
SMD 3381-1-3380(238)	75	100	2
SMD 3381-2-3380	25	25	0
SMD 3381-3-3380	25	0	2
SMD 3391-1-3390(239)	25	100	5
SMD 3391-2-3390	25	75	3
SMD 3401-1-3390(240)	75	100	3
SMD 3401-2-3390	25	75	2
SMD 3411-1-3410(241)	100	75	3
SMD 3411-2-3410	25	100	3
SMD 3421-1-3420(242)	25	100	3
SMD 3431-1-3430(243)	25	100	4
SMD 3431-2-3430	25	100	0
SMD 3451-1-3450(245)	100	75	3
SMD 3451-2-3450	25	50	2
SMD 3461-1-3460(246)	25	0	1
SMD 3461-2-3460	25	0	1
SMD 3551-1-3550(255)	25	100	3
SMD 3601-1-3600(260)	50	100	4
SMD 3601-2-3600	25	100	3
SMD 3601-3-3600	25	100	3
SMD 3611-1-3610(261)	50	100	6
SMD 3621-1-3620(262)	25	100	4
CG 053-1-0420	75	100	5
CG 053-2-0421	50	100	5
CG 080-1-0393	50	100	5
CG 094-1-1231	75	100	5
CG 094-2-1230	75	100	5
CG 192-1-0353	25	100	5
CG 220-1-0433	50	100	5
CG 254-1-0623	75	100	6
CG 295-1-0704	25	100	5
CG 296-1-0701	50	100	5
CG 370-1-0916	50	100	5
CG 371-1-0794	50	100	6
CG 372-1-0797	25	100	5
CG 373-1-0823	75	100	5
CG 374-1-1695	75	100	3
CG 374-2-1473	75	100	3
CG 380-1-0826	75	100	5
CG 381-1-0840	50	100	5
CG 382-1-0837	50	100	5
CG 385-1-0853	50	100	5
CG 387-1-0746	25	100	5
CG 391-1-0925	25	100	5
CG 392-1-0856	75	100	5
CG 392-2-0855	75	100	5
CG 393-1-0875	75	100	5
CG 393-2-0874	50	100	5
CG 395-1-0879	75	100	5
CG 411-1-0901	75	100	4
CG 443-1-0953	25	100	4
CG 444-1-0957	25	100	5
CG 445-1-0960	25	100	4
CG 446-1-0964	25	100	5
CG 447-1-0968	25	100	5
CG 453-1-1315	25	100	5

Individual	*Compl*	*Frag*	*Surf p*
CG 477-1-1434	50	100	5
CG 511-1-1437	50	100	6
CG 512-1-1440	25	100	5
CG 519-1-1480	75	100	5
CG 597-1-1656	50	100	6
CG 598-1-1646	50	100	5
CG 599-1-1643	25	100	5
CG 692-1-1794	25	100	5
PMCV 14-1-109	25	100	2
PMCV 15-1-130	100	75	3
PMCV 15-2-126	25	100	3
PMCV 15-3-126	25	100	4
PMCV 16-1-103	50	100	3
PMCV 16-2-102	25	75	2
PMCV 18-1-114	75	100	2
PMCV 19-1-139	100	75	1
PMCV 19-2-141	75	100	2
PMCV 20-1-122	50	100	5
PMCV 21-1-160	100	100	4
PMCV 22-1-118	75	100	3
PMCV 22-2-116	75	100	2
PMCV 23-1-134	75	100	4
PMCV 43-1-350	100	100	4
PMCV 43-2-350	25	0	4
PMCV 44-1-469/470	75	100	4
PMCV 45-1-412	75	100	3
PMCV 46-1-444	50	100	4
PMCV 46-2-445	75	100	4
PMCV 46-3-444/445	50	100	4
PMCV 46-4-446	25	100	5
PMCV 47-1-357	25	100	2
PMCV 48-1-353	25	100	3
PMCV 49-1-451	50	100	1
PMCV 49-2-419	25	100	2
PMCV 50-1-458/472	25	100	2
PMCV 50-2-474	25	100	2
PMCV 51-1-454	50	100	3
PMCV 55-1-399	25	100	5
PMCV 55-2-399	25	25	0
PMCV 57-1-420/449	50	100	1
RVSM 002-1-027(003)	50	100	2
RVSM 003-1-056(004a)	25	25	0
RVSM 003-2-056(004b)	25	100	2
RVSM 004-1-057(005)	25	100	2
RVSM 007-1-060(010)	25	25	0
RVSM 009-1-062(012)	25	100	1
RVSM 010-1-078(013)	75	100	2
RVSM 011-1-079(016a)	50	100	1
RVSM 011-2-079(016b)	25	100	1
RVSM 011-3-079(016c)	25	100	1
RVSM 014-1-086(014a)	50	100	1
RVSM 014-2-086(014b)	25	100	1
RVSM 018-1-092(021)	50	100	1
RVSM 020-1-096(023)	50	100	2
RVSM 020-2-096(037)	25	100	1
RVSM 022-1-100(025)	50	100	1
RVSM 023-1-107(026)	25	100	1
RVSM 024-1-118(027a)	50	75	1
RVSM 024-2-118(027b)	25	100	1
RVSM 025-1-117(032)	25	100	3
RVSM 029-1-095(033)	75	100	1
RVSM 031-1-128(036)	75	100	1
RVSM 031-2-128(035)	50	100	1
RVSM 032-1-130(038b)	75	100	1
RVSM 032-2-129(038a1)	25	100	1
RVSM 032-3-129(038a2)	25	100	1
RVSM 032-4-129(038a3)	25	100	1
RVSM 033-1-132(039)	75	100	1
RVSM 034-1-143(040)	25	100	5
RVSM 034-2-145(145a)	25	100	1
RVSM 034-3-145(145b)	25	75	1
RVSM 035-1-146(041)	25	100	3
RVSM 038-1-156(047)	75	100	1
RVSM 038-2-155(046a)	25	100	2
RVSM 038-3-155(046b)	25	100	2
RVSM 042-1-158(050)	50	100	1
RVSM 048-1-170(056)	100	100	2
RVSM 049-1-171(057)	25	100	1
RVSM 051-1-152(059b)	50	100	3
RVSM 052-1-173(060a)	25	25	0
RVSM 052-2-173(060b)	25	100	1
RVSM 053-1-174(061)	25	100	2
RVSM 054-1-176(062)	50	100	2
RVSM 055-1-177(063)	25	100	1
RVSM 055-2-177(087a)	25	100	1
RVSM 055-3-177(087b)	25	25	1
RVSM 056-1-178(064a)	50	100	2
RVSM 056-2-178(064b)	25	25	1
RVSM 056-3-178(064c)	25	100	1
RVSM 060-1-184(068)	25	100	1
RVSM 062-1-194(070)	25	100	3
RVSM 064-1-200(074)	50	100	3
RVSM 064-2-199(073)	50	100	1
RVSM 113-1-384(126)	50	100	1
RVSM 114-1-385(127)	50	100	1
RVSM 115-1-386(128)	50	100	1

Individual	*Compl*	*Frag*	*Surf p*
RVSM 116-1-387(129b)	50	100	1
RVSM 116-2-387(129a)	25	25	0
RVSM 117-1-393(130)	50	100	1
RVSM 118-1-394(131)	25	100	1
RVSM 120-1-396(133)	25	100	1
RVSM 121-1-398(134a)	50	100	3
RVSM 121-2-398(134b)	25	100	2
RVSM 124-1-401(137)	25	100	1
RVSM 125-1-402(138)	50	100	1
RVSM 127-1-412(140)	25	100	1
RVSM 128-1-413(141)	75	100	2
RVSM 129-1-415(142a)	75	75	1
RVSM 129-2-415(142b)	25	50	1
RVSM 129-3-415(142c)	25	100	1
RVSM 130-1-416(143)	25	25	0
RVSM 141-1-436(152)	75	100	1
RVSM 142-1-437(153)	75	75	1
RVSM 146-1-454(157)	75	75	1
RVSM 154-2-462(165b)	75	75	1
RVSM 154-3-462(165a)	75	75	1

7.3 ZOOARCHAEOLOGY

Table 7.8. Chronology of fauna samples. Key: Taxon: d = domesticus, * = subadult individual

Individual	*Taxon*	*Chronology*
GOZ F5053-S	Sus scrofa d*	Mid-7th-mid-8th c.
GOZ F5056-B	Bos taurus	Mid-7th-mid-8th c.
GOZ F5086-S(1)	Sus scrofa d	6th-start 7th c.
GOZ F5086-S(2)	Sus scrofa d	6th-start 7th c.
GOZ F5321-B	Bos taurus	Start-mid-7th c.
GOZ F5412-B	Bos taurus	Mid-7th-mid-8th c.
GOZ F5412-E	Equus sp	Mid-7th-mid-8th c.
GOZ F5711-S	Sus scrofa d	Mid-7th-mid-8th c.
GOZ F5722-B	Bos taurus	6th-start 7th c.
GOZ F5722-E	Equus sp	6th-start 7th c.
GOZ F5737-E	Equus sp	Mid-7th-mid-8th c.
GOZ F5737-OC	Ovis/Capra	Mid-7th-mid-8th c.
GOZ F5802-B	Bos taurus	6th-start 7th c.
GOZ F5802-E	Equus sp	6th-start 7th c.
GOZ F5802-OC	Ovis/Capra	6th-start 7th c.
GOZ F5851-C	Capra hircus	Start-mid-7th c.
GOZ F5851-E	Equus sp	Start-mid-7th c.
GOZ F5896-S	Sus scrofa d	Start-mid-7th c.
GOZ F6181-A	Avis*	Mid-7th-mid-8th c.
GOZ F6181-O	Ovis aries	Mid-7th-mid-8th c.
GOZ F6192-A(1)	Avis	Mid-7th-mid-8th c.
GOZ F6192-A(2)	Avis	Mid-7th-mid-8th c.
GOZ F6621-OC	Ovis/Capra	6th-start 7th c.
GOZ F6761-E	Equus sp	Start-mid-7th c.
GOZ F6762-OC	Ovis/Capra	Start-mid-7th c.
GOZ F6781-B	Bos taurus	Start-mid-7th c.
ASI F01.1-A	Avis	End 5th-mid-8th c.
ASI F01.1-OC	Ovis/Capra	End 5th-mid-8th c.
ASI F01.1-S	Sus scrofa d	End 5th-mid-8th c.
ASI F01.3-CN	Canis familiaris	End 5th-mid-8th c.
ASI F05.1-S	Sus scrofa d	End 5th-mid-8th c.
ASI F08.2-E	Equus sp	End 5th-mid-8th c.

Individual	*Taxon*	*Chronology*
ASI F09.1-E	Equus sp	End 5th-mid-8th c.
ASI F09.1-OC	Ovis/Capra	End 5th-mid-8th c.
ASI F15.1-A	Avis	End 5th-mid-8th c.
ASI F15.1-S	Sus scrofa d	End 5th-mid-8th c.
ASI F24.3-B	Bos taurus	End 5th-mid-8th c.
ASI F29.1-E	Equus sp	End 5th-mid-8th c.
ASI F33.2-B	Bos taurus	End 5th-mid-8th c.
BOA F025-B	Bos taurus	End 5th-mid-8th c.
BOA F025-E	Equus sp	End 5th-mid-8th c.
BOA F051-C	Capra hircus	End 5th-mid-8th c.
BOA F053-A	Avis	End 5th-mid-8th c.
BOA F155-S	Sus scrofa d	End 5th-mid-8th c.
BOA F166A-OC	Ovis/Capra	End 5th-mid-8th c.
BOA F169-OC	Ovis/Capra	End 5th-mid-8th c.
SNC F30047-A(1)	Avis	Start 8th-mid-9th c.
SNC F30047-A(2)	Avis	Start 8th-mid-9th c.
SNC F30047-B	Bos taurus	Start 8th-mid-9th c.
SNC F30047-E(1)	Equus sp	Start 8th-mid-9th c.
SNC F30047-E(2)	Equus sp	Start 8th-mid-9th c.
SNC F30047-OC(1)	Ovis/Capra	Start 8th-mid-9th c.
SNC F30047-OC(2)	Ovis/Capra	Start 8th-mid-9th c.
SNC F31371-S	Sus scrofa d*	First half 5th c.
SNC F31373-B	Bos taurus*	First half 5th c.
SNC F31373-O	Ovis aries	First half 5th c.
SNC F31374-B	Bos taurus	First half 5th c.
SNC F31374-C(1)	Capra hircus	First half 5th c.
SNC F31374-C(2)	Capra hircus	First half 5th c.
SNC F31374-S	Sus scrofa d	First half 5th c.
ALD FA009-B(1)	Bos taurus	Mid-6th-start 8th c.
ALD FA009-B(2)	Bos taurus	Mid-6th-start 8th c.
ALD FB021-B	Bos taurus	Mid-6th-start 8th c.
ALD FB024-OC(1)	Ovis/Capra	Mid-6th-start 8th c.
ALD FB024-OC(2)	Ovis/Capra	Mid-6th-start 8th c.
ALD FB024-OC(3)	Ovis/Capra	Mid-6th-start 8th c.
ALD FB025-OC	Ovis/Capra	Mid-6th-start 8th c.
ALD FB029/B043-B(1)	Bos taurus	Mid-6th-start 8th c.
ALD FB029/B043-B(2)	Bos taurus*	Mid-6th-start 8th c.
ALD FB048/B054-B	Bos taurus	Mid-6th-start 8th c.
ALD FB064/B076-OC(1)	Ovis/Capra	Mid-6th-start 8th c.
ALD FB064/B076-OC(2)	Ovis/Capra	Mid-6th-start 8th c.
ALD FB064/B076-S	Sus scrofa d	Mid-6th-start 8th c.
ALD FB076-S	Sus scrofa d*	Mid-6th-start 8th c.
ALD FB077/B087-CN	Canis familiaris	Mid-6th-start 8th c.
SMD F023-B	Bos taurus	6th-7th c.
SMD F023-OC(1)	Ovis/Capra	6th-7th c.
SMD F023-OC(2)	Ovis/Capra	6th-7th c.
SMD F023-S(1)	Sus scrofa d*	6th-7th c.
SMD F023-S(2)	Sus scrofa d	6th-7th c.

Individual	*Taxon*	*Chronology*
SMD F074-B	Bos taurus	6th-9th c.
SMD F074-OC	Ovis/Capra	6th-9th c.
SMD F074-S(1)	Sus scrofa d	6th-9th c.
SMD F074-S(2)	Sus scrofa d	6th-9th c.
SMD F161-B	Bos taurus	6th-7th c.
SMD F206-B	Bos taurus	8th-9th c.
SMD F209-S	Sus scrofa d	8th-9th c.
SMD F227-S	Sus scrofa d	8th-9th c.
SMD F241-C	Capra hircus	6th-7th c.
SMD F241-S	Sus scrofa d	6th-7th c.
SMD F348-B	Bos taurus	8th-9th c.
SMD F373-B	Bos taurus	8th-9th c.
SMD F373-OC	Ovis/Capra	8th-9th c.
CG F102-1788-AG	Gallus gallus d	6th c.
CG F102-1788-B(1)	Bos taurus	6th c.
CG F102-1788-B(2)	Bos taurus	6th c.
CG F102-1788-E	Equus sp	6th c.
CG F102-1788-OC(1)	Ovis/Capra	6th c.
CG F102-1788-OC(2)	Ovis/Capra	6th c.
CG F102-1788-S	Sus scrofa d*	6th c.
CG F266-0864-B(1)	Bos taurus	6th-7th c.
CG F350-0868-S	Sus scrofa d	6th c.
CG F350-0869-F	Felis catus	6th c.
CG F350-0870-E	Equus sp	6th c.
CG F350-0928-OC(2)	Ovis/Capra	6th c.
CG F350-0985-AG	Gallus gallus d	6th c.
CG F350-1384-B	Bos taurus	6th c.
CG F350-1684-B	Bos taurus	6th c.
CG F374-0830-AG	Gallus gallus d	7th c.
CG F374-0830-CN(1)	Canis familiaris	7th c.
CG F374-0830-CN(2)	Canis familiaris	7th c.
CG F374-0830-CN(3)	Canis familiaris	7th c.
CG F374-0830-E	Equus sp	7th c.
CG F374-0830-F(1)	Felis catus	7th c.
CG F374-0830-F(2)	Felis catus	7th c.
CG F374-0830-S(2)	Sus scrofa d	7th c.
CG F374-0830-S(3)	Sus scrofa d	7th c.
CG F637-1746-AG	Gallus gallus d	6th c.
CG F637-1746-E	Equus sp	6th c.
CG F637-1746-OC(3)	Ovis/Capra	6th c.
CG F660-1789-AG	Gallus gallus d	6th c.
CG F660-1789-OC(2)	Ovis/Capra	6th c.
CG F660-1789-S	Sus scrofa d	6th c.
HCT F13-39-B	Bos taurus	8th c.
HCT F13-39-OC	Ovis/Capra	8th c.
HCT F13-39-S	Sus scrofa d	8th c.
HCT F16-46-B	Bos taurus	7th c.
HCT F16-46-OC(1)	Ovis/Capra	7th c.

Individual	*Taxon*	*Chronology*
HCT F16-46-OC(2)	Ovis/Capra*	7th c.
HCT F16-46-S	Sus scrofa d*	7th c.
PMCV F12-022-B	Bos taurus	6th c.
PMCV F12-022-OC	Ovis/Capra	6th c.
PMCV F12-022-S	Sus scrofa d*	6th c.
PMCV F12-164-B	Bos taurus	6th c.
PMCV F12-164-OC(1)	Ovis/Capra	6th c.
PMCV F12-164-OC(2)	Ovis/Capra	6th c.
PMCV F12-164-OC(3)	Ovis/Capra	6th c.
PMCV F12-164-S(1)	Sus scrofa d	6th c.
PMCV F12-164-S(2)	Sus scrofa d	6th c.
RVSM F0118-OC	Ovis/Capra	Mid-5th-6th c.
RVSM F0412-OC	Ovis/Capra	7th-8th c.
RVSM F0481-B	Bos taurus	Mid-end 5th c.
RVSM F0481-OC(1)	Ovis/Capra	Mid-end 5th c.
RVSM F0481-OC(2)	Ovis/Capra	Mid-end 5th c.
RVSM F0481-S	Sus scrofa d	Mid-end 5th c.
RVSM F1021-AG	Gallus gallus d	14th c.
RVSM F1021-OC(1)	Ovis/Capra	14th c.
RVSM F1021-OC(2)	Ovis/Capra	14th c.
RVSM F1021-S	Sus scrofa d	14th c.

7.4 CARBON AND NITROGEN STABLE ISOTOPE ANALYSES

Table 7.9. Carbon and nitrogen stable isotope measurements of humans, including collagen quality criteria. For a few measurements it is not possible to determine with confidence which individual was sampled. Then, the range of individuals the measurement could come from is indicated in the column *Individual* with a slash sign in the second figure (e.g. GOZ 047-2/4-4154 indicates the radiocarbon date may come from individual GOZ 047-2-4154, 047-3-4154 or GOZ 047-4-4154). Some samples are missing information on anatomical element and collagen yield because these data were not collected during pretreatment.

Individual	*Anatomical element*	*$\delta^{13}C$ (‰)*	*$\delta^{15}N$ (‰)*	*%C*	*%N*	*C/N*	*%coll*
GOZ 015-3-4209	Mandible	-19.5	10.0	39.3	12.7	3.6	-
GOZ 021-1-4048	Rib	-19.4	11.2	42.5	14.9	3.3	11.9
GOZ 047-1-4154	Rib	-18.5	8.9	42.7	15.6	3.2	2.1
GOZ 047-2/4-4154	Rib	-19.3	8.9	39.3	14.3	3.2	1.9
GOZ 054-1-4224	Rib	-18.3	10.8	42.7	16.3	3.1	11.2
GOZ 058-1-4198	Rib	-18.9	9.4	44.2	14.6	3.5	-
GOZ 060-1-4205	Long bone	-16.2	10.4	41.0	13.8	3.5	-
GOZ 061-1-4226	Long bone	-19.6	8.7	41.4	13.6	3.6	-
GOZ 066-1-4236	Rib	-18.9	8.8	43.1	14.4	3.5	-
GOZ 071-1-4259	Rib	-18.6	11.1	38.4	12.8	3.5	-
GOZ 086-1-4324	Rib	-20.0	9.5	42.1	14.7	3.4	-
GOZ 097-1-4377	Long bone	-19.0	10.6	40.0	13.0	3.6	-
GOZ 097-2-4378	Rib	-18.5	9.7	39.0	13.0	3.5	-
GOZ 098-2-4380	Long bone	-19.1	9.5	35.6	12.5	3.3	-
GOZ 100-2-4399	Rib	-18.2	10.7	40.4	13.4	3.5	-
GOZ 101-1-4438	Long bone	-19.0	8.9	33.5	11.7	3.3	-
GOZ 102-1-4403	Mandible	-18.1	8.6	33.1	11.1	3.5	-

Individual	*Anatomical element*	*δ^{13}C (‰)*	*δ^{15}N (‰)*	*%C*	*%N*	*C/N*	*%coll*
GOZ 102-2-4402	Long bone	-18.5	8.9	28.3	9.6	3.5	-
GOZ 107-1-4425	Long bone	-18.5	10.8	42.3	13.5	3.6	-
GOZ 110-1-4448	Rib	-18.2	10.2	42.2	14.4	3.4	-
GOZ 112-1-4467	Rib	-18.2	8.6	34.8	11.4	3.5	-
GOZ 112-2-4468	Rib	-18.4	8.4	38.7	13.1	3.5	-
GOZ 129-1-4538	Cranium	-18.9	8.8	36.3	13.7	3.1	-
GOZ 131-2-4550	Rib	-18.9	9.9	42.9	15.6	3.2	2.0
GOZ 131-3-4546	Long bone	-18.9	10.8	34.7	11.5	3.5	-
GOZ 132-2-4552	Rib	-19.0	10.3	40.0	13.2	3.5	-
GOZ 135-1-4568	Rib	-18.2	10.5	42.7	16.4	3.0	17.7
GOZ 158-1-4728	Cranium	-19.3	9.6	40.8	13.6	3.5	-
GOZ 162-4-4698	Long bone	-18.6	10.3	43.2	14.9	3.4	-
GOZ 200-1-4872	Long bone	-19.1	8.6	39.1	13.1	3.5	-
GOZ 220-1-4952	Vertebra	-18.8	9.8	38.1	12.7	3.5	-
GOZ 226-2-4985	Rib	-17.7	13.9	41.9	13.6	3.6	-
GOZ 230-1-5003	Long bone	-18.7	10.2	32.7	11.6	3.3	-
GOZ 5831-1-6150	Rib	-18.5	11.2	42.6	14.9	3.3	12.5
GOZ 5831-2-6150	Rib	-19.1	10.1	42.5	15.5	3.2	2.4
GOZ 6640-2-6644	Rib	-18.9	10.2	42.1	14.8	3.3	14.0
GOZ 6640-4-6644	Rib	-18.8	10.2	43.9	17.3	3.0	19.1
GOZ 6890-1-6891	Mandible	-18.5	11.5	25.6	8.7	3.4	-
BOA 009-1	Long bone	-18.6	9.8	39.1	14.0	3.3	3.0
BOA 012-1	Long bone	-18.4	11.5	40.3	15.4	3.1	3.1
BOA 014-1	Long bone	-17.9	10.7	37.7	14.4	3.0	2.0
BOA 015-1	Long bone	-18.1	11.0	41.6	13.9	3.5	4.0
BOA 016-1	Long bone	-18.1	10.8	39.8	14.9	3.1	2.7
BOA 017-1	Long bone	-18.4	10.2	34.0	12.9	3.1	3.4
BOA 018-1	Long bone	-18.0	12.1	43.6	16.6	3.1	4.9
BOA 019-1	Long bone	-18.2	10.2	40.1	15.6	3.0	3.1
BOA 021-1	Long bone	-18.4	11.4	39.4	15.0	3.1	3.3
BOA 026-1	Long bone	-18.2	10.6	34.0	11.3	3.5	1.5
BOA 030-1	Long bone	-18.7	10.5	30.9	11.7	3.1	1.4
BOA 034-1	Long bone	-18.7	10.2	39.5	15.1	3.1	5.1
BOA 039-1	Long bone	-18.9	10.3	35.1	13.2	3.1	1.0
BOA 044-1	Long bone	-18.6	10.5	38.5	13.8	3.3	1.7
BOA 047-1	Long bone	-18.3	11.3	40.9	15.1	3.2	4.7
BOA 048-1	Long bone	-18.5	10.3	40.3	15.5	3.0	3.4
BOA 050-1	Long bone	-18.4	10.2	14.1	5.4	3.0	0.9
BOA 051-1	Long bone	-18.4	9.7	40.8	14.5	3.3	3.4
BOA 055-1	Long bone	-18.5	9.3	29.7	10.5	3.3	1.4
BOA 055-2	Long bone	-18.5	9.4	40.8	14.6	3.3	3.4
BOA 058-1	Long bone	-18.3	10.3	37.7	12.4	3.5	2.7
BOA 061-1	Long bone	-18.5	10.0	41.3	14.5	3.3	4.5
BOA 065-1	Long bone	-18.5	9.9	34.1	13.3	3.0	1.8
BOA 068-1	Long bone	-18.8	10.2	15.0	5.7	3.1	0.6
BOA 069-1	Long bone	-18.6	9.5	36.1	13.1	3.2	0.7
BOA 069-2	Long bone	-18.7	9.2	39.0	14.2	3.2	0.6

Individual	*Anatomical element*	*δ¹³C (‰)*	*δ¹⁵N (‰)*	*%C*	*%N*	*C/N*	*%coll*
BOA 070-1	Long bone	-18.6	10.7	43.0	14.8	3.4	12.2
BOA 071-1	Long bone	-18.3	10.9	37.6	12.1	3.6	5.4
BOA 072-1	Long bone	-21.2	8.6	40.3	12.9	3.6	9.4
BOA 072-2	Long bone	-18.7	9.9	35.1	12.5	3.3	2.1
BOA 072-3	Long bone	-18.1	9.8	41.7	13.4	3.6	6.8
BOA 075-1	Long bone	-18.8	8.1	40.1	14.5	3.2	11.4
BOA 076-1	Long bone	-18.4	9.0	38.6	13.5	3.3	3.7
BOA 078-1	Long bone	-18.9	10.3	27.4	9.0	3.5	2.0
BOA 082-1	Long bone	-19.2	11.1	37.9	14.2	3.1	2.5
BOA 085-1	Long bone	-18.2	9.6	42.2	16.0	3.1	5.0
BOA 085-2	Long bone	-18.2	9.4	38.5	13.7	3.3	4.2
BOA 086-1	Long bone	-20.5	8.7	43.7	15.8	3.2	5.8
BOA 093-1	Long bone	-18.3	9.7	40.8	15.3	3.1	5.3
BOA 096-1	Long bone	-18.7	11.9	33.9	12.3	3.2	2.7
BOA 100-1	Long bone	-17.9	9.6	39.5	15.0	3.1	6.6
BOA 103-1	Long bone	-18.7	8.9	17.7	6.5	3.2	0.7
BOA 103-2	Metacarpal	-18.8	9.4	35.2	13.6	3.0	11.7
BOA 103-3	Long bone	-18.3	10.7	39.1	15.3	3.0	2.7
BOA 105-2	Fibula	-18.5	10.5	39.8	15.5	3.0	2.8
BOA 105-3	Long bone	-17.6	12.9	40.0	15.7	3.0	10.4
BOA 105-4	Long bone	-18.6	10.2	43.5	14.8	3.4	5.6
BOA 112-1	Long bone	-18.7	10.8	39.8	15.6	3.0	8.2
BOA 114-1	Long bone	-18.2	9.5	41.2	15.5	3.1	4.2
BOA 116-1	Long bone	-18.8	10.1	36.5	14.1	3.0	3.8
BOA 120-1	Long bone	-17.9	9.4	37.4	13.7	3.2	6.4
BOA 124-1	Metacarpal	-18.5	11.0	37.8	14.3	3.1	2.8
BOA 125-1	Long bone	-18.5	11.5	39.8	15.3	3.0	1.7
BOA 133-1	Long bone	-18.4	10.2	40.1	14.8	3.2	4.3
BOA 138-1	Long bone	-21.0	6.4	34.5	12.5	3.2	2.1
BOA 139-1	Long bone	-19.1	12.6	41.8	14.8	3.3	1.3
BOA 145-1	Long bone	-18.4	9.7	39.1	13.6	3.3	3.4
BOA 145-2	Cranium	-18.7	9.8	36.2	12.5	3.4	1.5
BOA 145-4	Cranium	-19.0	10.1	32.9	10.6	3.6	1.1
BOA 145-5	Long bone	-18.7	10.3	39.1	14.9	3.1	8.6
BOA 148-1	Long bone	-18.9	9.3	40.9	14.4	3.3	9.2
BOA 150-1	Long bone	-18.8	10.1	39.0	14.2	3.2	1.0
BOA 151-1	Long bone	-18.9	8.6	40.1	14.1	3.3	6.7
BOA 151-3	Long bone	-18.6	9.4	35.5	13.8	3.0	3.7
BOA 152-1	Long bone	-18.2	10.3	42.2	15.6	3.2	5.9
BOA 152-2	Long bone	-18.7	10.0	25.7	8.9	3.4	0.7
BOA 160-1	Long bone	-18.4	8.9	39.3	13.8	3.3	7.6
BOA 160-2	Long bone	-18.2	9.4	39.6	15.1	3.1	8.7
BOA 163-1	Long bone	-18.8	9.6	36.5	13.4	3.2	2.7
BOA 166A-1	Long bone	-18.3	10.3	39.7	15.0	3.1	7.9
BOA 174-1	Long bone	-18.8	9.7	38.7	14.8	3.1	11.0
BOA 177-1	Long bone	-18.7	9.7	33.9	12.4	3.2	3.1
BOA 178-1	Long bone	-18.5	10.5	39.4	13.7	3.4	5.1

Individual	*Anatomical element*	*$\delta^{13}C$ (‰)*	*$\delta^{15}N$ (‰)*	*%C*	*%N*	*C/N*	*%coll*
BOA 179-1	Long bone	-18.5	10.8	41.7	15.5	3.1	3.7
BOA 179-2	Long bone	-17.6	10.3	38.7	14.2	3.2	2.9
BOA 182-1	Long bone	-17.2	11.1	38.6	13.6	3.3	2.1
BOA 184-1	Long bone	-18.2	11.0	33.3	11.6	3.3	1.7
SNC 30100-1-30102	Rib	-19.5	11.5	42.8	14.0	3.6	0.6
SNC 30140-1-30143	Metatarsal	-18.4	11.2	41.7	13.8	3.5	0.7
SNC 30150-1-30152	Rib	-18.8	10.5	40.0	14.3	3.3	2.5
SNC 30170-1-30186	Rib	-18.2	11.5	38.6	12.8	3.5	0.8
SNC 30280-1-30283	Long bone	-18.2	10.8	36.3	12.6	3.4	0.6
SNC 30800-2-30802	Long bone	-19.0	10.7	39.8	13.9	3.3	1.4
SNC 30835-1-30837	Clavicle	-19.0	11.3	39.1	13.8	3.3	1.1
SNC 30865-1-30869	Metacarpal	-18.7	13.5	37.6	13.0	3.4	0.9
SNC 30880-1-30884	Rib	-18.2	11.1	41.0	14.5	3.3	0.9
SNC 33005-1-33004	Long bone	-18.7	10.8	38.4	12.9	3.5	0.6
SNC 33030-1-33032	Ulna	-19.0	10.7	36.8	12.8	3.3	0.8
SNC 33060-1-33064	Long bone	-19.3	10.2	21.3	7.5	3.3	0.6
LH 1-1-7023	Rib	-18.8	11.0	35.9	12.3	3.4	1.5
LH 2-1-7112	Rib	-19.8	8.4	29.3	10.1	3.4	1.0
LH 3-1-7132	Rib	-18.3	12.7	40.9	13.7	3.5	1.4
LH 4-1-7162	Long bone	-18.0	14.8	23.0	8.3	3.2	0.7
LH 7-1-7198	Rib	-18.8	12.1	23.3	8.0	3.4	0.7
LH 8-1-7202	Rib	-18.7	12.1	20.4	6.8	3.5	0.5
LH 9-1-7172	Rib	-19.0	9.8	25.7	8.5	3.5	0.6
ALD A008-1	Rib	-18.6	9.7	40.4	14.3	3.3	4.2
ALD A009-1	Rib	-18.7	9.9	37.8	13.4	3.3	0.8
ALD A011-1	Rib	-18.4	9.6	41.1	14.5	3.3	5.5
ALD B001-1	Humerus	-18.2	9.6	44.7	15.4	3.4	2.2
ALD B002-1	Rib	-18.0	10.3	42.8	15.6	3.2	1.3
ALD B003-1	Rib	-18.6	9.6	41.9	15.2	3.2	2.0
ALD B004-1	Rib	-17.3	9.5	42.1	15.0	3.3	2.9
ALD B005-1	Ulna	-17.6	10.0	46.2	16.6	3.3	1.1
ALD B006/B008-1/4#1	Cranium	-18.1	8.3	36.0	12.7	3.3	0.9
ALD B006/B008-1/4#2	Cranium	-18.4	8.3	34.4	11.5	3.5	0.5
ALD B012-1	Rib	-18.1	9.7	41.6	14.9	3.3	1.3
ALD B013-1	Rib	-18.0	9.0	44.3	16.0	3.2	3.7
ALD B014-1	Rib	-17.5	9.1	44.4	16.0	3.2	2.4
ALD B015-1	Rib	-18.6	9.2	42.9	15.5	3.2	3.9
ALD B016-1	Rib	-18.2	8.5	29.7	11.1	3.1	1.5
ALD B017-1	Rib	-18.7	8.7	41.7	15.0	3.3	1.2
ALD B018-1	Rib	-17.9	8.6	41.6	14.8	3.3	1.4
ALD B020-1	Fibula	-18.8	9.4	40.1	14.2	3.3	1.9
ALD B021-1	Rib	-18.3	8.4	39.8	14.0	3.3	1.5
ALD B022-1	Rib	-18.4	9.6	41.3	14.6	3.3	2.2
ALD B023-1	Rib	-18.9	10.0	40.0	13.6	3.4	0.7
ALD B024-1	Rib	-18.3	10.1	40.1	14.1	3.3	1.1
ALD B025-1	Rib	-18.8	10.0	41.0	14.5	3.3	0.8
ALD B026/B027-2(B027)	Mandible	-19.1	8.7	34.7	11.6	3.5	0.5

Individual	*Anatomical element*	$\delta^{13}C$ *(‰)*	$\delta^{15}N$ *(‰)*	*%C*	*%N*	*C/N*	*%coll*
ALD B028-1	Rib	-17.4	9.0	44.5	15.8	3.3	1.8
ALD B029/B043-01/10#1	Mandible	-18.2	8.2	25.2	9.7	3.0	0.6
ALD B029/B043-01/10#2	Mandible	-18.9	9.7	40.9	14.2	3.3	0.8
ALD B029/B043-01/10#3	Mandible	-18.3	9.1	40.8	14.1	3.4	1.2
ALD B029/B043-01/10#4	Mandible	-18.9	9.1	41.9	13.9	3.5	1.7
ALD B029/B043-11(B039)	Rib	-18.9	9.9	43.0	14.9	3.4	2.6
ALD B029/B043-12(B040)	Rib	-18.6	10.0	41.3	14.5	3.3	3.2
ALD B029/B043-15(B043)	Ulna	-18.4	10.0	44.7	15.7	3.3	1.8
ALD B044-1	Rib	-16.9	9.0	43.2	15.1	3.3	1.0
ALD B045/B047-1(B045)	Rib	-17.5	8.6	44.2	15.6	3.3	1.6
ALD B048/B054-1(B048)	Mandible	-19.2	8.4	43.3	15.1	3.4	1.3
ALD B055/B063-01(B055)	Ulna	-18.0	7.5	38.0	13.3	3.3	0.8
ALD B055/B063-02(B056)	Rib	-17.7	8.3	36.0	12.6	3.3	1.0
ALD B055/B063-03(B057)	Rib	-18.3	9.2	40.3	14.1	3.3	1.3
ALD B055/B063-04(B058)	Rib	-18.8	8.1	42.5	14.5	3.4	1.2
ALD B055/B063-06(B060)	Tibia	-17.0	8.8	43.4	15.2	3.3	1.1
ALD B055/B063-07(B061)	Rib	-18.2	8.9	41.3	14.3	3.4	0.6
ALD B055/B063-08(B062)	Rib	-18.2	9.1	42.9	14.8	3.4	1.0
ALD B064/B076-01(B064)	Rib	-18.8	9.6	39.7	13.9	3.3	0.5
ALD B064/B076-02(B065)	Rib	-17.4	9.1	38.9	13.5	3.3	0.8
ALD B064/B076-04(B067)	Clavicle	-18.5	9.2	44.4	15.7	3.3	1.0
ALD B064/B076-05(B068)	Mandible	-18.4	9.5	40.4	13.8	3.4	0.7
ALD B064/B076-08(B071)	Long bone	-18.3	9.3	41.8	14.7	3.3	1.3
ALD B064/B076-11(B074)	Rib	-19.6	9.5	41.9	14.3	3.4	0.5
ALD B064/B076-12(B075)	Tibia	-19.2	9.8	38.9	13.5	3.4	0.6
ALD B077/B087-01(B077)	Rib	-17.0	7.6	33.4	11.3	3.4	0.6
ALD B077/B087-02(B078)	Rib	-18.0	9.4	44.2	14.8	3.5	1.4
ALD B077/B087-03(B079)	Os coxae	-19.0	9.3	43.9	15.2	3.4	0.8
ALD B077/B087-07(B083)	Rib	-18.0	8.3	40.8	14.0	3.4	1.1
ALD B077/B087-08(B084)	Ulna	-20.8	8.2	42.7	14.3	3.5	1.1
ALD B077/B087-11(B087)	Rib	-18.2	9.1	38.8	13.5	3.4	0.6
ALD B088/B098-02(B089)	Radius	-17.6	8.4	42.8	14.8	3.4	0.8
ALD B088/B098-03(B090)	Fibula	-17.6	8.8	43.3	14.7	3.4	1.1
ALD B088/B098-04(B091)	Rib	-17.1	9.5	42.9	14.3	3.5	1.0
ALD B088/B098-05(B092)	Rib	-16.8	9.3	44.2	17.4	3.0	0.9
ALD B088/B098-06(B093)	Fibula	-18.5	8.7	42.2	14.0	3.5	1.8
ALD B088/B098-08(B095)	Radius	-18.6	8.9	35.9	12.1	3.5	0.9
ALD B088/B098-09(B096)	Rib	-17.6	9.7	37.3	12.7	3.4	0.6
ALD B088/B098-10(B097)	Humerus	-18.4	8.7	41.3	13.8	3.5	1.6
ALD B088/B098-11(B098)	Rib	-17.9	8.4	40.9	13.8	3.5	0.7
ALD B099/B101-1(B099)	Rib	-18.7	9.4	42.3	14.6	3.4	2.1
ALD B099/B101-3(B101)	Rib	-18.6	9.3	43.3	14.5	3.5	2.3
ALD B102/B103-1(B102)	Femur	-18.6	7.9	41.5	14.5	3.3	1.0
ALD B102/B103-2(B103)	Ulna	-18.4	9.3	42.9	14.3	3.5	0.9
ALD B104-1	Rib	-17.7	8.6	40.7	13.7	3.5	1.1
ALD B105-1	Rib	-18.5	9.0	42.4	14.0	3.5	0.9
FIN 02-1-44	Femur	-17.7	10.1	24.8	8.6	3.3	0.6

Individual	*Anatomical element*	*$\delta^{13}C$ (‰)*	*$\delta^{15}N$ (‰)*	*%C*	*%N*	*C/N*	*%coll*
FIN 07-1-57	Rib	-18.2	10.9	34.6	12.2	3.3	0.5
FIN 08-1-56	Rib	-18.2	10.8	41.2	14.7	3.3	1.3
FIN 09-1-60	Humerus	-18.2	10.1	29.2	10.1	3.4	0.5
FIN 14-1-73	Humerus	-17.5	10.6	24.9	8.6	3.4	1.1
FIN 15-1-74	Tibia	-18.4	10.6	36.3	12.7	3.3	0.7
SMD 2811-1-2810(181)	Rib	-19.1	10.1	33.0	10.6	3.6	22.5
SMD 2841-1-2840(184)	Rib	-18.0	9.2	33.9	11.3	3.5	18.5
SMD 2871-1-2870(187)	Rib	-17.8	9.7	41.0	16.0	3.0	14.4
SMD 2901-1-2900(190)	Rib	-17.1	9.4	30.3	11.2	3.2	12.8
SMD 2961-1-2960(196)	Rib	-17.7	9.7	37.0	14.4	3.0	12.4
SMD 2961-2-2970(197)	Rib	-18.2	9.7	34.1	11.0	3.6	6.6
SMD 2981-1-2990(199)	Rib	-19.1	9.8	29.3	10.1	3.4	16.3
SMD 2981-2-3120(212)	Rib	-19.5	10.2	39.6	13.2	3.5	12.9
SMD 2981-3-3030(203)	Rib	-21.4	5.4	21.4	6.9	3.6	6.0
SMD 2981-4-2980(198)	Rib	-18.9	9.1	34.3	12.9	3.1	6.8
SMD 3021-1-3020(202)	Rib	-19.5	9.7	28.8	9.6	3.5	21.5
SMD 3061-1-3060(206)	Rib	-20.3	9.7	25.7	8.3	3.6	13.7
SMD 3081-1-3080(208)	Rib	-19.1	9.4	45.4	14.6	3.6	9.4
SMD 3091-1-3090(209)	Rib	-19.2	8.8	34.5	11.5	3.5	9.2
SMD 3151-1-3150(215)	Rib	-18.9	9.8	37.1	12.8	3.4	11.1
SMD 3161-1-3160(216)	Rib	-19.2	9.7	35.1	11.7	3.5	19.0
SMD 3461-1-3460(246)	-	-18.7	10.8	40.7	14.4	3.3	-
SMD 3461-2-3460	-	-19.4	9.3	40.1	14.6	3.2	-
CG 053-1-0420	Rib	-19.3	9.5	34.8	12.3	3.3	4.1
CG 053-2-0421	Rib	-18.8	10.0	38.0	13.6	3.3	9.1
CG 080-1-0393	Rib	-19.0	9.8	38.9	13.7	3.3	4.2
CG 192-1-0353	Tibia	-20.2	8.5	16.7	5.9	3.3	0.9
CG 220-1-0433	Rib	-18.8	10.3	15.9	5.6	3.3	1.5
CG 254-1-0623	Rib	-18.9	10.6	19.6	6.5	3.5	1.0
CG 295-1-0704	Femur	-18.8	10.1	22.6	7.8	3.4	1.0
CG 370-1-0916	Femur	-19.6	9.9	25.1	8.8	3.3	1.6
CG 373-1-0823	Rib	-20.3	10.0	30.2	10.9	3.2	2.5
CG 374-2-1473	Rib	-19.4	9.0	14.6	5.3	3.2	0.8
CG 381-1-0840	Rib	-18.6	10.0	32.1	11.4	3.3	5.4
CG 382-1-0837	Rib	-18.3	9.9	38.4	13.7	3.3	8.1
CG 385-1-0853	Rib	-19.3	9.8	16.1	5.3	3.5	2.2
CG 391-1-0925	Os coxae	-19.3	9.3	18.3	6.1	3.5	1.3
CG 444-1-0957	Humerus	-20.7	8.6	14.0	4.9	3.3	1.0
CG 512-1-1440	Humerus	-18.8	8.7	26.7	9.4	3.3	5.5
PMCV 014-1-109	Femur	-18.8	9.0	40.5	13.8	3.4	1.6
PMCV 015-1-130	Rib	-18.6	9.3	38.2	13.5	3.3	0.9
PMCV 016-1-103	Rib	-17.3	11.7	37.2	12.5	3.5	2.6
PMCV 016-2-102	Rib	-17.8	10.3	39.0	13.3	3.4	5.6
PMCV 018-1-114	Rib	-19.1	8.7	38.3	12.5	3.6	0.5
PMCV 019-1-139	Rib	-18.1	9.4	36.3	12.9	3.3	3.9
PMCV 020-1-122	Rib	-18.6	8.8	39.2	13.8	3.3	1.5
PMCV 021-1-160	Rib	-19.2	9.7	41.8	14.5	3.4	1.5

Individual	*Anatomical element*	*$\delta^{13}C$ (‰)*	*$\delta^{15}N$ (‰)*	*%C*	*%N*	*C/N*	*%coll*
PMCV 022-1-118	Rib	-19.8	8.2	35.3	12.4	3.3	0.5
PMCV 022-2-116	Rib	-18.9	8.8	40.1	13.3	3.5	0.9
PMCV 023-1-134	Rib	-18.3	9.2	39.2	13.9	3.3	4.0
PMCV 043-1-350	Rib	-18.9	9.0	41.6	14.1	3.4	1.7
PMCV 044-1-469/470	Rib	-18.8	8.9	41.3	14.1	3.4	1.2
PMCV 045-1-412	Rib	-19.3	9.0	41.6	14.8	3.3	2.5
PMCV 046-1-444	Tibia	-18.5	9.1	41.1	13.7	3.5	2.7
PMCV 046-4-446	Metacarpal	-18.0	8.4	42.5	14.6	3.4	3.8
PMCV 048-1-353	Long bone	-19.0	9.1	30.7	10.8	3.3	1.6
PMCV 049-1-451	Rib	-19.4	9.4	36.5	12.1	3.5	0.7
PMCV 050-1-458/472	Femur	-19.1	12.9	35.4	12.6	3.3	6.2
PMCV 051-1-454	Rib	-18.6	9.0	41.3	14.6	3.3	3.7
PMCV 057-1-420/449	Long bone	-19.0	8.4	38.4	13.2	3.4	2.1
RVSM 014-1-086(014a)	Rib	-17.8	12.9	18.7	6.6	3.3	4.4
RVSM 020-2-096(037)	Rib	-17.9	10.1	36.4	12.7	3.3	4.0
RVSM 022-1-100(025)	Rib	-18.8	9.6	21.3	7.5	3.3	2.7
RVSM 024-2-118(027b)	Ulna	-17.9	10	34.7	12.0	3.4	2.3
RVSM 031-2-128(035)	Rib	-18.7	10.1	27.5	9.7	3.3	3.0
RVSM 032-4-129(038a3)	Ulna	-18.9	10.3	26.6	9.3	3.3	3.9
RVSM 115-1-386(128)	Rib	-18.8	9.9	15.8	5.6	3.3	1.4
RVSM 117-1-393(130)	Rib	-17.6	9.5	25.0	8.9	3.3	2.6
RVSM 118-1-394(131)	Tibia	-18.7	9.6	23.8	8.4	3.3	2.1
RVSM 127-1-412(140)	Tibia	-18.2	9.7	13.6	4.9	3.2	1.2
RVSM 128-1-413(141)	Rib	-19.3	9.5	16.1	5.5	3.4	1.0
RVSM 129-1-415(142a)	Rib	-19.0	9.3	20.9	7.4	3.3	2.6
RVSM 141-1-436(152)	Rib	-18.8	9.2	22.3	7.9	3.3	2.1
RVSM 154-2-462(165b)	Radius	-19.3	8.4	27.2	9.8	3.2	2.4
RVSM 154-3-462(165a)	Ulna	-19.4	7.7	44.7	15.8	3.3	1.5

Table 7.10. Excluded carbon and nitrogen stable isotope measurements of humans, including collagen quality criteria. For a few measurements it is not possible to determine with confidence which individual was sampled. Then, the range of individuals the measurement could come from is indicated in the column *Individual* with a slash sign in the second figure (e.g. GOZ 150-1/2-4638 indicates the radiocarbon date may come from individual GOZ 150-1-4638 or GOZ 150-2-4638). Figures highlighted in grey correspond to the indicators where samples did not meet the criteria for well preserved collagen. Some samples are missing information on collagen yield because these data were not collected during pretreatment. Some samples are missing data on elemental composition because low collagen yield indicated poor collagen preservation, so they were excluded from further measurements. There are also seven samples with acceptable collagen yields missing elemental composition due to technical issues. In these cases collagen quality could not be assessed, so these samples were excluded from the final dataset. Some samples are missing isotopic measurements because isotopic signal was so weak it could not be recorded or because they were omitted from IRMS measurement due to previous check of poor collagen preservation based on collagen yield or elemental composition.

Individual	*Anatomical element*	*$\delta^{13}C$ (‰)*	*$\delta^{15}N$ (‰)*	*%C*	*%N*	*C/N*	*%coll*
GOZ 150-1/2-4638	Cranium	-19.8	11.0	8.6	2.8	3.6	-
GOZ 206-1-4891	Cranium	-22.3	12.1	1.5	1.0	1.7	-
GOZ 236-2-5070	Long bone	-21.9	8.0	2.7	1.2	2.6	-
BOA 002-1	Long bone	-18.7	7.2	40.6	23.8	2.0	6.6
BOA 004-1	Long bone	-19.1	9.1	7.5	3.0	2.9	0.7
BOA 007-1	Long bone	-	-	-	-	-	0.1

Individual	*Anatomical element*	$\delta^{13}C$ *(‰)*	$\delta^{15}N$ *(‰)*	*%C*	*%N*	*C/N*	*%coll*
BOA 035-1	Long bone	-19.2	9.9	12.2	4.4	3.2	0.8
BOA 051-2	Long bone	-22.7	0.0	0.0	0.4	0.0	1.1
BOA 080-1	Long bone	-18.4	11.2	33.4	10.4	3.7	1.2
BOA 103-4	Long bone	-20.2	6.3	1.0	0.4	2.9	1.1
BOA 108-1	Long bone	-	-	1.0	1.0	1.2	0.6
BOA 145-3	Long bone	-18.9	9.5	8.7	3.7	2.8	1.4
BOA 151-2	Long bone	-19.1	7.4	7.9	3.2	2.9	0.9
SNC 30105-1-30108	Maxilla	-22.5	8.2	2.6	1.3	2.3	0.5
SNC 30110-1/3-30111	Long bone	-19.1	9.4	-	-	-	0.8
SNC 30130-1-30134	Long bone	-18.5	12.7	39.4	13.1	3.5	0.3
SNC 30180-1-30182	Long bone	-20.0	8.1	4.7	2.0	2.7	0.5
SNC 30270-1-30272	Long bone	-21.0	9.0	7.6	3.0	3.0	0.4
SNC 30740-1-30742	Long bone	-23.8	7.9	-	-	-	0.3
ALD A010-1	Rib	-	-	-	-	-	<0.1
ALD B011-1	Rib	-19.9	7.6	17.5	10.7	1.9	0.4
ALD B019-1	Rib	-18.2	9.1	41.1	14.2	3.4	0.4
ALD B026/B027-1(B026)	Mandible	-19.1	9.4	36.0	12.6	3.3	0.3
ALD B029/B043-14(B042)	Mandible	-17.9	9.6	37.6	12.7	3.5	0.4
ALD B045/B047-2(B046)	Humerus	-19.3	9.1	38.7	12.8	3.5	0.4
ALD B045/B047-3(B047)	Cranium	-20.8	8.4	23.4	7.4	3.7	0.2
ALD B055/B063-05(B059)	Humerus	-18.5	9.1	41.4	13.7	3.5	0.4
ALD B055/B063-09(B063)	Rib	-19.4	8.5	32.7	10.5	3.6	0.1
ALD B064/B076-06(B069)	Ulna	-18.7	9.1	40.7	14.3	3.3	0.3
ALD B064/B076-07(B070)	Ulna	-18.3	8.0	26.0	10.9	2.8	0.6
ALD B064/B076-09(B072)	Cranium	-18.2	9.9	40.5	14.0	3.4	0.4
ALD B064/B076-10(B073)	Rib	-19.3	9.4	39.5	13.5	3.4	0.3
ALD B064/B076-13(B076)	Rib	-19.1	8.8	34.9	12.0	3.4	0.3
ALD B077/B087-05(B081)	Cranium	-19.6	8.0	34.5	15.5	2.6	0.1
ALD B077/B087-06(B082)	Cranium	-19.2	9.2	29.2	19.6	1.7	0.1
ALD B077/B087-09(B085)	Rib	-20.1	8.3	20.4	7.1	3.4	0.3
ALD B077/B087-10(B086)	Ulna	-19.0	9.0	31.5	11.1	3.3	0.3
ALD B088/B098-01(B088)	Rib	-19.3	8.8	28.6	9.9	3.4	0.3
ALD B088/B098-07(B094)	Fibula	-18.5	7.9	13.4	9.1	1.7	0.3
ALD B099/B101-2(B100)	Rib	-	-	-	-	-	0.3
FIN 03-1-50	Humerus	-25.0	9.5	1.4	0.2	9.9	0.6
FIN 06-1-53	Tibia	-17.1	10.1	13.3	4.7	3.3	1.6
FIN 13-1-30	Long bone	-18.7	6.7	8.6	2.6	3.8	0.5
CG 094-1-1231	Rib	-21.0	10.2	3.2	1.2	3.1	0.5
CG 094-2-1230	Rib	-19.5	10.6	7.5	2.6	3.4	0.9
CG 296-1-0701	Femur	-20.4	10.5	13.9	5.0	3.2	0.4
CG 371-1-0794	Rib	-23.5	11.4	-	-	-	0.4
CG 372-1-0797	Femur	-19.6	8.8	-	-	-	0.7
CG 374-1-1695	Rib	-20.9	9.1	7.7	2.8	3.2	1.4
CG 380-1-0826	Humerus	-19.4	10.6	7.6	2.3	3.9	0.7
CG 387-1-0746	Femur	-19.7	9.6	9.1	3.2	3.3	1.0
CG 392-1-0856	Rib	-28.9	6.9	-	-	-	0.7
CG 392-2-0855	Rib	-19.0	10.0	-	-	-	2.9

Individual	*Anatomical element*	$\delta^{13}C$ *(‰)*	$\delta^{15}N$ *(‰)*	*%C*	*%N*	*C/N*	*%coll*
CG 393-1-0875	Rib	-19.0	10.2	-	-	-	2.2
CG 393-2-0874	Rib	-23.0	8.1	-	-	-	0.8
CG 395-1-0879	Rib	-22.7	6.9	-	-	-	0.7
CG 411-1-0901	Rib	-24.2	6.8	-	-	-	0.4
CG 443-1-0953	Rib	-23.3	8.2	2.3	0.7	3.8	0.9
CG 445-1-0960	Rib	-19.9	8.0	10.0	3.4	3.4	0.8
CG 446-1-0964	Long bone	-20.5	7.5	3.6	1.3	3.2	0.6
CG 447-1-0968	Rib	-18.4	9.3	35.2	12.6	3.3	0.2
CG 453-1-1315	Long bone	-20.3	8.3	6.9	2.4	3.4	1.5
CG 477- 1-1434	Rib	-19.1	10.4	12.7	4.5	3.3	4.8
CG 511-1-1437	Femur	-19.1	9.8	9.7	3.5	3.2	2.9
CG 519-1-1480	Rib	-19.3	8.8	12.7	4.4	3.4	1.5
CG 597-1-1656	Rib	-19.5	8.5	6.8	2.5	3.2	2.0
CG 598-1-1646	Femur	-24.4	-	1.3	0.1	15.2	1.7
CG 692-1-1794	Tibia	-19.3	10.2	5.9	2.1	3.3	1.8
PMCV 019-2-141	Long bone	-21.6	4.1	1.9	0.6	3.4	0.5
PMCV 046-2-445	Rib	-18.7	9.5	17.3	5.3	3.8	0.3
RVSM 002-1-027(003)	Femur	-18.9	10.3	7.0	2.6	3.1	1.5
RVSM 003-1-056(004a)	Rib	-19.8	9.1	4.8	1.5	3.7	2.3
RVSM 004-1-057(005)	Long bone	-19.9	9.4	2.8	1.0	3.3	2.8
RVSM 007-1-060(010)	Tibia	-19.3	10.9	6.8	2.4	3.3	2.1
RVSM 009-1-062(012)	Rib	-21.3	8.1	1.4	0.8	2.0	1.0
RVSM 010-1-078(013)	Rib	-19.7	10.0	6.5	2.3	3.3	0.9
RVSM 011-1-079(016a)	Rib	-19.3	10.8	1.6	0.7	2.7	0.7
RVSM 018-1-092(021)	Rib	-19.0	10.4	5.9	2.1	3.3	0.8
RVSM 020-1-096(023)	Rib	-27.1	4.8	0.3	0.1	3.5	0.4
RVSM 023-1-107(026)	Temporal	-26.0	7.2	0.7	0.1	8.2	0.9
RVSM 024-1-118(027a)	Rib	-22.5	8.6	1.0	0.2	5.8	0.8
RVSM 025-1-117(032)	Cranium	-24.2	6.1	0.9	0.1	10.5	1.0
RVSM 029-1-095(033)	Rib	-18.1	11.4	11.0	3.9	3.3	1.0
RVSM 031-1-128(036)	Tibia	-20.8	6.8	1.1	0.7	1.8	1.0
RVSM 032-1-130(038b)	Rib	-19.6	8.6	3.8	1.3	3.4	0.9
RVSM 032-2-129(038a1)	Humerus	-19.6	8.5	2.4	0.9	3.1	0.8
RVSM 032-3-129(038a2)	Humerus	-19.4	7.6	3.2	1.1	3.4	0.7
RVSM 033-1-132(039)	Rib	-19.0	10.1	8.7	3.1	3.3	1.3
RVSM 034-1-143(040)	Long bone	-19.2	9.6	6.6	2.3	3.3	0.5
RVSM 035-1-146(041)	Rib	-20.2	8.1	1.8	0.7	3.0	0.6
RVSM 038-1-156(047)	Rib	-17.7	11.3	13.3	4.6	3.4	1.8
RVSM 038-2-155(046a)	Humerus	-19.1	9.3	4.7	1.6	3.4	1.1
RVSM 038-3-155(046b)	Humerus	-19.6	9.3	4.6	1.4	3.8	0.7
RVSM 042-1-158(050)	Femur	-19.7	9.0	3.1	1.1	3.3	1.4
RVSM 048-1-170(056)	Rib	-19.1	9.2	5.2	1.8	3.4	0.6
RVSM 049-1-171(057)	Radius	-19.1	9.3	10.4	3.7	3.3	1.1
RVSM 051-1-152(059b)	Rib	-21.2	10.4	1.0	0.7	1.7	0.5
RVSM 052-1-173(060a)	Long bone	-19.9	9.1	2.9	1.0	3.4	0.7
RVSM 052-2-173(060b)	Tibia	-18.8	13.0	3.5	1.2	3.4	0.7
RVSM 053-1-174(061)	Rib	-19.6	6.8	11.8	4.1	3.4	1.2

Individual	*Anatomical element*	*δ¹³C (‰)*	*δ¹⁵N (‰)*	*%C*	*%N*	*C/N*	*%coll*
RVSM 054-1-176(062)	Rib	-19.4	9.0	5.8	2.0	3.4	0.9
RVSM 055-1-177(063)	Rib	-22.6	5.6	2.4	0.7	4.0	0.4
RVSM 055-2-177(087a)	Long bone	-19.2	9.2	5.6	1.9	3.4	0.1
RVSM 056-1-178(064a)	Metacarpal	-18.8	7.9	12.7	4.5	3.3	0.2
RVSM 060-1-184(068)	Rib	-18.0	9.9	18.9	6.7	3.3	0.3
RVSM 062-1-194(070)	Rib	-18.7	9.7	9.6	3.3	3.4	0.2
RVSM 064-1-200(074)	Rib	-19.8	8.4	2.8	1.0	3.3	0.1
RVSM 064-2-199(073)	Tibia	-20.8	9.5	5.3	1.8	3.4	0.2
RVSM 113-1-384(126)	Rib	-22.6	7.8	1.4	0.7	2.3	0.1
RVSM 114-1-385(127)	Rib	-23.7	5.9	0.7	0.2	4.1	0.4
RVSM 116-1-387(129b)	Zygoma, maxilla	-20.0	9.1	9.2	3.1	3.5	0.8
RVSM 116-2-387(129a	Rib	-19.6	9.9	4.3	1.4	3.6	0.6
RVSM 120-1-396(133)	Long bone	-21.3	5.4	1.5	0.7	2.5	0.7
RVSM 121-1-398(134a)	Rib	-23.1	7.2	2.5	1.0	2.9	0.8
RVSM 121-2-398(134b)	Tibia	-19.5	8.6	6.0	2.1	3.3	0.6
RVSM 124-1-401(137)	Clavicle	-21.6	8.4	6.5	2.3	3.3	0.7
RVSM 125-1-402(138)	Rib	-20.7	9.0	1.3	0.7	2.2	0.6
RVSM 130-1-416(143)	Rib	-19.5	8.4	6.4	2.2	3.4	0.9
RVSM 142-1-437(153)	Rib	-24.1	5.7	0.8	0.2	4.7	0.4
RVSM 146-1-454(157)	Rib	-18.8	9.0	12.2	4.4	3.2	1.1

Table 7.11. Carbon and nitrogen stable isotope measurements of fauna, including collagen quality criteria. Some samples are missing information on collagen yield because these data were not collected during pretreatment. Key: Taxon: d = domesticus; Anatomical element: Undet = undetermined, U = upper, L = lower, dec = deciduous, prox = proximal, interm = intermediate, dist = distal.

Individual	*Taxon*	*Anatomical element*	*δ¹³C (‰)*	*δ¹⁵N (‰)*	*%C*	*%N*	*C/N*	*%coll*
GOZ F5053-S	Sus scrofa d	Metatarsal	-20.4	8.3	43.8	15.9	3.2	15.0
GOZ F5056-B	Bos taurus	Humerus	-20.3	9.0	38.3	13.9	3.2	2.9
GOZ F5086-S(1)	Sus scrofa d	Mandible	-19.3	8.0	42.3	14.2	3.5	-
GOZ F5086-S(2)	Sus scrofa d	Mandible	-19.2	7.9	42.2	15.1	3.3	4.4
GOZ F5321-B	Bos taurus	Cranium	-18.8	9.4	42.0	15.1	3.2	6.5
GOZ F5412-B	Bos taurus	Metatarsal	-18.2	7.0	42.0	14.1	3.5	-
GOZ F5412-E	Equus sp	Phalanx prox	-21.3	6.9	43.9	15.9	3.2	6.4
GOZ F5711-S	Sus scrofa d	Scapula	-19.9	8.1	43.3	14.3	3.5	-
GOZ F5722-B	Bos taurus	Metapodial	-20.4	6.1	43.3	14.4	3.5	-
GOZ F5722-E	Equus sp	Metatarsal	-19.6	8.4	42.9	14.3	3.5	-
GOZ F5737-E	Equus sp	Phalanx prox	-19.0	8.6	41.4	13.9	3.5	-
GOZ F5737-OC	Ovis/Capra	Phalanx dist	-19.5	8.7	40.8	14.5	3.3	1.0
GOZ F5802-B	Bos taurus	Mandible	-18.7	8.9	40.8	14.7	3.2	4.5
GOZ F5802-E	Equus sp	Scapula	-19.9	8.1	43.5	16.5	3.1	9.4
GOZ F5802-OC	Ovis/Capra	Ulna	-19.2	8.1	44.0	14.7	3.5	-
GOZ F5851-C	Capra hircus	Metapodial	-18.1	7.8	42.8	15.5	3.2	-
GOZ F5896-S	Sus scrofa d	Scapula	-19.7	8.0	42.6	14.2	3.5	-
GOZ F6181-A	Avis	Tibiotarsal	-18.4	9.4	41.3	16.3	2.9	2.6
GOZ F6181-O	Ovis aries	Femur	-19.8	6.8	35.0	11.6	3.5	-
GOZ F6192-A(1)	Avis	Undet	-21.0	3.9	43.8	14.5	3.5	-
GOZ F6621-OC	Ovis/Capra	Phalanx prox	-20.3	8.4	42.8	15.4	3.2	8.0

Individual	*Taxon*	*Anatomical element*	*δ^{13}C (‰)*	*δ^{15}N (‰)*	*%C*	*%N*	*C/N*	*%coll*
GOZ F6761-E	Equus sp	Mandible	-19.3	9.9	41.8	15.8	3.1	11.0
GOZ F6781-B	Bos taurus	Phalanx prox	-20.8	5.7	43.1	15.4	3.3	-
ASI F01.1-A	Avis	Scapula	-19.1	9.6	41.6	14.6	3.3	6.7
ASI F01.1-OC	Ovis/Capra	Metapodial	-19.9	9.4	38.6	13.7	3.3	1.9
ASI F01.1-S	Sus scrofa d	Tibia	-20.3	8.0	42.6	15.1	3.3	5.9
ASI F01.3-CN	Canis familiaris	Astragalus	-18.0	10.0	37.1	13.1	3.3	0.7
ASI F05.1-S	Sus scrofa d	Femur	-19.5	8.9	40.9	14.5	3.3	4.9
ASI F08.2-E	Equus sp	Metacarpal	-21.0	6.1	30.1	10.4	3.4	1.4
ASI F09.1-E	Equus sp	Metacarpal	-19.6	8.5	40.0	14.2	3.3	3.5
ASI F09.1-OC	Ovis/Capra	Humerus	-20.1	7.7	42.1	14.9	3.3	6.3
ASI F15.1-A	Avis	Coracoid	-19.0	10.0	42.7	15.1	3.3	9.8
ASI F15.1-S	Sus scrofa d	Tibia	-19.7	7.9	35.7	12.7	3.3	2.2
ASI F24.3-B	Bos taurus	Scapula	-20.2	9.5	44.3	15.9	3.2	6.5
ASI F29.1-E	Equus sp	Mandible	-22.2	7.0	31.1	11.0	3.3	13.5
ASI F33.2-B	Bos taurus	Scapula	-19.4	7.4	39.7	14.2	3.3	3.4
BOA F025-B	Bos taurus	Astragalus	-20.3	8.3	39.6	14.2	3.3	1.9
BOA F025-E	Equus sp	Metapodial	-19.8	9.4	41.2	14.8	3.3	5.8
BOA F051-C	Capra hircus	Astragalus	-20.1	7.8	38.7	13.8	3.3	3.6
BOA F053-A	Avis	Tarsalmetatarsal	-21.6	9.8	37.1	13.0	3.3	5.6
BOA F155-S	Sus scrofa d	Phalanx interm	-19.9	8.4	41.5	14.8	3.3	0.5
BOA F166A-OC	Ovis/Capra	Calcaneus	-20.6	7.8	41.5	14.7	3.3	9.6
BOA F169-OC	Ovis/Capra	Metacarpal	-20.6	7.2	42.4	15.1	3.3	8.8
SNC F30047-A(1)	Avis	Coracoid	-19.0	10.6	38.2	14.2	3.1	5.9
SNC F30047-A(2)	Avis	Femur	-19.5	11.2	40.2	14.4	3.3	0.5
SNC F30047-B	Bos taurus	Tibia	-21.1	5.2	40.1	14.7	3.2	1.7
SNC F31371-S	Sus scrofa d	Metatarsal	-19.9	7.7	35.9	13.0	3.2	1.4
SNC F31373-B	Bos taurus	Calcaneus	-21.2	7.0	37.3	13.5	3.2	0.5
SNC F31373-O	Ovis aries	Tibia	-20.4	9.2	42.3	15.4	3.2	6.3
SNC F31374-B	Bos taurus	Phalanx prox	-20.4	7.5	41.4	14.8	3.3	1.6
SNC F31374-C(1)	Capra hircus	Tibia	-20.7	8.3	41.4	14.7	3.3	1.6
ALD FB021-B	Bos taurus	Molar	-22.0	5.8	27.8	9.0	3.6	4.5
ALD FB024-OC(1)	Ovis/Capra	L M3	-21.1	7.8	37.4	13.2	3.3	4.6
ALD FB024-OC(3)	Ovis/Capra	L M1/M2	-21.0	8.1	41.5	14.5	3.3	7.2
ALD FB025-OC	Ovis/Capra	L M1/M2 inf	-21.5	8.1	40.6	13.5	3.5	4.3
ALD FB029/B043-B(1)	Bos taurus	Phalanx interm	-21.9	4.8	33.6	11.3	3.5	1.4
ALD FB029/B043-B(2)	Bos taurus	U P4 dec	-22.2	6.7	28.1	9.9	3.3	3.6
ALD FB048/B054-B	Bos taurus	U M1/M2	-22.4	5.7	28.5	9.4	3.5	1.7
ALD FB064/B076-OC(1)	Ovis/Capra	Molar	-21.6	6.1	40.8	14.1	3.4	5.3
ALD FB077/B087-CN	Canis familiaris	U canine	-20.5	10.1	42.4	14.9	3.3	8.3
SMD F023-B	Bos taurus	Phalanx prox	-21.7	7.7	14.0	5.3	3.1	3.5
SMD F023-OC(1)	Ovis/Capra	Metatarsal	-21.2	6.3	30.7	11.2	3.2	14.4
SMD F023-OC(2)	Ovis/Capra	L M1/2	-19.8	7.7	36.2	13.7	3.1	8.4
SMD F023-S(1)	Sus scrofa d	Calcaneus	-20.6	4.7	37.8	12.2	3.6	5.6
SMD F023-S(2)	Sus scrofa d	U M3	-21.5	6.4	33.6	11.2	3.5	11.7
SMD F074-B	Bos taurus	U P3	-22.1	5.0	40.6	13.1	3.6	8.2
SMD F074-OC	Ovis/Capra	U M1/2	-20.6	8.0	39.7	15.1	3.1	3.8
SMD F074-S(1)	Sus scrofa d	L M1/2	-20.8	6.3	38.4	12.4	3.6	5.3

Individual	*Taxon*	*Anatomical element*	$\delta^{13}C$ *(‰)*	$\delta^{15}N$ *(‰)*	*%C*	*%N*	*C/N*	*%coll*
SMD F074-S(2	Sus scrofa d	Metapodial	-20.8	6.9	37.0	13.6	3.2	6.4
SMD F161-B	Bos taurus	L P3	-20.2	5.7	38.6	14.4	3.1	7.2
SMD F206-B	Bos taurus	Metacarpal	-20.5	3.9	41.6	15.7	3.1	4.0
SMD F209-S	Sus scrofa d	L incisor	-21.3	4.6	41.6	15.5	3.1	9.8
SMD F227-S	Sus scrofa d	L M1/2	-19.3	7.1	28.0	10.3	3.2	16.1
SMD F241-C	Capra hircus	L M3	-20.9	5.5	42.2	16.1	3.1	5.9
SMD F241-S	Sus scrofa d	Ulna	-20.3	4.7	39.0	14.5	3.1	6.1
SMD F348-B	Bos taurus	L incisor	-21.5	5.5	38.4	13.8	3.2	9.1
SMD F373-B	Bos taurus	L M1/2	-20.7	5.5	33.8	10.9	3.6	12.1
SMD F373-OC	Ovis/Capra	U M1/2	-21.1	9.8	15.2	5.7	3.1	5.4
CG F102-1788-B(1)	Bos taurus	Tibia	-19.9	6.1	13.6	5.0	3.2	1.3
CG F102-1788-OC(1)	Ovis/Capra	Tibia	-20.1	6.3	15.6	5.6	3.3	1.7
CG F102-1788-OC(2)	Ovis/Capra	Tibia	-19.7	4.0	14.6	5.3	3.2	2.9
CG F102-1788-S	Sus scrofa d	Humerus	-18.8	9.2	26.9	9.6	3.3	1.3
CG F350-0869-F	Felis catus	Tibia	-18.3	7.7	23.5	8.3	3.3	3.4
CG F350-0928-OC(2)	Ovis/Capra	Tibia	-20.4	4.8	17.0	5.9	3.4	1.5
CG F350-0985-AG	Gallus gallus d	Coracoid	-18.1	8.6	39.9	14.1	3.3	0.8
CG F350-1384-B	Bos taurus	Humerus	-19.6	4.2	16.3	5.9	3.2	2.1
CG F374-0830-AG	Gallus gallus d	Tibiotarsus	-18.2	9.2	18.0	6.5	3.2	3.7
CG F374-0830-CN(1)	Canis familiaris	Tibia	-18.3	8.3	16.3	5.9	3.2	1.4
CG F374-0830-CN(3)	Canis familiaris	Tibia	-19.2	8.0	17.0	6.2	3.2	2.1
CG F374-0830-F(2)	Felis catus	Femur	-20.0	6.5	14.0	4.9	3.3	1.6
CG F637-1746-AG	Gallus gallus d	Tarsalmetatarsal	-19.1	7.9	18.8	6.4	3.4	4.5
CG F660-1789-AG	Gallus gallus d	Tibiotarsus	-17.4	7.8	16.5	5.9	3.3	1.8
CG F660-1789-OC(2)	Ovis/Capra	Tibia	-18.8	7.2	27.6	10.0	3.2	2.9
HCT F13-39-B	Bos taurus	Long bone	-19.3	5.2	29.3	9.9	3.5	0.7
HCT F13-39-OC	Ovis/Capra	Rib	-20.1	7.6	38.8	13.8	3.3	5.4
HCT F13-39-S	Sus scrofa d	Scapula	-20.2	6.4	16.2	5.7	3.3	0.7
HCT F16-46-B	Bos taurus	Long bone	-18.9	4.7	26.7	9.6	3.2	2.0
HCT F16-46-OC(1)	Ovis/Capra	Mandible	-19.8	4.8	19.1	6.7	3.3	0.8
HCT F16-46-OC(2)	Ovis/Capra	Mandible	-19.6	4.0	16.7	5.7	3.4	0.9
HCT F16-46-S	Sus scrofa d	Calcaneus	-20.8	6.1	33.3	11.9	3.3	2.1
PMCV F12-022-OC	Ovis/Capra	Radius	-19.7	2.6	34.8	12.6	3.2	3.0
PMCV F12-022-S	Sus scrofa d	Mandible	-19.5	5.6	20.3	7.2	3.3	1.2
PMCV F12-164-B	Bos taurus	Tibia	-20.7	4.9	13.4	5.0	3.1	0.5
PMCV F12-164-OC(1)	Ovis/Capra	Mandible	-19.8	3.6	32.4	11.8	3.2	2.6
PMCV F12-164-OC(2)	Ovis/Capra	Mandible	-19.9	4.7	37.1	13.5	3.2	7.0
PMCV F12-164-OC(3)	Ovis/Capra	Mandible	-20.3	3.4	35.3	12.6	3.3	2.3
PMCV F12-164-S(1)	Sus scrofa d	Mandible	-20.2	5.5	29.9	10.9	3.2	1.4
PMCV F12-164-S(2)	Sus scrofa d	Mandible	-20.2	4.3	28.9	10.4	3.2	0.5
RVSM F0118-OC	Ovis/Capra	Phalanx prox	-18.7	6.1	48.9	18.7	3.1	0.5
RVSM F0481-OC(1)	Ovis/Capra	Metapodial	-20.2	3.5	20.5	7.2	3.3	0.8
RVSM F0481-S	Sus scrofa d	Cranium	-17.9	6.4	30.9	10.6	3.4	2.3
RVSM F1021-AG	Gallus gallus d	Tibiotarsus	-19.2	6.3	28.4	10.0	3.3	2.7
RVSM F1021-OC(1)	Ovis/Capra	Radius	-19.9	4.1	25.2	8.9	3.3	1.4
RVSM F1021-OC(2)	Ovis/Capra	Radius	-21.2	4.7	28.1	10.0	3.3	2.1
RVSM F1021-S	Sus scrofa d	Tibia	-20.6	9.4	21.8	7.8	3.3	1.4

Table 7.12. Excluded carbon and nitrogen stable isotope measurements of fauna, including collagen quality criteria. Figures highlighted in grey correspond to the indicators where samples did not meet the criteria for well preserved collagen. Some samples are missing information on collagen yield because these data were not collected during pretreatment. Some samples are missing data on elemental composition because low collagen yield indicated poor collagen preservation, so they were excluded from further measurements. There are also three samples with acceptable collagen yields missing elemental composition due to technical issues. In these cases collagen quality could not be assessed, so these samples were excluded from the final dataset. Some samples are missing isotopic measurements because isotopic signal was so weak it could not be recorded or because they were omitted from IRMS measurement due to previous check of poor collagen preservation based on collagen yield or elemental composition. Key: Taxon: d = domesticus; Anatomical element: Undet = undetermined, U = upper, L = lower, dec = deciduous, prox = proximal, interm = intermediate.

Individual	*Taxon*	*Anatomical element*	$\delta^{13}C$ *(‰)*	$\delta^{15}N$ *(‰)*	*%C*	*%N*	*C/N*	*%coll*
GOZ F5851-E	Equus sp	Cranium	-	-	44.1	15.9	3.2	-
GOZ F6192-A(2)	Avis	Undet	-	-	44.7	15.7	3.3	-
GOZ F6762-OC	Ovis/Capra	Radius	-	-	-	-	-	0.2
SNC F30047-E(1)	Equus sp	Molar	-	-	-	-	-	0.1
SNC F30047-E(2)	Equus sp	Molar	-18.6	9.2	32.1	13.2	2.8	0.7
SNC F30047-OC(1)	Ovis/Capra	Metacarpal	-20.8	9.0	4.1	1.7	2.8	0.2
SNC F30047-OC(2)	Ovis/Capra	Metacarpal	-	-	2.0	0.3	7.5	0.3
SNC F31374-C(2)	Capra hircus	Tibia	-	-	-	-	-	0.1
SNC F31374-S	Sus scrofa d	L incisor	-	-	-	-	-	0.1
ALD FA009-B(1)	Bos taurus	U M3	-23.6	4.3	9.7	2.6	4.4	1.4
ALD FA009-B(2)	Bos taurus	U M1/M2	-23.2	3.9	13.8	4.1	3.9	1.2
ALD FB024-OC(2)	Ovis/Capra	LP3 inf	-21.2	8.4	-	-	-	4.2
ALD FB064/B076-OC(2)	Ovis/Capra	L M1	-22.0	7.5	-	-	-	3.9
ALD FB064/B076-S	Sus scrofa d	M1	-22.5	5.4	-	-	-	2.5
ALD FB076-S	Sus scrofa d	L incisor dec	-	-	-	-	-	<0.1
CG F102-1788-AG	Gallus gallus d	Long bone	-19.3	9.3	11.1	3.9	3.3	2.6
CG F102-1788-B(2)	Bos taurus	Tibia	-20.0	3.7	11.1	4.0	3.2	4.2
CG F102-1788-E	Equus sp	Tibia	-21.0	7.9	1.1	0.5	2.6	1.8
CG F266-0864-B(1)	Bos taurus	Astragalus	-21.9	4.1	3.5	1.3	3.1	0.7
CG F350-0868-S	Sus scrofa d	Mandible	-21.1	6.6	10.2	3.7	3.2	0.8
CG F350-0870-E	Equus sp	Tibia	-22.8	5.8	11.0	3.9	3.3	2.1
CG F350-1684-B	Bos taurus	Humerus	-20.4	4.1	12.1	5.2	2.7	1.0
CG F374-0830-CN(2)	Canis familiaris	Tibia	-20.3	9.3	3.1	1.2	3.0	1.3
CG F374-0830-E	Equus sp	Metapodial	-20.2	5.2	4.1	1.5	3.2	<0.1
CG F374-0830-F(1)	Felis catus	Femur	-19.1	9.1	13.3	4.7	3.3	2.1
CG F374-0830-S(2)	Sus scrofa d	Humerus	-21.2	4.6	12.2	4.2	3.4	1.7
CG F374-0830-S(3)	Sus scrofa d	Humerus	-22.6	6.9	4.8	1.7	3.3	1.9
CG F637-1746-E	Equus sp	Scapula	-21.6	5.5	11.1	4.0	3.2	2.2
CG F637-1746-OC(3)	Ovis/Capra	Mandible	-19.4	6.8	12.0	4.2	3.3	1.4
CG F660-1789-S	Sus scrofa d	Phalanx prox	-20.2	7.9	16.6	6.9	2.8	2.1
PMCV F12-022-B	Bos taurus	Phalanx interm	-22.5	6.0	11.9	4.2	3.3	0.4
RVSM F0412-OC	Ovis/Capra	Calcaneus	-26.2	4.1	2.8	1.0	3.3	0.2
RVSM F0481-B	Bos taurus	Mandible	-21.9	3.9	3.3	1.0	3.9	0.3
RVSM F0481-OC(2)	Ovis/Capra	Metapodial	-20.6	2.5	8.5	3.0	3.3	0.6

Table 7.13. Summary statistics of carbon and nitrogen stable isotope ratios of all human assemblages known in Iberia dated to between 1st and 10th c. Standard deviation is only reported if sample size is greater than two. Key: Location: NW = north-western Iberia, NE = north-eastern Iberia, C = central Iberia, E = eastern Iberia, S = southern Iberian; Country: ES = Spain, PT = Portugal; Chronology: Rom = Roman age (1st-5th c.), EMA1 = First half of Early Middle Ages (5th-8th c.), EMA2 = Second half of Early Middle Ages (8th-10th c.); * = It is not possible to verify that all individuals are adults. Fauna assembl refers to table 7.14

							Humans			Adults				
Code	*Human assemblage*	*Location*			*Chronology*		*n*	*$\delta^{13}C$ (‰) Mean ± SD*	*$\delta^{15}N$ (‰) Mean ± SD*	*n*	*$\delta^{13}C$ (‰) Mean ± SD*	*$\delta^{15}N$ (‰) Mean ± SD*	*References*	*Fauna assembl*
12004	A Coruña Rom	NW	A Coruña, A Coruña	ES	Rom	3rd-5th c.	2	-16.7	10.6	2	-16.7	10.6	Grandal-d' Anglade *et al.* 2015, Grandal-d' Anglade & Bello 2018	22003
12005	A Lanzada Rom	NW	O Grove, Pontevedra	ES	Rom	2nd-4th c.	43	-16.7 ± 1.0	12.1 ± 0.9	39	-16.7 ± 1.1	12.2 ± 0.9	López-Costas & Müldner 2016	22004
12019	Ouvigo	NW	Os Blancos, Ourense	ES	Rom	3rd-5th c.	3	-18.9 ± 0.6	11.4 ± 1.2	3	-18.9 ± 0.6	11.4 ± 1.2	López-Costas 2012	-
12023	Santiamiñe	NW	Kortezubi, Bizkaia	ES	Rom	3rd-4th c.	1	-16.1	10.6	1	-16.1	10.6	López Quintana *et al.* 2015	-
12003	A Coruña EMA1	NW	A Coruña, A Coruña	ES	EMA1	5th-8th c.	3	-18.0 ± 1.2	11.7 ± 1.5	3	-18.0 ± 1.2	11.7 ± 1.5	Grandal-d' Anglade *et al.* 2015, Kaal *et al.* 2016	22003
12006	A Lanzada EMA1	NW	O Grove, Ponteveddra	ES	EMA1	5th-7th c	15	-14.0 ± 0.7	12.8 ± 0.5	13	-14.0 ± 0.8	12.8 ± 0.5	López-Costas & Müldner 2016	22004
11001	Aldaieta	NW	Nanclares de Gamboa, Araba	ES	EMA1	6th-8th c.	70	-18.3 ± 0.7	9.1 ± 0.6	57	-18.2 ± 0.6	9.1 ± 0.6	This thesis	21001
11006	Dulantzi phase 3	NW	Alegría-Dulantzi, Araba	ES	EMA1	5th-6th c.	2	-18.9	10.5	2	-18.9	10.5	This thesis	21005
11007	Dulantzi phase 4	NW	Alegría-Dulantzi, Araba	ES	EMA1	6th-7th c.	16	-19.0 ± 1.1	9.3 ± 1.1	15	-18.9 ± 1.1	9.3 ± 1.1	This thesis	21005
11010	Finaga	NW	Basauri, Bizkaia	ES	EMA1	5th-8th c.	6	-18.0 ± 0.4	10.5 ± 0.3	5	-18.1 ± 0.3	10.5 ± 0.4	This thesis	21001 21005
12020	Riocueva	NW	Entrambasaguas, Cantabria	ES	EMA1	7th-8th c.	11	-16.1 ± 1.0	9.9 ± 0.6	9	-16.2 ± 1.0	10.2 ± 0.3	E. Gutiérrez Cuenca & J. Á. Hierro, personal communication	-
12007	Aistra EMA2	NW	Zalduuondo, Araba	ES	EMA2	8th-10th c.	39	-18.9 ± 1.0	7.9 ± 0.9	24	-19.1 ± 0.9	7.8 ± 0.8	Lubritto *et al.* 2017	22006
12009	Catedral Oviedo	NW	Oviedo, Asturias	ES	EMA2	10th c.	4	-18.7 ± 0.2	12.0 ± 1.2	2	-18.9	12.8	MacKinnon *et al.* 2019	-
12010	Dulantzi phase 5	NW	Alegría-Dulantzi, Araba	ES	EMA2	8th-10th c.	36	-18.7 ± 1.4	8.9 ± 0.9	33	-18.7 ± 0.7	9.0 ± 0.5	Lubritto *et al.* 2017	21005

							Humans			Adults				
Code	Human assemblage		Location		Chronology		n	$\delta^{13}C$ (‰) Mean ± SD	$\delta^{15}N$ (‰) Mean ± SD	n	$\delta^{13}C$ (‰) Mean ± SD	$\delta^{15}N$ (‰) Mean ± SD	References	Fauna assembl
12018	Las Gobas EMA2	NW	Treviño county, Burgos	ES	EMA2	7th-9th c.	14	-18.7 ± 0.5	8.7 ± 0.6	14	-18.7 ± 0.5	8.7 ± 0.6	Guede, Ortega, Zuluaga, Alonso-Olazabal, Murelaga, Solaun, *et al.* 2017	22015
12022	Santa Eulalia Navaridas	NW	Navaridas, Araba	ES	EMA2	9th-11th c.	18	-19.0 ± 0.3	10.1 ± 1.0	13	-19.0 ± 0.3	9.9 ± 0.6	García-Collado 2019a	22016
12029	Viguera	NW	Viguera, La Rioja	ES	EMA2	7th-9th c.	3	-19.0 ± 0.6	10.2 ± 0.9	3	-19.0 ± 0.6	10.2 ± 0.9	García-Collado 2019b	22018
12008	Barcelona Carrer Ample 1	NE	Barcelona, Barcelona	ES	Rom	2nd-4th c.	23	-18.9 ± 0.4	11.2 ± 1.5	15	-18.9 ± 0.3	11.0 ± 0.4	Rissech *et al.* 2016	22008
12014	Gavà St Nicasi 18-24	NE	Gavà, Barcelona	ES	Rom	2nd-3rd c.	1	-18.7	10.1	1	-18.7	10.1	Rissech *et al.* 2013	-
11003	Can Gambús cemetery	E	Sabadell, Barcelona	ES	EMA1	6th-8th c.	11	-19.2 ± 0.7	9.7 ± 0.6	10	-19.3 ± 0.8	9.9 ± 0.6	This thesis	21003
11004	Can Gambús settlement	E	Sabadell, Barcelona	ES	EMA1	6th-8th c.	5	-19.3 ± 0.5	9.4 ± 0.6	1	-20.2	9.6	This thesis	21003
11005	Castellar del Vallès	E	Castellar de Vallès, Barcelona	ES	EMA1	6th-8th c.	21	-18.7 ± 0.6	9.3 ± 1.1	13	-18.7 ± 0.4	9.0 ± 0.4	This thesis	21004
11003	Can Gambús cemetery	E	Sabadell, Barcelona	ES	EMA1	6th-8th c.	36	-18.7 ± 0.4	10.0 ± 1.0	28	-18.6 ± 0.3	9.8 ± 0.7	Jordana *et al.* 2019	22011
11015	Sant Menna	E	Sentmenat, Barcelona	ES	EMA1	5th-8th c.	15	-18.6 ± 0.6	9.7 ± 1.1	7	-18.7 ± 0.4	9.4 ± 0.5	This thesis	21008
11015	Sant Menna	E	Sentmenat, Barcelona	ES	EMA1	5th-8th c.	32	-18.7 ± 0.4	9.3 ± 1.0	20	-18.8 ± 0.3	9.4 ± 0.7	Jordana *et al.* 2019	22012
12021	S Juan de la Peña	NE	Jaca, Zaragoza	ES	EMA2	8th-10th c.	6	-18.5 ± 0.4	9.3 ± 0.4	4	-18.4 ± 0.3	9.5 ± 0.2	Martínez-Jarreta *et al.* 2017	-
12025	Tauste	NE	Tauste, Zaragoza	ES	EMA2	8th-10th c.	31	-19.1 ± 0.5	15.0 ± 1.7	21	-19.1 ± 0.3	15.1 ± 1.2	Guede, Ortega, Zuluaga, Alonso-Olazabal, Murelaga, Pina, *et al.* 2017	-
12030	Zaragoza Roman theatre	NE	Zaragoza, Zaragoza	ES	EMA2	8th-9th c.	3	-18.2 ± 0.4	10.7 ± 1.2	3	-18.2 ± 0.4	10.7 ± 1.2	Mundee 2010	-
12013	El Vergel	C	S Pedro del Arroyo, Ávila	ES	Rom	4th c.	1	-17.2	11.2	1	-17.2	11.2	Moreda *et al.* 2010	-
11002	Boadilla	C	Illescas, Toledo	ES	EMA1	5th-8th c.	77	-18.6 ± 0.6	10.1 ± 1.0	53	-18.6 ± 0.5	10.2 ± 1.0	This thesis	21002

							Humans			Adults				
Code	*Human assemblage*		*Location*		*Chronology*		*n*	$\delta^{13}C$ *(‰) Mean ± SD*	$\delta^{15}N$ *(‰) Mean ± SD*	*n*	$\delta^{13}C$ *(‰) Mean ± SD*	$\delta^{15}N$ *(‰) Mean ± SD*	*References*	*Fauna assembl*
11008	El Soto/El Encadenado phase 1	C	Madrid, Madrid	ES	EMA1	5th c.	3	-19.0 ± 0.3	10.6 ± 0.3	2	-18.9	10.8	This thesis	21006
11011	Gózquez cemetery	C	S Martín de la Vega, Madrid	ES	EMA1	6th-8th c.	33	-18.7 ± 0.7	9.9 ± 1.1	24	-18.7 ± 0.7	9.8 ± 0.8	This thesis	21007
11012	Gózquez settlement	C	S Martín de la Vega, Madrid	ES	EMA1	6th-8th c.	5	-18.8 ± 0.3	10.6 ± 0.7	-	-	-	This thesis	21007
11013	La Huelga phase 2	C	Madrid, Madrid	ES	EMA1	7th c.	1	-18.8	11.0	1	-18.8	11.0	This thesis	21006
11009	El Soto/El Encadenado phase 3	C	Madrid, Madrid	ES	EMA2	8th-9th c.	9	-18.7 ± 0.5	11.3 ± 0.9	5	-18.7 ± 0.4	11.6 ± 1.1	This thesis	21006
11014	La Huelga phase 3	C	Madrid, Madrid	ES	EMA2	8th-9th c.	6	-18.8 ± 0.6	11.7 ± 2.3	4	-18.7 ± 0.3	11.7 ± 1.3	This thesis	21006
11009	El Soto/El Encadenado	C	Madrid, Madrid	ES	EMA2	8th-9th c.	38	-18.7 ± 0.5	10.9 ± 1.3	22	-18.7 ± 0.5	11.3 ± 1.4	Alaica *et al.* 2019	22013
12015	Ibiza Joan Planells	E	Ibiza, Balearic islands	ES	EMA1	4th-7th c.	60	-19.0 ± 0.4	11.1 ± 1.1	34	-19.0 ± 0.4	11.1 ± 0.9	Fuller *et al.* 2010	22013
12016	Ibiza S´Hort des Llimoners	E	Ibiza, Balearic islands	ES	EMA1	4th-6th c.	3	-18.9 ± 0.2	9.6 ± 0.2	3	-18.9 ± 0.2	9.6 ± 0.2	Cau *et al.* 2014	22013
12026	Tossal de les Basses EMA1	E	Alicante, Alicante	ES	EMA1	6th-7th c.	36	-18.2 ± 0.3	10.8 ± 0.9	36	-18.2 ± 0.3	10.8 ± 0.9	Salazar-García *et al.* 2016	-
12028	Valencia Plaza de la Almoina	E	Valencia, Valencia	ES	EMA1	5th-7th c.	10	-18.4 ± 0.3	10.8 ± 0.6	10	-18.4 ± 0.3	10.8 ± 0.6	Alexander *et al.* 2019	22017
12027	Tossal de les Basses EMA2	E	Alicante, Alicante	ES	EMA2	8th-9th c.	14	-18.3 ± 0.3	11.4 ± 0.9	14	-18.3 ± 0.3	11.4 ± 0.9	Salazar-García *et al.* 2016	-
12031	Mondragones Rom	S	Granada, Granada	ES	Rom	4th-5th c.	21	-18.6 ± 0.4	10.4 ± 1.3	10	-18.7 ± 0.4	10.0 ± 0.7	Fernández-Martínez *et al.* 2020	22022
12032	Mondragones EMA1	S	Granada, Granada	ES	EMA1	5th-7th c.	25	-18.6 ± 0.6	10.3 ± 1.4	11	-18.7 ± 0.3	9.8 ± 0.6	Fernández-Martínez *et al.* 2020	22022
12002	Setubal Casa dos Mosaicoos Romanos	S	Setubal, Lisboa	PT	EMA1	6th-7th c.	4	-16.6 ± 0.5	13.3 ± 2.0	11	-16.3	12.9	Toso & Alexander 2018	22001
12017	La Ontavia	S	Terrinches, Ciudad Real	ES	EMA1 EMA2	5th-9th c.	24	-19.0 ± 0.3	10.9 ± 1.0	24*	-19.0 ± 0.3	10.9 ± 1.0	Salazar-García *et al.* 2013	-
12001	Monte da Cegonha	S	Beja, Alentejo	PT	EMA2	7th-9th c.	21	-18.3 ± 0.3	10.3 ± 0.8	15	-18.3 ± 0.3	10.1 ± 0.5	Saragoça *et al.* 2016	22002

Table 7.14. Summary statistics of carbon and nitrogen stable isotope ratios of all fauna assemblages known in Iberia dated to between 1st and 10th c. Standard deviation is only reported if sample size is greater than two. Key: Location: NW = north-western Iberia, NE = north-eastern Iberia, C = central Iberia, E = eastern Iberia, S = southern Iberian; Country: ES = Spain, PT = Portugal; Chronology: Rom = Roman period (1st-5th c.), EMA1 = First half of Early Middle Ages (5th-8th c.), EMA2 = Second half of Early Middle Ages (8th-10th c.); Med = Middle Ages (5th-15th c.)

							Fauna			*Domestic herbivores*			
Code	*Fauna assemblage*	*Location*			*Chronology*		*n*	*δ¹³C (‰) Mean ± SD*	*δ¹⁵N (‰) Mean ± SD*	*n*	*δ¹³C (‰) Mean ± SD*	*δ¹⁵N (‰) Mean ± SD*	*References*
22003	A Coruña	NW	A Coruña, A Coruña	ES	Rom	5th c.	1	-20.4	4.2	1	-20.4	4.2	Grandal-d' Anglade *et al.* 2015, Grandal-d' Anglade & Bello 2018
22021	Zornoztegi Rom	NW	Salvatierra-Agurain, Araba	ES	Rom	4th-5th c.	1	-20.7	6.8	1	-20.7	6.8	Sirignano *et al.* 2014
22004	A Lanzada	NW	O Grove, Pontevedra	ES	Rom EMA1	2nd-7th c.	24	-19.9 ± 1.2	7.8 ± 1.8	21	-20.1 ± 0.9	7.6 ± 1.7	López-Costas & Müldner 2016
22005	Aistra EMA1	NW	Zalduondo, Araba	ES	EMA1	6th-8th c.	3	-21.7 ± 0.4	3.8 ± 1.3	2	-21.7	3.5	Sirignano *et al.* 2014
21001	Aldaieta	NW	Nanclares de Gamboa, Araba	ES	EMA1	6th-8th c.	9	-21.6 ± 0.6	7.0 ± 1.6	8	-21.7 ± 0.5	6.6 ± 1.2	This thesis
22014	Lantarón	NW	Lantarón, Araba	ES	EMA1	7th-8th c.	4	-20.5 ± 0.9	6.0 ± 1.3	4	-20.5 ± 0.9	6.0 ± 1.3	Jiménez-Brobeil *et al.* 2020
21005	Dulantzi	NW	Alegría-Dulantzi, Araba	ES	EMA1 EMA2	6th-9th c.	18	-20.8 ± 0.7	6.2 ± 1.5	11	-20.9 ± 0.7	6.4 ± 1.7	This thesis
22006	Aistra EMA2	NW	Zalduondo, Araba	ES	EMA2	8th-10th c.	3	-20.7 ± 1.7	5.9 ± 3.0	1	-21.5	4.6	Sirignano *et al.* 2014
22015	Las Gobas EMA2	NW	Treviño county, Burgos	ES	EMA2	7th-9th c.	9	-21.1 ± 0.6	4.8 ± 1.4	6	-21.1 ± 0.6	4.6 ± 1.0	Guede, Ortega, Zuluaga, Alonso-Olazabal, Murelaga, Solaun, *et al.* 2017
22016	Santa Eulalia Navaridas	NW	Navaridas, Araba	ES	EMA2	9th-11th c.	2	-21.5	6.3	2	-21.5	6.3	García-Collado 2019a
22018	Viguera	NW	Viguera, La Rioja	ES	EMA2	7th-9th c.	1	-21.8	5.8	1	-21.8	5.8	García-Collado 2019b
22019	Zaballa EMA	NW	Nanclares de la Oca, Araba	ES	EMA2	9th-10th c.	5	-19.4 ± 1.0	6.4 ± 1.5	2	-19.5	6.6	Sirignano *et al.* 2014
22020	Zornoztegi EMA	NW	Salvatierra-Agurain, Araba	ES	EMA2	8th-10th c.	3	-20.7 ± 1.7	4.1 ± 1.3	3	-20.7 ± 1.7	4.1 ± 1.3	Sirignano *et al.* 2014
22008	Barcelona Carrer Ample 1	NE	Barcelona, Barcelona	ES	Rom	1st-4th c.	21	-19.5 ± 2.3	4.8 ± 2.4	6	-20.9 ± 0.6	3.5 ± 1.5	Rissech *et al.* 2016

							Fauna			Domestic herbivores			
Code	Fauna assemblage		Location		Chronology		n	δ13C (‰) Mean ± SD	δ15N (‰) Mean ± SD	n	δ13C (‰) Mean ± SD	δ15N (‰) Mean ± SD	References
21003	Can Gambús	NE	Sabadell, Barcelona	ES	EMA1	6th-7th c.	15	-19.1 ± 0.9	7.1 ± 1.7	6	-19.8 ± 0.5	5.4 ± 1.3	This thesis
21004	Castellar del Vallès	NE	Castellar del Vallès, Barcelona	ES	EMA1	6th-8th c.	15	-19.9 ± 0.5	4.9 ± 1.3	10	-19.8 ± 0.5	4.6 ± 1.3	This thesis
22011	Egara EMA1	NE	Terrassa, Barcelona	ES	EMA1	5th-8th c.	14	-20.0 ± 1.0	5.5 ± 1.6	7	-19.8 ± 1.0	5.6 ± 1.8	Jordana *et al.* 2019
22012	Egara EMA2	NE	Terrassa, Barcelona	ES	EMA2	9th-10th c.	22	-20.8 ± 1.0	5.0 ± 2.0	7	-20.4 ± 0.5	4.4 ± 1.0	Jordana *et al.* 2019
21008	Sant Menna	NE	Sentmenat, Barcelona	ES	Med	Med	7	-19.7 ± 1.1	5.8 ± 2.0	4	-20.0 ± 1.0	4.6 ± 1.1	This thesis
22007	Bajo del Cercado	C	Madrid, Madrid	ES	EMA1	6th-8th c.	1	-18.6	12.1	-	-	-	Díaz-del-Río *et al.* 2017
21002	Boadilla	C	Illescas, Toledo	ES	EMA1	5th-8th c.	20	-20.0 ± 0.9	8.4 ± 1.1	12	-20.3 ± 0.7	8.0 ± 1.1	This thesis
22009	Congosto	C	Rivas-Vaciamadrid, Madrid	ES	EMA1	6th-8th c.	1	-18.8	11.6	-	-	-	Díaz-del-Río *et al.* 2017
21007	Gózquez	C	S Martín de la Vega, Madrid	ES	EMA1	6th-8th c.	23	-19.6 ± 0.9	7.9 ± 1.3	16	-19.6 ± 0.9	8.0 ± 1.2	This thesis
21006	El Soto/El Encadenado	C	Madrid, Madrid	ES	EMA1 EMA2	5th-9th c.	8	-20.3 ± 0.8	8.3 ± 2.0	5	-20.8 ± 0.4	7.4 ± 1.5	This thesis
22013	Ibiza S´Hort des Llimoners	E	Ibiza, Balearic islands	ES	EMA1	4th-6th c.	13	-20.0 ± 0.8	6.1 ± 1.6	10	-19.9 ± 0.7	5.9 ± 1.5	Fuller *et al.* 2010
22017	Valencia Plaza de la Almoina	E	Valencia, Valencia	ES	EMA1	5th-7th c.	12	-19.4 ± 1.4	6.0 ± 2.0	7	-19.7 ± 0.7	5.1 ± 1.4	Alexander *et al.* 2019
22010	Córdoba Llanos del Pretorio	S	Córdoba, Córdoba	ES	Rom	1st c.	3	-18.5 ± 1.2	10.2 ± 0.2	-	-	-	Martínez Sánchez *et al.* 2020
22001	Lisboa Praça da Figueira	S	Lisboa, Lisboa	PT	Rom	1st-3rd c.	26	-19.7 ± 2.1	7.7 ± 2.8	15	-20.7 ± 0.9	6.3 ± 2.0	Toso *et al.* 2019
22022	Mondragones	S	Granada, Granada	ES	Rom EMA1	1st-7th c.	7	-20.1 ± 0.7	7.4 ± 0.8	7	-20.1 ± 0.7	7.4 ± 0.8	Fernández-Martínez *et al.* 2020
22002	Monte da Cegonha	S	Beja, Alentejo	PT	EMA2	7th-9th c.	15	-20.0 ± 0.8	6.8 ± 1.0	12	-19.8 ± 0.8	7.0 ± 0.6	Saragoça *et al.* 2016

Table 7.15. Summary statistics of carbon and nitrogen stable isotope ratios of all human assemblages known in Europe, the Middle East and northern Africa dated to between 5th and 10th c. Standard deviation is only reported if sample size is greater than two. Key: Location: BI = British isles, SC = Scandinavia, IB = Iberia (see table 7.13), SF = southern France, LC = Low Countries, GB = Germany & Bohemia, CB = Carpathian basin, AP = Alps & Po plain, CI = central Italy, NB = northern Balkans, SB = southern Balkans, ME = Middle East, CA = Caucasus; Country: AL = Albania, AT = Austria, BE = Belgium, CR = Croatia, CZ = Czech Republic, FR = France, DE = Germany, GR = Greece, HU = Hungary, IE = Ireland, IT = Italy, JO = Jordan, NL = Netherlands, NO = Norway, PA = Palestine, PT = Portugal, RU = Russia, ES = Spain, TR = Turkey, UK = UK; Chronology: EMA1 = First half of Early Middle Ages (5th-8th c.), EMA2 = Second half of Early Middle Ages (8th-10th c.); * = It is not possible to verify that all individuals are adults. Fauna assembl refers to table 7.16

							Humans			Adults				
Code	*Human assemblage*		*Location*		*Chronology*		*n*	*$\delta^{13}C$ (‰) Mean ± SD*	*$\delta^{15}N$ (‰) Mean ± SD*	*n*	*$\delta^{13}C$ (‰) Mean ± SD*	*$\delta^{15}N$ (‰) Mean ± SD*	*References*	*Fauna assembl*
13119	Apple Down Compton	BI	Compton, South East England	UK	EMA1	5th-7th c.	3	-20.4 ± 0.2	8.2 ± 0.4	3	-20.4 ± 0.2	8.2 ± 0.4	Mays & Beavan-Athfield 2012	-
13120	Atlantic Trading Estate	BI	Barry, Wales	UK	EMA1	4th-6th c.	10	-20.6 ± 0.3	10.5 ±0.7	9	-20.7 ± 0.2	10.5 ± 0.8	Hemer *et al.* 2016	-
13121	Balladoole	BI	Castledown, Isle of Man	UK	EMA1	4th-7th c.	3	-20.7 ± 0.5	11.8 ± 0.6	3	-20.7 ± 0.5	11.8 ± 0.6	Hemer *et al.* 2016	-
13122	Barrington Edix Hill	BI	Barrington, East England	UK	EMA1	5th-7th c.	8	-20.3 ± 0.2	9.9 ± 0.6	8	-20.3 ± 0.2	9.9 ± 0.6	Mays & Beavan-Athfield 2012	-
13123	Belle Vue House/Lamel Hill	BI	Fulford, Yorkshire & the Humber	UK	EMA1	7th-8th c.	33	-20.0 ± 0.3	10.3 ± 0.9	32	-20.1 ± 0.3	10.2 ± 0.9	Müldner & Richards 2007	23093
13124	Berinsfield	BI	Berinsfield, South East England	UK	EMA1	5th-7th c.	92	-20.1 ± 0.2	9.8 ± 0.8	66	-20.1 ± 0.2	9.7 ± 0.7	Privat *et al.* 2002	23083
13125	Bloodmoor Hill	BI	Carlton Colville, East England	UK	EMA1	7th c.	17	-20.5 ± 0.2	9.7 ± 0.6	15	-20.5 ± 0.2	9.8 ± 0.6	O' Connell & Lawler 2009	23084
13126	Broughton Lodge	BI	Willoughy on the Wolds, East Midlands	UK	EMA1	5th-7th c.	3	-20.4 ± 0.2	10.6 ± 0.7	2	-20.5	11.0	Moore 2017	-
13128	Buttermarket	BI	Ipswich, East Anglia	UK	EMA1	5th-8th c.	17	-19.9 ± 0.3	10.6 ± 1.0	15	-19.9 ± 0.3	10.6 ± 1.0	Beavan-Athfield & Mays 2009	-
13129	Castledyke South	BI	Barton-upon-Humber, Yorkshire & the Humber	UK	EMA1	5th-7th c.	7	-20.8 ± 0.4	10.2 ± 0.8	7	-20.8 ± 0.4	10.2 ± 0.8	Mays & Beavan-Athfield 2012	-
13130	Coddenham	BI	Coddenham, East England	UK	EMA1	5th-7th c.	1	-20.4	10.3	1	-20.4	10.3	Mays & Beavan-Athfield 2012	-
13131	Cronk keeillane	BI	Peel, Isle of Man	UK	EMA1	6th-8th c.	6	-21.0 ± 0.3	10.9 ± 0.5	6	-21.0 ± 0.3	10.9 ± 0.5	Hemer *et al.* 2016	-
13132	Dover Buckland	BI	Dover, South East England	UK	EMA1	5th-7th c.	6	-19.8 ± 0.1	9.6 ± 0.5	6	-19.8 ± 0.1	9.6 ± 0.5	Mays & Beavan-Athfield 2012	-
13133	Dunstable Marina Drive	BI	Dunstable, East England	UK	EMA1	5th-7th c.	2	-20.4	1.5	2	-20.4	1.5	Mays & Beavan-Athfield 2012	-

							Humans			Adults				
Code	Human assemblage		Location		Chronology		n	δ^{13}C (‰) Mean ± SD	δ^{15}N (‰) Mean ± SD	n	δ^{13}C (‰) Mean ± SD	δ^{15}N (‰) Mean ± SD	References	Fauna assembl
13134	Ford Laverstock	BI	Laverstock & Ford, South West England	UK	EMA1	5th-7th c.	1	-20.4	9.0	1	-20.4	9.0	Mays & Beavan-Athfield 2012	-
13135	Gally Hills Banstead Down	BI	Banstead, South East England	UK	EMA1	5th-7th c.	1	-20.2	10.4	1	-20.2	10.4	Mays & Beavan-Athfield 2012	-
13136	Great Chesterford	BI	Great Chesterford, East England	UK	EMA1	5th-6th c.	1	-20.4	10.9	1	-20.4	10.9	Inskip *et al.* 2015	-
13137	Horcott	BI	Fairford, South West England	UK	EMA1	5th-7th c.	8	-20.2 ± 0.5	10.2 ± 1.0	3	-20.6 ± 0.2	10.7 ± 0.5	Sakai 2017	23086
13138	Lakenheath Eriswell	BI	Lakenheath, East England	UK	EMA1	5th-7th c.	1	-19.8	9.2	1	-19.8	9.2	Mays & Beavan-Athfield 2012	-
13139	Lechlade Butler´s Field	BI	Lechlade, South West England	UK	EMA1	5th-7th c.	9	-20.2 ± 0.4	9.4 ± 1.1	9	-20.2 ± 0.4	9.4 ± 1.1	Mays & Beavan-Athfield 2012	23086
13142	Melbourn	BI	Melbourn, East England	UK	EMA1	6th-7th c.	51	-20.2 ± 0.3	9.9 ± 0.6	33	-20.1 ± 0.3	9.9 ± 0.5	Hannah *et al.* 2018	-
13143	Mill Hill Deal	BI	Deal, South East England	UK	EMA1	5th-7th c.	8	-19.8 ± 0.4	9.7 ± 0.5	8	-19.8 ± 0.4	9.7 ± 0.5	Mays & Beavan-Athfield 2012	-
13145	Polhill	BI	Sevenoaks, South East England	UK	EMA1	7th-8th c.	65	-20.4 ± 0.2	9.7 ± 0.8	32	-20.4 ± 0.2	9.8 ± 0.9	Hannah *et al.* 2018	-
13147	Portmahomack EMA1	BI	Portmahomack, Scotland	UK	EMA1	6th-7th c.	4	-20.7 ± 0.3	11.2 ± 1.3	4	-20.7 ± 0.3	11.2 ± 1.3	Curtis-Summers *et al.* 2014	23089
13149	Poundbury Camp	BI	Dorchester, South West England	UK	EMA1	5th-7th c.	1	-19.9	7.4	1	-19.9	7.4	Richards *et al.* 1998	-
13150	Queenford Farm	BI	Dochester-on-Thames, South East England	UK	EMA1	4th-6th c.	87	-19.9 ± 0.4	10.4 ± 1.1	33	-19.6 ± 0.4	10.3 ± 0.8	Fuller *et al.* 2006	23083
13152	St Peter´s Tip Broadstairs	BI	Broadstairs, South East England	UK	EMA1	5th-7th c.	12	-19.9 ± 0.2	9.5 ± 0.7	12	-19.9 ± 0.2	9.5 ± 0.7	Mays & Beavan-Athfield 2012	-
13153	Tring Hill Aston Clinton	BI	Aston Clinton, South East England	UK	EMA1	5th-7th c.	1	-20.8	9.4	1	-20.8	9.4	Mays & Beavan-Athfield 2012	-
13156	West Heslerton	BI	West Heslerton, Yorkshire & the HUmber	UK	EMA1	5th-7th c.	1	-20.3	8.9	1	-20.3	8.9	Mays & Beavan-Athfield 2012	-
13157	Westfield Farm	BI	Ely, East England	UK	EMA1	7th c.	15	-20.2 ± 0.4	11.5 ± 0.9	12	-20.1 ± 0.3	11.4 ± 0.9	Lucy *et al.* 2009	-
13158	Westgarth Gardens	BI	Bury St Edmunds, East England	UK	EMA1	5th-7th c.	2	-20.4	9.2	2	-20.4	9.2	Mays & Beavan-Athfield 2012	-
13159	Westness EMA1	BI	Rousay, Orkney islands	UK	EMA1	5th-9th c.	9	-20.8 ± 0.2	10.9 ± 0.4	8	-20.8 ± 0.2	11.0 ± 0.3	Barrett & Richards 2004	-

							Humans			*Adults*				
Code	*Human assemblage*		*Location*		*Chronology*		*n*	*δ^{13}C (‰) Mean ± SD*	*δ^{15}N (‰) Mean ± SD*	*n*	*δ^{13}C (‰) Mean ± SD*	*δ^{15}N (‰) Mean ± SD*	*References*	*Fauna assembl*
13161	Yarnton	BI	Yarnton, South East England	UK	EMA1	5th-8th c.	9	-19.8 ± 0.3	11.5 ± 1.5	5	-19.7 ± 0.1	11.8 ± 1.6	Lightfoot *et al.* 2009	-
13072	Collierstown	BI	Collierstown, Meath	IE	EMA1 EMA2	5th-9th c.	6	-21.0 ± 0.2	12.7 ± 0.5	5	-21.0 ± 0.2	12.7 ± 0.5	Ryan *et al.* 2018	23048
13074	Johnstown	BI	Johnstown, Meath	IE	EMA1 EMA2	5th-9th c.	12	-21.2 ± 0.4	11.9 ± 0.8	11	-21.2 ± 0.4	11.9 ± 0.9	Ryan *et al.* 2018	23048
13075	Owenbristy	BI	Owenbristy, Galway	IE	EMA1 EMA2	6th-10th c.	33	-21.6 ± 0.6	10.2 ± 1.0	19	-21.8 ± 0.6	10.0 ± 0.7	Geber 2010	-
13076	Raystown	BI	Raystown, Meath	IE	EMA1 EMA2	5th-10th c.	19	-20.9 ± 0.4	11.9 ± 0.9	17	-20.9 ± 0.5	11.7 ± 0.7	Ryan *et al.* 2018	23048
13140	Llandough	BI	Llandough, Wales	UK	EMA1 EMA2	4th-11th c.	31	-20.2 ± 0.4	10.4 ± 0.7	27	-20.2 ± 0.3	10.5 ± 0.7	Hemer *et al.* 2016	-
13146	Porthclew	BI	Freshwater East, Wales	UK	EMA1 EMA2	5th-10th c.	5	-20.9 ± 0.1	10.3 ± 0.6	3	-20.9 ± 0.1	10.5 ± 0.7	Hemer *et al.* 2016	-
13073	Dublin Fishamble st & John´s lane	BI	Dublin, Dublin city	IE	EMA2	9th-11th c.	7	-20.9 ± 0.6	9.8 ± 2.2	6	-21.0 ± 0.6	9.5 ± 2.3	Knudson *et al.* 2012	-
13127	Brownslade Barrow	BI	Castlemartin, Wales	UK	EMA2	7th-9th c.	10	-20.4 ± 0.4	10.6 ± 0.3	9	-20.3 ± 0.4	10.6 ± 0.3	Hemer *et al.* 2016	-
13141	Masham	BI	Masham, Yorkshire & the Humber	UK	EMA2	8th-10th c.	37	-20.4 ± 0.3	10.2 ± 1.8	37*	-20.4 ± 0.3	10.2 ± 1.8	Buckberry *et al.* 2014	23088
13144	Peel Castle	BI	St Patrick´s Isle, Isle of Mann	UK	EMA2	7th-10th c.	4	-20.5 ± 0.4	11.7 ± 0.1	4	-20.5 ± 0.4	11.7 ± 0.1	Hemer *et al.* 2016	-
13148	Portmahomack EMA2	BI	Portmahomack, Scotland	UK	EMA2	7th-9th c.	15	-20.4 ± 0.6	12.3 ± 1.1	15	-20.4 ± 0.6	12.3 ± 1.1	Curtis-Summers *et al.* 2014	23089
13151	St Patrick´s chapel	BI	St Davids, Wales	UK	EMA2	7th-10th c.	16	-20.5 ± 0.4	11.4 ± 1.1	15	-20.5 ± 0.4	11.3 ± 0.9	Hemer *et al.* 2016	23092
13154	Ty Newydd	BI	Ynys Enlli, Wales	UK	EMA2	10th c.	5	-20.2 ± 0.5	9.7 ± 0.4	4	-20.4 ± 0.4	9.8 ± 0.2	Arnold *et al.* 1998	-
13155	West Angle Bay	BI	Milford Haven, Wales	UK	EMA2	7th-12th c.	1	-20.6	12.3	1	-20.6	12.3	Hemer *et al.* 2016	-
13160	Westness EMA2	BI	Rousay, Orkney islands	UK	EMA2	9th-10th c.	4	-19.4 ± 1.5	13.0 ± 1.5	4	-19.4 ± 1.5	13.0 ± 1.5	Barrett & Richards 2004	-
13162	York Coppergate	BI	York, Yorkshire & the Humber	UK	EMA2	9th-11th c.	3	-20.4 ± 0.4	10.4 ± 0.9	3	-20.4 ± 0.4	10.4 ± 0.9	Buckberry *et al.* 2014	23093
13115	Flakstad	SC	Flakstad, Nordland	NO	EMA2	9th-11th c.	10	-16.7 ± 1.2	15.8 ± 1.8	9	-16.8 ± 1.3	15.7 ± 1.8	Naumann *et al.* 2014	23078
13035	Baïse Ste Anne	SF	Valensole, Provence-Alpes-Côte d´Azur	FR	EMA1	4th-7th c.	32	-19.2 ± 0.3	8.5 ± 0.7	32	-19.2 ± 0.3	8.5 ± 0.7	Mion 2019	23025

							Humans			*Adults*				
Code	*Human assemblage*		*Location*		*Chronology*		*n*	*δ¹³C (‰) Mean ± SD*	*δ¹⁵N (‰) Mean ± SD*	*n*	*δ¹³C (‰) Mean ± SD*	*δ¹⁵N (‰) Mean ± SD*	*References*	*Fauna assembl*
13036	Maguelone Basilique funéraire	SF	Îlot de Maguelone, Occitanie	FR	EMA1	6th-7th c.	15	-18.6 ± 0.4	11.1 ± 0.8	15	-18.6 ± 0.4	11.1 ± 0.8	Mion 2019	23026
13037	Chapelle St Honorat	SF	Île de Lérins, Provence-Alpes-Côte d'Azur	FR	EMA1	5th-7th c.	6	-18.4 ± 0.3	10.4 ± 0.5	6	-18.4 ± 0.3	10.4 ± 0.5	Mion 2019	23018
13039	Marseille Malaval	SF	Marseille, Provence-Alpes-Côte d'Azur	FR	EMA1	5th-6th c.	30	-18.7 ± 0.3	10.6 ± 0.8	30	-18.7 ± 0.3	10.6 ± 0.8	Mion 2019	23020
13040	Marseille Pharo	SF	Marseille, Provence-Alpes-Côte d'Azur	FR	EMA1	6th-8th c.	21	-18.5 ± 0.6	11.1 ± 0.8	21	-18.5 ± 0.6	11.1 ± 0.8	Mion 2019	23020
13045	St Géniès de Liténis	SF	St-Jean-de-Fos, Occitanie	FR	EMA1	5th-8th c.	1	-19.0	10.0	1	-19.0	10.0	Mion 2019	-
13047	Ubac St Jean	SF	Riez, Provence-Alpes-Côte d'Azur	FR	EMA1	4th-7th c.	29	-19.4 ± 0.2	8.5 ± 0.8	29	-19.4 ± 0.2	8.5 ± 0.8	Mion 2019	-
13044	Richeaume XIII	SF	Puyloubier, Provence-Alpes-Côte d'Azur	FR	EMA1 EMA2	4th-9th c.	9	-19.4 ± 0.4	9.0 ± 0.7	9	-19.4 ± 0.4	9.0 ± 0.7	Mion 2019	23024
13038	Lallemand	SF	Mauguio, Occitaine	FR	EMA2	7th-10th c.	13	-19.0 ± 0.3	10.0 ± 0.7	13	-19.0 ± 0.3	10.0 ± 0.7	Mion 2019	23019
13041	Missignac	SF	Aimargues, Occitanie	FR	EMA2	7th-10th c.	58	-18.7 ± 0.3	9.9 ± 0.7	58	-18.7 ± 0.3	9.9 ± 0.7	Mion 2019	23021
13043	Notre Dame du Bourg	SF	Digne-les-Bains, Provence-Alpes-Côte d'Azur	FR	EMA2	6th-10th c.	7	-19.1 ± 0.2	8.8 ± 0.8	7	-19.1 ± 0.2	8.8 ± 0.8	Mion 2019	23023
13046	St Sébastien de Maroiol	SF	Aniane, Occitanie	FR	EMA2	7th-11th c.	1	-19.1	10.2	1	-19.1	10.2	Mion 2019	-
13008	Ciply	LC	Ciply, Hainaut	BE	EMA1	6th-7th c.	9	-20.2 ± 0.5	9.1 ± 0.5	9	-20.2 ± 0.5	9.1 ± 0.5	Polet & Katzenberg 2002	-
13011	St Bavo	LC	Ghent, East Flanders	BE	EMA1	7th c.	1	-19.2	10.7	1	-19.2	10.7	Van Strydonck *et al.* 2009	-
13013	St Ermelindis	LC	Lummen, Limburg	BE	EMA1	7th c.	1	-20.4	10.2	1	-20.4	10.2	Van Strydonck *et al.* 2009	-
13015	St Odrada	LC	Balen, Antwerp	BE	EMA1	7th-8th c.	1	-18.2	11.7	1	-18.2	11.7	Van Strydonck *et al.* 2009	-
13016	St Romuuldus	LC	Mechelen, Antwep	BE	EMA1	6th-7th c.	1	-19.8	9.9	1	-19.8	9.9	Van Strydonck *et al.* 2009	-
13019	Torgny	LC	Torgny, Luxembourg	BE	EMA1	6th-7th c.	20	-19.8 ± 0.3	9.1 ± 0.7	20	-19.8 ± 0.3	9.1 ± 0.7	Polet & Katzenberg 2002	-

							Humans			*Adults*				
Code	*Human assemblage*		*Location*		*Chronology*		*n*	δ^{13}*C (‰) Mean ± SD*	δ^{15}*N (‰) Mean ± SD*	*n*	δ^{13}*C (‰) Mean ± SD*	δ^{15}*N (‰) Mean ± SD*	*References*	*Fauna assembl*
13042	Norroy-le-Veneur	LC	Norroy-le-Veneur, Grand East	FR	EMA1	5th-7th c.	74	-20.1 ± 0.3	9.8 ± 0.6	74	-20.1 ± 0.3	9.8 ± 0.6	Vytlačil *et al.* 2018	23022
13055	Morken	LC	Bergheim, North Rhine-Westphalia	DE	EMA1	7th c.	10	-20.1 ± 0.2	10.2 ± 0.5	9	-20.1 ± 0.2	10.1 ± 0.6	Knipper *et al.* 2015	23034
13114	Oosterbeintum	LC	Noardeast-Fryslân, Frisia	NL	EMA1	5th-8th c.	34	-20.1 ± 0.4	12.4 ± 1.5	27	-20.1 ± 0.4	12.3 ± 1.2	McManus *et al.* 2013	23077
13014	St Hilduardus & St Christiana	LC	Dendermonde, East Flanders	BE	EMA1 EMA2	6th-9th c.	5	-19.8 ± 0.8	11.0 ± 1.4	5	-19.8 ± 0.8	11.0 ± 1.4	Van Strydonck *et al.* 2009	-
13017	St Vicentius, St Waldetrudis & St Landericus	LC	Mons, Hainaut	BE	EMA1 EMA2	5th-9th c.	3	-20.0 ± 0.5	12.7 ± 2.4	3	-20.0 ± 0.5	12.7 ± 2.4	Van Strydonck *et al.* 2009	-
13009	Eibertingen enclosed garden	LC	Eibertingen, Liège	BE	EMA2	7th-9th c.	1	-19.3	8.2	1	-19.3	8.2	Van Strydonck *et al.* 2009	-
13010	St Alena	LC	Vorst, Brussels	BE	EMA2	8th-10th c.	2	-20.0	10.7	2	-20.0	10.7	Van Strydonck *et al.* 2009	-
13012	St Dimpna & St Gerebernus	LC	Geel, Antwerp	BE	EMA2	7th-9th c.	3	-19.8 ± 0.0	11.4 ± 1.1	3	-19.8 ± 0.0	11.4 ± 1.1	Van Strydonck *et al.* 2009	-
13018	Tielt-Winge enclosed garden	LC	Tielt-Winge, Flemish Brabant	BE	EMA2	8th-9th c.	2	-20.5	10.2	2	-20.5	10.2	Van Strydonck *et al.* 2009	-
13048	Altenerding	GB	Erding, Bavaria	DE	EMA1	5th-6th c.	73	-19.4 ± 0.5	9.6 ± 0.7	66	-19.4 ± 0.5	9.6 ± 0.7	Hakenbeck *et al.* 2010	23027
13049	Bruckmühl	GB	Bruckmühl, Bavaria	DE	EMA1	7th-8th c.	30	-19.9 ± 0.2	9.6 ± 0.8	22	-1.8 ± 0.2	9.5 ± 0.4	Czermak 2011	-
13050	Enkering-Mauergarten	GB	Eichstätt, Bavaria	DE	EMA1	8th c.	2	-20.2	10.0	2	-20.2	10.0	Czermak 2011	23032
13051	Etting-Sandfeld	GB	Etting, Bavaria	DE	EMA1	8th c.	29	-21.6 ± 0.6	9.9 ± 0.9	23	-21.7 ± 0.7	9.8 ± 0.5	Czermak 2011	23030
13052	Grossmehring	GB	Grossmehring, Bavaria	DE	EMA1	8th c.	84	-20.0 ± 0.4	10.1 ± 1.1	58	-20.0 ± 0.3	10.0 ± 0.8	Czermak 2011	23032
13053	Kelheim-Kanal I	GB	Kelheim, Bavaria	DE	EMA1	8th c.	33	-20.2 ± 0.3	10.4 ± 1.0	26	-20.2 ± 0.3	10.4 ± 1.0	Czermak 2011	23033
13056	Obermöllern	GB	Lanitz-Hassel-Ttal, Saxony-Anhalt	DE	EMA1	5th-6th c.	27	-19.9 ± 0.3	9.6 ± 1.0	17	-19.8 ± 0.3	9.5 ± 0.7	Knipper *et al.* 2013	23036
13057	Rathewitz	GB	Mertendorf, Saxony-Anhalt	DE	EMA1	5th-6th c.	16	-19.8 ± 0.3	9.7 ± 0.9	15	-19.8 ± 0.3	9.5 ± 0.5	Knipper *et al.* 2013	23037
13058	Straubing-Bajuwarenstrasse	GB	Straubing, Bavaria	DE	EMA1	5th-7th c.	94	-19.7 ± 0.3	9.6 ± 0.5	94	-19.7 ± 0.3	9.6 ± 0.5	Hakenbeck *et al.* 2010	-
13060	Weingarten	GB	Weingarten, Baden-Württemberg	DE	EMA1	4th-8th c.	37	-19.8 ± 0.7	8.4 ± 1.4	37	-19.8 ± 0.7	8.4 ± 1.4	Schutkowski *et al.* 1999	-

							Humans			Adults			
Code	Human assemblage		Location		Chronology		n	δ13C (‰) Mean ± SD	δ15N (‰) Mean ± SD	n	δ13C (‰) Mean ± SD	δ15N (‰) Mean ± SD	References	Fauna assembl
13030	Prague castle	GB	Prague, Prague	CZ	EMA2	9th-11th c.	26	-19.1 ± 0.6	10.7 ± 1.0	26	-19.1 ± 0.6	10.7 ± 1.0	Kaupová, Velemínský,	23015
13031	Prague Milady Horákové st	GB	Prague, Prague	CZ	EMA2	9th-10th c.	31	-18.9 ± 0.7	9.1 ± 0.8	31	-18.9 ± 0.7	9.1 ± 0.8	Kaupová, Velemínský,	23015
13032	Prague Střešovice-Triangl	GB	Prague, Prague	CZ	EMA2	10th c.	19	-18.6 ± 0.3	9.6 ± 0.7	19	-18.6 ± 0.3	9.6 ± 0.7	Kaupová, Velemínský,	23015
13033	Žalov-Cihelna B	GB	Roztoky, Central Bohemia	CZ	EMA2	9th-10th c.	13	-18.7 ± 0.5	9.3 ± 0.8	13	-18.7 ± 0.5	9.3 ± 0.8	Kaupová, Velemínský,	23011
13034	Žalov-Na Panenské	GB	Roztoky, Central Bohhemia	CZ	EMA2	9th-10th c.	12	-18.6 ± 0.6	9.0 ± 0.9	12	-18.6 ± 0.6	9.0 ± 0.9	Kaupová, Velemínský,	23011
13054	Magdeburg	GB	Magdeburg, Saxony-Anhalt	DE	EMA2	8th-10th c.	13	-19.1 ± 0.5	11.3 ± 0.8	12	19.1 ± 0.5	11.4 ± 0.7	Knipper *et al.* 2015	-
13059	Unterigling-Loibachanger	GB	Landsberg am Lech, Bavaria	DE	EMA2	7th-9th c.	50	-19.9 ± 0.6	9.3 ± 1.2	50	-19.9 ± 0.6	9.3 ± 1.2	Strott *et al.* 2008	23038
13002	Leobersdorf	CB	Leobersdorf, Lower Austria	AT	EMA1	7th-8th c.	45	-17.2 ± 0.8	10.7 ± 0.5	38	-17.2 ± 0.7	10.8 ± 0.6	Herold 2008	-
13006	Wien-Csokorgasse	CB	Vienna, Vienna	AT	EMA1	7th-8th c.	40	-17.3 ± 0.7	9.7 ± 0.6	39	-17.2 ± 0.7	9.7 ± 0.6	Herold 2008	-
13027	Kyjov	CB	Kyjov, South Moravia	CZ	EMA1	5th-6th c.	73	-19.4 ± 0.6	9.5 ± 0.6	73	-19.4 ± 0.6	9.5 ± 0.6	Plecerová *et al.* 2020	23010
13065	Györ-Széchenyi sq	CB	Györ, Western Transdanubia	HU	EMA1	5th c.	28	-18.2 ± 0.9	10.8 ± 0.9	21	-18.2 ± 1.0	10.9 ± 0.9	Hakenbeck *et al.* 2017	23042
13066	Hács-Béndekpuszta	CB	Hács, Western Transdanubia	HU	EMA1	5th c.	10	-17.8 ± 1.3	8.9 ± 1.0	9	-17.7 ± 1.3	9.2 ± 0.7	Hakenbeck *et al.* 2017	23043 23045
13067	Keszthely-Fenékpuszta	CB	Keszthely, Western Transdanubia	HU	EMA1	5th c.	16	-17.0 ± 0.8	10.0 ± 0.7	13	-16.7 ± 0.6	10.1 ± 0.8	Hakenbeck *et al.* 2017	23043
13068	Mözs	CB	Tolna, Southern Transdanubia	HU	EMA1	5th c.	11	-16.6 ± 0.8	10.1 ± 1.2	10	-16.7 ± 0.8	9.9 ± 1.2	Hakenbeck *et al.* 2017	23044
13069	Sajópetry	CB	Sajópetry, Borsod-Abaúj-Zemplén	HU	EMA1	6th-9th c.	27	-17.6 ± 0.6	10.7 ± 0.5	27	-17.6 ± 0.6	10.7 ± 0.5	Noche-Dowdy 2015	-
13070	Szólád	HU	Szólád, Somogy	HU	EMA1	6th c.	44	-18.8 ± 0.6	9.9 ± 1.0	25	-19.0 ± 0.7	9.6 ± 0.8	Alt *et al.* 2014	23045
13071	Szolnok-Szanda	HU	Szolnok, Northern Great Plain	HU	EMA1	5th-6th c.	11	-17.6 ± 0.7	10.7 ± 0.6	10	-17.7 ± 0.5	10.8 ± 0.6	Hakenbeck *et al.* 2017	23046
13003	Pitten	AT	Pitten, Lower Austria	AT	EMA2	9th c.	39	-17.7 ± 0.8	9.9 ± 0.5	35	-17.6 ± 0.8	9.8 ± 0.5	Herold 2008	-
13004	Pottenbrunn	AT	Pottenbrunn, Lower Austria	AT	EMA2	9th c.	40	-18.5 ± 0.6	9.3 ± 0.8	37	-18.5 ± 0.6	9.4 ± 0.8	Herold 2008	-

							Humans			Adults				
Code	Human assemblage		Location		Chronology		*n*	$\delta^{13}C$ (‰) Mean ± SD	$\delta^{15}N$ (‰) Mean ± SD	*n*	$\delta^{13}C$ (‰) Mean ± SD	$\delta^{15}N$ (‰) Mean ± SD	References	Fauna assembl
13007	Zwölfaxing	CB	Zwölfaxing, Lower Austria	AT	EMA2	7th-9th c.	41	-17.1 ± 0.5	9.7 ± 0.6	36	-17.1 ± 0.5	9.8 ± 0.6	Herold 2008	-
13026	Josefov I	CB	Josefov, South Moravia	CZ	EMA2	9th-10th c.	50	-17.6 ± 0.9	10.5 ± 1.4	32	-17.9 ± 0.7	9.7 ± 0.8	Kaupová 2016, Kaupová, Velemínský, Herrscher, *et al.* 2018	-
13028	Mikulčice-Kostelisko	CB	Hodonín, South Moravia	CZ	EMA2	9th-10th c.	136	-17.9 ± 0.8	11.0 ± 1.4	104	-18.0 ± 0.6	10.7 ± 1.0	Halffman & Velemínský 2015, Kaupová 2016, Kaupová, Velemínský, Herrscher, *et al.* 2018, Smrčka *et al.* 2008	23012
13029	Pohansko	CB	Břeclav, South Moravia	CZ	EMA2	9th-10th c.	56	-18.0 ± 0.6	10.7 ± 1.1	56	-18.0 ± 0.6	10.7 ± 1.1	Kaupová, Velemínský, Herrscher, *et al.* 2018	23014
13005	Volders	AP	Volders, Tyrol	AT	EMA1	6th-7th c.	112	-20.0 ± 0.5	10.1 ± 1.1	100	-20.0 ± 0.4	10.0 ± 1.0	McGlynn 2007	23002
13077	Appiano Castelvecchp	AP	Appiano sulla Strada del Vino, Trentino-Alto Adige	IT	EMA1	7th-8th c.	4	-17.7 ± 0.4	9.9 ± 0.5	3	-17.8 ± 0.4	9.7 ± 0.5	Paladin *et al.* 2020	23050
13078	Bardolino	AP	Bardolino, Veneto	IT	EMA1	6th-8th c.	7	-17.1 ± 0.4	9.4 ± 0.4	7	-17.1 ± 0.4	9.4 ± 0.4	Maxwell 2019	-
13079	Bellinzana	AP	Covo, Lombardia	IT	EMA1	4th-6th c.	19	-16.8 ± 1.4	8.7 ± 1.0	16	-16.9 ± 1.4	8.5 ± 0.7	Marinato 2016	23051
13080	Bressanone Elvas	AP	Bressanone, Trentino-Alto Adige	IT	EMA1	6th-7th c.	19	-18.8 ± 0.8	10.4 ± 1.2	15	-18.8 ± 0.9	10.2 ± 0.9	Paladin *et al.* 2020	23052
13081	Burgusio S Stefano	AP	Burgusio, Trentino-Alto Adige	IT	EMA1	5th-8th c.	14	-19.2 ± 0.4	10.5 ± 0.8	12	-19.1 ± 0.4	10.4 ± 0.8	Paladin *et al.* 2020	23053
13084	Cividale del Friuli Gallo	AP	Cividale del Friuli, Friuli-Veneto Giulia	IT	EMA1	6th-7th c.	7	-16.5 ± 1.3	8.7 ± 1.5	2	-16.3	8.0	Iacumin *et al.* 2014	-
13085	Cividale del Friuli S Stefano in Pertica	AP	Cividale del Friuli, Friuli-Veneto Giulia	IT	EMA1	6th-7th c.	11	-17.3 ± 1.1	8.5 ± 1.0	11	-17.3 ± 1.1	8.5 ± 1.0	Iacumin *et al.* 2014	-
13086	Collegno	AP	Collegno, Piemonte	IT	EMA1	6th-7th c.	31	-18.4 ± 0.4	8.4 ± 0.6	27	-18.5 ± 0.4	8.4 ± 0.6	Amorim *et al.* 2018	-

							Humans			Adults				
Code	Human assemblage		Location		Chronology		n	δ^{13}C (‰) Mean ± SD	δ^{15}N (‰) Mean ± SD	n	δ^{13}C (‰) Mean ± SD	δ^{15}N (‰) Mean ± SD	References	Fauna assembl
13089	Desmontà	AP	Veronella, Veneto	IT	EMA1	6th-7th c.	6	-17.3 ± 1.5	8.3 ± 1.2	6	-17.3 ± 1.5	8.3 ± 1.2	Maxwell 2019	-
13090	Dueville	AP	Dueville, Veneto	IT	EMA1	6th-7th c.	50	-14.5 ± 0.8	8.5 ± 0.5	50	-14.5 ± 0.8	8.5 ± 0.5	Maxwell 2019	23059
13091	Fara Olivana	AP	Fara Olivana con Sola, Lombardia	IT	EMA1	6th-8th c.	22	-18.2 ± 0.6	8.8 ± 0.8	20	-18.1 ± 0.6	8.8 ± 0.9	Marinato 2016	23049 23051 23069
13092	Flero	AP	Flero, Lombardia	IT	EMA1	6th-7th c.	3	-17.5 ± 1.3	9.7 ± 0.9	-	-	-	Marinato 2016	-
13093	Invillino	AP	Villa Santina, Friuli-Venezia Giulia	IT	EMA1	5th-7th c.	2	-16.5	7.6	2	-16.5	7.6	Iacumin *et al.* 2014	23060
13095	Maso Pauli	AP	Malles Ventosa, Trentino-Alto Adige	IT	EMA1	7th c.	1	-19.6	11.5	-	-	-	Paladin *et al.* 2020	-
13096	Montagna Pinzano	AP	Montagna, Trentino-Alto Adige	IT	EMA1	7th-8th c.	5	-17.6 ± 0.9	9.7 ± 0.4	4	-17.7 ± 1.0	9.6 ± 0.4	Paladin *et al.* 2020	23063
13098	Ortaia	AP	Povegliano Veronese, Veneto	IT	EMA1	6th-8th c.	6	-17.9 ± 0.4	8.5 ± 0.9	5	-17.8 ± 0.5	8.4 ± 1.0	Marinato 2016	-
13100	Riformati st	AP	Adria, Veneto	IT	EMA1	4th-6th c.	6	-16.6 ± 0.4	10.9 ± 0.6	6	-16.6 ± 0.4	10.9 ± 0.6	Maxwell 2019	23065
13106	Romans d´Isonzo	AP	Romans d´Isonzo, Friuli-Veneto Giulia	IT	EMA1	6th-7th c.	46	-16.4 ± 0.8	8.4 ± 0.5	23	-16.3 ± 0.5	8.5 ± 0.6	Iacumin *et al.* 2014	-
13107	S Basilio	AP	Ariano nel Polinese, Veneto	IT	EMA1	4th-6th c.	22	-19.5 ± 0.4	10.7 ± 1.1	22	-19.5 ± 0.4	10.7 ± 1.1	Maxwell 2019	23070
13108	Sovizzo	AP	Sovizzo, Veneto	IT	EMA1	6th-8th c.	50	-15.5 ± 1.2	9.1 ± 0.8	50	-15.5 ± 1.2	9.1 ± 0.8	Maxwell 2019	23071
13109	Spilamberto via Macchioni	AP	Spilamberto, Emilia-Romagna	IT	EMA1	4th-6th c.	29	-18.7 ± 0.7	8.2 ± 1.0	20	-18.8 ± 0.6	7.9 ± 0.6	Marinato 2016	23072
13083	Castel Tirolo	AP	Tirolo, Trentino-Alto Adige	IT	EMA2	7th-11th c.	24	-18.5 ± 1.0	10.1 ± 1.0	6	-18.9 ± 1.6	9.3 ± 0.8	Paladin *et al.* 2020	23055
13097	Nalles	AP	Nalles, Trentino-Alto Adige	IT	EMA2	7th-9th c.	1	-18.5	9.3	1	-18.5	9.3	Paladin *et al.* 2020	23064
13110	Tanas	AP	Tanas, Trentino-Alto Adige	IT	EMA2	9th-11th c.	2	-18.3	9.7	2	-18.3	9.7	Paladin *et al.* 2020	23073
13111	Terlano	AP	Terlano, Trentino-Alto Adigge	IT	EMA2	8th-10th c..	10	-18.3 ± 1.2	9.7 ± 0.6	10	-18.3 ± 1.2	9.7 ± 0.6	Paladin *et al.* 2020	23074
13112	Verona amphitheatre	AP	Verona, Veneto	IT	EMA2	8th-9th c.	10	-15.1 ± 1.8	8.9 ± 1.1	6	-14.9 ± 1.8	9.2 ± 0.5	Laffranchi *et al.* 2020	23075

							Humans			Adults				
Code	*Human assemblage*		*Location*		*Chronology*		*n*	*$\delta^{13}C$ (‰) Mean ± SD*	*$\delta^{15}N$ (‰) Mean ± SD*	*n*	*$\delta^{13}C$ (‰) Mean ± SD*	*$\delta^{15}N$ (‰) Mean ± SD*	*References*	*Fauna assembl*
13082	Casale Mmadonna del Piano	CI	Castro Dei Volsci, Lazio	IT	EMA1	6th c.	13	-19.8 ± 0.3	7.4 ± 0.6	13	-19.8 ± 0.3	7.4 ± 0.6	Salamon *et al.* 2008	-
13088	Cosa	CI	Ansedonia, Toscana	IT	EMA1	6th c.	4	-18.1 ± 0.5	9.0 ± 1.5	2	-17.8	10.2	Scorrano *et al.* 2014	-
13094	La Selvicciola	CI	Ischia di Castro, Lazio	IT	EMA1	7th c.	33	-19.5 ± 0.4	8.9 ± 1.0	26	-19.5 ± 0.4	8.9 ± 1.1	Tafuri *et al.* 2018	23061
13099	Pava Pieve	CI	S Giovanni d´Asso, Toscana	IT	EMA1	7th-8th c.	1	-19.0	10.1	1	-19.0	10.1	Ricci *et al.* 2012	-
13101	Roma Amba Aradam	CI	Roma, Lazio	IT	EMA1	5th c.	4	-20.1 ± 0.8	8.2 ± 0.8	4	-20.1 ± 0.8	8.2 ± 0.8	Varano *et al.* 2020	23066 23067 23068
13103	Roma Piazza della Madonna di	CI	Roma, Lazio	IT	EMA1	8th c.	20	-19.8 ± 1.0	8.9 ± 1.0	12	-20.1 ± 0.7	8.7 ± 0.8	Pescucci *et al.* 2013	23067
13104	Roma Piazzale Ostiense	CI	Roma, Lazio	IT	EMA1	4th-5th c.	10	-19.5 ± 0.5	8.9 ± 1.0	8	-19.5 ± 0.5	9.2 ± 0.8	Varano *et al.* 2020	23066 23067 23068
13105	Roma S Pancrazio	CI	Roma, Lazio	IT	EMA1	7th-8th c.	9	-18.3 ± 0.6	11.5 ± 1.4	8	-18.4 ± 0.6	11.5 ± 1.5	Varano *et al.* 2020	23068
13163	Vicus Walari Borgo S Genaro EMA1	CI	S Miniato, Toscana	IT	EMA1	6th-7th c.	11	-17.7 ± 1.1	10.6 ± 0.8	11	-17.7 ± 1.1	10.6 ± 0.8	Riccomi *et al.* 2020	23094
13102	Roma Celio	CI	Roma, Lazio	IT	EMA1 EMA2	6th-9th c.	22	-19.0 ± 0.4	8.1 ± 0.9	14	-19.1 ± 0.3	8.1 ± 1.0	Varano *et al.* 2020	23066 23067 23068
13087	Colonna	CI	Colonna, Llazio	IT	EMA2	8th-10th c.	56	-18.9 ± 0.5	7.7 ± 0.6	43	-18.9 ± 0.4	7.8 ± 0.7	Baldoni *et al.* 2016	23057
13164	Vicus Walari Borgo S Genaro EMA2	CI	S Miniato, Toscana	IT	EMA2	8th-10th c.	12	-17.2 ± 1.1	10.9 ± 0.9	12	-17.2 ± 1.1	10.9 ± 0.9	Riccomi *et al.* 2020	23094
13022	Površje	NB	Murter-Kornati, Šibenik-Knin	CR	EMA1	5th-6th c.	11	-18.5 ± 0.3	10.9 ± 0.9	11	-18.5 ± 0.3	10.9 ± 0.9	Lightfoot *et al.* 2012	23008
13020	Glavice Gluvine	NB	Glavice, Split-Dalmatia	CR	EMA2	8th-9th c.	33	-18.0 ± 0.7	9.2 ± 0.5	28	-18.0 ± 0.6	9.3 ± 0.5	Lightfoot *et al.* 2012	23008
13021	Nuštar	NB	Nuštar, Vukovar-Syrmia	CR	EMA2	8th-9th c-	44	-16.4 ± 0.6	10.2 ± 0.6	30	-16.4 ± 0.5	10.2 ± 0.6	Vidal-Ronchas *et al.* 2018	23007
13023	Radašinovci-Vinogradine	NB	Radašinovci, Zadar	CR	EMA2	9th c.	68	-17.7 ± 0.5	9.7 ± 0.5	64	-17.7 ± 0.5	9.7 ± 0.5	Lightfoot *et al.* 2012	23008
13024	Šibenik-Sveti Lovre	NB	Šibenik, Šibenik-Knin	CR	EMA2	9th-11th c.	54	-18.4 ± 0.4	10.0 ± 0.6	52	-18.3 ± 0.4	10.0 ± 0.6	Lightfoot *et al.* 2012	23008
13025	Velim-Velištak	NB	Stankovci, Zadar	CR	EMA2	7th-9th c.	105	-17.6 ± 0.5	9.5 ± 0.4	103	-17.6 ± 0.5	9.4 ± 0.4	Lightfoot *et al.* 2012	23008
13001	Butrint	SB	Ksamil, Vlorë	AL	EMA1	5th-7th c.	14	-19.2 ± 0.8	8.8 ± 1.5	8	-19.7 ± 0.4	7.9 ± 0.6	Kline 2015	23001

							Humans			Adults				
Code	*Human assemblage*		*Location*		*Chronology*		*n*	*$\delta^{13}C$ (‰) Mean ± SD*	*$\delta^{15}N$ (‰) Mean ± SD*	*n*	*$\delta^{13}C$ (‰) Mean ± SD*	*$\delta^{15}N$ (‰) Mean ± SD*	*References*	*Fauna assembl*
13061	Eleutherna	SB	Rethymno, Crete	GR	EMA1	6th-7th c.	43	-19.0 ± 0.6	8.3 ± 1.5	26	-18.9 ± 0.6	8.1 ± 1.3	Bourbou *et al.* 2011	23040
13062	Messene	SB	Ithomi, Peloponnese	GR	EMA1	6th-7th c.	26	-19.3 ± 0.4	8.5 ± 1.1	17	-19.3 ± 0.3	8.8 ± 1.1	Bourbou *et al.* 2011, Bourbou *et al.* 2013	-
13063	Nemea	SB	Archaia Nemea, Corinthia	GR	EMA1	5th-6th c.	22	-19.0 ± 0.8	8.6 ± 0.6	18	-19.0 ± 0.8	8.6 ± 0.6	Garvie-Lok 2001	-
13064	Sourtara	SB	Kozani, West Macedonia	GR	EMA1	6th-7th c.	43	-18.2 ± 0.4	9.8 ± 0.7	22	-18.2 ± 0.2	9.5 ± 0.3	Bourbou *et al.* 2011, Bourbou *et al.* 2013	23041
13113	Ya'amūn	ME	An-Nuayyimah, Irbid	JO	EMA1	4th-6th c.	17	-19.1 ± 0.3	8.1 ± 0.6	17*	-19.1 ± 0.3	8.1 ± 0.6	Sandias & Müldner 2015	23076
13116	Jerusalem St Stephen	ME	Jerusalem, Quds	PA	EMA1	5th-7th c.	54	-19.0 ± 0.5	9.6 ± 1.2	54	-19.0 ± 0.5	9.6 ± 1.2	Gregoricka & Sheridan 2013	23079
13118	Elaiuussa	ME	Ayaş, Mersin	TR	EMA1	5th-7th c.	8	-18.8 ± 0.5	9.0 ± 1.1	8*	-18.8 ± 0.5	9.0 ± 1.1	Giorgi *et al.* 2005	23081
13117	Kin-Yar	CA	Kislovodsk, Stavropol Krai	RU	EMA1	6th-7th c.	13	-17.8 ± 1.1	11.0 ± 1.6	8	-18.2 ± 0.4	10.5 ± 0.6	Higham *et al.* 2010	23080

Table 7.16. Summary statistics of carbon and nitrogen stable isotope ratios of all fauna assemblages known in Europe, the Middle East and northern Africa dated to between 5th and 10th c. Standard deviation is only reported if sample size is greater than two. Key: Location: BI = British isles, SC = Scandinavia, IB = Iberia (see table 7.14table 7.13), SF = southern France, LC = Low Countries, GB = Germany & Bohemia, CB = Carpathian basin, AP = Alps & Po plain, CI = central Italy, NB = northern Balkans, SB = southern Balkans, ME = Middle East, CA = Caucasus; Country: AL = Albania, AT = Austria, BE = Belgium, CR = Croatia, CZ = Czech Republic, FR = France, DE = Germany, GR = Greece, HU = Hungary, IE = Ireland, IT = Italy, JO = Jordan, NL = Netherlands, NO = Norway, PA = Palestine, PT = Portugal, RU = Russia, ES = Spain, TR = Turkey, UK = UK; Chronology: EMA1 = First half of Early Middle Ages (5th-8th c.), EMA2 = Second half of Early Middle Ages (8th-10th c.); Med = Middle Ages (5th-15th c.)

							Fauna			Domestic herbivores			
Code	*Fauna assemblage*		*Location*		*Chronology*		*n*	$\delta^{13}C$ *(‰) Mean ± SD*	$\delta^{15}N$ *(‰) Mean ± SD*	*n*	$\delta^{13}C$ *(‰) Mean ± SD*	$\delta^{15}N$ *(‰) Mean ± SD*	*References*
23083	Berinsfiled	BI	Berinsfield, South East England	UK	EMA1	5th-7th c.	14	-21.5 ± 0.6	6.7 ± 1.7	9	-21.8 ± 0.5	5.7 ± 0.5	Privat *et al.* 2002
23084	Bloodmoor HIll	BI	Carlton Colville, East England	UK	EMA1	6th-8th c.	18	-22.0 ± 0.7	4.7 ± 2.0	12	-22.3 ± 0.6	4.4 ± 1.6	O’ Connell & Lawler 2009
23086	Horcott	BI	Fairford, South West England	UK	EMA1	5th-7th c.	61	-21.7 ± 0.5	5.5 ± 1.4	50	-21.8 ± 0.4	5.1 ± 1.1	Sakai 2017
23093	York Fishergate	BI	York, Yorkshire & the Humber	UK	EMA1	7th-8th c.	21	-21.4 ± 2.4	8.0 ± 2.8	7	-21.8 ± 0.5	5.2 ± 0.7	Müldner & Richards 2007
23048	Raystown	BI	Raystown, Meath	IE	EMA1 EMA2	5th-10th c.	15	-21.8 ± 0.5	9.8 ± 1.7	6	-21.9 ± 0.2	9.6 ± 1.4	Ryan *et al.* 2018
23047	Dublin Fishamble st & John's lane	BI	Dublin, Dublin city	IE	EMA2	9th-11th c.	10	-21.2 ± 0.6	6.8 ± 1.3	-	-	-	Knudson *et al.* 2012
23085	Flixborough	BI	Flixborough, Yorkshire & the Humber	UK	EMA2	8th-9th c.	27	-21.2 ± 0.8	8.0 ± 1.9	-	-	-	Colonese *et al.* 2017
23087	London Southampton st	BI	London, London	UK	EMA2	8th-9th c.	3	-12.8 ± 0.2	15.8 ± 0.8	-	-	-	Barrett *et al.* 2011
23088	Masham	BI	Masham, Yorkshire & the Humber	UK	EMA2	8th-10th c.	8	-22.0 ± 0.1	6.7 ± 1.5	5	-21.9 ± 0.1	6.1 ± 1.6	Buckberry *et al.* 2014
23089	Portmahomack EMA2	BI	Portmahomack, Scotland	UK	EMA2	7th-9th c.	10	-21.9 ± 0.4	6.7 ± 1.5	7	-22.1 ± 0.3	5.9 ± 1.2	Curtis-Summers *et al.* 2014
23090	Quoygrew	BI	Rackwick, Orkey islands	UK	EMA2	10th c.	26	-21.0 ± 1.0	6.0 ± 1.2	22	-21.0 ± 0.6	5.6 ± 0.5	Barrett & Richards 2012
23091	Southampton Lower High st & site 859	BI	Southampton, South East England	UK	EMA2	9th-10th c.	8	-12.6 ± 0.5	16.2 ± 0.5	-	-	-	Barrett *et al.* 2011
23092	St Patrick's chapel	BI	St Davids, Wales	UK	EMA2	7th-10th c.	13	-22.1 ± 0.5	7.4 ± 1.1	12	-22.1 ± 0.5	7.2 ± 0.9	Hemer *et al.* 2016
23016	Selsø-Vestby	SC	Frederikssund, Hovedstaden	DK	EMA2	8th-9th c.	4	-12.7 ± 1.1	11.9 ± 0.5	-	-	-	Barrett *et al.* 2011
23078	Flakstad	SC	Flakstad, Nordland	NO	EMA2	9th-11th c.	8	-20.4 ± 3.6	7.6 ± 5.8	6	-22.3 ± 0.4	4.5 ± 0.7	Naumann *et al.* 2014
23017	Aix-en-Provence Notre Dame de la Seds	SF	Marseille, Provence-Alpes-Côte d'Azur	FR	EMA1	7th-8th c.	20	-20.1 ± 0.8	5.9 ± 2.3	10	-20.4 ± 0.8	4.7 ± 2.1	Mion 2019

							Fauna			Domestic herbivores			
Code	Fauna assemblage		Location		Chronology		n	δ13C (‰) Mean ± SD	δ15N (‰) Mean ± SD	n	δ13C (‰) Mean ± SD	δ15N (‰) Mean ± SD	References
23018	Chapelle St Honorat	SF	Île de Lérins, Provence-Alpes-Côte d'Azur	FR	EMA1	5th-8th c.	15	-20.3 ± 0.8	5.7 ± 2.0	11	-20.2 ± 0.9	6.1 ± 2.2	Mion 2019
23020	Marseille La Bourse	SF	Marseille, Provence-Alpes-Côte d'Azur	FR	EMA1	5th-7th c.	24	-20.3 ± 0.9	5.3 ± 1.8	19	-20.5 ± 0.9	4.9 ± 1.6	Mion 2019
23024	Richeaume I	SF	Puyloubier, Provence-Alpes-Côte d'Azur	FR	EMA1	5th-6th c.	14	-20.9 ± 0.8	4.9 ± 1.7	6	-20.8 ± 0.5	4.6 ± 1.4	Mion 2019
23025	Riez Cathédrale	SF	Riez, Provence-Alpes-Côte d'Azur	FR	EMA1	4th-7th c.	15	-20.3 ± 0.4	5.0 ± 1.5	10	-20.3 ± 0.5	4.6 ± 1.1	Mion 2019
23026	Maguelone Vigne Ouest	SF	Îlot de Maguelone, Occitanie	FR	EMA1	6th c.	24	-19.6 ± 1.6	7.1 ± 1.7	9	-19.7 ± 0.7	5.6 ± 0.9	Mion 2019
23019	Lallemand	SF	Mauguio, Occitanie	FR	EMA2	7th-11th c.	11	-20.0 ± 0.3	6.8 ± 2.5	6	-20.1 ± 0.2	5.8 ± 1.4	Mion 2019
23021	Missignac	SF	Aimargues, Occitanie	FR	EMA2	7th-11th c.	31	-19.8 ± 0.7	6.7 ± 1.9	17	-19.8 ± 0.6	6.6 ± 1.7	Mion 2019
23023	Notre Dame du Bourg	SF	Digne-les-Bains, Provence-Alpes-Côte d'Azur	FR	EMA2	6th-10th c.	16	-20.6 ± 0.5	4.5 ± 1.3	9	-20.4 ± 0.3	4.3 ± 1.5	Mion 2019
23005	Torgny	LC	Torgny, Luxembourg	BE	EMA1	6th-7th c.	1	-22.2	4.0	-	-	-	Polet & Katzenberg 2002
23022	Norroy-le-Veneur	LC	Norroy-le-Veneur, Grand East	FR	EMA1	5th-7th c.	5	-21.3 ± 0.4	7.7 ± 0.8	1	-22.0	7.5	Vytlačil *et al.* 2018
23077	Oosterbeintum	LC	Noardeast-Fryslân, Frisia	NL	EMA1	5th-8th c.	21	-20.5 ± 1.4	9.7 ± 2.5	12	-21.1 ± 0.4	8.8 ± 1.2	McManus *et al.* 2013
23003	Brugge	LC	Brugge, West Flanders	BE	EMA2	9th-10th c.	26	-21.2 ± 0.8	8.2 ± 1.5	26	-21.2 ± 0.8	8.2 ± 1.5	Müldner *et al.* 2014
23004	Leffinge	LC	Leffinge, West Flanders	BE	EMA2	7th-11th c.	8	-20.1 ± 1.1	10.1 ± 1.8	8	-20.1 ± 1.1	10.1 ± 1.8	Ervynck *et al.* 2012
23006	Uitkerke	LC	Uitkerke, West Flanders	BE	EMA2	8th-10th c.	49	-20.4 ± 1.0	9.5 ± 1.2	49	-20.4 ± 1.0	9.5 ± 1.2	Müldner *et al.* 2014
23034	Morken	LC	Bergheim, North Rhine-Westphalia	DE	Med	1st-15th c.	22	-21.6 ± 0.6	7.3 ± 1.4	8	-21.9 ± 0.5	7.2 ± 1.6	Knipper *et al.* 2015
23027	Altenerding	GB	Erding, Bavaria	DE	EMA1	5th-7th c.	3	-20.7 ± 0.3	4.8 ± 0.2	1	-22.3	4.9	Hakenbeck *et al.* 2010
23028	Aschheim-Bajuwarenring	GB	Aschheim, Bavaria	DE	EMA1	6th c.	4	-20.9 ± 0.5	5.4 ± 0.8	3	-21.0 ± 0.5	5.5 ± 1.0	Hakenbeck *et al.* 2010
23029	Eching-Kleiststrasse	GB	Eching, Bavaria	DE	EMA1	6th c.	30	-21.5 ± 0.5	6.5 ± 1.8	29	-21.5 ± 0.5	6.3 ± 1.6	Hakenbeck *et al.* 2010
23031	Freising-Attaching	GB	Freising, Bavaria	DE	EMA1	7th c.	10	-20.8 ± 0.7	7.5 ± 1.5	-	-	-	Hakenbeck *et al.* 2010

							Fauna			*Domestic herbivores*			
Code	*Fauna assemblage*		*Location*		*Chronology*		*n*	*$\delta^{13}C$ (‰) Mean ± SD*	*$\delta^{15}N$ (‰) Mean ± SD*	*n*	*$\delta^{13}C$ (‰) Mean ± SD*	*$\delta^{15}N$ (‰) Mean ± SD*	*References*
23035	Naumburg	GB	Naumburg, Saxony-Anhalt	DE	EMA1	5th-6th c.	2	-21.9	6.4	1	-22.3	6.5	Knipper *et al.* 2013
23036	Obermöllern	GB	Lanitz-Hassel-Tal, Saxony-Anhalt	DE	EMA1	5th-6th c.	13	-21.2 ± 0.4	6.6 ± 1.4	8	-21.2 ± 0.4	6.2 ± 1.0	Knipper *et al.* 2013
23037	Rathewitz	GB	Mertendorf, Saxony-Anhalt	DE	EMA1	5th-6th c.	7	-21.8 ± 0.5	5.8 ± 1.6	5	-21.9 ± 0.5	5.4 ± 1.5	Knipper *et al.* 2013
23011	Levý Hradec castle	GB	Roztoky, Central Bohemia	CZ	EMA2	9th-11th c.	8	-20.7 ± 0.6	7.1 ± 1.1	5	-21.1 ± 0.4	6.9 ± 0.9	Kaupová, Velemínský, Stránská, *et al.* 2018
23015	Prague castle	GB	Prague, Prague	CZ	EMA2	9th-11th c.	11	-20.5 ± 1.2	6.5 ± 1.7	6	-20.9 ± 0.5	5.7 ± 1.2	Kaupová, Velemínský, Stránská, *et al.* 2018
23030	Etting-Sandfeld	GB	Etting, Bavaria	DE	EMA2	8th c.	2	-21.6	7.8	1	-21.7	6.1	Strott *et al.* 2008
23032	Grossmehring	GB	Eichstätt, Bavaria	DE	EMA2	8th c.	10	-21.3 ± 0.9	7.1 ± 1.5	7	-21.5 ± 0.6	6.3 ± 0.7	Strott *et al.* 2008
23033	Kelheim-Kanal I	GB	Kelheim, Bavaria	DE	EMA2	8th c.	13	-21.8 ± 0.8	6.9 ± 1.6	7	-22.1 ± 0.7	7.6 ± 1.6	Strott *et al.* 2008
23038	Unterigling-Loibachanger	GB	Landsberg am Lech, Bavaria	DE	EMA2	7th-9th c.	13	-21.5 ± 0.7	6.7 ± 1.2	9	-21.8 ± 0.7	6.4 ± 1.2	Strott *et al.* 2008
23010	Kyjov	CB	Kyjov, South Moravia	CZ	EMA1	5th-6th c.	19	-20.5 ± 0.7	6.6 ± 1.2	7	-21.1 ± 0.5	5.7 ± 0.9	Plecerová *et al.* 2020
23042	Györ-Széchenyi sq	CB	Györ, Western Transdanubia	HU	EMA1	5th c.	20	-19.7 ± 1.8	7.5 ± 1.9	15	-19.8 ± 2.0	7.2 ± 1.7	Hakenbeck *et al.* 2017
23043	Keszthely-Fenékpuszta	CB	Keszthely, Western Transdanubia	HU	EMA1	5th c.	30	-20.9 ± 1.8	6.8 ± 2.0	13	-20.6 ± 1.1	6.3 ± 1.2	Hakenbeck *et al.* 2017
23044	Mözs	CB	Tolna, Southern Transdanubia	HU	EMA1	5th c.	22	-20.1 ± 1.3	7.1 ± 0.9	12	-19.9 ± 0.9	7.2 ± 0.6	Hakenbeck *et al.* 2017
23045	Szólád	CB	Szólád, Somogy	HU	EMA1	6th c.	8	-19.9 ± 1.3	6.3 ± 1.3	3	-19.1 ± 2.0	5.4 ± 1.0	Alt *et al.* 2014
23009	Josefov I	CB	Josefov, South Moravia	CZ	EMA2	9th-10th c.	3	-17.9 ± 1.8	7.9 ± 0.3	-	-	-	Kaupová, Velemínský, Herrscher, *et al.* 2018
23012	Mikulčice-Kostelisko	CB	Hodonín, South Moravia	CZ	EMA2	9th-10th c.	56	-20.6 ± 1.7	7.5 ± 1.8	24	-20.6 ± 0.6	6.6 ± 1.0	Halffman & Velemínský 2015, Kaupová, Velemínský, Herrscher, *et al.* 2018

							Fauna			Domestic herbivores		
Code	*Fauna assemblage*		*Location*		*Chronology*		*n*	*δ^{13}C (‰) Mean ± SD*	*δ^{15}N (‰) Mean ± SD*	*n*	*δ^{13}C (‰) Mean ± SD*	*δ^{15}N (‰) Mean ± SD*	*References*
23013	Mutěnice	CB	Mutěnice, South Moravia	CZ	EMA2	9th-10th c.	15	-19.9 ± 1.8	7.4 ± 1.1	9	-20.2 ± 1.6	7.4 ± 1.3	Kaupová, Velemínský, Herrscher, *et al.* 2018
23014	Pohansko	CB	Břeclav, South Moravia	CZ	EMA2	9th-10th c.	9	-20.7 ± 2.6	7.5 ± 1.5	2	-20.1	6.9	Kaupová, Velemínský, Herrscher, *et al.* 2018
23046	Szolnok-Szanda	CB	Szolnok, Northern Great Plain	HU	EMA2	10th c.	22	-20.5 ± 0.8	7.5 ± 1.7	16	-20.5 ± 0.7	7.3 ± 1.4	Hakenbeck *et al.* 2017
23002	Volders	AP	Volders, Tyrol	IT	EMA1	6th-7th c.	20	-21.8 ± 0.6	5.9 ± 1.7	12	-21.9 ± 0.6	5.0 ± 0.8	McGlynn 2007
23050	Appiano Castelvecchio	AP	Appiano sulla Strada del Vino, Trentino-Alto Adige	IT	EMA1	7th-8th c.	3	-19.4 ± 2.7	5.6 ± 2.4	1	-21.2	4.3	Paladin *et al.* 2020
23051	Bellinzana	AP	Covo, Lombardia	IT	EMA1	4th-6th c.	2	-19.8	5.7	1	-20.1	5.5	Marinato 2016
23052	Burgusio S Stefano	AP	Bressanone, Trentino-Alto Adige	IT	EMA1	6th-7th c.	3	-19.5 ± 0.8	6.3 ± 1.4	2	-19.8	6.1	Paladin *et al.* 2020
23053	Burgusio S Stefano	AP	Burgusio, Trentino-Alto Adige	IT	EMA1	5th-8th c.	3	-20.5 ± 0.4	5.3 ± 2.7	2	-20.6	6.6	Paladin *et al.* 2020
23054	Casirate d'Adda/Treviglio	AP	Casirate d'Adda, Lombardia	IT	EMA1	6th-8th c.	6	-17.5 ± 3.2	5.5 ± 1.5	3	-19.1 ± 2.0	4.7 ± 1.9	Marinato 2016
23056	Cividale del Friuli Paul the Deacon sq	AP	Cividale del Friuli, Friuli-Venezia Giulia	IT	EMA1	6th-7th c.	13	-19.8 ± 1.3	3.6 ± 1.7	-	-	-	Iacumin *et al.* 2014
23058	Desmontà	AP	Veronella, Veneto	IT	EMA1	6th-7th c.	1	-21.9	5.2	-	-	-	Maxwell 2019
23059	Dueville	AP	Dueville, Veneto	IT	EMA1	6th-7th c.	2	-15.3	9.3	2	-15.3	9.3	Maxwell 2019
23060	Invillino	AP	Villa Santina, Friuli-Venezia Giulia	IT	EMA1	5th-7th c.	11	-19.9 ± 1.0	3.1 ± 1.3	3	-19.8 ± 0.7	2.2 ± 1.0	Iacumin *et al.* 2014
23062	Maso Pauli	AP	Malles Venosta, Trentino-Alto Adige	IT	EMA1	7th c.	5	-20.5 ± 0.7	4.9 ± 2.3	2	-21.2	3.8	Paladin *et al.* 2020
23063	Montagna Pinzano	AP	Montagna, Trentino-Alto Adige	IT	EMA1	7th-8th c.	1	-19.5	9.4	1	-19.5	9.4	Paladin *et al.* 2020
23065	Riformati st	AP	Adria, Veneto	IT	EMA1	4th-6th c.	6	-17.9 ± 3.5	8.7 ± 2.0	2	-20.0	9.9	Maxwell 2019
23070	S Basilio	AP	Ariano nel Polesine, Veneto	IT	EMA1	4th-6th c.	7	-19.9 ± 1.7	7.8 ± 1.5	3	-19.6 ± 1.2	7.4 ± 1.7	Maxwell 2019
23071	Sovizzo	AP	Sovizzo, Veneto	IT	EMA1	6th-8th c.	2	-17.7	7.1	2	-17.7	7.1	Maxwell 2019
23072	Spilamberto via Macchioni	AP	Spilamberto, Emilia-Romagna	IT	EMA1	4th-6th c.	11	-20.8 ± 0.9	5.1 ± 2.3	5	-20.8 ± 0.7	3.8 ± 2.3	Marinato 2016
23049	Antegnate	AP	Antegnate, Lombardia	IT	EMA1 EMA2	5th-10th c.	1	-15.4	6.0	1	-15.4	6.0	Marinato 2016

							Fauna			Domestic herbivores			
Code	Fauna assemblage		Location		Chronology		n	δ13C (‰) Mean ± SD	δ15N (‰) Mean ± SD	n	δ13C (‰) Mean ± SD	δ15N (‰) Mean ± SD	References
23055	Castel Tirolo	AP	Tirolo, Trentino-Alto Adige	IT	EMA2	7th-11th c.	7	-19.9 ± 1.0	5.8 ± 2.9	3	-19.8 ± 1.6	5.0 ± 0.5	Paladin *et al.* 2020
23064	Nalles	AP	Nalles, Trentino-Alto Adige	IT	EMA2	7th-9th c.	3	-20.9 ± 0.5	4.7 ± 2.3	1	-20.8	4.2	Paladin *et al.* 2020
23073	Tanas	AP	Tanas, Trentino-Alto Adige	IT	EMA2	9th-11th c.	2	-21.0	7.1	2	-21.0	7.1	Paladin *et al.* 2020
23074	Terlano	AP	Terlano, Trentino-Alto Adige	IT	EMA2	8th-10th c.	3	-20.1 ± 0.5	6.0 ± 1.8	2	-20.0	5.0	Paladin *et al.* 2020
23075	Verona amphitheatre	AP	Verona, Veneto	IT	EMA2	8th-9th c.	3	-19.6 ± 1.5	6.4 ± 0.9	2	-20.5	6.0	Laffranchi *et al.* 2020
23069	Romano di Lombardia	AP	Romano di Lombardia, Lombardia	IT	Med	4th-13th c.	20	-17.4 ± 2.0	5.6 ± 1.9	11	-19.4 ± 0.9	4.6 ± 1.7	Marinato 2016
23061	La Selvicciola	CI	Ischia di Castro, Lazio	IT	EMA1	7th c.	3	-20.4 ± 0.4	4.3 ± 0.4	1	-21.1	4.0	Tafuri *et al.* 2018
23067	Roma Piazza della Madonna di Loreto	CI	Roma, Lazio	IT	EMA1	8th c.	3	-22.6 ± 0.5	7.4 ± 0.9	2	-22.9	6.9	Pescucci *et al.* 2013
23068	Roma S Pancrazio	CI	Roma, Lazio	IT	EMA1	7th-8th c.	6	-19.9 ± 0.6	6.2 ± 2.8	2	-19.8	5.2	Varano *et al.* 2020
23066	Roma Colosseo	CI	Roma, Lazio	IT	EMA1 EMA2	5th-9th c.	5	-20.4 ± 0.7	5.0 ± 1.3	2	-21.2	4.2	Varano *et al.* 2020
23057	Colonna	CI	Colonna, Lazio	IT	EMA2	8th-10th c.	7	-20.4 ± 0.7	6.0 ± 1.6	3	-20.7 ± 0.6	5.3 ± 1.5	Baldoni *et al.* 2016
23094	Vicus Walari Borgo S Genaro	CI	S Miniato, Toscana	IT	Med	6th-13th c.	33	-20.3 ± 2.1	7.0 ± 2.2	14	-20.7 ± 1.5	6.2 ± 1.4	Riccomi *et al.* 2020
23007	Nuštar	NB	Nuštar, Vukovar-Syrmia	CR	EMA2	8th-9th c.	17	-17.7 ± 2.1	8.1 ± 1.2	13	-18.3 ± 1.9	7.9 ± 1.2	Vidal-Ronchas *et al.* 2018
23008	Velim-Velištak	NB	Stankovci, Zadar	CR	EMA2	7th-9th c.	30	-19.3 ± 1.0	6.6 ± 1.8	16	-19.5 ± 0.9	5.5 ± 1.3	Lightfoot *et al.* 2012
23040	Eleutherna	SB	Rethymno, Crete	GR	EMA1	6th-7th c.	2	-20.4	5.3	2	-20.4	5.3	Bourbou *et al.* 2011
23041	Sourtara	SB	Kozani, West Macedonia	GR	EMA1	6th-7th c.	2	-19.7	5.5	1	-20.7	2.6	Bourbou *et al.* 2011
23039	Athens Agora	SB	Athens, Attica	GR	EMA2	9th-10th c.	8	-19.7 ± 1.2	6.0 ± 2.9	5	-19.5 ± 1.4	5.6 ± 3.4	Garvie-Lok 2001
23001	Butrint	SB	Ksamil, Vlorë	AL	Med	3rd-14th c.	15	-20.2 ± 0.7	5.4 ± 1.8	2	-19.7	7.2	Kline 2015
23076	Ya'amūn	ME	An-Nuayyimah, Irbid	JO	EMA1	4th-6th c.	11	-16.9 ± 5.0	6.4 ± 1.8	7	-18.7 ± 1.5	5.9 ± 1.8	Sandias & Müldner 2015
23079	JJerusalem 3rd Wall	ME	Jerusalem, Quds	PA	EMA1	4th-7th c.	5	-19.7 ± 0.7	6.9 ± 1.3	2	-20.0	8.3	Gregoricka & Sheridan 2013

							Fauna			Domestic herbivores			
Code	*Fauna assemblage*		*Location*		*Chronology*		*n*	*δ^{13}C (‰) Mean ± SD*	*δ^{15}N (‰) Mean ± SD*	*n*	*δ^{13}C (‰) Mean ± SD*	*δ^{15}N (‰) Mean ± SD*	*References*
23081	Elaiussa	ME	Ayaş, Mersin	TR	EMA1	5th-7th c.	1	-18.7	4.8	1	-18.7	4.8	Giorgi *et al.* 2005
23082	Sagalassos	ME	Ağlasun, Burdur	TR	EMA1	5th-7th c.	140	-19.9 ± 0.9	6.4 ± 2.2	59	-19.7 ± 0.7	5.6 ± 1.7	Fuller *et al.* 2012
23080	Klin-Yar	CA	Kislovodsk, Stavropol Krai	RU	EMA1	6th-7th c.	11	-20.1 ± 1.1	5.5 ± 2.3	9	-20.2 ± 1.1	5.1 ± 2.3	Higham *et al.* 2010